Town of Timnath

Master Drainage Plan Update
2018

Prepared for:

Town of Timnath
4800 Goodman Rd, Timnath, CO 80547

August 2018 – FINAL
Revised – November 2018

Town of Timnath

Master Drainage Plan Update
2018

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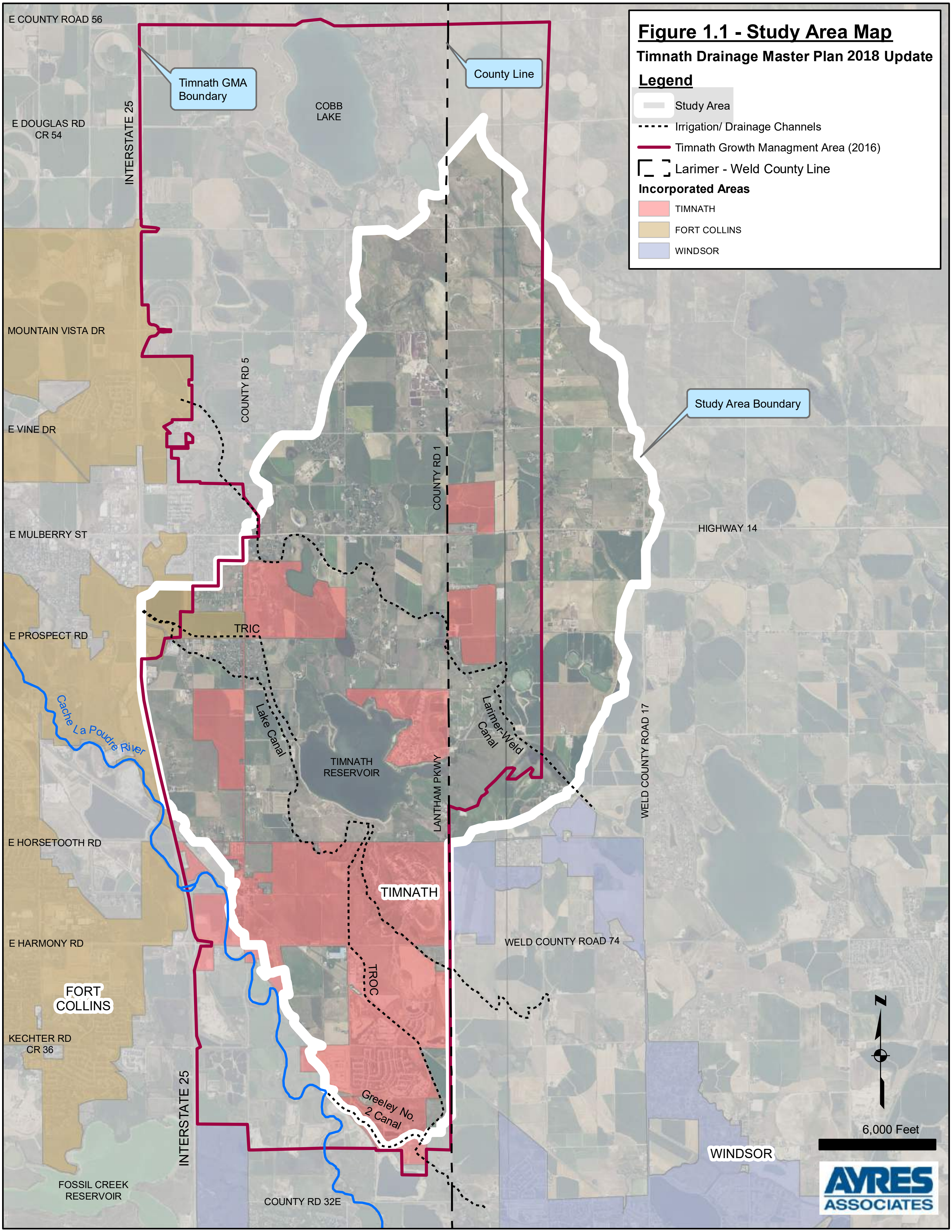
1. Introduction

The Town of Timnath lies in east-central Larimer County. The existing Town center is located on County Road 5, north of Harmony Road (County Road 38), and consists of a mix of land uses including single-family residential, industrial, commercial, religious and educational properties. At the commencement of this Master Drainage Plan Update, the incorporated area was approximately 6.3 square miles. Since the 2005 Master Drainage Plan, several development projects have been constructed and other development proposals continue to be prepared.

The Growth Management Area (GMA) for the Town was updated in 2016 and increased the GMA area from 10.25 square miles to approximately 36.3 square miles. The GMA is bounded roughly by the Larimer-Weld County line (south of Timnath Reservoir) and Weld County Road 15 (north of Timnath Reservoir) on the east, Interstate 25 on the west, Larimer County Road 34C on the south, and Larimer County Road 56 to the north. The GMA for the Town of Timnath is shown in Figure 1.1.

The Town of Timnath contracted with Ayres Associates to perform an update to the 2005 Master Drainage Plan. This update converted the previous ModSWMM hydrology model into EPA SWMM while also incorporating recent development and drainage improvements since the previous study. The most significant of these improvements are the upstream Boxelder Creek projects which removed a 100-year split flow and eliminated a large regulatory floodplain running through the Timnath GMA.

This drainage study update provides the Town with revised baseline conditions hydrology (without the Boxelder flows), projected future conditions hydrology (with full development), and a hydrologic model that is accessible to the Town staff and easier to use than the previous model. These results provide a framework for the design of a stormwater infrastructure that can be implemented as the Town grows. This report summarizes the results of the hydrologic and hydraulic modeling and master planning efforts for the Town of Timnath.



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1.1. Project Goals and Objectives

The goal of this project was to update the Master Drainage Plan (MDP) that can be used as a tool for making decisions related to stormwater management within the boundaries of the Timnath Reservoir Outlet Canal Basin. This basin lies within the Timnath Growth Management Area and includes the Timnath Reservoir Inlet Canal (TRIC) basin, Timnath Reservoir Basin, Clark Channel Basin, and the Old Town Timnath basin. Completion of this Master Plan involved the development of a planning document that would:

a) Assist the Town in identifying long-term capital improvements and rehabilitation measures for the existing drainage system;
b) Be a tool for implementing future improvements associated with new developments within the basin boundaries;
c) Provide a basis for prioritizing and scheduling required improvements (implementation plan);
d) Be flexible enough to allow the development of cost effective flood protection alternatives, and;
e) Identify uniform criteria for the planning and design of major drainageway facilities and detention.

1.2. Scope of Work

To meet the project objectives, the following five steps were taken:

1. Convert the previous Existing Conditions ModSWMM hydrology model to the EPA SWMM 5 modeling platform.
2. Update the Existing Condition hydrology model with development since 2005.
3. Provide future conditions hydrology with full buildout in the Master Planned Area.
4. Analyze the hydraulic capacity of the Timnath Reservoir Inlet Canal (TRIC) and Timnath Reservoir Outlet Canal (TROC).
5. Review the hydraulic capacity of the Greeley No. 2 Canal, which receives nearly all the Town's drainage, and conceptually size a spill weir to remove flows in excess of the canal capacity.

These steps are further broken down into tasks performed for the Master Drainage Plan Update.

Task 1 –Project Coordination

Ayres held progress meetings periodically throughout the project, meeting with Town staff to help ensure the project was moving in the right direction and meeting the needs of the Town and the community.

Ayres compiled and collected the necessary baseline information to create the hydraulic and hydrologic models for the study, including lidar and topographic information, drainage master plans, growth plans and development drainage plans. The Town provided zoning and land use planning information and Ayres coordinated with the Town of Windsor's master drainage planning effort to verify consistency in drainage shed boundaries.

Task 2 –Master Plan Update

The previous Existing Condition ModSWMM model was converted to SWMM 5. Site visits were made to verify site conditions and answer remaining questions. Sub-basin parameters were transferred to the new model and sub-basin boundaries were verified or adjusted as needed, based on Box Elder lidar data. The conveyance element routing was transferred to the new model and slope, cross section shape, and Manning's "n" values were updated. The previous Box Elder Creek diversion, upstream of Timnath, was removed from the model to reflect the improvements that have been made in the Box Elder basin that eliminated the overflow through the Town. Detention ponds were reflected in the SWMM 5 model using a combination of previous ModSWMM data, information from development reports, and existing topographic data where necessary.

The 100-year model was executed using both the Kinematic and Dynamic interface in SWMM 5 and the results were reviewed and discussed with Town staff. Ultimately Kinematic wave routing was selected for the final model update. The drainage reports for the developments that have occurred since 2005 were incorporated into the model.

Ayres prepared the future conditions model by adjusting the existing conditions model to reflect developed land use conditions using the previous Master Plan as a guide, along with the current Town of Timnath Land Use Plan. Consistent with the 2005 Master Plan and the Town Drainage Criteria, 100-year flows from future developments were detained to 10-year existing condition discharges. The future conditions model followed the concepts from the recommended Alternative 3 in the 2005 Master Plan. This included a conceptual channel design for the improved Clark Drainage Channel and TROC reaches. No other alternatives from the previous study were kept for this update.

Task 3 and Task 4 –Timnath Reservoir Inlet Canal (TRIC) and Timnath Reservoir Outlet Canal (TROC) Evaluations

- **Site Visits** - Ayres to visited portions of the TRIC and TROC as needed, including a visit to see the Town of Timnath Reservoir inlet and outlet works.
- **Survey** - Ayres to compiled and reviewed the existing information available since the 2005 study and collected additional survey information. The reservoir inlet works and outlet works were surveyed as well as culvert crossings in the channel. Along the TRIC, there are 5 culvert crossings (between I-25 and the reservoir) and 10 bridge or culvert crossings along the TROC (between the reservoir and the Greeley Number 2 Canal) that were surveyed with this project. The channel cross section information was obtained using the Box Elder lidar data.
- **Existing Conditions SRH 2D Model** - Ayres analyzed the capacity of the TRIC and TROC using SRH 2D. Input hydrographs for the canal were obtained from the EPA SWMM model created in task 1. The channel cross section information was obtained using the Box Elder lidar data and ground survey. Existing spill locations were identified; however, a floodplain map of the spills was not determined with this scope. Spills from the TRIC were input into the EPA SWMM model and routed through the Town; conversely, no flow splits from the TROC were identified by the study. These canals were evaluated for the 10 and 100-year storm events.
- **Future Conditions SRH 2D Model** - Ayres analyzed the impacts of development on the TRIC and TROC. Natural proposed spill locations were identified. This scope analyzed the impacts of development on the TRIC and TROC but not did not determine solutions to any spills that may occur. A floodplain of the spills was not determined with this scope. The spills were reflected in the EPA SWMM model and routed through the Town. The canals were evaluated for the 10 and 100-year storm events with canal base flows (190-cfs for TRIC and 200-cfs in TROC)
- **Spills Map** - Maps of the spill locations was created for the existing and future conditions along the TRIC and TROC.

Task 5 –Greeley Number 2 Canal

The TROC discharges into the Greeley No 2 Canal, south of Timnath. The No. 2 Canal cannot contain the 100-year flows from the canal.

- **Site Visits** – Ayres visited the location where the TROC discharges into the Greeley No 2.
- **Survey** - No additional survey was performed for this analysis. The Box Elder lidar data was used in the analysis of the canal.
- **Existing Conditions Greeley No. 2 SRH 2D Model** - Ayres created an SRH 2D model of the Greeley No2 Canal near where the TROC discharges into the canal. Ayres delineated sub-basins that discharge into the canal from the Box Elder Lidar data as additional inputs into the model. The model extended from the Poudre River to County Road 32 E. There is one structure in the ditch. The information for that structure was obtained from the Box Elder Lidar data. The model was used to determine the capacity of the Greeley No.2 with and without the inflows from the TROC. The modeling included 650-cfs of base flow in the No.2, divided as 450-cfs from the Poudre head gate and 200-cfs from the TROC.
- **Future Conditions Greeley No2 SRH 2D Model** - Ayres adjusted the model to reflect the future condition flows from the TROC and the Clark Drainage Channel.
- **Design Spill from Greeley No2 to the Poudre River Floodplain** - Using the results from the SRH 2D models, Ayres provided a preliminary design of a spill from the Greely No2 to the Poudre River.

Task 6 –Master Plan Report

A draft of the Town of Timnath Master Drainage Plan Update report was prepared and submitted to the Town for review and comment. Comments were addressed, and the report finalized.

1.3. Acknowledgements

The preparation of this report and supporting documentation involved the efforts and guidance from the Town staff, adjoining communities, and irrigation companies. These individuals are identified below.

Mr. Eric Fuhrman, TST, Inc., Town of Timnath Engineer
Anderson Consulting, Consultant for Town of Windsor
Mr. Michael Massey, Coffey Surveying, Surveyor
Mr. Dale Trowbridge, New Cache La Poudre Irrigating Company

The assistance and cooperation of these individuals are acknowledged and greatly appreciated. Any omissions from this list were unintentional.

1.4. Previous Studies

This master drainage plan update relied primarily on the 2005 Timnath Master Drainage plan, performed by Ayres Associates. However other relevant studies related to current or historic stormwater management near the Town of Timnath include the following:

- Flood Insurance Study (FIS), Larimer County, Colorado, (Federal Emergency Management Agency, February 6, 2013).
- Boxelder and Cooper Slough Letter of Map Revision (LOMR) for the Boxelder 6 Project. (Ayres Associates, August 2017)
- Hydrologic Analysis of the Box Elder Creek/ Cooper Slough Watershed, City of Fort Collins (ICON Engineering, Inc. April 2014)
- Floodplain Mapping for the Boxelder Creek Split Flow Path East of Timnath, Colorado (Anderson Consulting Engineers, December 9, 2002).
- Alternatives Feasibility Analysis of the Boxelder Creek/Cooper Slough Basin (Anderson Consulting Engineers, September 30, 2002).
- Hydrologic Modeling of the Boxelder Creek/Cooper Slough Basin (Anderson Consulting Engineers, January 25, 2002).
- Boxelder Creek/Cooper Slough Drainageway Planning Study (Simons, Li and Associates 1981).
- Town of Windsor Master Drainage Plan (Anderson Consulting Engineers, October 3, 2003).
- Town of Windsor Master Drainage Plan Update (Anderson Consulting Engineers, 2017) – used for drainage basin comparison.

1.5. Mapping and Surveying

Digital mapping within the study area was compiled by Ayres Associates from several sources:

- 2012 lidar data obtained for the Box Elder projects
- 2005 Town Contour data
- Timnath Reservoir Inlet Canal Ground Survey
- Timnath Reservoir Outlet Canal Ground Survey

2. Hydrology Plan

2.1. Timnath Basin Description

The Timnath watershed flows generally from north to south and can be divided into two main areas, the upper watershed tributary to Timnath Reservoir and the lower watershed not tributary to the reservoir. The Timnath Reservoir watershed area extends from the reservoir north to Larimer County Road 54/ Weld County Road 90 and east to Weld County Road 17. Areas tributary to the Timnath Reservoir Inlet Canal (TRIC), northwest of the reservoir, also drain to the reservoir.

The lower watershed begins at the southern bank of the TRIC and extends south to the Greeley No. 2 Canal. The eastern limit of the lower watershed is County Road 1 (Larimer-Weld County Line) and on the west side, the limit of the model is generally defined by the ridge that separates the Timnath watershed from the Cache la Poudre River (although several drainage basins discharging directly towards the Poudre River were included).

In the lower watershed, there are two noteworthy flow paths: 1) the "main flow path" flowing to the southeast which is referred to as the Clark Drainage (located between Downtown Timnath and Timnath Reservoir); and 2) the Timnath Reservoir Outlet Canal (TROC), which begins at the outlet of the reservoir and proceeds south to the Greeley No. 2 Canal. The Clark Drainage connects with the TROC just upstream of Harmony Road. The TRIC and Greeley No. 2 canals do not have capacity to convey the majority of runoff flows and will overtop the southern banks of the respective canals. Overflows from the TRIC will continue through the lower Timnath watershed and concentrate together in the Clark Drainage by County Road 40. Overflows from the Greeley No. 2 Canal will spill into the Cache la Poudre River floodplain and eventually connect with the main river channel.

Sub-watershed areas within the Timnath Watershed are enumerated in the following list:

- Total Study Area = 17,059 acres (26.7 sq. mi.).
- Upper Watershed tributary to Timnath Reservoir = 11, 331 acres (17.7 sq. mi.).
- Areas tributary to the TRIC = 788 acres (1.2 sq. mi.)
- Lower Watershed areas tributary to the TROC (excluding TRIC and Timnath Reservoir areas) = 4,075 acres (6.4 sq. mi.).
- Areas tributary to the Greeley No. 2 Canal (excluding TROC areas) = 605 acres (0.9 sq. mi.)
- Areas tributary to other outfalls (such as downtown south storm drain, areas discharging to the Poudre river, and areas discharging across County Road 1) = 260 acres (0.4 sq. mi.)

2.2. General Modeling Procedures

2.2.1. Modeling Approach

The hydrologic analysis was performed for the baseline and fully developed (master plan) conditions for the 2-, 5-, 10-, 25-, 50-, and 100-year rainfall events. This study converted the previous Existing Conditions MODSWMM hydrology model to the current version of EPA SWMM (v. 5.1.012). The conversion process is essentially a manual re-building of the hydrology model in EPA SWMM software using the prior model as a guide.

A review of the Kinematic Wave versus Dynamic Wave SWMM model routing methods was performed for the Town. The kinematic wave routing method solves both the continuity equation and a simplified version of the momentum equation for each conduit. Kinematic wave does not account for backwater or pressure effects; however, historically it is the typical approach for master planning and is recommended for master planning by Denver Urban Drainage and Flood Control District (UDFCD). On the other hand, the dynamic wave method performs a more robust routing computation by solving the complete one-dimensional Saint-Venant equations, which account for pressure and backwater effects. The City of Fort Collins has also recently used dynamic wave SWMM models for some master planning studies. The result of this review, which included discussion with the Town Engineer, was the selection of the more-conservative Kinematic Wave routing method for the hydrology update.

The rainfall-runoff conversion was performed using the native EPA SWMM subbasin hydrology routine and subbasin parameters are discussed later in this report.

2.2.2. Rainfall

Consistent with the 2005 drainage study, design rainfall hyetographs were obtained from the Town Design Criteria Manual (Timnath 2016). Timnath has adopted the City of Fort Collins 2-hour hyetographs, which are presented in Table 2.1.

Table 2.1 Rainfall Hyetographs

Time (min)	**Rainfall Intensity** (in/hr)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
5	0.29	0.40	0.49	0.63	0.79	1.00
10	0.33	0.45	0.56	0.72	0.90	1.14
15	0.38	0.53	0.65	0.84	1.05	1.33
20	0.64	0.89	1.09	1.41	1.77	2.23
25	0.81	1.13	1.39	1.80	2.25	2.84
30	1.57	2.19	2.69	3.48	4.36	5.49
35	2.85	3.97	4.87	6.30	7.90	9.95
40	1.18	1.64	2.02	2.61	3.27	4.12
45	0.71	0.99	1.21	1.57	1.97	2.48
50	0.42	0.58	0.71	0.92	1.16	1.46
55	0.35	0.49	0.60	0.77	0.97	1.22
60	0.30	0.42	0.52	0.67	0.84	1.06
65	0.20	0.28	0.39	0.62	0.79	1.00
70	0.19	0.27	0.37	0.59	0.75	0.95
75	0.18	0.25	0.35	0.56	0.72	0.91
80	0.17	0.24	0.34	0.54	0.69	0.87
85	0.17	0.23	0.32	0.52	0.66	0.84
90	0.16	0.22	0.31	0.50	0.64	0.81
95	0.15	0.21	0.30	0.48	0.62	0.78
100	0.15	0.20	0.29	0.47	0.60	0.75
105	0.14	0.19	0.28	0.45	0.58	0.73
110	0.14	0.19	0.27	0.44	0.56	0.71
115	0.13	0.18	0.26	0.42	0.54	0.69
120	0.13	0.18	0.25	0.41	0.53	0.67
Total Depth (in)	0.98	1.36	1.71	2.31	2.91	3.67

In the SWMM model, the onset of rainfall displayed above was delayed by 8-hours to allow time for the TRIC and TROC to fill with the irrigation baseflow.

2.3. Baseline Condition Hydrology Model

2.3.1. Delineation and Definition of Subbasins

The baseline condition model was prepared for the Timnath watershed using the 2005 MODSWMM hydrology model as a guide. Subbasin boundaries from the previous study were verified and adjusted only where appropriate due to recent development, land changes, or supporting evidence from the detailed 2012 lidar topography. The differences in subbasin layout occurred primarily in two locations: First, in the recently developed areas south of Harmony Road, including the Timnath Ranch, Timnath South, and Brunner Farm developments. Second, the lidar topography showed somewhat different flow patterns in the undeveloped area between the TRIC and County Road 40.

A total of 163 subbasins were delineated, compared to 108 subbasins from the previous study. Seven of these subbasins are tributary to Timnath Reservoir, with no change from the previous study, these subbasins are extra-ordinarily large and cover 17.7 square-miles or an average of 1,619 acres per subbasin. The remaining 154 subbasins not directly tributary to Timnath Reservoir are considerably smaller, covering approximately 9 square-miles, with an average subbasin size of 36.7 acres. The hydrologic model base map is provided in Appendix A.

2.3.2. Subbasin Hydrology Parameters

Subbasin parameters from the previous MODSWMM model were transferred to SWMM 5 with as little change as possible. The previous study developed the subbasin parameters using the Timnath storm drainage criteria and the UDFCD Urban Storm Drainage Criteria Manual (USDCM). Where subbasin boundaries remained largely the same as the 2005 model, the basin parameters were preserved. However, where the subbasin boundary was significantly revised the associated basin parameters required adjustments, including updates to the basin width, impervious percentage, and basin slope parameters. The hydrologic parameters for each subbasin are documented in Appendix A.

For revised or new subbasins, parameters were developed using a process similar to the 2005 study and is described in the following list:

- Subbasin area and slope were updated using basin delineation and topographic mapping
- Imperviousness values were estimated visually from aerial imagery and referencing UDFCD tables.
- The overland flow length/basin width parameter was estimated using the topographic mapping. Subbasin width was calculated by dividing the subbasin area by the overland flow length. In large undeveloped subbasins the overland flow length was limited to a maximum of 500 feet, except for the six subbasins upstream of Timnath Reservoir; in these cases, the overland flow length was set to 1,000 feet. For urbanized basins, the overland flow length was limited to a maximum of 300 feet.
- Additional subbasin hydrologic parameters, including overland roughness and surface storage, were set to standardized values for the watershed and based on USDCM guidelines. The following values were used for these parameters:
    - Overland roughness coefficient (impervious areas) = 0.016
    - Overland roughness coefficient (pervious areas) = 0.250
    - Surface storage (impervious areas) = 0.10 inches
    - Surface storage (pervious areas, developed and undeveloped) = 0.35 inches

Infiltration Parameters

Infiltration parameters from the 2005 study were carried forward to the present study and applied to the EPA SWMM subbasins. These parameters had previously been developed based upon the NRCS hydrologic soil map and composite values for each subbasin were determined. The NRCS Soil Survey of Larimer County indicates that the soils in the watershed are predominantly classified as B soils, with a minority of C soils, and small horizons of A and D soils. The initial and final infiltration rates for each soil type are given in Table 2.2.

Table 2.2 Hydrologic Soil Group Recommended Values.

SCS Hydrologic Soil Group	Infiltration Rate (in/hr)		Horton's Decay Coefficient (1/sec.)
	Initial	Final	
A*	5.0	1.0	0.0007
B	4.5	0.6	0.0018
C	3.0	0.5	0.0018
D	3.0	0.5	0.0018

*Due to the limited size of areas with Type A soils, these areas were assumed to have infiltration parameters commensurate with Type B soils.

2.3.3. Conveyance Element Routing

Conveyance elements or 'links' for the routing network were laid out using the 2005 study as a guide and were checked against the updated topographic mapping. As described in Delineation and Definition of Subbasins subsection, the differences occurred primarily in two locations: 1) in the recently developed areas south of Harmony Road and 2) in the undeveloped area between the TRIC and County Road 40.

All irrigation ditches or canals, except for the TRIC and TROC, were assumed to be flowing full and have no capacity for conveyance of stormwater. All ditches and canals besides the TRIC and TROC were excluded from the hydrology model and the flow routing ignored their presence and assumed flows would continue directly downstream. It is worth noting that the Larimer-Weld canal, which is a sizeable canal, was excluded from the hydrology model. The Larimer-Weld canal crosses through upper portions of the study area including subbasins tributary to the TRIC and the entire area which drains to Timnath Reservoir.

The restrictions of culvert crossings and roadway embankments were not reflected in the hydrology model. Backwater and inadvertent storage behind these structures was not included or accounted for in the hydrology model.

2.3.4. Conveyance Element Parameters

Cross section shape for the conveyance elements were re-defined using nine (9) typical cross section shapes. These typical cross sections were developed by sampling sections from the lidar surface for many of the link elements. Hydraulic roughness coefficients (Mannings n) were selected based upon general conditions for each category. The typical cross section categories are presented in the following list and more detail can be found in Appendix A.

Conveyance Element Cross Sections Shapes (Manning n):

- Overland, (n = 0.045)

- Field, (n = 0.045)
- Road Ditch, (n = 0.45 overbank; 0.035 ditch channel; 0.02 pavement)
- Trapezoid - Large, (n = 0.035)
- Trapezoid - Medium, (n = 0.035)
- Trapezoid - Small, (n = 0.035)
- TRIC, (n = 0.03)
- TROC, (n = 0.03)
- Street, (n = 0.013)

In downtown Timnath, the main drainage pipe for the north and south storm systems were included in the model. Street overflow elements were added for each pipe to carry flow in excess of the pipe capacity. Storm drain lateral pipes and inlets were not included; this model assumes that inlet and lateral pipe capacity are not a limiting factor and the main line pipe is filled to capacity.

2.3.5. Node Elevations

Node or 'junction' elevations were obtained from a DEM developed from the 2012 Boxelder lidar data.

2.3.6. External Inflows

The 2005 MODSWMM hydrology model included spill flows from Boxelder Creek at node 927. These spill flows have now been eliminated by recent drainage projects constructed in the Boxelder watershed. As such, the EPA SWMM hydrology model does not include inflows from Boxelder Creek. The new hydrology model does however include "inflows" at the upstream ends of the TRIC (node TRIC1) and TROC (node ResOutlet) for canal base flow and are explained further in the following sections.

2.3.7. Timnath Reservoir Inlet Canal

Timnath Reservoir is filled via the Timnath Reservoir Inlet Canal (TRIC) which diverts water from the Poudre River near Fort Collins and conveys flows easterly to Timnath Reservoir. This canal enters the study area near the location where the canal crosses under Interstate-25, immediately north of Prospect Road. The canal varies in depth from 7 to 9-feet and the bottom width is approximately 10 to 11-feet. The canal is limited in capacity due to the flat bed slope of approximately 0.02% to 0.06%. At the downstream end, the TRIC enters Timnath Reservoir through a twin 5' (W) x 6.5' (H) concrete box culvert. On the reservoir side, the culvert includes a counter-weighted flap gate which restricts reservoir water from back-flowing into the TRIC canal.

The TRIC was excluded from the 2005 study under the assumption that it would be flowing full during rainfall events and offered little capacity to convey stormwater flows. However, for the present study, the Town specifically requested the evaluation of this canal as an option for conveying stormwater. As such, a detailed hydraulic analysis of the canal capacity, spill locations, and spill rating curves were performed using the SRH-2D model. Details and results of the SRH-2D analysis are presented in Section 3 and Appendix E. The Town is currently coordinating with the ditch owner, New Cache La Poudre Irrigating Company, to use the TRIC as a drainage conveyance, but it has not been confirmed as an assured route at this time.

For the present hydrology study, the TRIC was included in the routing network of the SWMM model. It was assumed that the TRIC would intercept all upstream flows for both existing (baseline) and future (developed) conditions. Four (4) spill locations from the TRIC were identified in the SRH-2D hydraulics model and input to SWMM with divider nodes using tabular rating curves developed in SRH. These diversion elements are nodes TRIC2, TRIC4A, TRIC5A, and TRIC6A.

For modeling purposes, the TRIC was assumed to be flowing at full irrigation flow before rainfall begins for all scenarios and frequencies. Although, the TRIC decree flow is 200 cfs, it was determined with SRH-2D hydraulics analysis that canal flows will begin to spill at 190-cfs. In the SWMM hydrology models, 189-cfs was used as the TRIC baseflow so that the canal was not spilling flow before rainfall began. The spill rating curves and summary of SWMM and SRH spills results are presented in Appendix E.

2.3.8. Timnath Reservoir Outlet Canal

The Timnath Reservoir Outlet Canal (TROC) was also modeled in both the EPA SWMM hydrology and SRH-2D hydraulics models. Both models included 200-cfs of base irrigation flow (decreed flow). The SRH hydraulics results showed that the 100-year flows spill out of the TROC channel and pond in several overbank locations, however no split-flow paths were identified. Based on this analysis, the SWMM hydrology model simply incorporated the TROC channel as a routing link and did not include any inadvertent ponding in overbank areas. Results of the SRH hydraulics analysis are discussed later in Section 4. A summary of SWMM hydrology model results and SRH-2D hydraulics model results are presented in Appendix F.

2.3.9. Timnath Reservoir

Description

Timnath Reservoir was originally constructed as an irrigation reservoir. The dam and outlet works were rebuilt in 1976 and the reservoir is still operated for irrigation storage today. For master planning purposes, storm detention was considered only above the normal high-water level.

The physical outlet of the reservoir includes a primary gated outlet, a service spillway, and an emergency spillway. The primary outlet consists of a 5'-6" diameter gated outlet pipe that changes to a 5'-0" diameter pipe at the control structure in the middle of the dam. The service spillway is a morning-glory type overflow structure located inside of the control tower structure inside the dam and directly above the primary outlet pipe. The service spillway shares the same 5'-0" diameter outlet pipe as the primary outlet pipe. The crest elevation of the service spillway is 4907.7 (NGVD 29 – Converted to 4910.77 NAVD 88 for this study) and is 34-feet above the invert of the reservoir. The combined primary outlet and service spillway pipe discharge directly into the TROC immediately south of the reservoir. The 900-foot (design) emergency spillway is located east of the primary outlet structure, with a crest elevation of 4910.0 (NGVD 29 – converted to 4913.07 NAVD88 for this study) or 2.3 feet above the service spillway crest.

SWMM Modeling

Timnath Reservoir was modeled in SWMM using a storage element for the reservoir (P-120) and an outlet rating (OP-120) for the combined outlet works. The reservoir storage information from the 2005 study was updated with more detail from contour data and the reservoir level was assumed to be at the "Normal High-Water Level" (HWL), or crest of the service spillway, at the beginning of the simulation. Storage below the Normal-HWL was not included in the hydrology model and the invert of the SWMM storage basin was set at the service spillway crest. The reservoir surface area at Normal-HWL is approximately 622 acres. Table 2.3 below presents the stage-storage information for Timnath Reservoir

The outlet rating from the 2005 study was checked against documents from the State Engineers Office and updated with more detail. The outlet rating used in the model combined flows from the service and emergency spillways, but did not account for flows from the primary gated outlet. For the hydrology model, the primary outlet pipe was assumed to be flowing at a constant base flow of 200-cfs based on the TROC decree flow. However, the primary outlet pipe when fully open has 465-cfs capacity with the reservoir level at normal-HWL. The 200-cfs of base flow was input to the TROC at the "ResOutlet" node, immediately downstream of the reservoir. Table 2.4 below presents the Timnath Reservoir outlet rating information for the service and emergency spillways.

Table 2.3 Timnath Reservoir Stage-Storage Information

WSEL		Depth		Area		Total Storage	Notes
(NGVD29)	(NAVD88)	Above Invert (ft)	Above HWL (ft)	(SF)	(acres)	(AF)	
4873.7	4876.77	0		0	0	0	
4883.7	4886.77	10		7,840,780	180	900	
4893.7	4896.77	20		12,632,420	290	3,250	
4903.7	4906.77	30		26,135,980	600	7,700	
4907.7	4910.77	34	0	27,099,908	622	10,144	Normal HWL
4908.7	4911.77	35	1	27,459,973	630	10,771	
4910.0	4913.07	36.3	2.3	27,928,058	641	11,597	Emergency Spillway Crest
4910.7	4913.77	37	3	28,180,104	647	12,048	

Table 2.4 Timnath Reservoir Outlet Rating

WSEL		Depth		Combined Outlet Discharge[1]	Notes
(NGVD29)	(NAVD88)	Above Invert (ft)	Above HWL (ft)	(cfs)	
4907.7	4910.77	34	0	0	Normal HWL
4908.7	4911.77	35	1	65	
4910.0	4913.07	36.3	2.3	145	Emergency Spillway Crest
4910.7	4913.77	37	3	1,365	
4912.7	4915.77	39	5	10,440	

[1]Outlet Rating for Service + Emergency Spillways. Does not include flows in primary gated outlet.

2.3.10. Downtown Timnath

In the Downtown Timnath area, surface flows and pipe flows were modeled in SWMM. However, only the main storm drainage pipes were included; lateral pipes and inlets were not modeled. This consisted of two storm drainage networks - the Main Street/ 3rd Avenue drainage system (north of the Great Western Railroad) and the Dixon Street system (south of 3rd Avenue). The interim detention pond near 3rd Avenue and Kern Street was also modeled.

Modeling of the downtown storm pipes required surface flow links to handle flows in excess of pipe capacity. This was accomplished in the Kinematic Wave SWMM model with parallel surface flow links and "flow dividers" at each junction. The flow dividers were set to route flows first into the pipe link and then all excess flows through the overflow link which represents the street. This model did not include stormwater inlets and lateral pipes; it is assumed that the capacity of the storm drain systems is not limited at the inlets.

2.3.11. Diversions

This study identified four (4) locations along the TRIC where surface flows spill from the canal. These locations were modeled in SWMM with diversion nodes based on the SRH-2D model hydraulics runs. Aside from TRIC, this study and model did not identify or model any other surface flow diversions. The 2005 study did not contain any surface flow diversions. The SWMM model did however use divider elements to split flow between storm drain pipe and surface flows, as discussed in the Downtown Timnath subsection.

2.3.12. Development Since 2005

This study incorporated developments that have occurred since the 2005 study into the updated hydrology model. Detention basins for these developments were included based primarily on information from the final drainage reports and supplemented were necessary with contour data and field measurements. The following developments were incorporated:

- Harmony Development
- Saratoga Falls Development
- Timnath Ranch Development
- Timnath South Development
- Fairview Development
- Brunner Farm

The future Timnath Landings development has not been approved at the time of this study and was not included in the existing conditions model.

2.3.13. Outfalls

In all, there are fourteen (14) outfall elements in the SWMM model. Outfall elements are locations where flow leaves the model. These outfall locations are briefly described in the following list:

1. Outfall 165 – Releases discharges from subbasin 23 along the northern side of E. Mulberry Street. This subbasin was included in the previous model, but appears to discharge westerly, towards to Boxelder watershed.

2. TRIC-OUTFALL – Releases water from the TRIC into Timnath Reservoir.

3. Outfall 352 – Discharges water from subbasin 114, on the south side of Downtown Timnath, towards the Poudre River.

4. Outfall DTS01 – Outfalls the downtown south storm drain system into a detention pond, just north of Harmony Road

5. Outfall 351 - Discharges water from subbasin 119, on the south side of Downtown Timnath, to the same detention pond where Outfall DTS01 discharges, just north of Harmony Road.

6. Outfall 348 – Outfalls the County Road 5 storm drain system into the Poudre River, just south of Harmony Road.
7. Outfall 346 – Discharges water from subbasin 109, just south of Harmony Road, towards the Poudre River.
8. Outfall 330 – Discharges water from portions of the Brunner Farm development, towards the Poudre River.
9. Outfall 338 – Discharges water from portions of the Brunner Farm development, towards the Poudre River.
10. Outfall G3-1 – Discharges water from subbasin 106, near the south end of County Road 3, into the Greeley No. 2 canal.
11. Outfall G3-2 – Discharges water from the "square detention pond" P-106A, south of the Timnath South development, into the Greeley No. 2 canal.
12. Outfall 335 – Discharges water from subbasin 108A into the Greeley No. 2 canal.
13. TROC-OUTFALL – Discharges the TROC into the Greeley No. 2 canal.
14. Outfall 295 – Discharges water from portions of the Harmony development into the southeasterly flow path located east of County Road 1, near the Harmony Road intersection.

2.3.14. Results of Baseline Hydrology Model

The results of the baseline condition analysis are presented in Table 2.5. The peak 100-year discharge in the TROC is 1,629-cfs at Harmony Road and 1,735-cfs at the outfall into the Greeley No. 2 Canal. These discharges include 200-cfs of baseflow in the TROC for all frequencies.

Timnath Reservoir

Baseline Condition results for Timnath Reservoir show a peak inflow of 7,073-cfs and outflow of 322-cfs (including 200-cfs of base irrigation flow). This corresponds to a water depth of 1.93-feet above the normal high-water level (WSEL = 4912.70) with 1,219 acre-feet of detention storage.

2.3.15. Comparison of Results to Previous Study

In Table 2.6 below the existing condition (baseline) results of this study are compared to the 2005 MODSWMM model results, with and without flows from Boxelder. Results along the TROC are similar between the studies, especially considering that the MODSWMM model may not have included the 200-cfs of baseflow from Timnath Reservoir. However, results along the Clark Drainage, between Downtown Timnath and Timnath Reservoir, were approximately 20% - 50% higher in this new study. These differences are likely due to different routing layout north of downtown Timnath, small differences in land use, and differences within the rainfall-runoff and routing algorithms between the models.

Table 2.5 Summary of Results for Baseline Condition SWMM Hydrology Model

Element ID	Location	Discharge (cfs)					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
-	Boxelder Creek Overflow Discharge	-	-	-	-	-	-
39	Clark Drainage at County Road 5	28	40	59	162	364	701
199	Clark Drainage at County Road 40	30	42	66	239	596	1,200
OP-51	Downtown Outfall to Clark Drainage	0	0	0	12	43	99
173	Clark Drainage at Harmony Rd. U/S of TROC confluence	29	43	63	231	589	1,269
-	Harmony Roadside Swale, NW of confluence with TROC	-	-	-	-	-	-
ResOutlet	Timnath Reservoir Discharge[1]	214	219	223	242	273	322
TROCL6	Timnath Res. Outlet Ditch U/S of confluence	224	235	246	314	439	635
TROC6	Timnath Res. Outlet Ditch at Harmony Road	252	273	301	491	885	1,629
TROC9	Timnath Res. Outlet Ditch at Summerfield Pkwy	254	276	304	495	888	1,632
TROC11	Timnath Res. Outlet Ditch at County Road 36	260	283	312	529	946	1,736
TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	260	283	312	529	946	1,735
295	Discharge at Harmony Road and County Rd. 1	1	2	4	10	19	28
348	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	10	15	18	26	38	54
DTSO1	Dixon Street Outfall	8	12	15	21	30	40
G3-2	Timnath South Outfall to Greeley No. 2	5	7	9	13	20	68

[1] Timnath Reservoir Discharge includes 200 cfs of baseflow for all frequencies

Table 2.6 Comparison of Baseline Hydrology Model Results to Previous Study

Element ID		Location	100-Year Discharge (cfs)		
EPA SWMM	MOD-SWMM		**2018 EPA SWMM**	2005 MODSWMM With Boxelder	MODSWMM Without Boxelder
-	927	Boxelder Creek Overflow Discharge	**-**	3,885	-
39	321	Clark Drainage at County Road 5	**701**	3,933	466
199	345	Clark Drainage at County Road 40	**1,200**	4,001	975
OP-51	151	Downtown Outfall to Clark Drainage	**99**	96	96
67	173	Clark Drainage at Harmony Rd. U/S of TROC confluence	**1,269**	4,000	1,085
-	270	Harmony Road Ditch, NW of confluence with TROC	**-**	48	48
ResOutlet	920	Timnath Reservoir Discharge[2]	**322**	395	395
TROCL6	280	Timnath Res. Outlet Ditch U/S of confluence	**635**	401	401
TROC6	383	Timnath Res. Outlet Ditch at Harmony Road	**1,629**	4,415	1,418
TROC9	188	Timnath Res. Outlet Ditch at Summerfield Pkwy	**1,632**	4,395	1,497
TROC11	397	Timnath Res. Outlet Ditch at County Road 36	**1,736**	4,400	1,530
TROC-OUTFALL	300	Timnath Res. Outlet Ditch at Greeley No. 2	**1,735**	4,418	1,616
295	374	Discharge at Harmony Road and County Rd. 1	**28**	85	85
348	810	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	**54**	19	19

[2] Timnath Reservoir Discharge includes 200 cfs of baseflow for the 2018 EPA SWMM model. It is likely that the MODSWMM model did not include the 200 cfs baseflow.

2.4. Developed Condition Hydrology Model

The hydrologic model for the developed condition was prepared in EPA SWMM in similar fashion to the 2005 Study. This model evaluates the effectiveness of on-site detention and provides a design discharge for future conveyance facilities. Several modifications were made to the baseline condition model to represent future development in the Timnath GMA. Although local drainage patterns will change slightly with the advent of development, it would not be possible to identify those modifications in advance. Consequently, the delineation of drainage basins was not modified for the developed condition. However, subbasin and conveyance elements were modified to reflect the developed condition. In addition, on-site detention was modeled for each of the subbasins projected to be developed in the Timnath GMA. These modifications are summarized in the following sections. The schematic diagram for the developed condition SWMM model is provided in the Appendix B.

The developed conditions for the present study may be compared with Alternative 3 from the 2005 Study (also referred to as Alternative C). Alternative 3 had assumed the removal of the Boxelder Creek spill flows and the future construction of the improved Clark Channel along the Clark Drainage, upstream of the TROC.

2.4.1. Future Land Use Conversion

Fully developed land uses were assumed for all subcatchments based on the 2016 Timnath Future Land Use maps, as shown in Appendix B. Land use designations were converted to impervious values based on Table 2.7. There were several locations inside of the Study Area that did not have defined future land use (near I-25 and Prospect), for which future land uses were assumed. For subbasins containing multiple land uses, a composite impervious value was calculated. The future imperviousness map and table of subbasin parameters are provided in Appendix B.

Table 2.7 Land Use to Imperviousness Table

Land-Use	Description	Impervious Percent
OS	Open Space	5%
CDR-AB	County Density Residential/ Agri-Business	10%
VLR	Very Low Density Residential	30%
LDR	Low Density Residential	45%
MDR	Multi-Family / Duplex	50%
HDR	Multi-Family Residential / Multiple Attached Units	75%
P	Public	55%
LDMU	Low Density Mixed Use	50%
RMU	Residential Mixed Use	70%
MU	Mixed Use	70%
CMU	Commercial Mixed Use	80%
DC	Downtown Core	80%
RC	Regional Commercial	80%
E	Employment	80%
C	Commercial	90%
Water	Lake surface	100%

In addition to modifying impervious values, other subbasin parameters were modified to represent developed conditions. For subbasins where the average ground slope was less than 1.0%, it was assumed that site grading would result in an average ground slope of 1.0% for the overland flow. For urbanized subbasins, the overland flow length was limited to a maximum of 300 feet. The hydrologic parameters for each of the developed condition subbasins are presented in Appendix B.

2.4.2. Conceptual Detention for Future Development

In a similar manner as the 2005 Study, each subbasin with proposed future development (i.e. undeveloped land that is assumed to be developed according to the 2016 Land Use Plan) was routed directly into a conceptual on-site detention pond. The conceptual detention ponds were modeled with a function storage rating curve (storage equation in EPA SWMM), that was developed based on the developed hydrograph volumes and an iterative sizing procedure. Consistent with Timnath criteria, the 100-year design discharge was set at the 10-year existing condition peak flow rate and an outlet orifice was iteratively sized. These 10-year outlet controls also met the Timnath 2-year flow control requirement. No specific future developments were considered in the developed model. A summary of the conceptual detention pond release rates is given in Appendix B.

2.4.3. Routing Changes for Future Conditions

In addition to the modification of the subbasin and on-site detention parameters for the developed condition, the conveyance elements were also modified to reflect a developed condition. In contrast to the existing condition, where the majority of the conveyance is over broad, shallow valleys with tall grasses, it was presumed that regional conveyance will be in grass-lined trapezoidal channels. The channel shapes and roughness were modified to replicate conceptual design conditions. Also, routing network was slightly modified to represent the future alignment of the Clark Drainage Channel. The future conditions routing map is provided in Appendix B.

2.4.4. Downtown Timnath

Two future options were considered for Downtown Timnath, north of the Great Western Railroad, consisting of 100-year storm drain conveyance and two options for future detention on the Timnath Elementary School parcel/ subbasin. Both options assumed a future regional detention pond, located just north of 5th Avenue and Kern Street, restricting 100-year future flows to the 10-year existing flow rate. Details of these options are discussed in Section 5.3.

2.4.5. Summary of Developed Condition Hydrology Results

The results of the developed condition analysis are summarized in Table 2.8. These results show that the 100-year discharges would decrease from the baseline flows at nearly every location. Along the future Clark Channel, immediately upstream of the TROC, 100-year flows would decrease from 1,269-cfs to 869-cfs. Discharges along the TROC would also decrease from 1,629-cfs to 1,264-cfs at Harmony Road and from 1,735-cfs to 1,379-cfs at the outfall to the Greeley No. 2 Canal. Although on-site detention lowers the individual subbasin discharge for all frequencies (refer to tables provided in Appendix B), the 2-year through 50-year results along the Clark Drainage show increases in future discharge. This effect is due to superposition of the prolonged detention hydrographs and the increased runoff volume from urban development.

Table 2.8 Summary of Results for Developed Condition SWMM Hydrology Model

Element ID	Location	Discharge (cfs)					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
-	Boxelder Creek Overflow Discharge	-	-	-	-	-	-
CLARK8	Clark Drainage at County Road 5	73	122	167	249	330	430
199	Clark Drainage at County Road 40	107	177	244	386	543	727
OP-51	Downtown Outfall to Clark Drainage	14	22	28	37	46	56
CLARK1	Clark Drainage north of Harmony Rd. U/S of TROC confluence	132	217	298	467	653	869
173	Harmony Road Swale, NW of confluence with TROC	4	7	9	13	16	20
ResOutlet	Timnath Reservoir Discharge[1]	226	238	249	274	306	409
TROCL6	Timnath Res. Outlet Ditch U/S of confluence	227	239	251	292	385	531
TROC6	Timnath Res. Outlet Ditch at Harmony Road	360	456	549	744	970	1,264
TROC9	Timnath Res. Outlet Ditch at Summerfield Pkwy	363	460	552	749	975	1,280
TROC11	Timnath Res. Outlet Ditch at County Road 36	371	473	576	784	1,021	1,356
TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	373	476	581	796	1,038	1,379
295	Discharge at Harmony Road and County Rd. 1	1	2	4	10	19	28
348	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	8	13	16	22	29	39
DTSO1	Dixon Street Outfall	7	10	13	19	26	37
G3-2	Timnath South Outfall to Greeley No. 2	3	4	5	8	10	72

[1] Timnath Reservoir Discharge includes 200 cfs of baseflow for all frequencies

Timnath Reservoir

Developed Condition results for Timnath Reservoir show a peak inflow of 6,848-cfs and outflow of 409-cfs (including 200-cfs of base irrigation flow). This corresponds to a water depth of 2.34-feet above the normal high-water level (WSEL = 4913.11) and approximately 0.04-feet above the emergency spillway crest. The maximum detention storage was 1,476 acre-feet.

2.4.6. Comparison of Developed Results to Alternative 3 from Previous Study

Table 2.9 compares 100-year developed condition results from this study with Alternative 3 from the 2005 study. These results show and increase in flow along the TROC of approximately 140-cfs above the confluence with Clark Channel and approximately 360-cfs increase below the confluence with the Clark. However, it should be noted that the MODSWMM model may not have included the 200-cfs of baseflow from Timnath Reservoir.

Table 2.9 Comparison of Developed Hydrology Model Results to Previous Study

Element ID			Discharge (cfs)					
			2018 EPA SWMM			2005 MODSWMM Alt. 3		
EPA SWMM	MOD-SWMM	Location	100-yr	50-yr	10-yr	100-yr	50-yr	10-yr
-	927	Boxelder Creek Overflow Discharge	-	-	-	0	0	0
39	321	Clark Drainage at County Road 5	430	330	167	318	222	94
199	345	Clark Drainage at County Road 40	727	543	244	580	399	163
OP-51	151	Downtown Outfall to Clark Drainage	56	46	28	116	82	37
CLARK1	173	Clark Drainage at Harmony Rd. U/S of TROC confluence	869	653	298	661	453	184
173	270	Harmony Road Swale, NW of confluence with TROC	20	16	9	13	10	5
ResOutlet	920	Timnath Reservoir Discharge[2]	409	306	249	366	100	32
TROCL6	280	Timnath Res. Outlet Ditch U/S of confluence	531	385	251	388	125	37
TROC6	383	Timnath Res. Outlet Ditch at Harmony Road	1,264	970	549	902	607	235
TROC9	188	Timnath Res. Outlet Ditch at Summerfield Pkwy	1,280	975	552	943	638	251
TROC11	397	Timnath Res. Outlet Ditch at County Road 36	1,356	1,021	576	996	674	265
TROC-OUTFALL	300	Timnath Res. Outlet Ditch at Greeley No. 2	1,379	1,038	581	1,028	702	277
295	374	Discharge at Harmony Road and County Rd. 1	28	19	4	14	10	4
348	810	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	39	29	16	8	6	3

[2] Timnath Reservoir Discharge includes 200 cfs of baseflow for the 2018 EPA SWMM model. It is likely that the MODSWMM model did not include the 200 cfs baseflow.

3. Hydraulic Evaluation of Timnath Reservoir Inlet Canal

The goals of the hydraulic analysis of the Timnath Reservoir Inlet Canal (TRIC) were to quantify the capacity of the canal, identify the natural spill locations, develop spill rating curves to be used in the hydrology model, evaluate the impact of development, and to analyze the performance of the current canal during the 10- and 100-year storm events. This study identified canal spill locations but did not evaluate alternatives, solutions for the spills, or define a floodplain.

3.1. SRH-2D Hydraulic Model Parameters

Model input data for the SRH-2D hydraulic model included lidar topography data and hydraulic roughness (Manning's n) coverages. The manning's n values used for this model were 0.035 for the channel and 0.04 for the overbank areas.

Modeling for the TRIC bridge and culvert structures were performed using the SRH-2D pressure flow routine. Culvert and bridge opening dimensions were verified with survey information. Pressure flow structures were modeled at the County Road 5, Prospect Road, and County Road 42E crossings, as well as at the Timnath Reservoir inlet culvert which consists of twin 5'(W) x 6.5'(H) concrete box culverts. Tailwater conditions in Timnath Reservoir, at the downstream end of the model, were set to match the normal high-water level of the Reservoir (WSEL 4910.77) which is essentially equal to the crown of the inlet culverts (El. 4910.79). This tailwater assumption is discussed further in Section 3.3.1.

On the downstream end of the inlet culverts (reservoir side) there are two flap gates which prevent reservoir water from flowing back into the TRIC canal. These flap gates were not discretely modeled with either the hydrology or hydraulics models; essentially the models function such that the flap gates would be open during storm flows. This decision was made for two reasons: 1) There is no design or rating information available for the hydraulic performance of the flap gates, and 2) the counter-weighted flap gates open rather easily and result in relatively small head loss compared with the hydraulic controls of the culvert restriction and the high reservoir tailwater (at the crown of the inlet culverts). The culvert gates are shown in Figure 3.1 below.

The TRIC drain into Lake Canal was ignored because the relatively small flow rate was considered negligible (approx. 5 cfs) and because this gate is manually operated.

Figure 3.1 Timnath Reservoir Inlet Culvert Gates (Reservoir Side)
Photo Credit (Fuhrman, 2017)

3.2. TRIC Capacity Analysis

To determine capacity of the canal, the TRIC was broken into three reaches: I-25 to Prospect, Prospect to CR42E, and CR42E to Timnath Reservoir. These reaches were analyzed in three separate SRH-2D models with increasing discharge until flows began to spill out of the channel's downslope embankment (to the southwest). The maximum flow rate that was completely contained within the canal's banks was considered the channel capacity. A map of the results from this analysis can be found in Appendix E. The maximum capacities for each individual section are as follows:

1. I-25 to Prospect Road (near McLaughlin Lane): 244 cfs.
   (Note: Ponding in adjacent areas north of the channel begins at approximately 185 cfs.)
2. Prospect Road (near McLaughlin Lane) to TRIC crossing with Prospect Road: 350 cfs
3. Prospect Road to CR42E:
   a. Upstream Section: 275 cfs
   b. Downstream Section: 190 cfs
4. CR42E to Timnath Reservoir Inlet: 200 cfs

Using the three individual 2D models described above, rating curves were developed for each spill location. These locations are labeled A through E, from upstream to downstream, and are briefly described as follows:

- Spill A is an area of ponding on the north side of the channel 1,400 feet east of I-25. At this location, water that spills out of the channel does not leave the model but ponds in the adjacent fields. When the TRIC discharge decreases, most of the ponding in this area will to drain back into the canal leaving a small amount of shallow ponding adjacent to the ditch road.
- Spill B is 1500 feet further downstream where the TRIC turns parallel to Prospect Rd. This location begins spilling south when flows in the canal exceed 244 cfs.
- Spill C is south of Prospect where flows will spill to the west when flows exceed 275 cfs.
- Spill D is just north of CR42E, this is the most limiting area of the channel where water spills to the west when flows exceed 190 cfs.
- Spill E is approximately 700 feet downstream of CR42E and spills exit the channel when flows exceed 200 cfs.

The spill rating curves were developed by placing model monitoring lines immediately upstream, downstream, and perpendicular to each spill location. Monitor lines are features of SRH-2D which track flow through the line at each timestep. The monitor line data was used to develop channel and spill rating curves at each spill location, the rating curves were then entered to the hydrology model. Appendix E presents these rating curves and spill results for the 10 and 100-year storm events (existing and future conditions).

3.3. Unsteady Hydraulic Analysis of 10-year and 100-year Flows

Hydraulic analyses of the 10-year and 100-year TRIC flows were performed in SRH-2D using input hydrographs from the EPA SWMM hydrology model. It was assumed that all upstream drainage would be intercepted by the TRIC. Prior to the storm inflows, irrigation baseflow was run through the model in steady state until equilibrium was reached through the entire channel. The decreed flow for this channel is 200-cfs, but because the TRIC begins to spill flow at 190-cfs, this flow rate was chosen as the baseline condition. The 190-cfs base irrigation flow continued during the storm duration. With these inflows, the 2D model was run in an unsteady condition for an 8-hour period.

The canal flow and canal spill results compared reasonably well between the SRH-2D hydraulics model and the EPA SWMM hydrology model, with some variation that would be expected between different models. These comparisons are presented in Appendix E.

3.3.1. Tailwater Conditions/ Timnath Reservoir WSEL Discussion

The TRIC canal terminates at the Timnath Reservoir inlet, which is the downstream boundary of the SRH-2D analysis. The SRH analysis assumed a constant water surface in Timnath Reservoir equal to the normal-high water level (normal-HWL) or service spillway crest at WSEL 4910.77. However, the final SWMM hydrology models showed that the reservoir level may rise above the normal HWL, during a 100-year storm event, by 1.93-feet (existing/ baseline conditions) to 2.34-feet (future conditions). These depths correspond to water surface elevations of 4912.70 (existing) and 4913.11 (future). The hydrology model assumed conservatively that the Timnath Reservoir initial conditions would be at Normal-HWL prior to 100-year rainfall.

The existing and future SWMM model results show that, given a drainage basin wide storm event, the TRIC would not only have the inability to convey flows into the Reservoir, but that the Reservoir could backflow through the TRIC if the inlet flap gates were left in the fixed open position. Without the Reservoir inlet flap gates in place, these maximum reservoir WSELs would fill the TRIC to 3-feet deep at Prospect Road and 2-feet deep at I-25. These maximum Reservoir WSELs are higher than the TRIC spill crests at the Spill D and E locations and presents a situation where — without the inlet culvert flap gates — reservoir water could backflow through the TRIC and spill over the canal banks (existing and future scenarios).

3.4. Discussion of TRIC Results

As presented in the previous sections, the primary purpose of the TRIC hydraulic analyses focused on conveyance of the 10-year and 100-year stormwater flows in addition to the 190-cfs of irrigation base flow. These analyses showed that the TRIC does not have capacity, above the 190-cfs of irrigation base flow, to convey additional stormwater flows without spills from the canal. In addition, the SWMM hydrology models showed that the existing and future 100-yr WSELs in the Reservoir would be higher than portions of the TRIC embankment.

At the direction of the Town, a less conservative SRH modeling run was performed which removed the 190-cfs irrigation baseflow and allowed storm flows to be run through a dry TRIC channel. The results showed that, without irrigation flows, the TRIC would be able to convey all of the future condition 100-year flows (or about 70% of existing condition flows) to Timnath Reservoir. This model run assumed the Reservoir level would remain at the normal-HWL. The reduction in canal spills from these runs is due to a combination of two main factors: 1) flow attenuation from the empty TRIC provides storage volume similar to a detention pond, and 2) the hydraulic capacity of the TRIC to convey 190-cfs to the reservoir – assuming the reservoir level would not rise above the normal-HWL. However, the SWMM hydrology results, as discussed in Section 3.3.1. showed that a watershed wide rain event would increase the Timnath Reservoir WSELs such that storm flows could not be conveyed into the Reservoir via the TRIC.

Summarizing the overall TRIC modeling results, the following conclusions can be made:

1. The overall capacity of the TRIC is 190-cfs before canal spills begin. This is slightly less than the decreed flow of 200-cfs and with the caveat that at 185-cfs ponding begins in adjacent areas north of the TRIC, between I-25 and Prospect Road. Flows spills to the south/ southwest of the TRIC begin at 190-cfs and are located along the canal section between Prospect Road and CR 42E.
2. The capacity of the TRIC to convey 190-cfs is based on the WSEL of Timnath Reservoir staying at, or below, the normal HWL of the reservoir (4910.77 NAVD 88).
3. In the event of a drainage basin wide 100-year storm event, the water surface of Timnath Reservoir will fill to elevations higher than portions of the TRIC embankment (Existing WSEL: 4912.70; Future WSEL: 4913.11). The reservoir inlet flap gates will prevent back flow in this situation. As-such, the TRIC — along its current alignment and profile — would be unable to convey flows into the Reservoir in this situation.
4. Based on points 1 - 3, the present configuration of the TRIC cannot be relied upon to convey major storm flows. Significant improvements to the TRIC would be required to provide assurance that storm flows can be conveyed to the Reservoir.
5. Future implementation of 100-year to 10-year over-detention (per current Timnath criteria), in developing areas tributary to the TRIC, will reduce but not eliminate the flow spills.

The TRIC analyses and the conclusions stated above lay the framework for several TRIC stormwater management scenarios to be considered by the Town, presented in the following list. These scenarios were not modeled or evaluated, but are conceptual in nature.

A. **<u>Disconnect stormwater discharges from TRIC:</u>** This management scenario assumes the most conservative case (being: Timnath Reservoir full, irrigation base flow in the TRIC, and 100-year rainfall event in the drainage basin), for which the TRIC has no capacity to convey storm flows. Under this scenario, all future development, upstream of the TRIC, will need to find a separate outfall for stormwater discharges. This will likely require construction of stormwater channels on the downstream side of the TRIC.

B. **<u>Convey stormwater through the TRIC to formal spill location(s):</u>** This scenario would convey all storm water intercepted by the TRIC to a formalized spill location(s) where excess flows would be routed into the Clark Drainage. This will require constructed drainage channels between the TRIC and the main Clark Drainage channel and improvements to the TRIC to eliminate informal flow spills.

   The dimensions and sizing of TRIC channel improvements and spill weir configuration would require further hydraulic evaluation with an appropriate backwater model and were beyond the scope of this study. This scenario may need further hydrologic evaluation in EPA SWMM if the formalized spill locations significantly change the existing flow spills.

C. **<u>Convey stormwater through the TRIC to Timnath Reservoir:</u>** This scenario would convey all storm flows through the TRIC into Timnath Reservoir. Significant improvements to the TRIC would be necessary so that the full 100-year flows could be conveyed into the Reservoir, without spills and with assuming the highest tailwater in the Reservoir (as shown in the existing and future hydrology models). The required improvements would include raising the canal embankment height and may include widening the canal or the addition of a second channel along a higher profile grade-line.

The dimensions and sizing of these TRIC channel improvements would require further hydraulic evaluation with an appropriate backwater model and were beyond the scope of this study. This scenario would need further evaluation in EPA SWMM hydrology to determine the full TRIC flow rate without spills. Alternative hydrology scenarios for the TRIC were not part of the present study.

D. **Hydrology Alternatives:** In addition to the conveyance alternatives presented in points A-C, hydrology alternatives may also be considered for further evaluation. Scenarios such as more restrictive detention requirements upstream from the TRIC or regional detention facilities would lower peak flow rates and reduce the size of future conveyance improvements.

Beyond these options, two other stormwater management scenarios were initially considered but not recommended for further evaluation because of impacts to irrigation flows and storage. These scenarios would increase the effectiveness of the current TRIC and Reservoir facilities for stormwater management but would require significant concessions from the TRIC and Reservoir owners (such as constraints on the timing of TRIC irrigation flows or reduction of the maximum irrigation water storage in the Reservoir), and therefore were not recommended for further consideration.

4. Hydraulic Evaluation of Timnath Reservoir Outlet Canal

The objectives of the SRH-2D hydraulic analysis of the Timnath Reservoir Outlet Canal (TROC) were to analyze the channel's capacity and identify spill locations. Input hydrographs were obtained from the SWMM hydrology model and channel bathymetry was developed using Box Elder lidar with supplemental cross-sectional survey information. The results of this analysis are that ponding areas adjacent to the TROC channel were identified, near and south of the Great Western Railroad crossing, but no split flows were found (i.e. ponded water flowed back into the TROC when capacity became available).

Hydraulic modeling was performed in the SRH-2D model, version 12.2.9, run inside of the AquaVeo SMS model interface software.

4.1. Capacity Analysis

Channel capacity determination, for individual reaches of the TROC, was performed as part of the 10- and 100-year unsteady hydraulics analysis. In locations where water left the channel, flowing into surrounding low areas, the channel capacity was determined by the maximum flowrate prior to water leaving the channel. In areas where the channel capacity exceeded the model flowrates, the maximum channel capacity was not determined. The channel capacity through the different TROC sections is presented on a map in Appendix F and is described in the following list:

1. Timnath Reservoir outlet to the point where the TROC turns due south: 505+ cfs
2. TROC turns due south to Harmony Rd.: 590+ cfs
3. Harmony Rd. to Brookline Dr.: 1690+ cfs
4. Brookline Dr. to Railroad bridge: 1365 cfs
5. Railroad bridge to Folsom Pkwy: 700 cfs (overbank ponding exists above 700 cfs)
6. Folsom Pkwy to 500 feet north of Greeley No. 2 confluence: 1170+ cfs
7. Final 500 feet before Greeley No. 2 confluence: 530 cfs

The results map presented in Appendix F is a capacity map, which shows the ponding areas adjacent to the TROC channel, it should not be considered a detailed floodplain or regulatory floodplain map.

4.2. SRH-2D Hydraulic Model Parameters

Model input data for the SRH-2D hydraulic model included lidar topography data and hydraulic roughness (Mannings n) coverages. The manning n values used for this model were 0.03 for the channel and 0.04 for the overbank areas. Bridges and culvert structures were placed in the model based on field measurements and survey data and modeled using SRH-2D's pressure flow routine.

4.3. Unsteady Analysis of 10- and 100-year Flows

The unsteady analysis of the TROC was performed by obtaining inflow hydrographs from the SWMM hydrology model at locations where links and subbasins drained into the TROC. These were entered to the 2D model as "Inlet-Q's," which push flow into the model as either a constant flow or a time-series. The decree flow of the TROC is 200-cfs from Timnath Reservoir; as such, prior to the inflow hydrographs, the model was run with a constant 200-cfs inflow from the reservoir until the channel reached equilibrium. This was used as the starting condition for the 10- and 100-year model runs. The model was run for an 8-

hour period for the four (4) following conditions: 10- and 100-year flow frequency, for both existing and future conditions.

Results show that the TROC channel is insufficient to convey 100-year flows (existing and future condition) from the south end of the double channel, near the Great Western Railroad crossing, to the confluence with the Greeley No. 2 canal. The most limiting section of the TROC is the stretch from the railroad crossing to Folsom Parkway, with a channel capacity of approximately 700-cfs. Significant ponding was seen through this reach, on both sides of the canal, in the 100-year model runs. However, the channel was able to contain the 10-year flows.

Results from the SRH-2D model runs, along with a comparison to SWMM model flows, are presented in Appendix F.

4.4. Discussion of TROC Results

Charts and tables comparing TROC results between the SRH-2D hydraulics model and the SWMM hydrology model are presented in Appendix F. These charts show similarities and differences between results of the two models. Several of the key differences are summarized in the following list:

1. The SRH model flows, in general, were 60 to 100-cfs higher than the SWMM model flows.
2. At the confluence with the Greeley No. 2 canal, the 100-year SWMM flows were approximately 45% larger than the SRH flows;
3. At the confluence with the Greeley No. 2 canal, the opposite was observed for the 10-year event, where the SRH flows were approximately 77% higher than the SWMM flows.

These result differences are likely attributed to a number of factors, including fundamental differences between the model algorithms. However, several noteworthy differences between the models, that likely contribute to these discrepancies, include the following items:

- The SWMM hydrology model used one representative cross section shape for all the TROC elements; this section was defined with an 18-foot bottom width and 2:1 side slopes. On the other hand, the SRH-2D model incorporated lidar topography for all locations along the TROC. Upon review, there are reaches where the TROC geometry is smaller than the SWMM typical cross section and it appears that the SRH model propagated flows downstream faster in these locations. These model differences would contribute to the discrepancies in point #1 above.

- The SWMM hydrology model did not allow for overbank ponding along the TROC, whereas the SRH hydraulics model included overbank topography. This allowed for ponding and peak flow attenuation in the SRH model, which was observed in the 100-year scenarios between County Road 36 and the Greeley No. 2 outfall. This major model difference accounts for the 100-year peak flow differences in point #2 above.

- The SRH model did not consider the impact of the large Timnath Ranch detention pond near Twin Bridge Drive and County Road 36. In the 2D model, local inflows to the "double channel" which would have flowed into this detention pond, were input unattenuated to the double TROC channel. On the other hand, the SWMM model routed these flows through the Timnath Ranch detention pond prior to discharge into the TROC for all conditions.

Under low flow conditions, up to the 10-year event, local drainage flows in the “stormwater” portion (northeast) of the larger “double channel” would flow into the Timnath Ranch detention pond. However, under 100-year flow conditions, TROC flows would flood both sides of the double channel and local storm flows would combine with TROC flows and the detention pond would be flooded with TROC water. Therefore, the 2D inflow configuration is correct for the 100-year condition and the SWMM configuration is correct for lower flows, including the 10-year condition. These differences between models most likely explain item #3 on the list above.

For the analysis of the Greeley No. 2 canal, it was assumed that the TROC will be improved in the future to convey the full 100-year flow rate, and the larger peak flow rate was used (from SWMM). Results from the 2D model runs can be found in Appendix F.

5. Alternative Evaluations and Conceptual Design

This section presents alternative evaluation for the Downtown Timnath drainage situation and conceptual channel designs for the Clark and TROC outfall channels. The conceptual design for the TROC, presented here, applies to the unimproved portions of the TROC, south of the Great Western Railroad (GWRR) and County Road 36 (River Pass Road) crossings. Between the Reservoir outlet and the GWRR crossing, the SRH-2D hydraulics results showed the existing TROC channel geometry was sufficient to convey existing and future 100-year flows.

5.1. Hydrology for Channel Design

Within the lower Timnath watershed, improvements to increase the conveyance of the main drainage channels were evaluated; these channels convey locally generated runoff to the watershed outfall at the Greeley No. 2 canal. This main drainage path is broken into two distinct channel sections: 1) the section between County Road 5 (near County Road 40) and the confluence with the TROC is referred to as the Clark Channel; and 2) the TROC channel downstream from the Clark Channel confluence (north of Harmony Road) to the Greeley No. 2 Canal. A conceptual channel cross section for each reach is presented in Section 5.2. This section presents the selected discharges for the designs which are shown in Table 5.1 below.

Table 5.1 Summary of Discharge for Design of Clark and Timnath Reservoir Outlet Canal Channels

Element ID		Location	Discharge (cfs)					
			Baseline (Existing) Results			Developed (Future) Results		
Baseline Model	Developed Model		2-Yr	10-Yr	**100-Yr**	2-Yr	**10-Yr**	100-Yr
173	CLARK1	Clark Channel - Above Confluence with TROC	29	63	**1,269**	132	**298**	869
TROC-OUTFALL	TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	260	312	**1,735**	373	**581**	1,379

Table 5.1 shows that the 100-year flow rates will decrease in the future, however the 2- and 10-year discharges are projected to increase; this phenomenon is not unique and was discussed previously in Section 2.4.5. (Summary of Developed Condition Hydrology Results). Following discussion with the Town, it was decided that the design discharge for each proposed channel would be the larger of the Baseline or Developed Condition results. Consistent with the previous 2005 Master Plan design, compound channels were sized for 10-year and 100-year channel sections. The selected flow rates are highlighted in grey in Table 5.1 above.

5.2. Conceptual Hydraulic Design of Clark and TROC Drainage Channels

The hydraulic analyses for the conceptual channel design was performed using the UD-Channel spreadsheet, version 1.04, distributed by UDFCD. Both the TROC and Clark channel sections were designed to convey the 100-year discharge with 2-feet of freeboard (UDFCD recommends a minimum of 18-inches). The Clark channel was designed with one flow bench above the 10-year water surface, whereas the TROC channel was designed with two flow benches, the first for the 200-cfs irrigation flow and the second for the 10-year flow event.

The character of the low flow channel will vary between the Clark and TROC channel sections. For the TROC, irrigation water releases from Timnath Reservoir will compose the base flow for several months each year. It was assumed that the TROC channel improvements would include preservation of the existing bed material (removal and reuse) along with riprap banks for the low flow irrigation channel. In contrast, the Clark section would have intermittent storm flows and likely remain dry for portions of the year, with base flows increasing as development increases. In both channels, the average velocity and shear stress results indicate that a channel lining is not required, and a grass-lined channel was assumed for all channel sections except for the TROC irrigation channel, where a lining is recommended. It is also recommended that further design of the Clark channel include a 2-year low flow channel, which was not included in this design (consistent with the 2005 study). This 2-year low flow channel may meander through the lower bench.

The conceptual designs for the Clark and TROC channels are presented in Figure 5.1 and a summary of the hydraulic design parameters is provided in Table 5.2 and Table 5.3. Hydraulic design calculations are provided in Appendix C. The TROC conceptual design presented here applies to the unimproved portions of the TROC, south of the Great Western Railroad and County Road 36 (River Pass Road) crossings; north from this location, TROC channel improvements to not appear to be necessary to convey 100-year flows.

Table 5.2 Clark Channel Design Summary

Channel Section	Section Bottom Width (ft)	Top Width (ft)	Cumulative Depth (ft)	Cumulative Capacity (cfs)	Average Velocity (ft/sec)	Froude Number	Shear Stress (lb/sf)
10-yr	45’	65’	2.5’	298	2.2	0.26	0.42
100-yr	99.5’	121’	4.3’	1,269	3.8	0.40	0.72
Freeboard	121’	145’	6.3’	-	-	-	-
Slope	0.0027	ft/ft					

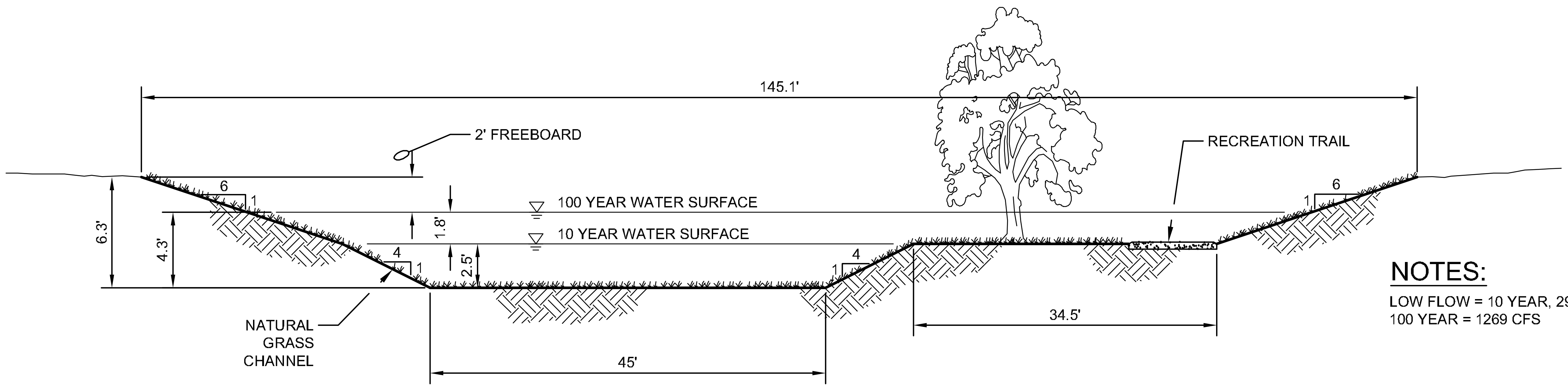
Table 5.3 Timnath Reservoir Outlet Canal - Channel Design Summary

Channel Section	Section Bottom Width (ft)	Top Width (ft)	Cumulative Depth (ft)	Cumulative Capacity (cfs)	Average Velocity (ft/sec)	Froude Number	Shear Stress (lb/sf)
200-cfs	16’	34’	3’	200	2.8	0.33	0.37
10-yr	79’	90’	4.4’	581	3.0	0.36	0.55
100-yr	140’	170’	6.9’	1,735	3.1	0.30	0.86
Freeboard	170’	194’	8.9’	-	-	-	-
Slope	0.0020	ft/ft					

In comparison with the conceptual channel cross sections from the 2005 study, the designs presented here roughly doubled the top-width of the proposed channels. The Clark channel top-width would increase from 75-feet for the 2005 study, to 145-feet; and the TROC channel would increase from 89-feet to 194-feet. The increase in channel sizes are a combination of several factors which are different from the previous study. These include increase in discharge, flatter channel slopes than assumed in the prior study, and increases in hydraulic roughness based on updated guidance from the UD-Channel spreadsheet. A detailed comparison of these parameters is provided with the channel sizing documentation in Appendix C.

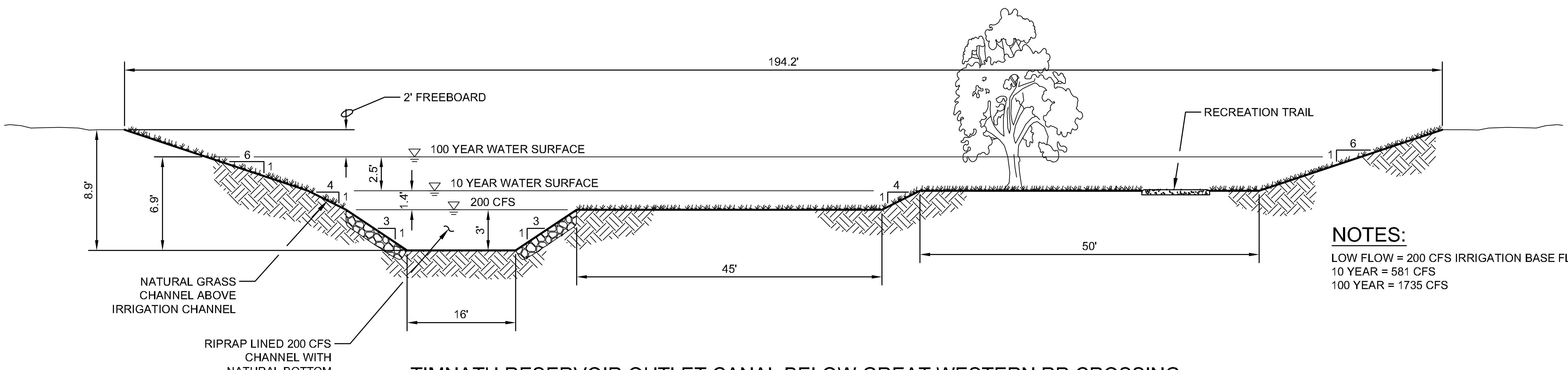
Major roadway crossings were not conceptually designed with this master plan update but will be needed in conjunction with the channel improvements. Multiple-opening reinforced concrete box culverts or clear span bridge sections should be evaluated for cost, conveyance, and aesthetic benefits at the time of final design, to determine size, specific location and other crossing details. Improved bridge or culvert crossings will be required at County Road 5, County Road 40, the Great Western Railroad, and County Road 36 (River Pass Road). Improvements have already been constructed at the Harmony Road and Summerfield Parkway crossings. The Harmony Road crossing consists of triple (3) 12 x 10-foot reinforced box culverts and was designed to convey approximately 1,600-cfs. The Summerfield Parkway crossing consists of a 12 x 6-foot and a 12 x 8-foot reinforced box culverts, which was assumed to convey approximately 1,700-cfs.

Full backwater analysis should be performed during the preliminary design of any future channel or crossing improvements to confirm channel geometry, hydraulic grade line, freeboard, crossing structure sizing, and adequate representation of all hydraulic controls. The conceptual designs presented here were based on an assumed slope and normal depth hydraulic conditions.



NOTES:
LOW FLOW = 10 YEAR, 298 CFS
100 YEAR = 1269 CFS

CLARK CHANNEL ABOVE TIMNATH RESERVOIR OUTLET CANAL (HARMONY)
NOT TO SCALE



NOTES:
LOW FLOW = 200 CFS IRRIGATION BASE FLOW
10 YEAR = 581 CFS
100 YEAR = 1735 CFS

TIMNATH RESERVOIR OUTLET CANAL BELOW GREAT WESTERN RR CROSSING
(NEAR CR-36/RIVER PASS ROAD)
NOT TO SCALE

Figure 5.1
Typical Cross Sections

AYRES ASSOCIATES

5.3. Downtown Area Improvement Alternatives

This alternatives evaluation reviewed the Downtown Timnath storm drain system, north of the Great Western Railroad, and proposed two future improvement options. These options consist of 100-year storm drain system improvements with two detention options for the Timnath Elementary School parcel. Both options include improvements the existing downtown regional detention pond, located just north of 5th Avenue and Kern Street, which would restrict 100-year future flows to the existing 10-year discharge rate.

5.3.1. Land Use and Imperviousness Assumptions

All future condition options used fully developed impervious levels based on the 2016 Timnath Future Land Use Plan. It should be noted that the future imperviousness assumptions for the downtown area are now roughly 70% - 80% impervious, (for Mixed-Use, Downtown Core and Commercial Mixed-Use areas), whereas the 2005 Drainage Master Plan had assumed 50% impervious for most of the Downtown area. It is understood that the current downtown storm drain system was designed for the 50% imperviousness, based on the previous master plan.

5.3.2. Timnath Elementary School Detention

Information from Town staff indicated that there is a possibility for the Timnath Elementary School parcel to re-develop in the future. This parcel and subbasin just north of Downtown Timnath presents an opportunity for future detention that would lower peak flow rates along Main Street and 5th Avenue. The evaluation considered two different detention options for this parcel.

The **Alternative 1** option assumed that this parcel would be required to provide over-detention of future 100-year flows to the existing 10-year rates, consistent with Timnath storm drainage criteria. The existing condition for the school parcel was estimated at 45% impervious, which corresponds to a 10-year release rate of 22-cfs. **Alternative 2** increased the over-detention requirement by basing the 10-year release rate on historic, not existing, imperviousness. The historic imperviousness was assumed to be 5%, which corresponds to the Alternative 2 release rate of 3-cfs.

5.3.3. Storm Drain Sizing Criteria - 100-Year Flows

The proposed storm pipes, along Main Street and 5th Avenue, were sized so that the residual 100-year surface flows would not exceed street capacity between the curb gutters (limited to 6-inch flow depth). The Main Street capacity was calculated to be 41-cfs and the 5th Avenue capacity was 26-cfs.

5.3.4. Recommended Improvements – Existing Condition Flows

The existing condition modeling shows that the 50- and 100-year rainfall events would cause street flooding (beyond the street capacity), along 5th Avenue, east of Main Street. The modeling also showed that the existing Main Street storm system is currently at capacity, including full use of street capacity. While the modeling showed that the existing storm system would benefit from improvements, it is recommended that further storm drainage improvements be based on the larger of existing or future flow rates.

5.3.5. Recommended Improvements – Future Flows

For this study, town staff directed that future development within the Downtown Core area may not be required to provide onsite detention if adequate improvements are completed and offsite detention is available. Further increase in imperviousness, without mitigation, in the downtown area will exacerbate current street flooding issues along Main Street and 5th Avenue. To mitigate the impacts of future development in the downtown area (north of the GWRR) it is recommended that either A) new development/ re-development install on-site detention to maintain current flow rates (or over-detention, per Timnath criteria); or B) installation of larger storm drainage infrastructure, based on this Master Plan, to accept the additional flows as presented in the list below and on Figure 5.2.

Both Future Alternatives scenarios resulted in the same future pipe sizes along 5th Avenue and Main Street. These recommended pipes sizes are presented in the following list:

- The existing 36-inch pipe in 5th Avenue should be replaced with a proposed 48-inch concrete pipe; this sizing assumes there will be future detention provided on the Timnath Elementary parcel. Without this detention, the proposed 5th Street pipe size would increase to 54-inches.
- The existing 24-inch pipe in Main Street, between East 5th Ave and West 5th Ave, should be replaced with a 36-inch concrete pipe.
- The existing 24-inch pipe in Main Street, south of W. 5th Avenue, appears to have sufficient capacity.
- The existing 18-inch storm pipe, between Timnath Elementary and E. 5th Avenue should be sufficient if future detention is implemented on the elementary school parcel.

Detention on Timnath Elementary School parcel would reduce the future 100-year subbasin discharge from 85-cfs (undetained) to 22-cfs for Alternative 1, or 3-cfs for Alternative 2. The corresponding detention volumes are 1.2 acre-feet and 2.3 acre-feet for Alternatives 1 and 2 respectively. The existing condition 100-year discharge is 53-cfs.

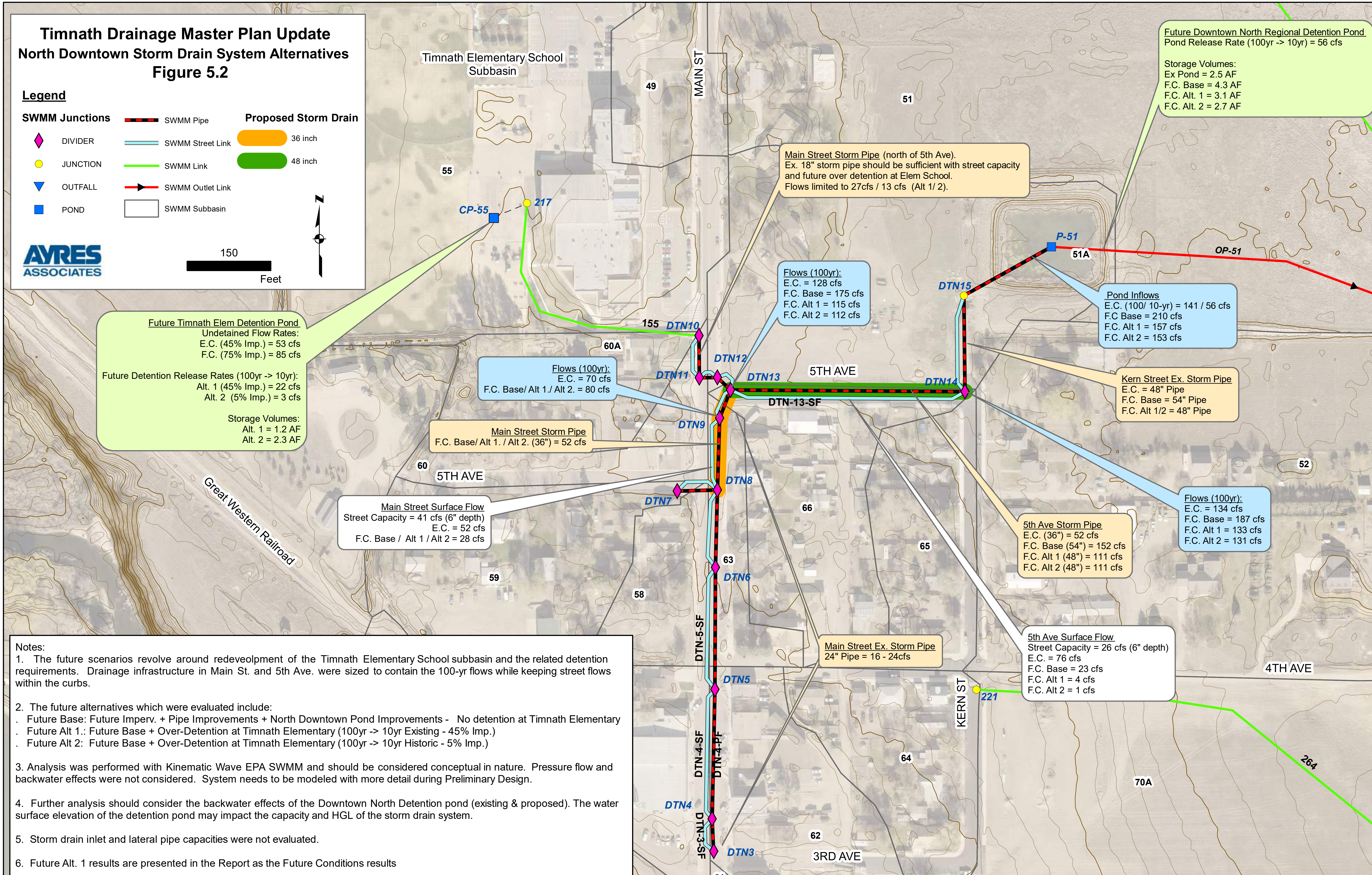
Improvements to formalize the temporary Downtown North retention pond, located at the north end of Kern Street, into permanent detention would need to restrict 100-year future flows to the existing 10-year discharge rate of 56-cfs. The existing 2.5-acre-foot pond would need to be enlarged to 4.3 acre-feet if no detention is implemented at Timnath Elementary, 3.1 acre-feet for Alternative 1, or 2.7 acre-feet for Alternative 2.

Figure 5.2 on the next page presents a map showing the master plan alternatives for Downtown Timnath. A detailed summary of the results is provided in Appendix D.

5.3.6. Limitations and Further Study Recommendations

This hydrology study was performed with Kinematic Wave routing in EPA SWMM and the future pipe size presented here should be considered conceptual in nature. Kinematic wave routing does not evaluate pressure flow or backwater effects. To confirm the proposed pipe sizing, it is recommended that the pipe system be modeled with more detail at the time of Preliminary/Final Design. This analysis should consider the backwater effects of the Downtown North detention pond (existing & proposed) to verify if water surface elevation of the pond impacts the capacity and hydraulic grade line of the storm drain system. Finally, storm drain inlets and lateral pipes were not evaluated with this study. It was assumed that the inlets and lateral pipes would have sufficient capacity and the main drainage pipe would be the most restrictive element.

Timnath Drainage Master Plan Update
North Downtown Storm Drain System Alternatives
Figure 5.2



Notes:

1. The future scenarios revolve around redeveolpment of the Timnath Elementary School subbasin and the related detention requirements. Drainage infrastructure in Main St. and 5th Ave. were sized to contain the 100-yr flows while keeping street flows within the curbs.

2. The future alternatives which were evaluated include:
- Future Base: Future Imperv. + Pipe Improvements + North Downtown Pond Improvements - No detention at Timnath Elementary
- Future Alt 1.: Future Base + Over-Detention at Timnath Elementary (100yr -> 10yr Existing - 45% Imp.)
- Future Alt 2: Future Base + Over-Detention at Timnath Elementary (100yr -> 10yr Historic - 5% Imp.)

3. Analysis was performed with Kinematic Wave EPA SWMM and should be considered conceptual in nature. Pressure flow and backwater effects were not considered. System needs to be modeled with more detail during Preliminary Design.

4. Further analysis should consider the backwater effects of the Downtown North Detention pond (existing & proposed). The water surface elevation of the detention pond may impact the capacity and HGL of the storm drain system.

5. Storm drain inlet and lateral pipe capacities were not evaluated.

6. Future Alt. 1 results are presented in the Report as the Future Conditions results

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Date: 8/21/2018

6. Hydraulic Evaluation of Greeley No. 2 Canal and Conceptual Spill Weir Design

In its present condition, the TROC discharges directly into the Greeley No. 2 canal. The Greeley No. 2 does not have capacity to contain large storm discharges from the TROC, and spills from the canal appear to occur in an informal and uncontrolled manner. The goals of this analysis were to document the capacity of the Greeley No. 2 canal and develop a conceptual spill weir design. This design would allow flows exceeding canal capacity to pass over the Greeley No. 2 and into the existing Poudre River floodplain.

6.1. Capacity Analysis

To analyze the capacity of the existing canal, an SRH-2D hydraulics model was constructed of the canal from the Poudre River head gate to County Road 32E. The capacity analysis was performed using a stepped hydrograph as the sole input in the canal model at the Poudre River head gate. Increasing flows were run through the model until spills were seen at multiple locations. Model monitor lines, placed immediately upstream of the identified spill locations, provided flow results for the maximum channel capacity in each reach. Two reaches for the Greeley No. 2 were defined: 1) Poudre head gate to the confluence with the TROC, and 2) confluence with TROC to County Road 32E. Upstream of the confluence the channel has a capacity of 830-cfs and downstream of the confluence the channel capacity is 740-cfs.

6.2. SRH-2D Hydraulic Model Parameters

Model input data for the SRH-2D hydraulic model included lidar topography data and hydraulic roughness (Mannings n) coverages. The manning n values used for this model were 0.03 for the channel, 0.025 for the spill weir, and 0.04 for the overbank areas.

6.3. Unsteady Hydraulics Analysis

In order to establish boundary conditions for the conceptual weir model, an unsteady SRH-2D model was run for 100-year existing conditions (existing condition TROC flows were 26% larger than future condition). In addition to the 100-year inflows, the Greeley No. 2 irrigation flow was added to the model. The maximum decree flow in the Greeley No. 2 is 650 cfs; for modeling purposes, this flow was assumed to be split between the Greeley No. 2 and the TROC, with 450-cfs at the Poudre River head gate and 200-cfs coming from the TROC. These irrigation flows were run through the model until the channel reached equilibrium, then 100-year storm hydrographs from the SWMM model were added. These SWMM hydrographs were obtained at two locations upstream of the TROC confluence and for the TROC flows. Results of the unsteady analysis show that the Greeley No. 2 peak flow, upstream of the TROC confluence, would be 513-cfs.

6.4. Conceptual Design of Spill Weir

After the unsteady 100-year model was completed, a shortened steady state model was developed to test multiple weir configurations. The steady state inflows were obtained from peak flows from the full-length Greeley No. 2 model and the Timnath SWMM hydrology model; these peak flows were 513-cfs in the Greeley No. 2 and 1,735-cfs in the TROC. An iterative approach was employed to analyze several different weir configurations in order to maximize weir efficiency.

The final and most effective configuration of the proposed weir design included a 1,300-foot spill weir on the southwestern bank of the Greeley No. 2 with a flow restriction structure across the canal immediately downstream of the proposed weir. A map showing this layout is presented in Appendix G.

For this configuration, the final 300 feet of the TROC would be re-aligned so that it would intersect the Greeley No. 2 at a right angle and directly facing the proposed spill weir on the opposite bank. The right bank of the re-aligned TROC was also lowered to help direct flows exceeding irrigation decree directly at the spill weir. The upstream limit of the proposed weir was approximately 200 feet upstream of the confluence with the re-aligned TROC and the downstream limit was just past the southeasterly bend of the No. 2. The elevation of the proposed weir was set at 0.10-feet above the 650-cfs WSEL (maximum decree flow). Additionally, it was necessary to place a flow restriction structure (such as a bridge) at the downstream end of the weir to limit flows above the irrigation flow rate and produce extra water depth over the weir crest. The low-chord elevation of this obstruction was set to match the water surface elevation of the 650-cfs decree flow. Results of this weir configuration, with the 100-year peak inflows, are that 1500-cfs would spill over the weir toward the Poudre River and 742-cfs would continue downstream in the Greeley No. 2.

6.4.1. Limitations and Further Study Recommendations

The intent of this model was to be conceptual in nature. Further analysis will be needed prior to final design. This model was built using lidar data only, with no survey of the channel invert. Water depth, below the lidar data, was assumed to be 3-feet and the lidar topography was modified to create an assumed channel cross section. It is recommended that this analysis be updated with bathymetric and ground survey along the Greeley No. 2 before proceeding with final design. Further, it is recommended that future modeling include other flow frequencies to produce discharge information for more frequent events. Last, the design and implementation of an outfall channel from the Greeley No. 2 canal to the Poudre River is also recommended.

7. Implementation Plan

There are a number of key components to the successful implementation of this Master Drainage Plan. They are contingent on suitable follow-up and administration by the Town staff and will often be the responsibility of developers and their engineers and planners to adhere to this plan. The requirements for implementation are listed by category in the following sections.

7.1. Regional Drainage Facilities

With the completion of improvements to eliminate the Boxelder Creek split flows, the Town is moving closer to officially removing the FEMA designated 100-year floodplain along the Clark Drainage and TROC flow paths, between Prospect Road and the Greeley No. 2 canal. The FEMA Letter of Determination for this flood map change has been issued, with the planned effective date of February 21, 2019.

7.1.1. Timnath Reservoir Inlet Canal (TRIC)

Currently the Timnath Reservoir Inlet Canal (TRIC) primarily serves to convey irrigation water from the Cache la Poudre River into Timnath Reservoir, however the TRIC also intercepts all surface runoff from areas tributary to the canal. This study identified canal spill locations for existing and future runoff scenarios, but did not evaluate alternatives, solutions for the spills, or define a floodplain. The analyses showed that the TRIC capacity is approximately 190-cfs, which is slightly less than the 200-cfs decreed flow; above 190-cfs spills will begin to the south and west of the canal. As-such, the TRIC does not have capacity to convey stormwater flows in addition to the base irrigation flow, without spills from the canal. Future over-detention in areas tributary to the TRIC will reduce, but not eliminate these spills.

The final SWMM hydrology model results showed that the existing and future 100-year storm WSELs in the Reservoir would be higher than portions of the TRIC embankment. In this event, potential backflows in the TRIC will be prevented with the inlet culvert one-way flap gates, however these maximum WSELs in the reservoir would prevent the TRIC from conveying any flows into the reservoir during a 100-year storm event.

This study discussed, but did not analyze, several storm water management options for the TRIC. These options include: (A) Disconnect stormwater discharges from TRIC; (B) Convey stormwater through the TRIC to formal spill location(s); (C) Convey stormwater through the TRIC (with improvements to handle additional flows) to Timnath Reservoir; and (D) Hydrology alternatives (more restrictive detention policy upstream of the TRIC). The dimensions and sizing of these TRIC channel improvements would require further hydraulic and hydrologic evaluation which were beyond the scope of this study. It is recommended that the Town pursue an alternatives analysis and quantitative evaluation of storm water alternatives for the TRIC.

7.1.2. Timnath Reservoir Outlet Canal (TROC)

Currently the Timnath Reservoir Outlet Canal (TROC) channel serves as the primary outfall channel for the vast majority of the Timnath watershed as the TROC is located along the low point of the valley and there are no other logical places for conveyance of stormwater flows. The owners of the TROC should be contacted to discuss an agreement for the operation of a combined irrigation and stormwater channel. Ayres recommends that the Town consider taking responsibility for the operation and maintenance of the TROC, as it would allow both aesthetic and regulatory control over the landscape, hydraulic operation, and inflows into the channel. In conjunction with this, is it recommended that the right-of-way necessary for the operation, maintenance and access to the TROC channel be deeded to the Town in the final development plat of adjacent future developments.

It is the recommendation of this Master Drainage Plan that the Clark Channel and ultimate TROC channel be designed and constructed in conjunction with adjacent development and/or prior to upstream development. The design of each channel section shall be continued at a preliminary level for approximately 500 feet upstream and downstream of the development to verify that an undue burden is not placed on adjacent landowners. The transitions at the upstream and downstream ends of the development project should be logical and reflective of existing conditions. Adequate measures would need to be designed to safely direct all upstream discharge into the designed channel. Also, the downstream channel hydraulics and geomorphology should be incorporated into the downstream transition.

Along the future Clark Channel, crossing improvements will be needed at County Road 5 and County Road 40. Discharges for these crossings were determined with this study, but crossing sizes were not evaluated.

Along the TROC, crossing improvements are needed at the Great Western Railroad and at County Road 36. The Great Western Railroad should be contacted regarding the needed culvert or bridge crossing improvements. The Town should consider partnering with the railroad company for the final design and construction of required major drainage crossings. For example, a railroad crossing could be designed at a preliminary level by the Town, but the final design and construction of the bridge crossing could be turned over to the railroad company. This has been previously successful for the City of Fort Collins.

The lower section of the TROC, south of the Great Western Railroad, is currently the most limited section in channel capacity and upgrades to this section should be considered a priority. This study presented a conceptual channel cross section for future improvements along this reach. In addition, the current outfall situation, into the Greeley No. 2 Canal, is insufficient and will require upgrades to divert storm flows above the canal capacity towards the Poudre River. Finally, there is presently no outfall channel from the Greeley No. 2 to the Poudre River. Analysis and scoping of this channel was not a component of this study but should be giving high priority.

7.2. On-Site Detention

On-site detention will be required for all future development to limit the 100-year developed discharges to the 10-year existing condition rate. This is an important criterion for several reasons: (1) on-site over-detention to the 10-year existing rate will help mitigate the increased volume of runoff coming from the development site; (2) the 100-year discharge to downstream receiving waters will be reduced, thus decreasing the required size for conveyance of major flood event; (3) the downstream receiving entities have requested this on-site detention; and (4) it is commensurate with the development requirements in the surrounding communities. Detention design must also meet the Town's 2-year design criteria, releasing the 2-year storm at the existing 2-year flow rate.

Each detention pond shall be designed in accordance with the Town Design Criteria Manual. Preference is given to EPA SWMM rainfall-runoff modeling for detention pond design, rather than the Rational-FAA Method. It is suggested that the recent UDFCD Full-Spectrum detention method may also be considered, as long as it can be shown that 10-year and 2-year flow rate requirements have been met. The Master Drainage Plan intentionally did not show the location of on-site detention ponds. The location, design, and sizing of each pond shall be left to the discretion of the land developer and Town review staff, so long as the required release criteria is met for the overall development project.

The detention pond volume and outlet-works construction shall be certified by a registered professional engineer, architect, or land-surveyor, to verify that the facility is in substantial conformance with the design plans. To aid in the development review and certification process, the designed water surface elevation, storage volume and spillway design information should be readily visible on the construction drawings.

It is the policy of the Town that all on-site detention ponds be maintained by a property owner's association. However, it is recommended that the Town develop a detention pond inspection and enforcement program; this would help owners associations with issues related to their detention facilities and ensure the Town and community that these facilities remain functional as designed.

Areas that are directly tributary to the Cache la Poudre River and not tributary to the Greeley No. 2 Canal or the Town of Windsor watershed, on-site detention is not required for major and minor storms. However, the developer/ engineering must demonstrate that stormwater flows can be safely conveyed to the river in a non-erosive manner. Water quality detention and/or other best management practices are always required and are critical to maintain the health and stability of the receiving waterways.

7.3. Minor Lateral Drainage Facilities

It is the responsibility of land developers to convey existing condition upstream flows through their development property. As land development proceeds upstream, the channels will then be oversized, but will not present a flooding risk in the interim.

Land developers must convey their developed condition project flows downstream to an appropriate outfall location. The developed condition discharge may also include any upstream undeveloped and undetained historic flows. Appropriately sized engineered channels, with necessary road or canal crossings and easement acquisition, are the preferred method of conveyance. The use of flowage or floodplain easements as drainage solutions are discouraged.

7.4. Downtown Drainage Improvements

Recommended drainage improvements within the north Downtown area (north of GWRR) have been identified for both existing and future drainage conditions. These improvements are intended to keep 100-year street flooding within the street curb gutters and consist of replacing the existing 24- to 36-inch storm drain — between the Main Street / 5th Avenue (south) intersection and then to the Downtown North detention pond — with a 36- to 48/54-inch storm drain system (size depending on detention scenario). Improvements are also recommended for the Downtown North detention pond, so that outflows are restricted to the existing 10-year discharge. Last, if the Timnath Elementary School parcel is re-developed in the future, it is recommended that new development be required to provide over-detention of future 100-year flows. This detention release rate, at the discretion of the Town, may be based on either the existing or historic 10-year flow rates. Detention storage on this site will reduce the size of the proposed 5th Avenue storm drain pipe from 54-inches to 48-inches.

Town staff directed that future development within the Downtown Core area may not be required to provide onsite detention; this was reflected in the future conditions hydrology modeling. However, the existing condition hydrology model shows that, along 5th Avenue east of Main Street, the 50- and 100-year rainfall events would cause street flooding beyond street capacity. The modeling also showed that the existing Main Street storm system is currently at capacity (including use of street flow capacity, between the curbs). Allowing further imperviousness increases in the downtown area will exacerbate current street flooding issues along Main Street and 5th Avenue. To mitigate the impacts of future development in the downtown area (north of the GWRR) it is recommended that either A) new development/ re-development install detention to maintain current flow rates (or over-detention, per criteria); or B) the installation of larger storm drainage infrastructure in the north Downtown area, based on this Master Plan, to accept the additional runoff (see Figure 5.2).

To confirm the conceptual pipe sizing, proposed with this master plan, it is recommended that the pipe system be modeled with more detail at the time of Preliminary/Final Design. This analysis should consider the backwater effects of the Downtown North detention pond (existing & proposed) to verify if water surface elevation of the pond impacts the capacity and hydraulic grade line of the storm drain system. The current master planning analysis was based on kinematic wave routing and could not evaluate backwater or pressure conditions.

7.5. Timnath Reservoir

Timnath Reservoir was constructed primarily for the purpose of water storage, but also provides significant benefit for the detention of stormwater runoff. The existing condition 100-year inflow discharge is approximately 7,100 cfs and the release through the service spillway is approximately 120-cfs, with an additional 200-cfs of base flow through the primary gated outlet. The Town does not currently have an agreement with the owner of the reservoir that formalizes this storage. It is recommended that the Town form an agreement with the reservoir company to formalize the permanent storage of stormwater in Timnath Reservoir.

In the unlikely event that Timnath Reservoir is ever removed, and the valley returned to its natural state, it is critical that the storm detention storage be replaced. In the existing condition, the active storm storage for the 100-year event is approximately 1,220 acre-feet (and 1,480 acre-feet for future conditions). It is recommended that a portion of the dam embankment be retained, or otherwise replaced, so that the outflowing discharge would never exceed the existing condition discharge with the reservoir in place.

7.6. Further Study Recommendations

This study identified several areas that would benefit from further investigation, analysis, and alternative scoping. It is it is recommended that the Town pursue further study of the following items:

1. Timnath Reservoir Inlet Canal: Stormwater management alternatives analysis and conceptual design.
2. Serratoga Falls drainage area: Detailed study and alternatives recommendations.
3. Downtown storm drain system and north Downtown regional detention: Preliminary design and detailed analysis of future improvements.
4. Timnath Reservoir Outlet Canal and Greeley No. 2 Canal Outfall: Alternatives and conceptual design.

8. References

Ayres Associates. (2005). *Town of Timnath Master Drainage Plan.*

Environmental Protection Agency (EPA). (2017, March 30). Storm Water Managment Model (SWMM), version 5.1.012.

Fuhrman, E. (2017, September 13). Timnath Reservoir Inlet Gates Photo.

Town of Timnath. (2016). *Design Criteria Manual.*

Urban Drainage and Flood Control Disctrict (UDFCD). (2016). *Urban Storm Drainage Criteria Manual (USDCM): Vol 1-3.* Denver, CO.

US Bureau of Reclamation (USBR). (2014, May). Sedimentation and River Hydraulics - Two Dimensional Model (SRH-2D), version 3.1.1. *Pre- and post-processing performed in Aqua Veo - Surface Water Modeling System (SMS) v.12.2.9*.

Appendix A

Baseline Condition Hydrology

Maps:

1) A-1 – Existing Basin Map – North
2) A-2 – Existing Basin Map – South
3) A-3 – Existing Routing Map – North
4) A-4 – Existing Routing Map – South
5) A-5 – Existing Downtown SWMM Map
6) A-6 – Existing Overall SWMM Map

Tables:

1) A-1 – SWMM Subbasin Parameters – Existing Conditions
2) A-2 – SWMM Routing Link Shapes
3) A-3 – Summary of Detention Pond Storage and Outlet Ratings
4) A-4 – Timnath Reservoir Storage and Outlet Ratings
5) A-5 – SWMM Results – Links
6) A-6 – SWMM Results – Nodes
7) A-7 – SWMM Results – Subbasins
8) A-8 – Summary and Comparison of Results

EXHIBIT A-1 - SWMM Subbasin Map
Baseline Condition - North Map

Timnath Drainage Master Plan 2018 Update

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppA_Existing\A-2 - EX_BasinMap_South.mxd - Plot By: SimpsonM - Date: 8/21/2018

EXHIBIT A-3 - SWMM Routing Map
Baseline Condition - North Map
Timnath Drainage Master Plan 2018 Update

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppA_Existing\A-3 - EX_RoutingMap_North.mxd - Plot By: SimpsonM - Date: 8/21/2018

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppA_Existing\A-4 - EX_RoutingMap_South.mxd - Plot By: SimpsonM - Date: 8/21/2018

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppA_Existing\A-5 - EX_Downtown_SWMM.mxd - Plot By: SimpsonM - Date: 8/21/2018

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppA_Existing\A-6 - EX_SWMM_TimnathRes.mxd - Plot By: SimpsonM - Date: 8/21/2018

Table A-1 - SWMM Subbasin Parameters - Existing Condition

[SUBCATCHMENTS] **Existing Condition**

;;Name	RainGage	Outlet	Area	Exist %Imperv	Width	%Slope	CurbLen	SnowPack	FlowLength
2	RG1	53	67.09	2	5845	0.64	0		500
3	RG1	54	36.68	5	3196	0.4	0		500
4	RG1	117	32.45	20	2827	0.41	0		500
5	RG1	129	82.16	2	7158	0.4	0		500
6	RG1	133	8.54	2	744	0.4	0		500
7	RG1	132	31.57	20	2750	0.57	0		500
8	RG1	134	197.45	5	17202	0.4	0		500
9	RG1	500	142.96	5	12455	0.47	0		500
10	RG1	138	115.38	12	10052	0.44	0		500
11	RG1	142	36.46	2	3176	0.4	0		500
12	RG1	143	41.68	5	3631	0.87	0		500
13	RG1	LAKECANAL2	26.3	20	3819	0.57	0		300
14	RG1	146	102.97	2	8971	0.43	0		500
15	RG1	149	86.87	5	7568	0.76	0		500
16	RG1	LAKECANAL3	42.8	25	6235	0.44	0		299
17	RG1	153	37.16	2	5396	0.51	0		300
18	RG1	156	76.37	2	6653	0.56	0		500
20	RG1	159	36.41	12	3172	0.76	0		500
21	RG1	162	54.43	12	4742	0.4	0		500
22	RG1	164	47.17	20	7110	1.8	0		289
23	RG1	165	7.37	30	642	0.54	0		500
24	RG1	166	21.36	15	3101	1.86	0		300
25	RG1	P-25	36.96	15	3220	0.65	0		500
26	RG1	169	33.5	10	2919	0.55	0		500
27	RG1	170	33.05	20	2879	0.43	0		500
28	RG1	173	35.06	20	3054	1.73	0		500
29	RG1	P-29	22.18	20	1932	2.48	0		500
30	RG1	177	9.32	5	1720	1.18	0		236
31	RG1	P-31	45.38	25	4707	2.57	0		420
32	RG1	LAKECANAL4	56.49	20	8202	0.57	0		300
33	RG1	179	10.33	12	1125	0.6	0		400
34	RG1	180	44.49	10	3876	1.75	0		500
35	RG1	182	81.61	5	7110	1.5	0		500
37	RG1	187	117.18	5	10209	0.4	0		500
38	RG1	186	66.39	5	5784	0.4	0		500
39	RG1	TRIC6	47.66	5	4152	3	0		500
43	RG1	193	107.04	5	9325	1	0		500
44	RG1	LAKECANAL8	20.16	5	4391	5.8	0		200
45	RG1	199	65.97	2	5747	1.57	0		500
46	RG1	201	56.24	12	4900	0.4	0		500
47	RG1	LAKECANAL9	19.4	5	4225	6.64	0		200
48	RG1	204	84.49	5	7361	0.46	0		500
49	RG1	207	32.41	12	3529	0.44	0		400
50	RG1	P-50	5.78	50	3187	0.72	0		79
51	RG1	213	20.68	10	1802	0.71	0		500
52	RG1	216	14.31	20	2078	0.52	0		300
55	RG1	217	10.68	45	1551	0.4	0		300
57	RG1	DTN4	2.69	80	391	0.43	0		300
58	RG1	DTN6	1.11	50	322	1.15	0		150
59	RG1	DTN7	3.22	50	712	0.81	0		197
60	RG1	DTN7	1.38	50	707	0.86	0		85
61	RG1	220	2.51	40	547	0.66	0		200
62	RG1	DTN3	2.53	70	841	0.4	0		131
63	RG1	DTN6	0.91	50	551	0.73	0		72
64	RG1	221	2.17	50	722	1.56	0		131
65	RG1	DTN14	1.94	50	397	1.15	0		213
66	RG1	DTN13	2.72	50	601	1.31	0		197
67	RG1	223	30.08	2	2621	0.45	0		500
68	RG1	225	50.77	2	4423	0.49	0		500
69	RG1	229	40.03	2	3487	0.58	0		500
70	RG1	230	55.26	2	4814	0.4	0		500
71	RG1	LAKECANAL11	16.84	5	1467	3.69	0		500
72	RG1	234	88.1	2	7675	1.47	0		500
73	RG1	238	159.21	2	13870	0.4	0		500
74	RG1	LAKECANAL18	31.57	20	4584	3.24	0		300
75	RG1	P-75	33.51	30	4866	0.86	0		300
76	RG1	250	79.02	5	11474	1.98	0		300
77	RG1	252	77.02	15	6710	2.04	0		500
78	RG1	LAKECANAL12	72.45	5	10520	3.72	0		300
79	RG1	TROC_1A	28.16	5	4089	1.29	0		300
80	RG1	P-80	7.7	15	1280	3.6	0		262
81	RG1	P-81	44.6	25	6476	2.05	0		300
82	RG1	LAKECANAL16	20.67	30	4570	2.95	0		197
83	RG1	276	72.31	5	6300	1.13	0		500

[SUBAREAS]

;;Subcatchment	N-Imperv	N-Perv	S-Imperv	S-Perv	PctZero	RouteTo	PctRouted
2	0.016	0.25	0.1	0.35	0	OUTLET	
3	0.016	0.25	0.1	0.35	0	OUTLET	
4	0.016	0.25	0.1	0.35	0	OUTLET	
5	0.016	0.25	0.1	0.35	0	OUTLET	
6	0.016	0.25	0.1	0.35	0	OUTLET	
7	0.016	0.25	0.1	0.35	0	OUTLET	
8	0.016	0.25	0.1	0.35	0	OUTLET	
9	0.016	0.25	0.1	0.35	0	OUTLET	
10	0.016	0.25	0.1	0.35	0	OUTLET	
11	0.016	0.25	0.1	0.35	0	OUTLET	
12	0.016	0.25	0.1	0.35	0	OUTLET	
13	0.016	0.25	0.1	0.35	0	OUTLET	
14	0.016	0.25	0.1	0.35	0	OUTLET	
15	0.016	0.25	0.1	0.35	0	OUTLET	
16	0.016	0.25	0.1	0.35	0	OUTLET	
17	0.016	0.25	0.1	0.35	0	OUTLET	
18	0.016	0.25	0.1	0.35	0	OUTLET	
20	0.016	0.25	0.1	0.35	0	OUTLET	
21	0.016	0.25	0.1	0.35	0	OUTLET	
22	0.016	0.25	0.1	0.35	0	OUTLET	
23	0.016	0.25	0.1	0.35	0	OUTLET	
24	0.016	0.25	0.1	0.35	0	OUTLET	
25	0.016	0.25	0.1	0.35	0	OUTLET	
26	0.016	0.25	0.1	0.35	0	OUTLET	
27	0.016	0.25	0.1	0.35	0	OUTLET	
28	0.016	0.25	0.1	0.35	0	OUTLET	
29	0.016	0.25	0.1	0.35	0	OUTLET	
30	0.016	0.25	0.1	0.35	0	OUTLET	
31	0.016	0.25	0.1	0.35	0	OUTLET	
32	0.016	0.25	0.1	0.35	0	OUTLET	
33	0.016	0.25	0.1	0.35	0	OUTLET	
34	0.016	0.25	0.1	0.35	0	OUTLET	
35	0.016	0.25	0.1	0.35	0	OUTLET	
37	0.016	0.25	0.1	0.35	0	OUTLET	
38	0.016	0.25	0.1	0.35	0	OUTLET	
39	0.016	0.25	0.1	0.35	0	OUTLET	
43	0.016	0.25	0.1	0.35	0	OUTLET	
44	0.016	0.25	0.1	0.35	0	OUTLET	
45	0.016	0.25	0.1	0.35	0	OUTLET	
46	0.016	0.25	0.1	0.35	0	OUTLET	
47	0.016	0.25	0.1	0.35	0	OUTLET	
48	0.016	0.25	0.1	0.35	0	OUTLET	
49	0.016	0.25	0.1	0.35	0	OUTLET	
50	0.016	0.25	0.1	0.35	0	OUTLET	
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52	0.016	0.25	0.1	0.35	0	OUTLET	
55	0.016	0.25	0.1	0.35	0	OUTLET	
57	0.016	0.25	0.1	0.35	0	OUTLET	
58	0.016	0.25	0.1	0.35	0	OUTLET	
59	0.016	0.25	0.1	0.35	0	OUTLET	
60	0.016	0.25	0.1	0.35	0	OUTLET	
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74	0.016	0.25	0.1	0.35	0	OUTLET	
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77	0.016	0.25	0.1	0.35	0	OUTLET	
78	0.016	0.25	0.1	0.35	0	OUTLET	
79	0.016	0.25	0.1	0.35	0	OUTLET	
80	0.016	0.25	0.1	0.35	0	OUTLET	
81	0.016	0.25	0.1	0.35	0	OUTLET	
82	0.016	0.25	0.1	0.35	0	OUTLET	
83	0.016	0.25	0.1	0.35	0	OUTLET	

[INFILTRATION]

;;Subcatchment	MaxRate	MinRate	Decay	DryTime	MaxInfil
2	4.5	0.6	6.48	7	0
3	4.05	0.57	6.48	7	0
4	4.43	0.6	6.48	7	0
5	3.38	0.53	6.48	7	0
6	3	0.5	6.48	7	0
7	3.38	0.53	6.48	7	0
8	3.9	0.56	6.48	7	0
9	4.13	0.58	6.48	7	0
10	4.43	0.6	6.48	7	0
11	4.35	0.59	6.48	7	0
12	4.5	0.6	6.48	7	0
13	3.45	0.53	6.48	7	0
14	4.35	0.59	6.48	7	0
15	3.9	0.56	6.48	7	0
16	3.98	0.57	6.48	7	0
17	4.28	0.59	6.48	7	0
18	4.43	0.6	6.48	7	0
20	4.5	0.6	6.48	7	0
21	4.5	0.6	6.48	7	0
22	4.2	0.58	6.48	7	0
23	4.5	0.6	6.48	7	0
24	4.28	0.59	6.48	7	0
25	4.28	0.59	6.48	7	0
26	4.5	0.6	6.48	7	0
27	4.5	0.6	6.48	7	0
28	4.43	0.6	6.48	7	0
29	4.5	0.6	6.48	7	0
30	4.35	0.59	6.48	7	0
31	3.75	0.55	6.48	7	0
32	4.5	0.6	6.48	7	0
33	4.5	0.6	6.48	7	0
34	3	0.5	6.48	7	0
35	3.15	0.51	6.48	7	0
37	4.5	0.6	6.48	7	0
38	4.5	0.6	6.48	7	0
39	3.9	0.56	6.48	7	0
43	4.35	0.59	6.48	7	0
44	3.68	0.55	6.48	7	0
45	3.9	0.56	6.48	7	0
46	3.98	0.57	6.48	7	0
47	4.5	0.6	6.48	7	0
48	4.13	0.58	6.48	7	0
49	4.5	0.6	6.48	7	0
50	4.5	0.6	6.48	7	0
51	4.5	0.6	6.48	7	0
52	4.2	0.58	6.48	7	0
55	4.5	0.6	6.48	7	0
57	4.5	0.6	6.48	7	0
58	4.5	0.6	6.48	7	0
59	4.5	0.6	6.48	7	0
60	4.5	0.6	6.48	7	0
61	4.5	0.6	6.48	7	0
62	4.5	0.6	6.48	7	0
63	4.5	0.6	6.48	7	0
64	4.5	0.6	6.48	7	0
65	4.5	0.6	6.48	7	0
66	4.5	0.6	6.48	7	0
67	4.2	0.58	6.48	7	0
68	3.53	0.54	6.48	7	0
69	4.5	0.6	6.48	7	0
70	4.35	0.59	6.48	7	0
71	4.5	0.6	6.48	7	0
72	3.38	0.53	6.48	7	0
73	3.53	0.54	6.48	7	0
74	4.35	0.59	6.48	7	0
75	3.75	0.55	6.48	7	0
76	4.2	0.58	6.48	7	0
77	3.38	0.53	6.48	7	0
78	4.28	0.59	6.48	7	0
79	3.68	0.55	6.48	7	0
80	3.3	0.52	6.48	7	0
81	3.75	0.55	6.48	7	0
82	4.5	0.6	6.48	7	0
83	3.83	0.56	6.48	7	0

Table A-1 - SWMM Subbasin Parameters - Existing Condition

[SUBCATCHMENTS] **Existing Condition**

;;Name	RainGage	Outlet	Area	Exist %Imperv	Width	%Slope	CurbLen	SnowPack	FlowLength
84	RG1	279	48.61	25	18413	2.26	0		115
85	RG1	283	140.74	5	12261	0.4	0		500
86	RG1	296	67.54	30	5884	1.96	0		500
87	RG1	LAKECANAL21	15.89	2	2814	3.28	0		246
88	RG1	303	98.14	35	14250	0.84	0		300
89	RG1	LAKECANAL22	13.7	2	1194	2.3	0		500
90	RG1	J-90	51.03	2	4446	0.98	0		500
91	RG1	307	16.99	5	2467	0.4	0		300
92	RG1	P-92	28.41	10	5031	1.31	0		246
93	RG1	310	98.93	2	8619	0.4	0		500
94	RG1	312	72.39	2	6307	0.4	0		500
95	RG1	P-95	61.22	45	20357	0.51	0		131
96	RG1	TROC9	11.7	10	5201	3.73	0		98
97	RG1	317	60.76	35	27007	0.52	0		98
98	RG1	321	76.4	30	11093	0.8	0		300
99	RG1	324	20.26	2	1765	0.63	0		500
100	RG1	TROC12	43.64	5	3802	0.79	0		500
101	RG1	327	83.24	2	7252	0.54	0		500
102	RG1	328	38.8	5	3380	0.89	0		500
103	RG1	P-103	25.42	45	3691	0.86	0		300
104	RG1	P-104	62.48	50	20776	0.47	0		131
105	RG1	P-105	42.19	30	3676	0.5	0		500
106	RG1	501	24.5	10	5010	0.5	0		213
107	RG1	P-107	57	40	15140	0.54	0		164
108	RG1	G3-2_A	17.25	10	2505	0.5	0		300
109	RG1	346	30.78	10	2682	0.4	0		500
110	RG1	P-110	26.68	6	2324	0.73	0		500
112	RG1	DTS5	1.21	50	703	1.4	0		75
114	RG1	352	4.05	40	896	1.4	0		197
119	RG1	351	3.89	50	1130	1.43	0		150
120	RG1	P-120	1225.46	52	53381	1	0		1000
121	RG1	190	2570.35	10	111964	1	0		1000
122	RG1	189	742.59	2	32347	1	0		1000
123	RG1	185	697.3	2	30374	1	0		1000
124	RG1	184	1625.8	2	70820	1	0		1000
125	RG1	178	1047.36	15	45623	1	0		1000
126	RG1	176	3422.54	10	149086	1	0		1000
130	RG1	360	2.4	50	1045	1.05	0		100
100A	RG1	TROC13	43.69	5	3806	0.5	0		500
103A	RG1	P-103A	20.78	45	3902	1.27	0		232
103B	RG1	330	5.26	45	2291	1.5	0		100
103C	RG1	P-103C	16.11	45	2395	1.96	0		293
103D	RG1	P-103D1	17.66	45	8547	1.03	0		90
106A	RG1	342	103.01	35	8974	0.5	0		500
107A	RG1	341	14.59	45	6908	0.73	0		92
108A	RG1	335	7.86	5	1141	0.5	0		300
111A	RG1	DTS3	1.68	50	523	1.05	0		140
111B	RG1	349	5.52	50	874	1.05	0		275
113A	RG1	DTS2	4.51	10	786	0.91	0		250
113B	RG1	350	2.8	70	488	0.91	0		250
15A	RG1	151	43.24	3	3767	0.61	0		500
21A	RG1	140	76.57	2	6671	0.4	0		500
25A	RG1	P-25	17.14	10	1493	0.68	0		500
43A	RG1	196	40.52	5	3530	1.04	0		500
47A	RG1	LAKECANAL10	22.53	5	1963	4.25	0		500
4A	RG1	P-4A	30.17	70	4395	0.4	0		299
50A	RG1	P-50A	7.14	50	3174	0.47	0		98
51A	RG1	P-51	5.81	5	844	0.71	0		300
5A	RG1	127	33.35	15	4842	0.55	0		300
60A	RG1	DTN10	1.67	50	428	0.4	0		170
70A	RG1	231	30.29	2	2639	0.4	0		500
72A	RG1	P-80	4.9	10	427	2.71	0		500
75A	RG1	243	23.78	30	3464	1.33	0		299
75B	RG1	LAKECANAL19	27.14	10	3941	3.78	0		300
75C	RG1	248	8.43	5	1224	1.73	0		300
75D	RG1	P-75D	3.32	5	699	5.93	0		207
77A	RG1	254	2.31	10	875	1.56	0		115
77B	RG1	P-77B	1.87	10	529	3.07	0		154
77C	RG1	P-77C	9.31	25	3526	5.76	0		115
77D	RG1	P-77D	27.4	30	4852	2.52	0		246
80A	RG1	TROC2	4.01	10	1713	2.92	0		102
80B	RG1	TROC2	1.39	10	561	4	0		108
80C	RG1	TROC3	10.45	10	1979	3.58	0		230
80D	RG1	P-80D	9.66	10	3366	2.41	0		125

[SUBAREAS]

;;Subcatchment	N-Imperv	N-Perv	S-Imperv	S-Perv	PctZero	RouteTo	PctRouted
84	0.016	0.25	0.1	0.35	0	OUTLET	
85	0.016	0.25	0.1	0.35	0	OUTLET	
86	0.016	0.25	0.1	0.35	0	OUTLET	
87	0.016	0.25	0.1	0.35	0	OUTLET	
88	0.016	0.25	0.1	0.35	0	OUTLET	
89	0.016	0.25	0.1	0.35	0	OUTLET	
90	0.016	0.25	0.1	0.35	0	OUTLET	
91	0.016	0.25	0.1	0.35	0	OUTLET	
92	0.016	0.25	0.1	0.35	0	OUTLET	
93	0.016	0.25	0.1	0.35	0	OUTLET	
94	0.016	0.25	0.1	0.35	0	OUTLET	
95	0.016	0.25	0.1	0.35	0	OUTLET	
96	0.016	0.25	0.1	0.35	0	OUTLET	
97	0.016	0.25	0.1	0.35	0	OUTLET	
98	0.016	0.25	0.1	0.35	0	OUTLET	
99	0.016	0.25	0.1	0.35	0	OUTLET	
100	0.016	0.25	0.1	0.35	0	OUTLET	
101	0.016	0.25	0.1	0.35	0	OUTLET	
102	0.016	0.25	0.1	0.35	0	OUTLET	
103	0.016	0.25	0.1	0.35	0	OUTLET	
104	0.016	0.25	0.1	0.35	0	OUTLET	
105	0.016	0.25	0.1	0.35	0	OUTLET	
106	0.016	0.25	0.1	0.35	0	OUTLET	
107	0.016	0.25	0.1	0.35	0	OUTLET	
108	0.016	0.25	0.1	0.35	0	OUTLET	
109	0.016	0.25	0.1	0.35	0	OUTLET	
110	0.016	0.25	0.1	0.35	0	OUTLET	
112	0.016	0.25	0.1	0.35	0	OUTLET	
114	0.016	0.25	0.1	0.35	0	OUTLET	
119	0.016	0.25	0.1	0.35	0	OUTLET	
120	0.016	0.25	0.1	0.35	0	OUTLET	
121	0.016	0.25	0.1	0.35	0	OUTLET	
122	0.016	0.25	0.1	0.35	0	OUTLET	
123	0.016	0.25	0.1	0.35	0	OUTLET	
124	0.016	0.25	0.1	0.35	0	OUTLET	
125	0.016	0.25	0.1	0.35	0	OUTLET	
126	0.016	0.25	0.1	0.35	0	OUTLET	
130	0.016	0.25	0.1	0.35	0	OUTLET	
100A	0.016	0.25	0.1	0.35	0	OUTLET	
103A	0.016	0.25	0.1	0.35	0	OUTLET	
103B	0.016	0.25	0.1	0.35	0	OUTLET	
103C	0.016	0.25	0.1	0.35	0	OUTLET	
103D	0.016	0.25	0.1	0.35	0	OUTLET	
106A	0.016	0.25	0.1	0.35	0	OUTLET	
107A	0.016	0.25	0.1	0.35	0	OUTLET	
108A	0.016	0.25	0.1	0.35	0	OUTLET	
111A	0.016	0.25	0.1	0.35	0	OUTLET	
111B	0.016	0.25	0.1	0.35	0	OUTLET	
113A	0.016	0.25	0.1	0.35	0	OUTLET	
113B	0.016	0.25	0.1	0.35	0	OUTLET	
15A	0.016	0.25	0.1	0.35	0	OUTLET	
21A	0.016	0.25	0.1	0.35	0	OUTLET	
25A	0.016	0.25	0.1	0.35	0	OUTLET	
43A	0.016	0.25	0.1	0.35	0	OUTLET	
47A	0.016	0.25	0.1	0.35	0	OUTLET	
4A	0.016	0.25	0.1	0.35	0	OUTLET	
50A	0.016	0.25	0.1	0.35	0	OUTLET	
51A	0.016	0.25	0.1	0.35	0	OUTLET	
5A	0.016	0.25	0.1	0.35	0	OUTLET	
60A	0.016	0.25	0.1	0.35	0	OUTLET	
70A	0.016	0.25	0.1	0.35	0	OUTLET	
72A	0.016	0.25	0.1	0.35	0	OUTLET	
75A	0.016	0.25	0.1	0.35	0	OUTLET	
75B	0.016	0.25	0.1	0.35	0	OUTLET	
75C	0.016	0.25	0.1	0.35	0	OUTLET	
75D	0.016	0.25	0.1	0.35	0	OUTLET	
77A	0.016	0.25	0.1	0.35	0	OUTLET	
77B	0.016	0.25	0.1	0.35	0	OUTLET	
77C	0.016	0.25	0.1	0.35	0	OUTLET	
77D	0.016	0.25	0.1	0.35	0	OUTLET	
80A	0.016	0.25	0.1	0.35	0	OUTLET	
80B	0.016	0.25	0.1	0.35	0	OUTLET	
80C	0.016	0.25	0.1	0.35	0	OUTLET	
80D	0.016	0.25	0.1	0.35	0	OUTLET	

[INFILTRATION]

;;Subcatchment	MaxRate	MinRate	Decay	DryTime	MaxInfil
84	4.5	0.6	6.48	7	0
85	4.5	0.6	6.48	7	0
86	4.5	0.6	6.48	7	0
87	4.5	0.6	6.48	7	0
88	4.2	0.58	6.48	7	0
89	4.5	0.6	6.48	7	0
90	4.5	0.6	6.48	7	0
91	4.43	0.6	6.48	7	0
92	4.35	0.59	6.48	7	0
93	4.5	0.6	6.48	7	0
94	4.5	0.6	6.48	7	0
95	4.5	0.6	6.48	7	0
96	4.5	0.6	6.48	7	0
97	4.5	0.6	6.48	7	0
98	3.83	0.56	6.48	7	0
99	3.75	0.55	6.48	7	0
100	4.13	0.58	6.48	7	0
101	4.35	0.59	6.48	7	0
102	4.5	0.6	6.48	7	0
103	4.5	0.6	6.48	7	0
104	4.28	0.59	6.48	7	0
105	4.2	0.58	6.48	7	0
106	3.75	0.55	6.48	7	0
107	4.2	0.58	6.48	7	0
108	4.2	0.58	6.48	7	0
109	4.2	0.58	6.48	7	0
110	4.5	0.6	6.48	7	0
112	4.5	0.6	6.48	7	0
114	4.5	0.6	6.48	7	0
119	4.5	0.6	6.48	7	0
120	4.2	0.58	6.48	7	0
121	4.2	0.58	6.48	7	0
122	4.2	0.58	6.48	7	0
123	4.2	0.58	6.48	7	0
124	4.2	0.58	6.48	7	0
125	4.2	0.58	6.48	7	0
126	4.2	0.58	6.48	7	0
130	4.5	0.6	6.48	7	0
100A	4.2	0.58	6.48	7	0
103A	4.2	0.58	6.48	7	0
103B	4.2	0.58	6.48	7	0
103C	4.2	0.58	6.48	7	0
103D	4.2	0.58	6.48	7	0
106A	4.2	0.58	6.48	7	0
107A	4.2	0.58	6.48	7	0
108A	4.2	0.58	6.48	7	0
111A	4.5	0.6	6.48	7	0
111B	4.5	0.6	6.48	7	0
113A	4.5	0.6	6.48	7	0
113B	4.5	0.6	6.48	7	0
15A	4.2	0.58	6.48	7	0
21A	4.35	0.59	6.48	7	0
25A	4.2	0.58	6.48	7	0
43A	4.2	0.58	6.48	7	0
47A	4.2	0.58	6.48	7	0
4A	4.2	0.58	6.48	7	0
50A	4.2	0.58	6.48	7	0
51A	4.5	0.6	6.48	7	0
5A	4.2	0.58	6.48	7	0
60A	4.5	0.6	6.48	7	0
70A	4.35	0.59	6.48	7	0
72A	4.2	0.58	6.48	7	0
75A	4.2	0.58	6.48	7	0
75B	4.2	0.58	6.48	7	0
75C	4.2	0.58	6.48	7	0
75D	4.2	0.58	6.48	7	0
77A	4.2	0.58	6.48	7	0
77B	4.2	0.58	6.48	7	0
77C	4.2	0.58	6.48	7	0
77D	4.2	0.58	6.48	7	0
80A	4.2	0.58	6.48	7	0
80B	4.2	0.58	6.48	7	0
80C	4.2	0.58	6.48	7	0
80D	4.2	0.58	6.48	7	0

Table A-1 - SWMM Subbasin Parameters - Existing Condition

[SUBCATCHMENTS]	Existing Condition								
;;Name	RainGage	Outlet	Area	Exist %Imperv	Width	%Slope	CurbLen	SnowPack	FlowLength
81A	RG1	353	5.86	30	851	7.08	0		300
82A	RG1	TROC5	16.43	10	2386	1.8	0		300
82B	RG1	TROC5	3.2	10	1515	15.7	0		92
82C	RG1	TROC6	8.06	10	5320	18.13	0		66
82D	RG1	P-82D1	109.07	30	15837	5.7	0		300
83A	RG1	277	11.65	5	1015	1.65	0		500
85A	RG1	TROC7	13.25	90	1924	0.66	0		300
85B	RG1	P-85B	29.59	90	4296	0.73	0		300
85C	RG1	293	45.4	5	3955	0.91	0		500
86A	RG1	P-86A	13.15	30	2569	2.66	0		223
86B	RG1	298	21.22	10	1849	1.78	0		500
86C	RG1	P-86C	5.41	20	788	5.64	0		299
92A	RG1	309	20.02	50	4094	0.54	0		213
98A	RG1	P-98A	34.18	30	7558	0.66	0		197
9A	RG1	136	22.55	5	1965	0.47	0		500

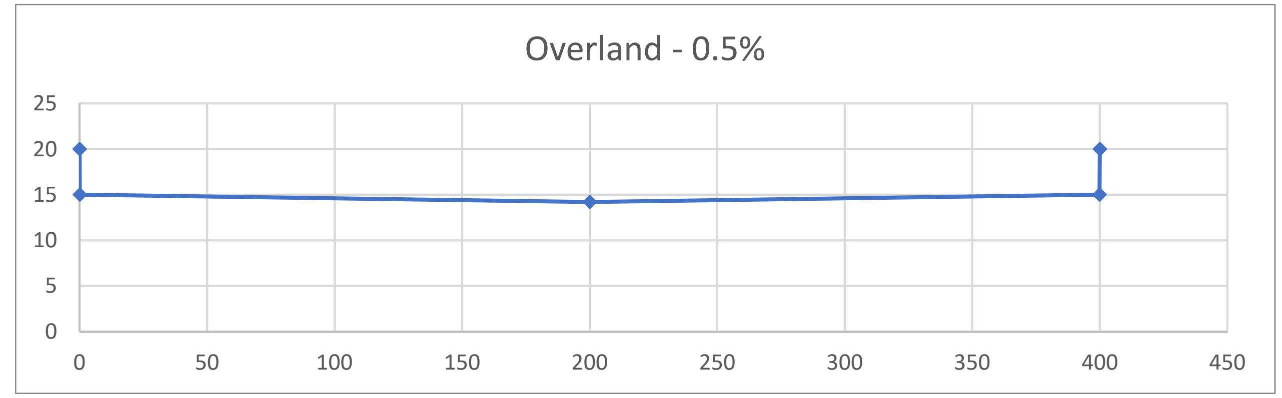
[SUBAREAS]							
;;Subcatchment	N-Imperv	N-Perv	S-Imperv	S-Perv	PctZero	RouteTo	PctRouted
81A	0.016	0.25	0.1	0.35	0	OUTLET	
82A	0.016	0.25	0.1	0.35	0	OUTLET	
82B	0.016	0.25	0.1	0.35	0	OUTLET	
82C	0.016	0.25	0.1	0.35	0	OUTLET	
82D	0.016	0.25	0.1	0.35	0	OUTLET	
83A	0.016	0.25	0.1	0.35	0	OUTLET	
85A	0.016	0.25	0.1	0.35	0	OUTLET	
85B	0.016	0.25	0.1	0.35	0	OUTLET	
85C	0.016	0.25	0.1	0.35	0	OUTLET	
86A	0.016	0.25	0.1	0.35	0	OUTLET	
86B	0.016	0.25	0.1	0.35	0	OUTLET	
86C	0.016	0.25	0.1	0.35	0	OUTLET	
92A	0.016	0.25	0.1	0.35	0	OUTLET	
98A	0.016	0.25	0.1	0.35	0	OUTLET	
9A	0.016	0.25	0.1	0.35	0	OUTLET	

[INFILTRATION]					
;;Subcatchment	MaxRate	MinRate	Decay	DryTime	MaxInfil
81A	4.2	0.58	6.48	7	0
82A	4.2	0.58	6.48	7	0
82B	4.2	0.58	6.48	7	0
82C	4.2	0.58	6.48	7	0
82D	4.2	0.58	6.48	7	0
83A	4.2	0.58	6.48	7	0
85A	4.2	0.58	6.48	7	0
85B	4.2	0.58	6.48	7	0
85C	4.2	0.58	6.48	7	0
86A	4.2	0.58	6.48	7	0
86B	4.2	0.58	6.48	7	0
86C	4.2	0.58	6.48	7	0
92A	4.2	0.58	6.48	7	0
98A	4.2	0.58	6.48	7	0
9A	4.13	0.58	6.48	7	0

SWMM Model - Link Cross Section Shapes

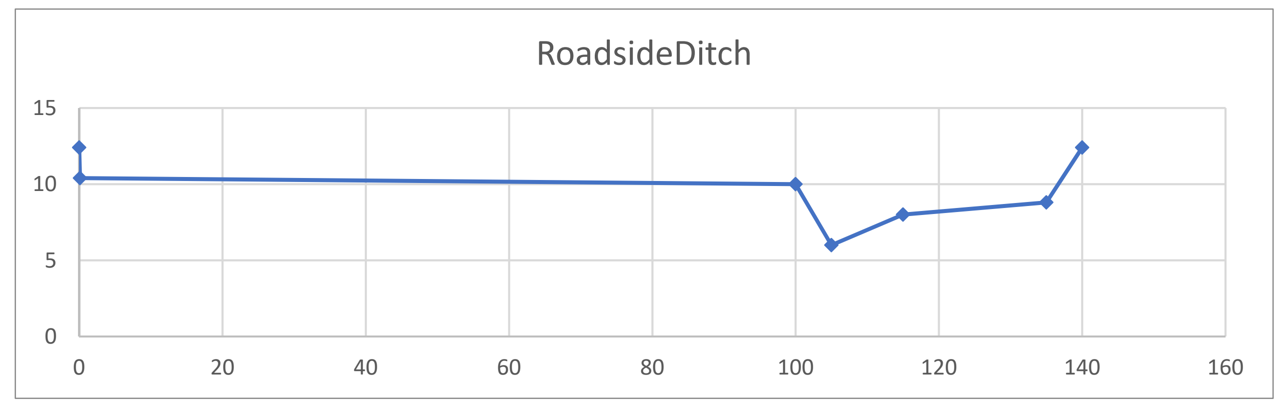
Overland - 0.5%

STA	ELEV
0	20
0.1	15
200	14.2004
399.9	15
400	20



RoadsideDitch

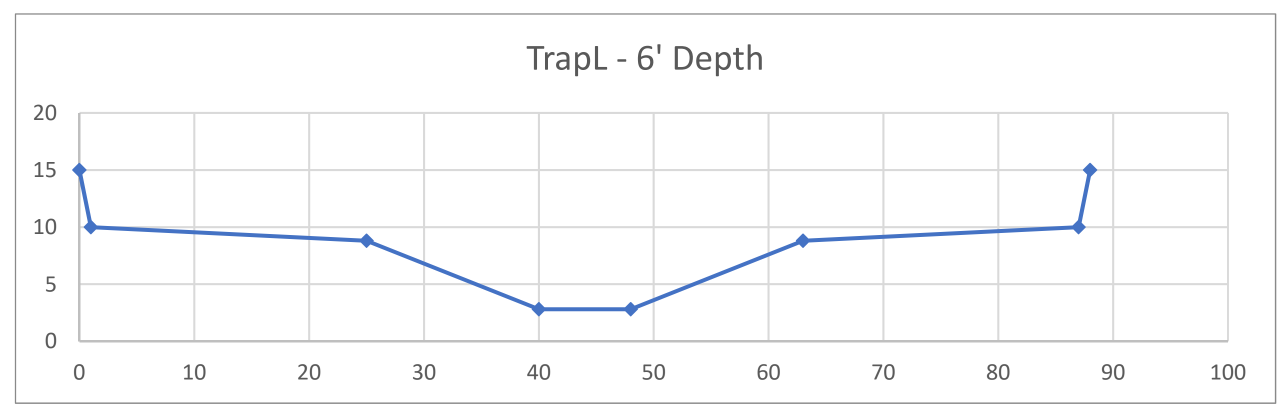
STA	ELEV
0	12.4
0.1	10.4
100	10
105	6
115	8
135	8.8
140	12.4



TrapL - 6' Depth

Z	2.5
Tw	38
Bw	8

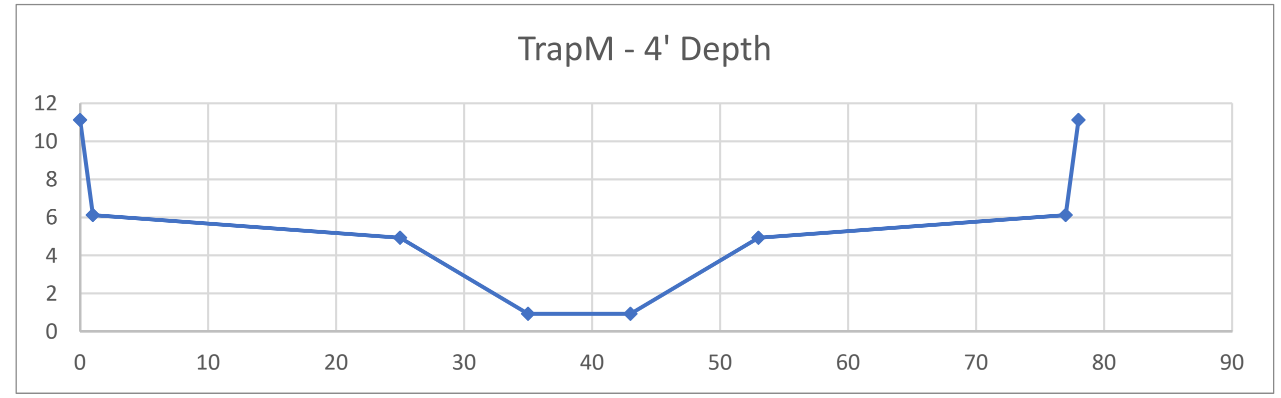
STA	ELEV
0	15
1	10
25	8.8
40	2.8
48	2.8
63	8.8
87	10
88	15



SWMM Model - Link Cross Section Shapes

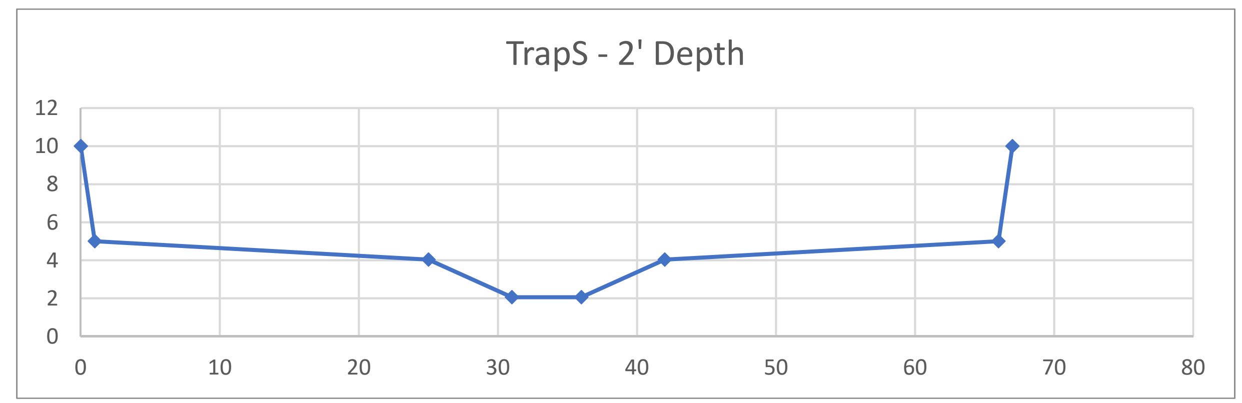
TrapM - 4' Depth

		STA	ELEV
		0	11.125
		1	6.125
Z	2.50	25	4.925
Tw	28	35	0.925
Bw	8	43	0.925
		53	4.925
		77	6.125
		78	11.125



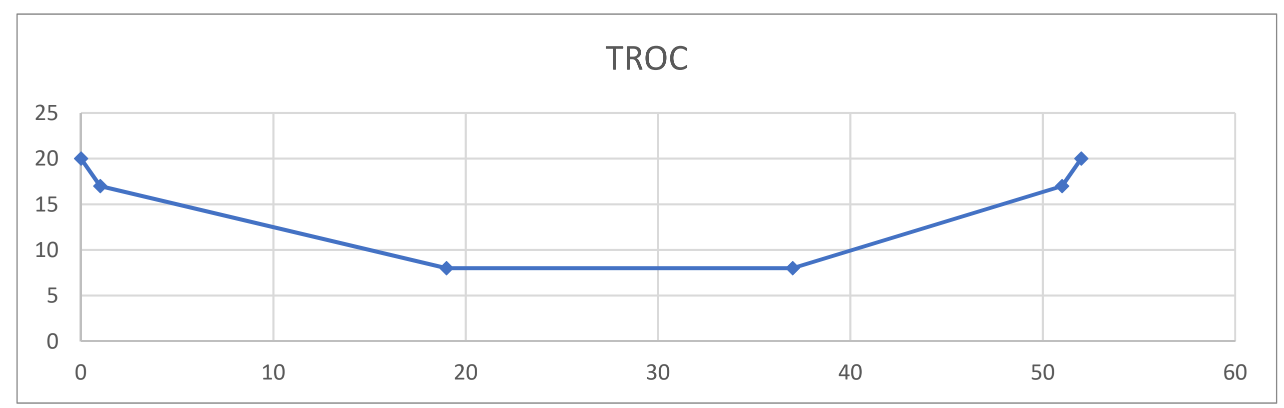
TrapS - 2' Depth

		STA	ELEV	slope ahead
		0	10	
		1	5	0.04
Z	25	25	4.04	0.33
Tw	17	31	2.06	
Bw	5	36	2.06	0.33
		42	4.04	0.04
		66	5	
		67	10	



TROC

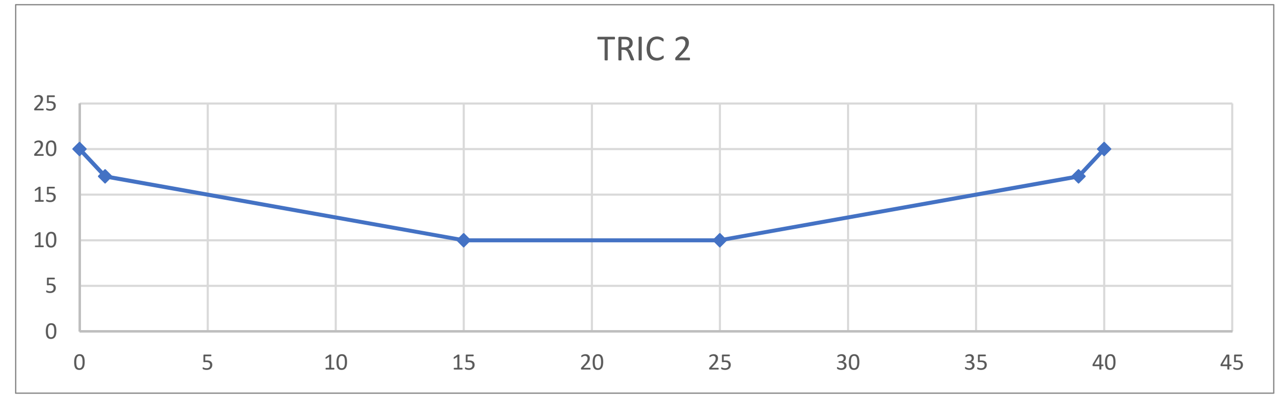
		STA	ELEV
		0	20
		1	17
Z	2	19	8
Tw	50	37	8
Bw	18	51	17
		52	20



SWMM Model - Link Cross Section Shapes

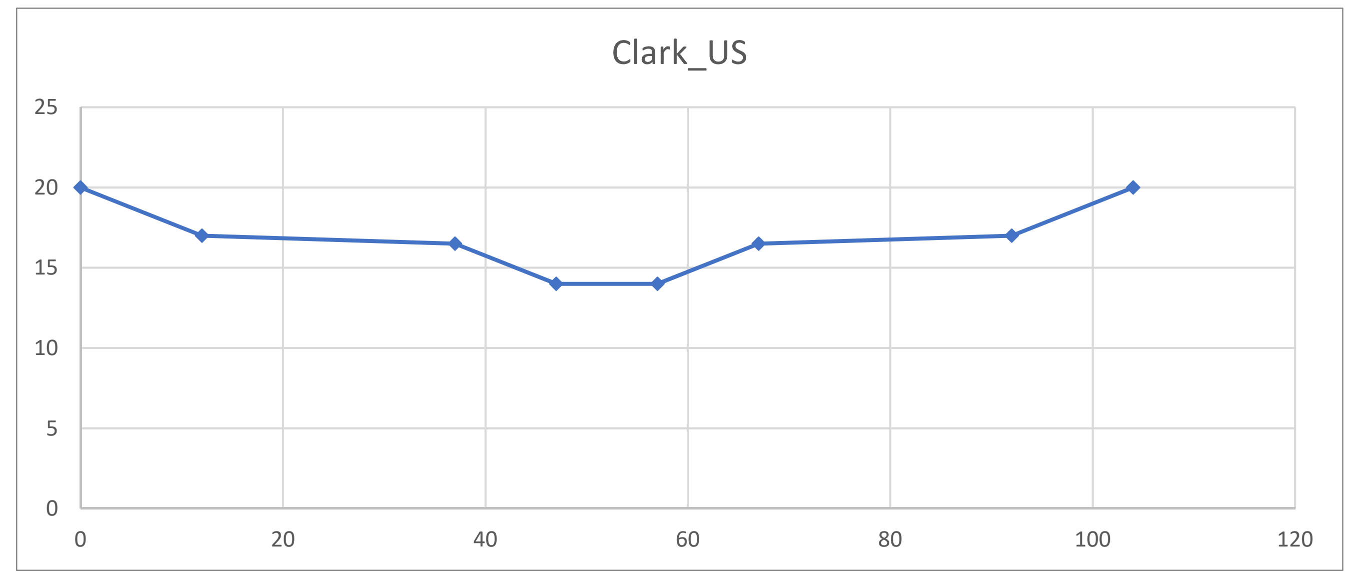
TRIC 2

		STA	ELEV
		0	20
		1	17
Z	2	15	10
Tw	38	25	10
Bw	10	39	17
		40	20



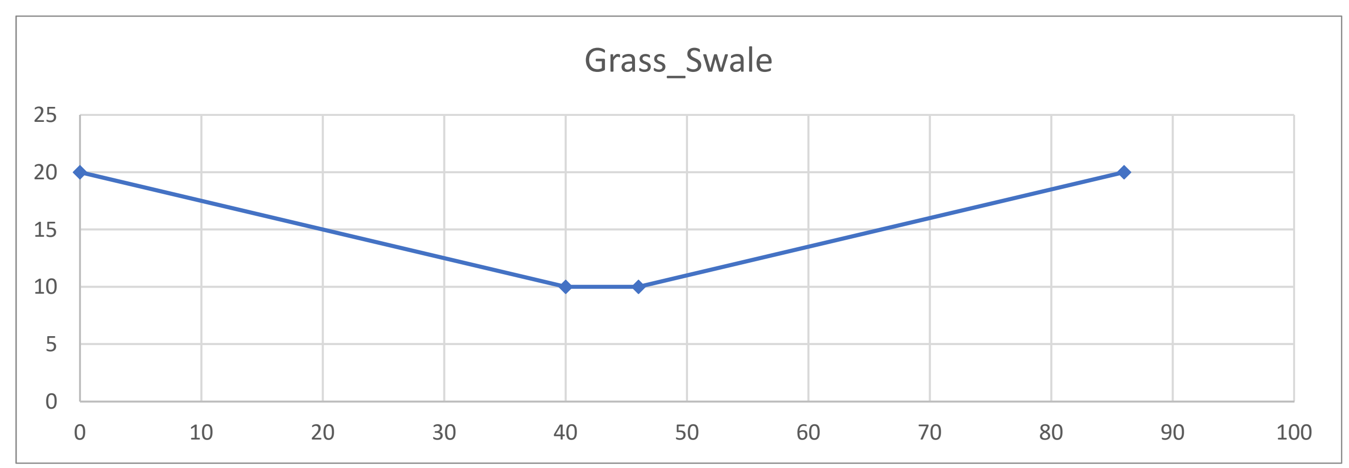
Clark_US

		STA	ELEV
		0	20
		12	17
		37	16.5
Z	4	47	14
Tw	30	57	14
Bw	10	67	16.5
		92	17
		104	20



Grass_Swale

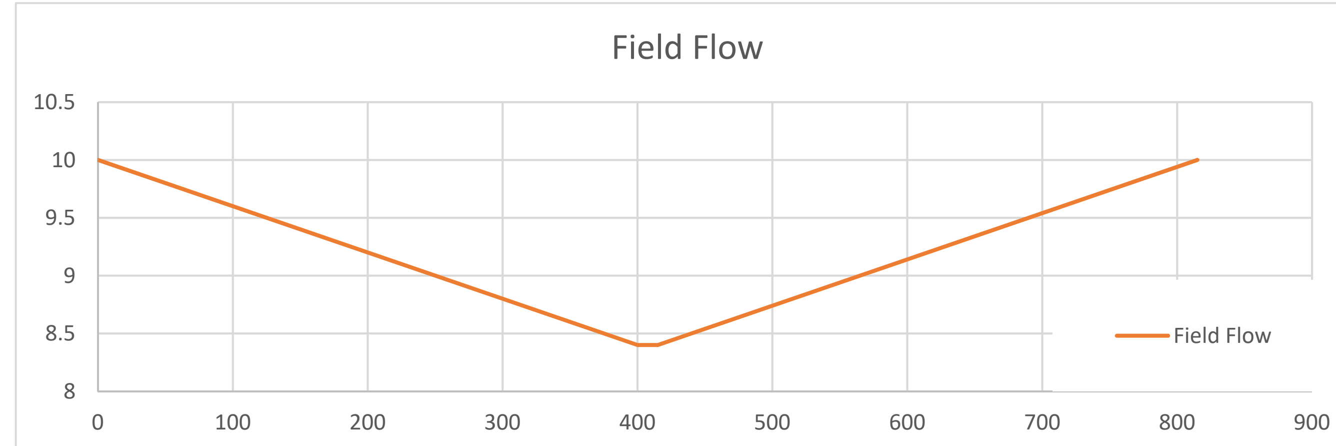
		STA	ELEV
		0	20
Z	4	40	10
Tw	86	46	10
Bw	6	86	20



SWMM Model - Link Cross Section Shapes

Concept Link - "Field"

	Dist	Base El	Shift	Elev.
	0	10	4859.5	10
0.40%	400	8.4		8.4
	400	8.4		8.4
	415	8.4		8.4
	415	8.4		8.4
	815	10		10



Timnath Stormwater Master Plan Update - 2018
A-3 - Summary of Detention Pond Storage and Outlet Ratings

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)	Outflow Rate (cfs)
P-28	-	0	0.00	0.0
Serratoga Falls	-	1	0.03	
Pond 1	-	2	0.24	
	-	3	0.81	
	-	4	1.91	
	-	5	3.74	
	-	6	6.46	3.6
	-	7	10.26	
	-	7.51	12.66	93.0
P-29	-	0	0.00	0.0
Serratoga Falls	-	1	0.05	
Pond 2	-	2	0.42	
	-	3	1.42	
	-	4	3.35	
	-	5	6.55	
	-	5.33	7.94	4.3
P-31	4922	0	0.00	
Serratoga Falls	4923	1	0.53	
Pond 3	4925	3	1.05	
	4926	4	2.51	
	4929	7	3.70	
P-25	-	0	0.00	0.0
Serratoga Falls	-	1	0.04	
Pond 4	-	2	0.34	
	-	3	1.16	
	-	4	2.75	
	-	5	5.37	
	-	6	9.28	49.5
	-	7	14.74	
	-	7.67	19.39	130.2
P-50	4866.72	0	0.00	0.0
Fairview	4867	0.28	0.00	
Det. Pnd 2	4868	1.28	0.11	
	4869	2.28	0.33	
	4869.5	2.78	0.49	
	4870	3.28	0.65	
	4871	4.28	1.02	
	4871.6	4.88	1.27	0.5

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)	Outflow Rate (cfs)
P-50A	4868.45	0	0.00	0.0
Fairview	4869	0.55	0.04	
Det. Pnd 1	4870	1.55	0.35	
	4871	2.55	0.88	
	4871.47	3.02	0.00	0.5
	4872	3.55	1.52	
	4872.51	4.06	1.94	19.0
P-75	4901.5	0	0.00	0.0
1276	4902	0.5	1.21	0.7
	4903	1.5	3.78	1.3
	4904	2.5	6.51	1.7
	4905	3.5	9.46	2.0
P-75A	4893	0	0.00	24" PIPE
1227	4894	1	0.11	
No Info	4895	2	0.25	
	4896	3	0.41	
	4897	4	0.62	
P-75D	4889	0	0.00	6.2" Orifice w/ 15" pipe Overflow weir at 5' depth
1279	4890	1	0.24	
"Pond 2A"	4891	2	0.71	
	4892	3	1.31	
	4894	5	2.65	
P-77	4888	0	0.00	0.0
1200	4888	2	0.00	
"pond 6"	4890	4	0.00	
	4892	6	0.00	
	4894	8	0.00	
	4896	10	0.00	
	4898	12	0.00	
	4900	14	6.12	
	4902	16	12.92	
	4902.12	0	0.00	
	4904	18	20.46	5.0
P-77B	4880	0	0.00	0.0
1205	4881	0	0.08	
"pond 15"	4881.39	1.39	0.00	0.5
	4882	0	0.31	
	4882.76	2.76	0.00	17.0
	4883	3	0.65	17.0
P-77C	4894	0	0.00	0.0
1201	4896	2	0.00	
"pond 7"	4898	4	0.88	1.0

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)	Outflow Rate (cfs)
P-77D	4874	1	0.00	0.0
1226	4875	2	1.19	
"pond 16"	4876	3	2.51	
	4877	4	4.01	5.0
	4877.43	3.43	0.00	
	4878	5	5.70	29.3
P-80	4848	0	0.00	0.0
1255	4850	2	0.00	
"pond 14"	4852	4	2.86	
	4854	6	7.03	1.0
P-80D	4854	0	0.00	0.0
1087	4856	2	0.00	
"pond 13"	4858	4	1.41	
	4860	6	3.33	4.0
	4861.5	7.5	0.00	4.1
P-81	4892	0	0.00	0.0
1225	4897	2	0.00	4.0
"pond 8"	4895.55	0	0.00	
	4896	4	8.01	19.8
P-84	4872	0	0.00	0.0
1250	4873	1	0.00	
"pond 18"	4874	2	2.52	
	4876	4	5.40	
	4878	6	8.76	20.0
P-82D1	4846	0	0.00	0.0
1251	4848	2	0.00	
"pond 11"	4849.63	0	0.00	
	4850	4	7.93	30.0
	4851	5	0.00	32.0
P-82D2	4844	0	0.00	0.0
1252	4845	1	0.00	
"pond 11a"	4846	2	0.77	9.0
	4848	4	2.02	21.0
	4849	5	0.00	51.0
	4849.44	5.44	0.00	
	4850	6	3.88	66.0
P-82D3	4839	0	0.00	0.0
1253	4840	1	0.00	
"pond MU1"	4841	2	1.96	
	4842	3	5.72	
	4843	4	10.07	
	4844	5	14.74	
	4845	6	19.76	37.1

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)	Outflow Rate (cfs)
P-86	4884	0	0.00	0.0
1280	4886	2	0.00	2.0
"pond 2b"	4888	4	0.94	
	4889.96	0	0.00	
	4890	6	2.10	29.2
P-86A	4884	0	0.00	0.0
1208	4886	2	0.00	
"pond 3"	4888	4	2.40	
	4890	6	5.16	
	4892	8	8.35	20.0
P-86C	4931	0	0.00	0.0
1275	4932	1	0.12	0.1
	4933	2	0.38	0.3
	4934	3	0.83	0.8
	4935	4	1.62	20.5
P-85C	4929	0	0.00	
Det. Pnd 2	4930	1	0.04	
Timnath Ranch	4931	2	0.13	
	4932	3	0.29	
	4933	4	0.50	
	4934	5	0.71	
	4935	6	0.93	
	4936	7	1.38	
P-88	4832	0	0.00	0.0
Pond 4	4833	1	0.24	2.8
Timnath Ranch	4834	2	1.11	3.5
	4835	3	2.52	4.3
	4836	4	4.17	4.9
	4837	5	6.03	5.5
	4837.5	5.5	0.00	84.0
	4837.9	5.9	0.00	206.0
	4838	6	8.11	
P-95	4826	0	0.00	0.5
Pond 1	4827	1	0.41	3.1
Timnath Ranch South	4828	2	2.03	4.4
	4829	3	5.42	5.4
	4830	4	10.52	6.2
	4831	5	16.60	7.0
	4832	6	23.16	7.0

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)	Outflow Rate (cfs)
P-97	4820.4	0	0.00	0.0
Pond 2	4821	0.6	0.00	12.1
Timnath Ranch South	4822	1.6	0.29	17.3
	4823	2.6	1.20	21.1
	4824	3.6	3.12	24.5
	4825	4.6	6.41	203.0
	4826	5.6	11.49	599.0
	4827	6.6	18.73	599.0
P-103	4832.4	0	0.00	0.0
Pond A1	4833.4	1	0.03	
Brunner Farm	4834.4	2	0.15	
	4835.4	3	0.35	
	4836.4	4	0.67	
	4837.4	5	1.18	
	4838.4	6	1.88	4.0
P-103A	4835	0	0.00	0.0
Pond D	4836	1	0.00	
Brunner Farm	4837	2	0.04	
	4838	3	0.16	
	4839	4	0.48	
	4840	5	1.07	
	4840.4	6	1.38	
	4840.63	5.63	0.00	31.4
	4841.11	6.11	0.00	57.4
P-103C	4821.8	0	0.00	0.0
Pond C	4822	0.2	0.00	
Brunner Farm	4823	1.2	0.20	
	4824	2.2	0.59	
	4824.8	3	1.01	20.0
	4825.47	3.67	0.00	46.1
P-103D1	4830	0	0.00	0.0
Pond B.1	4831	1	0.01	
Brunner Farm	4832	2	0.09	
	4833	3	0.33	
	4834	4	0.73	
	4835.5	5.5	1.49	90.9
P-103D2	4829	0	0.00	0.0
Pond B.2	4830	1	0.03	
Brunner Farm	4831	2	0.20	
	4832	3	0.55	
	4833	4	1.01	
	4834	5	1.55	
	4834.8	5.8	2.03	
	4835.58	6.58	0.00	50.7

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)	Outflow Rate (cfs)
P-104	4822.5	0	0.00	0.0
Pond 1	4823	0.5	0.76	0.0
Timnath Ranch South	4824	1.5	2.45	0.5
	4825	2.5	4.30	0.7
	4826	3.5	6.31	0.8
	4827	4.5	8.49	1.0
	4828	5.5	10.91	1.1
	4829	6.5	13.90	1.2
P-107	4819	0	0.00	0.0
Pond 2	4820	1	1.67	0.0
Timnath Ranch South	4821	2	3.55	0.6
	4822	3	5.66	0.8
	4823	4	7.99	0.9
	4824	5	10.56	1.0
	4825	6	13.38	1.1
	4826	7	16.46	1.2
	4827	8	20.49	1.3
P-98	4817	0	0.00	1.1
Pond 3	4818	1	1.37	4.1
Timnath Ranch South	4819	2	6.14	5.6
	4820	3	14.60	6.8
	4821	4	24.81	7.9
	4822	5	36.48	8.8
P-98A	4815	0	0.00	0.0
Pond 4	4816	1	0.54	0.0
Timnath Ranch South	4817	2	2.84	0.6
	4818	3	6.82	0.8
	4819	4	11.90	0.9
P-106A	4810	0	0.00	0.0
Pond 5	4811	1	4.04	2.0
Timnath Ranch South	4812	2	8.40	3.2
	4813	3	13.08	4.0
	4814	4	18.09	4.5
	4815	5	23.45	5.0
P-105	4812	0	0.00	0.0
Pond 6	4813	1	2.37	1.0
Timnath Ranch South	4814	2	5.02	2.0
	4814.5	2.5	6.50	3.5
	4815	3	7.98	4.5
Timnath	4910.77	0	0.00	0.0
Reservoir	4911.77	1	0.00	65.0
	4913.07	2.3	0.00	145.0
	4913.77	3	0.00	1365.0
	4915.77	5	0.00	10440.0

Timnath Stormwater Master Plan Update - 2018
A-3 - Summary of Detention Pond Storage and Outlet Ratings
(Ponds Not Included in Drainage Reports)

Pond ID	Elevation (ft)	Stage (ft)	Cumulative Volume (ac-ft)
P-5A	4919	0	0.00
	4920	1	0.26
	4921	2	0.60
P-15	4918	0	0.00
	4919	1	0.50
	4920	2	1.10
	4921	3	1.78
P-4A	4895	0	0.00
	4896	1	0.08
	4897	2	0.20
	4898	3	0.36
	4899	4	0.64
P-43	4878	0	0.00
	4879	1	0.81
	4880	2	1.81
	4881	3	3.00
P-51	4862	0	0.00
	4863	1	0.51
	4864	2	1.13
	4865	3	1.80
	4866	4	2.54
P-110	4839	0	0.00
	4840	1	0.00
	4841	2	0.05
	4842	3	0.17
	4843	4	0.34
	4844	5	0.56
	4845	6	0.82
P-92	4839	0	0.00
	4840	1	0.91
	4841	2	2.07
	4842	3	3.44
	4843	4	5.00
	4844	5	6.75
P-85B	4835	0	0.00
	4836	1	0.30
	4837	2	1.13
	4838	3	2.33
	4839	4	3.75
	4840	5	5.33
P-90	4838	0	0.00
	4839	1	0.83
	4840	2	3.59

Timnath Stormwater Master Plan Update - 2018
A-4 - Timnath Reservoir Storage and Outlet Ratings

WSEL		Depth		Area		Total Storage	Notes
(NGVD29)	(NAVD88)	Above Invert (ft)	Above HWL (ft)	(SF)	(acres)	(AF)	
4873.7	4876.77	0		0	0	0	
4883.7	4886.77	10		7,840,780	180	900	
4893.7	4896.77	20		12,632,420	290	3,250	
4903.7	4906.77	30		26,135,980	600	7,700	
4907.7	4910.77	34	0	27,099,908	622	10,144	Normal HWL
4908.7	4911.77	35	1	27,459,973	630	10,771	
4910	4913.07	36.3	2.3	27,928,058	641	11,597	Emergency Spillway Crest
4910.7	4913.77	37	3	28,180,104	647	12,048	

WSEL		Depth		Combined Outlet Discharge[1]	Notes
(NGVD29)	(NAVD88)	Above Invert (ft)	Above HWL (ft)	(cfs)	
4907.7	4910.77	34	0	0	Normal HWL
4908.7	4911.77	35	1	65	
4910	4913.07	36.3	2.3	145	Emergency Spillway Crest
4910.7	4913.77	37	3	1,365	
4912.7	4915.77	39	5	10,440	

[1]Outlet Rating for Service + Emergency Spillways. Does not include flows in primary gated outlet.

Timnath Stormwater Master Plan Update - 2018
A-5 - SWMM Model Results - Link Flows

Element ID	Existing SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
5	10	16	21	29	39	55
10	10	16	20	28	39	94
14	16	23	30	50	84	140
31	14	20	32	90	213	423
33	8	11	13	23	52	103
35	3	7	21	91	223	466
37	30	41	65	236	586	1,192
39	28	40	59	162	364	701
45	30	42	64	236	591	1,224
46	2	2	4	16	36	69
53	2	2	4	16	36	69
59	372	549	702	1,054	1,732	3,035
60	28	40	56	203	573	1,213
61	6	8	10	30	70	133
62	295	438	553	771	1,149	2,007
63	1	2	3	9	25	55
64	15	21	33	91	205	379
67	29	43	63	231	589	1,269
70	7	10	13	22	46	84
71	14	20	26	48	90	160
75	15	22	28	52	126	249
76	13	19	25	52	125	247
87	10	15	20	51	122	240
88	2	2	3	4	8	16
89	75	114	145	198	269	379
94	2	3	3	11	27	55
95	2	3	4	12	37	83
97	6	7	8	17	42	89
98	62	88	109	149	213	318
99	38	53	64	81	123	199
101	50	76	97	133	183	260
102	2	3	3	9	25	52
103	3	5	6	8	15	29
104	12	19	25	34	46	61
107	0	1	1	4	9	17
108	13	20	30	71	133	227
109	2	3	3	12	31	62
112	5	6	8	27	61	111
114	0	0	0	0	0	0
115	12	17	21	30	49	93
118	2	3	4	10	28	57
119	12	17	23	58	123	230
120	9	12	13	15	19	34
122	23	35	45	63	94	157
123	19	27	34	46	66	97
124	74	113	147	200	262	335
127	22	33	41	56	76	104
128	18	26	34	54	83	132
133	6	9	12	16	22	30
134	1	1	1	3	7	14
135	11	18	27	59	113	199
137	14	20	32	90	211	410
138	5	7	9	12	15	21
142	0	0	1	3	8	17
143	0	1	1	7	18	35
144	1	1	2	2	2	23
145	7	10	13	18	37	68
146	11	16	21	29	48	81
147	3	4	5	9	13	18
148	29	41	64	234	583	1,199
149	6	8	10	14	21	34
151	11	17	22	29	45	73
152	5	8	10	14	20	29
153	5	7	9	13	19	29
155	11	17	21	28	38	52
156	7	11	13	37	85	162
158	1	2	2	10	25	47

Timnath Stormwater Master Plan Update - 2018
A-5 - SWMM Model Results - Link Flows

Element ID	Existing SWMM Model Results					
	Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
159	1	2	4	15	31	54
160	0	0	0	0	0	0
161	0	0	0	0	49	117
162	26	38	45	56	74	148
163	15	23	29	41	57	84
164	7	9	11	16	24	39
165	6	9	12	17	31	87
166	10	20	30	48	73	106
169	1	2	2	6	15	32
170	3	4	5	10	19	34
171	2	2	3	8	19	35
172	4	7	10	35	75	138
173	29	43	63	231	589	1,269
174	5	8	10	17	45	90
175	3	4	5	7	15	28
176	4	7	21	91	224	469
177	17	25	32	49	81	136
178	14	21	27	38	53	81
183	5	8	9	25	58	111
184	24	38	48	65	112	190
185	14	22	28	38	56	108
186	48	72	91	123	166	234
193	2	4	4	11	28	56
203	2	3	4	7	15	28
206	0	0	1	2	16	66
208	10	18	28	67	124	216
209	9	13	16	22	32	52
210	38	54	68	92	150	271
211	7	10	14	34	74	162
212	3	4	5	7	17	33
214	3	4	5	13	33	69
217	14	21	28	47	80	135
218	15	21	28	56	106	189
219	27	39	57	156	347	665
220	6	8	10	13	19	34
223	14	20	30	84	188	341
224	6	9	11	16	26	46
226	9	13	16	22	30	44
234	9	13	16	26	48	84
246	29	41	59	166	377	726
249	4	5	7	10	17	30
251	30	42	64	236	591	1,221
261	2	2	3	4	6	9
264	1	2	2	3	4	7
268	28	42	63	230	580	1,216
270	3	4	6	19	47	95
283	4	6	8	25	57	109
291	1	2	2	4	9	18
292	0	0	0	0	0	0
349	3	5	6	12	23	43
361	8	12	15	21	30	42
600	9	13	16	38	75	166
601	3	4	5	13	32	63
1121	295	438	553	771	1,149	2,007
1122	15	21	26	77	194	405
1123	28	40	56	203	573	1,213
1124	33	47	57	171	420	876
1125	372	549	702	1,054	1,732	3,035
1126	363	532	666	901	1,361	2,353
1611	11	15	26	73	141	218
105A	14	20	25	35	50	74
105C	3	4	5	22	58	114
111A	24	36	47	106	223	436
111B	16	28	42	106	236	472
115AB	2	3	3	7	47	107
116_pipe	1	1	1	1	1	1
116_SF	0	0	0	0	0	0

Timnath Stormwater Master Plan Update - 2018
A-5 - SWMM Model Results - Link Flows

Element ID	Existing SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
120A	7	10	13	18	28	46
121A	16	24	30	41	56	75
121B	28	40	58	161	363	698
125A	19	29	38	56	91	153
134A	11	17	21	31	49	85
175A	19	28	34	47	65	94
177A	0	1	1	1	2	2
185C	6	9	11	15	26	49
209A	7	10	14	35	76	168
209B	33	49	61	108	224	438
267A	2	3	7	25	59	104
277A	1	1	1	3	5	13
282D	8	11	12	18	26	80
286A	2	2	3	4	5	6
286B	4	6	8	11	18	32
286C	0	0	0	0	0	1
292A	21	32	41	56	76	105
DTN-10-PF	8	8	8	8	8	8
DTN-10-SF	5	11	16	25	36	52
DTN-11-PF	12	15	15	15	15	15
DTN-11-SF	0	4	7	14	23	39
DTN-12-PF	12	18	21	24	24	24
DTN-12-SF	0	0	0	5	15	31
DTN-13-PF	31	43	51	55	55	55
DTN-13-SF	0	0	0	15	40	77
DTN-14-PF	33	46	55	65	66	66
DTN-14-SF	0	0	0	8	32	71
DTN-15-PF	33	46	55	74	93	132
DTN-3-PF	5	7	8	11	15	20
DTN-3-SF	0	0	0	0	0	0
DTN-4-PF	9	13	17	24	24	24
DTN-4-SF	0	0	0	0	6	15
DTN-5-PF	9	13	17	17	17	17
DTN-5-SF	0	0	1	7	13	21
DTN-6-PF	11	17	21	21	21	21
DTN-6-SF	0	0	1	8	15	26
DTN-7-PF	6	9	11	12	12	12
DTN-7-SF	0	0	0	4	10	18
DTN-8-PF	17	17	17	17	17	17
DTN-8-SF	1	9	15	26	37	54
DTN-9-PF	18	21	22	22	21	21
DTN-9-SF	0	5	11	21	33	49
DTS-2-PF	5	8	10	14	20	22
DTS-2-SF	0	0	0	0	0	6
DTS-3-PF	7	11	13	19	26	33
DTS-3-SF	0	0	0	0	0	0
DTS-4-PF	7	10	13	18	26	33
DTS-4-SF	0	0	0	0	0	0
DTS-5-PF	8	12	15	21	30	40
DTS-5-SF	0	0	0	0	0	0
DTS-6-PF	8	12	15	21	30	40
DTS-6-SF	0	0	0	0	0	0
DTS-7-PF	8	12	15	21	30	40
G3-2_DUMMY	5	7	9	13	20	68
L-90	2	3	4	11	31	65
L-TRIC2_SPILL	0	0	0	0	13	59
L-TRIC4A-SPILL	0	0	0	0	50	119
L-TRIC5A-SPILL	11	15	27	73	141	218
L-TRIC6A-SPILL	1	2	4	11	29	63
OP-103	2	3	3	3	3	4
OP-103_WEIR	0	0	0	20	52	109
OP-103A	15	18	19	22	26	31
OP-103C	8	10	11	14	18	33
OP-103D1_Pipe	11	13	14	16	18	18
OP-103D1_WEIR	0	0	0	0	12	48
OP-103D2_PIPE	10	12	13	16	23	41
OP-103D2_WEIR	0	0	0	0	0	0

Timnath Stormwater Master Plan Update - 2018
A-5 - SWMM Model Results - Link Flows

Element ID	Existing SWMM Model Results					
	Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
OP-104	1	1	1	1	1	1
OP-104_WEIR	0	0	0	0	0	4
OP-105	0	1	1	1	2	3
OP-106A	2	2	3	4	4	5
OP-106A_WEIR	0	0	0	0	0	59
OP-107	0	1	1	1	1	1
OP-107_WEIR	0	0	0	0	0	0
OP-110	10	15	18	26	38	54
OP-120	14	19	23	42	73	122
OP-15	0	0	0	0	36	82
OP-25	19	23	27	37	47	80
OP-28	2	2	2	3	9	42
OP-29	2	2	2	2	3	4
OP-31	9	13	17	23	30	35
OP-31_WEIR	0	0	0	0	0	0
OP-43	0	7	23	91	223	462
OP-4A	16	34	52	86	120	150
OP-50	0	0	0	0	0	0
OP-50A	0	0	0	0	0	4
OP-51	0	0	0	12	43	99
OP-5A	0	0	0	8	25	52
OP-75	0	1	1	1	1	2
OP-75A	8	12	15	19	24	29
OP-75A_WEIR	0	0	0	0	0	0
OP-75D	1	1	2	2	2	3
OP-75D_WEIR	0	0	0	0	0	21
OP-77	0	1	1	1	2	2
OP-77B	1	1	1	2	4	11
OP-77C	0	0	0	1	1	1
OP-77C_WEIR	0	0	0	0	0	9
OP-77D	1	1	1	3	4	12
OP-80	0	0	0	0	0	0
OP-80D	1	1	1	2	3	3
OP-80D_WEIR	0	0	0	0	1	14
OP-81	2	2	2	3	5	10
OP-82D1	10	12	14	21	29	31
OP-82D1_WEIR	0	0	0	0	0	80
OP-82D2	8	11	12	18	26	62
OP-82D2_WEIR	0	0	0	0	0	18
OP-82D3	9	10	12	16	21	32
OP-84	3	4	5	9	13	18
OP-85B	3	4	4	5	5	5
OP-85B-WEIR	0	0	0	0	0	14
OP-85C	6	8	11	33	78	151
OP-86	1	2	4	10	19	28
OP-86A	2	2	3	4	5	6
OP-86C	0	0	0	0	0	1
OP-88	1	3	4	15	35	41
OP-92	0	0	0	0	0	0
OP-95	4	4	5	5	6	6
OP-97	18	20	21	24	66	115
OP-98	4	4	5	5	6	6
OP-98A	1	1	1	1	1	1
OP-98A_WEIR	0	0	0	0	0	0
TRICL1	191	191	192	198	213	240
TRICL2	192	193	196	219	252	276
TRICL3	193	195	198	225	297	380
TRICL4	212	218	225	261	343	445
TRICL5	212	218	225	261	293	326
TRICL6	218	227	242	294	369	453
TRICL7	207	211	215	221	227	235
TRICL7A	207	212	217	233	256	292
TRICL8	205	209	213	222	227	229
TROC_1B	214	219	223	242	273	322
TROCL1	216	223	229	287	387	546
TROCL1_A	216	223	229	287	387	546
TROCL10	254	276	304	495	888	1,632

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A-5 - SWMM Model Results - Link Flows

Element ID	Existing SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
TROCL11	254	276	304	495	888	1,631
TROCL13	256	278	307	508	921	1,669
TROCL14	260	283	312	529	946	1,735
TROCL15	260	283	312	529	946	1,735
TROCL16	260	283	312	529	946	1,735
TROCL17	260	283	312	529	946	1,735
TROCL18	260	283	312	529	946	1,735
TROCL3	216	223	230	290	395	561
TROCL4	216	224	232	295	404	578
TROCL5	217	224	232	296	405	578
TROCL6	224	235	246	314	439	635
TROCL8	252	273	301	491	885	1,629
TROCL9	252	273	301	491	884	1,628
CLARK1	-	-	-	-	-	-
CLARK2	-	-	-	-	-	-
CLARK3	-	-	-	-	-	-
CLARK4	-	-	-	-	-	-
CLARK5	-	-	-	-	-	-
CLARK6	-	-	-	-	-	-
CLARK7	-	-	-	-	-	-
CLARK8	-	-	-	-	-	-

Timnath Stormwater Master Plan Update - 2018
A-6 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results					
	Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
115	3	5	6	8	15	29
116	12	19	25	34	46	61
117	17	24	30	41	55	76
118	16	34	52	86	120	150
127	14	20	24	35	50	76
129	5	7	9	23	61	122
132	17	24	30	42	58	96
133	0	1	1	2	16	66
134	28	39	49	82	151	253
135	13	20	30	71	133	227
136	7	10	14	36	76	168
137	9	13	16	38	75	166
138	38	54	67	92	150	271
140	27	41	53	115	248	487
142	40	57	71	109	225	439
143	6	8	10	16	26	44
144	33	49	61	108	224	438
146	6	8	10	18	38	78
147	0	0	0	0	0	0
149	12	17	22	34	57	96
151	4	5	6	11	51	117
153	22	32	40	62	98	158
154	16	23	30	50	84	140
155	15	22	29	58	107	191
156	4	6	8	13	31	63
157	27	39	57	156	347	665
158	16	23	31	69	140	258
159	12	17	21	29	42	63
160	28	40	59	162	364	701
161	28	40	58	161	363	698
162	18	26	32	43	60	86
163	23	35	45	63	94	157
164	29	42	53	77	115	179
165	5	8	10	13	18	25
166	9	13	16	24	37	61
169	9	13	16	23	32	49
170	24	35	44	60	81	115
171	22	33	41	56	76	104
173	20	28	37	57	87	139
176	935	1,325	1,639	2,263	3,148	4,530
177	1	2	2	4	9	18
178	454	666	840	1,187	1,802	3,088
179	28	42	49	87	192	358
180	13	18	23	37	58	93
181	372	549	702	1,054	1,732	3,035
182	13	20	30	62	116	204
183	11	17	21	31	49	85
184	93	130	160	267	506	1,019
185	40	57	70	212	584	1,231
186	14	20	32	90	213	424
187	17	24	35	95	215	427
188	28	40	56	203	573	1,213
189	43	59	73	122	231	465
190	702	996	1,231	1,700	2,364	3,402
191	295	438	553	771	1,149	2,007
193	15	21	26	41	69	120
194	15	21	33	91	206	379
196	6	8	23	91	224	469
197	4	7	21	91	224	470
199	30	42	66	239	596	1,200
200	29	41	59	166	378	726
201	19	26	32	45	63	92
204	30	41	65	236	586	1,203
206	6	8	10	14	21	34
207	11	15	19	26	37	55
213	4	6	7	14	25	46
214	30	42	64	237	593	1,224

Timnath Stormwater Master Plan Update - 2018
A-6 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results					
	Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
216	8	11	14	19	27	39
217	12	17	21	29	39	53
220	3	4	5	7	9	13
221	3	4	5	7	11	15
223	30	42	64	236	591	1,224
224	2	2	4	16	36	69
225	3	4	6	18	42	80
226	4	7	10	35	75	138
229	2	3	4	7	16	33
230	4	6	8	22	53	104
231	3	5	6	11	20	35
234	7	10	14	37	81	151
237	29	43	63	231	589	1,269
238	29	43	64	233	592	1,273
239	30	42	64	237	597	1,246
243	20	28	35	48	68	99
248	7	11	14	22	46	85
250	11	16	19	39	84	161
252	33	46	58	86	129	198
253	0	1	1	1	2	2
254	1	1	1	3	5	13
274	17	26	34	50	94	164
275	5	8	9	25	58	111
276	10	15	18	30	63	123
277	2	2	3	5	9	16
279	35	49	61	97	162	266
283	20	28	34	50	77	125
284	19	29	38	52	127	250
285	15	22	28	52	126	249
287	13	19	25	52	125	247
291	0	0	0	0	0	0
293	7	9	11	18	29	51
295	1	2	4	10	19	28
296	55	78	97	132	181	256
297	0	0	0	0	0	1
298	6	8	10	16	24	39
303	94	133	165	227	312	440
307	2	3	4	7	11	19
309	26	38	47	64	86	118
310	6	8	10	16	34	71
311	2	4	4	11	28	56
312	4	6	7	12	37	82
314	6	7	8	17	43	89
316	62	88	109	150	214	319
317	60	85	104	148	217	325
321	63	89	110	153	213	304
323	1	1	1	1	1	1
323-surf	0	0	0	0	0	0
324	1	2	2	5	10	20
326	3	4	5	13	32	63
327	5	7	8	15	34	69
328	6	8	10	17	45	90
329	7	10	12	33	74	146
330	21	26	30	38	48	63
335	1	2	2	3	6	10
338	8	10	11	14	18	33
339	10	12	13	16	23	41
341	19	26	32	46	67	98
342	102	150	188	256	346	477
346	9	12	15	21	30	43
348	10	15	18	26	38	54
349	7	10	13	18	24	33
350	5	7	9	12	16	22
351	5	8	9	13	19	27
352	5	6	8	11	15	22
353	5	7	9	13	20	31
355	8	11	12	18	26	80

Timnath Stormwater Master Plan Update - 2018
A-6 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
356	2	2	3	4	5	6
360	8	12	16	22	30	43
500	20	29	35	53	83	169
501	7	10	12	19	32	53
53	4	5	7	12	28	58
54	5	7	9	14	21	34
DTN10	13	19	24	33	44	60
DTN11	12	19	24	33	44	60
DTN12	12	18	21	28	37	53
DTN13	32	44	51	66	91	128
DTN14	33	46	56	69	95	134
DTN15	33	46	55	74	93	132
DTN3	5	7	8	11	15	20
DTN4	9	13	17	23	31	41
DTN5	9	13	17	24	30	38
DTN6	11	17	21	28	35	46
DTN7	6	9	11	15	21	30
DTN8	17	25	32	42	54	70
DTN9	18	25	31	42	53	70
DTS2	5	8	10	14	20	29
DTS3	7	11	14	19	27	33
DTS4	7	11	13	19	26	33
DTS5	8	12	15	21	30	40
DTS6	8	12	15	21	30	40
DTS7	8	12	15	21	30	40
DTSO1	8	12	15	21	30	40
G3-1	7	10	13	18	28	46
G3-2	5	7	9	13	20	68
G3-2_A	5	7	9	13	20	68
J-90	3	4	5	11	31	65
LAKECANAL1	10	16	20	28	39	94
LAKECANAL10	3	5	6	11	22	42
LAKECANAL11	2	3	4	7	15	29
LAKECANAL12	10	15	18	41	93	177
LAKECANAL16	18	25	30	45	68	106
LAKECANAL17	3	4	5	9	13	18
LAKECANAL18	18	25	31	46	72	116
LAKECANAL19	8	11	13	24	43	78
LAKECANAL2	15	21	26	37	53	77
LAKECANAL20	1	1	2	2	2	23
LAKECANAL21	1	1	2	8	20	39
LAKECANAL22	1	1	1	4	9	19
LAKECANAL3	29	41	51	70	97	138
LAKECANAL4	31	44	55	75	106	155
LAKECANAL7	0	0	0	0	0	0
LAKECANAL8	3	4	6	21	43	79
LAKECANAL9	3	4	5	16	36	70
P-103	30	43	53	72	97	134
P-103A	26	36	45	62	86	121
P-103C	20	28	35	48	67	94
P-103D1	23	32	39	57	85	124
P-103D2	11	13	14	16	30	66
P-104	86	122	151	209	288	398
P-105	31	45	57	77	103	141
P-106A	76	115	149	203	267	338
P-107	63	89	110	153	212	301
P-110	10	15	20	29	42	66
P-120	1,161	1,825	2,381	3,311	4,431	7,073
P-15	12	17	21	30	49	93
P-25	34	51	66	98	154	247
P-28	18	26	34	54	83	132
P-29	13	18	22	31	44	66
P-31	33	46	57	81	117	173
P-43	15	21	32	92	224	463
P-4A	46	70	90	126	169	225
P-50	8	12	14	20	29	42
P-50A	10	14	17	24	34	48

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A-6 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results					
	Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
P-51	34	47	56	76	98	141
P-5A	14	20	25	35	50	74
P-75	28	39	48	68	95	135
P-75A	19	28	34	47	65	94
P-75D	9	12	15	22	28	36
P-77	17	25	32	49	81	136
P-77B	1	2	2	4	8	16
P-77C	7	9	11	21	38	62
P-77D	25	34	42	60	89	134
P-80	5	7	8	14	24	40
P-80D	7	10	13	21	38	67
P-81	32	44	55	81	120	180
P-82D1	94	131	161	239	364	559
P-82D2	10	12	14	21	29	110
P-82D3	16	23	29	53	96	166
P-84	24	38	48	65	112	190
P-85B	58	88	111	152	200	263
P-85C	6	9	11	33	78	151
P-86	52	78	99	134	181	258
P-86A	11	16	19	28	43	65
P-86C	3	4	5	8	14	23
P-88	77	117	149	204	279	403
P-92	25	39	50	73	109	167
P-95	76	108	133	183	254	361
P-97	38	53	64	81	123	199
P-98	50	76	97	133	183	260
P-98A	30	42	52	72	102	148
ResOutlet	214	219	223	242	273	322
TRIC1	191	192	192	198	214	241
TRIC2	193	194	197	220	266	337
TRIC3	193	195	198	225	298	382
TRIC4	212	218	225	261	343	445
TRIC4A	212	218	225	261	343	445
TRIC4-SPILL	0	0	0	0	50	119
TRIC5	218	227	242	294	369	454
TRIC5A	218	227	242	294	369	453
TRIC5A_SPILL	11	15	27	73	141	218
TRIC6	207	212	217	233	257	294
TRIC6_Spill	1	2	4	11	29	63
TRIC6A	207	212	217	233	256	292
TRIC-OUTFALL	205	209	213	222	227	229
TROC_1A	216	223	229	287	387	546
TROC1	216	223	229	287	387	546
TROC10a	256	278	307	508	921	1,669
TROC11	260	283	312	529	946	1,736
TROC12	260	283	312	529	946	1,735
TROC-12A	260	283	312	529	946	1,735
TROC13	260	283	312	529	946	1,735
TROC14	260	283	312	529	946	1,735
TROC2	216	223	230	290	395	562
TROC3	217	224	232	295	405	579
TROC4	217	225	232	296	406	580
TROC5	226	237	248	316	443	645
TROC6	252	273	301	491	885	1,629
TROC7	252	273	301	491	885	1,629
TROC8	254	276	304	495	889	1,634
TROC9	254	276	304	495	888	1,632
TROC-OUTFALL	260	283	312	529	946	1,735
CP-10	-	-	-	-	-	-
CP-100	-	-	-	-	-	-
CP-100A	-	-	-	-	-	-
CP-101	-	-	-	-	-	-
CP-102	-	-	-	-	-	-
CP-106	-	-	-	-	-	-
CP-108	-	-	-	-	-	-
CP-108A	-	-	-	-	-	-
CP-109	-	-	-	-	-	-

Timnath Stormwater Master Plan Update - 2018
A-6 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
CP-11	-	-	-	-	-	-
CP-110	-	-	-	-	-	-
CP-113A	-	-	-	-	-	-
CP-12	-	-	-	-	-	-
CP-121	-	-	-	-	-	-
CP-122	-	-	-	-	-	-
CP-123	-	-	-	-	-	-
CP-124	-	-	-	-	-	-
CP-125	-	-	-	-	-	-
CP-126	-	-	-	-	-	-
CP-13	-	-	-	-	-	-
CP-14	-	-	-	-	-	-
CP-15	-	-	-	-	-	-
CP-15A	-	-	-	-	-	-
CP-17	-	-	-	-	-	-
CP-18	-	-	-	-	-	-
CP-2	-	-	-	-	-	-
CP-20	-	-	-	-	-	-
CP-21	-	-	-	-	-	-
CP-21A	-	-	-	-	-	-
CP-26	-	-	-	-	-	-
CP-3	-	-	-	-	-	-
CP-30	-	-	-	-	-	-
CP-33	-	-	-	-	-	-
CP-34	-	-	-	-	-	-
CP-35	-	-	-	-	-	-
CP-37	-	-	-	-	-	-
CP-38	-	-	-	-	-	-
CP-39	-	-	-	-	-	-
CP-4	-	-	-	-	-	-
CP-43	-	-	-	-	-	-
CP-43A	-	-	-	-	-	-
CP-45	-	-	-	-	-	-
CP-46	-	-	-	-	-	-
CP-47	-	-	-	-	-	-
CP-47A	-	-	-	-	-	-
CP-48	-	-	-	-	-	-
CP-49	-	-	-	-	-	-
CP-5	-	-	-	-	-	-
CP-51	-	-	-	-	-	-
CP-52	-	-	-	-	-	-
CP-55	-	-	-	-	-	-
CP-6	-	-	-	-	-	-
CP-61	-	-	-	-	-	-
CP-64	-	-	-	-	-	-
CP-67	-	-	-	-	-	-
CP-68	-	-	-	-	-	-
CP-69	-	-	-	-	-	-
CP-7	-	-	-	-	-	-
CP-70	-	-	-	-	-	-
CP-70A	-	-	-	-	-	-
CP-71	-	-	-	-	-	-
CP-72	-	-	-	-	-	-
CP-72A	-	-	-	-	-	-
CP-73	-	-	-	-	-	-
CP-76	-	-	-	-	-	-
CP-8	-	-	-	-	-	-
CP-83	-	-	-	-	-	-
CP-83A	-	-	-	-	-	-
CP-85	-	-	-	-	-	-
CP-85C	-	-	-	-	-	-
CP-87	-	-	-	-	-	-
CP-89	-	-	-	-	-	-
CP-9	-	-	-	-	-	-
CP-90	-	-	-	-	-	-
CP-91	-	-	-	-	-	-
CP-92	-	-	-	-	-	-

Timnath Stormwater Master Plan Update - 2018
A-6 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
CP-93	-	-	-	-	-	-
CP-94	-	-	-	-	-	-
CP-99	-	-	-	-	-	-
CP-9A	-	-	-	-	-	-
J-CLARK1	-	-	-	-	-	-
J-CLARK2	-	-	-	-	-	-
J-CLARK3	-	-	-	-	-	-
J-CLARK4	-	-	-	-	-	-
J-CLARK5	-	-	-	-	-	-

Table A-7 - Subbasin Discharge Results

Subbasin	Concept Detention Outlet Link	Existing SWMM Model Results - Subbasin Discharge					
		Discharge (cfs)					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
2	L-CP-2	4	5	7	12	28	58
3	L-CP-3	5	7	9	14	21	34
4	L-CP-4	17	24	30	41	55	76
5	L-CP-5	5	7	9	17	37	71
6	L-CP-6	0	1	1	2	4	8
7	L-CP-7	17	24	30	42	57	81
8	L-CP-8	28	39	49	74	116	187
9	L-CP-9	20	29	35	53	83	137
10	L-CP-10	38	54	67	92	128	185
11	L-CP-11	2	3	4	6	13	27
12	L-CP-12	6	8	10	16	26	44
13	L-CP-13	15	21	26	37	53	77
14	L-CP-14	6	8	10	18	38	78
15	L-CP-15	12	17	22	34	57	96
16	-	29	41	51	70	97	138
17	L-CP-17	2	3	4	9	22	45
18	L-CP-18	4	6	8	13	31	63
20	L-CP-20	12	17	21	29	42	63
21	L-CP-21	18	25	31	43	60	86
22	-	27	38	46	68	103	160
23	-	5	8	10	13	18	25
24	-	9	13	16	24	37	61
25	-	15	22	27	37	51	74
26	L-CP-26	9	13	16	23	32	49
27	-	17	25	31	42	56	78
28	-	20	28	34	47	66	97
29	-	12	18	22	30	43	65
30	L-CP-30	1	2	2	4	9	18
31	-	32	45	56	80	116	171
32	-	31	44	55	75	106	155
33	L-CP-33	3	5	6	8	12	18
34	L-CP-34	13	18	23	37	58	93
35	L-CP-35	12	16	22	40	70	125
37	L-CP-37	17	23	29	42	64	104
38	L-CP-38	9	13	16	24	36	59
39	L-CP-39	7	10	12	22	44	83
43	L-CP-43	15	21	26	41	69	120
44	-	3	4	6	21	43	79
45	L-CP-45	4	5	7	20	46	88
46	L-CP-46	19	26	32	45	63	92
47	L-CP-47	3	4	5	16	36	70
48	L-CP-48	12	17	21	31	49	80
49	L-CP-49	11	15	19	26	37	55
50	-	8	12	14	20	29	42
51	L-CP-51	3	4	5	8	12	21
52	L-CP-52	8	11	14	19	27	39
55	L-CP-55	12	17	21	29	39	53
57	-	4	7	9	12	16	21
58	-	2	2	3	4	5	7
59	-	4	6	8	10	14	20
60	-	2	3	3	5	7	10
61	L-CP-61	3	4	5	7	9	13
62	-	5	7	8	11	15	20
63	-	1	2	2	3	5	7
64	L-CP-64	3	4	5	7	11	15
65	-	3	4	5	6	9	12
66	-	4	5	7	9	12	17
67	L-CP-67	2	2	3	5	12	24
68	L-CP-68	3	4	5	11	24	46
69	L-CP-69	2	3	4	7	16	33
70	L-CP-70	3	4	5	9	20	41
71	L-CP-71	2	3	4	7	15	29
72	L-CP-72	5	7	10	31	67	124
73	L-CP-73	9	13	17	32	70	134
74	-	18	25	31	46	72	116
75	-	28	39	48	68	95	135
76	L-CP-76	11	16	19	39	84	161
77	-	33	46	58	86	129	198
78	-	10	15	18	41	93	177
79	-	4	6	7	14	29	54

Table A-7 - Subbasin Discharge Results

Subbasin	Concept Detention Outlet Link	Existing SWMM Model Results - Subbasin Discharge					
		Discharge (cfs)					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
80	-	3	5	6	11	18	30
81	-	32	44	55	81	120	180
82	-	18	25	30	45	68	106
83	L-CP-83	10	14	18	30	52	91
84	-	35	49	60	95	160	264
85	L-CP-85	20	28	34	50	77	125
86	-	55	78	97	132	181	256
87	L-CP-87	1	1	2	8	20	39
88	-	93	132	163	224	307	432
89	L-CP-89	1	1	1	4	9	19
90	L-CP-90	3	4	5	10	25	52
91	L-CP-91	2	3	4	7	11	19
92	L-CP-92	8	11	14	22	38	67
93	L-CP-93	6	8	10	16	34	71
94	L-CP-94	4	6	7	12	25	52
95	-	76	108	133	183	254	361
96	-	3	5	6	14	31	60
97	-	60	85	104	148	217	325
98	-	63	89	110	153	213	304
99	L-CP-99	1	2	2	5	10	20
100	L-CP-100	6	9	11	17	28	47
101	L-CP-101	5	7	8	15	34	69
102	L-CP-102	6	8	10	15	24	41
103	-	30	43	53	72	97	134
104	-	86	121	150	206	284	398
105	-	31	45	57	77	103	141
106	L-CP-106	7	10	12	19	32	53
107	-	63	89	110	152	211	300
108	L-CP-108	5	7	8	12	19	30
109	L-CP-109	9	12	15	21	30	43
110	L-CP-110	5	6	8	12	18	30
112	-	2	2	3	4	7	9
114	-	5	6	8	11	15	22
119	-	5	8	9	13	19	27
120	-	1,144	1,796	2,331	3,237	4,328	5,829
121	L-CP-121	702	995	1,231	1,700	2,364	3,402
122	L-CP-122	43	59	73	122	231	465
123	L-CP-123	40	56	68	114	217	437
124	L-CP-124	93	130	160	267	506	1,019
125	L-CP-125	409	588	731	998	1,354	1,886
126	L-CP-126	935	1,325	1,639	2,263	3,148	4,530
130	-	3	5	6	8	12	17
100A	L-CP-100A	6	9	11	16	26	42
103A	-	26	36	45	62	86	121
103B	-	7	9	12	17	26	38
103C	-	20	28	35	48	67	94
103D	-	23	32	39	57	85	124
106A	-	85	125	158	215	286	389
107A	-	19	26	32	46	67	98
108A	L-CP-108A	1	2	2	3	6	10
111A	-	2	3	4	6	8	11
111B	-	7	10	13	18	24	33
113A	L-CP-113A	1	2	2	3	6	9
113B	-	5	7	9	12	16	22
15A	L-CP-15A	4	5	6	11	20	40
21A	L-CP-21A	4	6	8	13	28	57
25A	-	5	7	8	12	17	26
43A	L-CP-43A	6	8	10	16	27	47
47A	L-CP-47A	3	5	6	11	22	42
4A	-	46	69	87	119	159	212
50A	-	10	14	17	24	34	48
51A	-	2	2	3	4	7	11
5A	-	14	20	24	35	50	76
60A	-	2	3	4	5	7	10
70A	L-CP-70A	2	2	3	5	11	22
72A	L-CP-72A	1	2	2	4	6	10
75A	-	20	28	35	48	68	99
75B	-	8	11	13	24	43	78
75C	-	1	2	2	4	9	16
75D	-	0	1	1	3	6	12

Table A-7 - Subbasin Discharge Results

Subbasin	Concept Detention Outlet Link	Existing SWMM Model Results - Subbasin Discharge					
		Discharge (cfs)					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
77A	-	1	1	1	2	5	9
77B	-	1	1	1	2	4	7
77C	-	7	9	11	21	38	62
77D	-	23	33	40	58	87	131
80A	-	1	2	2	5	11	20
80B	-	0	1	1	2	4	7
80C	-	3	4	5	10	19	34
80D	-	3	4	5	10	22	40
81A	-	5	7	9	13	20	31
82A	-	5	7	8	13	22	39
82B	-	1	1	2	6	14	24
82C	-	2	3	4	20	42	66
82D	-	93	131	160	238	363	558
83A	L-CP-83A	2	2	3	5	9	16
85A	-	26	39	49	67	89	117
85B	-	58	88	111	152	200	263
85C	L-CP-85C	7	9	11	18	29	51
86A	-	11	16	19	28	43	65
86B	-	6	8	10	16	24	39
86C	-	3	4	5	8	14	23
92A	-	26	38	47	64	86	118
98A	-	29	40	50	70	99	144
9A	L-CP-9A	3	5	6	8	13	22

Table A-8 - Results at Key Locations - Comparison to Prior ModSWMM Results

Timnath Stormwater Master Plan Update - 2018
SWMM Model Results
8/21/2018

Link/ Node	Element ID (E.C.)	Element ID (F.C.)	Location	Existing SWMM Model Results Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
-	-	-	Boxelder Creek Overflow Discharge	-	-	-	-	-	-
Link	39	CLARK8	Clark Drainage at County Road 5	28	40	59	162	364	701
Node	199	199	Clark Drainage at County Road 40	30	42	66	239	596	1,200
Link	OP-51	OP-51	Downtown Outfall to Clark Drainage	0	0	0	12	43	99
Link	173	CLARK1	Clark Drainage at Harmony Rd. U/S of TROC confluence	29	43	63	231	589	1,269
Link	-	173	Harmony Road Ditch, NW of confluence with TROC	-	-	-	-	-	-
Node	ResOutlet	ResOutlet	Timnath Reservoir Discharge	214	219	223	242	273	322
Link	TROCL6	TROCL6	Timnath Res. Outlet Ditch U/S of confluence	224	235	246	314	439	635
Node	TROC6	TROC6	Timnath Res. Outlet Ditch at Harmony Road	252	273	301	491	885	1,629
Node	TROC9	TROC9	Timnath Res. Outlet Ditch at Summerfield Pkwy	254	276	304	495	888	1,632
Node	TROC11	TROC11	Timnath Res. Outlet Ditch at County Road 36	260	283	312	529	946	1,736
Node	TROC-OUTFALL	TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	260	283	312	529	946	1,735
Node	295	295	Discharge at Harmony Road and County Rd. 1	1	2	4	10	19	28
Node	348	348	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	10	15	18	26	38	54
Node	DTSO1	DTSO1	Dixon Street Outfall	8	12	15	21	30	40
Node	G3-2	G3-2	Timnath South Outfall to Greeley No. 2	5	7	9	13	20	68

2005 Master Plan - MODSWMM Results
Existing Condition

Element ID	Location	Baseline Condition - with Boxelder Flows (From Report Table 2.4) Discharge (cfs) 10-Year	50-Year	100-Year	Existing w/o Boxelder Flows* 100-Year
927	Boxelder Creek Overflow Discharge	0	1,776	3,885	-
321	Main flowpath at County Road 5	33	1,806	3,933	466
345	Main flowpath at County Road 40	80	1,841	4,001	975
151	Downtown Outfall to Main flowpath	19	59	96	96
173	Main flowpath at Harmony Rd. U/S of TROC confluence	88	1,842	4,000	1,085
270	Harmony Road Ditch, NW of confluence with TROC	3	24	48	48
920	Timnath Reservoir Discharge	29	100	395	395
280	Timnath Res. Outlet Ditch U/S of confluence	37	173	401	401
383	Timnath Res. Outlet Ditch at Harmony Road	131	1,951	4,415	1,418
188	Timnath Res. Outlet Ditch at Summerfield Pkwy	135	1,948	4,395	1,497
397	Timnath Res. Outlet Ditch at County Road 36	139	1,950	4,400	1,530
300	Timnath Res. Outlet Ditch at Greeley No. 2	143	1,960	4,418	1,616
374	Discharge at Harmony Road and County Rd. 1	6	45	85	85
810	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	4	11	19	19

*Provided by Timnath

Appendix B

Developed Condition Hydrology

Maps:

1) B-1 – Future Basin Map – North
2) B-2 – Future Basin Map – South
3) B-3 – Future Routing Map – North
4) B-4 – Future Routing Map – South
5) B-5 – Future Downtown SWMM Map
6) B-6 – Future Overall SWMM Map
7) B-7 – Future Land Use Map with SWMM Basins

Tables:

1) B-1 – SWMM Subbasin Parameters – Future Conditions
2) B-2 – Summary of Conceptual Detention Flow Rates
3) B-3 – SWMM Results – Subbasins – Future Conditions
4) B-4 – SWMM Results – Links
5) B-5 – SWMM Results – Nodes
6) B-6 – Summary and Comparison of Results – Existing to Future Conditions
7) B-7 – Summary and Comparison of Future Results – 2018 Study with 2005 Study

EXHIBIT B-1 - SWMM Subbasin Map
Developed Condition - North Map

Timnath Drainage Master Plan 2018 Update

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppB_Future\B-1 - FUT_BasinMap_North.mxd - Plot By: SimpsonM - Date: 8/21/2018

EXHIBIT B-2 - SWMM Subbasin Map
Developed Condition - South Map

Timnath Drainage Master Plan 2018 Update

Legend

SWMM Subbasins - Developed Impver. Percent

- 0 - 6%
- 7 - 20%
- 21 - 35%
- 36 - 50%
- 51 - 65%
- 66 - 80%
- 81 - 100%

SWMM Subbasin (Name, Area - Ac, % Imp.)

SWMM Routing Link

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppB_Future\B-3 - FUT_RoutingMap_North.mxd - Plot By: SimpsonM - Date: 8/21/2018

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppB_Future\B-4 - EX_RoutingMap_South.mxd - Plot By: SimpsonM - Date: 8/21/2018

EXHIBIT B-5 - Downtown Timnath SWMM Map
Developed Condition
Timnath Drainage Master Plan 2018 Update
Legend
SWMM Subbasins - Developed Imperv. Percent
0 - 6%
7 - 20%
21 - 35%
36 - 50%
51 - 65%
66 - 80%
81 - 100%
SWMM Subbasin (Name, Area - Ac, % Imp.)
Subbasin Connnection
SWMM Conveyance Links
Link
Orifice; Outlet; Weir
SWMM Nodes
DIVIDER
JUNCTION
OUTFALL
POND (EXIST.)
AYRES ASSOCIATES
200
Feet
E COUNTY ROAD 40
MAIN ST.
TIMNATH ELEMENTARY
GREAT WESTERN RAILROAD
E HARMONY RD
Cache La Poudre River
SB 21 54 ac. 45%
SB 50 6 ac. 50%
SB 50A 7 ac. 50%
SB 49 32 ac. 64%
SB 48 84 ac. 68%
SB 51 21 ac. 78%
SB 55 11 ac. 75%
SB 51A 6 ac. 80%
SB 60A 2 ac. 56%
SB 60 1 ac. 56%
SB 59 3 ac. 50%
SB 58 1 ac. 80%
SB 66 3 ac. 80%
SB 65 2 ac. 80%
SB 63 1 ac. 80%
SB 52 14 ac. 78%
SB 67 30 ac. 49%
SB 57 3 ac. 80%
SB 62 2 ac. 79%
SB 64 2 ac. 77%
SB 113A 5 ac. 72%
SB 113B 3 ac. 70%
SB 61 3 ac. 70%
SB 70A 30 ac. 67%
SB 111A 2 ac. 50%
SB 111B 6 ac. 50%
SB 114 4 ac. 40%
SB 70 55 ac. 50%
SB 112 1 ac. 50%
SB 119 4 ac. 50%
SB 130 2 ac. 50%
SB 110 27 ac. 73%
SB 69 40 ac. 75%

File: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\AppendixMaps\AppB_Future\B-6 - FUT_SWMM_TimnathRes.mxd - Plot By: SimpsonM - Date: 8/21/2018


EXHIBIT B-7 - Land Use and Subbasin Map
Developed Conditions
Timnath Drainage Master Plan 2018 Update
Legend
2016 Timnath Zoning
C
RC
CMU
E
DC
MU
RMU
LDMU
OS
P
HDR
MDR
VLR
LDR
CDR-AB
W
Timnath Growth Managment Area (2016)
Subbasin Boundary
Subasin Label (Name, Percent Impervious)
1,400
Feet
AYRES ASSOCIATES
E COUNTY ROAD 52
COUNTY ROAD 1
WELD COUNTY RD 15
COUNTY ROAD 5
E MULBERRY ST
INTERSTATE 25
HIGHWAY 14
E PROSPECT RD
TIMNATH RESERVOIR
WELD COUNTY ROAD 78
E HORSETOOTH RD
MAIN ST.
LCR 40
WELD COUNTY ROAD 76
S COUNTY ROAD 1
E HARMONY RD
WELD COUNTY ROAD 74
Cache La Poudre River
KECHTER RD
E COUNTY ROAD 36
WELD COUNTY ROAD 72
S COUNTY ROAD 5
GREAT WESTERN RAILROAD
HIGHWAY 257

Table B-1 - SWMM Subbasin Parameters - Future Condition

[SUBCATCHMENTS]	Existing Condition				Future				
Name	RainGage	Outlet	Area	Exist %Imperv	Future Imperviousness	Width	Flow Length	Slope	Land Use Conversion
2	RG1	53	67.09	2	90	9741	300	1	Yes
3	RG1	54	36.68	5	80	5326	300	1	Yes
4	RG1	117	32.45	20	80	4712	300	1	Yes
5	RG1	129	82.16	2	55	11930	300	1	Yes
6	RG1	133	8.54	2	90	1240	300	1	Yes
7	RG1	132	31.57	20	40	4584	300	1	Yes
8	RG1	134	197.45	5	67	28670	300	1	Yes
9	RG1	500	142.96	5	50	20758	300	1	Yes
10	RG1	138	115.38	12	55	16753	300	1	Yes
11	RG1	142	36.46	2	39	5294	300	1	Yes
12	RG1	143	41.68	5	44	6052	300	1	Yes
13	RG1	LAKECANAL2	26.3	20	38	3819	300	1	Yes
14	RG1	146	102.97	2	33	14951	300	1	Yes
15	RG1	149	86.87	5	20	12614	300	1	Yes
16	RG1	LAKECANAL3	42.8	25	25	6235	299	0.44	No
17	RG1	153	37.16	2	45	5396	300	1	Yes
18	RG1	156	76.37	2	51	11089	300	1	Yes
20	RG1	159	36.41	12	40	5287	300	1	Yes
21	RG1	162	54.43	12	45	7903	300	1	Yes
22	RG1	164	47.17	20	20	7110	289	1.8	No
23	RG1	165	7.37	30	30	642	500	0.54	No
24	RG1	166	21.36	15	15	3101	300	1.86	No
25	RG1	P-25	36.96	15	15	3220	500	0.65	No
26	RG1	169	33.5	10	66	4864	300	1	Yes
27	RG1	170	33.05	20	20	2879	500	0.43	No
28	RG1	173	35.06	20	20	3054	500	1.73	No
29	RG1	P-29	22.18	20	20	1932	500	2.48	No
30	RG1	177	9.32	5	30	1720	236	1.18	Yes
31	RG1	P-31	45.38	25	25	4707	420	2.57	No
32	RG1	LAKECANAL4	56.49	20	20	8202	300	0.57	No
33	RG1	179	10.33	12	29	1500	300	1	Yes
34	RG1	180	44.49	10	61	6460	300	1.75	Yes
35	RG1	182	81.61	5	45	11850	300	1.5	Yes
37	RG1	187	117.18	5	37	17015	300	1	Yes
38	RG1	186	66.39	5	30	9640	300	1	Yes
39	RG1	TRIC6	47.66	5	21	6920	300	3	Yes
43	RG1	193	107.04	5	22	15542	300	1	Yes
44	RG1	LAKECANAL8	20.16	5	6	4391	200	5.8	Yes
45	RG1	199	65.97	2	42	9579	300	1.57	Yes
46	RG1	201	56.24	12	38	8166	300	1	Yes
47	RG1	LAKECANAL9	19.4	5	34	2817	300	6.64	Yes
48	RG1	204	84.49	5	68	12268	300	1	Yes
49	RG1	207	32.41	12	64	4706	300	1	Yes
50	RG1	P-50	5.78	50	50	3187	79	0.72	No
51	RG1	213	20.68	10	78	3003	300	1	Yes
52	RG1	216	14.31	20	78	2078	300	1	Yes
55	RG1	217	10.68	45	75	1551	300	1	Yes
57	RG1	DTN4	2.69	80	80	391	300	1	Yes
58	RG1	DTN6	1.11	50	80	322	150	1.15	Yes
59	RG1	DTN7	3.22	50	50	712	197	1	Yes
60	RG1	DTN7	1.38	50	56	707	85	1	Yes
61	RG1	220	2.51	40	70	547	200	1	Yes
62	RG1	DTN3	2.53	70	79	841	131	1	Yes
63	RG1	DTN6	0.91	50	80	551	72	1	Yes
64	RG1	221	2.17	50	77	722	131	1.56	Yes
65	RG1	DTN14	1.94	50	80	397	213	1.15	Yes

Table B-1 - SWMM Subbasin Parameters - Future Condition

[SUBCATCHMENTS]	Existing Condition				Future				
Name	RainGage	Outlet	Area	Exist %Imperv	Future Imperviousness	Width	Flow Length	Slope	Land Use Conversion
66	RG1	DTN13	2.72	50	80	601	197	1.31	Yes
67	RG1	223	30.08	2	49	4368	300	1	Yes
68	RG1	225	50.77	2	36	7372	300	1	Yes
69	RG1	229	40.03	2	75	5812	300	1	Yes
70	RG1	230	55.26	2	50	8024	300	1	Yes
71	RG1	LAKECANAL11	16.84	5	30	2445	300	3.69	Yes
72	RG1	234	88.1	2	32	12792	300	1.47	Yes
73	RG1	238	159.21	2	50	23117	300	1	Yes
74	RG1	LAKECANAL18	31.57	20	20	4584	300	3.24	No
75	RG1	P-75	33.51	30	30	4866	300	0.86	No
76	RG1	250	79.02	5	35	11474	300	1.98	Yes
77	RG1	252	77.02	15	15	6710	500	2.04	No
78	RG1	LAKECANAL12	72.45	5	5	10520	300	3.72	Yes
79	RG1	TROC_1A	28.16	5	5	4089	300	1.29	Yes
80	RG1	P-80	7.7	15	15	1280	262	3.6	No
81	RG1	P-81	44.6	25	25	6476	300	2.05	No
82	RG1	LAKECANAL16	20.67	30	30	4570	197	2.95	No
83	RG1	276	72.31	5	72	10499	300	1.13	Yes
84	RG1	279	48.61	25	25	18413	115	2.26	No
85	RG1	283	140.74	5	54	20435	300	1	Yes
86	RG1	296	67.54	30	30	5884	500	1.96	No
87	RG1	LAKECANAL21	15.89	2	45	2814	246	3.28	Yes
88	RG1	303	98.14	35	35	14250	300	0.84	No
89	RG1	LAKECANAL22	13.7	2	31	1989	300	2.3	Yes
90	RG1	J-90	51.03	2	34	7410	300	1	Yes
91	RG1	307	16.99	5	80	2467	300	1	Yes
92	RG1	P-92	28.41	10	80	5031	246	1.31	Yes
93	RG1	310	98.93	2	51	14365	300	1	Yes
94	RG1	312	72.39	2	45	10511	300	1	Yes
95	RG1	P-95	61.22	45	45	20357	131	0.51	No
96	RG1	TROC9	11.7	10	10	5201	98	3.73	No
97	RG1	317	60.76	35	35	27007	98	0.52	No
98	RG1	321	76.4	30	30	11093	300	0.8	No
99	RG1	324	20.26	2	25	2942	300	1	Yes
100	RG1	TROC12	43.64	5	27	6337	300	1	Yes
101	RG1	327	83.24	2	45	12086	300	1	Yes
102	RG1	328	38.8	5	50	5634	300	1	Yes
103	RG1	P-103	25.42	45	45	3691	300	0.86	No
104	RG1	P-104	62.48	50	50	20776	131	0.47	No
105	RG1	P-105	42.19	30	30	3676	500	0.5	No
106	RG1	501	24.5	10	45	5010	213	1	Yes
107	RG1	P-107	57	40	40	15140	164	0.54	No
108	RG1	G3-2_A	17.25	10	35	2505	300	1	Yes
109	RG1	346	30.78	10	75	4469	300	1	Yes
110	RG1	P-110	26.68	6	73	3874	300	1	Yes
112	RG1	DTS5	1.21	50	50	703	75	1.4	No
114	RG1	352	4.05	40	40	896	197	1.4	No
119	RG1	351	3.89	50	50	1130	150	1.43	No
120	RG1	P-120	1225.46	52	65	53381	1000	1	Yes
121	RG1	190	2570.35	10	45	111964	1000	1	Yes
122	RG1	189	742.59	2	45	32347	1000	1	Yes
123	RG1	185	697.3	2	39	30374	1000	1	Yes
124	RG1	184	1625.8	2	48	70820	1000	1	Yes
125	RG1	178	1047.36	15	43	45623	1000	1	Yes
126	RG1	176	3422.54	10	15	149086	1000	1	Yes
130	RG1	360	2.4	50	50	1045	100	1.05	No

Table B-1 - SWMM Subbasin Parameters - Future Condition

[SUBCATCHMENTS]	Existing Condition				Future				
Name	RainGage	Outlet	Area	Exist %Imperv	Future Imperviousness	Width	Flow Length	Slope	Land Use Conversion
100A	RG1	TROC13	43.69	5	27	6344	300	1	Yes
103A	RG1	P-103A	20.78	45	45	3902	232	1.27	No
103B	RG1	330	5.26	45	45	2291	100	1.5	No
103C	RG1	P-103C	16.11	45	45	2395	293	1.96	No
103D	RG1	P-103D1	17.66	45	45	8547	90	1.03	No
106A	RG1	342	103.01	35	35	8974	500	0.5	No
107A	RG1	341	14.59	45	45	6908	92	0.73	No
108A	RG1	335	7.86	5	25	1141	300	1	Yes
111A	RG1	DTS3	1.68	50	50	523	140	1.05	No
111B	RG1	349	5.52	50	50	874	275	1.05	No
113A	RG1	DTS2	4.51	10	72	786	250	1	Yes
113B	RG1	350	2.8	70	70	488	250	0.91	No
15A	RG1	151	43.24	3	55	6278	300	1	Yes
21A	RG1	140	76.57	2	42	11118	300	1	Yes
25A	RG1	P-25	17.14	10	10	1493	500	0.68	No
43A	RG1	196	40.52	5	44	5884	300	1.04	Yes
47A	RG1	LAKECANAL10	22.53	5	43	3271	300	4.25	Yes
4A	RG1	P-4A	30.17	70	70	4395	299	0.4	No
50A	RG1	P-50A	7.14	50	50	3174	98	0.47	No
51A	RG1	P-51	5.81	5	80	844	300	1	Yes
5A	RG1	127	33.35	15	15	4842	300	0.55	No
60A	RG1	DTN10	1.67	50	56	428	170	1	Yes
70A	RG1	231	30.29	2	67	4398	300	1	Yes
72A	RG1	P-80	4.9	10	30	711	300	2.71	Yes
75A	RG1	243	23.78	30	30	3464	299	1.33	No
75B	RG1	LAKECANAL19	27.14	10	10	3941	300	3.78	No
75C	RG1	248	8.43	5	5	1224	300	1.73	No
75D	RG1	P-75D	3.32	5	5	699	207	5.93	No
77A	RG1	254	2.31	10	10	875	115	1.56	No
77B	RG1	P-77B	1.87	10	10	529	154	3.07	No
77C	RG1	P-77C	9.31	25	25	3526	115	5.76	No
77D	RG1	P-77D	27.4	30	30	4852	246	2.52	No
80A	RG1	TROC2	4.01	10	10	1713	102	2.92	No
80B	RG1	TROC2	1.39	10	10	561	108	4	No
80C	RG1	TROC3	10.45	10	10	1979	230	3.58	No
80D	RG1	P-80D	9.66	10	10	3366	125	2.41	No
81A	RG1	353	5.86	30	30	851	300	7.08	No
82A	RG1	TROC5	16.43	10	10	2386	300	1.8	No
82B	RG1	TROC5	3.2	10	10	1515	92	15.7	No
82C	RG1	TROC6	8.06	10	10	5320	66	18.13	No
82D	RG1	P-82D1	109.07	30	30	15837	300	5.7	No
83A	RG1	277	11.65	5	47	1692	300	1.65	Yes
85A	RG1	TROC7	13.25	90	90	1924	300	0.66	No
85B	RG1	P-85B	29.59	90	90	4296	300	0.73	No
85C	RG1	293	45.4	5	50	6592	300	1	Yes
86A	RG1	P-86A	13.15	30	30	2569	223	2.66	No
86B	RG1	298	21.22	10	10	1849	500	1.78	No
86C	RG1	P-86C	5.41	20	20	788	299	5.64	No
92A	RG1	309	20.02	50	50	4094	213	0.54	No
98A	RG1	P-98A	34.18	30	30	7558	197	0.66	No
9A	RG1	136	22.55	5	25	3274	300	1	Yes

Table B-2 - Summary of Conceptual Detention Basin Flow Rates

Notes	Subbasins with Land Use Change	Pond Name	Outlet Link	Outlet Node	Existing Impervious (%)	Future Impervious (%)	Target Outflow Rate (cfs) (Exist 10yr)	Model Pond Outlet Discharge (cfs) (Future 100-yr Pond Outflows)	Existing Subbasin Outflows (cfs) 100-yr	Existing Subbasin Outflows (cfs) 10-yr	Existing Subbasin Outflows (cfs) 2-yr	Future Pond Outlet Flows (cfs) 100-yr	Future Pond Outlet Flows (cfs) 10-yr	Future Pond Outlet Flows (cfs) 2-yr	Discharge Comparison EX --> FUT (cfs) 100-yr	Discharge Comparison EX --> FUT (cfs) 10-yr	Discharge Comparison EX --> FUT (cfs) 2-yr	100-yr Future Concept Pond Storage Volume (AF)
	2	CP-2	L-CP-2	53	2	90	7	7	58	7	4	7	4	2	-51	-3	-2	17.7
	3	CP-3	L-CP-3	54	5	80	10	10	34	9	5	10	5	2	-24	-4	-3	8.4
	4	CP-4	L-CP-4	117	20	80	31	32	76	30	17	32	18	10	-45	-13	-7	5.0
	5	CP-5	L-CP-5	129	2	55	9	9	71	9	5	9	4	1	-62	-5	-3	17.5
	6	CP-6	L-CP-6	133	2	90	1	1	8	1	0	1	1	0	-7	0	0	2.3
	7	CP-7	L-CP-7	132	20	40	30	32	81	30	17	32	14	7	-49	-16	-10	3.1
	8	CP-8	L-CP-8	134	5	67	49	49	187	49	28	49	24	11	-137	-24	-17	41.7
	9	CP-9	L-CP-9	500	5	50	36	37	137	35	20	37	16	7	-100	-19	-13	25.6
	10	CP-10	L-CP-10	138	12	55	67	67	185	67	38	67	33	18	-118	-34	-20	16.8
	11	CP-11	L-CP-11	142	2	39	4	4	27	4	2	4	2	1	-23	-2	-1	6.3
	12	CP-12	L-CP-12	143	5	44	11	11	44	10	6	11	4	2	-34	-7	-4	6.9
	13	CP-13	L-CP-13	LAKECANAL2	20	38	26	27	77	26	15	27	12	6	-50	-14	-9	2.4
	14	CP-14	L-CP-14	146	2	33	11	11	78	10	6	11	3	1	-67	-7	-5	16.7
	15	CP-15	L-CP-15	149	5	20	22	22	96	22	12	22	5	2	-74	-16	-10	10.9
	17	CP-17	L-CP-17	153	2	45	4	4	45	4	2	4	2	1	-41	-2	-1	6.9
	18	CP-18	L-CP-18	156	2	51	8	8	63	8	4	8	3	1	-56	-4	-3	15.0
	20	CP-20	L-CP-20	159	12	40	22	22	63	21	12	22	9	5	-41	-12	-8	4.2
	21	CP-21	L-CP-21	162	12	45	32	32	86	31	18	32	14	6	-54	-17	-12	6.9
	26	CP-26	L-CP-26	169	10	66	17	18	49	16	9	18	9	6	-31	-7	-4	5.7
	30	CP-30	L-CP-30	177	5	30	3	3	18	2	1	3	1	0	-16	-1	-1	1.3
	33	CP-33	L-CP-33	179	12	29	7	6	18	6	3	6	2	1	-12	-4	-3	1.0
	34	CP-34	L-CP-34	180	10	61	24	24	93	23	13	24	12	6	-69	-11	-7	7.7
	35	CP-35	L-CP-35	182	5	45	22	22	125	22	12	22	10	4	-103	-12	-8	14.7
	37	CP-37	L-CP-37	187	5	37	29	29	104	29	17	29	11	5	-75	-18	-12	17.8
	38	CP-38	L-CP-38	186	5	30	17	17	59	16	9	17	6	3	-42	-10	-7	9.1
	39	CP-39	L-CP-39	TRIC6	5	21	12	12	83	12	7	12	4	1	-71	-8	-6	6.5
	43	CP-43	L-CP-43	193	5	22	27	27	120	26	15	27	7	3	-93	-19	-12	13.1
	45	CP-45	L-CP-45	199	2	42	7	7	88	7	4	7	3	1	-81	-4	-3	12.4
	46	CP-46	L-CP-46	201	12	38	33	33	92	32	19	33	13	6	-59	-19	-13	6.7
	47	CP-47	L-CP-47	LAKECANAL9	5	34	5	5	70	5	3	5	2	1	-65	-3	-2	3.0
	48	CP-48	L-CP-48	204	5	68	21	21	80	21	12	21	11	6	-60	-10	-6	17.9
	49	CP-49	L-CP-49	207	12	64	19	19	55	19	11	19	10	5	-36	-9	-6	5.2
	51	CP-51	L-CP-51	213	5	78	6	6	21	5	3	6	3	2	-15	-2	-1	4.6
	52	CP-52	L-CP-52	216	20	78	14	14	39	14	8	14	8	5	-26	-6	-3	2.2
Timnath Elem	55	CP-55	L-CP-55	217	45	75	22	22	53	21	12	22	12	7	-31	-10	-5	1.2
	61	CP-61	L-CP-61	220	40	70	5.0	4.9	13	5	3	5	2	1	-8	-3	-2	0.3
	64	CP-64	L-CP-64	221	50	77	6	5	15	5	3	5	3	1	-10	-3	-2	0.3
	67	CP-67	L-CP-67	J-CLARK3	2	49	3	3	24	3	2	3	1	1	-21	-1	-1	5.9
	68	CP-68	L-CP-68	225	2	36	6	6	46	5	3	6	2	1	-41	-3	-2	9.0
	69	CP-69	L-CP-69	229	2	75	4	4	33	4	2	4	2	1	-29	-2	-1	9.6
	70	CP-70	L-CP-70	230	2	50	6	6	41	5	3	6	3	1	-35	-3	-2	10.8
	71	CP-71	L-CP-71	LAKECANAL11	5	30	5	5	29	4	2	5	1	1	-24	-3	-2	2.4
	72	CP-72	L-CP-72	234	2	32	10	10	124	10	5	10	3	1	-114	-7	-4	15.4
	73	CP-73	L-CP-73	J-CLARK1	2	50	17	17	134	17	9	17	8	4	-117	-8	-5	32.2
	76	CP-76	L-CP-76	250	5	35	20	20	161	19	11	20	7	3	-142	-12	-8	12.3
	83	CP-83	L-CP-83	276	5	72	19	19	91	18	10	19	10	6	-73	-8	-5	15.8
	85	CP-85	L-CP-85	283	5	54	35	35	125	34	20	35	16	7	-90	-19	-13	25.9
	87	CP-87	L-CP-87	LAKECANAL21	2	45	2	2	39	2	1	2	1	1	-37	-1	0	3.0
	89	CP-89	L-CP-89	LAKECANAL22	2	31	2	2	19	1	1	2	1	0	-17	-1	0	2.1
	90	CP-90	L-CP-90	J-90	2	34	6	6	52	5	3	6	2	1	-46	-3	-2	8.2
	91	CP-91	L-CP-91	307	5	80	5	5	19	4	2	5	3	1	-15	-2	-1	3.9
	92	CP-92	L-CP-92	P-92	10	80	14	14	67	14	8	14	7	3	-53	-7	-5	5.8
	93	CP-93	L-CP-93	310	2	51	10	10	71	10	6	10	4	2	-62	-6	-4	19.5
	94	CP-94	L-CP-94	312	2	45	8	8	52	7	4	8	3	1	-44	-4	-3	13.3
	99	CP-99	L-CP-99	324	2	25	3	3	20	2	1	3	1	0	-17	-1	-1	3.0
	100	CP-100	L-CP-100	TROC12	5	27	11	11	47	11	6	11	2	1	-37	-8	-5	6.0
	101	CP-101	L-CP-101	327	2	45	9	9	69	8	5	9	3	1	-61	-5	-3	15.5
	102	CP-102	L-CP-102	328	5	50	10	10	41	10	6	10	4	2	-32	-6	-4	6.9
	106	CP-106	L-CP-106	501	10	45	13	12	53	12	7	12	4	2	-40	-8	-5	3.7
	108	CP-108	L-CP-108	G3-2_A	10	35	9	8	30	8	5	8	2	1	-22	-6	-4	2.2
	109	CP-109	L-CP-109	346	10	75	15	14	43	15	9	14	6	3	-29	-9	-6	6.1

Table B-2 - Summary of Conceptual Detention Basin Flow Rates

									Existing Subbasin Outflows (cfs)			Future Pond Outlet Flows (cfs)			Discharge Comparison EX --> FUT (cfs)			
Notes	**Subbasins with Land Use Change**	**Pond Name**	**Outlet Link**	**Outlet Node**	**Existing Impervious** (%)	**Future Impervious** (%)	**Target Outflow Rate (cfs)** (Exist 10yr)	**Model Pond Outlet Discharge (cfs)** (Future 100-yr Pond Outflows)	**100-yr**	**10-yr**	**2-yr**	**100-yr**	**10-yr**	**2-yr**	**100-yr**	**10-yr**	**2-yr**	**100-yr Future Concept Pond Storage Volume (AF)**
	110	CP-110	L-CP-110	P-110	*6*	*73*	*8*	*8*	30	8	5	8	4	2	-22	-4	-3	5.7
Upstream of Tim Res	121	CP-121	L-CP-121	190	*10*	*45*	*1231*	*1238*	3402	1231	702	1238	558	259	-2164	-673	-443	310.5
	122	CP-122	L-CP-122	189	*2*	*45*	*73*	*72*	465	73	43	72	36	21	-393	-37	-22	125.8
	123	CP-123	L-CP-123	185	*2*	*39*	*69*	*68*	437	68	40	68	33	18	-368	-36	-22	108.4
	124	CP-124	L-CP-124	184	*2*	*48*	*160*	*159*	1019	160	93	159	76	36	-859	-83	-57	286.7
	125	CP-125	L-CP-125	178	*15*	*43*	*732*	*730*	1886	731	409	730	362	194	-1156	-369	-215	94.9
	126	CP-126	L-CP-126	176	*10*	*15*	*1639*	*1641*	4530	1639	935	1641	465	203	-2889	-1174	-732	164.3
	100A	CP-100A	L-CP-100A	TROC13	*5*	*27*	*11*	*11*	42	11	6	11	3	1	-31	-8	-5	5.9
	108A	CP-108A	L-CP-108A	335	*5*	*25*	*2*	*1.9*	10	2	1	2	1	0	-8	-1	-1	1.0
	113A	CP-113A	L-CP-113A	DTS2	*10*	*72*	*3*	*3*	9	2	1	3	1	1	-7	-1	-1	0.8
	15A	CP-15A	L-CP-15A	151	*3*	*55*	*7*	*7*	40	6	4	7	3	1	-33	-3	-2	8.6
	21A	CP-21A	L-CP-21A	140	*2*	*42*	*8*	*8*	57	8	4	8	3	1	-49	-5	-3	13.8
	43A	CP-43A	L-CP-43A	196	*5*	*44*	*10*	*10*	47	10	6	10	3	1	-38	-7	-4	6.9
	47A	CP-47A	L-CP-47A	LAKECANAL10	*5*	*43*	*6*	*6*	42	6	3	6	2	1	-37	-3	-2	3.9
	70A	CP-70A	L-CP-70A	231	*2*	*67*	*3*	*3*	22	3	2	3	2	1	-19	-1	-1	6.8
	72A	CP-72A	L-CP-72A	P-80	*10*	*30*	*3*	*3*	10	2	1	3	1	0	-7	-2	-1	0.6
	83A	CP-83A	L-CP-83A	277	*5*	*47*	*3*	*3*	16	3	2	3	1	1	-13	-2	-1	2.0
	85C	CP-85C	L-CP-85C	293	*5*	*50*	*12*	*12*	51	11	7	12	5	2	-39	-7	-5	8.1
	9A	CP-9A	L-CP-9A	136	*5*	*25*	*6*	*6*	22	6	3	6	1	1	-16	-4	-3	3.0
	Subasins with LU Change & No Detention Pond																	
Downtown	57			DTN4	*80*	*80*			21	9	4							
Downtown	58			DTN6	*50*	*80*			7	3	2							
Downtown	59			DTN7	*50*	*50*			20	8	4							
Downtown	60			DTN7	*50*	*56*			10	3	2							
Downtown	60A			DTN10	*50*	*56*			10	4	2							
Downtown	62			DTN3	*70*	*79*			20	8	5							
Downtown	63			DTN6	*50*	*80*			7	2	1							
Downtown	65			DTN14	*50*	*80*			12	5	3							
Downtown	66			DTN13	*50*	*80*			17	7	4							
Tim Res.	120			P-120	*52*	*65*			5829	2331	1144							
Downtown	51A				*10*	*80*			11	3	2							

Table B-3 - Subbasin Discharge Results

Subbasin	Concept Detention Outlet Link	Existing SWMM Model Results - Subbasin Discharge: Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results - Subbasin Discharge: Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results - Concept Detention Discharge: Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
2	L-CP-2	4	5	7	12	28	58	139	206	260	352	463	607	2	3	4	5	6	7
3	L-CP-3	5	7	9	14	21	34	70	102	129	176	233	309	2	4	5	7	8	10
4	L-CP-4	17	24	30	41	55	76	62	91	114	155	204	272	10	15	18	22	27	32
5	L-CP-5	5	7	9	17	37	71	116	167	210	290	391	534	1	2	4	6	7	9
6	L-CP-6	0	1	1	2	4	8	18	26	33	46	60	78	0	1	1	1	1	1
7	L-CP-7	17	24	30	42	57	81	34	48	60	84	116	162	7	11	14	19	25	32
8	L-CP-8	28	39	49	74	116	187	327	476	597	815	1,089	1,466	11	18	24	33	41	49
9	L-CP-9	20	29	35	53	83	137	186	267	333	454	613	842	7	12	16	23	30	37
10	L-CP-10	38	54	67	92	128	185	163	235	293	396	531	725	18	27	33	44	55	67
11	L-CP-11	2	3	4	6	13	27	38	54	67	92	126	176	1	1	2	2	3	4
12	L-CP-12	6	8	10	16	26	44	49	69	86	117	158	219	2	3	4	6	8	11
13	L-CP-13	15	21	26	37	53	77	27	38	48	67	93	130	6	10	12	16	21	27
14	L-CP-14	6	8	10	18	38	78	93	132	163	223	309	438	1	2	3	6	8	11
15	L-CP-15	12	17	22	34	57	96	49	69	85	123	179	269	2	3	5	12	17	22
16	-	29	41	51	70	97	138	29	41	51	70	97	138	-	-	-	-	-	-
17	L-CP-17	2	3	4	9	22	45	44	63	79	107	145	201	1	1	2	3	3	4
18	L-CP-18	4	6	8	13	31	63	101	145	181	245	330	452	1	2	3	5	6	8
20	L-CP-20	12	17	21	29	42	63	39	56	69	94	128	178	5	8	9	13	17	22
21	L-CP-21	18	25	31	43	60	86	65	93	115	156	211	292	6	11	14	19	25	32
22	-	27	38	46	68	103	160	27	38	46	68	103	160	-	-	-	-	-	-
23	-	5	8	10	13	18	25	5	8	10	13	18	25	-	-	-	-	-	-
24	-	9	13	16	24	37	61	9	13	16	24	37	61	-	-	-	-	-	-
25	-	15	22	27	37	51	74	15	22	27	37	51	74	-	-	-	-	-	-
26	L-CP-26	9	13	16	23	32	49	55	80	100	135	180	242	6	8	9	12	15	18
27	-	17	25	31	42	56	78	17	25	31	42	56	78	-	-	-	-	-	-
28	-	20	28	34	47	66	97	20	28	34	47	66	97	-	-	-	-	-	-
29	-	12	18	22	30	43	65	12	18	22	30	43	65	-	-	-	-	-	-
30	L-CP-30	1	2	2	4	9	18	8	11	14	19	27	40	0	1	1	2	2	3
31	-	32	45	56	80	116	171	32	45	56	80	116	171	-	-	-	-	-	-
32	-	31	44	55	75	106	155	31	44	55	75	106	155	-	-	-	-	-	-
33	L-CP-33	3	5	6	8	12	18	8	12	14	20	28	40	1	1	2	3	5	6
34	L-CP-34	13	18	23	37	58	93	71	102	129	180	244	332	6	9	12	16	20	24
35	L-CP-35	12	16	22	40	70	125	99	141	178	251	346	482	4	7	10	14	18	22
37	L-CP-37	17	23	29	42	64	104	117	167	206	281	384	540	5	8	11	17	22	29
38	L-CP-38	9	13	16	24	36	59	55	78	96	131	182	261	3	5	6	10	13	17
39	L-CP-39	7	10	12	22	44	83	29	40	49	75	117	184	1	2	4	6	9	12
43	L-CP-43	15	21	26	41	69	120	66	93	115	160	230	341	3	5	7	14	21	27
44	-	3	4	6	21	43	79	3	4	6	21	43	79	-	-	-	-	-	-
45	L-CP-45	4	5	7	20	46	88	76	107	133	185	256	360	1	2	3	4	6	7
46	L-CP-46	19	26	32	45	63	92	58	82	102	140	193	271	6	9	13	19	26	33
47	L-CP-47	3	4	5	16	36	70	19	26	32	47	70	106	1	1	2	3	4	5
48	L-CP-48	12	17	21	31	49	80	141	206	258	352	469	631	6	9	11	14	17	21
49	L-CP-49	11	15	19	26	37	55	52	75	94	127	169	229	5	8	10	12	15	19
50	-	8	12	14	20	29	42	8	12	14	20	29	42	-	-	-	-	-	-
51	L-CP-51	3	4	5	8	12	21	38	57	71	96	127	170	2	2	3	4	5	6
52	L-CP-52	8	11	14	19	27	39	27	39	49	67	89	118	5	6	8	10	11	14
55	L-CP-55	12	17	21	29	39	53	19	28	36	48	64	85	7	10	12	15	18	22
57	-	4	7	9	12	16	21	5	8	9	13	17	23	-	-	-	-	-	-
58	-	2	2	3	4	5	7	2	3	4	6	8	10	-	-	-	-	-	-
59	-	4	6	8	10	14	20	4	6	8	11	14	20	-	-	-	-	-	-
60	-	2	3	3	5	7	10	2	3	4	5	8	11	-	-	-	-	-	-
61	L-CP-61	3	4	5	7	9	13	5	7	8	11	15	20	1	2	2	3	4	5
62	-	5	7	8	11	15	20	5	8	10	13	17	23	-	-	-	-	-	-
63	-	1	2	2	3	5	7	2	3	4	5	7	9	-	-	-	-	-	-
64	L-CP-64	3	4	5	7	11	15	5	7	8	11	15	20	1	2	3	3	4	5
65	-	3	4	5	6	9	12	4	6	7	10	13	17	-	-	-	-	-	-
66	-	4	5	7	9	12	17	6	8	10	14	18	24	-	-	-	-	-	-
67	L-CP-67	2	2	3	5	12	24	38	55	69	94	127	174	1	1	1	2	3	3
68	L-CP-68	3	4	5	11	24	46	50	70	88	123	170	240	1	1	2	4	5	6
69	L-CP-69	2	3	4	7	16	33	72	106	133	180	239	319	1	2	2	3	3	4
70	L-CP-70	3	4	5	9	20	41	72	103	129	175	235	323	1	2	3	4	5	6
71	L-CP-71	2	3	4	7	15	29	14	20	25	35	52	79	1	1	1	2	3	5
72	L-CP-72	5	7	10	31	67	124	78	111	139	198	282	406	1	2	3	5	8	10
73	L-CP-73	9	13	17	32	70	134	207	298	373	515	698	959	4	7	8	11	14	17
74	-	18	25	31	46	72	116	18	25	31	46	72	116	-	-	-	-	-	-
75	-	28	39	48	68	95	135	28	39	48	68	95	135	-	-	-	-	-	-
76	L-CP-76	11	16	19	39	84	161	77	109	134	188	265	383	3	5	7	12	15	20
77	-	33	46	58	86	129	198	33	46	58	86	129	198	-	-	-	-	-	-
78	-	10	15	18	41	93	177	10	15	18	41	93	177	-	-	-	-	-	-
79	-	4	6	7	14	29	54	4	6	7	14	29	54	-	-	-	-	-	-
80	-	3	5	6	11	18	30	3	5	6	11	18	30	-	-	-	-	-	-
81	-	32	44	55	81	120	180	32	44	55	81	120	180	-	-	-	-	-	-
82	-	18	25	30	45	68	106	18	25	30	45	68	106	-	-	-	-	-	-
83	L-CP-83	10	14	18	30	52	91	128	187	235	321	427	573	6	8	10	13	16	19
84	-	35	49	60	95	160	264	35	49	60	95	160	264	-	-	-	-	-	-
85	L-CP-85	20	28	34	50	77	125	195	282	351	475	637	870	7	12	16	22	28	35
86	-	55	78	97	132	181	256	55	78	97	132	181	256	-	-	-	-	-	-
87	L-CP-87	1	1	2	8	20	39	20	28	35	49	69	100	1	1	1	1	2	2
88	-	93	132	163	224	307	432	93	132	163	224	307	432	-	-	-	-	-	-
89	L-CP-89	1	1	1	4	9	19	12	17	21	29	41	61	0	1	1	1	2	2
90	L-CP-90	3	4	5	10	25	52	47	67	83	113	156	221	1	1	2	3	5	6
91	L-CP-91	2	3	4	7	11	19	32	47	60	81	107	142	1	2	3	3	4	5
92	L-CP-92	8	11	14	22	38	67	58	84	104	141	187	249	3	5	7	9	11	14
93	L-CP-93	6	8	10	16	34	71	131	188	234	317	426	585	2	3	4	6	8	10
94	L-CP-94	4	6	7	12	25	52	86	123	153	207	280	388	1	2	3	5	6	8
95	-	76	108	133	183	254	361	76	108	133	183	254	361	-	-	-	-	-	-
96	-	3	5	6	14	31	60	3	5	6	14	31	60	-	-	-	-	-	-
97	-	60	85	104	148	217	325	60	85	104	148	217	325	-	-	-	-	-	-
98	-	63	89	110	153	213	304	63	89	110	153	213	304	-	-	-	-	-	-
99	L-CP-99	1	2	2	5	10	20	14	20	25	35	50	73	0	1	1	2	2	3
100	L-CP-100	6	9	11	17	28	47	33	46	57	80	112	163	1	2	2	6	8	11
101	L-CP-101	5	7	8	15	34	69	99	142	176	239	324	449	1	2	3	5	7	9
102	L-CP-102	6	8	10	15	24	41	51	73	90	122	164	226	2	3	4	6	8	10
103	-	30	43	53	72	97	134	30	43	53	72	97	134	-	-	-	-	-	-
104	-	86	121	150	206	284	398	86	121	150	206	284	398	-	-	-	-	-	-
105	-	31	45	57	77	103	141	31	45	57	77	103	141	-	-	-	-	-	-
106	L-CP-106	7	10	12	19	32	53	30	43	53	74	103	145	2	3	4	7	10	12
107	-	63	89	110	152	211	300	63	89	110	152	211	300	-	-	-	-	-	-
108	L-CP-108	5	7	8	12	19	30	16	23	29	40	55	77	1	2	2	4	6	8
109	L-CP-109	9	12	15	21	30	43	56	82	102	139	185	247	3	4	6	9	12	14
110	L-CP-110	5	6	8	12	18	30	47	69	87	117	156	209	2	3	4	5	6	8
112	-	2	2	3	4	7	9	2	2	3	4	7	9	-	-	-	-	-	-
114	-	5	6	8	11	15	22	5	6	8	11	15	22	-	-	-	-	-	-
119	-	5	8	9	13	19	27	5	8	9	13	19	27	-	-	-	-	-	-
120	-	1,144	1,796	2,331	3,237	4,328	5,829	1,277	2,049	2,691	3,774	5,073	6,847	-	-	-	-	-	-
121	L-CP-121	702	995	1,231	1,700	2,364	3,402	2,216	3,433	4,425	6,109	8,149	10,971	259	431	558	754	974	1,238
122	L-CP-122	43	59	73	122	231	465	640	992	1,278	1,765	2,354	3,170	21	30	36	47	59	72
123	L-CP-123	40	56	68	114	217	437	552	845	1,082	1,486	1,980	2,668	18	27	33	44	55	68
124	L-CP-124	93	130	160	267	506	1,019	1,454	2,265	2,929	4,053	5,411	7,285	36	61	76	103	130	159
125	L-CP-125	409	588	731	998	1,354	1,886	880	1,357	1,745	2,406	3,207	4,319	194	298	362	464	579	730
126	L-CP-126	935	1,325	1,639	2,263	3,148	4,530	1,336	1,920	2,389	3,261	4,424	6,163	203	337	465	753	1,112	1,641
130	-	3	5	6	8	12	17	3	5	6	8	12	17	-	-	-	-	-	-

Table B-3 - Subbasin Discharge Results

Subbasin	Concept Detention Outlet Link	Existing SWMM Model Results - Subbasin Discharge						Future SWMM Model Results - Subbasin Discharge						Future SWMM Model Results - Concept Detention Discharge					
		Discharge (cfs)						Discharge (cfs)						Discharge (cfs)					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
100A	L-CP-100A	6	9	11	16	26	42	33	46	57	79	112	162	1	2	3	6	8	11
103A	-	26	36	45	62	86	121	26	36	45	62	86	121	-	-	-	-	-	-
103B	-	7	9	12	17	26	38	7	9	12	17	26	38	-	-	-	-	-	-
103C	-	20	28	35	48	67	94	20	28	35	48	67	94	-	-	-	-	-	-
103D	-	23	32	39	57	85	124	23	32	39	57	85	124	-	-	-	-	-	-
106A	-	85	125	158	215	286	389	85	125	158	215	286	389	-	-	-	-	-	-
107A	-	19	26	32	46	67	98	19	26	32	46	67	98	-	-	-	-	-	-
108A	L-CP-108A	1	2	2	3	6	10	5	8	10	13	19	28	0	0	1	1	1	2
111A	-	2	3	4	6	8	11	2	3	4	6	8	11	-	-	-	-	-	-
111B	-	7	10	13	18	24	33	7	10	13	18	24	33	-	-	-	-	-	-
113A	L-CP-113A	1	2	2	3	6	9	8	12	15	20	27	36	1	1	1	2	2	3
113B	-	5	7	9	12	16	22	5	7	9	12	16	22	-	-	-	-	-	-
15A	L-CP-15A	4	5	6	11	20	40	61	88	110	149	201	274	1	2	3	4	6	7
21A	L-CP-21A	4	6	8	13	28	57	86	122	152	207	281	391	1	2	3	5	6	8
25A	-	5	7	8	12	17	26	5	7	8	12	17	26	-	-	-	-	-	-
43A	L-CP-43A	6	8	10	16	27	47	47	68	84	115	156	217	1	2	3	6	8	10
47A	L-CP-47A	3	5	6	11	22	42	27	38	47	67	95	137	1	1	2	3	4	6
4A	-	46	69	87	119	159	212	46	69	87	119	159	212	-	-	-	-	-	-
50A	-	10	14	17	24	34	48	10	14	17	24	34	48	-	-	-	-	-	-
51A	-	2	2	3	4	7	11	11	16	20	28	37	49	-	-	-	-	-	-
5A	-	14	20	24	35	50	76	14	20	24	35	50	76	-	-	-	-	-	-
60A	-	2	3	4	5	7	10	3	4	4	6	8	12	-	-	-	-	-	-
70A	L-CP-70A	2	2	3	5	11	22	50	73	91	124	165	222	1	1	2	2	3	3
72A	L-CP-72A	1	2	2	4	6	10	4	6	7	10	15	22	0	1	1	1	2	3
75A	-	20	28	35	48	68	99	20	28	35	48	68	99	-	-	-	-	-	-
75B	-	8	11	13	24	43	78	8	11	13	24	43	78	-	-	-	-	-	-
75C	-	1	2	2	4	9	16	1	2	2	4	9	16	-	-	-	-	-	-
75D	-	0	1	1	3	6	12	0	1	1	3	6	12	-	-	-	-	-	-
77A	-	1	1	1	2	5	9	1	1	1	2	5	9	-	-	-	-	-	-
77B	-	1	1	1	2	4	7	1	1	1	2	4	7	-	-	-	-	-	-
77C	-	7	9	11	21	38	62	7	9	11	21	38	62	-	-	-	-	-	-
77D	-	23	33	40	58	87	131	23	33	40	58	87	131	-	-	-	-	-	-
80A	-	1	2	2	5	11	20	1	2	2	5	11	20	-	-	-	-	-	-
80B	-	0	1	1	2	4	7	0	1	1	2	4	7	-	-	-	-	-	-
80C	-	3	4	5	10	19	34	3	4	5	10	19	34	-	-	-	-	-	-
80D	-	3	4	5	10	22	40	3	4	5	10	22	40	-	-	-	-	-	-
81A	-	5	7	9	13	20	31	5	7	9	13	20	31	-	-	-	-	-	-
82A	-	5	7	8	13	22	39	5	7	8	13	22	39	-	-	-	-	-	-
82B	-	1	1	2	6	14	24	1	1	2	6	14	24	-	-	-	-	-	-
82C	-	2	3	4	20	42	66	2	3	4	20	42	66	-	-	-	-	-	-
82D	-	93	131	160	238	363	558	93	131	160	238	363	558	-	-	-	-	-	-
83A	L-CP-83A	2	2	3	5	9	16	15	21	26	36	49	68	1	1	1	2	2	3
85A	-	26	39	49	67	89	117	26	39	49	67	89	117	-	-	-	-	-	-
85B	-	58	88	111	152	200	263	58	88	111	152	200	263	-	-	-	-	-	-
85C	L-CP-85C	7	9	11	18	29	51	59	85	106	144	194	267	2	3	5	7	10	12
86A	-	11	16	19	28	43	65	11	16	19	28	43	65	-	-	-	-	-	-
86B	-	6	8	10	16	24	39	6	8	10	16	24	39	-	-	-	-	-	-
86C	-	3	4	5	8	14	23	3	4	5	8	14	23	-	-	-	-	-	-
92A	-	26	38	47	64	86	118	26	38	47	64	86	118	-	-	-	-	-	-
98A	-	29	40	50	70	99	144	29	40	50	70	99	144	-	-	-	-	-	-
9A	L-CP-9A	3	5	6	8	13	22	16	22	27	38	54	80	1	1	1	3	4	6

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Element ID	Existing SWMM Model Results						Future SWMM Model Results					
	Discharge (cfs)						Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
5	10	16	21	29	39	55	11	17	21	28	34	40
10	10	16	20	28	39	94	7	12	15	20	26	34
14	16	23	30	50	84	140	19	30	38	54	76	110
31	14	20	32	90	213	423	23	38	55	100	153	227
33	8	11	13	23	52	103	3	5	7	14	21	27
35	3	7	21	91	223	466	28	45	65	119	181	264
37	30	41	65	236	586	1,192	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
39	28	40	59	162	364	701	0	0	1	1	1	4
45	30	42	64	236	591	1,224	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
46	2	2	4	16	36	69	2	3	4	7	9	11
53	2	2	4	16	36	69	2	3	4	7	9	11
59	372	549	702	1,054	1,732	3,035	260	436	614	1,065	1,617	2,313
60	28	40	56	203	573	1,213	46	79	101	140	178	222
61	6	8	10	30	70	133	3	5	7	12	15	19
62	295	438	553	771	1,149	2,007	247	406	543	772	1,009	1,283
63	1	2	3	9	25	55	2	3	4	5	10	13
64	15	21	33	91	205	379	17	27	38	74	118	182
67	29	43	63	231	589	1,269	4	7	9	13	16	20
70	7	10	13	22	46	84	7	10	13	22	46	84
71	14	20	26	48	90	160	14	20	26	48	90	160
75	15	22	28	52	126	249	15	24	32	44	55	68
76	13	19	25	52	125	247	15	24	31	44	55	68
87	10	15	20	51	122	240	15	24	31	44	55	67
88	2	2	3	4	8	16	1	1	1	2	2	3
89	75	114	145	198	269	379	74	112	143	196	266	374
94	2	3	3	11	27	55	2	3	4	6	8	10
95	2	3	4	12	37	83	3	5	7	11	14	17
97	6	7	8	17	42	89	6	9	11	16	20	23
98	62	88	109	149	213	318	62	88	109	149	213	318
99	38	53	64	81	123	199	38	53	65	82	125	201
101	50	76	97	133	183	260	50	76	97	133	183	260
102	2	3	3	9	25	52	2	3	4	5	6	7
103	3	5	6	8	15	29	2	4	5	7	8	10
104	12	19	25	34	46	61	11	17	21	28	34	40
107	0	1	1	4	9	17	0	1	1	2	2	3
108	13	20	30	71	133	227	25	41	54	77	106	150
109	2	3	3	12	31	62	1	2	3	5	7	9
112	5	6	8	27	61	111	5	7	10	20	45	82
114	0	0	0	0	0	0	0	0	0	0	0	0
115	12	17	21	30	49	93	2	3	5	12	17	22
118	2	3	4	10	28	57	1	2	3	5	6	8
119	12	17	23	58	123	230	13	21	29	46	69	101
120	9	12	13	15	19	34	9	12	13	15	19	34
122	23	35	45	63	94	157	23	35	45	63	94	157
123	19	27	34	46	66	97	19	27	34	46	66	97
124	74	113	147	200	262	335	74	113	147	200	262	335
127	22	33	41	56	76	104	15	23	30	42	57	80
128	18	26	34	54	83	132	21	34	44	63	93	139
133	6	9	12	16	22	30	6	9	12	16	22	30
134	1	1	1	3	7	14	0	1	1	2	2	3
135	11	18	27	59	113	199	10	17	22	32	40	49
137	14	20	32	90	211	410	21	34	49	91	140	211
138	5	7	9	12	15	21	5	7	9	12	15	21
142	0	0	1	3	8	17	0	1	1	1	2	2
143	0	1	1	7	18	35	1	1	1	1	2	2
144	1	1	2	2	2	23	1	1	2	2	2	23
145	7	10	13	18	37	68	7	10	13	18	37	68
146	11	16	21	29	48	81	11	16	21	29	48	81
147	3	4	5	9	13	18	3	4	5	9	13	18
148	29	41	64	234	583	1,199	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
149	6	8	10	14	21	34	5	8	10	12	15	19
151	11	17	22	29	45	73	11	17	22	29	45	73
152	5	8	10	14	20	29	5	6	8	10	11	14
153	5	7	9	13	19	29	5	7	9	13	19	29
155	11	17	21	28	38	52	7	10	12	15	18	22
156	7	11	13	37	85	162	7	11	13	37	85	162
158	1	2	2	10	25	47	1	1	2	3	4	5
159	1	2	4	15	31	54	2	3	5	19	39	69
160	0	0	0	0	0	0	0	0	0	0	0	0
161	0	0	0	0	49	117	0	0	0	0	0	25
162	26	38	45	56	74	148	26	38	45	56	74	110
163	15	23	29	41	57	84	24	37	46	63	86	122
164	7	9	11	16	24	39	5	9	11	16	21	27

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Element ID	Existing SWMM Model Results Discharge (cfs)						Future SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
165	6	9	12	17	31	87	7	11	14	20	26	34
166	10	20	30	48	73	106	15	24	32	52	81	122
169	1	2	2	6	15	32	1	2	2	3	3	4
170	3	4	5	10	19	34	2	4	5	7	9	12
171	2	2	3	8	19	35	1	1	2	3	4	6
172	4	7	10	35	75	138	1	2	4	8	11	14
173	29	43	63	231	589	1,269	4	7	9	13	16	20
174	5	8	10	17	45	90	3	5	7	11	14	18
175	3	4	5	7	15	28	1	1	1	2	3	5
176	4	7	21	91	224	469	28	45	65	119	183	267
177	17	25	32	49	81	136	17	25	32	49	81	136
178	14	21	27	38	53	81	13	20	26	37	51	72
183	5	8	9	25	58	111	6	9	11	14	17	21
184	24	38	48	65	112	190	24	38	48	65	112	190
185	14	22	28	38	56	108	7	12	16	22	28	35
186	48	72	91	123	166	234	48	72	91	123	166	234
193	2	4	4	11	28	56	2	3	4	6	8	10
203	2	3	4	7	15	28	2	4	5	7	8	10
206	0	0	1	2	16	66	0	1	1	1	1	4
208	10	18	28	67	124	216	25	41	54	77	106	150
209	9	13	16	22	32	52	6	9	13	19	26	33
210	38	54	68	92	150	271	18	27	33	44	55	67
211	7	10	14	34	74	162	13	21	29	41	54	68
212	3	4	5	7	17	33	2	3	4	6	8	11
214	3	4	5	13	33	69	1	2	3	6	8	11
217	14	21	28	47	80	135	14	21	28	42	62	93
218	15	21	28	56	106	189	13	21	28	43	64	95
219	27	39	57	156	347	665	65	108	147	217	287	377
220	6	8	10	13	19	34	4	7	9	13	17	22
223	14	20	30	84	188	341	17	27	35	69	109	169
224	6	9	11	16	26	46	6	9	11	16	26	46
226	9	13	16	22	30	44	6	8	9	12	15	18
234	9	13	16	26	48	84	6	10	13	18	22	27
246	29	41	59	166	377	726	0	0	1	1	1	4
249	4	5	7	10	17	30	5	8	10	12	15	19
251	30	42	64	236	591	1,221	17	28	36	50	62	76
261	2	2	3	4	6	9	1	1	2	3	4	5
264	1	2	2	3	4	7	1	1	2	3	4	4
268	28	42	63	230	580	1,216	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
270	3	4	6	19	47	95	5	7	9	13	16	20
283	4	6	8	25	57	109	6	9	11	14	17	21
291	1	2	2	4	9	18	1	2	3	3	4	5
292	0	0	0	0	0	0	0	0	0	0	2	11
349	3	5	6	12	23	43	7	10	12	16	20	24
361	8	12	15	21	30	42	8	12	15	21	30	42
600	9	13	16	38	75	166	13	21	29	42	54	68
601	3	4	5	13	32	63	1	2	3	5	7	9
1121	295	438	553	771	1,149	2,007	247	406	543	772	1,009	1,283
1122	15	21	26	77	194	405	19	28	34	46	58	71
1123	28	40	56	203	573	1,213	46	79	101	140	178	222
1124	33	47	57	171	420	876	32	56	72	99	126	156
1125	372	549	702	1,054	1,732	3,035	260	436	614	1,065	1,617	2,313
1126	363	532	666	901	1,361	2,353	145	237	334	660	1,091	1,630
1611	11	15	26	73	141	218	11	19	29	59	85	110
105A	14	20	25	35	50	74	14	20	25	35	50	74
105C	3	4	5	22	58	114	1	2	4	13	29	57
111A	24	36	47	106	223	436	53	87	116	165	210	265
111B	16	28	42	106	236	472	55	91	122	175	224	281
115AB	2	3	3	7	47	107	1	2	3	12	20	28
116_pipe	1	1	1	1	1	1	1	1	1	1	1	1
116_SF	0	0	0	0	0	0	0	0	0	0	0	0
120A	7	10	13	18	28	46	2	3	4	7	10	12
121A	16	24	30	41	56	75	11	18	23	32	42	54
121B	28	40	58	161	363	698	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
125A	19	29	38	56	91	153	19	29	38	56	91	153
134A	11	17	21	31	49	85	6	10	13	18	22	27
175A	19	28	34	47	65	94	19	28	34	47	65	94
177A	0	1	1	1	2	2	0	1	1	1	2	2
185C	6	9	11	15	26	49	2	3	5	7	10	12
209A	7	10	14	35	76	168	38	62	84	119	152	195
209B	33	49	61	108	224	438	53	87	116	165	210	265
267A	2	3	7	25	59	104	1	2	4	8	11	14
277A	1	1	1	3	5	13	1	1	1	3	5	13

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Element ID	Existing SWMM Model Results Discharge (cfs)						Future SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
282D	8	11	12	18	26	80	8	11	12	18	26	80
286A	2	2	3	4	5	6	2	2	3	4	5	6
286B	4	6	8	11	18	32	4	6	8	11	18	32
286C	0	0	0	0	0	1	0	0	0	0	0	1
292A	21	32	41	56	76	105	21	32	41	56	76	105
DTN-10-PF	8	8	8	8	8	8	7	8	8	8	8	8
DTN-10-SF	5	11	16	25	36	52	0	3	5	9	13	18
DTN-11-PF	12	15	15	15	15	15	7	11	13	15	15	15
DTN-11-SF	0	4	7	14	23	39	0	0	0	3	7	12
DTN-12-PF	12	18	21	24	24	24	7	11	13	17	21	24
DTN-12-SF	0	0	0	5	15	31	0	0	0	0	0	3
DTN-13-PF	31	43	51	55	55	55	30	44	55	75	90	117
DTN-13-SF	0	0	0	15	40	77	0	0	0	0	0	5
DTN-14-PF	33	46	55	65	66	66	33	49	60	66	66	66
DTN-14-SF	0	0	0	8	32	71	0	0	0	17	33	64
DTN-15-PF	33	46	55	74	93	132	33	49	60	80	94	125
DTN-3-PF	5	7	8	11	15	20	5	8	10	13	17	22
DTN-3-SF	0	0	0	0	0	0	0	0	0	0	0	1
DTN-4-PF	9	13	17	24	24	24	10	15	19	24	24	24
DTN-4-SF	0	0	0	0	6	15	0	0	0	2	10	21
DTN-5-PF	9	13	17	17	17	17	10	15	17	17	17	17
DTN-5-SF	0	0	1	7	13	21	0	0	3	9	17	26
DTN-6-PF	11	17	21	21	21	21	14	21	21	21	21	21
DTN-6-SF	0	0	1	8	15	26	0	1	6	14	20	33
DTN-7-PF	6	9	11	12	12	12	7	9	12	12	12	12
DTN-7-SF	0	0	0	4	10	18	0	0	0	5	11	20
DTN-8-PF	17	17	17	17	17	17	21	30	37	50	51	51
DTN-8-SF	1	9	15	26	37	54	0	0	0	1	12	32
DTN-9-PF	18	21	22	22	21	21	21	30	37	51	62	64
DTN-9-SF	0	5	11	21	33	49	0	0	0	0	0	20
DTS-2-PF	5	8	10	14	20	22	5	7	9	13	17	21
DTS-2-SF	0	0	0	0	0	6	0	0	0	0	0	2
DTS-3-PF	7	11	13	19	26	33	6	9	12	17	22	31
DTS-3-SF	0	0	0	0	0	0	0	0	0	0	0	0
DTS-4-PF	7	10	13	18	26	33	6	9	12	16	22	30
DTS-4-SF	0	0	0	0	0	0	0	0	0	0	0	0
DTS-5-PF	8	12	15	21	30	40	7	10	13	19	26	37
DTS-5-SF	0	0	0	0	0	0	0	0	0	0	0	0
DTS-6-PF	8	12	15	21	30	40	7	10	13	19	26	37
DTS-6-SF	0	0	0	0	0	0	0	0	0	0	0	0
DTS-7-PF	8	12	15	21	30	40	7	10	13	19	26	37
G3-2_DUMMY	5	7	9	13	20	68	3	4	5	8	10	72
L-90	2	3	4	11	31	65	1	2	3	5	6	8
L-TRIC2_SPILL	0	0	0	0	13	59	0	0	0	0	0	3
L-TRIC4A-SPILL	0	0	0	0	50	119	0	0	0	0	0	26
L-TRIC5A-SPILL	11	15	27	73	141	218	11	19	29	59	85	110
L-TRIC6A-SPILL	1	2	4	11	29	63	2	3	4	5	10	13
OP-103	2	3	3	3	3	4	2	3	3	3	3	4
OP-103_WEIR	0	0	0	20	52	109	0	0	0	20	52	109
OP-103A	15	18	19	22	26	31	15	18	19	22	26	31
OP-103C	8	10	11	14	18	33	8	10	11	14	18	33
OP-103D1_Pipe	11	13	14	16	18	18	11	13	14	16	18	18
OP-103D1_WEIR	0	0	0	0	12	48	0	0	0	0	12	48
OP-103D2_PIPE	10	12	13	16	23	41	10	12	13	16	23	41
OP-103D2_WEIR	0	0	0	0	0	0	0	0	0	0	0	0
OP-104	1	1	1	1	1	1	1	1	1	1	1	1
OP-104_WEIR	0	0	0	0	0	4	0	0	0	0	0	7
OP-105	0	1	1	1	2	3	0	1	1	1	2	3
OP-106A	2	2	3	4	4	5	2	2	3	4	4	5
OP-106A_WEIR	0	0	0	0	0	59	0	0	0	0	0	59
OP-107	0	1	1	1	1	1	1	1	1	1	1	1
OP-107_WEIR	0	0	0	0	0	0	0	0	0	0	0	3
OP-110	10	15	18	26	38	54	8	13	16	22	29	39
OP-120	14	19	23	42	73	122	26	38	49	74	106	209
OP-15	0	0	0	0	36	82	0	0	0	8	15	22
OP-25	19	23	27	37	47	80	19	23	27	37	47	80
OP-28	2	2	2	3	9	42	2	3	3	3	13	38
OP-29	2	2	2	2	3	4	2	2	2	3	4	4
OP-31	9	13	17	23	30	35	9	13	17	23	30	35
OP-31_WEIR	0	0	0	0	0	0	0	0	0	0	0	0
OP-43	0	7	23	91	223	462	26	43	61	114	173	255
OP-4A	16	34	52	86	120	150	15	25	38	66	104	136
OP-50	0	0	0	0	0	0	0	0	0	0	0	0

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B-4 - SWMM Model Results - Link Flows

Element ID	Existing SWMM Model Results Discharge (cfs)						Future SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
OP-50A	0	0	0	0	0	4	0	0	0	0	0	4
OP-51	0	0	0	12	43	99	14	22	28	37	46	56
OP-5A	0	0	0	8	25	52	0	0	0	8	25	52
OP-75	0	1	1	1	1	2	0	1	1	1	1	2
OP-75A	8	12	15	19	24	29	8	12	15	19	24	29
OP-75A_WEIR	0	0	0	0	0	0	0	0	0	0	0	0
OP-75D	1	1	2	2	2	3	1	1	2	2	2	3
OP-75D_WEIR	0	0	0	0	0	21	0	0	0	0	0	21
OP-77	0	1	1	1	2	2	0	1	1	1	2	2
OP-77B	1	1	1	2	4	11	1	1	1	2	4	11
OP-77C	0	0	0	1	1	1	0	0	0	1	1	1
OP-77C_WEIR	0	0	0	0	0	9	0	0	0	0	0	9
OP-77D	1	1	1	3	4	12	1	1	1	3	4	12
OP-80	0	0	0	0	0	0	0	0	0	0	0	0
OP-80D	1	1	1	2	3	3	1	1	1	2	3	3
OP-80D_WEIR	0	0	0	0	1	14	0	0	0	0	1	14
OP-81	2	2	2	3	5	10	2	2	2	3	5	10
OP-82D1	10	12	14	21	29	31	10	12	14	21	29	31
OP-82D1_WEIR	0	0	0	0	0	80	0	0	0	0	0	80
OP-82D2	8	11	12	18	26	62	8	11	12	18	26	62
OP-82D2_WEIR	0	0	0	0	0	18	0	0	0	0	0	18
OP-82D3	9	10	12	16	21	32	9	10	12	16	21	32
OP-84	3	4	5	9	13	18	3	4	5	9	13	18
OP-85B	3	4	4	5	5	5	3	4	4	5	5	5
OP-85B-WEIR	0	0	0	0	0	14	0	0	0	0	0	14
OP-85C	6	8	11	33	78	151	8	12	16	22	27	33
OP-86	1	2	4	10	19	28	1	2	4	10	19	28
OP-86A	2	2	3	4	5	6	2	2	3	4	5	6
OP-86C	0	0	0	0	0	1	0	0	0	0	0	1
OP-88	1	3	4	15	35	41	6	10	15	26	36	41
OP-92	0	0	0	0	0	0	0	0	0	0	2	11
OP-95	4	4	5	5	6	6	4	4	5	5	6	6
OP-97	18	20	21	24	66	115	18	20	21	24	54	97
OP-98	4	4	5	5	6	6	4	4	5	5	6	6
OP-98A	1	1	1	1	1	1	1	1	1	1	1	1
OP-98A_WEIR	0	0	0	0	0	0	0	0	0	0	0	0
TRICL1	191	191	192	198	213	240	191	192	193	194	195	196
TRICL2	192	193	196	219	252	276	192	195	197	205	218	236
TRICL3	193	195	198	225	297	380	194	197	200	211	223	241
TRICL4	212	218	225	261	343	445	209	216	223	246	268	311
TRICL5	212	218	225	261	293	326	209	216	223	246	267	286
TRICL6	218	227	242	294	369	453	219	232	246	278	307	334
TRICL7	207	211	215	221	227	235	208	213	216	219	222	224
TRICL7A	207	212	217	233	256	292	209	215	220	225	231	236
TRICL8	205	209	213	222	227	229	207	212	216	220	222	223
TROC_1B	214	219	223	242	273	322	226	238	249	274	306	409
TROCL1	216	223	229	287	387	546	226	238	249	275	326	430
TROCL1_A	216	223	229	287	387	546	226	238	249	275	326	430
TROCL10	254	276	304	495	888	1,632	363	460	552	749	975	1,280
TROCL11	254	276	304	495	888	1,631	363	460	552	749	975	1,280
TROCL13	256	278	307	508	921	1,669	365	464	558	761	995	1,309
TROCL14	260	283	312	529	946	1,735	371	472	576	784	1,021	1,355
TROCL15	260	283	312	529	946	1,735	372	474	579	791	1,031	1,369
TROCL16	260	283	312	529	946	1,735	372	474	579	791	1,030	1,369
TROCL17	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379
TROCL18	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379
TROCL3	216	223	230	290	395	561	226	238	250	276	335	446
TROCL4	216	224	232	295	404	578	226	238	250	276	346	465
TROCL5	217	224	232	296	405	578	227	239	251	278	346	464
TROCL6	224	235	246	314	439	635	227	239	251	292	385	531
TROCL8	252	273	301	491	885	1,629	360	456	549	744	969	1,264
TROCL9	252	273	301	491	884	1,628	360	457	549	745	971	1,267
CLARK1	-	-	-	-	-	-	132	217	298	467	653	869
CLARK2	-	-	-	-	-	-	127	208	287	448	628	838
CLARK3	-	-	-	-	-	-	125	206	283	442	619	827
CLARK4	-	-	-	-	-	-	112	185	254	400	559	747
CLARK5	-	-	-	-	-	-	107	177	244	386	542	727
CLARK6	-	-	-	-	-	-	105	174	240	378	533	711
CLARK7	-	-	-	-	-	-	78	129	177	267	355	462
CLARK8	-	-	-	-	-	-	73	122	167	249	330	430

Timnath Stormwater Master Plan Update - 2018
B-5 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results – Discharge (cfs)						Future SWMM Model Results – Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
115	3	5	6	8	15	29	2	4	5	7	8	10
116	12	19	25	34	46	61	11	17	21	28	34	40
117	17	24	30	41	55	76	11	17	21	28	34	40
118	16	34	52	86	120	150	15	25	38	66	104	136
127	14	20	24	35	50	76	14	20	24	35	50	76
129	5	7	9	23	61	122	1	2	4	13	30	58
132	17	24	30	42	58	96	7	12	15	20	26	34
133	0	1	1	2	16	66	0	1	1	1	1	4
134	28	39	49	82	151	253	25	41	55	80	114	162
135	13	20	30	71	133	227	25	41	54	77	106	150
136	7	10	14	36	76	168	38	62	84	119	152	197
137	9	13	16	38	75	166	13	21	29	42	54	68
138	38	54	67	92	150	271	18	27	33	44	55	67
140	27	41	53	115	248	487	55	91	123	175	224	282
142	40	57	71	109	225	439	53	87	117	165	210	265
143	6	8	10	16	26	44	2	3	4	6	8	11
144	33	49	61	108	224	438	53	87	116	165	210	265
146	6	8	10	18	38	78	1	2	3	6	8	11
147	0	0	0	0	0	0	0	0	0	0	0	0
149	12	17	22	34	57	96	2	3	5	12	17	22
151	4	5	6	11	51	117	1	2	3	12	21	28
153	22	32	40	62	98	158	25	37	47	65	90	128
154	16	23	30	50	84	140	19	30	38	54	76	110
155	15	22	29	58	107	191	14	23	30	45	67	99
156	4	6	8	13	31	63	1	2	3	5	6	8
157	27	39	57	156	347	665	65	108	147	217	287	377
158	16	23	31	69	140	258	14	22	30	47	70	103
159	12	17	21	29	42	63	5	8	9	13	17	22
160	28	40	59	162	364	701	0	0	1	1	1	4
161	28	40	58	161	363	698	74	122	167	249	330	430
162	18	26	32	43	60	86	11	18	23	32	42	54
163	23	35	45	63	94	157	23	35	45	63	94	157
164	29	42	53	77	115	179	29	42	53	77	115	179
165	5	8	10	13	18	25	5	8	10	13	18	25
166	9	13	16	24	37	61	9	13	16	24	37	61
169	9	13	16	23	32	49	6	8	9	12	15	18
170	24	35	44	60	81	115	17	25	32	45	62	86
171	22	33	41	56	76	104	15	23	30	42	57	80
173	20	28	37	57	87	139	23	36	46	66	94	139
176	935	1,325	1,639	2,263	3,148	4,530	203	337	465	753	1,112	1,641
177	1	2	2	4	9	18	0	1	1	2	2	3
178	454	666	840	1,187	1,802	3,088	267	455	630	1,078	1,620	2,319
179	28	42	49	87	192	358	27	40	48	69	109	169
180	13	18	23	37	58	93	6	10	13	18	22	27
181	372	549	702	1,054	1,732	3,035	260	436	614	1,065	1,617	2,313
182	13	20	30	62	116	204	10	17	22	32	40	49
183	11	17	21	31	49	85	6	10	13	18	22	27
184	93	130	160	267	506	1,019	36	61	76	103	130	159
185	40	57	70	212	584	1,231	47	79	102	140	179	222
186	14	20	32	90	213	424	23	38	55	100	153	227
187	17	24	35	95	215	427	21	34	49	91	140	210
188	28	40	56	203	573	1,213	46	79	101	140	178	222
189	43	59	73	122	231	465	21	30	36	47	59	72
190	702	996	1,231	1,700	2,364	3,402	260	433	561	773	1,012	1,288
191	295	438	553	771	1,149	2,007	247	406	543	772	1,009	1,283
193	15	21	26	41	69	120	3	5	7	14	21	27
194	15	21	33	91	206	379	17	27	38	74	118	182
196	6	8	23	91	224	469	28	45	65	119	181	264
197	4	7	21	91	224	470	28	45	65	119	183	267
199	30	42	66	239	596	1,200	107	177	244	386	543	727
200	29	41	59	166	378	726	0	0	1	1	1	4
201	19	26	32	45	63	92	6	9	13	19	26	33
204	30	41	65	236	586	1,203	112	185	255	400	560	747
206	6	8	10	14	21	34	5	8	10	12	15	19
207	11	15	19	26	37	55	5	8	10	12	15	19
213	4	6	7	14	25	46	7	10	12	16	20	24
214	30	42	64	237	593	1,224	17	28	37	50	62	76
216	8	11	14	19	27	39	5	6	8	10	11	14
217	12	17	21	29	39	53	7	10	12	15	18	22
220	3	4	5	7	9	13	1	2	2	3	4	5
221	3	4	5	7	11	15	1	2	3	3	4	5
223	30	42	64	236	591	1,224	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
224	2	2	4	16	36	69	2	3	4	7	9	11

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B-5 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results – Discharge (cfs)						Future SWMM Model Results – Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
225	3	4	6	18	42	80	2	3	4	7	9	11
226	4	7	10	35	75	138	1	2	4	8	11	14
229	2	3	4	7	16	33	1	2	2	3	3	4
230	4	6	8	22	53	104	5	7	9	13	17	20
231	3	5	6	11	20	35	3	4	5	7	10	12
234	7	10	14	37	81	151	1	2	4	8	11	14
237	29	43	63	231	589	1,269	4	7	9	13	16	20
238	29	43	64	233	592	1,273	5	7	9	13	16	20
239	30	42	64	237	597	1,246	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
243	20	28	35	48	68	99	20	28	35	48	68	99
248	7	11	14	22	46	85	7	11	14	22	46	85
250	11	16	19	39	84	161	3	5	7	12	15	20
252	33	46	58	86	129	198	33	46	58	86	129	198
253	0	1	1	1	2	2	0	1	1	1	2	2
254	1	1	1	3	5	13	1	1	1	3	5	13
274	17	26	34	50	94	164	17	26	34	50	94	164
275	5	8	9	25	58	111	6	9	11	14	17	21
276	10	15	18	30	63	123	6	9	11	14	17	21
277	2	2	3	5	9	16	1	1	1	2	2	3
279	35	49	61	97	162	266	35	49	61	97	162	266
283	20	28	34	50	77	125	7	12	16	22	28	35
284	19	29	38	52	127	250	15	24	32	44	55	68
285	15	22	28	52	126	249	15	24	32	44	55	68
287	13	19	25	52	125	247	15	24	31	44	55	68
291	0	0	0	0	0	0	0	0	0	0	2	11
293	7	9	11	18	29	51	2	3	5	7	10	12
295	1	2	4	10	19	28	1	2	4	10	19	28
296	55	78	97	132	181	256	55	78	97	132	181	256
297	0	0	0	0	0	1	0	0	0	0	0	1
298	6	8	10	16	24	39	6	8	10	16	24	39
303	94	133	165	227	312	440	93	132	163	224	307	432
307	2	3	4	7	11	19	1	2	3	3	4	5
309	26	38	47	64	86	118	26	38	47	64	86	118
310	6	8	10	16	34	71	2	3	4	6	8	10
311	2	4	4	11	28	56	2	3	4	6	8	10
312	4	6	7	12	37	82	3	5	7	11	14	17
314	6	7	8	17	43	89	6	9	11	16	20	24
316	62	88	109	150	214	319	62	89	110	150	215	320
317	60	85	104	148	217	325	60	85	104	148	217	325
321	63	89	110	153	213	304	63	89	110	153	213	304
323	1	1	1	1	1	1	1	1	1	1	1	1
323-surf	0	0	0	0	0	0	0	0	0	0	0	0
324	1	2	2	5	10	20	0	1	1	2	2	3
326	3	4	5	13	32	63	1	2	3	5	7	9
327	5	7	8	15	34	69	1	2	3	5	7	9
328	6	8	10	17	45	90	3	5	7	11	14	18
329	7	10	12	33	74	146	5	7	10	26	58	114
330	21	26	30	38	48	63	21	26	30	38	48	63
335	1	2	2	3	6	10	0	0	1	1	1	2
338	8	10	11	14	18	33	8	10	11	14	18	33
339	10	12	13	16	23	41	10	12	13	16	23	41
341	19	26	32	46	67	98	19	26	32	46	67	98
342	102	150	188	256	346	477	102	150	188	256	346	477
346	9	12	15	21	30	43	3	4	6	9	12	14
348	10	15	18	26	38	54	8	13	16	22	29	39
349	7	10	13	18	24	33	7	10	13	18	24	33
350	5	7	9	12	16	22	5	7	9	12	16	22
351	5	8	9	13	19	27	5	8	9	13	19	27
352	5	6	8	11	15	22	5	6	8	11	15	22
353	5	7	9	13	20	31	5	7	9	13	20	31
355	8	11	12	18	26	80	8	11	12	18	26	80
356	2	2	3	4	5	6	2	2	3	4	5	6
360	8	12	16	22	30	43	8	12	16	22	30	43
500	20	29	35	53	83	169	13	22	30	42	54	68
501	7	10	12	19	32	53	2	3	4	7	10	12
53	4	5	7	12	28	58	2	3	4	5	6	7
54	5	7	9	14	21	34	2	4	5	7	8	10
DTN10	13	19	24	33	44	60	7	11	13	17	21	27
DTN11	12	19	24	33	44	60	7	11	13	17	21	26
DTN12	12	18	21	28	37	53	7	11	13	17	21	26
DTN13	32	44	51	66	91	128	30	45	55	76	91	115
DTN14	33	46	56	69	95	134	33	49	61	83	101	133
DTN15	33	46	55	74	93	132	33	49	60	80	94	125

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B-5 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results – Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results – Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
DTN3	5	7	8	11	15	20	5	8	10	13	17	23
DTN4	9	13	17	23	31	41	11	15	19	26	34	46
DTN5	9	13	17	24	30	38	10	15	19	26	33	43
DTN6	11	17	21	28	35	46	14	21	26	34	40	53
DTN7	6	9	11	15	21	30	7	9	11	16	22	31
DTN8	17	25	32	42	54	70	21	30	38	49	60	81
DTN9	18	25	31	42	53	70	21	30	37	52	60	80
DTS2	5	8	10	14	20	29	5	7	9	13	17	23
DTS3	7	11	14	19	27	33	6	9	12	17	23	31
DTS4	7	11	13	19	26	33	6	9	12	17	22	31
DTS5	8	12	15	21	30	40	7	10	13	19	27	37
DTS6	8	12	15	21	30	40	7	10	13	19	26	37
DTS7	8	12	15	21	30	40	7	10	13	19	26	37
DTSO1	8	12	15	21	30	40	7	10	13	19	26	37
G3-1	7	10	13	18	28	46	2	3	4	7	10	12
G3-2	5	7	9	13	20	68	3	4	5	8	10	72
G3-2_A	5	7	9	13	20	68	3	4	5	8	10	72
J-90	3	4	5	11	31	65	1	2	3	5	6	8
LAKECANAL1	10	16	20	28	39	94	7	12	15	20	26	34
LAKECANAL10	3	5	6	11	22	42	1	1	2	3	4	6
LAKECANAL11	2	3	4	7	15	29	1	1	1	2	3	5
LAKECANAL12	10	15	18	41	93	177	10	15	18	41	93	177
LAKECANAL16	18	25	30	45	68	106	18	25	30	45	68	106
LAKECANAL17	3	4	5	9	13	18	3	4	5	9	13	18
LAKECANAL18	18	25	31	46	72	116	18	25	31	46	72	116
LAKECANAL19	8	11	13	24	43	78	8	11	13	24	43	78
LAKECANAL2	15	21	26	37	53	77	6	10	12	16	21	27
LAKECANAL20	1	1	2	2	2	23	1	1	2	2	2	23
LAKECANAL21	1	1	2	8	20	39	1	1	1	1	2	2
LAKECANAL22	1	1	1	4	9	19	0	1	1	1	2	2
LAKECANAL3	29	41	51	70	97	138	29	41	51	70	97	138
LAKECANAL4	31	44	55	75	106	155	31	44	55	75	106	155
LAKECANAL7	0	0	0	0	0	0	0	0	0	0	0	0
LAKECANAL8	3	4	6	21	43	79	3	4	6	21	43	79
LAKECANAL9	3	4	5	16	36	70	1	1	2	3	4	5
P-103	30	43	53	72	97	134	30	43	53	72	97	134
P-103A	26	36	45	62	86	121	26	36	45	62	86	121
P-103C	20	28	35	48	67	94	20	28	35	48	67	94
P-103D1	23	32	39	57	85	124	23	32	39	57	85	124
P-103D2	11	13	14	16	30	66	11	13	14	16	30	66
P-104	86	122	151	209	288	398	86	121	150	207	285	398
P-105	31	45	57	77	103	141	31	45	57	77	103	141
P-106A	76	115	149	203	267	338	76	115	149	203	267	338
P-107	63	89	110	153	212	301	63	89	110	153	212	301
P-110	10	15	20	29	42	66	8	13	17	24	33	47
P-120	1,161	1,825	2,381	3,311	4,431	7,073	1,277	2,049	2,691	3,774	5,073	6,848
P-15	12	17	21	30	49	93	2	3	5	12	17	22
P-25	34	51	66	98	154	247	34	51	66	98	154	247
P-28	18	26	34	54	83	132	21	34	44	63	93	139
P-29	13	18	22	31	44	66	13	19	23	32	45	66
P-31	33	46	57	81	117	173	33	46	57	81	117	173
P-43	15	21	32	92	224	463	26	43	61	114	173	255
P-4A	46	70	90	126	169	225	46	69	87	119	159	213
P-50	8	12	14	20	29	42	8	12	14	20	29	42
P-50A	10	14	17	24	34	48	10	14	17	24	34	48
P-51	34	47	56	76	98	141	43	63	78	96	120	157
P-5A	14	20	25	35	50	74	14	20	25	35	50	74
P-75	28	39	48	68	95	135	28	39	48	68	95	135
P-75A	19	28	34	47	65	94	19	28	34	47	65	94
P-75D	9	12	15	22	28	36	9	12	15	22	28	36
P-77	17	25	32	49	81	136	17	25	32	49	81	136
P-77B	1	2	2	4	8	16	1	2	2	4	8	16
P-77C	7	9	11	21	38	62	7	9	11	21	38	62
P-77D	25	34	42	60	89	134	25	34	42	60	89	134
P-80	5	7	8	14	24	40	3	5	6	11	19	32
P-80D	7	10	13	21	38	67	7	10	13	21	38	67
P-81	32	44	55	81	120	180	32	44	55	81	120	180
P-82D1	94	131	161	239	364	559	94	131	161	239	364	559
P-82D2	10	12	14	21	29	110	10	12	14	21	29	110
P-82D3	16	23	29	53	96	166	16	23	29	53	96	166
P-84	24	38	48	65	112	190	24	38	48	65	112	190
P-85B	58	88	111	152	200	263	58	88	111	152	200	263
P-85C	6	9	11	33	78	151	8	12	16	22	27	33

Timnath Stormwater Master Plan Update - 2018
B-5 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
P-86	52	78	99	134	181	258	52	78	99	134	181	258
P-86A	11	16	19	28	43	65	11	16	19	28	43	65
P-86C	3	4	5	8	14	23	3	4	5	8	14	23
P-88	77	117	149	204	279	403	74	112	143	196	266	374
P-92	25	39	50	73	109	167	22	34	44	61	83	114
P-95	76	108	133	183	254	361	76	108	133	183	254	361
P-97	38	53	64	81	123	199	38	53	65	82	125	201
P-98	50	76	97	133	183	260	50	76	97	133	183	260
P-98A	30	42	52	72	102	148	30	42	52	72	102	148
ResOutlet	214	219	223	242	273	322	226	238	249	274	306	409
TRIC1	191	192	192	198	214	241	191	192	193	194	195	196
TRIC2	193	194	197	220	266	337	192	195	197	206	221	247
TRIC3	193	195	198	225	298	382	194	197	200	211	223	242
TRIC4	212	218	225	261	343	445	209	216	223	246	268	311
TRIC4A	212	218	225	261	343	445	209	216	223	246	268	311
TRIC4-SPILL	0	0	0	0	50	119	0	0	0	0	0	26
TRIC5	218	227	242	294	369	454	219	232	246	278	307	334
TRIC5A	218	227	242	294	369	453	219	232	246	278	307	334
TRIC5A_SPILL	11	15	27	73	141	218	11	19	29	59	85	110
TRIC6	207	212	217	233	257	294	209	215	220	225	231	236
TRIC6_Spill	1	2	4	11	29	63	2	3	4	5	10	13
TRIC6A	207	212	217	233	256	292	209	215	220	225	231	236
TRIC-OUTFALL	205	209	213	222	227	229	207	212	216	220	222	223
TROC_1A	216	223	229	287	387	546	226	238	249	275	326	430
TROC1	216	223	229	287	387	546	226	238	249	275	326	430
TROC10a	256	278	307	508	921	1,669	365	464	558	761	995	1,309
TROC11	260	283	312	529	946	1,736	371	472	576	785	1,021	1,356
TROC12	260	283	312	529	946	1,735	372	474	579	791	1,031	1,369
TROC-12A	260	283	312	529	946	1,735	372	474	579	791	1,031	1,369
TROC13	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379
TROC14	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379
TROC2	216	223	230	290	395	562	226	238	250	276	335	448
TROC3	217	224	232	295	405	579	226	238	250	276	346	467
TROC4	217	225	232	296	406	580	227	239	251	278	347	468
TROC5	226	237	248	316	443	645	227	239	251	294	389	540
TROC6	252	273	301	491	885	1,629	360	456	549	745	969	1,264
TROC7	252	273	301	491	885	1,629	360	457	549	745	971	1,267
TROC8	254	276	304	495	889	1,634	363	460	553	750	976	1,281
TROC9	254	276	304	495	888	1,632	363	460	552	749	975	1,280
TROC-OUTFALL	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379
CP-10	-	-	-	-	-	-	163	235	293	396	531	725
CP-100	-	-	-	-	-	-	33	46	57	80	112	163
CP-100A	-	-	-	-	-	-	33	46	57	79	112	162
CP-101	-	-	-	-	-	-	99	142	176	239	324	449
CP-102	-	-	-	-	-	-	51	73	90	122	164	226
CP-106	-	-	-	-	-	-	30	43	53	74	103	145
CP-108	-	-	-	-	-	-	16	23	29	40	55	77
CP-108A	-	-	-	-	-	-	5	8	10	13	19	28
CP-109	-	-	-	-	-	-	56	82	102	139	185	247
CP-11	-	-	-	-	-	-	38	54	67	92	126	176
CP-110	-	-	-	-	-	-	47	69	87	117	156	209
CP-113A	-	-	-	-	-	-	8	12	15	20	27	36
CP-12	-	-	-	-	-	-	49	69	86	117	158	219
CP-121	-	-	-	-	-	-	2,216	3,433	4,425	6,109	8,149	10,971
CP-122	-	-	-	-	-	-	640	992	1,278	1,765	2,354	3,170
CP-123	-	-	-	-	-	-	552	845	1,082	1,486	1,980	2,668
CP-124	-	-	-	-	-	-	1,454	2,265	2,929	4,053	5,411	7,285
CP-125	-	-	-	-	-	-	880	1,357	1,745	2,406	3,207	4,319
CP-126	-	-	-	-	-	-	1,336	1,920	2,389	3,261	4,424	6,163
CP-13	-	-	-	-	-	-	27	38	48	67	93	130
CP-14	-	-	-	-	-	-	93	132	163	223	309	438
CP-15	-	-	-	-	-	-	49	69	85	123	179	269
CP-15A	-	-	-	-	-	-	61	88	110	149	201	274
CP-17	-	-	-	-	-	-	44	63	79	107	145	201
CP-18	-	-	-	-	-	-	101	145	181	245	330	452
CP-2	-	-	-	-	-	-	139	206	260	352	463	607
CP-20	-	-	-	-	-	-	39	56	69	94	128	178
CP-21	-	-	-	-	-	-	65	93	115	156	211	292
CP-21A	-	-	-	-	-	-	86	122	152	207	281	391
CP-26	-	-	-	-	-	-	55	80	100	135	180	242
CP-3	-	-	-	-	-	-	70	102	129	176	233	309
CP-30	-	-	-	-	-	-	8	11	14	19	27	40
CP-33	-	-	-	-	-	-	8	12	14	20	28	40

Timnath Stormwater Master Plan Update - 2018
B-5 - SWMM Model Results - Node Flows

Element ID	Existing SWMM Model Results Discharge (cfs)						Future SWMM Model Results Discharge (cfs)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
CP-34	-	-	-	-	-	-	71	102	129	180	244	332
CP-35	-	-	-	-	-	-	99	141	178	251	346	482
CP-37	-	-	-	-	-	-	117	167	206	281	384	540
CP-38	-	-	-	-	-	-	55	78	96	131	182	261
CP-39	-	-	-	-	-	-	29	40	49	75	117	184
CP-4	-	-	-	-	-	-	62	91	114	155	204	272
CP-43	-	-	-	-	-	-	66	93	115	160	230	341
CP-43A	-	-	-	-	-	-	47	68	84	115	156	217
CP-45	-	-	-	-	-	-	76	107	133	185	256	360
CP-46	-	-	-	-	-	-	58	82	102	140	193	271
CP-47	-	-	-	-	-	-	19	26	32	47	70	106
CP-47A	-	-	-	-	-	-	27	38	47	67	95	137
CP-48	-	-	-	-	-	-	141	206	258	352	469	631
CP-49	-	-	-	-	-	-	52	75	94	127	169	229
CP-5	-	-	-	-	-	-	116	167	210	290	391	534
CP-51	-	-	-	-	-	-	38	57	71	96	127	170
CP-52	-	-	-	-	-	-	27	39	49	67	89	118
CP-55	-	-	-	-	-	-	19	28	36	48	64	85
CP-6	-	-	-	-	-	-	18	26	33	46	60	78
CP-61	-	-	-	-	-	-	5	7	8	11	15	20
CP-64	-	-	-	-	-	-	5	7	8	11	15	20
CP-67	-	-	-	-	-	-	38	55	69	94	127	174
CP-68	-	-	-	-	-	-	50	70	88	123	170	240
CP-69	-	-	-	-	-	-	72	106	133	180	239	319
CP-7	-	-	-	-	-	-	34	48	60	84	116	162
CP-70	-	-	-	-	-	-	72	103	129	175	235	323
CP-70A	-	-	-	-	-	-	50	73	91	124	165	222
CP-71	-	-	-	-	-	-	14	20	25	35	52	79
CP-72	-	-	-	-	-	-	78	111	139	198	282	406
CP-72A	-	-	-	-	-	-	4	6	7	10	15	22
CP-73	-	-	-	-	-	-	207	298	373	515	698	959
CP-76	-	-	-	-	-	-	77	109	134	188	265	383
CP-8	-	-	-	-	-	-	327	476	597	815	1,089	1,466
CP-83	-	-	-	-	-	-	128	187	235	321	427	573
CP-83A	-	-	-	-	-	-	15	21	26	36	49	68
CP-85	-	-	-	-	-	-	195	282	351	475	637	870
CP-85C	-	-	-	-	-	-	59	85	106	144	194	267
CP-87	-	-	-	-	-	-	20	28	35	49	69	100
CP-89	-	-	-	-	-	-	12	17	21	29	41	61
CP-9	-	-	-	-	-	-	186	267	333	454	613	842
CP-90	-	-	-	-	-	-	47	67	83	113	156	221
CP-91	-	-	-	-	-	-	32	47	60	81	107	142
CP-92	-	-	-	-	-	-	58	84	104	141	187	249
CP-93	-	-	-	-	-	-	131	188	234	317	426	585
CP-94	-	-	-	-	-	-	86	123	153	207	280	388
CP-99	-	-	-	-	-	-	14	20	25	35	50	73
CP-9A	-	-	-	-	-	-	16	22	27	38	54	80
J-CLARK1	-	-	-	-	-	-	132	217	299	467	653	869
J-CLARK2	-	-	-	-	-	-	127	209	287	449	628	839
J-CLARK3	-	-	-	-	-	-	125	206	283	442	619	827
J-CLARK4	-	-	-	-	-	-	105	174	240	378	533	711
J-CLARK5	-	-	-	-	-	-	78	129	177	267	355	463

Table B-6 - Results at Key Locations - Future Comparison with Existing

Timnath Stormwater Master Plan Update - 2018
SWMM Model Results

8/21/2018

Link/ Node	Element ID (E.C.)	Element ID (F.C.)	Location	Existing SWMM Model Results Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
-	-	-	Boxelder Creek Overflow Discharge	-	-	-	-	-	-	-	-	-	-	-	-
Link	39	CLARK8	Clark Drainage at County Road 5	28	40	59	162	364	701	73	122	167	249	330	430
Node	199	199	Clark Drainage at County Road 40	30	42	66	239	596	1,200	107	177	244	386	543	727
Link	OP-51	OP-51	Downtown Outfall to Clark Drainage	0	0	0	12	43	99	14	22	28	37	46	56
Link	173	CLARK1	Clark Drainage at Harmony Rd. U/S of TROC confluence	29	43	63	231	589	1,269	132	217	298	467	653	869
Link	-	173	Harmony Road Ditch, NW of confluence with TROC	-	-	-	-	-	-	4	7	9	13	16	20
Node	ResOutlet	ResOutlet	Timnath Reservoir Discharge	214	219	223	242	273	322	226	238	249	274	306	409
Link	TROCL6	TROCL6	Timnath Res. Outlet Ditch U/S of confluence	224	235	246	314	439	635	227	239	251	292	385	531
Node	TROC6	TROC6	Timnath Res. Outlet Ditch at Harmony Road	252	273	301	491	885	1,629	360	456	549	745	969	1,264
Node	TROC9	TROC9	Timnath Res. Outlet Ditch at Summerfield Pkwy	254	276	304	495	888	1,632	363	460	552	749	975	1,280
Node	TROC11	TROC11	Timnath Res. Outlet Ditch at County Road 36	260	283	312	529	946	1,736	371	472	576	785	1,021	1,356
Node	TROC-OUTFALL	TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379
Node	295	295	Discharge at Harmony Road and County Rd. 1	1	2	4	10	19	28	1	2	4	10	19	28
Node	348	348	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	10	15	18	26	38	54	8	13	16	22	29	39
Node	DTSO1	DTSO1	Dixon Street Outfall	8	12	15	21	30	40	7	10	13	19	26	37
Node	G3-2	G3-2	Timnath South Outfall to Greeley No. 2	5	7	9	13	20	68	3	4	5	8	10	72

Table B-7 - Results at Key Locations - Comparison with 2005 Study Alternative 3

Timnath Stormwater Master Plan Update - 2018
SWMM Model Results

8/21/2018

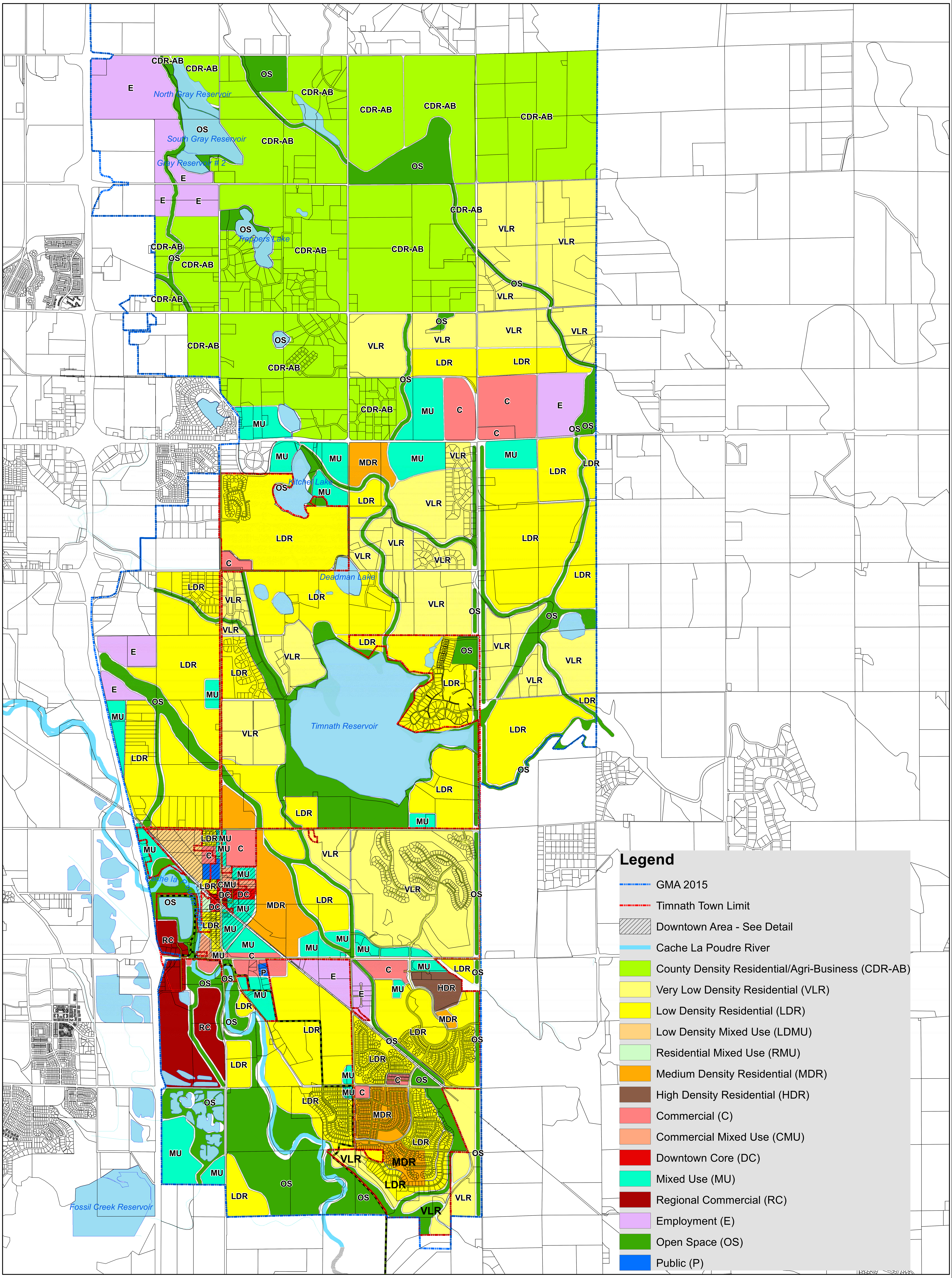
Link/ Node	Element ID (E.C.)	Element ID (F.C.)	Location	Future SWMM Model Results Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
-	-	-	Boxelder Creek Overflow Discharge	-	-	-	-	-	-
Link	39	CLARK8	Clark Drainage at County Road 5	73	122	167	249	330	430
Node	199	199	Clark Drainage at County Road 40	107	177	244	386	543	727
Link	OP-51	OP-51	Downtown Outfall to Clark Drainage	14	22	28	37	46	56
Link	173	CLARK1	Clark Drainage at Harmony Rd. U/S of TROC confluence	132	217	298	467	653	869
Link	-	173	Harmony Road Ditch, NW of confluence with TROC	4	7	9	13	16	20
Node	ResOutlet	ResOutlet	Timnath Reservoir Discharge	226	238	249	274	306	409
Link	TROCL6	TROCL6	Timnath Res. Outlet Ditch U/S of confluence	227	239	251	292	385	531
Node	TROC6	TROC6	Timnath Res. Outlet Ditch at Harmony Road	360	456	549	745	969	1,264
Node	TROC9	TROC9	Timnath Res. Outlet Ditch at Summerfield Pkwy	363	460	552	749	975	1,280
Node	TROC11	TROC11	Timnath Res. Outlet Ditch at County Road 36	371	472	576	785	1,021	1,356
Node	TROC-OUTFALL	TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	373	476	581	796	1,038	1,379
Node	295	295	Discharge at Harmony Road and County Rd. 1	1	2	4	10	19	28
Node	348	348	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	8	13	16	22	29	39
Node	DTSO1	DTSO1	Dixon Street Outfall	7	10	13	19	26	37
Node	G3-2	G3-2	Timnath South Outfall to Greeley No. 2	3	4	5	8	10	72

2005 Master Plan - MODSWMM Results
Developed Condition - Alternative 3

Developed Condition - without Boxelder Flows
(From Report Table 5.6)

Element ID	Location	10-Year Discharge (cfs)	50-Year	100-Year
927	Boxelder Creek Overflow Discharge	0	0	0
321	Main flowpath at County Road 5	94	222	318
345	Main flowpath at County Road 40	163	399	580
151	Downtown Outfall to Main flowpath	37	82	116
173	Main flowpath at Harmony Rd. U/S of TROC confluence	184	453	661
270	Harmony Road Ditch, NW of confluence with TROC	5	10	13
920	Timnath Reservoir Discharge	32	100	366
280	Timnath Res. Outlet Ditch U/S of confluence	37	125	388
383	Timnath Res. Outlet Ditch at Harmony Road	235	607	902
188	Timnath Res. Outlet Ditch at Summerfield Pkwy	251	638	943
397	Timnath Res. Outlet Ditch at County Road 36	265	674	996
300	Timnath Res. Outlet Ditch at Greeley No. 2	277	702	1,028
374	Discharge at Harmony Road and County Rd. 1	4	10	14
810	Outfall to Poudre River at County Rd. 5 & Harmony Rd.	3	6	8

Timnath, Colorado Comprehensive Plan Update



Revised Future Land Use Map
Timnath Growth Management Area

Updated March 23, 2016

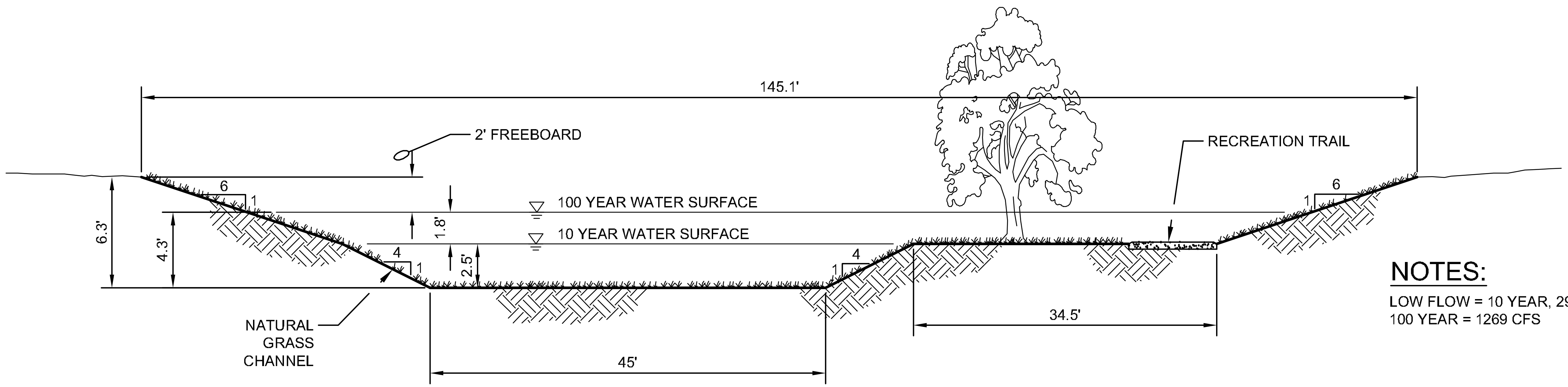
0 0.5 1 2 Miles N

Town of Timnath

Appendix C

Conceptual Hydraulic Design of Clark Channel and Timnath Reservoir Outlet Canal Channel

1) Figure C-1 – Clark Channel and TROC Channel Typical Cross Sections
2) Table C-1 – Summary of Discharges - Clark and TROC Channel Design
3) Appendix C-2 - Clark Channel Conceptual Design
4) Appendix C-3 – TROC Channel Conceptual Design

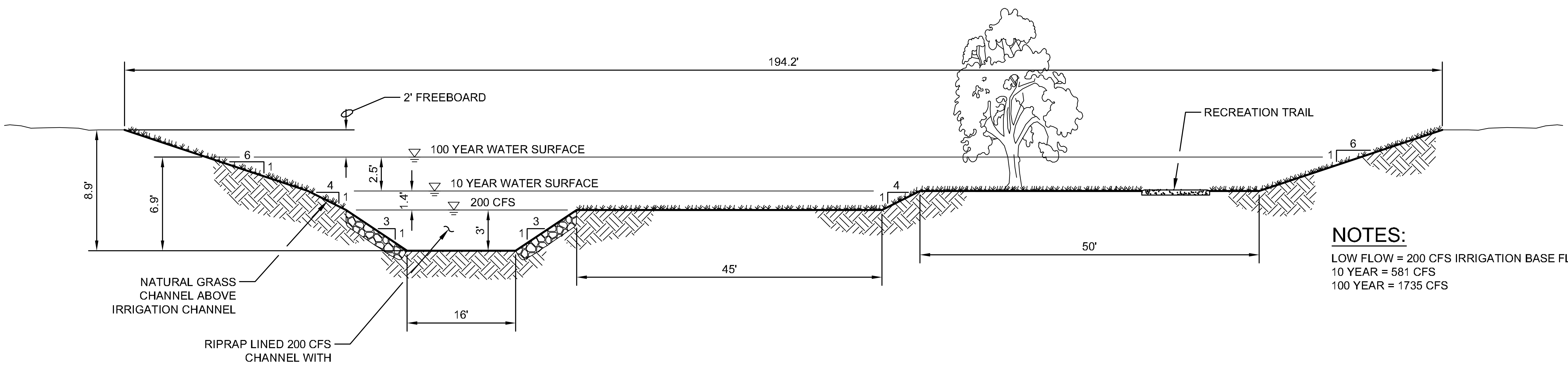


NOTES:

LOW FLOW = 10 YEAR, 298 CFS
100 YEAR = 1269 CFS

CLARK CHANNEL ABOVE TIMNATH RESERVOIR OUTLET CANAL (HARMONY)

NOT TO SCALE



NOTES:

LOW FLOW = 200 CFS IRRIGATION BASE FLOW
10 YEAR = 581 CFS
100 YEAR = 1735 CFS

TIMNATH RESERVOIR OUTLET CANAL BELOW GREAT WESTERN RR CROSSING (NEAR CR-36/RIVER PASS ROAD)

NOT TO SCALE

Figure 5.1
Typical Cross Sections

AYRES ASSOCIATES

Drawing Name: F:\32-1881.00 TIMNATH MASTER PLAN UPDATE\MAINDWGS\EXHIBITS\32-1881.00 CHANNEL SECTIONS EXHIBIT.DWG Tuesday, August 21, 2018 1:16 PM By: RICKS, RONALD

Table C-1 - Summary of Discharges - Clark and TROC Channel Design

Timnath Stormwater Master Plan Update - 2018
SWMM Model Results

8/21/2018

Link/ Node	Element ID (E.C.)	Element ID (F.C.)	Location	Existing SWMM Model Results – Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results – Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Clark and TROC Channel Flows															
Link	246	CLARK6	Clark Drainage - East of CR5	29	41	59	166	377	726	105	174	240	378	533	711
Link	37	CLARK4	Clark Drainage - South of CR40	30	41	65	236	586	1,192	112	185	254	400	559	747
Link	173	CLARK1	Clark Drainage - Above Confluence with TROC	29	43	63	231	589	1,269	132	217	298	467	653	869
Node	TROC6	TROC6	Timnath Res. Outlet Ditch at Harmony Road	252	273	301	491	885	1,629	360	456	549	745	969	1,264
Node	TROC11	TROC11	Timnath Res. Outlet Ditch at County Road 36	260	283	312	529	946	1,736	371	472	576	785	1,021	1,356
Node	TROC-OUTFALL	TROC-OUTFALL	Timnath Res. Outlet Ditch at Greeley No. 2	260	283	312	529	946	1,735	373	476	581	796	1,038	1,379

Appendix C-2

Clark Channel Conceptual Design

Clark Channel - Concept Design Dimensions

Clark - Upstream of TROC

	Discharge (cfs)		
	2005 Study	2018 Study	
Frequency	Future	Existing	Future
100-yr	647	1,269	869
10-yr	175	63	298
2-yr	-	29	132
	Used for Design	Used for Design	
		(Flows from CLARK1 Link)	

Slope (%)	0.35%	0.27%

Geometry		
Bottom Width (ft)	10	45
Top Width - Low Flow (ft)	30	65
Overbank Bench Width (ft)	25	34.5
Top Width - Main Channel (ft)	67	121
Top Width - with Free Board	75	145
Depth - Low Flow (ft)	2.5	2.5
Depth - Main Channel (ft)	4	4.3
Freeboard (ft)	1	2
Total Depth (ft)	5	6.3
Low Flow Side Slope (z:1)	4	4
Main Channel Side Slope (z:1)	4	6

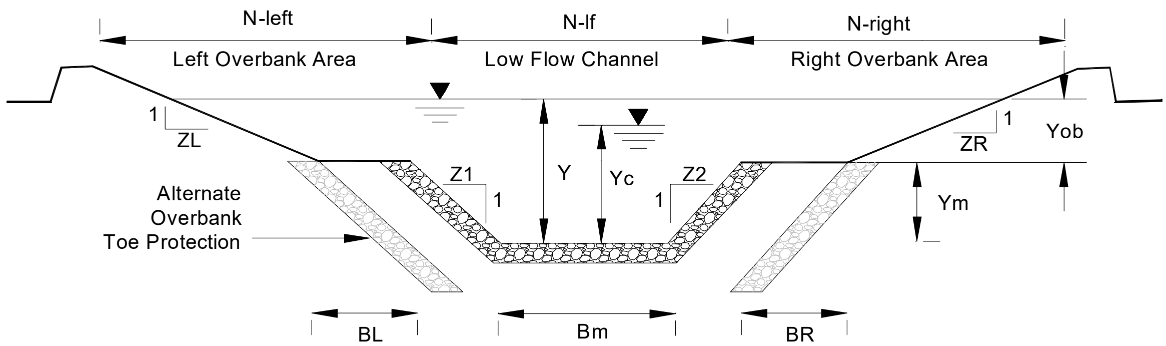
Manning n - Low Flow	0.035	0.059	(riprap sides- natural bottom w/ wetland veg.)
Manning n - Overbank	0.035	0.05	(2' grass)

Final Results

Capacity Analysis of Composite Channel

Project: Town of Timnath - Drainage Master Plan Update (2017)

Channel ID: Clark Major Drainage Channel - Upstream of TROC Confluence



Design Information (Input)							
Channel Invert Slope	So =	0.00270	ft/ft	Left Overbank Bottom Width	BL =	0.00	ft
				Left Overbank Side Slope	ZL =	6.00	ft/ft
Low Flow Channel Bottom Width	Bm =	45.00	ft	Left Overbank Manning's n	n-left =	0.0500	
Low Flow Channel Left Side Slope	Z1 =	4.00	ft/ft	Right Overbank Bottom Width	BR =	34.50	ft
Low Flow Channel Right Side Slope	Z2 =	4.00	ft/ft	Right Overbank Side Slope	ZR =	6.00	ft/ft
Low Flow Channel Manning's Nn for Qd	n-lf =	0.0590		Right Overbank Manning's n	n-right =	0.0500	
Low Flow Channel Manning's Nn for Q100	n-m-Q100 =	0.0440					
(See USDCM Vol. II, n vs. Depth Graph)							
Low Flow Channel Bank-full depth	**Ym =**	**2.50**	**ft**	**Overbank Flow Depth Yob (Y - Ym)**	**Yob =**	**1.80**	**ft**

Low Flow Channel Condition for Qd				**Low Flow Channel Flow Condition for Q100**			
Top width	Tlf =	65.0	ft	Top width	Tm =	65.0	ft
Flow area	Alf =	137.5	sq ft	Flow area	Am =	254.5	sq ft
Wetted perimeter	Plf =	65.6	ft	Wetted perimeter	Pm =	65.6	ft
Discharge (Calculated)	**Qlf =**	**295.5**	**cfs**	**Discharge**	**Qm =**	**1,105.5**	**cfs**
Velocity	**Vlf=**	**2.2**	**fps**	**Velocity**	**Vm =**	**4.3**	**fps**
Froude number	**Fr-lf =**	**0.26**		**Froude number**	**Frm =**	**0.39**	
Qd Critical Velocity	Vlfc =	5.63	fps	100-Yr. Critical Velocity	Vmc =	8.2	fps
Qd Critical Depth	Ylfc =	1.07	ft	100-Yr. Critical Depth	Ymc =	2.5	ft
Left Overbank Flow Condition for Q100				**Right Overbank Flow Condition for Q100**			
Top width	TL =	10.8	ft	Top width	TR =	45.3	ft
Flow area	AL =	9.7200	sq ft	Flow area	AR =	71.8200	sq ft
Wetted perimeter	PL =	10.9500	ft	Wetted perimeter	PR =	45.4500	ft
Discharge	**QL =**	**13.9**	**cfs**	**Discharge**	**QR =**	**150.9**	**cfs**
Velocity	**VL =**	**1.4**	**fps**	**Velocity**	**VR =**	**2.1**	**fps**
Froude number	**FrL =**	**0.27**		**Froude number**	**FrR =**	**0.29**	
100-Yr. Critical Velocity	VLc =	4.1	fps	100-Yr. Critical Velocity	VRc =	5.0	fps
100-Yr. Critical Depth in Overbanks	YLc =	1.1	ft	100-Yr. Critical Depth in Overbanks	YRc =	0.8	ft

Composite Cross-Section Flow Condition for Q100

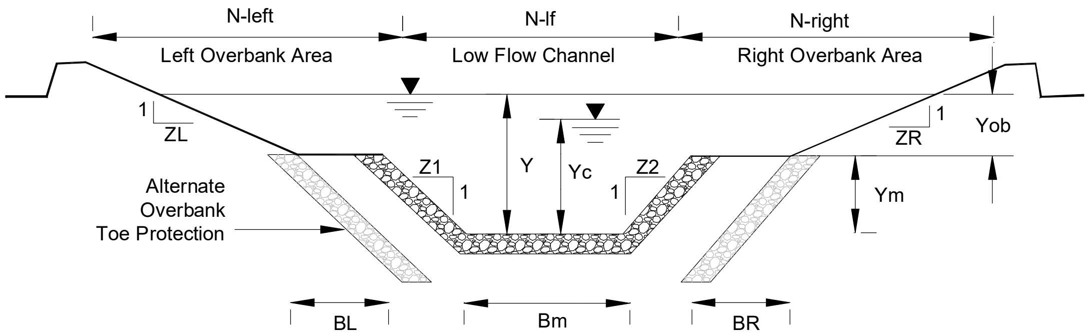
Top width	**T =**	**121.1**	**ft**	**Discharge**	**Q =**	**1,270.3**	**cfs**
Channel Depth Y	**Y =**	**4.30**	**ft**	**Velocity**	**V =**	**3.8**	**fps**
Flow area	A =	336.0	sq ft	**Froude number**	**Fr =**	**0.40**	
Wetted perimeter	P =	122.0	ft	100-Yr. Critical Velocity	Vc =	7.3	fps
Cross-Sectional Manning's n (Calculated)	n =	0.0402		100-Yr. Critical Depth in Overbanks	Yc =	0.36	ft

Design Spreadsheet - Draft Results

Design of Composite Channel

Project: Town of Timnath - Drainage Master Plan Update (2017)

Channel ID: Clark Major Drainage Channel - Upstream of TROC Confluence



	Design Information (Input)						
	2-Year Discharge - Total	Q-2yr =	132 cfs				
	100-Year Discharge - Total	Q-100yr =	1,269 cfs	**Check one of the following toe protection types**			
Warning 01	Design Discharge - Low Flow Channel	Qlf =	298 cfs		Low Flow Channel Sideslope Protection	X	check, OR
	Low Flow Channel Left Side Slope	Z1 =	4.0 ft/ft		Overbank Toe Protection		check
	Low Flow Channel Right Side Slope	Z2 =	4.0 ft/ft				
Warning 02	Low Flow Channel Bank-full depth	Ym =	2.50 ft		Left overbank width as a		
	Left Overbank Side Slope	ZL =	6.0 ft/ft		percentage of total overbank width	0	%
Warning 04	Left Overbank Manning's n	n-left =	0.0500				
	Right Overbank Side Slope	ZR =	6.0 ft/ft	**Check one of the following soil types**			
Warning 04	Right Overbank Manning's n	n-right =	0.0500		Sandy Soil	X	check, OR
	Overbank Flow Depth Yob (Y - Ym)	Yob =	1.79 ft		Non-Sandy Soil		check

Flow Condition (Calculated)					
Channel Invert Slope	**So =**	**0.0027 ft/ft**			
Low Flow Channel Condition for Qd			**Low Flow Channel Flow Condition for Q100**		
Channel Bottom Width	Blf =	45.1 ft	Low Flow Channel Bottom Width	Bm =	45.1 ft
Channel Normal Flow Depth	Ylf =	2.50 ft	Top width	Tm =	65.1 ft
Top width	Tlf =	65.1 ft	Flow area	Am =	254.1 sq ft
Flow area	Alf =	137.6 sq ft	Wetted perimeter	Pm =	65.7 ft
Wetted perimeter	Plf =	65.7 ft	Manning's n (Calculated)	n-m =	0.0440
Manning's n (Calculated)	n-lf =	0.0590	**Discharge**	**Qm =**	**1,109 cfs**
Discharge (Calculated)	**Qlf =**	**298 cfs**	Velocity	Vm =	4.4 fps
Velocity	Vlf =	2.2 fps	**Froude number**	**Frm =**	**0.39**
Froude number	Fr-lf =	0.26	100-Yr. Critical Velocity	Vmc =	8.2 fps
			100-Yr. Critical Depth	Ymc =	2.5 ft
Left Overbank Flow Condition for Q100			**Right Overbank Flow Condition for Q100**		
Overbank Bench Width	BL =	0.0 ft	Overbank Bench Width	BR =	33.6 ft
Normal Depth in Overbanks	YLob =	1.8 ft	Normal Depth in Overbanks	YRob =	1.8 ft
Top width	TL =	10.7 ft	Top width	TR =	44.3 ft
Flow area	AL =	9.6 sq ft	Flow area	AR =	69.7 sq ft
Wetted perimeter	PL =	10.9 ft	Wetted perimeter	PR =	44.4 ft
Discharge	**QL =**	**14 cfs**	**Discharge**	**QR =**	**147 cfs**
Velocity	**VL =**	**1.4 fps**	**Velocity**	**VR =**	**2.1 fps**
Froude number	**FrL =**	**0.27**	**Froude number**	**FrR =**	**0.30**
100-Yr. Critical Velocity	VLc =	4.1 fps	100-Yr. Critical Velocity	VRc =	5.0 fps
100-Yr. Critical Depth in Overbanks	YLc =	1.1 ft	100-Yr. Critical Depth in Overbanks	YRc =	0.8 ft

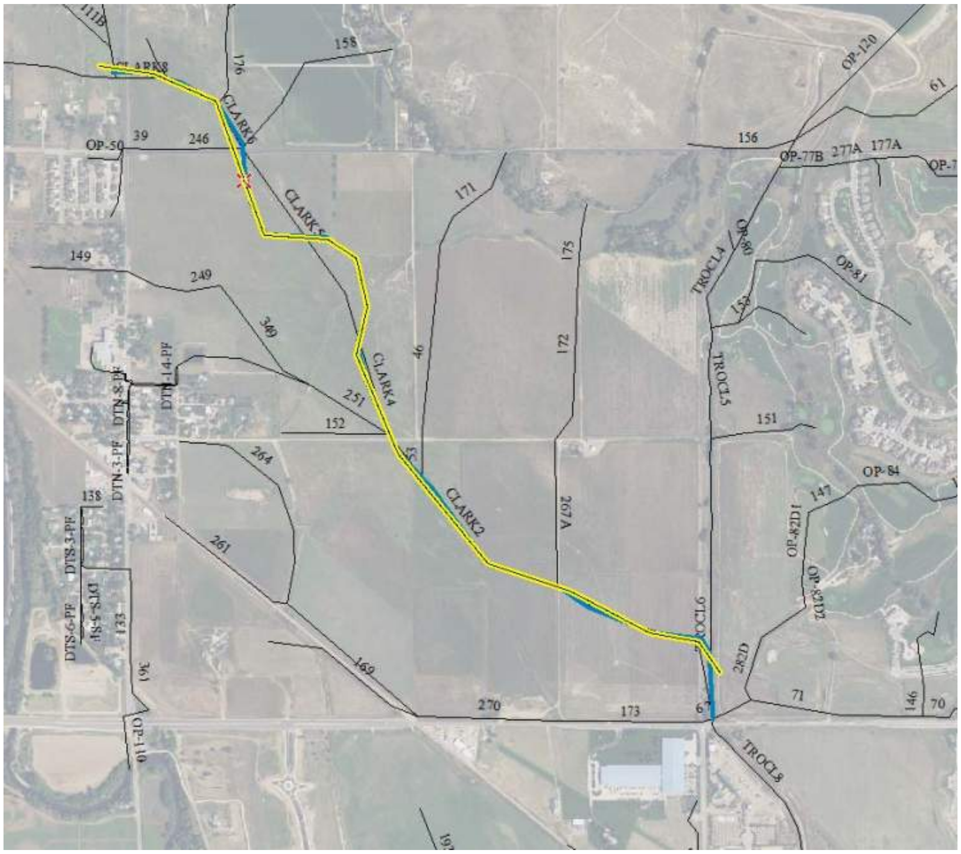
Composite Cross-Section Flow Condition for Q100

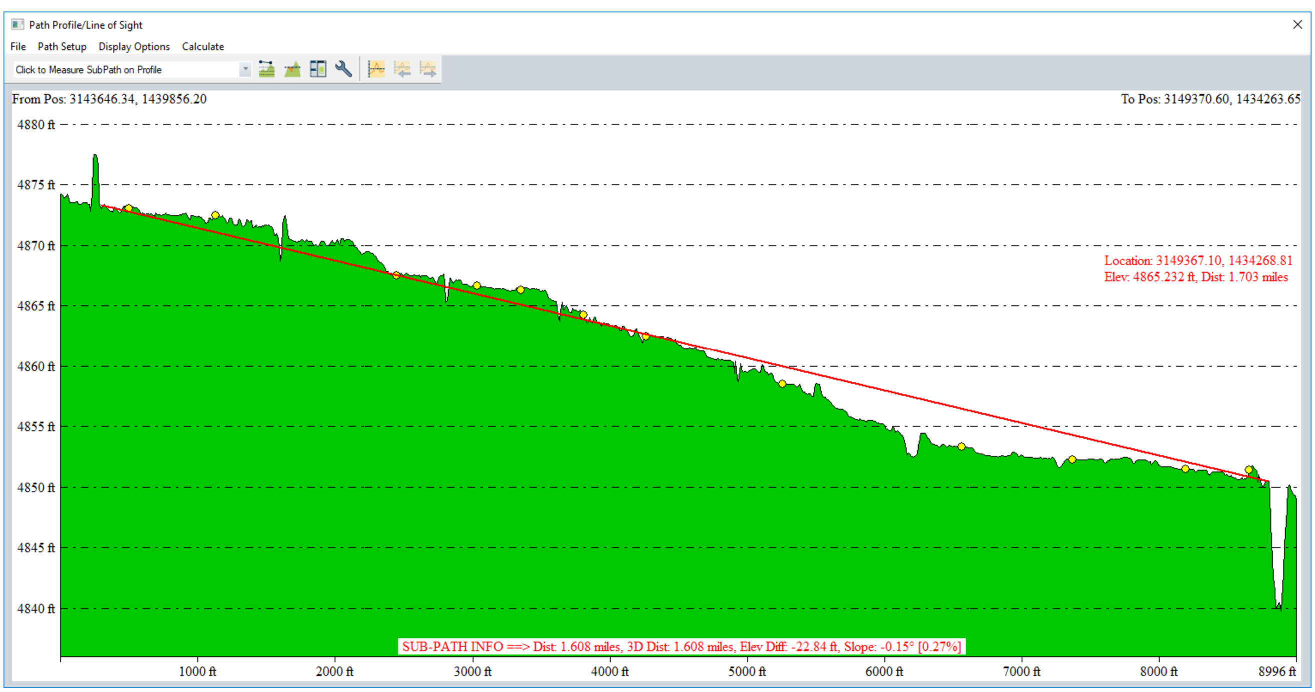
Top width	**T =**	**120.1 ft**	**Discharge**	**Q =**	**1,269 cfs**
Channel Depth Y	**Y =**	**4.29 ft**	**Velocity (average)**	**V =**	**3.8 fps**
Flow area	A =	333.3 sq ft	Froude number	Fr =	0.40
Wetted perimeter	P =	121.0 ft	100-Yr. Critical Velocity	Vc =	7.4 fps
Cross-Sectional Manning's n (Calculated)	n =	0.0402	100-Yr. Critical Depth in Overbanks	Yc =	0.35 ft

Warning 01: Design flow does not meet USDCM Volume I criteria.
Warning 02: Low flow channel depth does not meet USDCM Volume I minimum criteria.

Warning 04: Manning's n for grass-lined channel not within USDCM Volume I recommendation.

Clark Channel – Upstream of TROC Confluence – Profile Slope = 0.27%





Appendix C-3

TROC Channel Conceptual Design

TROC Channel - Concept Design Dimensions

TROC - Downstream of Clark

	Discharge (cfs)		
	2005 Study	2018 Study	
Frequency	Future	Existing	Future
100-yr	1,185	1,735	1,379
10-yr	284	312	581
2-yr	-	260	373
	Used for Design	Used for Design	
		(Flows from TROC-OUTFALL Node)	

Slope (%)	0.35%	0.20%
Geometry		
Bottom Width (ft)	20	16
Top Width - Low Flow (ft)	-	34
Overbank Bench - 200cfs (ft)	-	45
Top Width - 10yr (ft)	40	90
Overbank Bench - 10yr (ft)	25	50
Top Width - Main Channel (ft)	81	170
Top Width - with Free Board	89	194
Depth - Low Flow (ft)	2.5	3
Depth - 10yr (ft)	4.5	4.4
Depth - 100yr (ft)	4.5	6.9
Freeboard (ft)	1	2
Total Depth (ft)	5.5	8.9
Low Flow Side Slope (z:1)	4	3
10yr Channel Side Slope (z:1)	4	4
100yr Channel Side Slope (z:1)	4	6
Manning n - Low Flow	0.035	0.04 (riprap sides- no veg)
Manning n - Overbank	0.035	0.05 (2' grass)

TROC Channel - Flow Master Results - 100-year Compound Channel

Worksheet : TROC - DS of Harmony

Uniform Flow | Gradually Varied Flow | Messages

Solve For: Normal Depth   Friction Method: Manning Formula

Roughness Coefficient:	0.048	
Channel Slope:	0.00200	ft/ft
Elevation:	9.91	ft
Elevation Range:	3.10 to 10.00 ft	
Discharge:	1735.00	ft³/s

Flow Area:	565.54	ft²
Wetted Perimeter:	170.79	ft
Hydraulic Radius:	3.31	ft
Top Width:	169.08	ft
Normal Depth:	6.81	ft
Critical Depth:	4.71	ft
Critical Slope:	0.02890	ft/ft
Velocity:	3.07	ft/s
Velocity Head:	0.15	ft
Specific Energy:	6.95	ft
Froude Number:	0.30	
Flow Type:	Subcritical	

Edit Section Options

Calculation Successful.

Irregular Section Editor : TROC - DS of Harmony

Section Geometry

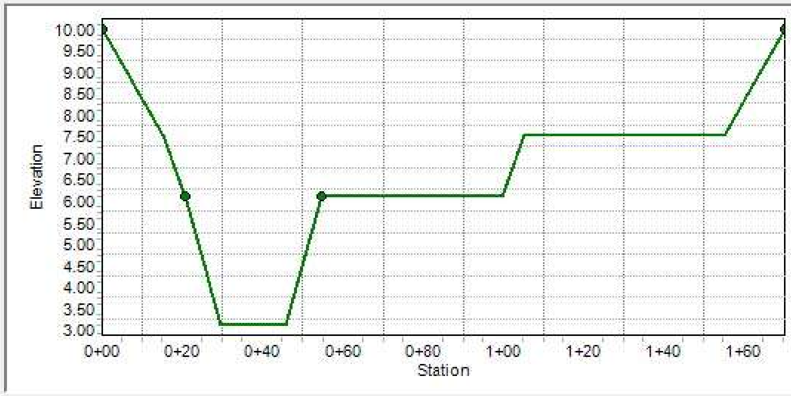
Insert Delete

	Station (ft)	Elevation (ft)
1	0+00	10.00
2	0+15	7.50
3	0+21	6.10
4	0+30	3.10
5	0+46	3.10
6	0+55	6.10

Segment Roughness

Insert Delete

	Start Station & Elevation	End Station & Elevation	Roughness Coefficient
1	(0+00, 10.00)	(0+21, 6.10)	0.050
2	(0+21, 6.10)	(0+55, 6.10)	0.040
3	(0+55, 6.10)	(1+70, 10.00)	0.050
*			



OK Cancel Help

Worksheet for TROC - DS of Harmony

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00200	ft/ft
Discharge	1735.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	10.00
0+15	7.50
0+21	6.10
0+30	3.10
0+46	3.10
0+55	6.10
1+00	6.10
1+05	7.50
1+55	7.50
1+70	10.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 10.00)	(0+21, 6.10)	0.050
(0+21, 6.10)	(0+55, 6.10)	0.040
(0+55, 6.10)	(1+70, 10.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	6.81	ft

Worksheet for TROC - DS of Harmony

Results

Elevation Range	3.10 to 10.00 ft	
Flow Area	565.54	ft²
Wetted Perimeter	170.79	ft
Hydraulic Radius	3.31	ft
Top Width	169.08	ft
Normal Depth	6.81	ft
Critical Depth	4.71	ft
Critical Slope	0.02890	ft/ft
Velocity	3.07	ft/s
Velocity Head	0.15	ft
Specific Energy	6.95	ft
Froude Number	0.30	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

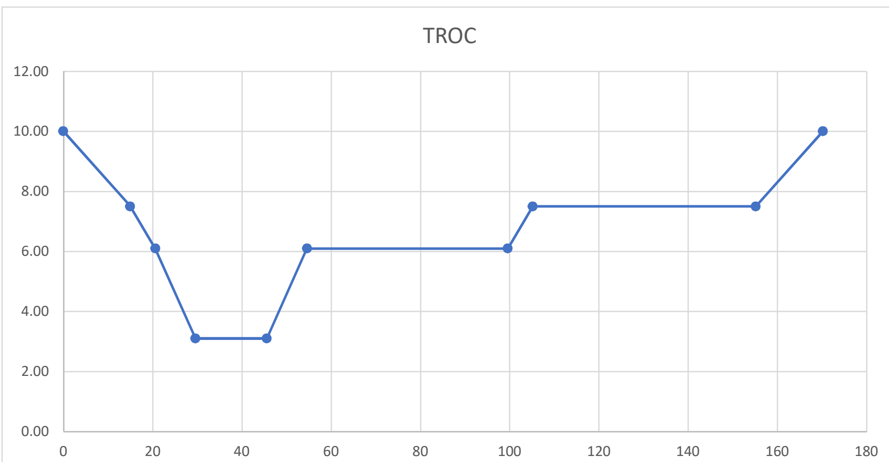
GVF Output Data

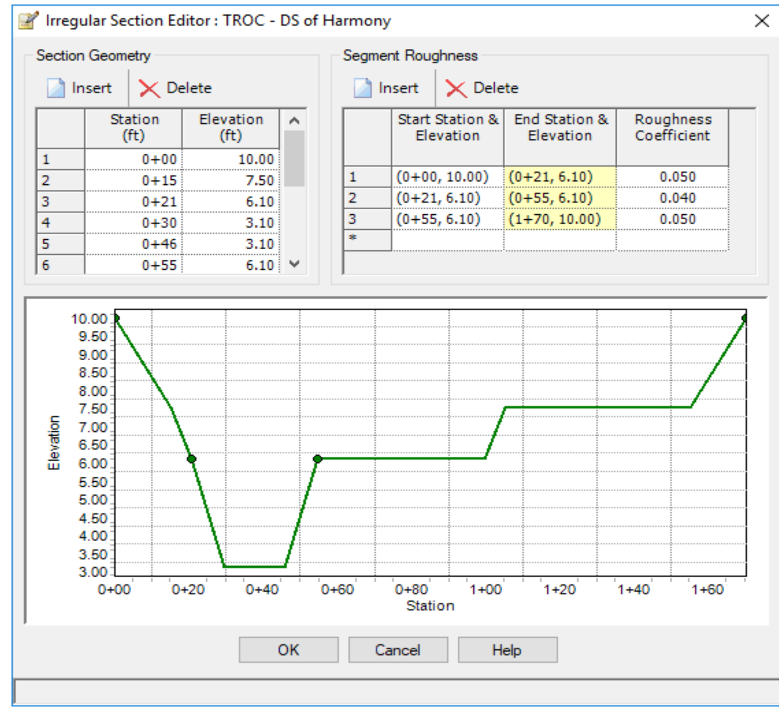
Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.81	ft
Critical Depth	4.71	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.02890	ft/ft

TROC Cross Section

Dimensions		
200cfs Bw	16	
200cfs Tw	34	
10yr Bw	79	
10yr Tw	90.2	
100yr Bw	140.2	
100yr Tw	170.2	
Y (200)	3.0	
Y (10yr)	4.4	1.4
Y (100yr)	6.9	2.5

Station	Elevation	Slope	Dist (dx)	Delta y	Note
0	10.00				100yr WSE
15	7.50	-0.17	15	-2.50	6:1 slope - 10yr WSE
20.6	6.10	-0.25	5.6	-1.40	4:1 Slope - 200cfs WSE
29.6	3.10	-0.33	9	-3.00	Channel Invert.
45.6	3.10	0.00	16	0.00	Channel Invert.
54.6	6.10	0.33	9	3.00	200 cfs WSE
99.6	6.10	0.00	45	0.00	200 cfs bench
105.2	7.50	0.25	5.6	1.40	10yr WSE
155.2	7.50	0	50	0.00	10yr Bench
170.2	10.00	0.17	15	2.50	100yr WSE



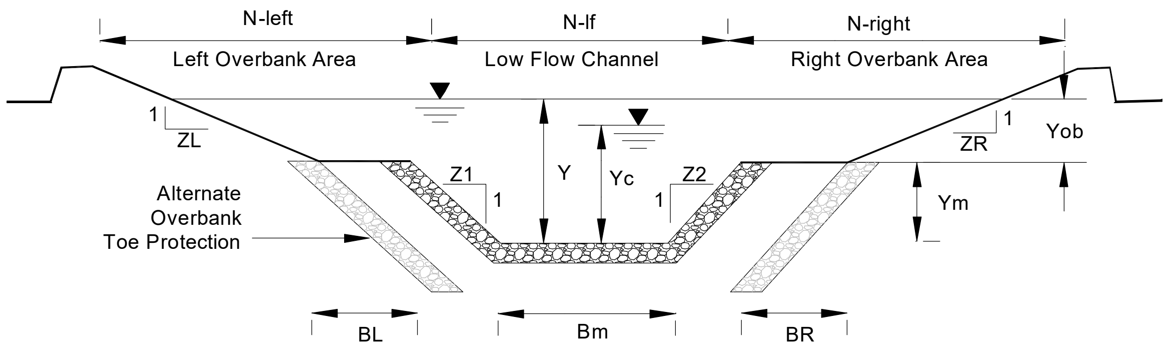


Final Results - 10yr and 200 cfs channels

Capacity Analysis of Composite Channel

Project: Town of Timnath - Drainage Master Plan Update (2017)

Channel ID: TROC - Major Drainage Channel - Downstream Clark Confluence (Harmony) - 10yr channel



Design Information (Input)

Channel Invert Slope	So =	0.00200	ft/ft	Left Overbank Bottom Width	BL =	0.00	ft
				Left Overbank Side Slope	ZL =	4.00	ft/ft
Low Flow Channel Bottom Width	Bm =	16.00	ft	Left Overbank Manning's n	n-left =	0.0500	
Low Flow Channel Left Side Slope	Z1 =	3.00	ft/ft	Right Overbank Bottom Width	BR =	45.00	ft
Low Flow Channel Right Side Slope	Z2 =	3.00	ft/ft	Right Overbank Side Slope	ZR =	4.00	ft/ft
Low Flow Channel Manning's Nn for Qd	n-lf =	0.0400		Right Overbank Manning's n	n-right =	0.0500	
Low Flow Channel Manning's Nn for Q100	n-m-Q100 =	0.0400					
(See USDCM Vol. II, n vs. Depth Graph)							
Low Flow Channel Bank-full depth	**Ym =**	**3.00**	**ft**	**Overbank Flow Depth Yob (Y - Ym)**	**Yob =**	**1.40**	**ft**

Low Flow Channel Condition for Qd				**Low Flow Channel Flow Condition for Q100**			
Top width	Tlf =	34.0	ft	Top width	Tm =	34.0	ft
Flow area	Alf =	75.0	sq ft	Flow area	Am =	122.6	sq ft
Wetted perimeter	Plf =	35.0	ft	Wetted perimeter	Pm =	35.0	ft
Discharge (Calculated)	**Qlf =**	**207.8**	**cfs**	**Discharge**	**Qm =**	**471.3**	**cfs**
Velocity	**Vlf=**	**2.8**	**fps**	**Velocity**	**Vm =**	**3.8**	**fps**
Froude number	**Fr-lf =**	**0.33**		**Froude number**	**Frm =**	**0.36**	
Qd Critical Velocity	Vlfc =	6.42	fps	100-Yr. Critical Velocity	Vmc =	7.9	fps
Qd Critical Depth	Ylfc =	1.56	ft	100-Yr. Critical Depth	Ymc =	2.5	ft
Left Overbank Flow Condition for Q100				**Right Overbank Flow Condition for Q100**			
Top width	TL =	5.6	ft	Top width	TR =	50.6	ft
Flow area	AL =	3.9200	sq ft	Flow area	AR =	66.9200	sq ft
Wetted perimeter	PL =	5.7700	ft	Wetted perimeter	PR =	50.7700	ft
Discharge	**QL =**	**4.0**	**cfs**	**Discharge**	**QR =**	**107.2**	**cfs**
Velocity	**VL =**	**1.0**	**fps**	**Velocity**	**VR =**	**1.6**	**fps**
Froude number	**FrL =**	**0.22**		**Froude number**	**FrR =**	**0.25**	
100-Yr. Critical Velocity	VLc =	3.5	fps	100-Yr. Critical Velocity	VRc =	4.2	fps
100-Yr. Critical Depth in Overbanks	YLc =	0.8	ft	100-Yr. Critical Depth in Overbanks	YRc =	0.6	ft

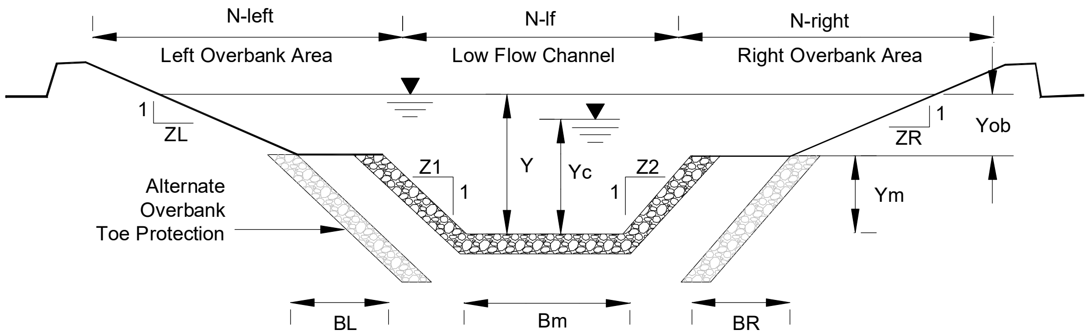
Composite Cross-Section Flow Condition for Q100 **10-year channel**

Top width	**T =**	**90.2**	**ft**	**Discharge**	**Q =**	**582.6**	**cfs**
Channel Depth Y	**Y =**	**4.40**	**ft**	**Velocity**	**V =**	**3.0**	**fps**
Flow area	A =	193.4	sq ft	**Froude number**	**Fr =**	**0.36**	
Wetted perimeter	P =	91.5	ft	100-Yr. Critical Velocity	Vc =	6.1	fps
Cross-Sectional Manning's n (Calculated)	n =	0.0364		100-Yr. Critical Depth in Overbanks	Yc =	0.31	ft

Design Spreadsheet - 10yr and 200 cfs channels

Design of Composite Channel

Project: Town of Timnath - Drainage Master Plan Update (2017)
Channel ID: Timnath Reservoir Outlet Canal - Major Drainage Channel - Downstream Clark Confluence (Harmony) - 10yr Channel



Design Information (Input)

	2-Year Discharge - Total	Q-2yr =	373	cfs			
	100-Year Discharge - Total	Q-100yr =	581	cfs	**Check one of the following toe protection types**		
Warning 01	Design Discharge - Low Flow Channel	Qlf =	200	cfs	Low Flow Channel Sideslope Protection	X	check, OR
	Low Flow Channel Left Side Slope	Z1 =	3.0	ft/ft	Overbank Toe Protection		check
	Low Flow Channel Right Side Slope	Z2 =	3.0	ft/ft			
	Low Flow Channel Bank-full depth	Ym =	3.00	ft	Left overbank width as a		
	Left Overbank Side Slope	ZL =	4.0	ft/ft	percentage of total overbank width	0	%
Warning 04	Left Overbank Manning's n	n-left =	0.0500				
	Right Overbank Side Slope	ZR =	4.0	ft/ft	**Check one of the following soil types**		
Warning 04	Right Overbank Manning's n	n-right =	0.0500		Sandy Soil	X	check, OR
	Overbank Flow Depth Yob (Y - Ym)	Yob =	1.19	ft	Non-Sandy Soil		check

Flow Condition (Calculated)

Channel Invert Slope **So = 0.0020 ft/ft**

Low Flow Channel Condition for Qd				**Low Flow Channel Flow Condition for Q100**			
Channel Bottom Width	Blf =	21.5	ft	Low Flow Channel Bottom Width	Bm =	21.5	ft
Channel Normal Flow Depth	Ylf =	3.00	ft	Top width	Tm =	39.5	ft
Top width	Tlf =	39.5	ft	Flow area	Am =	138.3	sq ft
Flow area	Alf =	91.4	sq ft	Wetted perimeter	Pm =	40.4	ft
Wetted perimeter	Plf =	40.4	ft	Manning's n (Calculated)	n-m =	0.0440	
Manning's n (Calculated)	n-lf =	0.0530		**Discharge**	**Qm =**	**481**	**cfs**
Discharge (Calculated)	**Qlf =**	**200**	**cfs**	Velocity	Vm =	3.5	fps
Velocity	Vlf =	2.2	fps	**Froude number**	**Frm =**	**0.33**	
Froude number	Fr-lf =	0.25		100-Yr. Critical Velocity	Vmc =	7.6	fps
				100-Yr. Critical Depth	Ymc =	2.2	ft
Left Overbank Flow Condition for Q100				**Right Overbank Flow Condition for Q100**			
Overbank Bench Width	BL =	0.0	ft	Overbank Bench Width	BR =	53.7	ft
Normal Depth in Overbanks	YLob =	1.2	ft	Normal Depth in Overbanks	YRob =	1.2	ft
Top width	TL =	4.8	ft	Top width	TR =	58.4	ft
Flow area	AL =	2.8	sq ft	Flow area	AR =	66.7	sq ft
Wetted perimeter	PL =	4.9	ft	Wetted perimeter	PR =	58.6	ft
Discharge	**QL =**	**3**	**cfs**	**Discharge**	**QR =**	**98**	**cfs**
Velocity	**VL =**	**0.9**	**fps**	**Velocity**	**VR =**	**1.5**	**fps**
Froude number	**FrL =**	**0.21**		**Froude number**	**FrR =**	**0.24**	
100-Yr. Critical Velocity	VLc =	3.2	fps	100-Yr. Critical Velocity	VRc =	3.9	fps
100-Yr. Critical Depth in Overbanks	YLc =	0.6	ft	100-Yr. Critical Depth in Overbanks	YRc =	0.5	ft

Composite Cross-Section Flow Condition for Q100 **10-year channel**

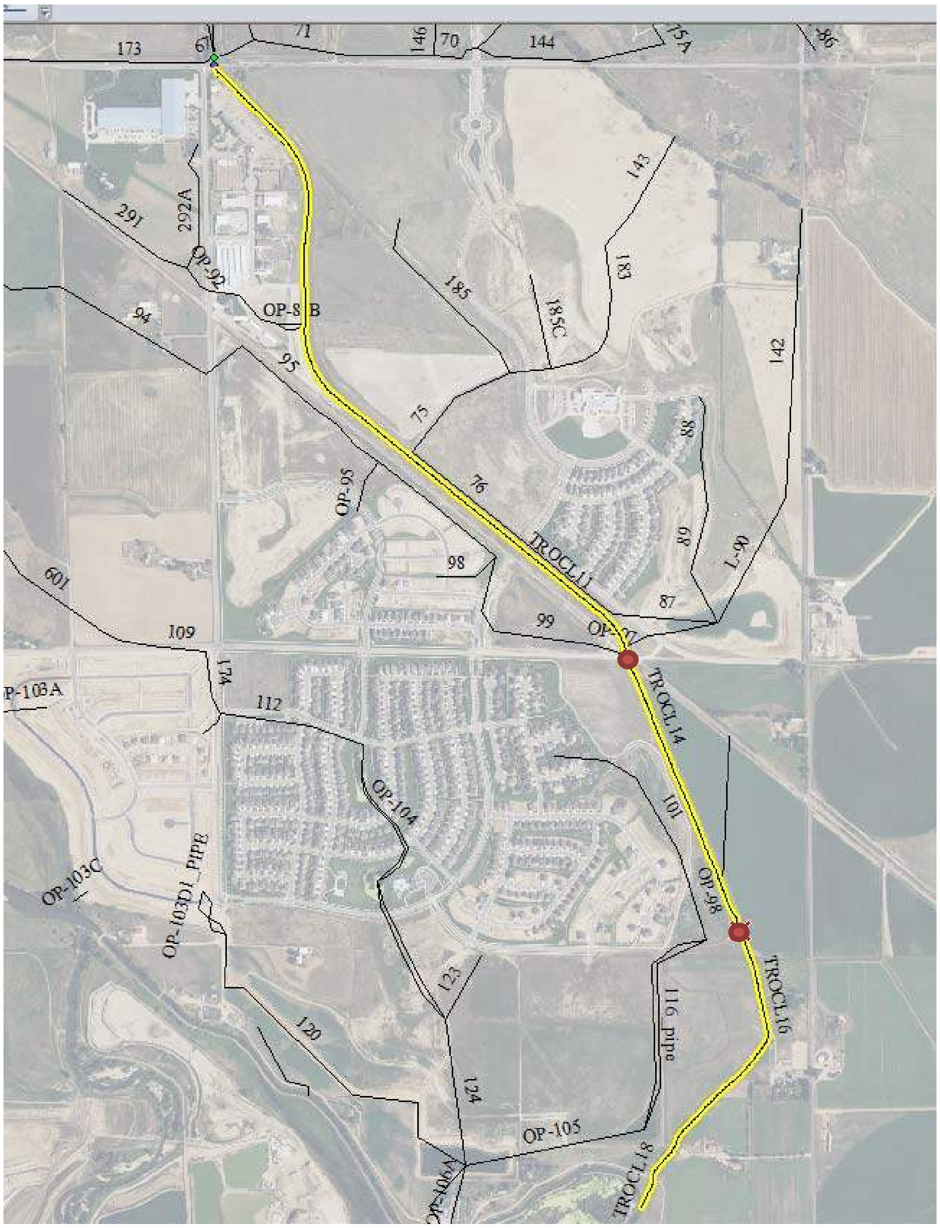
Top width	**T =**	**102.6**	**ft**	**Discharge**	**Q =**	**581**	**cfs**
Channel Depth Y	**Y =**	**4.19**	**ft**	**Velocity (average)**	**V =**	**2.8**	**fps**
Flow area	A =	207.8	sq ft	Froude number	Fr =	0.35	
Wetted perimeter	P =	103.9	ft	100-Yr. Critical Velocity	Vc =	5.9	fps
Cross-Sectional Manning's n (Calculated)	n =	0.0382		100-Yr. Critical Depth in Overbanks	Yc =	0.09	ft

Warning 01: Design flow does not meet USDCM Volume I criteria.

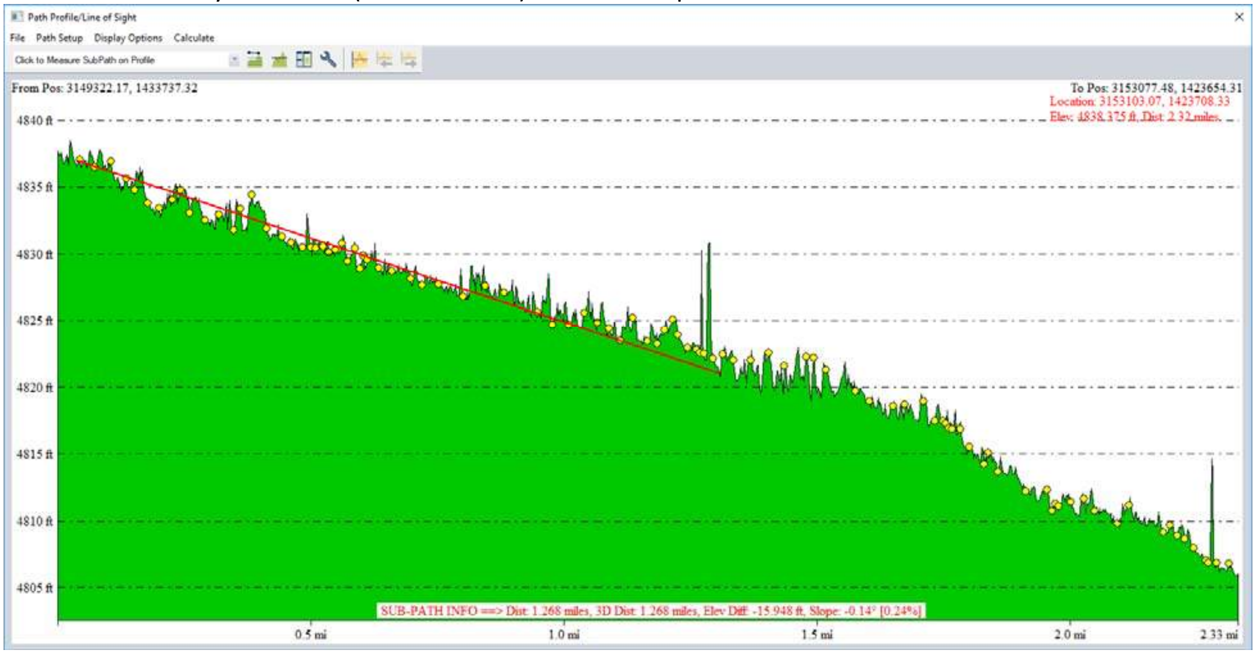
Warning 04: Manning's n for grass-lined channel not within USDCM Volume I recommendation.

TROC Profiles – South of Harmony (Confluence with Clark Channel)

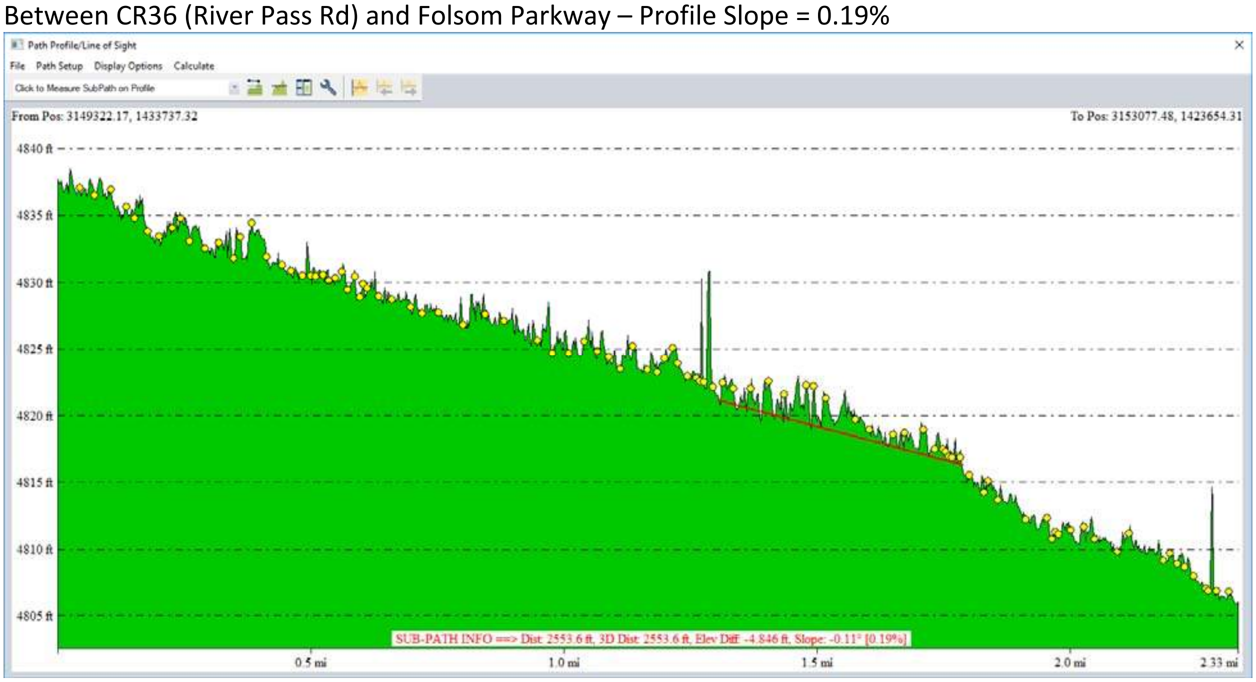
- Between Harmony and CR36 (River Pass Rd) – Profile Slope = 0.24%
- Between CR36 (River Pass Rd) and Folsom Parkway – Profile Slope = 0.19%
- Between Folsom Parkway and Greeley No. 2 – Profile Slope = 0.33%



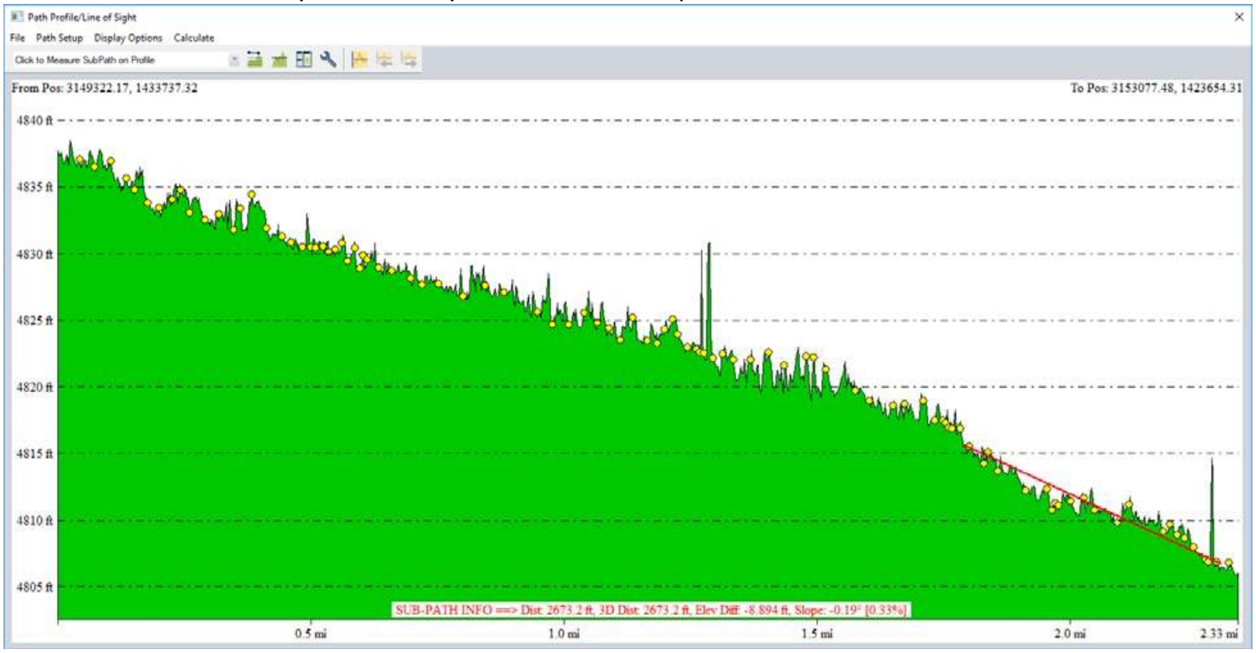
Between Harmony and CR36 (River Pass Rd) - Profile Slope = 0.24%



Between CR36 (River Pass Rd) and Folsom Parkway – Profile Slope = 0.19%



Between Folsom Parkway and Greeley No. 2 – Profile Slope = 0.33%

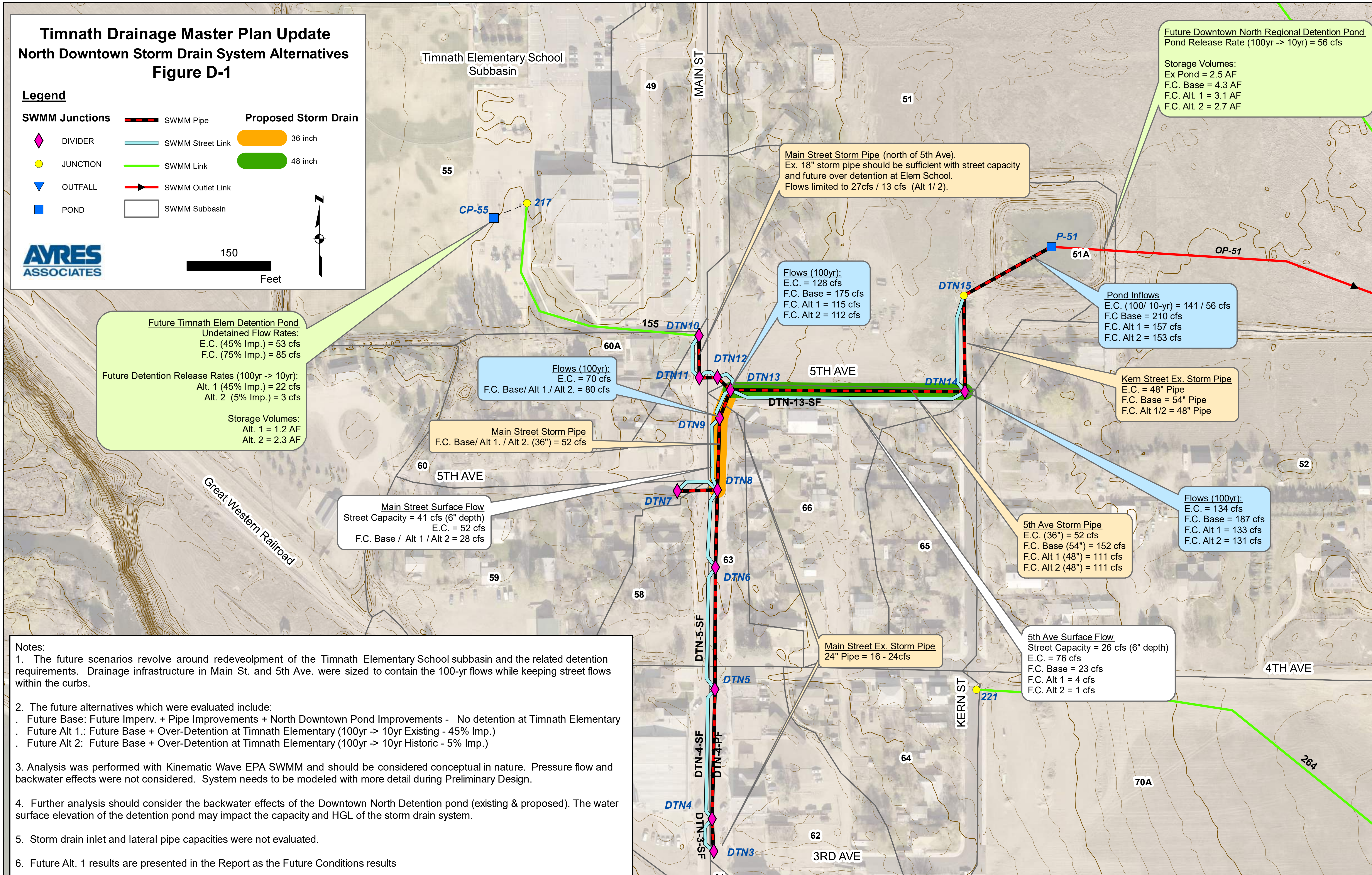


Appendix D

Downtown Area Improvement Alternatives

1) Figure D-1 - North Downtown Storm Drain System Alternatives
2) Table D-2 – Downtown Alternatives Summary Table
3) Appendix D-3 – Street Capacity Calculations
4) Appendix D-4 – Pipe Full Flow Calculations

Timnath Drainage Master Plan Update
North Downtown Storm Drain System Alternatives
Figure D-1



Notes:

1. The future scenarios revolve around redeveolpment of the Timnath Elementary School subbasin and the related detention requirements. Drainage infrastructure in Main St. and 5th Ave. were sized to contain the 100-yr flows while keeping street flows within the curbs.

2. The future alternatives which were evaluated include:
. Future Base: Future Imperv. + Pipe Improvements + North Downtown Pond Improvements - No detention at Timnath Elementary
. Future Alt 1.: Future Base + Over-Detention at Timnath Elementary (100yr -> 10yr Existing - 45% Imp.)
. Future Alt 2: Future Base + Over-Detention at Timnath Elementary (100yr -> 10yr Historic - 5% Imp.)

3. Analysis was performed with Kinematic Wave EPA SWMM and should be considered conceptual in nature. Pressure flow and backwater effects were not considered. System needs to be modeled with more detail during Preliminary Design.

4. Further analysis should consider the backwater effects of the Downtown North Detention pond (existing & proposed). The water surface elevation of the detention pond may impact the capacity and HGL of the storm drain system.

5. Storm drain inlet and lateral pipe capacities were not evaluated.

6. Future Alt. 1 results are presented in the Report as the Future Conditions results

Timnath Drainage Master Plan Update
Downtown Timnath - North of Railroad Tracks - Future Alternatives
8/21/2018

Item	Element	Existing Condition	Future Base	Future Alternative 1	Future Alternative 2	Notes
Timnath Elementary Subbasin	Detention requirement	No Detention 45% Imp.	No Detention 75% Imp.	Fut. 100yr -> Ex. 10yr (Existing Imp. = 45%)	Fut. 100yr -> Hist. 10yr (Historic Imp. = 5%)	Subbasin 55; Area = 10.68 ac **Future Redevelopment Impervious = 75%**
	Undetained Subbasin Flow Rate	53 cfs	85 cfs	85 cfs	85 cfs	
	Detention release rate	- cfs	- cfs	22 cfs	3 cfs	Pond Orifice = 1.49' / 0.54' (Alt 1/ Alt 2 ; Base = undetainted) (L-CP-55)
	Detention Volume	- AF	- AF	1.2 AF	2.3 AF	Detention Area = 7,700 SF/ 15,000 SF (Alt 1/ Alt 2 ; Base = undetainted) (Pond CP-55)
Downtown Timnath North Storm System	**Main Street** Pipe Size	24 in	36 in	36 in	36 in	Existing Main St. pipe is 24" Main St. Pipe: proposed 36" - between 5th Ave (west) to 5th Ave (east). South of 5th Ave, existing 24" is sufficient. North of 5th Ave, existing 18" pipe north (to School) should be sufficient with future over detention (27cfs / 13cfs for Alt 1/ 2)
	Pipe Flow	18 cfs	52 cfs	52 cfs	52 cfs	FlowMaster - 36" @ 0.6%
	Street Capacity	41 cfs	41 cfs	41 cfs	41 cfs	Street Capacity Calc (FlowMaster)
	Street Flow	52 cfs	28 cfs	28 cfs	28 cfs	Flow above pipe capacity
	Total Flow	70 cfs	80 cfs	80 cfs	80 cfs	Node DTN9
	5th Ave Pipe Size - 5th Ave	36 in	54 in	48 in	48 in	Existing Pipe is 36"
	Pipe Flow - 5th Ave	52 cfs	152 cfs	111 cfs	111 cfs	FlowMaster - 54" or 48" @ 0.6%
	Street Capacity - 5th Ave	26 cfs	26 cfs	26 cfs	26 cfs	Street Capacity Calc (FlowMaster)
	Street Flow - 5th Ave	76 cfs	23 cfs	4 cfs	1 cfs	Based on total flow at Main St. and 5th Ave minus pipe capacity
	Total Flow (5th Ave/ Main St.)	128 cfs	175 cfs	115 cfs	112 cfs	Node DTN13 - Corner of 5th Ave and Main St.
	Total Flow (5th Ave/ Kern St.)	134 cfs	187 cfs	133 cfs	131 cfs	Node DTN14 - Corner of 5th Ave and Kern
Downtown Timnath North Regional Detention Pond	Detention requirement	No Detention	100yr Future -> 10yr Existing	100yr Future -> 10yr Existing	100yr Future -> 10yr Existing	
	100yr Inflow Rate	141 cfs	210 cfs	157 cfs	153 cfs	P-51 inflows
	100yr Detention release rate *(100yr -> Exist 10yr)*	99 cfs	56 cfs	56 cfs	56 cfs	Link DTN-15-PF (existing) Link OP-51 (future) **Existing Inflows: 10-yr = 56 cfs,** 100yr = 141 cfs Choose to use 10-yr existing flows as outlet criteria.
	Detention Volume	2.5 AF	4.3 AF	3.1 AF	2.7 AF	P-51. Orifice = 2.13' / 2.4' / 2.52' (Fut/ Base / Alt 1 / Alt 2)

Notes

1. The future scenarios revolve around redevelopment of the Timnath Elementary School subbasin and the related detention requirements. Drainage infrastructure in Main St. and 5th Ave. were sized to contain the 100-yr flows while keeping street flows within the curbs.

2. The future alternatives which were evaluated include:
. Future Base: Future Imperv. + Pipe Improvements + North Dowtown Pond Improvments. No detention at Timnath Elementary
. Future Alt 1.: Future Base + 100yr -> 10yr Existing (45% Imp.) detention at Timnath Elementary
. Future Alt 2.: Future Base + 100yr -> 10yr Historic (5% Imp.) detention at Timnath Elementary

3. Analysis was performed with Kinematic Wave EPA SWMM and should be considered conceptual in nature. Pressure flow and backwater effects were not considered. System needs to be modeled with more detail during Preliminary Design.

4. Further analysis should consider the backwater effects of the Downtown North Detention pond (existing & proposed). The water surface elevation of the detention pond may impact the capacity and HGL of the storm drain system.

5. Storm drain inlet and lateral pipe capacities were not evaluated.

6. Future Alt 1. results are presented in the Report as the Future Conditions results.

Main Street Capacity Normal Depth Calc - 6" Depth

Worksheet for Main St.

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00600	ft/ft
Normal Depth	0.50	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00	4875.40
0+00	4875.39
0+01	4875.37
0+01	4875.34
0+02	4875.30
0+02	4875.25
0+02	4875.21
0+03	4875.17
0+03	4875.13
0+04	4875.07
0+04	4875.02
0+04	4874.97
0+05	4874.91
0+05	4874.86
0+06	4874.81
0+06	4874.75
0+07	4874.69
0+07	4874.64
0+07	4874.58
0+08	4874.52
0+08	4874.48
0+09	4874.45
0+09	4874.41
0+09	4874.38
0+10	4874.34
0+10	4874.30
0+11	4874.28

Worksheet for Main St.

Input Data

Station (ft)	Elevation (ft)
0+11	4874.25
0+11	4874.22
0+12	4874.19
0+12	4874.16
0+13	4874.13
0+13	4874.11
0+13	4874.08
0+14	4874.05
0+14	4874.02
0+15	4873.99
0+15	4873.96
0+15	4873.93
0+16	4873.90
0+16	4873.87
0+17	4873.84
0+17	4873.83
0+18	4873.82
0+18	4873.82
0+18	4873.82
0+19	4873.81
0+19	4873.81
0+20	4873.82
0+20	4873.84
0+20	4873.85
0+21	4873.86
0+21	4873.87
0+22	4873.89
0+22	4873.90
0+22	4873.91
0+23	4873.93
0+23	4873.94
0+24	4873.95
0+24	4873.97
0+24	4873.98
0+25	4873.99
0+25	4874.01
0+26	4874.02

Worksheet for Main St.

Input Data

Station (ft)	Elevation (ft)
0+26	4874.03
0+27	4874.05
0+27	4874.06
0+27	4874.07
0+28	4874.09
0+28	4874.10
0+29	4874.11
0+29	4874.13
0+29	4874.14
0+30	4874.15
0+30	4874.17
0+31	4874.18
0+31	4874.19
0+31	4874.21
0+32	4874.22
0+32	4874.23
0+33	4874.25
0+33	4874.26
0+33	4874.27
0+34	4874.29
0+34	4874.30
0+35	4874.31
0+35	4874.33
0+35	4874.33
0+36	4874.34
0+36	4874.34
0+37	4874.34
0+37	4874.34
0+38	4874.34
0+38	4874.33
0+38	4874.32
0+39	4874.31
0+39	4874.30
0+40	4874.28
0+40	4874.27
0+40	4874.26
0+41	4874.25

Worksheet for Main St.

Input Data

Station (ft)	Elevation (ft)
0+41	4874.24
0+42	4874.22
0+42	4874.21
0+42	4874.20
0+43	4874.19
0+43	4874.18
0+44	4874.17
0+44	4874.15
0+44	4874.14
0+45	4874.13
0+45	4874.12
0+46	4874.11
0+46	4874.09
0+46	4874.08
0+47	4874.07
0+47	4874.06
0+48	4874.05
0+48	4874.04
0+49	4874.02
0+49	4874.01
0+49	4874.00
0+50	4873.99
0+50	4873.98
0+51	4873.96
0+51	4873.95
0+51	4873.94
0+52	4873.93
0+52	4873.92
0+53	4873.91
0+53	4873.89
0+53	4873.88
0+54	4873.87
0+54	4873.86
0+55	4873.85
0+55	4873.83
0+55	4873.82
0+56	4873.83

Worksheet for Main St.

Input Data

Station (ft)	Elevation (ft)
0+56	4873.85
0+57	4873.87
0+57	4873.89
0+57	4873.90
0+58	4873.92
0+58	4873.94
0+59	4873.97
0+59	4873.99
0+60	4874.01
0+60	4874.03
0+60	4874.05
0+61	4874.07
0+61	4874.09
0+62	4874.11
0+62	4874.14
0+62	4874.16
0+63	4874.18
0+63	4874.20
0+64	4874.22
0+64	4874.24
0+64	4874.26
0+65	4874.29
0+65	4874.31
0+66	4874.33
0+66	4874.35
0+66	4874.37
0+67	4874.39
0+67	4874.40
0+68	4874.41
0+68	4874.41
0+69	4874.42
0+69	4874.42
0+69	4874.42
0+70	4874.40

Worksheet for Main St.

Input Data

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 4875.40)	(0+70, 4874.40)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	

Results

Discharge		41.21	ft³/s
Elevation Range	4873.81 to 4875.40 ft		
Flow Area		13.22	ft²
Wetted Perimeter		51.11	ft
Hydraulic Radius		0.26	ft
Top Width		51.07	ft
Normal Depth		0.50	ft
Critical Depth		0.52	ft
Critical Slope		0.00510	ft/ft
Velocity		3.12	ft/s
Velocity Head		0.15	ft
Specific Energy		0.65	ft
Froude Number		1.08	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft

GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.52	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00510	ft/ft

5th Ave - Street Capacity Normal Depth Calc - 6" Depth

Worksheet for 5th Ave

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.50	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00	4872.27
0+00	4872.27
0+01	4872.27
0+01	4872.27
0+01	4872.27
0+02	4872.27
0+02	4872.27
0+02	4872.22
0+02	4872.17
0+03	4872.12
0+03	4872.07
0+03	4872.02
0+04	4871.97
0+04	4871.92
0+04	4871.87
0+05	4871.82
0+05	4871.77
0+05	4871.72
0+05	4871.68
0+06	4871.69
0+06	4871.70
0+06	4871.71
0+07	4871.73
0+07	4871.74
0+07	4871.75
0+08	4871.76
0+08	4871.78

Worksheet for 5th Ave

Input Data

Station (ft)	Elevation (ft)
0+08	4871.79
0+09	4871.80
0+09	4871.81
0+09	4871.83
0+09	4871.84
0+10	4871.85
0+10	4871.86
0+10	4871.88
0+11	4871.89
0+11	4871.90
0+11	4871.91
0+12	4871.92
0+12	4871.94
0+12	4871.95
0+12	4871.96
0+13	4871.97
0+13	4871.99
0+13	4872.00
0+14	4872.01
0+14	4872.02
0+14	4872.04
0+15	4872.05
0+15	4872.06
0+15	4872.07
0+16	4872.09
0+16	4872.10
0+16	4872.11
0+16	4872.13
0+17	4872.14
0+17	4872.15
0+17	4872.16
0+18	4872.18
0+18	4872.19
0+18	4872.20
0+19	4872.21
0+19	4872.23
0+19	4872.24

Worksheet for 5th Ave

Input Data

Station (ft)	Elevation (ft)
0+19	4872.25
0+20	4872.27
0+20	4872.25
0+20	4872.23
0+21	4872.21
0+21	4872.19
0+21	4872.17
0+22	4872.15
0+22	4872.13
0+22	4872.12
0+23	4872.10
0+23	4872.08
0+23	4872.06
0+23	4872.04
0+24	4872.02
0+24	4872.00
0+24	4871.98
0+25	4871.96
0+25	4871.94
0+25	4871.92
0+26	4871.90
0+26	4871.88
0+26	4871.86
0+26	4871.84
0+27	4871.82
0+27	4871.80
0+27	4871.79
0+28	4871.77
0+28	4871.76
0+28	4871.74
0+29	4871.73
0+29	4871.72
0+29	4871.70
0+30	4871.69
0+30	4871.67
0+30	4871.66
0+30	4871.64

Worksheet for 5th Ave

Input Data

Station (ft)	Elevation (ft)
0+31	4871.66
0+31	4871.70
0+31	4871.74
0+32	4871.77
0+32	4871.81
0+32	4871.85
0+33	4871.88
0+33	4871.92
0+33	4871.96
0+33	4871.99
0+34	4872.03
0+34	4872.07
0+34	4872.10
0+35	4872.13
0+35	4872.16
0+35	4872.19
0+36	4872.23
0+36	4872.26
0+36	4872.29
0+37	4872.32
0+37	4872.35
0+37	4872.39
0+37	4872.42
0+38	4872.45
0+38	4872.48
0+38	4872.50
0+39	4872.53
0+39	4872.56
0+39	4872.58
0+40	4872.61
0+40	4872.63
0+40	4872.66
0+40	4872.69
0+41	4872.71
0+41	4872.74
0+41	4872.76
0+42	4872.78

Worksheet for 5th Ave

Input Data

Station (ft)	Elevation (ft)
0+42	4872.79
0+42	4872.80
0+43	4872.82
0+43	4872.83
0+43	4872.84
0+44	4872.86
0+44	4872.87
0+44	4872.88
0+44	4872.90
0+45	4872.91
0+45	4872.92
0+45	4872.93
0+46	4872.94
0+46	4872.95
0+46	4872.96
0+47	4872.97
0+63	4874.18
0+63	4874.20
0+64	4874.22
0+64	4874.24
0+64	4874.26
0+65	4874.29
0+65	4874.31
0+66	4874.33
0+66	4874.35
0+66	4874.37
0+67	4874.39
0+67	4874.40
0+68	4874.41
0+68	4874.41
0+69	4874.42
0+69	4874.42
0+69	4874.42
0+70	4874.40

Worksheet for 5th Ave

Input Data

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 4872.27)	(0+70, 4874.40)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	

Results

Discharge	25.96	ft³/s
Elevation Range	4871.64 to 4874.42 ft	
Flow Area	6.69	ft²
Wetted Perimeter	27.26	ft
Hydraulic Radius	0.25	ft
Top Width	27.17	ft
Normal Depth	0.50	ft
Critical Depth	0.56	ft
Critical Slope	0.00504	ft/ft
Velocity	3.88	ft/s
Velocity Head	0.23	ft
Specific Energy	0.73	ft
Froude Number	1.38	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft

Worksheet for 5th Ave

GVF Output Data

Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.56	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00504	ft/ft

Worksheet for Main Street - Future Pipe

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Normal Depth	3.00	ft
Diameter	3.00	ft

Results

Discharge	51.66	ft³/s
Flow Area	7.07	ft²
Wetted Perimeter	9.42	ft
Hydraulic Radius	0.75	ft
Top Width	0.00	ft
Critical Depth	2.34	ft
Percent Full	100.0	%
Critical Slope	0.00663	ft/ft
Velocity	7.31	ft/s
Velocity Head	0.83	ft
Specific Energy	3.83	ft
Froude Number	0.00	
Maximum Discharge	55.57	ft³/s
Discharge Full	51.66	ft³/s
Slope Full	0.00600	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for Main Street - Future Pipe

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	3.00	ft
Critical Depth	2.34	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00663	ft/ft

Messages

Notes

Main Street proposed pipe between 5th Ave and 5th Ave (dogleg).

Worksheet for 5th Street - Future Pipe - 54"

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Normal Depth	4.50	ft
Diameter	4.50	ft

Results

Discharge	152.32	ft³/s
Flow Area	15.90	ft²
Wetted Perimeter	14.14	ft
Hydraulic Radius	1.13	ft
Top Width	0.00	ft
Critical Depth	3.62	ft
Percent Full	100.0	%
Critical Slope	0.00622	ft/ft
Velocity	9.58	ft/s
Velocity Head	1.43	ft
Specific Energy	5.93	ft
Froude Number	0.00	
Maximum Discharge	163.85	ft³/s
Discharge Full	152.32	ft³/s
Slope Full	0.00600	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 5th Street - Future Pipe - 54"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	4.50	ft
Critical Depth	3.62	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00622	ft/ft

Messages

Notes

5th Ave proposed pipe east of Main Street.
No detention at Elem School subbasin.

Worksheet for 5th Street - Future Pipe - 48"

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Normal Depth	4.00	ft
Diameter	4.00	ft

Results

Discharge	111.26	ft^3/s
Flow Area	12.57	ft^2
Wetted Perimeter	12.57	ft
Hydraulic Radius	1.00	ft
Top Width	0.00	ft
Critical Depth	3.19	ft
Percent Full	100.0	%
Critical Slope	0.00633	ft/ft
Velocity	8.85	ft/s
Velocity Head	1.22	ft
Specific Energy	5.22	ft
Froude Number	0.00	
Maximum Discharge	119.68	ft^3/s
Discharge Full	111.26	ft^3/s
Slope Full	0.00600	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	4.00	ft
Critical Depth	3.19	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00633	ft/ft

Messages

Notes

5th Ave proposed pipe east of Main Street. with over detention at Elem School subbasin.

Worksheet for 5th Street - Ex Pipe - 36"

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Normal Depth	3.00	ft
Diameter	3.00	ft

Results

Discharge	51.66	ft³/s
Flow Area	7.07	ft²
Wetted Perimeter	9.42	ft
Hydraulic Radius	0.75	ft
Top Width	0.00	ft
Critical Depth	2.34	ft
Percent Full	100.0	%
Critical Slope	0.00663	ft/ft
Velocity	7.31	ft/s
Velocity Head	0.83	ft
Specific Energy	3.83	ft
Froude Number	0.00	
Maximum Discharge	55.57	ft³/s
Discharge Full	51.66	ft³/s
Slope Full	0.00600	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 5th Street - Ex Pipe - 36"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	3.00	ft
Critical Depth	2.34	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00663	ft/ft

Messages

Notes

Exist. 5th Ave Pipe
Full flow calc

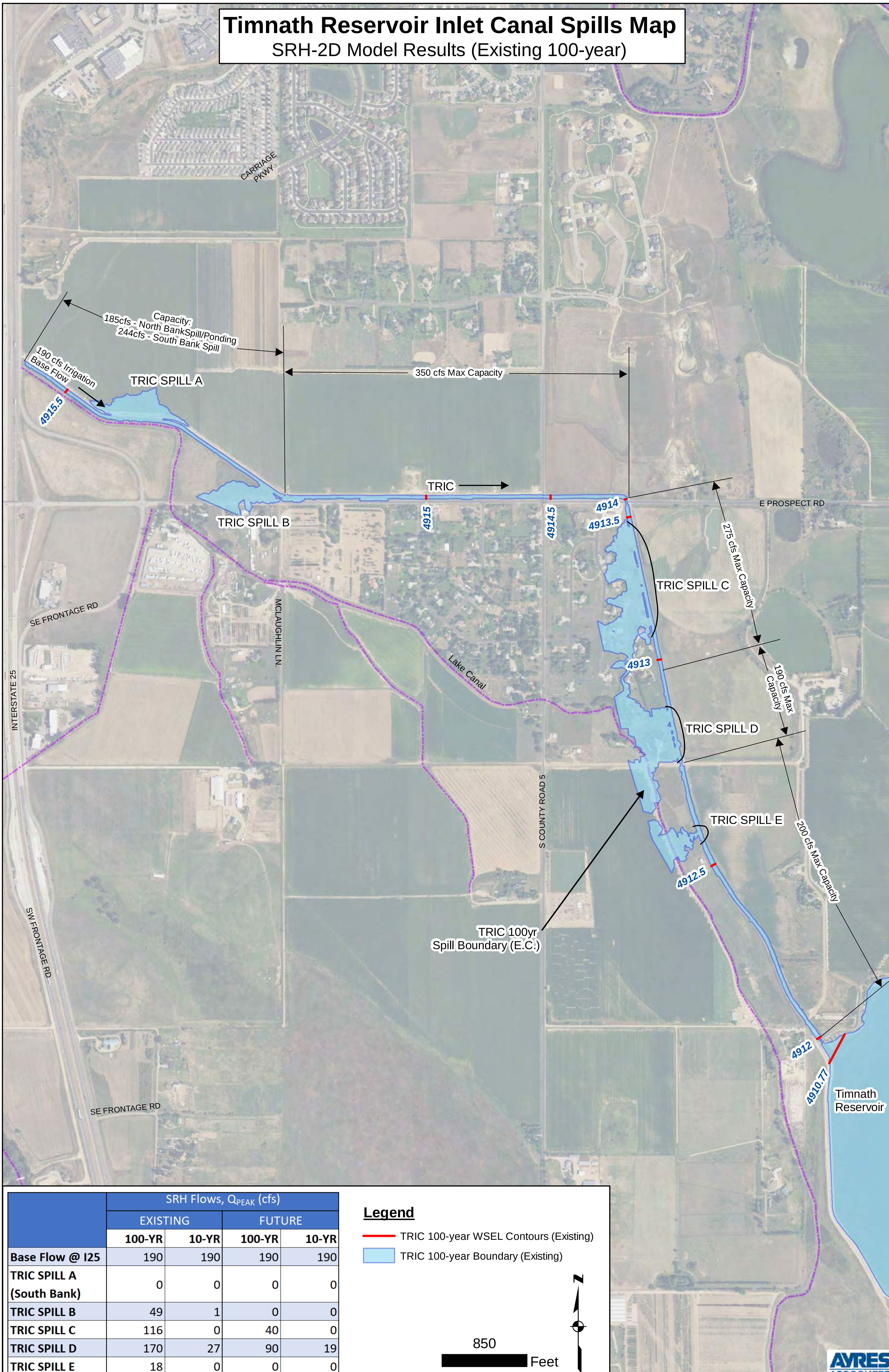
Appendix E

SRH-2D Hydraulics Results of Timnath Reservoir Inlet Canal

1) TRIC Spills Map
2) TRIC Spills Rating Curves
3) TRIC Analysis Results Summary Tables
4) TRIC Inflows Summary Table
5) Comparison of Spill Hydrographs - SRH-2D vs. SWMM

Timnath Reservoir Inlet Canal Spills Map

SRH-2D Model Results (Existing 100-year)



	SRH Flows, Q_{PEAK} (cfs)			
	EXISTING		FUTURE	
	100-YR	10-YR	100-YR	10-YR
Base Flow @ I25	190	190	190	190
TRIC SPILL A (South Bank)	0	0	0	0
TRIC SPILL B	49	1	0	0
TRIC SPILL C	116	0	40	0
TRIC SPILL D	170	27	90	19
TRIC SPILL E	18	0	0	0

Legend

- TRIC 100-year WSEL Contours (Existing)
- TRIC 100-year Boundary (Existing)

Document Path: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\TRIC Spills\TRIC Spills_100yr Existing.mxd

Date: 8/21/2018

Appendix E

SRH-2D Hydraulics Results of Timnath Reservoir Inlet Canal

Spill Rating Curves from 2D Analysis for SWMM

TRIC 2 (TRIC UP - Spill 1)			TRIC 4A (TRIC DOWN - Spill 1)			TRIC 5A (TRIC DOWN - Spill 2)			TRIC 6A (TRIC DOWN - Spill 3)		
Qin	Qspill	Qout	Qin	Qspill	Qout	Qin	Qspill	Qout	Qin	Qspill	Qout
0	0	0	0	0	0	0	0	0	0	0	0
190	0	190	200	0	200	190	0	190	188	0	188
199	0	199	225	0	225	200	4	195	200	0	200
222	0	222	250	0	250	225	14	212	225	5	220
244	2	242	275	0	275	250	32	217	250	23	227
270	14	255	300	16	284	284	64	220	275	48	227
296	31	265	325	37	288	295	74	221	300	69	231
321	49	272	350	55	295	344	119	225	325	93	232
343	63	279	500	156	344	411	180	229	350	114	236
448	137	303	750	339	411	500	261	239	500	259	241

Timnath Stormwater Master Plan Update - 2018
TRIC Flows Summary

Link/ Node	Element ID (E.C.)	Element ID (F.C.)	Location	Existing SWMM Model Results – Peak Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Future SWMM Model Results – Peak Discharge (cfs) 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Link	L-TRIC2_SPILL	L-TRIC2_SPILL	TRIC Spill B	0	0	0	0	13	59	0	0	0	0	0	3
Link	L-TRIC4A-SPILL	L-TRIC4A-SPILL	TRIC Spill C	0	0	0	0	50	119	0	0	0	0	0	26
Link	L-TRIC5A-SPILL	L-TRIC5A-SPILL	TRIC Spill D	11	15	27	73	141	218	11	19	29	59	85	110
Link	L-TRIC6A-SPILL	L-TRIC6A-SPILL	TRIC Spill E	1	2	4	11	29	63	2	3	4	5	10	13
Node	TRIC-OUTFALL	TRIC-OUTFALL	TRIC - Timnath Reservior Inlet	205	209	213	222	227	229	207	212	216	220	222	223

*TRIC Base Flow of 190 cfs.

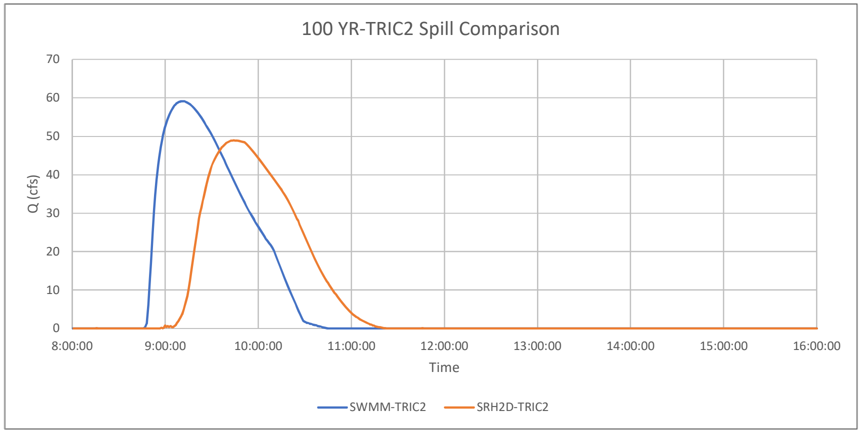
Location	Existing SRH-2D Model Results – Peak Discharge (cfs) 10-Yr	100-Yr	100-yr w/o Base Flow	Future SRH-2D Model Results – Peak Discharge (cfs) 10-Yr	100-Yr	100-yr w/o Base Flow
TRIC Spill B	1	49	0	0	0	0
TRIC Spill C	0	116	0	0	40	0
TRIC Spill D	27	170	93	19	90	0
TRIC Spill E	0	18	0	0	0	0
TRIC - Timnath Reservior Inlet	207	227	213	219	228	147

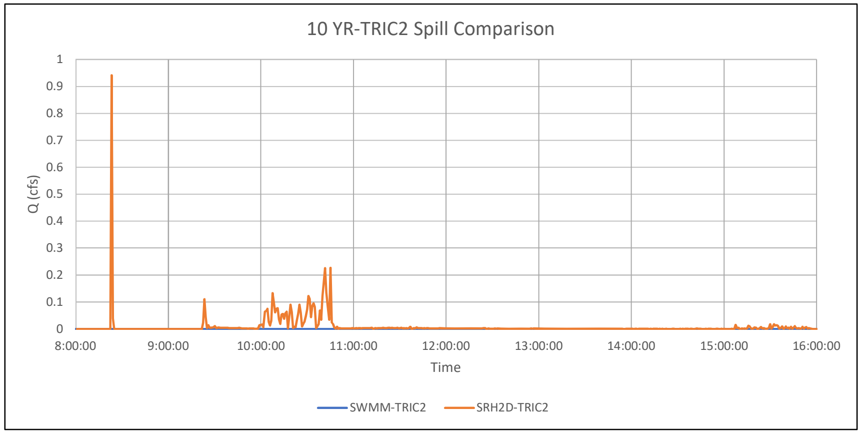
*TRIC Base Flow of 190 cfs.

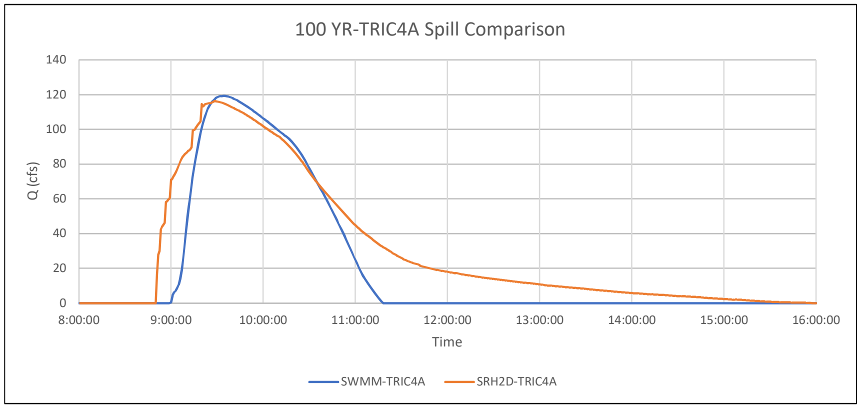
Timnath Stormwater Master Plan Update - 2018
TRIC Inflows Summary

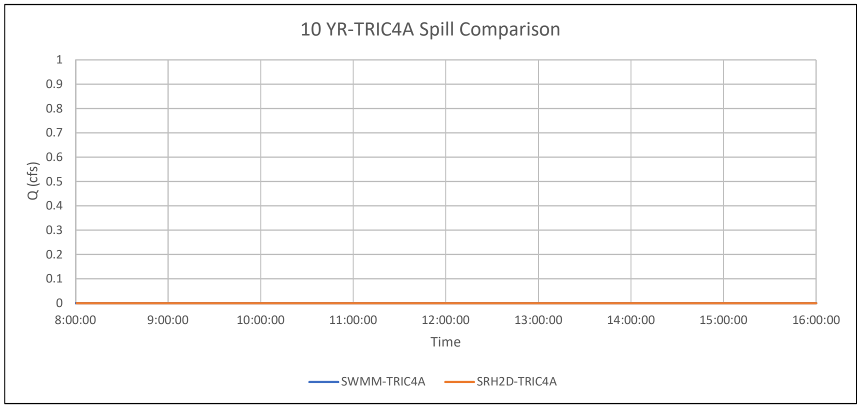
Link/ Node	Element ID (E.C.)	Element ID (F.C.)	Existing SRH Inflows from SWMM Peak Inflow (cfs) 10-Yr	Existing SRH Inflows from SWMM Peak Inflow (cfs) 100-Yr	Future SRH Inflows from SWMM Peak Inflow (cfs) 10-Yr	Future SRH Inflows from SWMM Peak Inflow (cfs) 100-Yr
Link	102	102	3	52	4	7
Link	105C	105C	5	114	4	57
Link	115AB	115AB	3	107	3	28
Link	OP-25	OP-25	27	80	27	80
Link	135	135	27	199	22	49
Subcatch	39	39	12	83	4	12

Comparison of Spill Flowrates from SRH-2D vs. SWMM

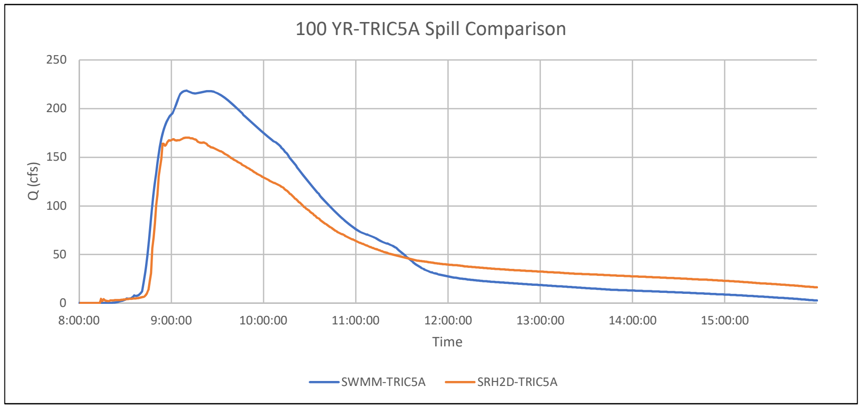


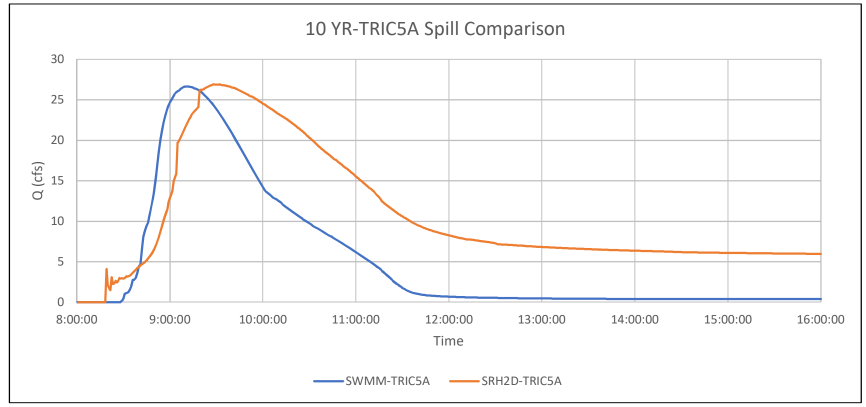


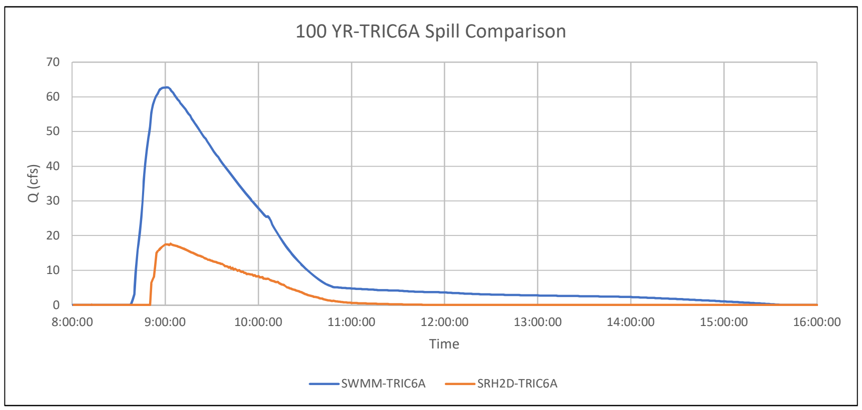


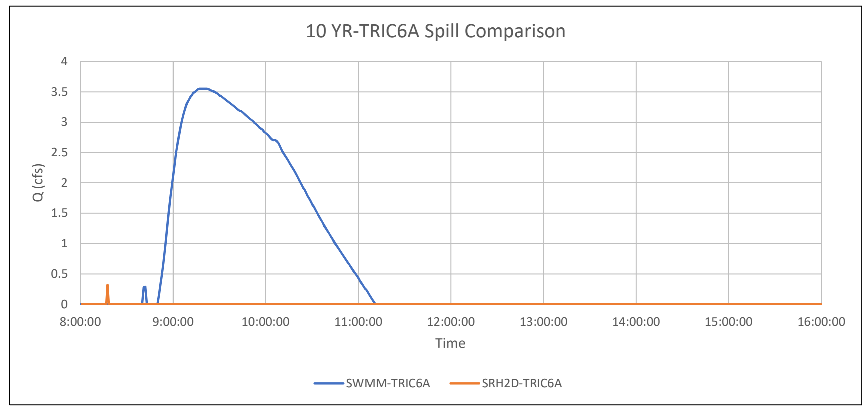


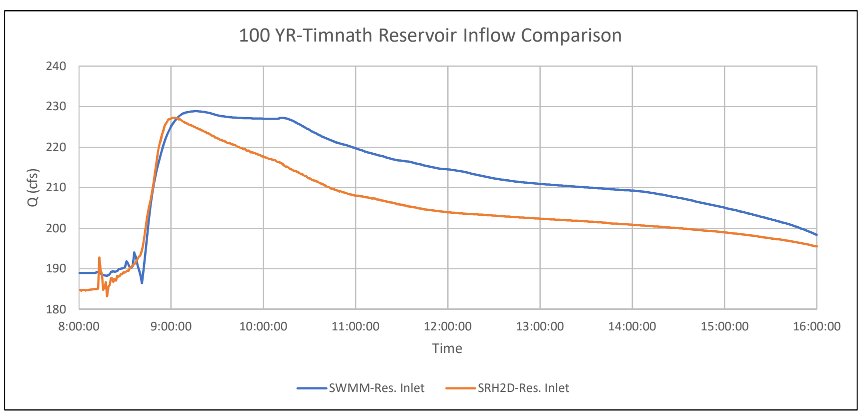
Comparison of Spill Flowrates from SRH-2D vs. SWMM

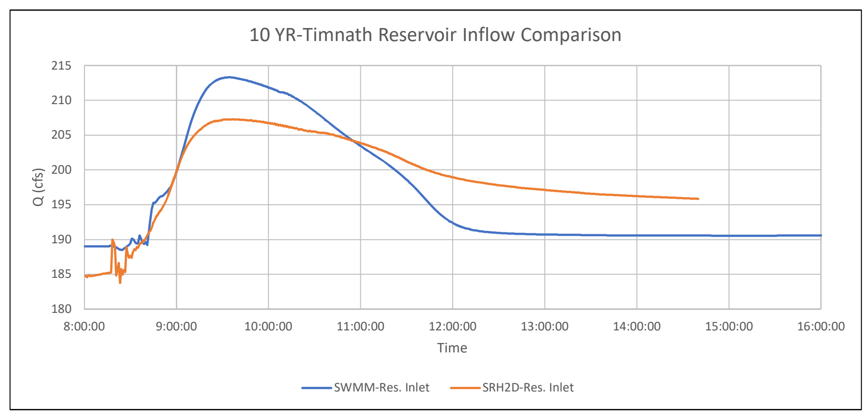








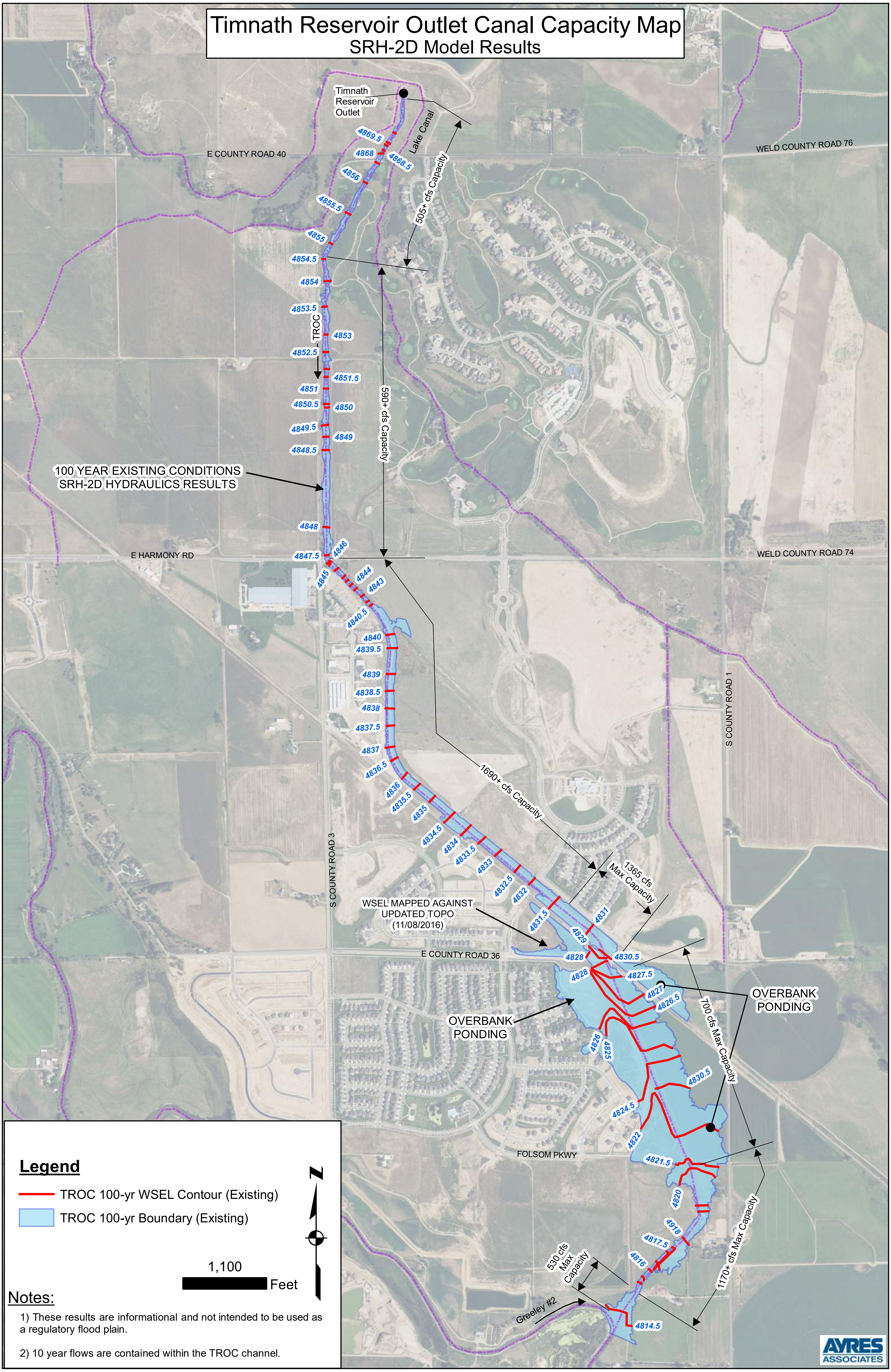




Appendix F

SRH-2D Hydraulics Results of Timnath Reservoir Outlet Canal

1) TROC Spills Map
2) TROC Analysis Results Summary Tables
3) Comparison of Hydrographs - SRH-2D vs. SWMM



Document Path: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\TROC Spills\TROC Spills_100yr Existing.mxd

Date: 11/2/2018

Appendix F

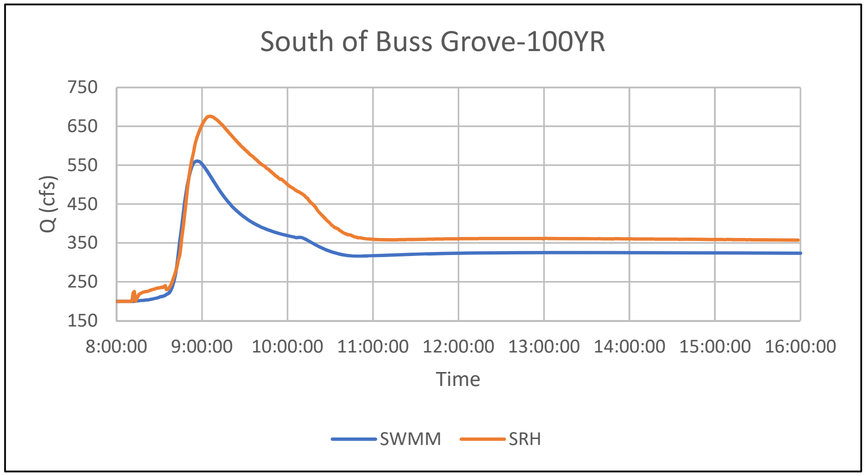
SRH-2D Hydraulics Results of Timnath Reservoir Outlet Canal

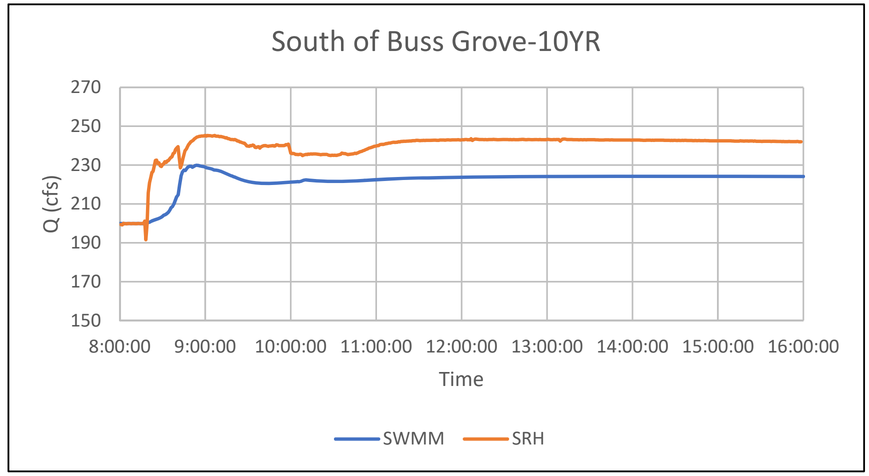
TROC Peak Flows Table

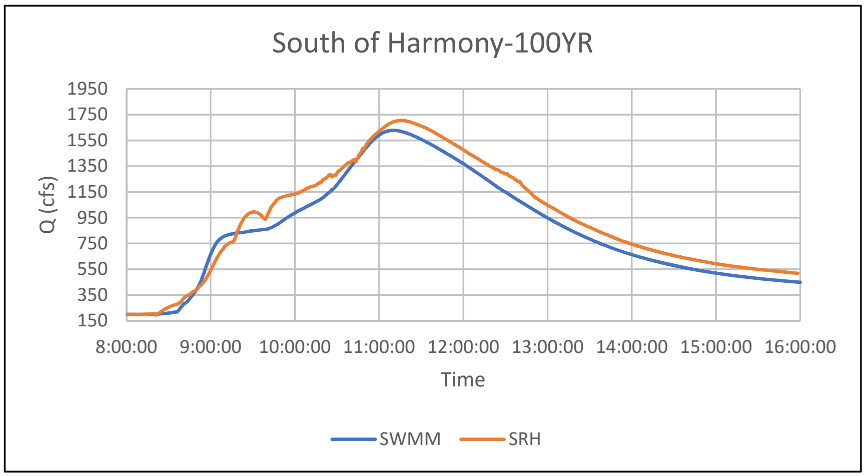
Location	Existing SRH-2D Model Results Peak Discharge (cfs)				Future SRH-2D Model Results Peak Discharge (cfs)			
		10-Yr		100-Yr		10-Yr		100-Yr
South of Buss Grove		245		676		264		338
South of Harmony		368		1,704		637		1,427
Downstream End of Double Channel		518		1,713		657		1,497
TROC at Greeley #2		526		1,191		692		1,105
TROC at Greeley #2 from SWMM Model		297		1,735		293		1,379

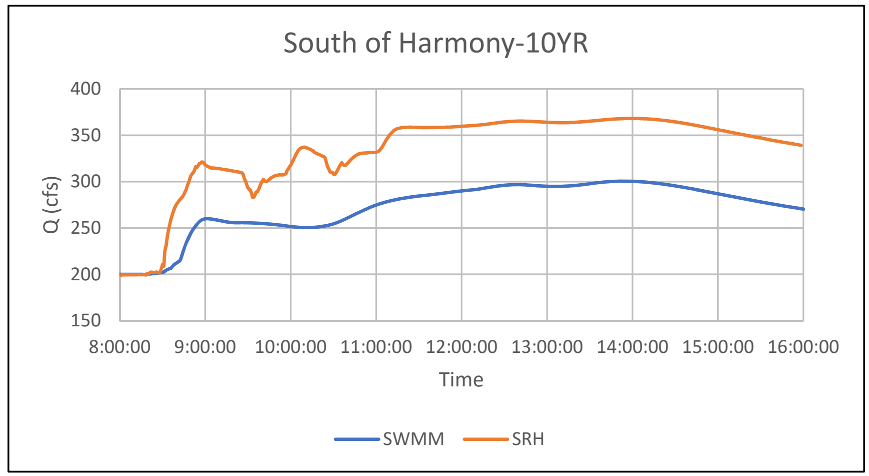
*TRIC Base Flow of 190 cfs.

Comparison of Flowrates from SRH-2D vs. SWMM - Existing Conditions

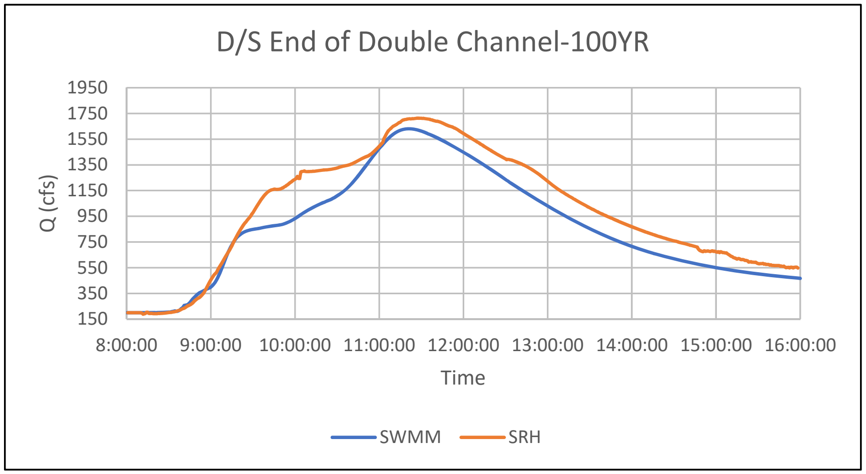


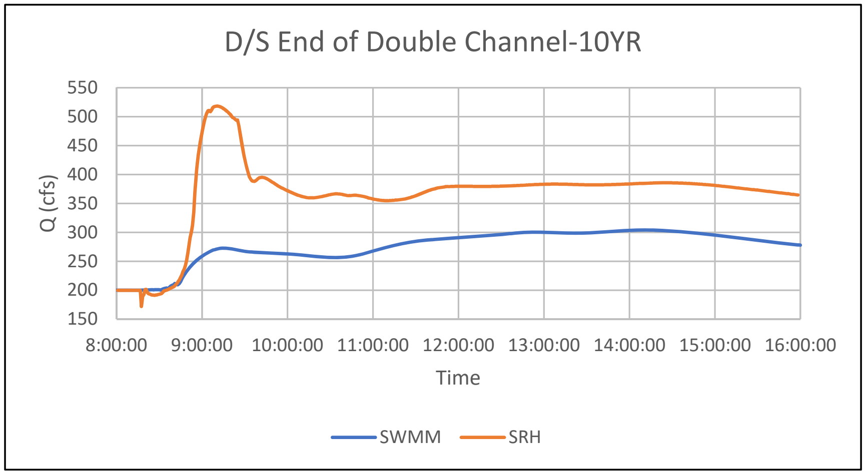


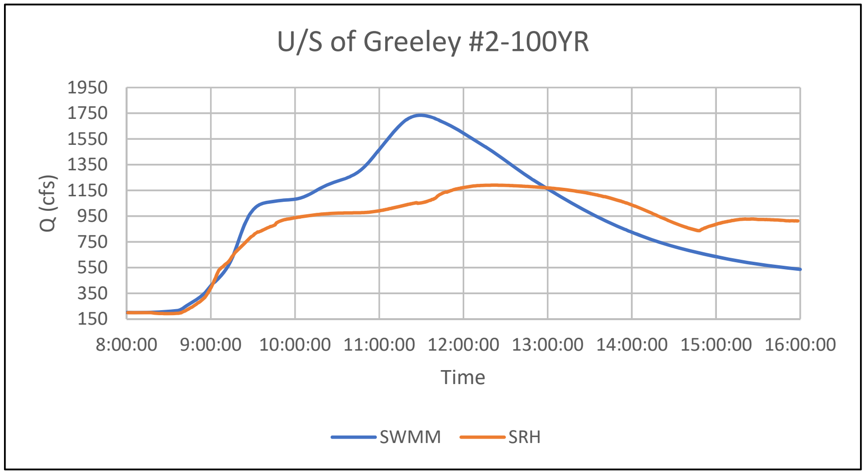


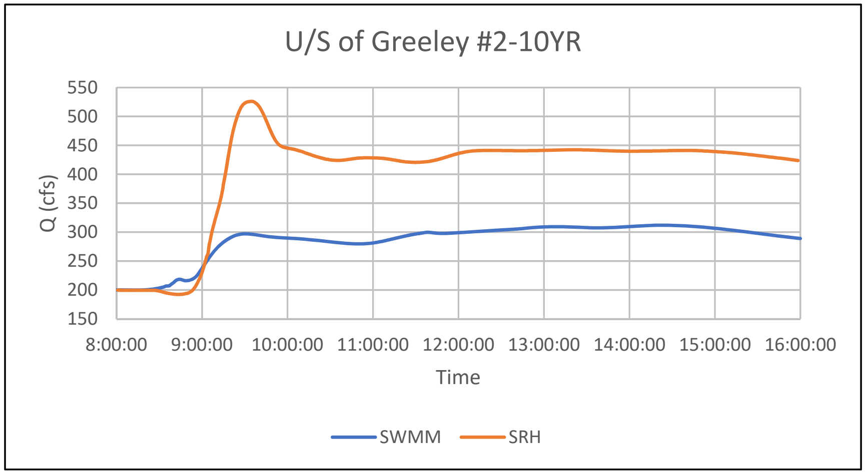


Comparison of Flowrates from SRH-2D vs. SWMM - Existing Conditions







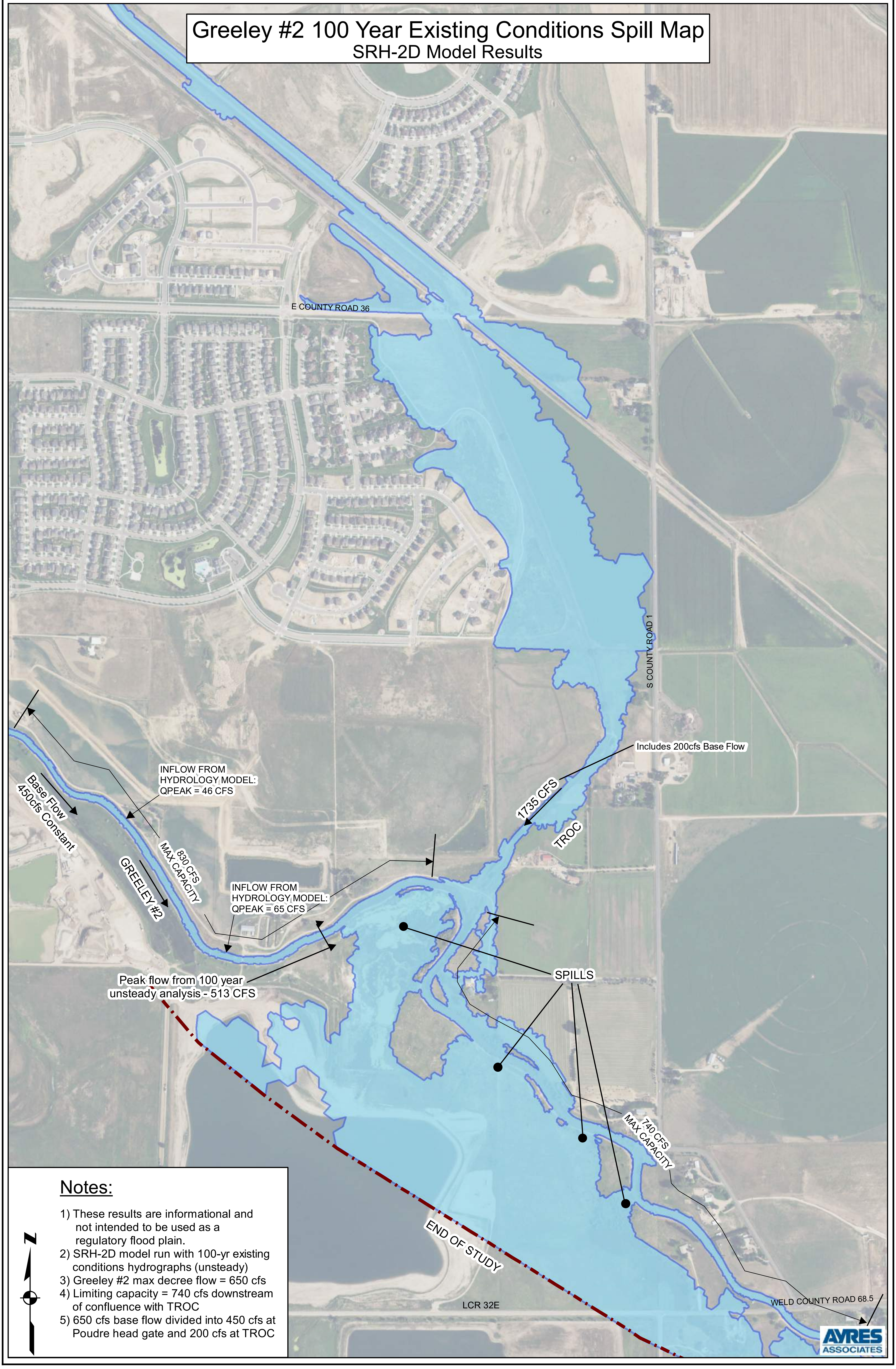


Appendix G

SRH-2D Hydraulics Results of Greeley No. 2 Canal

1) Greeley No. 2 Canal – Existing Condition Spills Map
2) Greeley No. 2 Canal – Conceptual Spill Weir Map
3) Greeley No. 2 Canal – Inflows Hydrographs

Greeley #2 100 Year Existing Conditions Spill Map
SRH-2D Model Results



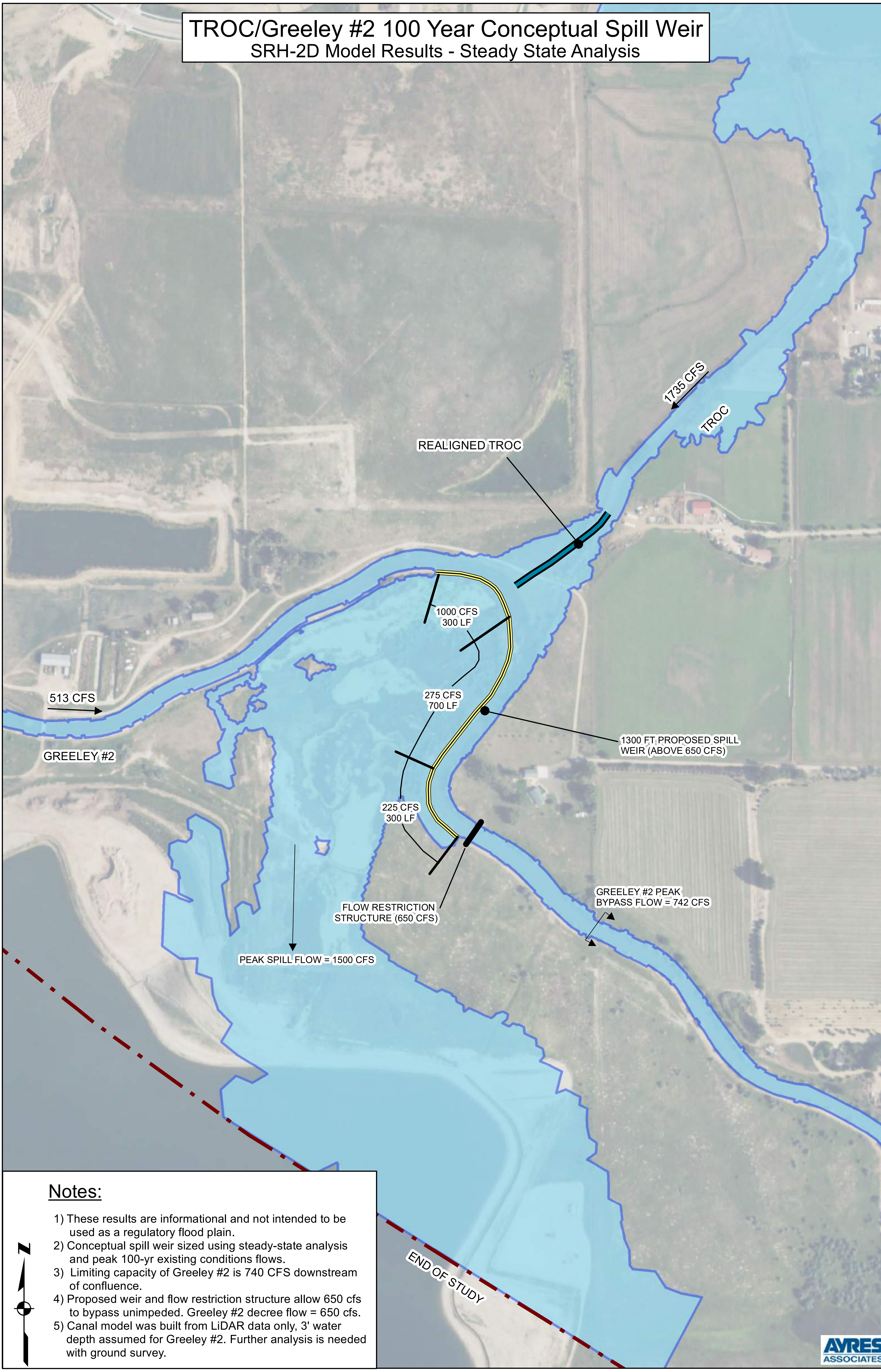
Notes:

1) These results are informational and not intended to be used as a regulatory flood plain.
2) SRH-2D model run with 100-yr existing conditions hydrographs (unsteady)
3) Greeley #2 max decree flow = 650 cfs
4) Limiting capacity = 740 cfs downstream of confluence with TROC
5) 650 cfs base flow divided into 450 cfs at Poudre head gate and 200 cfs at TROC

Document Path: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\Greeley #2\Greeley #2 EC_100yr Existing.mxd

Date: 11/2/2018

TROC/Greeley #2 100 Year Conceptual Spill Weir
SRH-2D Model Results - Steady State Analysis



Notes:

1) These results are informational and not intended to be used as a regulatory flood plain.
2) Conceptual spill weir sized using steady-state analysis and peak 100-yr existing conditions flows.
3) Limiting capacity of Greeley #2 is 740 CFS downstream of confluence.
4) Proposed weir and flow restriction structure allow 650 cfs to bypass unimpeded. Greeley #2 decree flow = 650 cfs.
5) Canal model was built from LiDAR data only, 3' water depth assumed for Greeley #2. Further analysis is needed with ground survey.

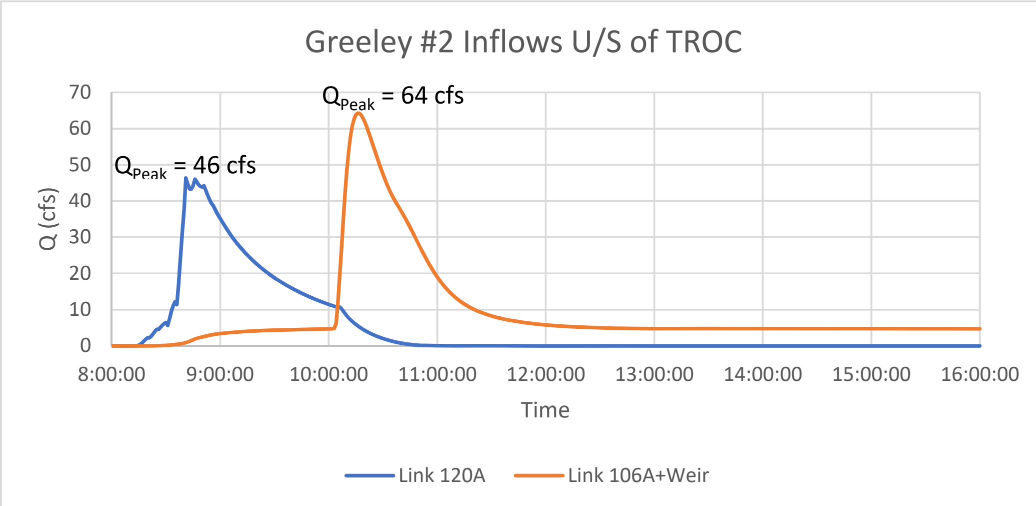
Document Path: F:\32-1881.00 Timnath Master Plan Update\GIS\MXD\Greeley #2\Greeley #2 Proposed Weir.mxd

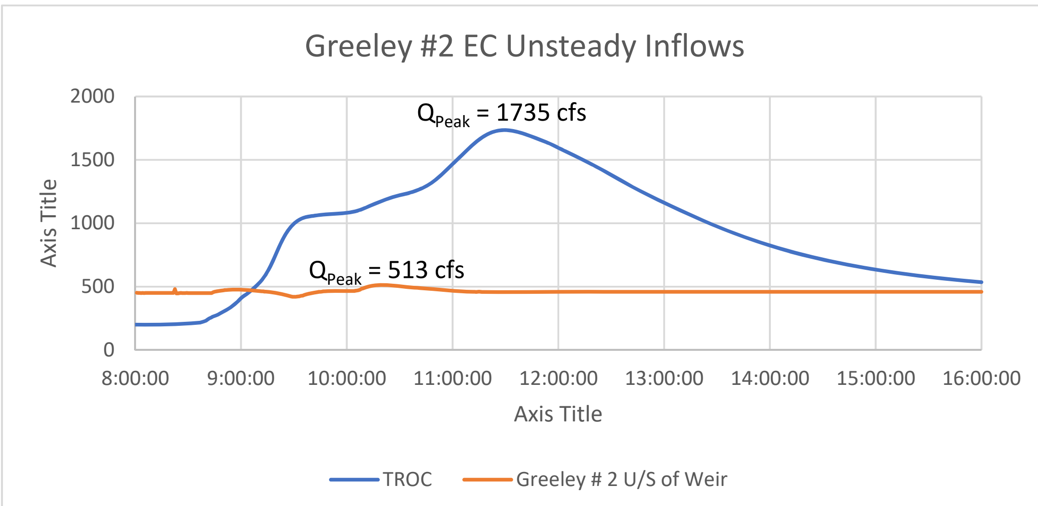
Date: 10/31/2017

Appendix G

SRH-2D Hydraulics Results of Greeley No. 2 Canal

Greeley #2 Inflow Results from Unsteady Existing Conditions Analysis





Inputs for Steady State Weir Analysis

Location	Flowrate
Greeley #2 Upstream of Weir	513 cfs
TROC Upstream of Greeley #2	1735 cfs

Appendix H

Digital Data – Modeling Files and GIS Data