Civil Engineering

Land Planning

Hydrology/ Flood Control

Geotechnical Engineering

Public Works Services

Storm Water Management

# FEASIBILITY HYDRAULIC CALCULATIONS
# 2525 E. HILLCREST DRIVE
# THOUSAND OAKS, CALIFORNIA

Prepared For:

**CONEJO VALLEY CHURCH OF CHRIST**
2525 E. Hillcrest Drive
Thousand Oaks, California 91362

Date: June 8, 2018

Project: 6014.60


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RCE 58383, Exp. 12-31-18

# HYDRAULIC ANALYSIS
# CONEJO VALLEY CHURCH OF CHRIST
# 2525 E. HILLCREST DRIVE
# THOUSAND OAKS, CALIFORNIA

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## EXECUTIVE SUMMARY

RJR Engineering Group (RJR) has prepared this Hydraulic Analysis regarding the proposed Storm Drain Improvements for Conejo Valley Church of Christ located at 2525 E. Hillcrest Drive in Thousand Oaks.

The scope of this analysis is to characterize the hydrologic and hydraulic conditions of the onsite drainage scheme and any impact on the existing Storm Drain System located on E Hillcrest Drive.

In anticipation of street resurfacing by The City of Thousand Oaks starting on July 1, 2018, the proposed storm drain junction structure for the proposed project, which occurs within the Hillcrest Drive right of way, will be constructed ahead of the proposed site improvement. A preliminary storm drain system has been designed and modeled to ensure functionality, but at this time only the street connection will be constructed. The proposed site improvements will consist of the construction of a junction structure on the existing 39" RCP Storm Drain Main Line located under E. Hillcrest Drive. A 36" RCP service line will be joined and extended to 35 feet past the right of way, onto the property, and capped until the final design can be constructed in the near future.

The proposed storm water facilities and improvements have all been designed for the interception and conveyance of the surface water runoff for a 25 year storm event in accordance with the City of Thousand Oaks requirements. Hydrology flow rates from the City of Thousand Oaks Master Drainage Plan were utilized in the hydraulic analysis.

It should be noted that this report has been prepared solely as a hydrologic and hydraulic analysis for the proposed site and drainage improvements. This analysis pertains solely to the conveyance of surface water, the related drainage devices and the storm water management system and does not include any assumptions relating to downstream conditions. All recommendations described herein are based on hydraulic and hydrologic analysis. Any changes in design or failure to address the outlined recommendations can alter the subsequent calculations and render this report void.

## 1.0. HYDRAULIC ANALYSIS

### Storm Drain Facility Design

One dimensional supportive calculations for the existing storm drain system with the addition of the proposed system are included in Appendix A. All the drainage structures have been sufficiently designed to convey the $Q_{25}$ flows to the corresponding inlet structures.

The Hydrology Map in Appendix B illustrates the total drainage area and the corresponding flow rates (Q's) for the specific conditions and flood frequencies, as well as the proposed catch basins, v-ditches, pipes, detention basin locations and any other relevant information.

### Hydraulic Modeling

Specifics from City Storm Drain As-Built Drawing Number 85-43A were incorporated into the hydraulic model. Flow rate values from the As-Builts were modeled in AutoDesk Storm Sewer Software to produce flow velocities and hydraulic grade lines to ensure the existing storm drain has the capacity to convey the proposed flow rate. Rain fall run off values from the City of Thousand Oaks Master Drainage Plan were also utilized to model the hydraulic capacity of the proposed configuration. The results from both modeling scenarios for the 10-year and 25-year storm are attached in Appendix A.

## 2.0. CONCLUSION

Based on the available data and analysis, it is of the opinion of RJR that the proposed storm drain system is hydraulically adequate to provide the necessary conveyance of water of the 25 year storm event.

Again, it should be noted that this report has been prepared solely as a surficial hydrology and hydraulic analysis for the grading and drainage improvements. The hydrology and hydraulic calculations are based on the survey provided, visual field measurements, civil plans designed by RJR, and the architectural and landscape structures designed by others. All recommendations described herein are based on hydraulic analysis associated with the above referenced grading and drainage design, and any changes in design or failure to address the outlined recommendations can alter the subsequent calculations and render this report void.

## REFERENCES


1. Ventura County Watershed Protection District, Hydrology Manual, December 2010.
2. City of Thousand Oaks Drawing Number 85-43A
3. City of Thousand Oaks Storm Drain System Master Plan, Hydrology Plate #6

# APPENDIX A

## Calculations

1. **Master Plan 25-year Hydraulic Analysis**
2. **Master Plan 10-year Hydraulic Analysis**
3. **As-Built Plan 25-year Hydraulic Analysis**
4. **As-Built Plan 10-year Hydraulic Analysis**

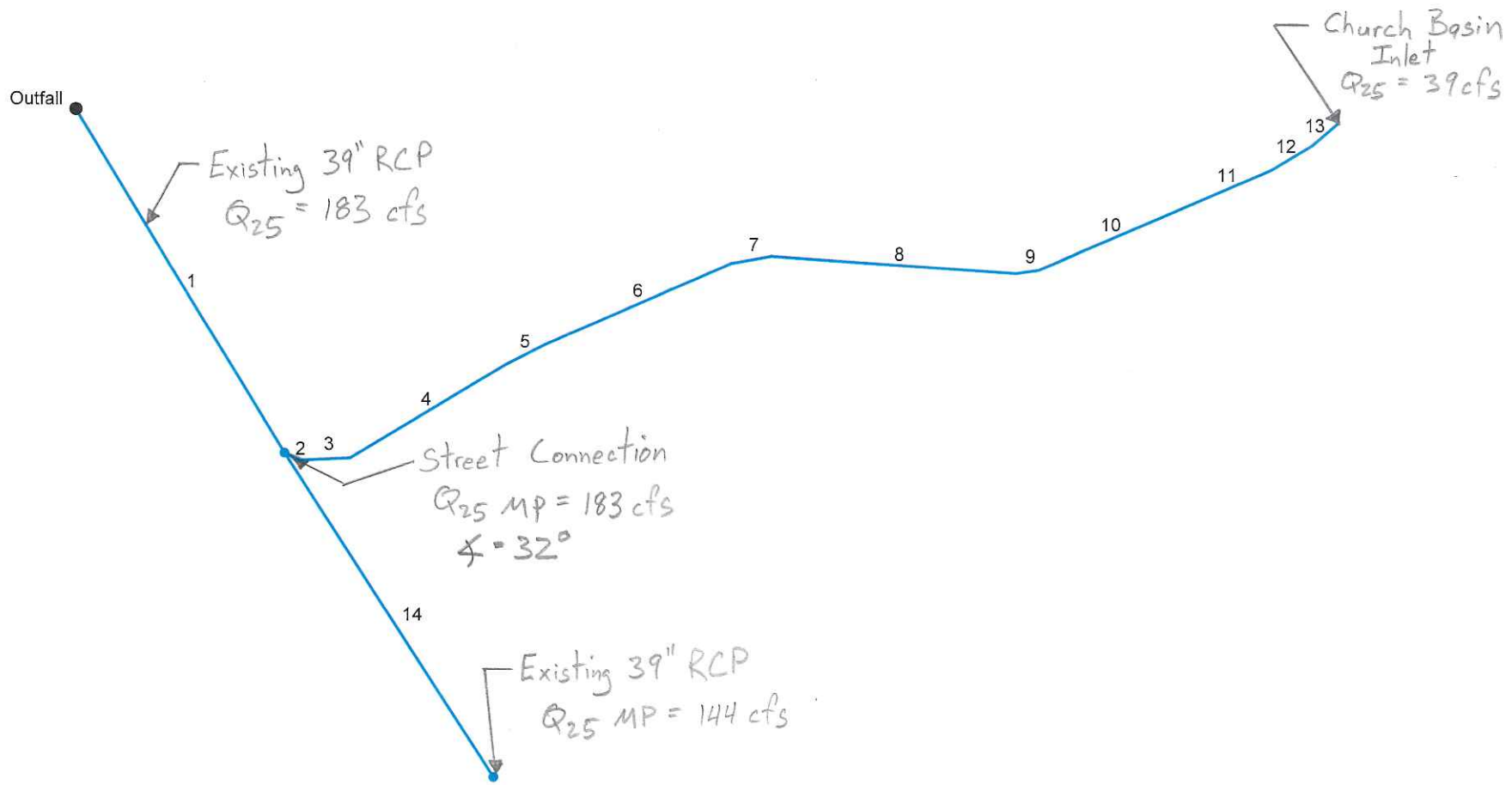
## EXHIBIT 21. DESIGN STORM RATIOS

| Category (1) | 2-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | 200-yr | 500-yr |
|---|---|---|---|---|---|---|---|---|
| * Precipitation | 0.43 | 0.61 | 0.73 | 0.88 | 1.00 | 1.11 | Not Analyzed | Not Analyzed |
| Undeveloped-HMS & HSPF | 0.043 | 0.144 | 0.262 | 0.484 | 0.711 | 1.000 | 1.345 | 1.952 |
| Developed HMS & HSPF | 0.166 | 0.330 | 0.464 | 0.660 | 0.882 | 1.000 | 1.191 | 1.502 |
| Undeveloped-VCRat (2) | 0.043 | 0.144 | 0.362 | 0.484 | 0.711 | 1.000 | 1.345 | 1.952 |
| Developed VCRat (2) | 0.166 | 0.330 | 0.567 | 0.660 | 0.882 | 1.000 | 1.191 | 1.502 |
| Casitas Dam Outflow | 0.005 | 0.030 | 0.048 | 0.110 | 0.143 | 1.000 | 1.191 | 1.448 |
| Coyote Ck below Dam | 0.005 | 0.100 | 0.200 | 0.400 | 0.580 | 1.000 | 1.191 | 1.416 |
| Piru Ck Below Dam | 0.031 | 0.042 | 0.061 | 0.136 | 0.805 | 1.000 | 1.183 | 1.463 |

Note (1): Ratios cannot be used for watersheds with detention basins or water storage dams affecting more than 10% of the area except for those developed specifically for dam outflow (Casitas and Piru).

Note (2): VCRat ratios provided for reference only as current practice is to run the model using the correct Tc's and rainfall for all storms required for design studies. In rare cases it may be necessary to use the multipliers in VCRat studies such as estimating 10-yr peaks from Soil Type 7 in the J' zone.

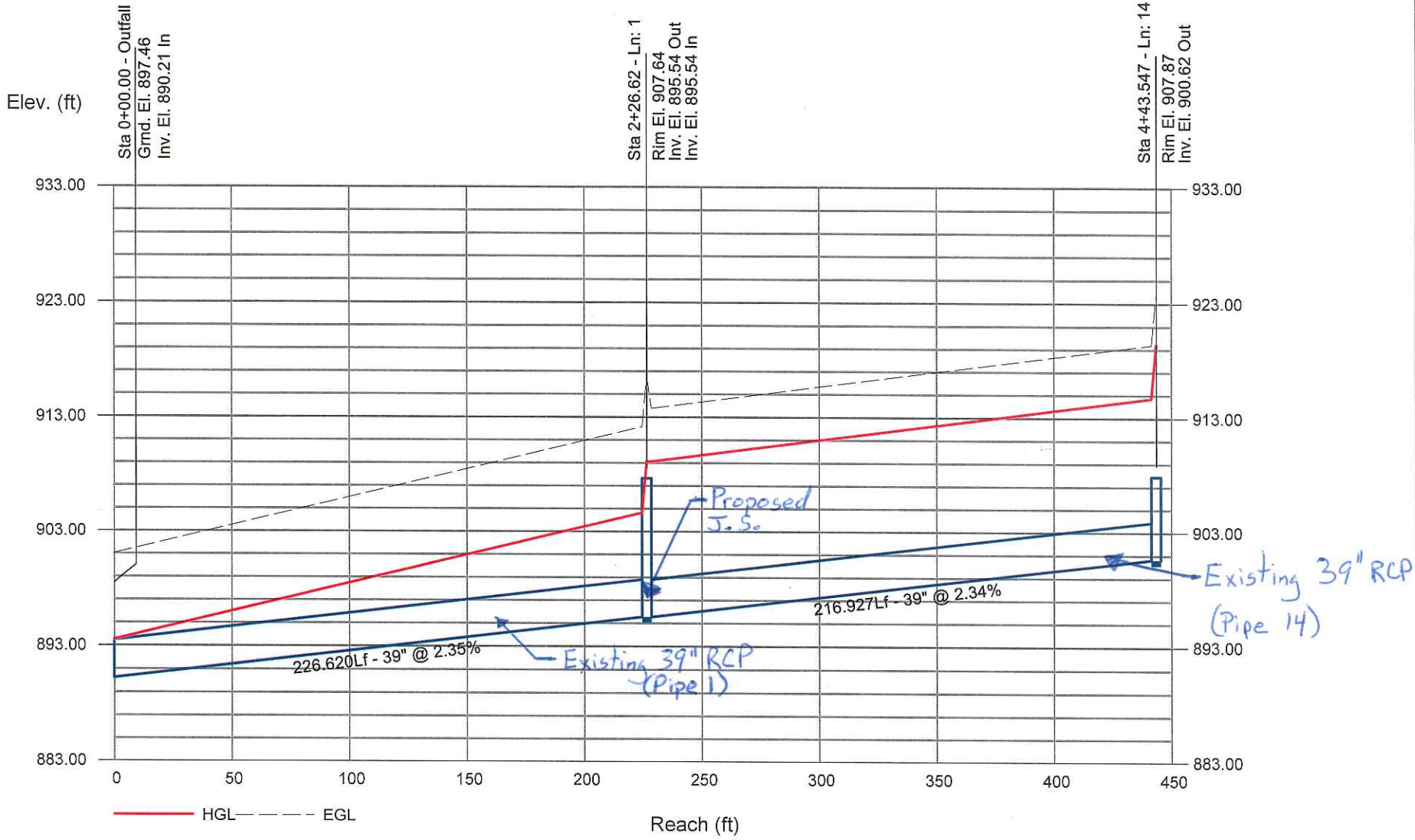
# Church Q25 w Q25 MP




| Project File: Church Q25 with 39in Q25 MP Junction Analysis.stm | Number of lines: 14 | Date: 6/8/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Church Q25 with 39in Q25 MP Junction Analysis.stm



# MyReport



| Line No. | Area Dn (sqft) | Area Up (sqft) | Byp Ln No | Coeff C1 (C) | Coeff C2 (C) | Coeff C3 (C) | Capac Full (cfs) | Crit Depth (ft) | Cross Sl, Sw (ft/ft) | Cross Sl, Sx (ft/ft) | Curb Len (ft) | Defl Ang (Deg) | Depth Dn (ft) | Depth Up (ft) | DnStm Ln No | Drng Area (ac) | Easting X (ft) | EGL Dn (ft) | EGL Up (ft) | Energy Loss (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8.29 | 8.30 | n/a | 0.20 | 0.50 | 0.90 | 126.62 | 3.23 | .... | .... | .... | 58.922 | 3.25 | 3.25 | Outfall | 0.00 | 4267.85 | 901.03 | 912.16 | 11.136 |
| * 2 | 7.07 | 7.07 | n/a | 0.20 | 0.50 | 0.90 | 120.65 | 2.03 | .... | .... | .... | -32.094 | 3.00 | 3.00 | 1 | 0.00 | 4276.17 | 909.54 | 909.56 | 0.027 |
| 3 | 7.07 | 7.07 | n/a | 0.20 | 0.50 | 0.90 | 164.61 | 2.03 | .... | .... | .... | -29.679 | 3.00 | 3.00 | 2 | 0.00 | 4304.65 | 909.82 | 909.91 | 0.083 |
| 4 | 5.09 | 5.11 | n/a | 0.20 | 0.50 | 0.90 | 228.56 | 2.03 | .... | .... | .... | -28.374 | 3.00 | 2.04** | 3 | 0.00 | 4393.09 | 910.16 | 910.57 | 0.384 |
| 5 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 228.08 | 2.03 | .... | .... | .... | 3.583 | 2.17 | 2.03** | 4 | 0.00 | 4414.96 | 910.72 | 913.03 | 0.000 |
| 6 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 250.32 | 2.03 | .... | .... | .... | 3.583 | 2.03 | 2.03** | 5 | 0.00 | 4519.11 | 913.03 | 926.72 | 0.000 |
| 7 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 251.49 | 2.03 | .... | .... | .... | 13.875 | 2.03 | 2.03** | 6 | 0.00 | 4541.53 | 926.72 | 929.48 | 0.000 |
| 8 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 260.57 | 2.03 | .... | .... | .... | 13.875 | 2.03 | 2.03** | 7 | 0.00 | 4678.94 | 929.48 | 947.39 | 0.000 |
| 9 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 162.48 | 2.03 | .... | .... | .... | -12.176 | 2.03 | 2.03** | 8 | 0.00 | 4691.46 | 947.39 | 948.03 | 0.000 |
| 10 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 161.44 | 2.03 | .... | .... | .... | -15.089 | 2.03 | 2.03** | 9 | 0.00 | 4774.99 | 948.03 | 952.58 | 0.000 |
| 11 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 161.77 | 2.03 | .... | .... | .... | 0.000 | 2.03 | 2.03** | 10 | 0.00 | 4821.98 | 952.58 | 955.15 | 0.000 |
| 12 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 161.50 | 2.03 | .... | .... | .... | -7.823 | 2.03 | 2.03** | 11 | 0.00 | 4845.21 | 955.15 | 956.51 | 0.000 |
| 13 | 5.09 | 5.09 | n/a | 0.20 | 0.50 | 0.90 | 569.08 | 2.03 | .... | .... | .... | -9.560 | 2.03 | 2.03** | 12 | 0.00 | 4859.12 | 956.51 | 967.94 | 0.000 |
| * 14 | 8.29 | 8.30 | 1 | 0.20 | 0.50 | 0.90 | 136.88 | 3.19 | .... | .... | .... | -1.589 | 3.25 | 3.25 | 1 | 0.00 | 4384.94 | 913.75 | 919.37 | 5.624 |

* Line 2 & 14 Form Junction

Church Q25 w Q25 MP | Number of lines: 14 | Date: 6/8/2018

NOTES: ** Critical depth

# MyReport



| Flow Rate (cfs) | Sf Ave (ft/ft) | Sf Dn (ft/ft) | Grate Area (sqft) | Grate Len (ft) | Grate Width (ft) | Gnd/Rim El Dn (ft) | Gnd/Rim El Up (ft) | Gutter Depth (ft) | Gutter Slope (ft/ft) | Gutter Spread (ft) | Gutter Width (ft) | HGL Dn (ft) | HGL Up (ft) | HGL Jnct (ft) | HGL Jmp Dn (ft) | HGL Jmp Up (ft) | Incr CxA | Incr Q (cfs) | Inlet Depth (ft) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 183.00 | 4.914 | 4.915 | .... | .... | .... | 0.00 | 907.64 | .... | .... | .... | .... | 893.46 | 904.60 | 909.06 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.291 | 0.291 | .... | .... | .... | 907.64 | 899.06 | .... | .... | .... | .... | 909.06 | 909.09 | 909.35 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.291 | 0.291 | .... | .... | .... | 899.06 | 900.54 | .... | .... | .... | .... | 909.35 | 909.43 | 909.68 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.371 | 0.291 | .... | .... | .... | 900.54 | 910.89 | .... | .... | .... | .... | 909.68 | 909.67 | 909.80 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 910.89 | 913.35 | .... | .... | .... | .... | 909.80 | 912.12 j | 912.12 | 909.91 | 910.51 | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 913.35 | 927.04 | .... | .... | .... | .... | 912.12 | 925.81 | 925.81 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 927.04 | 929.80 | .... | .... | .... | .... | 925.81 | 928.57 | 928.57 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 929.80 | 947.71 | .... | .... | .... | .... | 928.57 | 946.48 | 946.48 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 947.71 | 948.34 | .... | .... | .... | .... | 946.48 | 947.12 | 947.12 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 948.34 | 952.90 | .... | .... | .... | .... | 947.12 | 951.67 | 951.67 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 952.90 | 955.47 | .... | .... | .... | .... | 951.67 | 954.24 | 954.24 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 955.47 | 956.83 | .... | .... | .... | .... | 954.24 | 955.60 | 955.60 | .... | .... | 0.00 | 0.00 | .... | |
| 39.00 | 0.000 | 0.000 | .... | .... | .... | 956.83 | 969.10 | .... | .... | .... | .... | 955.60 | 967.03 | 967.03 | .... | .... | 0.00 | 39.00 | .... | |
| 144.00 | 2.592 | 2.593 | .... | .... | .... | 907.64 | 0.00 | .... | .... | .... | .... | 909.06 | 914.69 | 919.37 | .... | .... | 0.00 | 144.00 | .... | |

**Church Q25 w Q25 MP** | Number of lines: 14 | Date: 6/8/2018

NOTES: ** Critical depth

# MyReport



| Inlet Eff (%) | Inlet ID | Inlet Loc | (ft) | Inlet Time (min) | i Sys (in/hr) | i Inlet (in/hr) | Invert Dn (ft) | Invert Up (ft) | Jump Loc (ft) | Jump Len (ft) | Vel Hd Jmp Dn (ft) | Vel Hd Jmp Up (ft) | J-Loss Coeff | Junct Type | Known Q (cfs) | Cost RCP | Cost CMP | Cost PVC | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .... | Structure - (706) | On Grade | | 0.0 | 0.00 | 0.00 | 890.21 | 895.54 | .... | .... | 0.00 | 0.00 | 0.59 | MH | 0.00 | 160 | 144 | 136 | |
| .... | Structure - (705) | On Grade | | 0.0 | 0.00 | 0.00 | 895.54 | 895.80 | .... | .... | 0.00 | 0.00 | 0.55 | None | 0.00 | 660 | 594 | 561 | |
| .... | Structure - (704) | On Grade | | 0.0 | 0.00 | 0.00 | 895.80 | 897.28 | .... | .... | 0.00 | 0.00 | 0.53 | None | 0.00 | 1,354 | 1,219 | 1,151 | |
| .... | Structure - (703) | On Grade | | 0.0 | 0.00 | 0.00 | 897.28 | 907.63 | .... | .... | 0.00 | 0.00 | 0.15 | None | 0.00 | 4,632 | 4,169 | 3,937 | |
| .... | Structure - (702) | On Grade | | 0.0 | 0.00 | 0.00 | 907.63 | 910.09 | 2.47 | 10.15 | 0.91 | 1.54 | 0.15 z | None | 0.00 | 1,178 | 1,060 | 1,001 | |
| .... | Structure - (701) | On Grade | | 0.0 | 0.00 | 0.00 | 910.09 | 923.78 | .... | .... | 0.00 | 0.00 | 0.28 z | None | 0.00 | 5,116 | 4,604 | 4,349 | |
| .... | Structure - (700) | On Grade | | 0.0 | 0.00 | 0.00 | 923.78 | 926.54 | .... | .... | 0.00 | 0.00 | 0.28 z | None | 0.00 | 1,090 | 981 | 927 | |
| .... | Structure - (699) | On Grade | | 0.0 | 0.00 | 0.00 | 926.54 | 944.45 | .... | .... | 0.00 | 0.00 | 0.25 z | None | 0.00 | 6,150 | 5,535 | 5,228 | |
| .... | Structure - (698) | On Grade | | 0.0 | 0.00 | 0.00 | 944.45 | 945.09 | .... | .... | 0.00 | 0.00 | 0.31 z | None | 0.00 | 650 | 585 | 553 | |
| .... | Structure - (697) | On Grade | | 0.0 | 0.00 | 0.00 | 945.09 | 949.64 | .... | .... | 0.00 | 0.00 | 0.15 z | None | 0.00 | 4,104 | 3,694 | 3,488 | |
| .... | Structure - (696) | On Grade | | 0.0 | 0.00 | 0.00 | 949.64 | 952.21 | .... | .... | 0.00 | 0.00 | 0.17 z | None | 0.00 | 2,344 | 2,110 | 1,992 | |
| .... | Structure - (695) | On Grade | | 0.0 | 0.00 | 0.00 | 952.21 | 953.57 | .... | .... | 0.00 | 0.00 | 0.20 z | None | 0.00 | 1,288 | 1,159 | 1,095 | |
| .... | Structure - (694) | On Grade | | 0.0 | 0.00 | 0.00 | 953.57 | 965.00 | .... | .... | 0.00 | 0.00 | 1.00 z | MH | 39.00 | 928 | 835 | 789 | |
| .... | | Sag | | 0.0 | 0.00 | 0.00 | 895.54 | 900.62 | .... | .... | 0.00 | 0.00 | 1.00 | MH | 144.00 | 100 | 90 | 85 | |



NOTES: Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82 -- Return period = 25 Yrs. ; ** Critical depth

# MyReport



| Line ID | Line Length (ft) | Line Size (in) | Line Slope (%) | Line Type | Local Depr (in) | n-val Gutter | n-val Pipe | Minor Loss (ft) | Northing Y (ft) | Pipe Travel (min) | Q Byp (cfs) | Q Capt (cfs) | Q Carry (cfs) | Line Rise (in) | Runoff Coeff (C) | Line Span (in) | Area A1 (ac) | Area A2 (ac) | Area A3 (ac) | Tc (min) | Throat Ht (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pipe - (697) | 226.620 | 39 | 2.35 | Cir | .... | .... | 0.013 | 4.46 | 4811.37 | 0.17 | .... | .... | .... | 39 | 0.00 | 39 | 0.00 | 0.00 | 0.00 | 1.9 | .... |
| * Pipe - (695) | 9.325 | 36 | 2.79 | Cir | .... | .... | 0.012 | 0.26 | 4807.16 | 0.03 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 1.9 | .... |
| Pipe - (694) | 28.513 | 36 | 5.19 | Cir | .... | .... | 0.012 | 0.25 | 4808.58 | 0.09 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 1.8 | .... |
| Pipe - (693) | 103.428 | 36 | 10.01 | Cir | .... | .... | 0.012 | 0.14 | 4862.20 | 0.31 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 1.5 | .... |
| Pipe - (692) | 24.686 | 36 | 9.97 | Cir | .... | .... | 0.012 | n/a | 4873.65 | 0.07 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 1.4 | .... |
| Pipe - (691) | 114.056 | 36 | 12.00 | Cir | .... | .... | 0.012 | 0.26 | 4920.15 | 0.34 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 1.1 | .... |
| Pipe - (690) | 22.781 | 36 | 12.12 | Cir | .... | .... | 0.012 | 0.26 | 4924.17 | 0.07 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 1.0 | .... |
| Pipe - (689) | 137.700 | 36 | 13.01 | Cir | .... | .... | 0.012 | 0.23 | 4915.31 | 0.42 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 0.6 | .... |
| Pipe - (688) | 12.655 | 36 | 5.06 | Cir | .... | .... | 0.012 | 0.28 | 4917.18 | 0.04 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 0.6 | .... |
| Pipe - (687) | 91.135 | 36 | 4.99 | Cir | .... | .... | 0.012 | 0.14 | 4953.63 | 0.28 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 0.3 | .... |
| Pipe - (686) | 51.266 | 36 | 5.01 | Cir | .... | .... | 0.012 | 0.16 | 4974.13 | 0.15 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 0.1 | .... |
| Pipe - (685) | 27.218 | 36 | 5.00 | Cir | .... | .... | 0.012 | 0.18 | 4988.31 | 0.08 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 0.1 | .... |
| Pipe - (684) | 18.424 | 36 | 62.04 | Cir | .... | .... | 0.012 | 0.91 | 5000.39 | 0.06 | .... | .... | .... | 36 | 0.00 | 36 | 0.00 | 0.00 | 0.00 | 0.0 | .... |
| * | 216.927 | 39 | 2.34 | Cir | .... | .... | 0.012 | 4.68 | 4628.75 | 0.21 | .... | .... | .... | 39 | 0.00 | 39 | 0.00 | 0.00 | 0.00 | 0.0 | .... |

**Church Q25 w Q25 MP** | Number of lines: 14 | Date: 6/8/2018

NOTES: ** Critical depth

# MyReport



| Total Area (ac) | Total CxA | Total Runoff (cfs) | Vel Ave (ft/s) | Vel Dn (ft/s) | Vel Hd Dn (ft) | Vel Hd Up (ft) | Vel Up (ft/s) | Cover Dn (ft) | Cover Up (ft) | Storage (cft) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 22.06 | 22.06 | 7.57 | 7.57 | 22.06 | n/a | 8.85 | 1879.62 |
| 0.00 | 0.00 | 0.00 | 5.52 | 5.52 | 0.47 | 0.47 | 5.52 | 9.10 | 0.26 | 65.90 |
| 0.00 | 0.00 | 0.00 | 5.52 | 5.52 | 0.47 | 0.47 | 5.52 | 0.26 | 0.26 | 201.51 |
| 0.00 | 0.00 | 0.00 | 6.57 | 5.52 | 0.47 | 0.90 | 7.63 | 0.26 | 0.26 | 697.22 |
| 0.00 | 0.00 | 0.00 | 7.38 | 7.11 | 0.91 | 0.91 | 7.66 | 0.26 | 0.26 | 130.59 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 0.26 | 580.83 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 0.26 | 116.01 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 0.26 | 701.24 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 0.25 | 64.45 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.25 | 0.26 | 464.11 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 0.26 | 261.07 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 0.26 | 138.61 |
| 0.00 | 0.00 | 0.00 | 7.66 | 7.66 | 0.91 | 0.91 | 7.66 | 0.26 | 1.10 | 93.82 |
| 0.00 | 0.00 | 0.00 | 17.36 | 17.36 | 4.69 | 4.68 | 17.36 | 8.85 | n/a | 1799.22 |

**Church Q25 w Q25 MP** | Number of lines: 14 | Date: 6/8/2018

NOTES: ** Critical depth

# Hydraulic Grade Line Computations

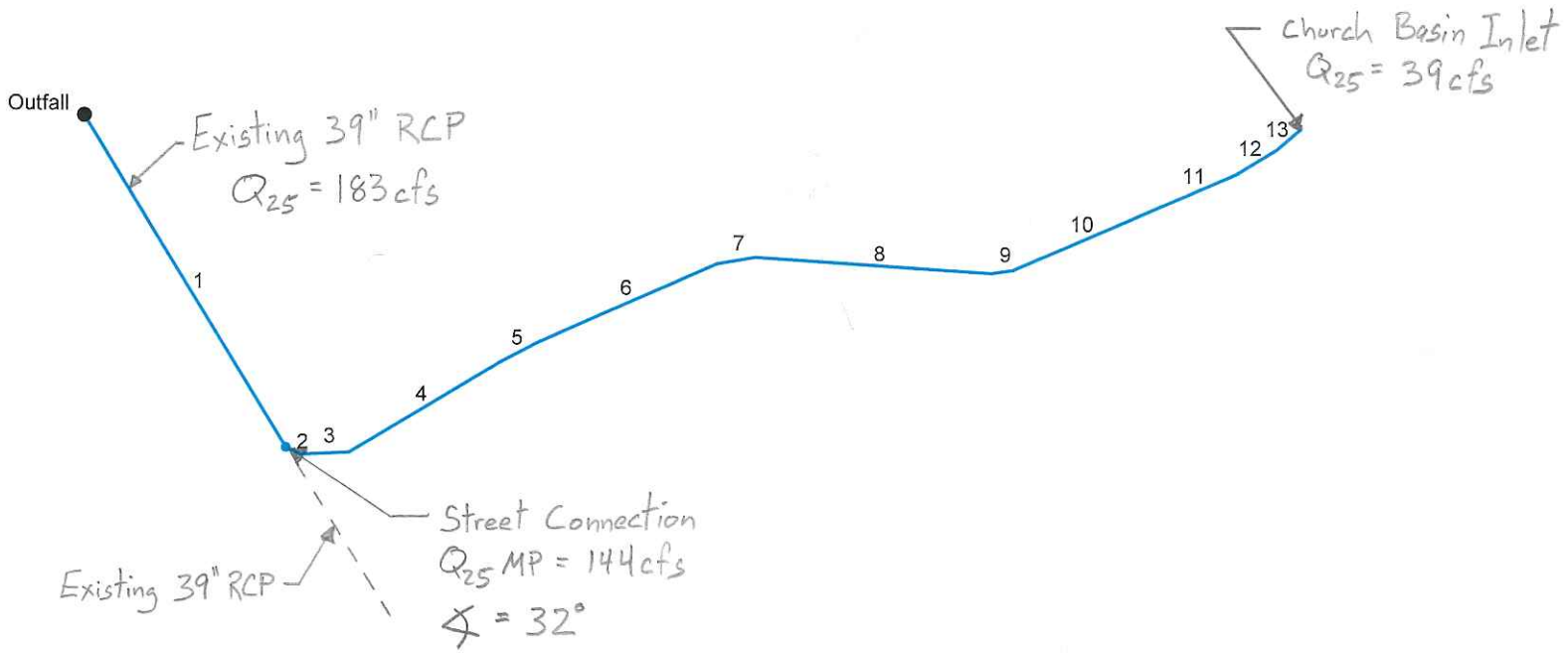


| Line | Size | Q | Downstream | | | | | | | | Len | Upstream | | | | | | | | Check | | JL coeff | Minor loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | Ave Sf | Enrgy loss | | |
| | (in) | (cfs) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (ft) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (%) | (ft) | (K) | (ft) |
| 1 | 39 | 183.0 | 890.21 | 893.46 | 3.25 | 8.29 | 22.06 | 7.57 | 901.03 | 4.915 | 226.62 | 895.54 | 904.60 | 3.25 | 8.30 | 22.06 | 7.57 | 912.16 | 4.913 | 4.914 | 11.14 | 0.59 | 4.46 |
| 2 | 36 | 39.00 | 895.54 | 909.06 | 3.00 | 7.07 | 5.52 | 0.47 | 909.54 | 0.291 | 9.325 | 895.80 | 909.09 | 3.00 | 7.07 | 5.52 | 0.47 | 909.56 | 0.291 | 0.291 | 0.027 | 0.55 | 0.26 |
| 3 | 36 | 39.00 | 895.80 | 909.35 | 3.00 | 7.07 | 5.52 | 0.47 | 909.82 | 0.291 | 28.513 | 897.28 | 909.43 | 3.00 | 7.07 | 5.52 | 0.47 | 909.91 | 0.291 | 0.291 | 0.083 | 0.53 | 0.25 |
| 4 | 36 | 39.00 | 897.28 | 909.68 | 3.00 | 5.09 | 5.52 | 0.47 | 910.16 | 0.291 | 103.42 | 907.63 | 909.67 | 2.04** | 5.11 | 7.63 | 0.90 | 910.57 | 0.450 | 0.371 | 0.384 | 0.15 | 0.14 |
| 5 | 36 | 39.00 | 907.63 | 909.80 | 2.17 | 5.09 | 7.11 | 0.91 | 910.72 | 0.000 | 24.686 | 910.09 | 912.12 j | 2.03** | 5.09 | 7.66 | 0.91 | 913.03 | 0.000 | 0.000 | n/a | 0.15 | 0.14 |
| 6 | 36 | 39.00 | 910.09 | 912.12 | 2.03* | 5.09 | 7.66 | 0.91 | 913.03 | 0.000 | 114.055 | 923.78 | 925.81 | 2.03** | 5.09 | 7.66 | 0.91 | 926.72 | 0.000 | 0.000 | n/a | 0.28 | 0.26 |
| 7 | 36 | 39.00 | 923.78 | 925.81 | 2.03* | 5.09 | 7.66 | 0.91 | 926.72 | 0.000 | 22.781 | 926.54 | 928.57 | 2.03** | 5.09 | 7.66 | 0.91 | 929.48 | 0.000 | 0.000 | n/a | 0.28 | 0.26 |
| 8 | 36 | 39.00 | 926.54 | 928.57 | 2.03* | 5.09 | 7.66 | 0.91 | 929.48 | 0.000 | 137.700 | 944.45 | 946.48 | 2.03** | 5.09 | 7.66 | 0.91 | 947.39 | 0.000 | 0.000 | n/a | 0.25 | 0.23 |
| 9 | 36 | 39.00 | 944.45 | 946.48 | 2.03* | 5.09 | 7.66 | 0.91 | 947.39 | 0.000 | 12.655 | 945.09 | 947.12 | 2.03** | 5.09 | 7.66 | 0.91 | 948.03 | 0.000 | 0.000 | n/a | 0.31 | 0.28 |
| 10 | 36 | 39.00 | 945.09 | 947.12 | 2.03* | 5.09 | 7.66 | 0.91 | 948.03 | 0.000 | 91.135 | 949.64 | 951.67 | 2.03** | 5.09 | 7.66 | 0.91 | 952.58 | 0.000 | 0.000 | n/a | 0.15 | 0.14 |
| 11 | 36 | 39.00 | 949.64 | 951.67 | 2.03* | 5.09 | 7.66 | 0.91 | 952.58 | 0.000 | 51.266 | 952.21 | 954.24 | 2.03** | 5.09 | 7.66 | 0.91 | 955.15 | 0.000 | 0.000 | n/a | 0.17 | 0.16 |
| 12 | 36 | 39.00 | 952.21 | 954.24 | 2.03* | 5.09 | 7.66 | 0.91 | 955.15 | 0.000 | 27.218 | 953.57 | 955.60 | 2.03** | 5.09 | 7.66 | 0.91 | 956.51 | 0.000 | 0.000 | n/a | 0.20 | 0.18 |
| 13 | 36 | 39.00 | 953.57 | 955.60 | 2.03* | 5.09 | 7.66 | 0.91 | 956.51 | 0.000 | 18.424 | 965.00 | 967.03 | 2.03** | 5.09 | 7.66 | 0.91 | 967.94 | 0.000 | 0.000 | n/a | 1.00 | 0.91 |
| 14 | 39 | 144.0 | 895.54 | 909.06 | 3.25 | 8.29 | 17.36 | 4.69 | 913.75 | 2.593 | 216.927 | 900.62 | 914.69 | 3.25 | 8.30 | 17.36 | 4.68 | 919.37 | 2.592 | 2.592 | 5.624 | 1.00 | 4.68 |

**Church Q25 w Q25 MP** | Number of lines: 14 | Run Date: 6/8/2018

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

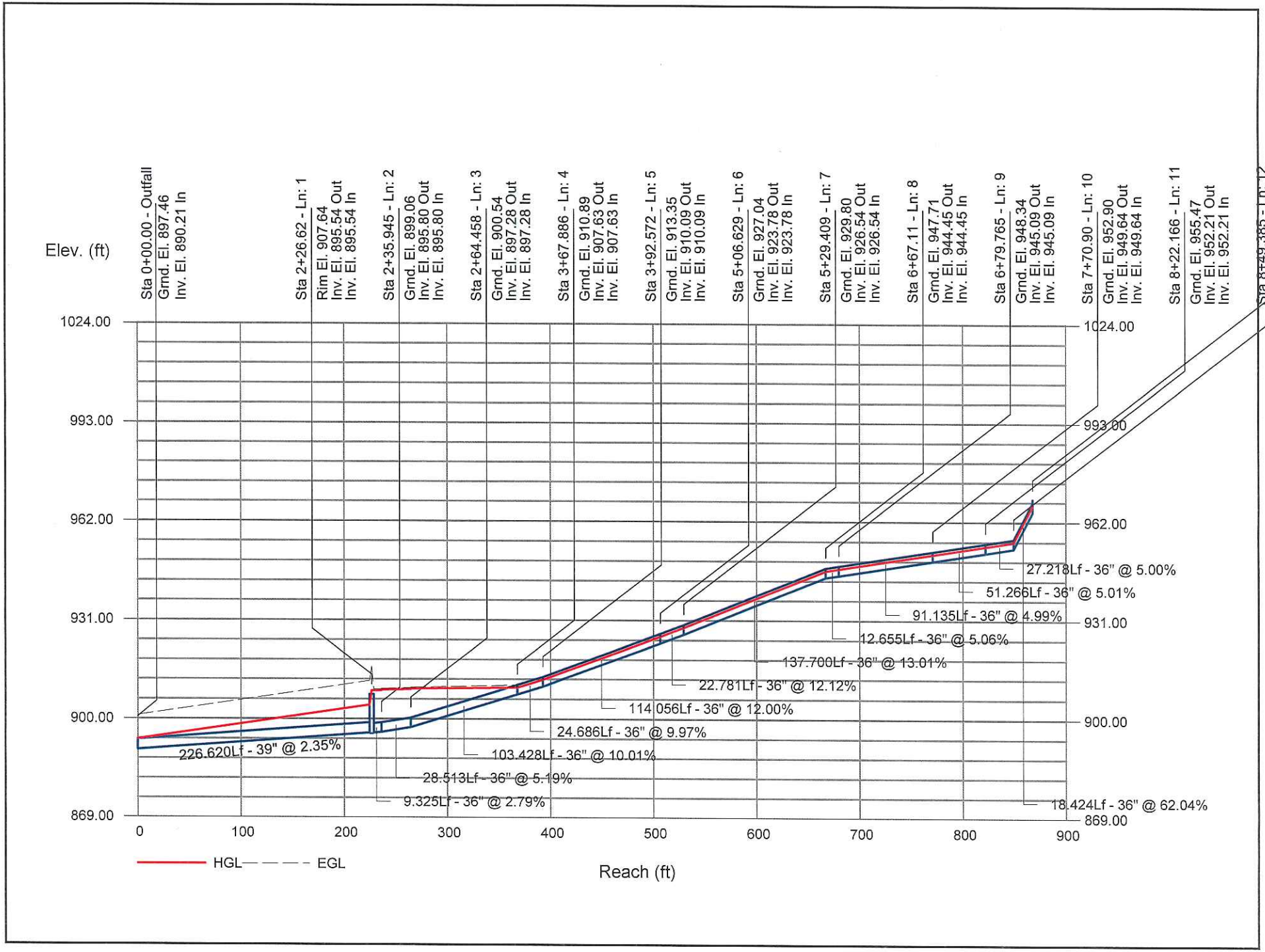
# Church Q25 w Q25 MP




| Project File: Church Q25 with 39in Q25 MP.stm | Number of lines: 13 | Date: 6/8/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Church Q25 with 39in Q25 MP.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 183.0 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.44* | 904.23* | 4.46 | 908.70 | End | Manhole |
| 2 | Pipe - (695) | 39.00 | 36 | Cir | 9.325 | 895.54 | 895.80 | 2.788 | 908.70* | 908.72* | 0.26 | 908.98 | 1 | None |
| 3 | Pipe - (694) | 39.00 | 36 | Cir | 28.513 | 895.80 | 897.28 | 5.191 | 908.98* | 909.07* | 0.25 | 909.32 | 2 | None |
| 4 | Pipe - (693) | 39.00 | 36 | Cir | 103.428 | 897.28 | 907.63 | 10.007 | 909.32 | 909.66 | 0.14 | 909.66 | 3 | None |
| 5 | Pipe - (692) | 39.00 | 36 | Cir | 24.686 | 907.63 | 910.09 | 9.965 | 909.66 | 912.12 | 0.14 | 912.12 | 4 | None |
| 6 | Pipe - (691) | 39.00 | 36 | Cir | 114.056 | 910.09 | 923.78 | 12.003 | 912.12 | 925.81 | 0.26 | 925.81 | 5 | None |
| 7 | Pipe - (690) | 39.00 | 36 | Cir | 22.781 | 923.78 | 926.54 | 12.115 | 925.81 | 928.57 | 0.26 | 928.57 | 6 | None |
| 8 | Pipe - (689) | 39.00 | 36 | Cir | 137.700 | 926.54 | 944.45 | 13.007 | 928.57 | 946.48 | 0.23 | 946.48 | 7 | None |
| 9 | Pipe - (688) | 39.00 | 36 | Cir | 12.655 | 944.45 | 945.09 | 5.057 | 946.48 | 947.12 | 0.28 | 947.12 | 8 | None |
| 10 | Pipe - (687) | 39.00 | 36 | Cir | 91.135 | 945.09 | 949.64 | 4.993 | 947.12 | 951.67 | 0.14 | 951.67 | 9 | None |
| 11 | Pipe - (686) | 39.00 | 36 | Cir | 51.266 | 949.64 | 952.21 | 5.013 | 951.67 | 954.24 | 0.16 | 954.24 | 10 | None |
| 12 | Pipe - (685) | 39.00 | 36 | Cir | 27.218 | 952.21 | 953.57 | 4.997 | 954.24 | 955.60 | 0.18 | 955.60 | 11 | None |
| 13 | Pipe - (684) | 39.00 | 36 | Cir | 18.424 | 953.57 | 965.00 | 62.038 | 955.60 | 967.03 | 0.91 | 967.03 | 12 | Manhole |

**Church Q25 w Q25 MP**

Number of lines: 13

Run Date: 6/8/2018

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

# Hydraulic Grade Line Computations

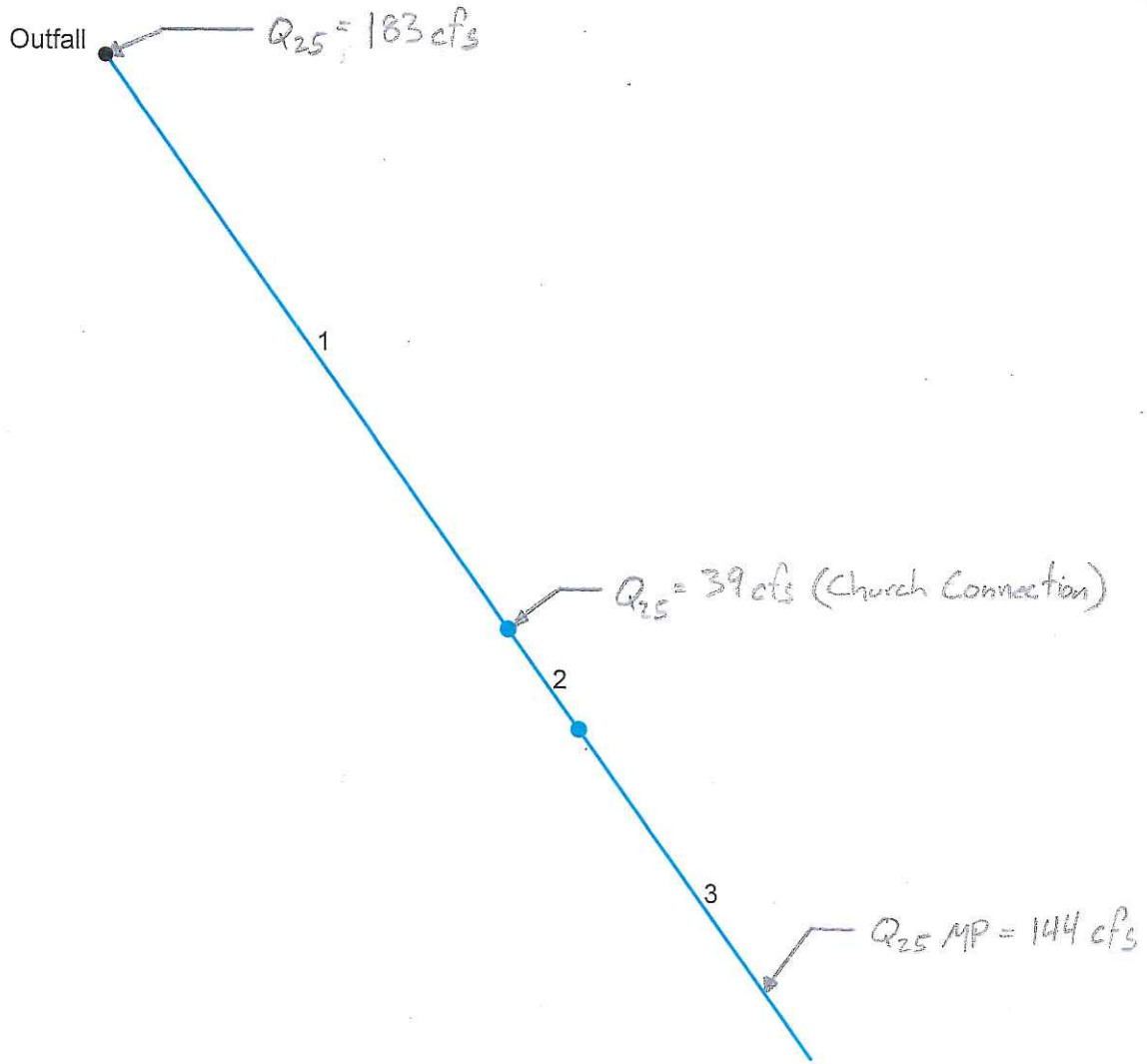


| Line | Size | Q | Downstream | | | | | | | | Len | Upstream | | | | | | | | Check | | JL coeff | Minor loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | Ave Sf | Enrgy loss | | |
| | (in) | (cfs) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (ft) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (%) | (ft) | (K) | (ft) |
| 1 | 39 | 183.0 | 890.21 | 893.44 | 3.23 | 8.29 | 22.08 | 7.58 | 901.02 | 4.600 | 226.62 | 895.54 | 904.23 | 3.25 | 8.30 | 22.06 | 7.57 | 911.80 | 4.913 | 4.757 | 10.78 | 0.59 | 4.46 |
| 2 | 36 | 39.00 | 895.54 | 908.70 | 3.00 | 7.07 | 5.52 | 0.47 | 909.17 | 0.291 | 9.325 | 895.80 | 908.72 | 3.00 | 7.07 | 5.52 | 0.47 | 909.20 | 0.291 | 0.291 | 0.027 | 0.55 | 0.26 |
| 3 | 36 | 39.00 | 895.80 | 908.98 | 3.00 | 7.07 | 5.52 | 0.47 | 909.46 | 0.291 | 28.513 | 897.28 | 909.07 | 3.00 | 7.07 | 5.52 | 0.47 | 909.54 | 0.291 | 0.291 | 0.083 | 0.53 | 0.25 |
| 4 | 36 | 39.00 | 897.28 | 909.32 | 3.00 | 5.09 | 5.52 | 0.47 | 909.79 | 0.291 | 103.428 | 907.63 | 909.66 | 2.03** | 5.09 | 7.66 | 0.91 | 910.57 | 0.455 | 0.373 | n/a | 0.15 | 0.14 |
| 5 | 36 | 39.00 | 907.63 | 909.66 | 2.03* | 5.09 | 7.66 | 0.91 | 910.57 | 0.000 | 24.686 | 910.09 | 912.12 | 2.03** | 5.09 | 7.66 | 0.91 | 913.03 | 0.000 | 0.000 | n/a | 0.15 | 0.14 |
| 6 | 36 | 39.00 | 910.09 | 912.12 | 2.03* | 5.09 | 7.66 | 0.91 | 913.03 | 0.000 | 114.056 | 923.78 | 925.81 | 2.03** | 5.09 | 7.66 | 0.91 | 926.72 | 0.000 | 0.000 | n/a | 0.28 | 0.26 |
| 7 | 36 | 39.00 | 923.78 | 925.81 | 2.03* | 5.09 | 7.66 | 0.91 | 926.72 | 0.000 | 22.781 | 926.54 | 928.57 | 2.03** | 5.09 | 7.66 | 0.91 | 929.48 | 0.000 | 0.000 | n/a | 0.28 | 0.26 |
| 8 | 36 | 39.00 | 926.54 | 928.57 | 2.03* | 5.09 | 7.66 | 0.91 | 929.48 | 0.000 | 137.700 | 944.45 | 946.48 | 2.03** | 5.09 | 7.66 | 0.91 | 947.39 | 0.000 | 0.000 | n/a | 0.25 | 0.23 |
| 9 | 36 | 39.00 | 944.45 | 946.48 | 2.03* | 5.09 | 7.66 | 0.91 | 947.39 | 0.000 | 12.655 | 945.09 | 947.12 | 2.03** | 5.09 | 7.66 | 0.91 | 948.03 | 0.000 | 0.000 | n/a | 0.31 | 0.28 |
| 10 | 36 | 39.00 | 945.09 | 947.12 | 2.03* | 5.09 | 7.66 | 0.91 | 948.03 | 0.000 | 91.135 | 949.64 | 951.67 | 2.03** | 5.09 | 7.66 | 0.91 | 952.58 | 0.000 | 0.000 | n/a | 0.15 | 0.14 |
| 11 | 36 | 39.00 | 949.64 | 951.67 | 2.03* | 5.09 | 7.66 | 0.91 | 952.58 | 0.000 | 51.266 | 952.21 | 954.24 | 2.03** | 5.09 | 7.66 | 0.91 | 955.15 | 0.000 | 0.000 | n/a | 0.17 | 0.16 |
| 12 | 36 | 39.00 | 952.21 | 954.24 | 2.03* | 5.09 | 7.66 | 0.91 | 955.15 | 0.000 | 27.218 | 953.57 | 955.60 | 2.03** | 5.09 | 7.66 | 0.91 | 956.51 | 0.000 | 0.000 | n/a | 0.20 | 0.18 |
| 13 | 36 | 39.00 | 953.57 | 955.60 | 2.03* | 5.09 | 7.66 | 0.91 | 956.51 | 0.000 | 18.424 | 965.00 | 967.03 | 2.03** | 5.09 | 7.66 | 0.91 | 967.94 | 0.000 | 0.000 | n/a | 1.00 | 0.91 |

**Church Q25 w Q25 MP** | Number of lines: 13 | Run Date: 6/8/2018

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

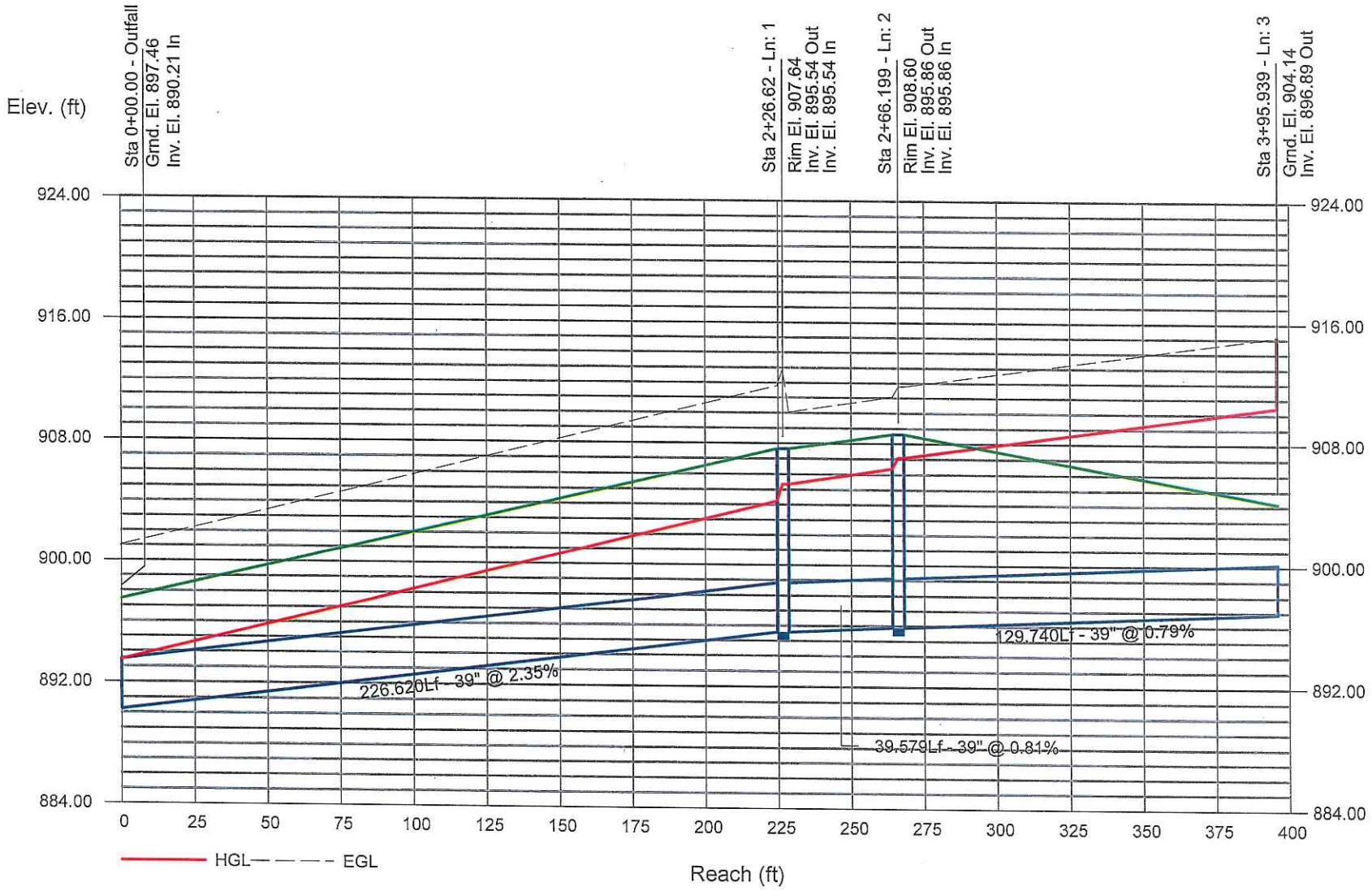
# Hillcrest Q25 MP




| Project File: Existing 39in Hillcrest Q25 MP with Church Q25.stm | Number of lines: 3 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Existing 39in Hillcrest Q25 MP with Church Q25.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 183.0 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.44* | 904.21* | 1.13 | 905.34 | End | Manhole |
| 2 | Pipe - (695) (1) (1) | 144.0 | 39 | Cir | 39.579 | 895.54 | 895.86 | 0.809 | 905.34* | 906.37* | 0.70 | 907.07 | 1 | Manhole |
| 3 | Pipe - (695) (1) | 144.0 | 39 | Cir | 129.740 | 895.86 | 896.89 | 0.794 | 907.07* | 910.44* | 4.68 | 915.12 | 2 | None |

Project File: Existing 39in Hillcrest Q25 MP with Church Q25.stm

Number of lines: 3

Run Date: 5/18/2018

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

# Hydraulic Grade Line Computations

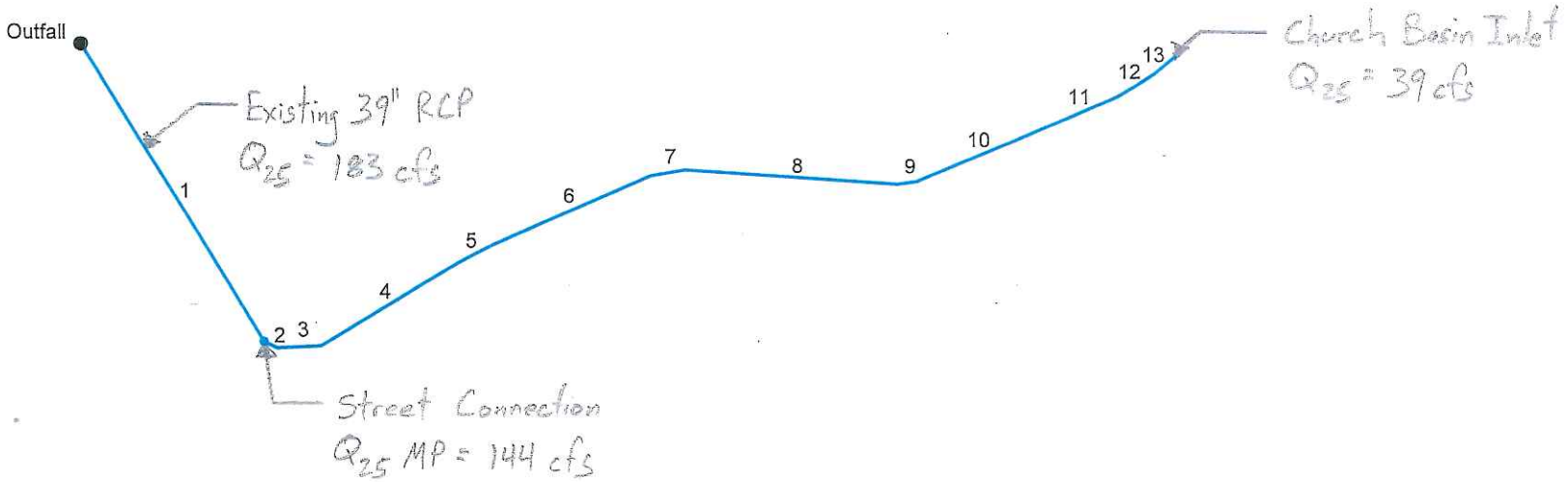


| Line | Size | Q | Downstream | | | | | | | | Len | Upstream | | | | | | | | Check | | JL coeff | Minor loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | Ave Sf | Enrgy loss | | |
| | (in) | (cfs) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (ft) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (%) | (ft) | (K) | (ft) |
| 1 | 39 | 183.0 | 890.21 | 893.44 | 3.23 | 8.29 | 22.08 | 7.58 | 901.02 | 4.578 | 226.62 | 895.54 | 904.21 | 3.25 | 8.30 | 22.06 | 7.57 | 911.77 | 4.913 | 4.745 | 10.75 | 0.15 | 1.13 |
| 2 | 39 | 144.0 | 895.54 | 905.34 | 3.25 | 8.29 | 17.36 | 4.69 | 910.03 | 2.593 | 39.579 | 895.86 | 906.37 | 3.25 | 8.30 | 17.36 | 4.68 | 911.05 | 2.592 | 2.592 | 1.026 | 0.15 | 0.70 |
| 3 | 39 | 144.0 | 895.86 | 907.07 | 3.25 | 8.29 | 17.36 | 4.69 | 911.76 | 2.593 | 129.74 | 896.89 | 910.44 | 3.25 | 8.30 | 17.36 | 4.68 | 915.12 | 2.592 | 2.592 | 3.363 | 1.00 | 4.68 |

Project File: Existing 39in Hillcrest Q25 MP with Church Q25.stm | Number of lines: 3 | Run Date: 5/18/2018

; c = cir e = ellip b = box

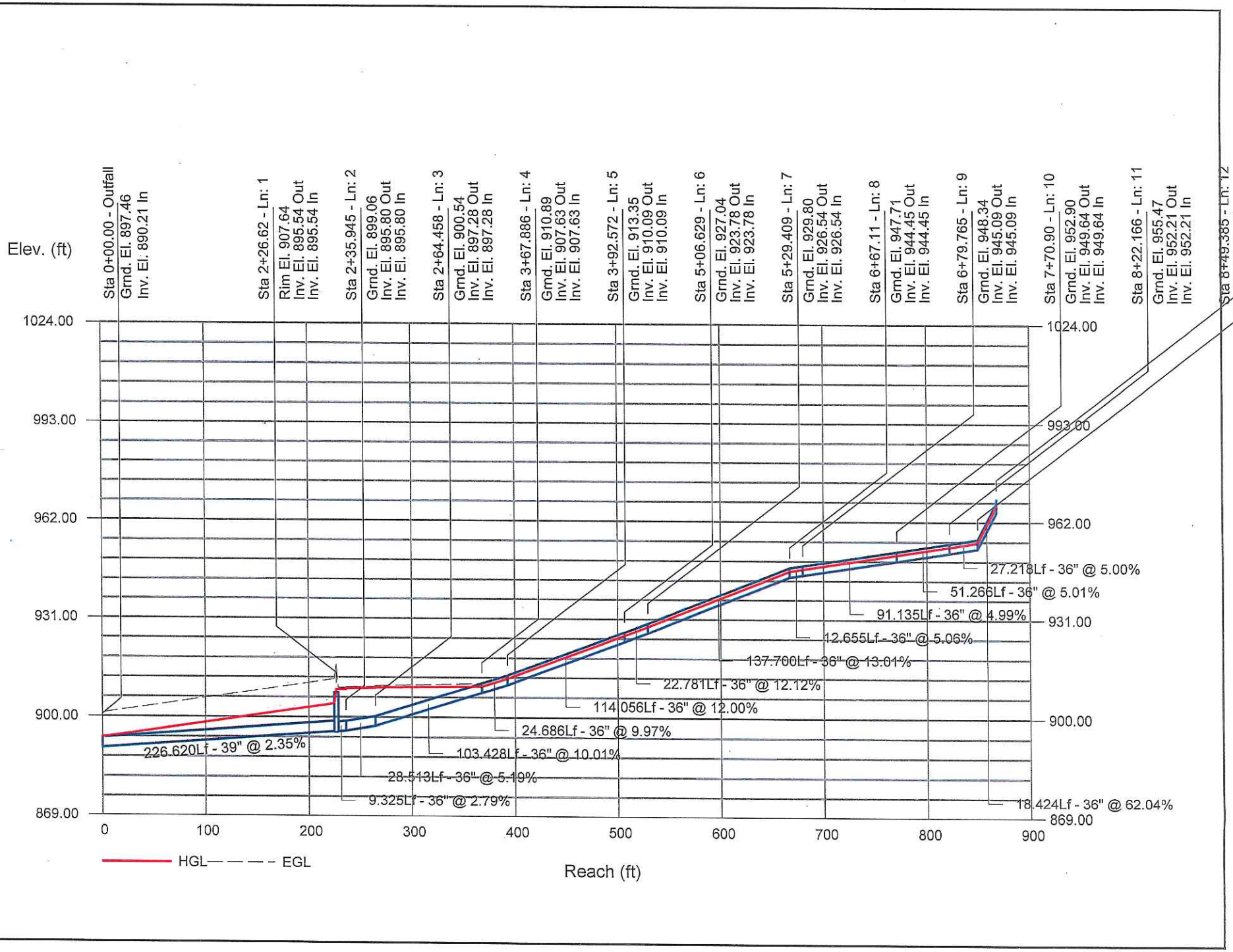
# Church Q25 w Q25 MP




| Project File: Church Q25 with 39in Q25 MP.stm | Number of lines: 13 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Church Q25 with 39in Q25 MP.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 183.0 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.44* | 904.23* | 4.46 | 908.70 | End | Manhole |
| 2 | Pipe - (695) | 39.00 | 36 | Cir | 9.325 | 895.54 | 895.80 | 2.788 | 908.70* | 908.72* | 0.26 | 908.98 | 1 | None |
| 3 | Pipe - (694) | 39.00 | 36 | Cir | 28.513 | 895.80 | 897.28 | 5.191 | 908.98* | 909.07* | 0.25 | 909.32 | 2 | None |
| 4 | Pipe - (693) | 39.00 | 36 | Cir | 103.428 | 897.28 | 907.63 | 10.007 | 909.32 | 909.66 | 0.14 | 909.66 | 3 | None |
| 5 | Pipe - (692) | 39.00 | 36 | Cir | 24.686 | 907.63 | 910.09 | 9.965 | 909.66 | 912.12 | 0.14 | 912.12 | 4 | None |
| 6 | Pipe - (691) | 39.00 | 36 | Cir | 114.056 | 910.09 | 923.78 | 12.003 | 912.12 | 925.81 | 0.26 | 925.81 | 5 | None |
| 7 | Pipe - (690) | 39.00 | 36 | Cir | 22.781 | 923.78 | 926.54 | 12.115 | 925.81 | 928.57 | 0.26 | 928.57 | 6 | None |
| 8 | Pipe - (689) | 39.00 | 36 | Cir | 137.700 | 926.54 | 944.45 | 13.007 | 928.57 | 946.48 | 0.23 | 946.48 | 7 | None |
| 9 | Pipe - (688) | 39.00 | 36 | Cir | 12.655 | 944.45 | 945.09 | 5.057 | 946.48 | 947.12 | 0.28 | 947.12 | 8 | None |
| 10 | Pipe - (687) | 39.00 | 36 | Cir | 91.135 | 945.09 | 949.64 | 4.993 | 947.12 | 951.67 | 0.14 | 951.67 | 9 | None |
| 11 | Pipe - (686) | 39.00 | 36 | Cir | 51.266 | 949.64 | 952.21 | 5.013 | 951.67 | 954.24 | 0.16 | 954.24 | 10 | None |
| 12 | Pipe - (685) | 39.00 | 36 | Cir | 27.218 | 952.21 | 953.57 | 4.997 | 954.24 | 955.60 | 0.18 | 955.60 | 11 | None |
| 13 | Pipe - (684) | 39.00 | 36 | Cir | 18.424 | 953.57 | 965.00 | 62.038 | 955.60 | 967.03 | 0.91 | 967.03 | 12 | Manhole |

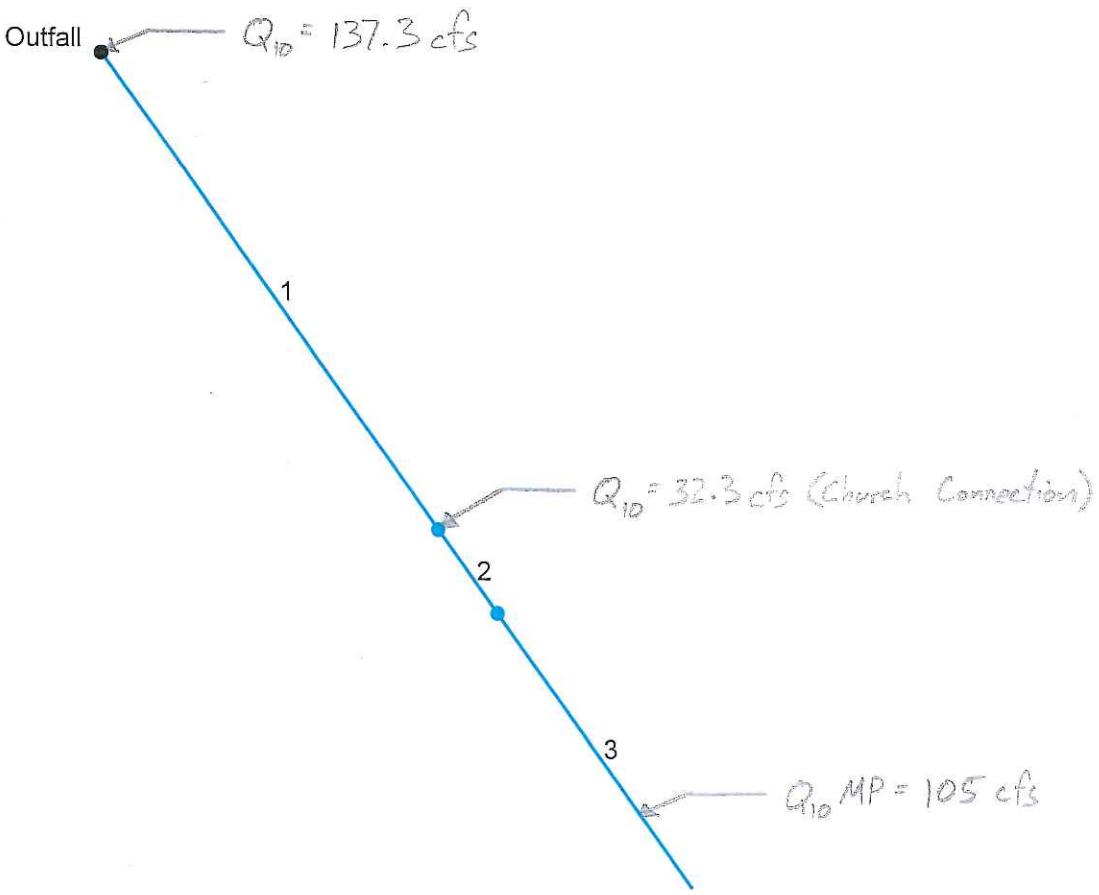
**Church Q25 w Q25 MP**

Number of lines: 13

Run Date: 5/16/2018

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

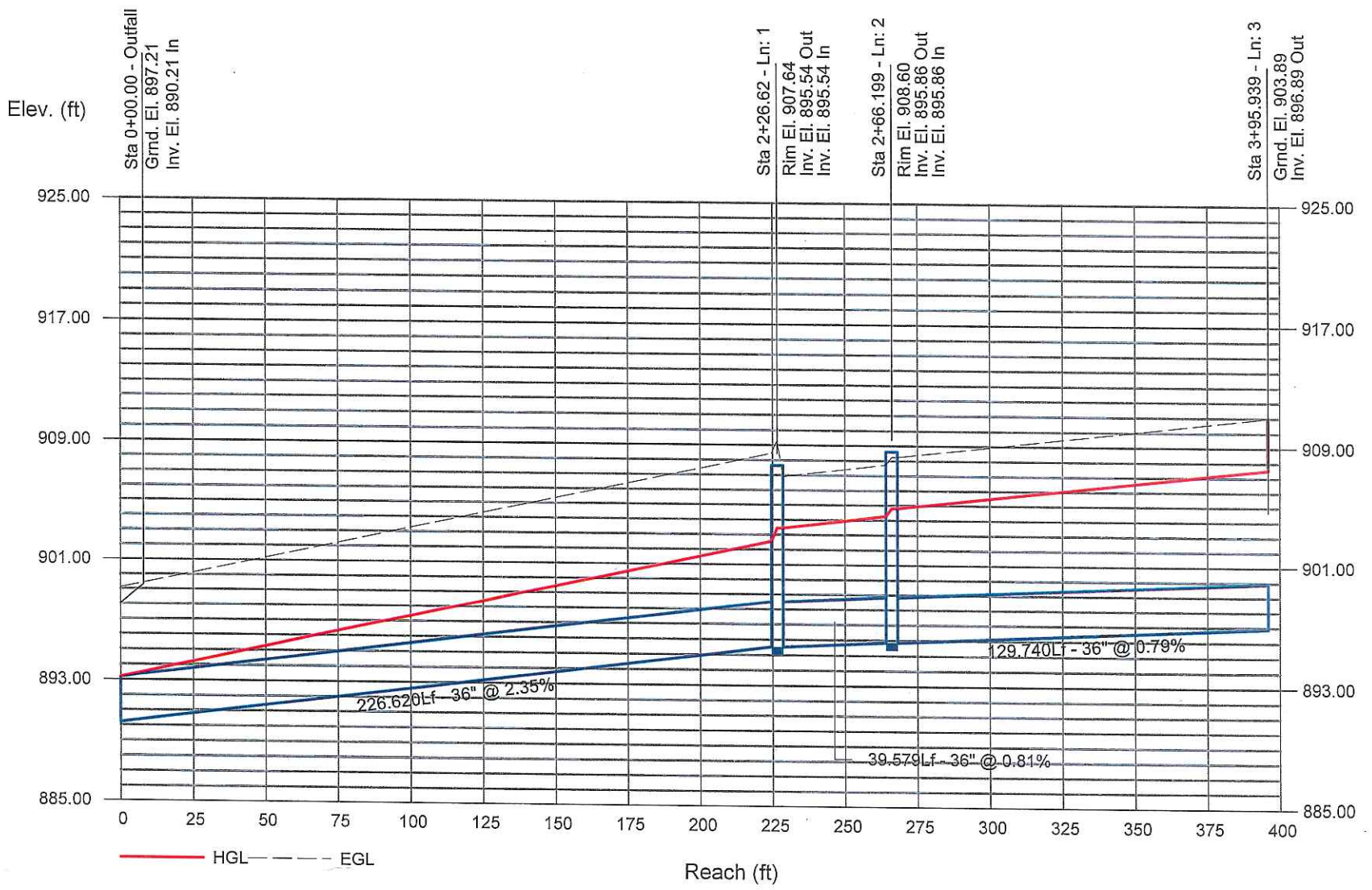
# Hillcrest Q10 MP




| Project File: Existing 39in Hillcrest Q10 MP with Church Q10.stm | Number of lines: 3 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Existing 39in Hillcrest Q10 MP with Church Q10.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 137.3 | 36 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.20* | 902.58* | 0.88 | 903.46 | End | Manhole |
| 2 | Pipe - (695) (1) (1) | 105.0 | 36 | Cir | 39.579 | 895.54 | 895.86 | 0.809 | 903.46* | 904.30* | 0.51 | 904.81 | 1 | Manhole |
| 3 | Pipe - (695) (1) | 105.0 | 36 | Cir | 129.740 | 895.86 | 896.89 | 0.794 | 904.81* | 907.55* | 3.43 | 910.98 | 2 | None |

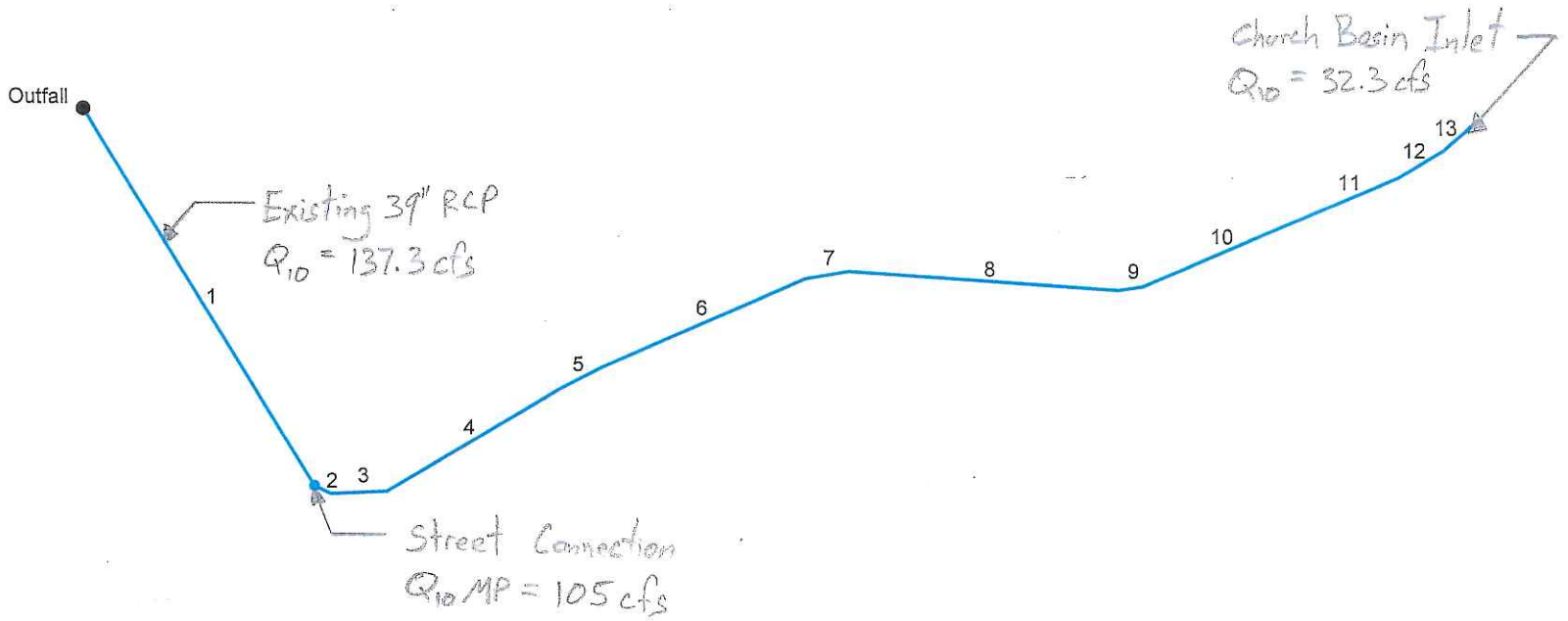
**Hillcrest Q10 MP**

Number of lines: 3

Run Date: 5/16/2018

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

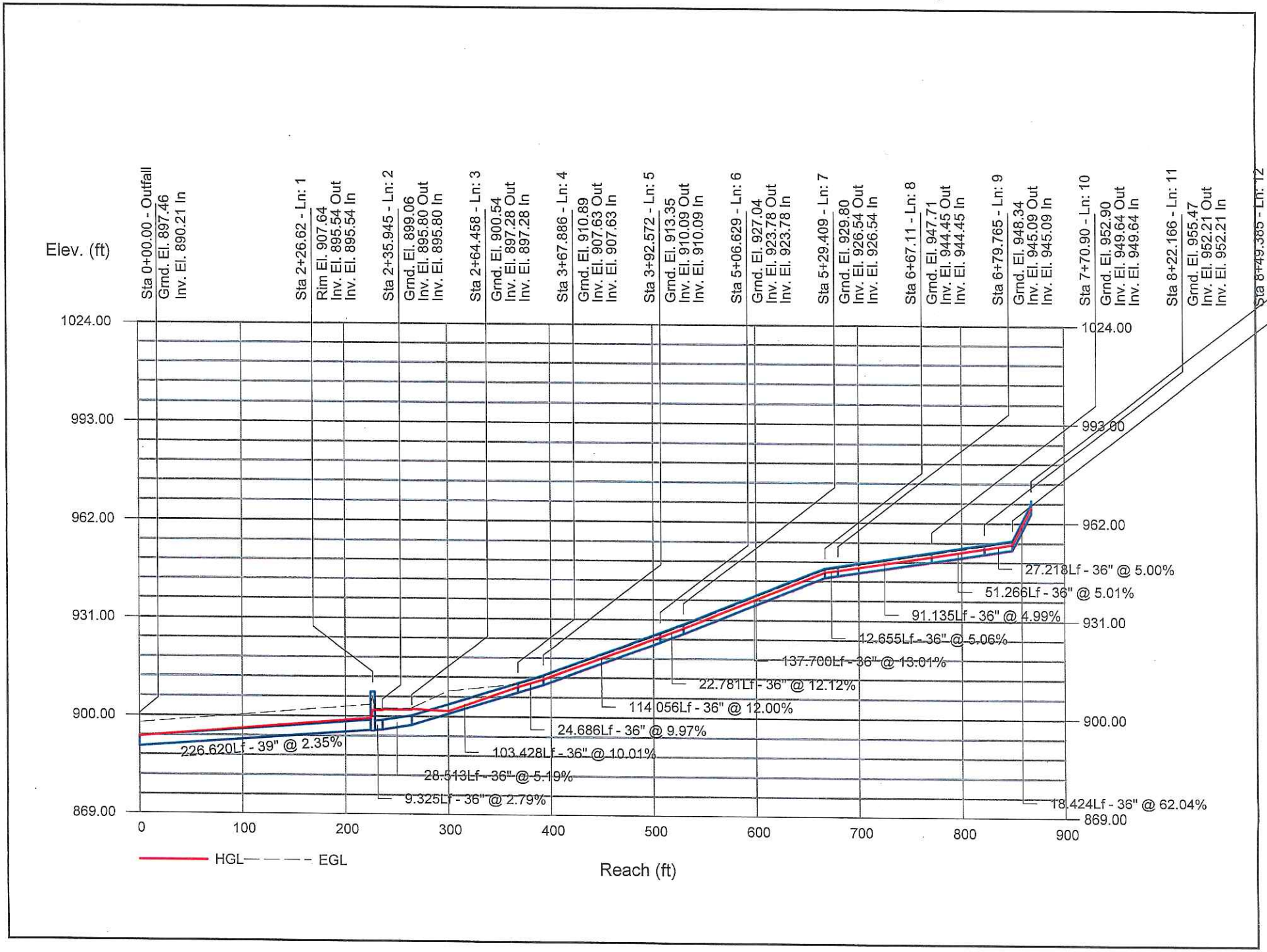
# Church Q10 w Q10 MP




| Project File: Church Q10 with 39in Q10 MP.stm | Number of lines: 13 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Church Q10 with 39in Q10 MP.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 137.3 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.44* | 899.51* | 2.51 | 902.03 | End | Manhole |
| 2 | Pipe - (695) | 32.30 | 36 | Cir | 9.325 | 895.54 | 895.80 | 2.788 | 902.03* | 902.05* | 0.18 | 902.22 | 1 | None |
| 3 | Pipe - (694) | 32.30 | 36 | Cir | 28.513 | 895.80 | 897.28 | 5.191 | 902.22* | 902.28* | 0.17 | 902.45 | 2 | None |
| 4 | Pipe - (693) | 32.30 | 36 | Cir | 103.428 | 897.28 | 907.63 | 10.007 | 902.45 | 909.47 | n/a | 909.47 j | 3 | None |
| 5 | Pipe - (692) | 32.30 | 36 | Cir | 24.686 | 907.63 | 910.09 | 9.965 | 909.47 | 911.93 | 0.12 | 911.93 | 4 | None |
| 6 | Pipe - (691) | 32.30 | 36 | Cir | 114.056 | 910.09 | 923.78 | 12.003 | 911.93 | 925.62 | 0.22 | 925.62 | 5 | None |
| 7 | Pipe - (690) | 32.30 | 36 | Cir | 22.781 | 923.78 | 926.54 | 12.115 | 925.62 | 928.38 | 0.22 | 928.38 | 6 | None |
| 8 | Pipe - (689) | 32.30 | 36 | Cir | 137.700 | 926.54 | 944.45 | 13.007 | 928.38 | 946.29 | 0.20 | 946.29 | 7 | None |
| 9 | Pipe - (688) | 32.30 | 36 | Cir | 12.655 | 944.45 | 945.09 | 5.057 | 946.29 | 946.93 | 0.24 | 946.93 | 8 | None |
| 10 | Pipe - (687) | 32.30 | 36 | Cir | 91.135 | 945.09 | 949.64 | 4.993 | 946.93 | 951.48 | 0.12 | 951.48 | 9 | None |
| 11 | Pipe - (686) | 32.30 | 36 | Cir | 51.266 | 949.64 | 952.21 | 5.013 | 951.48 | 954.05 | 0.13 | 954.05 | 10 | None |
| 12 | Pipe - (685) | 32.30 | 36 | Cir | 27.218 | 952.21 | 953.57 | 4.997 | 954.05 | 955.41 | 0.16 | 955.41 | 11 | None |
| 13 | Pipe - (684) | 32.30 | 36 | Cir | 18.424 | 953.57 | 965.00 | 62.038 | 955.41 | 966.84 | 0.78 | 966.84 | 12 | Manhole |

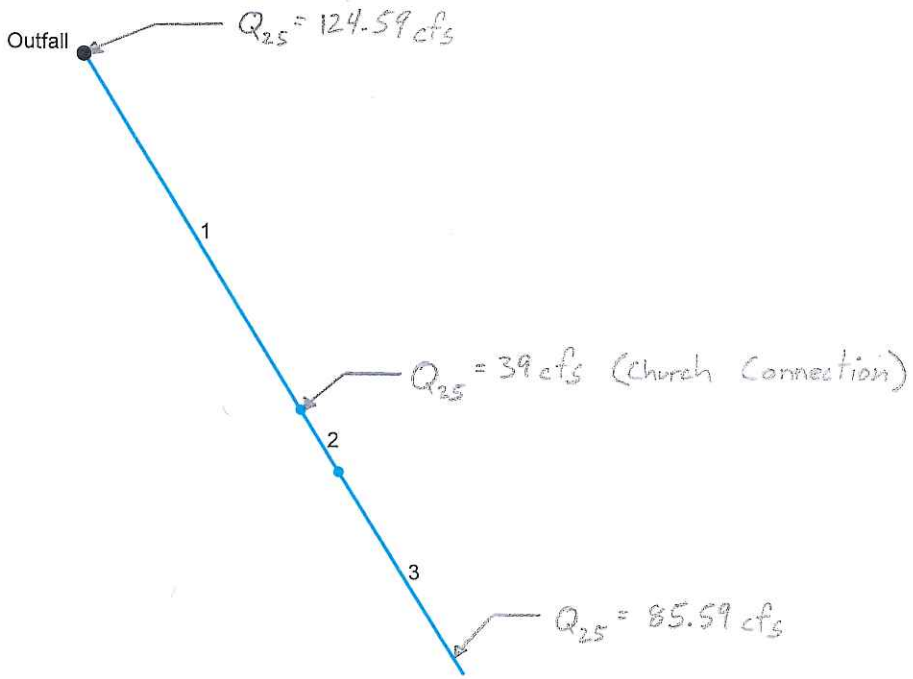
**Church Q10 w Q10 MP**

Number of lines: 13

Run Date: 5/16/2018

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

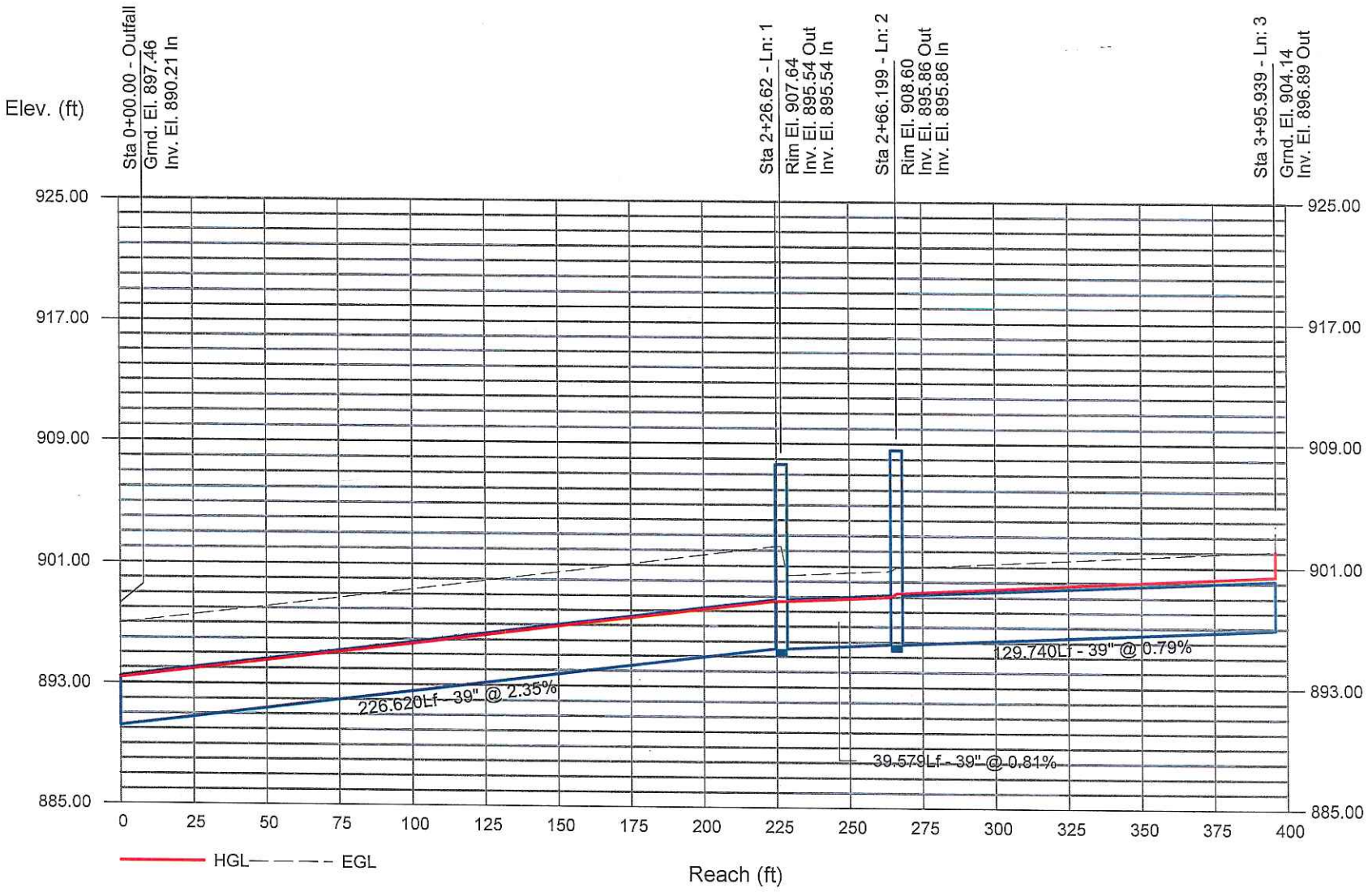
# Existing 39" RCP_Hillcrest Q25




| Project File: New.stm | Number of lines: 3 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Existing 39in Hillcrest Q25 with Church Q25.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 124.6 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.35 | 898.68 | 0.54 | 898.68 | End | Manhole |
| 2 | Pipe - (695) (1) (1) | 85.59 | 39 | Cir | 39.579 | 895.54 | 895.86 | 0.809 | 898.68 | 899.00 | 0.25 | 899.25 | 1 | Manhole |
| 3 | Pipe - (695) (1) | 85.59 | 39 | Cir | 129.740 | 895.86 | 896.89 | 0.794 | 899.25* | 900.44* | 1.65 | 902.10 | 2 | None |

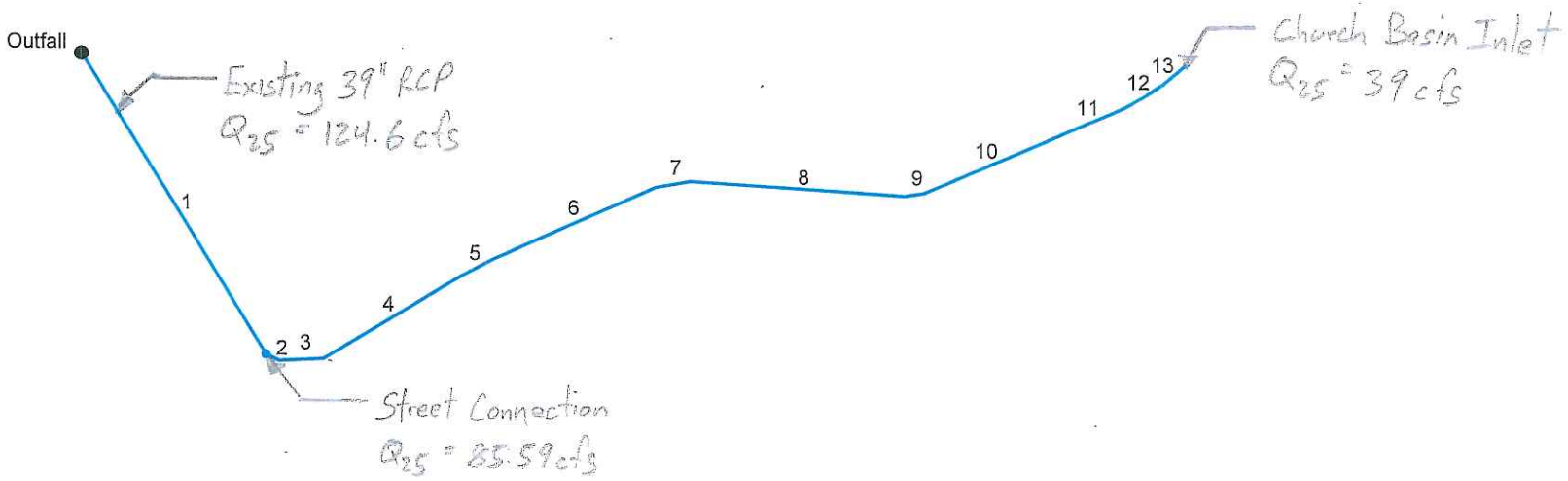
**Existing 39" RCP_Hillcrest Q25**

Number of lines: 3

Run Date: 5/16/2018

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

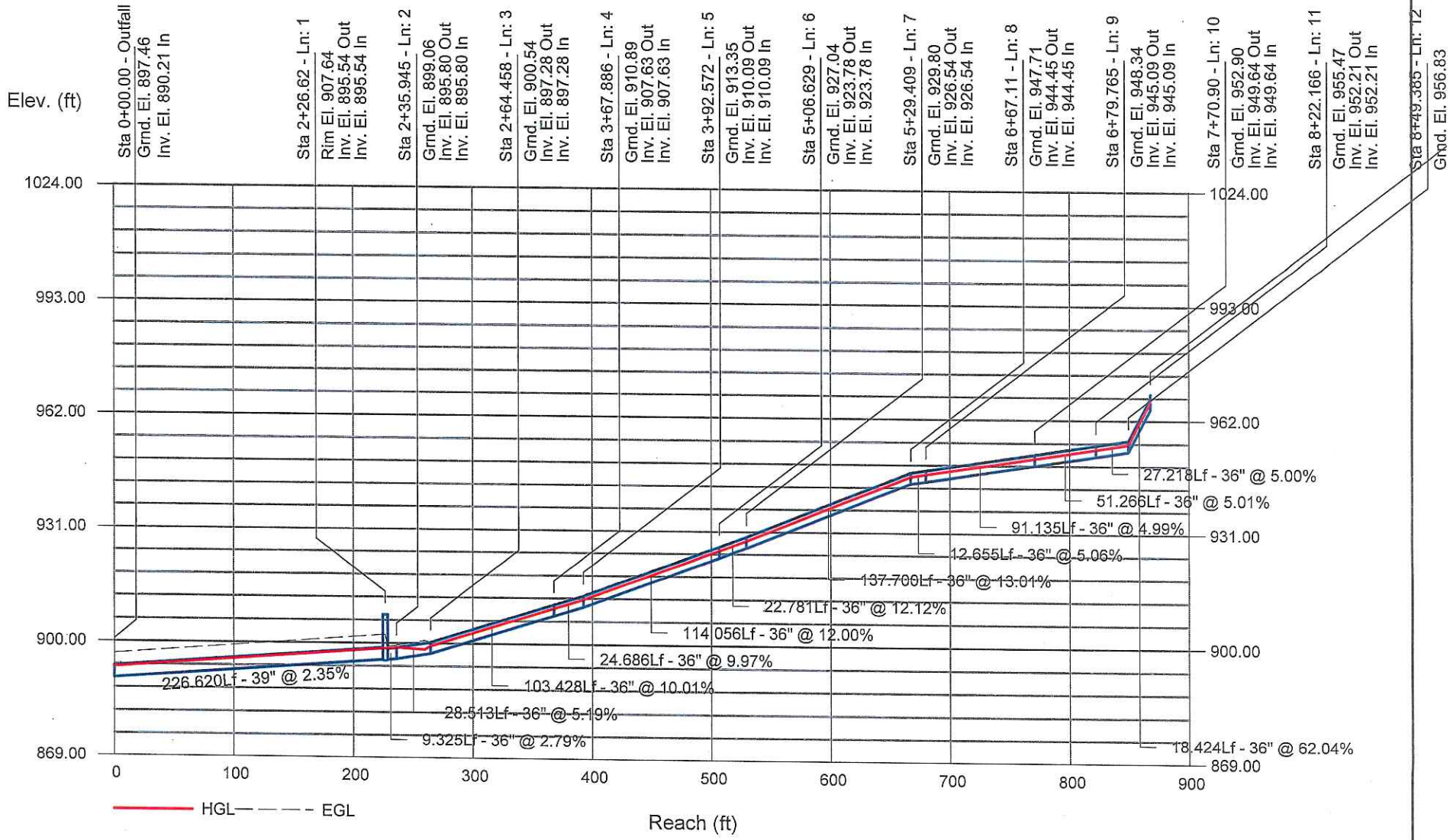
# Church Q25 w/ Existing 39" RCP




| Project File: Chuch Q25 with 39in RCP Downstream Connection.stm | Number of lines: 13 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Chuch Q25 with 39in RCP Downstream Connection.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 124.6 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.17 | 898.68 | 2.11 | 898.68 | End | Manhole |
| 2 | Pipe - (695) | 39.00 | 36 | Cir | 9.325 | 895.54 | 895.80 | 2.788 | 898.68 | 898.70 | 0.27 | 898.96 | 1 | None |
| 3 | Pipe - (694) | 39.00 | 36 | Cir | 28.513 | 895.80 | 897.28 | 5.191 | 898.96 | 899.31 | n/a | 899.31 j | 2 | None |
| 4 | Pipe - (693) | 39.00 | 36 | Cir | 103.428 | 897.28 | 907.63 | 10.007 | 899.31 | 909.66 | 0.14 | 909.66 | 3 | None |
| 5 | Pipe - (692) | 39.00 | 36 | Cir | 24.686 | 907.63 | 910.09 | 9.965 | 909.66 | 912.12 | 0.14 | 912.12 | 4 | None |
| 6 | Pipe - (691) | 39.00 | 36 | Cir | 114.056 | 910.09 | 923.78 | 12.003 | 912.12 | 925.81 | 0.26 | 925.81 | 5 | None |
| 7 | Pipe - (690) | 39.00 | 36 | Cir | 22.781 | 923.78 | 926.54 | 12.115 | 925.81 | 928.57 | 0.26 | 928.57 | 6 | None |
| 8 | Pipe - (689) | 39.00 | 36 | Cir | 137.700 | 926.54 | 944.45 | 13.007 | 928.57 | 946.48 | 0.23 | 946.48 | 7 | None |
| 9 | Pipe - (688) | 39.00 | 36 | Cir | 12.655 | 944.45 | 945.09 | 5.057 | 946.48 | 947.12 | 0.28 | 947.12 | 8 | None |
| 10 | Pipe - (687) | 39.00 | 36 | Cir | 91.135 | 945.09 | 949.64 | 4.993 | 947.12 | 951.67 | 0.14 | 951.67 | 9 | None |
| 11 | Pipe - (686) | 39.00 | 36 | Cir | 51.266 | 949.64 | 952.21 | 5.013 | 951.67 | 954.24 | 0.16 | 954.24 | 10 | None |
| 12 | Pipe - (685) | 39.00 | 36 | Cir | 27.218 | 952.21 | 953.57 | 4.997 | 954.24 | 955.60 | 0.18 | 955.60 | 11 | None |
| 13 | Pipe - (684) | 39.00 | 36 | Cir | 18.424 | 953.57 | 965.00 | 62.038 | 955.60 | 967.03 | 0.91 | 967.03 | 12 | Manhole |

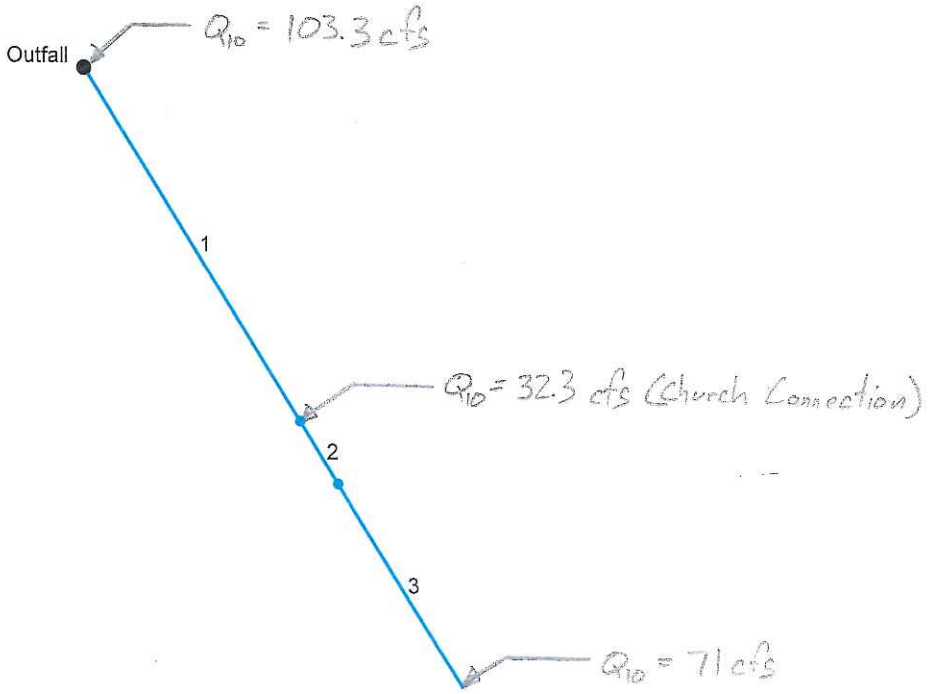
**Church Q25 w/ Existing 39" RCP**

Number of lines: 13

Run Date: 5/16/2018

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

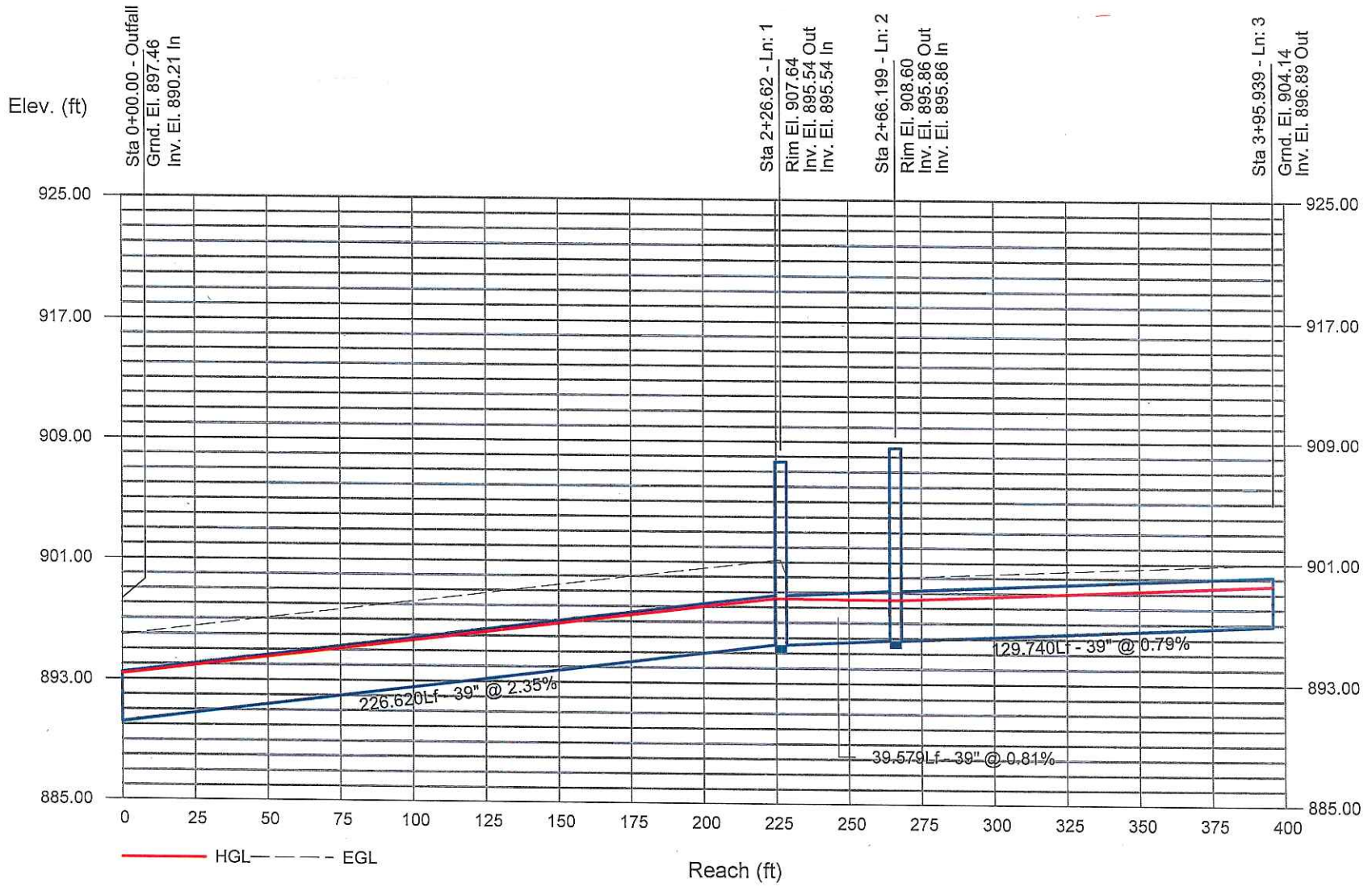
# Existing 39" RCP_Hillcrest Q10




| Project File: Existing 39in Hillcrest Q10 with Church Q10.stm | Number of lines: 3 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Existing 39in Hillcrest Q10 with Church Q10.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 103.3 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.35 | 898.58 | 0.38 | 898.58 | End | Manhole |
| 2 | Pipe - (695) (1) (1) | 71.00 | 39 | Cir | 39.579 | 895.54 | 895.86 | 0.809 | 898.58 | 898.53 | 0.22 | 898.53 | 1 | Manhole |
| 3 | Pipe - (695) (1) | 71.00 | 39 | Cir | 129.740 | 895.86 | 896.89 | 0.794 | 898.53 | 899.56 | 1.47 | 899.56 | 2 | None |

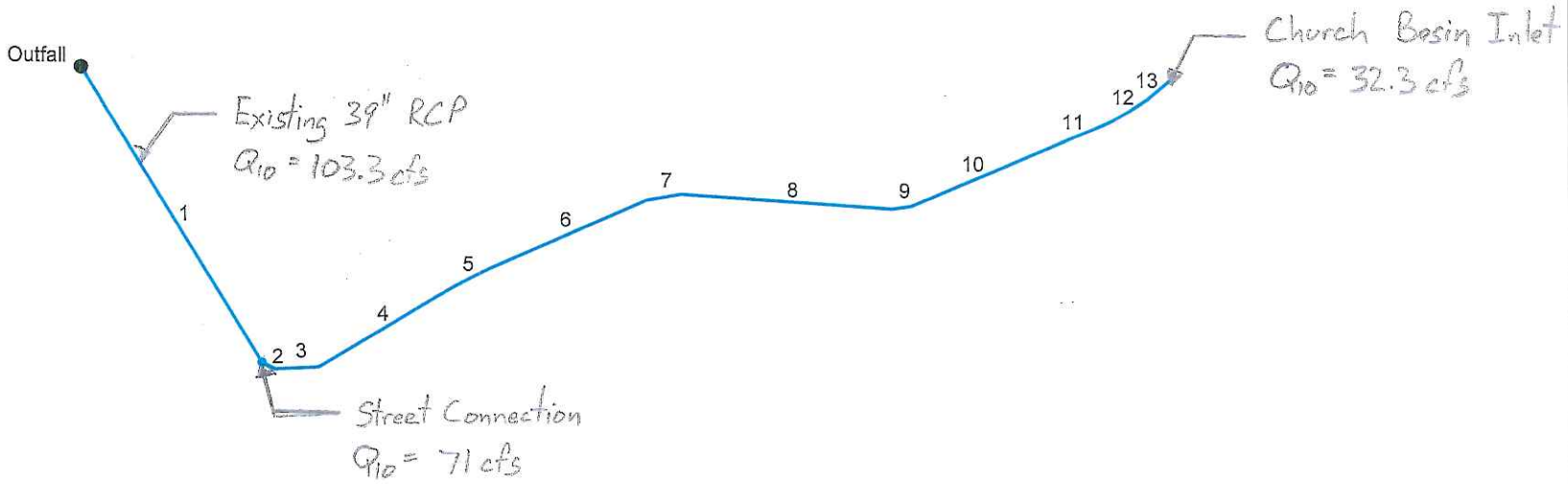
**Existing 39" RCP_Hillcrest Q10**

Number of lines: 3

Run Date: 5/16/2018

NOTES: Return period = 10 Yrs.

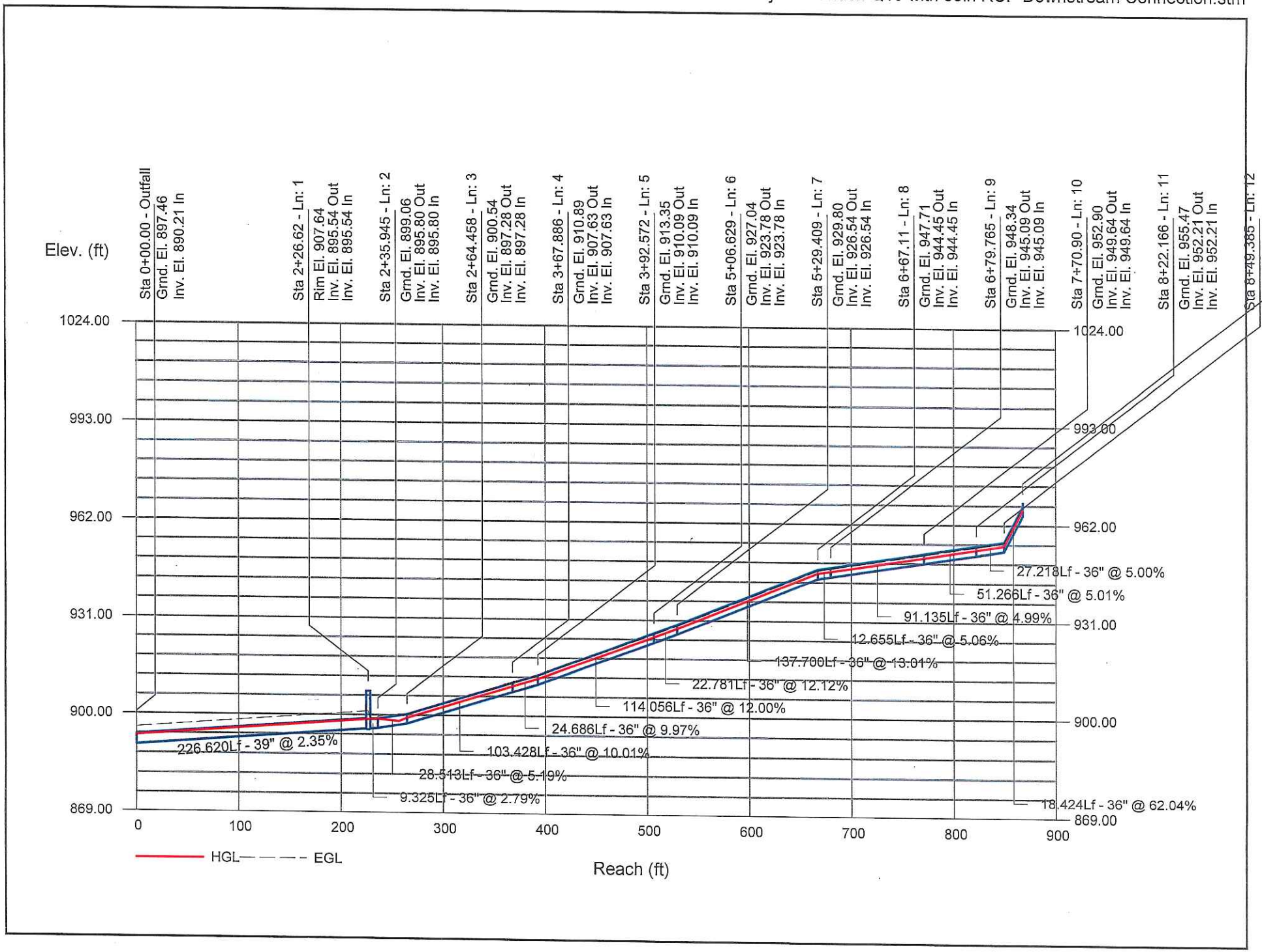
# Church Q10 w/ Existing 39" RCP




| Project File: Chuch Q10 with 39in RCP Downstream Connection.stm | Number of lines: 13 | Date: 5/16/2018 |
|---|---|---|

# Storm Sewer Profile

Proj. file: Chuch Q10 with 39in RCP Downstream Connection.stm



# Storm Sewer Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line Size (in) | Line shape | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line Slope (%) | HGL Down (ft) | HGL Up (ft) | Minor loss (ft) | HGL Junct (ft) | Dns Line No. | Junction Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pipe - (697) | 103.3 | 39 | Cir | 226.620 | 890.21 | 895.54 | 2.352 | 893.17 | 898.58 | 1.50 | 898.58 | End | Manhole |
| 2 | Pipe - (695) | 32.30 | 36 | Cir | 9.325 | 895.54 | 895.80 | 2.788 | 898.58 | 898.57 | 0.19 | 898.77 | 1 | None |
| 3 | Pipe - (694) | 32.30 | 36 | Cir | 28.513 | 895.80 | 897.28 | 5.191 | 898.77 | 899.12 | n/a | 899.12 j | 2 | None |
| 4 | Pipe - (693) | 32.30 | 36 | Cir | 103.428 | 897.28 | 907.63 | 10.007 | 899.12 | 909.47 | 0.12 | 909.47 | 3 | None |
| 5 | Pipe - (692) | 32.30 | 36 | Cir | 24.686 | 907.63 | 910.09 | 9.965 | 909.47 | 911.93 | 0.12 | 911.93 | 4 | None |
| 6 | Pipe - (691) | 32.30 | 36 | Cir | 114.056 | 910.09 | 923.78 | 12.003 | 911.93 | 925.62 | 0.22 | 925.62 | 5 | None |
| 7 | Pipe - (690) | 32.30 | 36 | Cir | 22.781 | 923.78 | 926.54 | 12.115 | 925.62 | 928.38 | 0.22 | 928.38 | 6 | None |
| 8 | Pipe - (689) | 32.30 | 36 | Cir | 137.700 | 926.54 | 944.45 | 13.007 | 928.38 | 946.29 | 0.20 | 946.29 | 7 | None |
| 9 | Pipe - (688) | 32.30 | 36 | Cir | 12.655 | 944.45 | 945.09 | 5.057 | 946.29 | 946.93 | 0.24 | 946.93 | 8 | None |
| 10 | Pipe - (687) | 32.30 | 36 | Cir | 91.135 | 945.09 | 949.64 | 4.993 | 946.93 | 951.48 | 0.12 | 951.48 | 9 | None |
| 11 | Pipe - (686) | 32.30 | 36 | Cir | 51.266 | 949.64 | 952.21 | 5.013 | 951.48 | 954.05 | 0.13 | 954.05 | 10 | None |
| 12 | Pipe - (685) | 32.30 | 36 | Cir | 27.218 | 952.21 | 953.57 | 4.997 | 954.05 | 955.41 | 0.16 | 955.41 | 11 | None |
| 13 | Pipe - (684) | 32.30 | 36 | Cir | 18.424 | 953.57 | 965.00 | 62.038 | 955.41 | 966.84 | 0.78 | 966.84 | 12 | Manhole |

**Church Q10 w/ Existing 39" RCP**

Number of lines: 13

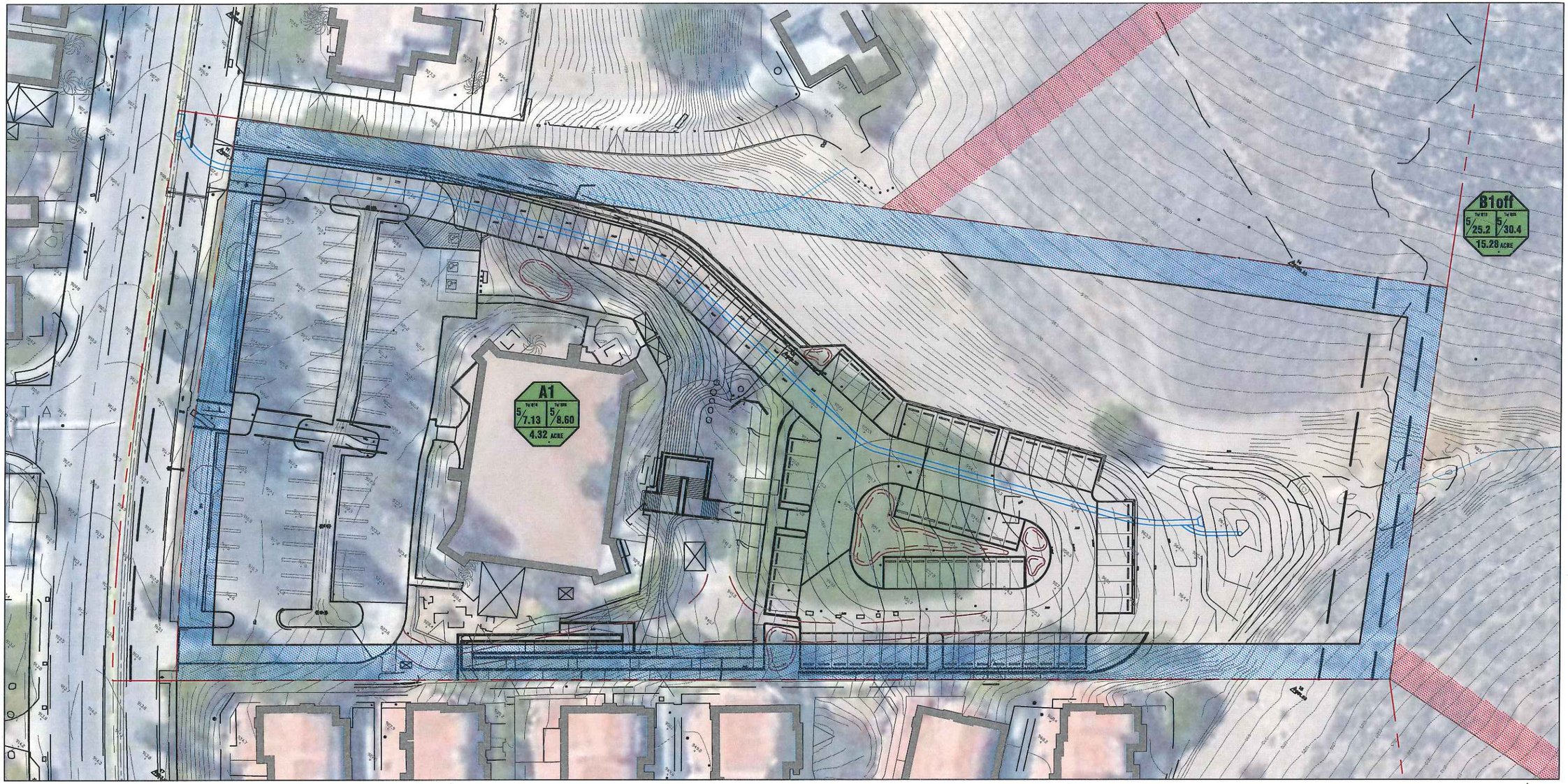
Run Date: 5/16/2018

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

# APPENDIX B

## Hydrology Maps

1. On-Site Hydrology Map
2. City of Thousand Oaks Storm Drain System Master Plan




| HYDROLOGY AREA INFORMATION | | | | |
|---|---|---|---|---|
| AREA NUMBER | AREA (Acres) | T.O.C. (Min.) | $Q_{25}$ (cfs) | $Q_{10}$ (cfs) |
| A1 | 4.32 | 5 | 8.60 | 7.13 |
| B1 OFF | 15.28 | 5 | 30.41 | 25.21 |

## HYDROLOGY INFORMATION

LOCATION: THOUSAND OAKS
RAINFALL: 10.6"
PROJECT AREA: 4.32 ACRE
IMPERVIOUS AREA: 1.78 ACRE
SOIL NUMBER: 2
$Q_{100}$=2.93 CFS/ACRE
$Q_{25}$=1.99 CFS/ACRE
$Q_{10}$=1.65 CFS/ACRE

GRAPHIC SCALE
0 1" 2"
0 25 50 100
1" = 50'

# HYDROLOGY MAP

CONEJO VALLEY CHURCH OF CHRIST
2525 E. HILLCREST DRIVE
THOUSAND OAKS, CALIFORNIA

RJR ENGINEERING GROUP
*Planning Civil Engineering Flood Control/Hydrology*
*Geotechnical Engineering Geology Water Resources Environmental*
*3500 Camino Ave, Suite 200, Oxnard, CA 93030*
*(805) 485-3935 (805) 485-6496 FAX*
*E-mail: rjreng@rjreng.com*

See Plate #2

See Plate #5

See Plate #7

See Plate #8

186D

Hidden Valley Wash (Lake Sherwood) Watershed

# City of Thousand Oaks
# Storm Drain System Master Plan

Hydrology Plate #6

0 1,000 2,000 3,000 Feet

±

## Legend

- Hydrology Links
- Subarea Boundaries
- Street Centerline
- City of Thousand Oaks Map Grid
- Thousand Oaks City Boundary
- 2001 - LIDAR 10 ft. Contours

October 2006


## HYDROLOGY INFORMATION

LOCATION: THOUSAND OAKS
RAINFALL: 10.6"
PROJECT AREA: 4.32 ACRE
IMPERVIOUS AREA: 1.78 ACRE
SOIL NUMBER: 2
$Q_{100}$=2.93 CFS/ACRE
$Q_{25}$=1.99 CFS/ACRE
$Q_{10}$=1.65 CFS/ACRE

**HYDROLOGY AREA INFORMATION**

| AREA NUMBER | AREA (Acres) | T.O.C. (Min.) | $Q_{25}$ (cfs) | $Q_{10}$ (cfs) |
|---|---|---|---|---|
| A1 | 4.32 | 5 | 8.60 | 7.13 |
| B1 OFF | 15.28 | 5 | 30.41 | 25.21 |

GRAPHIC SCALE
0 1" 2" 3"
0 25 50 100 150
1" = 50'

ROBERT W. ANDERSON CERTIFIED Municipal Separate Storm Sewer System DUMP NO WASTE CMS4S SPECIALIST CMS4S #0223

CERTIFIED PROFESSIONAL CPESC Robert W. Anderson No. 0840 IN EROSION AND SEDIMENT CONTROL

CERTIFIED PROFESSIONAL CPSWQ Robert W Anderson No. 920 IN STORM WATER QUALITY

811 Know what's below. Call before you dig.
DIAL TOLL FREE 811 AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

| REV. | SYMBOL | DESCRIPTION OF CHANGE | R.C.E. | DATE | P.D.E. | DATE |
|---|---|---|---|---|---|---|

DESIGNED BY: RET 6/8/18 DATE
DRAWN BY: RET 6/8/18 DATE
CHECKED BY: RWA 6/8/18 DATE

REGISTERED PROFESSIONAL ENGINEER ROBERT W. ANDERSON C-058383 EXP. 12-31-18 CIVIL STATE OF CALIFORNIA
ENGINEER'S SEAL

PREPARED BY:
REGISTERED ENGINEER
C-58383
RCE NUMBER

REVIEWED FOR PERMIT ISSUANCE BY: CITY OF THOUSAND OAKS

| | |
|---|---|
| DEVELOPMENT ENGINEER | DATE |
| PLANNING DIVISION | DATE |
| <TRAFFIC ENGINEER> | DATE |
| <BLDG. DIVISION - ADA COMPLIANCE> | DATE |
| <COSCA> | DATE |

CITY OF THOUSAND OAKS
**PUBLIC WORKS DEPARTMENT**

# HYDROLOGY MAP

CONEJO VALLEY CHURCH OF CHRIST
2525 E. HILLCREST DRIVE

CITY OF THOUSAND OAKS DWG. NO. _____ SHEET ___ OF ___