# WEST TOLL GATE CREEK TRIBUTARIES

Major Drainageway Plan

April 2024

DRAFT

1525 Raleigh St. Suite 400
Denver, CO 80204

olsson | AURORA | Southeast Metro Stormwater Authority | MHFD MILE HIGH FLOOD DISTRICT

April 24, 2024

Mr. Colin Haggerty, PE, PMP
Watershed Manager
Mile High Flood District
12575 W Bayaud Avenue
Lakewood, CO 80228

**Re: West Toll Gate Tributaries Major Drainageway Plan**
**Agreement No. 23-01.01**
**Olsson Project No. 022-02231**

Dear Mr. Haggerty:

Olsson is pleased to submit the draft hydrology report for the West Toll Gate Tributaries. This report documents the baseline hydrology development process.

The updated hydrology report was prepared with the cooperation of MHFD, the City of Aurora, and SEMSWA. The information from this study provides the project sponsors with design flows to be used for the next phases of the study, and also for future construction and development projects in the watershed.

We appreciate the opportunity to work with you on this project and look forward to developing alternatives to solve problems within the watershed.

Sincerely,

Amy M. Gabor

Amy M. Gabor, PE, CFM, LEED® AP
Project Manager

CC: Brik Zivkovich, Mile High Flood District
Bruce Rindahl, Mile High Flood District
Jessica Traynor, Southeast Metro Stormwater Authority
Sam Scorza, City of Aurora
Encl.

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Aurora – City of Aurora
Ave – Avenue
Blvd – Boulevard
BMP – Best Management Practice
CDOT – Colorado Department of Transportation
Centennial – City of Centennial
CMP – corrugated metal pipe
CUHP– Colorado Urban Hydrograph Procedure
DRCOG – Denver Regional Council of Governments
D/S - Downstream
E – East
EGL – energy grade line
EPA – Environmental Protection Agency
EURV – excess urban runoff volume
EX – existing
FEMA – Federal Emergency Management Agency
FHAD – Flood Hazard Area Delineation
FIRM – Flood Insurance Rate Map
FTR – future
HSG – hydrologic soils group
I/Imp. – Imperviousness
LiDAR – light detection and ranging
MDP – Major Drainageway Plan
MHFD – Mile High Flood District
N – North
NLCD – National Land Cover Database
No. – Number
NOAA – National Oceanic and Atmospheric Administration
NRCS – Natural Resources Conservation Service
O&M – operations and maintenance
Rd – Road
RCBC – reinforced concrete box culvert
RCP – reinforced concrete pipe
S – South
SEO – State Engineer's Office
SEMSWA – Southeast Metro Stormwater Authority
SSP – smooth steel pipe
St – Street
SWMM – Storm Water Management Model
U/S – upstream
USACE – United States Army Corps of Engineers
USDCM – Urban Storm Drainage Criteria Manual
W – West
WQCV – water quality capture volume
WSE – water surface elevation
% – percent
ac – acre
AF/ac-ft – acre-feet
cfs – cubic feet per second
ft or ' – foot/feet
in or " – inch/inches
mi – mile

# 1.0 INTRODUCTION

## 1.1 Authorization

Olsson was retained to complete a Major Drainageway Plan (MDP) for selected tributaries of West Toll Gate Creek, co-sponsored by the Mile High Flood District (MHFD), City of Aurora, and Southeast Metro Stormwater Authority (SEMSWA). Tributaries selected include Helena Circle Tributary, Woodrim Tributary, Cheery Creek Spillway, Meadowood Creek, Mission Viejo Tributary, Los Ninos Tributary, Summer Valley Ranch Tributary, Summer Lake Tributary, Marina Park Tributary, Tower Road Tributary, Smoky Ridge Tributary, Himalaya Tributary, and Park View Tributary. Agreement Regarding Major Drainageway Plan for the West Toll Gate Creek Tributaries (Agreement No. 23-01.01) was executed on January 12, 2023. Two amendments were executed for the study on September 5, 2023 and January 8, 2024 to further investigate the percent impervious values used in the hydrology.

## 1.2 Purpose and Scope

The purpose of this study was to update the hydrology, evaluate existing conditions in the channels, develop alternatives to alleviate potential issues in the channel, and complete a conceptual design of the plan selected by the project sponsors. The conceptual design will provide a guide for project sponsors to use for future construction projects for the tributaries of West Toll Gate Creek. The watershed is almost fully developed and the MDP will be used both to identify and rectify potential flooding hazards along the West Toll Gate Creek tributaries, as well as provide guidance to the project sponsors for future improvements.

The following tasks were completed as part of the major drainageway plan:

- Collected existing information, including a previous FHAD and MDP, development drainage studies, and drainage improvement as-built plans
- Solicited input from project sponsors
- Obtained base mapping, structure surveys, and GIS information from MHFD, SEMSWA, and City of Aurora
- Set up and maintained a project website linked to MHFD's website
- Determined subwatershed boundaries and parameters in accordance with MHFD criteria
- Developed existing conditions baseline hydrology using the Colorado Urban Hydrograph Procedure (CUHP) 2005, version 2.0.1 and the Environmental Protection Agency Stormwater Management Model (EPA SWMM) 5.2, version 5.2.3
- Reconciled the hydrology with previous studies
- Completed a report documenting the baseline hydrology

## 1.3 Planning Process

The effective hydrology of the West Toll Gate Creek watershed was completed as part of the *West Toll Gate Creek Major Drainageway Plan,* prepared by Michael Baker Jr., Inc. and Enginuity Engineering Solutions in December 2012 (2012 MDP). The *Flood Hazard Area Delineation, West Toll Gate Creek w*as completed, also by Michael Baker Jr. Inc. and Enginuity Engineering Solutions, in November 2013 (2013 FHAD). The 2012 MDP and 2013 FHAD were focused on West Toll Gate Creek itself and Unnamed Creek. While the 2012 MDP hydrology included the tributaries, the tributaries themselves were not studied in detail.

Meadowood Creek was studied as part of the *Quincy Creek, Shop Creek, and Meadowood Creek Outfall Systems Plan*, prepared by Michael Baker International in October 2017 (2017 OSP). This study included updated hydrology along Meadowood Creek.

The majority of West Toll Gate tributaries have no FEMA-floodplain designations. Only Cherry Creek Spillway and Meadowood Creek have a FEMA-floodplain designation. Cherry Creek Spillway has a Zone AE floodplain extending from South Chambers Road down to the confluence with West Toll Gate Creek. Meadowood Creek has FEMA-designated Zone A and Zone AE floodplains.

The baseline hydrology developed for this study represents an updated analysis using CUHP 2005, version 2.0.1 and EPA SWMM, version 5.2.3. Further information regarding the hydrologic modeling process is included in Section 3.0.

A kickoff meeting was held on September 7, 2022 to discuss the project goals, hydrologic analysis, and areas of concern with MHFD. Minutes from the meeting are included in Appendix A.

MHFD, City of Aurora, and SEMWSA reviewed the draft baseline hydrology, alternatives analysis, and conceptual design and returned comments on XXXX, XXXX, and XXXX, respectively. The comments were incorporated into this final report. Summaries of the key review comments and responses for the draft hydrology, alternatives analysis, and draft conceptual design are supplemented in the meeting minutes for the XXXX, XXXX, and XXXX meetings, respectively, included in Appendix A.

## 1.4 Mapping and Surveys

MHFD provided 1-foot (ft) interval 2020 LiDAR mapping for the entire West Toll Gate Creek watershed. The LiDAR mapping is referenced to the NAVD 88 vertical datum and the NAD 83 horizontal datum. Additional shapefiles and Geographic Information System (GIS) layers were provided by MHFD, City of Aurora, and SEMSWA.

## 1.5 Data Collection

Drainage studies and as-built plans were collected from MHFD and SEMSWA. The Arapahoe County, Colorado and Incorporated Areas FIS and Flood Insurance Rate Maps (FIRMs) were obtained from the Federal Emergency Management Agency (FEMA). The main studies and plans that were reviewed in the preparation of this report are shown in Table 1. A list of all studies reviewed in the preparation of this report is shown in Section 7.

***Table 1 – Data Collected***

| Title | Date | Author |
|---|---|---|
| Upper Toll Gate Creek Basin: Outfall Planning Study | August 1990 | Kiowa Engineering Corporation |
| Quincy Reservoir Watershed: Outfall Systems Planning Alternatives Evaluation Report Phase A | October 1998 | Turner Collie & Braden, Inc. |
| Quincy Reservoir Watershed: Outfall Systems Planning Alternatives Evaluation Report Phase B | September 1999 | Turner Collie & Braden, Inc. |
| Toll Gate Creek Watershed Hydrology Report | August 2006 | Kiowa Engineering Corporation |
| West Toll Gate Creek: Major Drainageway Plan | December 2012 | Michael Baker Jr., Inc. and Enginuity Engineering Solutions |
| Flood Hazard Area Delineation, West Toll Gate Creek | November 2013 | Michael Baker Jr., Inc. and Enginuity Engineering Solutions |
| City of Aurora Channel Stabilization Study Summary Report | September 2016 | Stantec Consulting Services, Inc. |
| Quincy Creek, Shop Creek, and Meadowood Creek Outfall Systems Plan | October 2017 | Michael Baker International |

### 1.6 Acknowledgements

The MDP was prepared with the cooperation of MHFD, City of Aurora, and SEMSWA. The representatives who were involved with this study are listed in Table 2.

***Table 2 – Project Participants***

| Name | Representing | Assignment |
|---|---|---|
| Colin Haggerty | MHFD | Watershed Manager |
| Derek Clark | MHFD | Project Sponsor |
| Brik Zivkovich | MHFD | Project Advisor - Hydrology |
| Bruce Rindahl | MHFD | Project Advisor - Hydrology |
| Craig Pearl | City of Aurora | Project Sponsor |
| Sam Scorza | City of Aurora | Project Sponsor |
| Tiffany Clark | SEMSWA | Project Sponsor |
| Jessica Traynor | SEMSWA | Project Sponsor |
| Amy Gabor | Olsson | Project Manager |
| Zack DelGrosso | Olsson | Associate Engineer |

# 2.0 STUDY AREA DESCRIPTION

## 2.1 Project Area

### Watershed and Drainageway Description

The total area of West Toll Gate Creek watershed is approximately 23.4 square miles, with approximately 7.89 square miles encompassing the tributaries of interest. The overall West Toll Gate Creek watershed extends from north of Smoky Hill Road and west of E-470 to the north to its confluence with East Toll Gate Creek, north of Alameda Parkway and west of Airport Boulevard. It is bound to the west by Smoky Hill Road and I-225. Descriptions for each tributary are provide below:

**Helena Circle Tributary –** Helena Circle Tributary is approximately 0.3 square miles, extending from the intersection of E Arkansas Drive and E Florida Avenue to the east to its confluence with West Toll Gate Creek east of S Idalia Street. This tributary is primarily piped underground until it outfalls to West Toll Gate Creek. Helena Circle Tributary is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 0.5 to 2 percent (%) with the lowest and highest watershed elevations being 5466 and 5619, respectively.

**Woodrim Tributary –** Woodrim Tributary is approximately 0.6 square miles, extending from the intersection of S Blackhawk Street and E Iliff Avenue to the northeast to its confluence with West Toll Gate Creek at E Mexico Drive. This tributary has a combination of underground storm drain system and vegetated open channel. Woodrim Tributary is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 0.4 to 3 percent (%) with the lowest and highest watershed elevations being 5481 and 5635, respectively.

**Cherry Creek Spillway –** Cherry Creek Spillway is approximately 2.2 square miles, extending from the intersection of S Parker Road and E Hampden Avenue to the north to its confluence with West Toll Gate Creek near Horseshoe Park. This tributary contains concrete and grass-lined open channels including the spillway for the Cherry Creek Reservoir. Cherry Creek Spillway is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 0.2 to 2 percent (%) with the lowest and highest watershed elevations being 5505 and 5698, respectively.

**Meadowood Creek –** Meadowood Creek is approximately 2.6 square miles, extending from E Smoky Hill Road and S Buckley Road to the north to its confluence with West Toll Gate Creek north of E Iliff Avenue. This tributary consists of a vegetated open channel extending along the middle of the entire watershed conveying flows north. Meadowood Creek is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 0.3 to 2 percent (%) with the lowest and highest watershed elevations being 5511 and 5823, respectively.

**Mission Viejo Tributary –** Mission Viejo Tributary is approximately 0.1 square miles, extending from S Mission Parkway to the north to its confluence with Meadowood Creek at E Hampden Avenue. This tributary conveys flows within underground storm drain system that outlets into a vegetated open channel. Mission Viejo is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 1 to 2 percent (%) with the lowest and highest watershed elevations being 5649 and 5722, respectively.

**Los Ninos Tributary –** Los Ninos Tributary is approximately 0.2 square miles, extending from S Chambers Road and S Chambers Way to the east to its confluence with Meadowood Creek near Mission Viejo Park. This tributary has a combination of underground storm drain systems vegetated open channel. Los Ninos is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 0.8 to 2 percent (%) with the lowest and highest watershed elevations being 5665 and 5782, respectively.

**Summer Valley Ranch Tributary –** Summer Valley Ranch Tributary is approximately 0.7 square miles, extending from E Quincy Avenue and S Reservoir Road to the northwest to its confluence with West Toll Gate Creek at E Hampden Avenue. This tributary consists of grass-lined open channels. Summer Valley Ranch Tributary is located in the City of Aurora as shown on Figure 1. Tributary slopes generally range from 0.6 to 3 percent (%) with the lowest and highest watershed elevations being 5606 and 5799, respectively.

**Summer Lake Tributary –** Summer Lake Tributary is approximately 0.3 square miles, extending from E Quincy Avenue and S Flanders Street to the south to its confluence with West Toll Gate Creek near Quincy Reservoir. This tributary has a combination of underground and natural conveyance systems. Summer Lake Tributary is located in the City of Aurora and the City of Centennial as shown on Figure 1. Tributary slopes generally range from 0.2 to 3 percent (%) with the lowest and highest watershed elevations being 5716 and 5816, respectively.

**Marina Park Tributary –** Marina Park Tributary is approximately 0.4 square miles, extending from the intersection of S Tower Road and E Smoky Hill Road to the northwest to its confluence with Tower Road Tributary near Quincy Reservoir. This tributary has a combination of underground storm drain systems, concrete open channel, and vegetated open channel. Marina Park Tributary is located in the City of Aurora and the City of Centennial as shown on Figure 1. Tributary slopes generally range from 0.8 to 2 percent (%) with the lowest and highest watershed elevations being 5718 and 5836, respectively.

**Tower Road Tributary –** Tower Road Tributary is approximately 1.0 square miles, extending from E Smoky Hill Road and S Gibraltar Way to the northwest to its confluence with West Toll Gate Creek near Quincy Reservoir. This tributary has a combination of underground storm drain systems and vegetated open channel. Tower Road Tributary is located in the City of Aurora and the City of Centennial as shown on Figure 1. Tributary slopes generally range from 0.5 to 3 percent (%) with the lowest and highest watershed elevations being 5718 and 5945, respectively.

**Smoky Ridge Tributary –** Smoky Ridge Tributary is approximately 0.10 square miles, extending from Peakview Elementary to the north to its confluence with West Toll Gate Creek. This tributary is primarily piped underground until it outfalls to West Toll Gate Creek near S Flanders Street. This tributary has a combination of underground storm drain systems and vegetated open channel. Smoky Ridge Tributary is located in the City of Centennial as shown on Figure 1. Tributary slopes generally range from 0.5 to 3 percent (%) with the lowest and highest watershed elevations being 5728 and 5862, respectively.

**Himalaya Tributary –** Himalaya Tributary is approximately 0.01 square miles, extending from S Himalaya Street and E Belleview Lane to the northeast to its confluence with West Toll Gate Creek at E Chenango Avenue. This tributary is conveyed primarily overland in a vegetated channel. Himalaya Tributary is located in the City of Centennial as shown on Figure 1. Tributary slopes generally range from 0.5 to 2 percent (%) with the lowest and highest watershed elevations being 5772 and 5944, respectively.

**Park View Tributary –** Park View Tributary is approximately 0.1 square miles, extending from E Smoky Hill Road and S Kirk Street to the north to its confluence with West Toll Gate Creek at E Willamette Avenue. This tributary is conveyed primarily overland in vegetated and concrete open channels and detention ponds. Park View Tributary is located in the City of Centennial as shown on Figure 1. Tributary slopes generally range from 0.5 to 3 percent (%) with the lowest and highest watershed elevations being 5809 and 5944, respectively.

**Reservoirs**

No reservoirs are located within the tributary watersheds, although several of the tributaries release flows into Quincy Reservoir.

**Existing Regional Detention Basins**

A total of three detention basins were included in the baseline hydrology. The tributary watersheds include more private detention facilities that were not included in the baseline hydrology, as well as several detention ponds that were previously modeled in the 2012 MDP, but do not significantly impact peak flows. These detention ponds were removed to simplify the model. The modeled detention basins include two (2) facilities along Tower Road Tributary, and one (1) facility along the Summer Lake Tributary. These three (3) detention basins have been included in the hydrologic models. More detailed information is included in Section 3.4.

**Irrigation Ditches**

No irrigation ditches cross the tributary watersheds. The High Line Canal crosses the West Toll Gate Creek watershed just north of Alameda Parkway.

**Soils**

Soil types were determined using the Natural Resources Conservation Service (NRCS) Web Soil Survey. Approximately half of the soils in the selected tributaries' watersheds consist of hydrologic soils group (HSG) Type B, which are generally characterized by moderate infiltration rates as defined by NRCS. Approximately 30% of the area consists of HSG Type C and D soils, which are generally characterized by low infiltration rates. The remaining 20% consists of HSG Type A soils, which are generally characterized by high infiltration rates. The soils map is included on Figures B-1A through B-1B in Appendix B.

## 2.2 Land Use

The watersheds are fully developed. Single-family residential is the primary land use. Other land uses include multi-family, mixed-use, commercial, and parks and open space. Existing land use was verified using aerial imagery and through site visit observations.

As the study area is fully developed, no future land use changes are anticipated. Additional discussion of land uses and corresponding percent impervious values is included in Section 3.3.

## 2.3 Reach Description

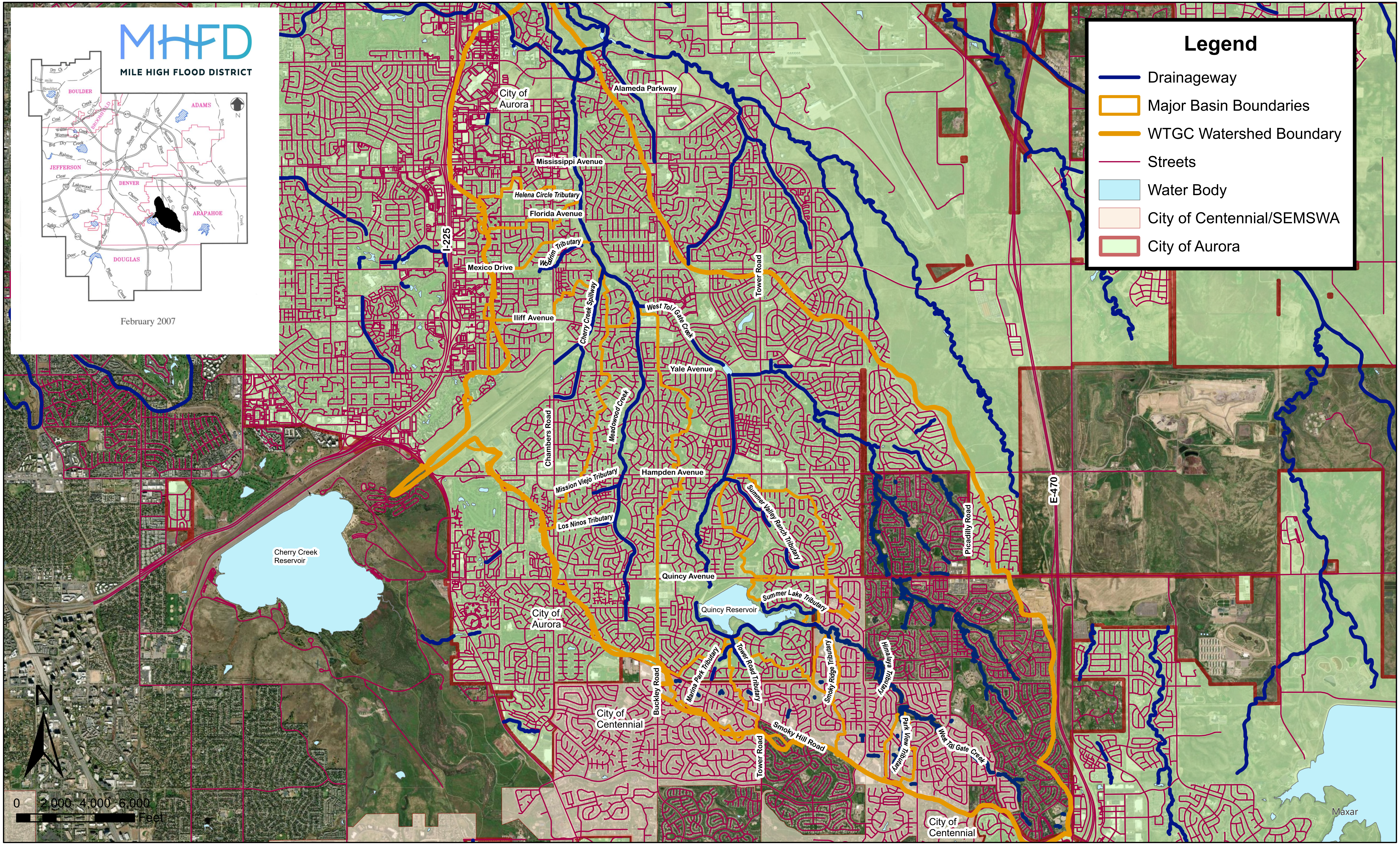
For this study, the West Toll Gate tributaries were broken out into thirteen distinct watersheds as shown on Figure 1. This section, along with Table 3, will be completed with the alternatives analysis.

## 2.4 Flood History

Flood history of the West Toll Gate Creek was briefly discussed as part of the *Toll Gate Creek Flood Warning Plan* prepared by the Mile High Flood District in April 2009. Overtopping of Mexico Avenue, as a result of undersized culverts, was identified as a flood hazard area at the confluence of Woodrim Tributary and West Toll Gate Creek. No other reported flooding history was found.

## 2.5 Environmental Assessment

This section will be completed with the alternatives analysis.




| PROJECT: 022-02231 | MILE HIGH FLOOD DISTRICT, CITY OF AURORA, AND SEMSWA | WEST TOLL GATE CREEK TRIBUTARIES STUDY AREA MAP | olsson | 1525 Raleigh Street Suite 400 Denver, CO 80204 | TEL: 303.237.2072 FAX: 303.237.2659 www.olsson.com | FIGURE 1 |
|---|---|---|---|---|---|---|
| DRAWN BY: KR | | | | | | |
| DATE: 04/2024 | | | | | | |

# 3.0 HYDROLOGIC ANALYSIS

## 3.1 Overview

Hydrology was developed for the baseline condition using existing infrastructure and existing land uses. Peak discharges for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year return period storms were analyzed using CUHP version 2.0.1, to generate hydrographs for each subwatershed. Hydrographs for the subwatersheds were routed using EPA SWMM, version 5.2.3, to determine peak discharge rates at select design points. The updated EPA SWMM results were compared to the 2012 MDP/2013 FHAD and 2017 OSP. The hydrology comparison is detailed in Section 3.6 and shown in *Error! Reference source not found.*.

## 3.2 Design Rainfall

One-hour rainfall depths from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 were input into CUHP to model the watershed hydrology for each storm event and are shown in Table 3. As no tributary drainage basins were greater than 5 square miles, no area adjustments were necessary for any of the storm events.

***Table 3 - One-Hour Point Rainfall (inches)***

| Duration | 2-Year | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
|---|---|---|---|---|---|---|---|
| 1-Hour | 0.87 | 1.14 | 1.39 | 1.77 | 2.08 | 2.41 | 3.28 |
| 6-Hour | 1.39 | 1.78 | 2.15 | 2.70 | 3.17 | 3.68 | 5.02 |

## 3.3 Subwatershed Characteristics

A summary of the CUHP 2.0.1 model parameters can be found in Appendix B. The 2020 LiDAR mapping, structure survey information, as-built drawings, drainage studies, aerial imagery, and future land use maps were used to determine input parameters.

**Subwatershed Delineation**

The overall watershed boundary was delineated using 2020 LiDAR mapping and then checked for general agreement with previous studies. The 2012 MDP did not redo hydrology, but rather updated the hydrology that was prepared as part of the *Toll Gate Creek Watershed Hydrology Report,* prepared by Kiowa Engineering Corporation in August 2006 (2006 Hydrology). The subbasins in the 2006 Hydrology were based on 10-foot topography and while the overall tributary watersheds are of similar size, many of the subbasins differ as a result of using more detailed topography in this study.

Subwatershed delineation and peak flow calculations for the West Toll Gate Creek tributary watersheds were divided into 89 subwatersheds at an average size of 56.7 acres and a maximum size of 127.7 acres. Subwatershed boundaries reflect the major storm event conditions and do not include minor storm drain systems. The subwatersheds are shown on Figures B-1A and B-1B in Appendix B.

**Length, Distance to Centroid, Slope**

The 2020 LiDAR data was used to determine subwatershed flow path lengths, distance to centroid values, and slopes. Private detention facilities were not included in the model. Where private detention basins were present, flow paths were determined based on the overflow path from the ponds, assuming the outlets would be clogged.

Subwatersheds were generally delineated to avoid shapes with elongated tails and very narrow and long shapes. To check these two scenarios, the following equations were used:

r = Length to Centroid / Total Length (if $0.1 \le r < 0.3$, the subwatershed may have an elongated tail)
r = $\text{Length}^2$ / Area (if $r > 4$, the subwatershed may be very narrow and long)

If the r value of a subwatershed indicated that it may have an elongated tail, or be very narrow and long, it was checked. Many of the subwatersheds in question did not have an elongated tail and were not long and narrow in shape. The questionable r values were generally a result of more winding flow paths, which results in longer flow paths. A sensitivity analysis was performed to determine which subbasins were more sensitive to the lengths. Subbasins that resulted in higher differences when lengths had acceptable r values were further subdivided.

The tributaries of West Toll Gate Creek generally slope down toward the north. Subbasin flow path slopes ranged from 0.04 to 3.0 percent (%). The lowest and highest watershed elevations are 5466 and 5945, respectively. Slopes were estimated using the weighted slope equation from the CUHP manual:

Weighted sloped = $((L_1 s_1^{0.24} + \ldots + L_n s_n^{0.24}) / (L_1 + \ldots + L_n))^{4.17}$

**Watershed Imperviousness**

The existing land uses are discussed in Section 2.2. To determine the existing conditions percent imperviousness, the 2020 Denver Regional Council of Governments (DRCOG) planimetrics data was used. To calculate the percent impervious values using DRCOG, five planimetric datasets were obtained and assigned a percent impervious value consistent with the MHFD criteria as follows:

- Roof prints – 95%
- Edge of Pavement – 95%
- Sidewalks – 95%
- Driveways – 95%
- Parking – 95%

The following additional adjustments were made to the base DRCOG data to calculate the percent imperviousness:

1. Because the database was prepared in 2020, aerial imagery from 2020 was compared to a 2024 aerial imagery to determine areas in the watershed that developed after the database was compiled. One area on Woodrim Tributary was updated based on aerial imagery (Subbasin W3). Mult-family housing was constructed. This area was assumed to have an imperviousness of 70%.

2. Areas with permanent water were delineated and assigned a value of 100% impervious.

3. The remaining pervious areas were split into two groups: disturbed soils (ie lawns and parks) and undisturbed soils (ie native open space areas). Disturbed soils were assigned a percent imperviousness of 20% based on MHFD criteria and assumed to include all non-impervious areas within the developed portions of the watershed. Undisturbed open space areas are primarily located near the West Toll Gate Creek confluences and along the Cherry Creek spillway and were assigned a percent imperviousness of 5%, per on MHFD criteria.

After the percent impervious values were determined using the DRCOG data, the values were spot checked for accuracy and were determined to be acceptable. Additionally, Olson completed a separate evaluation of percent impervious values using the 2021 National Land Cover Database (NLCD) and found the DRCOG data to more accurately represent the percent imperviousness. The percent impervious values are similar to the 2012 MDP study, which was based on land use designation. The overall existing percent imperviousness of the watershed is 51%. Overall existing percent imperviousness values for each tributary are shown in Table 4. The existing percent impervious values for each subbasin are shown on Figures B-1A and B-1B, in Appendix B.

***Table 4 – Tributary Imperviousness***

| Tributary | % Imperviousness |
|---|---|
| Helena Circle Tributary | 54 |
| Woodrim Tributary | 56 |
| Cherry Creek Spillway | 44 |
| Meadowood Creek | 55 |
| Mission Viejo Tributary | 59 |
| Los Ninos Tributary | 54 |
| Summer Valley Ranch Tributary | 54 |
| Summer Lake Tributary | 52 |
| Marina Park Tributary | 51 |
| Tower Road Tributary | 52 |
| Smoky Ridge Tributary | 44 |
| Himalaya Tributary | 17 |
| Park View Tributary | 46 |

**Depression Losses**

Depression losses were determined using Table 6-6 in the USDCM. A weighted average was used for the depression losses in each subbasin, based on land use designation. A pervious depression loss of 0.35 inches, which represents lawns and grass, was used for the developed portions of the watershed, and a value of 0.4, which represents open fields, was used for the open space portions of the watershed. An average of an impervious depression loss of 0.07, which represents sloped roofs, and 0.1, which represents large paved areas, was used for residential areas. A value of 0.1, which represents flat roofs and large paved areas, was used for commercial, office, and industrial areas.

**Infiltration**

Initial and final infiltration rates and Horton's decay rate were determined using Table 6-7 in the USDCM and are shown in Table . A weighted average of soil type was used to determine subwatershed rates. The hydrologic soil groups are shown on Figures B-1A and B-1B, in Appendix B.

***Table 5 - Horton's Equation Parameters***

| NRCS Hydrologic Soil Group | Infiltration (inches per hour) | | Decay Coefficient |
|---|---|---|---|
| | 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 |

## 3.4 Detention

Pursuant to MHFD's policy to recognize only regional and publicly-owned facilities, private detention basins, irrigation reservoirs, and inadvertent detention areas were not modeled. Additionally, four (4) detention basins that were included in the 2012 MDP were removed from the hydrology for this study, as described below:

- Two detention basins in the 2012 MDP were removed from the baseline hydrology model because they are primarily served by a storm drain system and the baseline hydrology generally focuses on overland flows and assumes storm drain systems are clogged. These two ponds included:
  - The Marina Park Tributary detention basin LBO Pond 2, located west of S Uravan Place and E Progress Place
  - The Tower Road Tributary detention basin, LBO Pond 1, located at S Yampa Circle

- Two detention basins in the 2012 MDP were removed from the baseline hydrology model in order to simplify the model since they had insignificant impact on peak flows. These two ponds included:
  - The Marina Park Tributary detention basin LBO Pond 3, located at the southwest corner of the intersection of E Smoky Hill Road and S Telluride Street
  - The Park View Tributary detention basin Pond 19, located south of E Berry Drive

Three (3) detention basins from the 2012 MDP were included in the baseline hydrology model, as summarized below:

- One detention basin, Pond 1, is within the Summer Lake Tributary, located at the downstream end of the Summer Lake Tributary east of Quincy Reservoir.

- Two detention basins are within the Tower Road Tributary. Smokey Ridge Pond is located at the upstream end of the Tower Road Tributary at the northwest corner of E Prentice Avenue and E Crestline Circle. Meadow Point Pond is located at the downstream end of Tower Road Tributary south of Quincy Reservoir.

Storage-discharge information for the detention basins were based on the 2012 MDP and are shown in Table B-2, in Appendix B.

### 3.5 Hydrograph Routing

The parameters for the EPA SWMM model conveyance elements were determined using the 2020 LiDAR data. Channel geometry was determined using the LiDAR mapping; sections could generally be defined by a trapezoidal section. For flows that are conveyed via streets, the street sections were modeled as irregular sections, separated by minor and major road type. The underground storm drain system was not modeled, except for the major storm event pipe at defined locations.

The Manning's n values for engineered conveyance elements, including engineered channels, pipe, and street, were increased 25 percent in accordance with the USDCM. Channel section Manning's n values ranged from 0.016 (concrete) to 0.05 (vegetated) in the model. Street section Manning's n values were set at 0.016, or 0.02 in the model. Concrete pipe Manning's n values were set at 0.013, or 0.016 in the model. One pipe section was changed to 0.013 in the model to avoid needing to add an overflow element.

The EPA SWMM 5.2 input parameters and 100-year future conditions output are included in Appendix B. EPA SWMM 5.2 model elements, including subwatersheds, design points and conveyance elements are shown on Figures B-1A and B-1B and a schematic of the model is shown on Figures B-2A through B-2B in Appendix B. No flow diversions were included in the analysis.

### 3.6 Previous Studies

The West Toll Gate Creek watershed has been included in several previous studies. The most recent hydrology studies are the 2017 OSP for Meadowood Creek and the 2012 MDP/2013 FHAD for the remainder of the included tributaries. The 2012 MDP was initially based on the previous hydrology study, the 2006 Hydrology.

In addition to these hydrology studies, outfall systems plans (OSPs) were created to analyze certain tributaries highlighted in this study. Marina Park Tributary, Tower Road Tributary, and Park View Tributary were all analyzed in the 1998/1999 *Quincy Reservoir Watershed Outfall Systems Planning Alternatives Evaluation Report* by Turner Collie & Braden Inc.

A comparison of peak flows in the 2012 MDP and 2017 OSP versus this study is shown in Table 6. In general, the peak flows are lower than the 2012 MDP, but similar to the 2017 OSP for Meadowood Creek. The 2012 MDP model was converted to the same model versions and the rainfall values were update to NOAA Atlas 14 to better compare the differences in peak flows. The unit discharges were compared to eliminate differences in tributary area. After converting the models, the peak flows in this studied ranged from 6% higher than the updated 2012 MDP to 26% lower than the updated 2012 MDP values. The remaining differences in peak flows can be mostly attributed to the more detailed 2020 LiDAR information that was used to delineate watersheds and flow paths. The 2012 MDP was an update of the 2006 Hydrology, which was based on 10-foot topography. The differences are within 30% and are reasonable and therefore no calibration was completed.

***Table 6 - Previous Studies Hydrology Reconciliation***

| Reference Location | 2012 MDP | | | | | 2012 MDP Update | | 2024 MDP | | | | | Comparisons | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Design Point | Total Tributary Area (Ac) | Future % Imp | FTR Q100 Peak Discharges (cfs) | Unit Discharge (cfs/ac) | FTR Q100 Peak Discharges (cfs) | Unit Discharge (cfs/ac) | Design Point | Total Tributary Area (Ac) | Future % Imp | FTR Q100 Peak Discharges (cfs) | Unit Discharge (cfs/ac) | % Diff Unit Discharge (2012 MDP vs. 2024 MDP) | % Diff Unit Discharge (2012 MDP Update vs. 2024 MDP) |
| Helena Circle at S Chambers Rd | J_LW17 | 153 | 54 | 690 | 4.50 | 438 | 2.86 | HC102 | 155 | 53 | 327 | 2.11 | -53% | -26% |
| Woodrim Tributary Confluence with WTGC | OUT_WOOD1 | 398 | 55 | 1,563 | 3.93 | 1,012 | 2.54 | W101 | 353 | 56 | 696 | 1.97 | -50% | -23% |
| Cherry Creek Spillway Confluence with WTGC | O_S1 | 1,272 | 41 | 2,914 | 2.29 | 1,978 | 1.56 | C101 | 1,379 | 44 | 1,929 | 1.40 | -39% | -10% |
| Meadowood Creek Tributary Confluence with WTGC | O_WT1 | 1,687 | 53 | 4,174 | 2.47 | 3,052 | 1.81 | MC101 | 1,670 | 55 | 2,424 | 1.45 | -41% | -20% |
| Summer View Tributary Confluence with WTGC | J_LQ109 | 362 | 55 | 1,347 | 3.72 | 859 | 2.37 | SV101 | 475 | 54 | 1,051 | 2.21 | -41% | -7% |
| Summer Lake Tributary Upstream of Pond 1 | J_QR625 | 62 | 44 | 262 | 4.22 | 178 | 2.86 | SL305 | 51 | 64 | 155 | 3.01 | -29% | 5% |
| Tower Road Tributary and Marina Park Tributary Upstream of Meadow Point Detention Pond | J_QR645 | 697 | 42 | 1,727 | 2.48 | 1,184 | 1.70 | T101 | 660 | 52 | 1,194 | 1.81 | -27% | 6% |
| Smokey Ridge Tributary Confluence with WTGC | Basin QR335 | 75 | 34 | 211 | 2.83 | 144 | 1.93 | SR101 | 66 | 44 | 133 | 2.01 | -29% | 4% |
| Park View Tributary Upstream of Pond 19 | J_QR623 | 24 | 45 | 109 | 4.58 | 71 | 2.98 | P103 | 20 | 45 | 49 | 2.38 | -48% | -20% |
| **Reference Location** | **2017 OSP** | | | | | **---** | | **2024 MDP** | | | | | **(2017 OSP vs. 2024)** | |
| Meadowood Creek Tributary Confluence with WTGC | 2017 OSP: Outfall | 1,694 | 47 | 2,206 | 1.30 | --- | --- | MC101 | 1670 | 55 | 2424 | 1.45 | 11% | --- |

### 3.7 Results of Analysis

In general, the peak flows are lower than the 2012 MDP, but similar to the 2017 OSP for Meadowood Creek, as discussed in Section 3.6. A summary of the 100-year peak flows at the downstream end of each tributary is summarized in Table 7. The baseline peak discharges and volumes for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storm events for all the EPA SWMM 5.2 design points can be found in Table B-3, in Appendix B. The peak discharges and volumes versus channel station for the West Toll Gate Creek Tributaries are shown in Table B-4 and are also shown in Figures B-3A through B-3J, in Appendix B. Select SWMM generated hydrographs are included as Figure B-4, in Appendix B.

***Table 7 - Summary of 100-Year Peak Flows***

| Design Point | Tributary | 100-Year Peak Flow at the Downstream End (cfs) |
|---|---|---|
| HC101 | Helena Circle Tributary | 388 |
| W101 | Woodrim Tributary | 696 |
| C101 | Cherry Creek Spillway | 1,929 |
| MC101 | Meadowood Creek | 2,424 |
| MV101 | Mission Viejo Tributary | 169 |
| LN101 | Los Ninos Tributary | 207 |
| SV101 | Summer Valley Ranch Tributary | 1,051 |
| SL101 | Summer Lake Tributary | 241 |
| MP101 | Marina Park Tributary | 519 |
| T101O | Tower Road Tributary | 1,074 |
| SR101 | Smoky Ridge Tributary | 133 |
| H101 | Himalaya Tributary | 5 |
| P101 | Park View Tributary | 202 |

## 4.0 HYDRAULIC ANALYSIS

To be included in future submittals.

## 5.0 ALTERNATIVE ANALYSIS

To be included in future submittals.

## 6.0 CONCEPTUAL DESIGN

To be included in future submittals.

## 7.0 REFERENCES

City of Aurora, Storm Drainage Design and Technical Criteria Manual, Aurora, Colorado, October 11, 2010

Federal Highway Administration. July 28, 2016. *HY-8 7.50*

J3 Engineering Consultants Inc. November 2013. *Toll Gate Creek and East Toll Gate Creek (Downstream of Hampton): Flood Hazard Area Delineation*

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Mile High Flood District. August 2018. *USDCM: Volume 1 – Management, Hydrology, and Hydraulics.*

Mile High Flood District. November 2019. *CUHP 2005 Version 2.0.1*

Michael Baker International. December, 18 2012. *West Toll Gate Creek Major Drainageway Plan*

Michael Baker International. November 20, 2013. *Flood Hazard Area Delineation, West Toll Gate Creek*

Stantec Consulting Services Inc. September 2016. *City of Aurora Channel Stabilization Study Summary Report*

Turner Collie & Braden Inc. October 1998. *Quincy Reservoir Outfall Systems Planning Alternatives Evaluation Report Phase A*

Turner Collie & Braden Inc. September 1999. *Quincy Reservoir Outfall Systems Planning Alternatives Evaluation Report Phase B*

US Army Corps of Engineers. March 2019. *HEC-RAS 5.0.7*

US Department of Agriculture, Natural Resources Conservations Service. November 14, 2018. *Custom Soil Resource Report for Parts of Adams and Denver Counties, Colorado; Arapahoe County, Colorado; and Denver County Area, Colorado.*

US Department of Commerce, National Oceanic and Atmospheric Administration, Atlas 14, Volume 8, Version 2. December 2, 2018. *Point Precipitation Frequency Estimates.*

US Department of Homeland Security. February 5, 2014. *Flood Insurance Rate Map: Map Numbers 08005C0179L, 08005C0183L, 08005C0187K, 08005C0191L, 08005C0189K, 08005C0193L, 08005C0194L, 08005C0481L, 08005C0482M*

US Environmental Protection Agency. July 31, 2018. *EPA SWMM 5.2.1*

US Geological Survey. January 2019. *National Land Cover Database – 2019 Dataset*

# APPENDIX A

## PROJECT CORRESPONDENCE

# MEETING MINUTES

# MEETING MINUTES

## Kickoff Meeting

| | |
|---|---|
| **Date:** | September 7, 2023 at 11:00 AM via Teams |
| **RE:** | West Toll Gate Creek Tributaries MDP Kick-off |
| **Attendees:** | Attendees listed below |
| **Project #** | 022-02231 |

**Attendees:**

| Name | Company | Email |
|---|---|---|
| Colin Haggerty | Mile High Flood District (MHFD) | chaggerty@mhfd.org |
| Derek Clark | MHFD | dclark@mhfd.org |
| Jessica Traynor | Southeast Metro Stormwater Authority (SEMSWA) | jtraynor@semswa.org |
| Tiffany Clark | SEMSWA | tclark@semswa.org |
| Nicole Harwell | SEMSWA | nharwell@semswa.org |
| Sam Scorza | City of Aurora (COA) | samiller@auroragov.org |
| Craig Perl | COA | cperl@aurora.org |
| Gustav Slovensky | COA | gslovens@auroragov.org |
| Amy Gabor | Olsson | agabor@olsson.com |
| Zack DelGrosso | Olsson | zdelgrosso@olsson.com |

**Discussion Items:**

**The purpose of this meeting was to discuss the start of the project and better define its scope. Specifically, determine which tributaries should be included in this study. This meeting was only to discuss the hydrology phase of the study. While this summary is not intended to represent a comprehensive account of the meeting, it is intended to reflect the key points raised and issues for further consideration and to identify the action items resulting from the discussions. The non-bold items comprised the meeting agenda. The items in bold resulted from the discussions.**

1) Introductions

2) Project goals
   a) **The main goal of this project is to continue the efforts of the District to update MDPs throughout its boundaries and identify potential issues and maintenance needs.**
   b) **This study will help provide an assessment of existing conditions, identify problem areas, and provide guidance on future construction projects for the West Toll Gate Creek tributaries.**

3) Needed Information
   a) 2020 LiDAR topo and contours – **MHFD to provide**
   b) GIS files (storm sewer, other utilities that are available, property lines, ROW, easement, streets, streams, FPs, City limits, SEMSWA limits, future land use or zoning, etc.) **– To be provided by MHFD, SEMSWA, and COA**
   c) GIS file of WTGC subbasins and overall watershed – **MHFD to provide**
   d) West Toll Gate Creek hydrology models – **MHFD to provide**
   e) Crossing structure surveys – **Crossing structure surveys are not needed at this time. Potential survey needs will be discussed in future phases of the study**
   f) Any plans, reports, or studies in the project area that not available on-line (ie the concrete channel assessment and sediment analysis by Aurora) – **To be provided by MHFD, SEMSWA, and COA**
   g) Contact information for any additional stakeholders that should be included as the study progresses

4) Hydrology
   a) **Hydrology will be based on NOAA Atlas 14 rainfall, CUHP 2005 Version 2.0.1, and EPA SWMM 5.2.3.**
   b) **Existing imperviousness determined using 2019 NLCD, with adjustments to change any values less than 2% to 2% and update open water to 100%. Aerial imagery will be used to update any development post-2019. Future imperviousness based on land use and zoning for undeveloped parcels.**
   c) **Only need to look at local drainage for Cherry Creek Spillway.**
   d) **Do not include hydrology routing down West Toll Gate Creek.**
   e) **Match detention in 2012 MDP. No additional detention ponds are anticipated to be included.**

5) Previous studies and existing conditions
   a) **West Toll Gate Creek was studied in 2012, but did not include the smaller tributaries. Other studies have been done that include some of the tributaries. Olsson will review available information on MHFD's website.**
   b) **COA completed an assessment of concrete channels, but it did not include an evaluation of peak flows. COA will send Olsson the report and it will be referenced as it relates to the existing conditions.**
   c) **COA completed a sediment analysis on West Toll Gate Creek. The study will be considered as it relates to the tributaries.**
   d) **At this time, it is anticipated that no effective floodplains will be updated by this study.**
   e) **Woodrim Tributary has recently been studied as part of a development.**

6) Determination of tributaries to be included in MDP
   a) **Olsson will provide a map to sponsors with recommendations on what tributaries should be included in the study. Generally, tributaries will be included if they have been previously studied and/or are open channels. Piped systems are not anticipated to be included.**
   b) **The Aurora Mall drainage system was completed recently and has complicated hydrology/hydraulics. Because it was completed recently, it will not be included in the study.**
   c) **Highline Canal will only be included as it relates to any other tributary crossing it.**
   d) **Unnamed Tributary was studied as part of the 2012 MDP and will not be included.**

7) Deliverables
   a) **The study will follow the typical PDF submittal and will not be a web-based master plan, but will include GIS files that are compatible with MHFD's Confluence system. MHFD prefers web-based.**

**Action Items:**

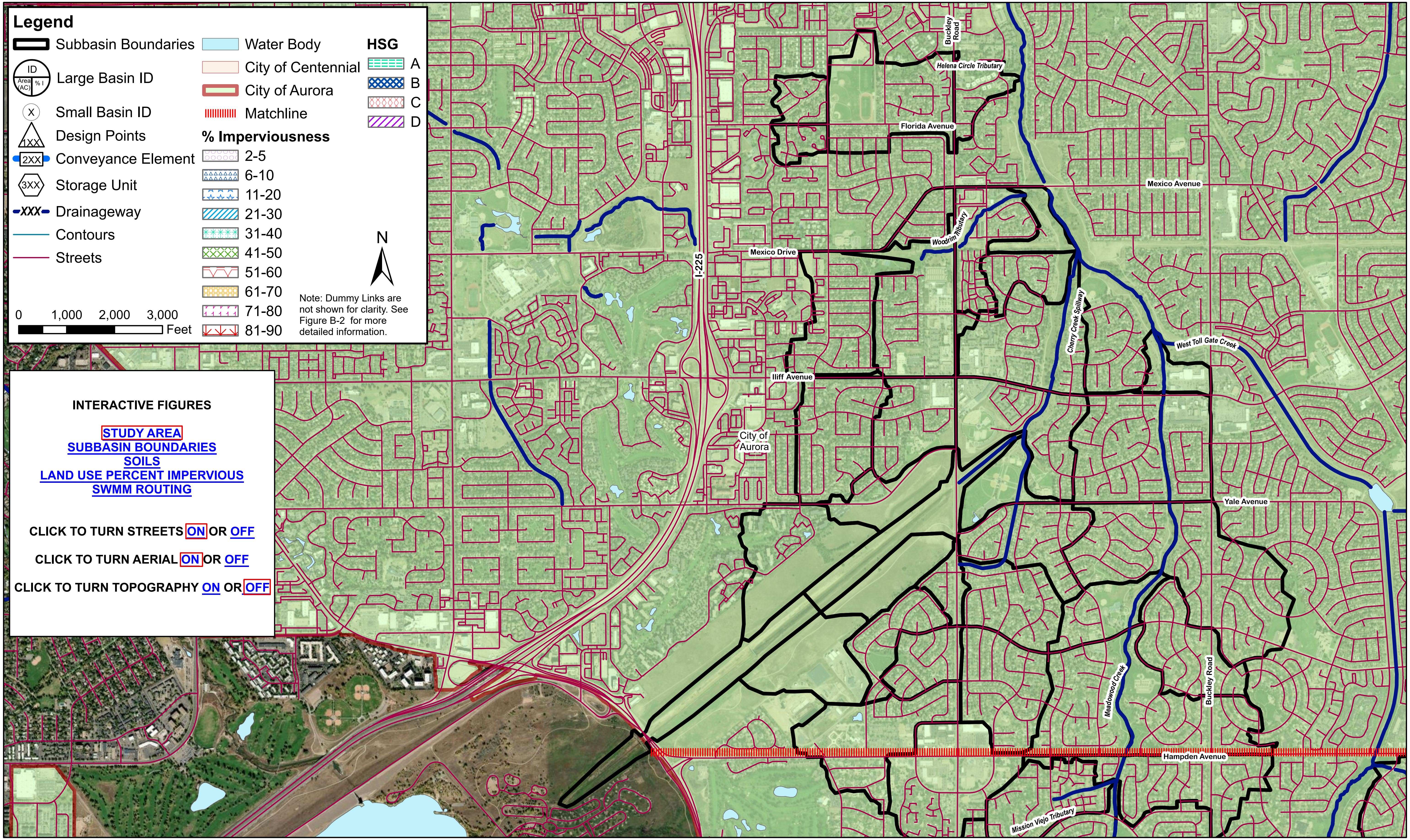
- **Olsson**
  - **Provide a map of tributaries outlining which have old studies/information**
  - **Provide scope and fee for hydrology**
- **MHFD**
  - **Provide 2020 LiDAR**
  - **Provide 2012 hydrology and GIS shapefiles**
  - **Provide any relevant studies and plans not accessible on-line**
- **COA/SEMSWA**
  - **Provide any relevant GIS files not accessible on-line**
  - **Provide any relevant studies and plans not accessible on-line**

**Please contact Olsson at 303-237-2072 with changes or questions regarding these meeting minutes. These minutes will be considered final unless comments are received within seven days of distribution. Although comments will be incorporated, as appropriate, only major revisions will be redistributed.**

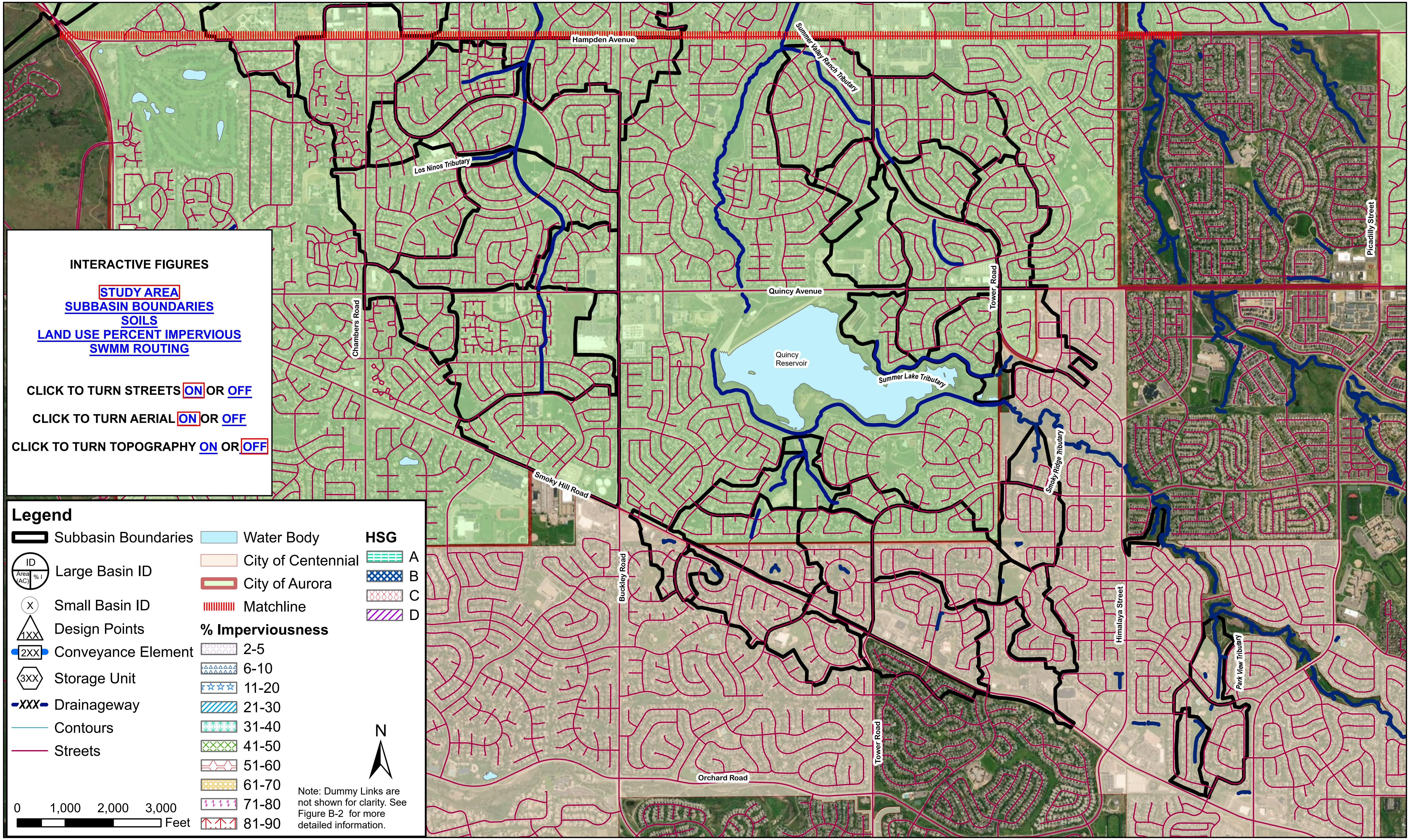
**Minutes prepared by: Zack DelGrosso**
**Distribution List: Attendees**

# APPENDIX B

## HYDROLOGIC ANALYSIS




| PROJECT: 022-02231 | MILE HIGH FLOOD DISTRICT, CITY OF AURORA, AND SEMSWA | WEST TOLL GATE CREEK TRIBUTARIES HYDROLOGY WORKMAP | olsson | 1525 Raleigh Street<br>Suite 400<br>Denver, CO 80204 | TEL: 303.237.2072<br>FAX: 303.237.2659<br>www.olsson.com | FIGURE |
|---|---|---|---|---|---|---|
| DRAWN BY: CG | | | | | | B-1A |
| DATE: 04/2024 | | | | | | |




PROJECT: 022-02231
DRAWN BY: CG
DATE: 04/2024

**MILE HIGH FLOOD DISTRICT, CITY OF AURORA, AND SEMSWA**

**WEST TOLL GATE CREEK TRIBUTARIES HYDROLOGY WORKMAP**

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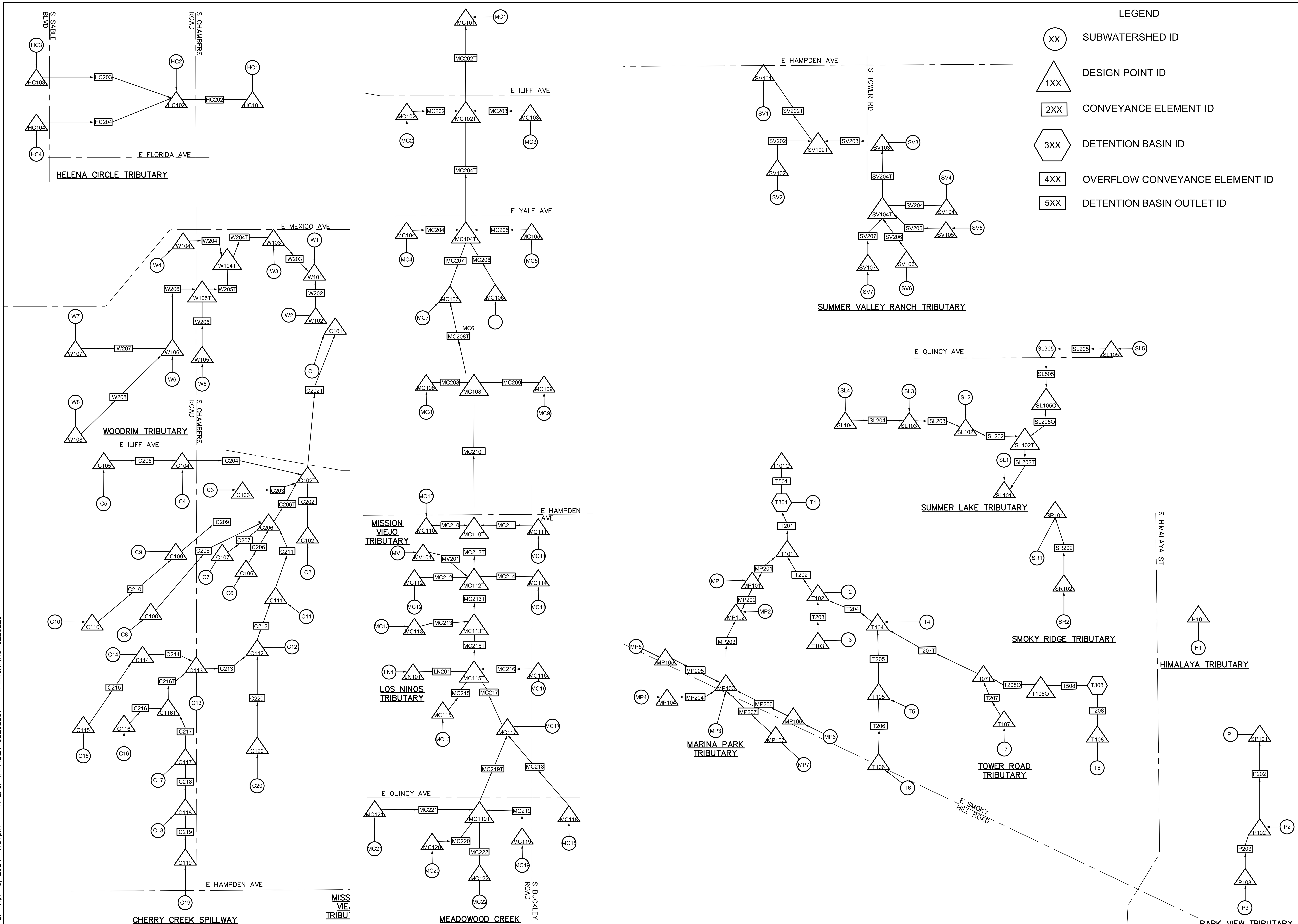
FIGURE
B-1B

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Denver, CO 80204
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| REV. NO. | DATE | REVISIONS DESCRIPTION |
|---|---|---|
| | | |

REVISIONS

SWMM SCHEMATIC

WEST TOLL GATE TRIBUTARIES
MASTER DRAINAGE PLAN

2023

ARVADA, COLORADO

drawn by: CG
checked by: AG
approved by: AG
QA/QC by: AG
project no.: 022-02231
drawing no.:
date: 04/2024

FIGURE B-2

DWG: F:\2022\02001-02500\022-02231\40-Design\Calcs\WTRS\7 AUTOCAD FILES\Baseline Hydrology\W_SWMMROUT_02202231.dwg USER: agabor
DATE: Apr 19, 2024 1:37pm XREFS: W_TTBLK_02202231 W_WORKING_02202231

# Table B-1 - Unadjusted Rainfall Distributions

| 1Hr Depth | 0.870 |
|---|---|
| Return Period | 2 |
| Time | Depth |
| 0:05 | 0.0174 |
| 0:10 | 0.0348 |
| 0:15 | 0.0731 |
| 0:20 | 0.1392 |
| 0:25 | 0.2175 |
| 0:30 | 0.1218 |
| 0:35 | 0.0548 |
| 0:40 | 0.0435 |
| 0:45 | 0.0261 |
| 0:50 | 0.0261 |
| 0:55 | 0.0261 |
| 1:00 | 0.0261 |
| 1:05 | 0.0261 |
| 1:10 | 0.0174 |
| 1:15 | 0.0174 |
| 1:20 | 0.0174 |
| 1:25 | 0.0174 |
| 1:30 | 0.0174 |
| 1:35 | 0.0174 |
| 1:40 | 0.0174 |
| 1:45 | 0.0174 |
| 1:50 | 0.0174 |
| 1:55 | 0.0087 |
| 2:00 | 0.0087 |

| 1Hr Depth | 1.14 |
|---|---|
| Return Period | 5 |
| Time | Depth |
| 0:05 | 0.0228 |
| 0:10 | 0.0422 |
| 0:15 | 0.0992 |
| 0:20 | 0.1744 |
| 0:25 | 0.2850 |
| 0:30 | 0.1482 |
| 0:35 | 0.0661 |
| 0:40 | 0.0502 |
| 0:45 | 0.0410 |
| 0:50 | 0.0410 |
| 0:55 | 0.0342 |
| 1:00 | 0.0342 |
| 1:05 | 0.0342 |
| 1:10 | 0.0342 |
| 1:15 | 0.0285 |
| 1:20 | 0.0251 |
| 1:25 | 0.0251 |
| 1:30 | 0.0251 |
| 1:35 | 0.0251 |
| 1:40 | 0.0171 |
| 1:45 | 0.0171 |
| 1:50 | 0.0171 |
| 1:55 | 0.0171 |
| 2:00 | 0.0148 |

| 1Hr Depth | 1.39 |
|---|---|
| Return Period | 10 |
| Time | Depth |
| 0:05 | 0.0278 |
| 0:10 | 0.0514 |
| 0:15 | 0.1140 |
| 0:20 | 0.2085 |
| 0:25 | 0.3475 |
| 0:30 | 0.1668 |
| 0:35 | 0.0778 |
| 0:40 | 0.0598 |
| 0:45 | 0.0528 |
| 0:50 | 0.0445 |
| 0:55 | 0.0445 |
| 1:00 | 0.0445 |
| 1:05 | 0.0445 |
| 1:10 | 0.0445 |
| 1:15 | 0.0445 |
| 1:20 | 0.0348 |
| 1:25 | 0.0264 |
| 1:30 | 0.0264 |
| 1:35 | 0.0264 |
| 1:40 | 0.0264 |
| 1:45 | 0.0264 |
| 1:50 | 0.0264 |
| 1:55 | 0.0236 |
| 2:00 | 0.0181 |

| 1Hr Depth | 1.77 |
|---|---|
| Return Period | 25 |
| Time | Depth |
| 0:05 | 0.0230 |
| 0:10 | 0.0619 |
| 0:15 | 0.0885 |
| 0:20 | 0.1416 |
| 0:25 | 0.2655 |
| 0:30 | 0.4425 |
| 0:35 | 0.2124 |
| 0:40 | 0.1416 |
| 0:45 | 0.0885 |
| 0:50 | 0.0885 |
| 0:55 | 0.0566 |
| 1:00 | 0.0566 |
| 1:05 | 0.0566 |
| 1:10 | 0.0425 |
| 1:15 | 0.0425 |
| 1:20 | 0.0319 |
| 1:25 | 0.0319 |
| 1:30 | 0.0248 |
| 1:35 | 0.0248 |
| 1:40 | 0.0248 |
| 1:45 | 0.0248 |
| 1:50 | 0.0248 |
| 1:55 | 0.0248 |
| 2:00 | 0.0248 |

| 1Hr Depth | 2.08 |
|---|---|
| Return Period | 50 |
| Time | Depth |
| 0:05 | 0.0270 |
| 0:10 | 0.0728 |
| 0:15 | 0.1040 |
| 0:20 | 0.1664 |
| 0:25 | 0.3120 |
| 0:30 | 0.5200 |
| 0:35 | 0.2496 |
| 0:40 | 0.1664 |
| 0:45 | 0.1040 |
| 0:50 | 0.1040 |
| 0:55 | 0.0666 |
| 1:00 | 0.0666 |
| 1:05 | 0.0666 |
| 1:10 | 0.0499 |
| 1:15 | 0.0499 |
| 1:20 | 0.0374 |
| 1:25 | 0.0374 |
| 1:30 | 0.0291 |
| 1:35 | 0.0291 |
| 1:40 | 0.0291 |
| 1:45 | 0.0291 |
| 1:50 | 0.0291 |
| 1:55 | 0.0291 |
| 2:00 | 0.0291 |

| 1Hr Depth | 2.41 |
|---|---|
| Return Period | 100 |
| Time | Depth |
| 0:05 | 0.0241 |
| 0:10 | 0.0723 |
| 0:15 | 0.1109 |
| 0:20 | 0.1928 |
| 0:25 | 0.3374 |
| 0:30 | 0.6025 |
| 0:35 | 0.3374 |
| 0:40 | 0.1928 |
| 0:45 | 0.1494 |
| 0:50 | 0.1205 |
| 0:55 | 0.0964 |
| 1:00 | 0.0964 |
| 1:05 | 0.0964 |
| 1:10 | 0.0482 |
| 1:15 | 0.0482 |
| 1:20 | 0.0289 |
| 1:25 | 0.0289 |
| 1:30 | 0.0289 |
| 1:35 | 0.0289 |
| 1:40 | 0.0289 |
| 1:45 | 0.0289 |
| 1:50 | 0.0289 |
| 1:55 | 0.0289 |
| 2:00 | 0.0289 |

| 1Hr Depth | 3.28 |
|---|---|
| Return Period | 500 |
| Time | Depth |
| 0:05 | 0.0328 |
| 0:10 | 0.0984 |
| 0:15 | 0.1509 |
| 0:20 | 0.2624 |
| 0:25 | 0.4592 |
| 0:30 | 0.8200 |
| 0:35 | 0.4592 |
| 0:40 | 0.2624 |
| 0:45 | 0.2034 |
| 0:50 | 0.1640 |
| 0:55 | 0.1312 |
| 1:00 | 0.1312 |
| 1:05 | 0.1312 |
| 1:10 | 0.0656 |
| 1:15 | 0.0656 |
| 1:20 | 0.0394 |
| 1:25 | 0.0394 |
| 1:30 | 0.0394 |
| 1:35 | 0.0394 |
| 1:40 | 0.0394 |
| 1:45 | 0.0394 |
| 1:50 | 0.0394 |
| 1:55 | 0.0394 |
| 2:00 | 0.0394 |

# Table B-2 - Detention Basin Stage-Storage-Discharge Information

| Design Point SL305 - Summer Lake Tributary (Pond 1) | |
|---|---|
| Storage (ac-ft) | Discharge (cfs) |
| 0 | 0 |
| 0.1 | 3 |
| 0.2 | 5 |
| 0.6 | 6 |
| 1.3 | 7 |
| 2.2 | 8 |
| 2.7 | 9 |
| 3.2 | 9 |
| 4.9 | 24 |
| 5.5 | 43 |
| 5.7 | 500 |

Values from *West Toll Gate Creek Major Drainageway Plan (2012)* - Outlet

| Design Point T301 - Tower Road Tributary (Meadow Point Pond) | |
|---|---|
| Storage (ac-ft) | Discharge (cfs) |
| 0 | 0 |
| 3.8 | 30 |
| 12.1 | 80 |
| 23.7 | 130 |
| 37.8 | 4125 |
| 54.5 | 11398 |

Values from *West Toll Gate Creek Major Drainageway Plan (2012)* - Outlet O_QRET_802

| Design Point T308- Tower Road Tributary (Smokey Ridge Pond) | |
|---|---|
| Storage (ac-ft) | Discharge (cfs) |
| 0 | 0 |
| 0.12 | 9.9 |
| 1.3 | 14.3 |
| 3.3 | 18 |
| 4.3 | 40.5 |
| 5.6 | 64 |
| 6.5 | 69 |
| 6.6 | 100 |

Values from *West Toll Gate Creek Major Drainageway Plan (2012)* - Outlet O_QRET_809

# CUHP INPUT TABLE

# CUHP SUBCATCHMENTS

| | | | | | | | | Maximum Depression Storage (Watershed inches) | | Horton's Infiltration Parameters | | | DCIA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Subcatchment Name** | **EPA SWMM Target Node** | **Raingage** | **Area ($ft^2$)** | **Length to Centroid (ft)** | **Length (ft)** | **Slope (ft/ft)** | **Percent Imperviousness** | **Pervious** | **Impervious** | **Initial Rate (in/hr)** | **Decay Coefficient (1/seconds)** | **Final Rate (in/hr)** | **Level 0, 1, or 2** |
| HC1 | HC101 | Rainfall | 1262297 | 991 | 2611 | 0.0157 | 58.03 | 0.35 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| HC2 | HC102 | Rainfall | 4904793 | 2010 | 3502 | 0.0166 | 50.74 | 0.35 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| HC3 | HC103 | Rainfall | 1067353 | 788 | 1434 | 0.0133 | 56.86 | 0.35 | 0.07 | 4.5233 | 0.00156 | 0.683 | 0 |
| HC4 | HC104 | Rainfall | 780766 | 755 | 1546 | 0.0055 | 59.04 | 0.35 | 0.07 | 4.2197 | 0.00177 | 0.592 | 0 |
| W1 | W101 | Rainfall | 1053402 | 1872 | 2985 | 0.0087 | 20.32 | 0.39 | 0.09 | 3.0000 | 0.00180 | 0.500 | 0 |
| W2 | W102 | Rainfall | 1620871 | 1437 | 2507 | 0.0157 | 44.85 | 0.37 | 0.08 | 3.1140 | 0.00179 | 0.510 | 0 |
| W3 | W103 | Rainfall | 2793204 | 1505 | 3327 | 0.0109 | 70.36 | 0.35 | 0.08 | 3.1223 | 0.00180 | 0.508 | 0 |
| W4 | W104 | Rainfall | 1021730 | 936 | 2129 | 0.0122 | 57.32 | 0.35 | 0.07 | 3.4207 | 0.00180 | 0.528 | 0 |
| W5 | W105 | Rainfall | 216921 | 338 | 1327 | 0.0133 | 75.33 | 0.35 | 0.09 | 4.4348 | 0.00180 | 0.596 | 0 |
| W6 | W106 | Rainfall | 4526800 | 1439 | 3955 | 0.0128 | 57.83 | 0.36 | 0.08 | 4.0375 | 0.00180 | 0.569 | 0 |
| W7 | W107 | Rainfall | 4067005 | 1742 | 4200 | 0.0119 | 54.57 | 0.36 | 0.08 | 4.3456 | 0.00162 | 0.651 | 0 |
| W8 | W108 | Rainfall | 91636 | 623 | 1566 | 0.0116 | 84.14 | 0.35 | 0.1 | 4.6149 | 0.00155 | 0.692 | 0 |
| C1 | C101 | Rainfall | 4724751 | 2343 | 4909 | 0.0103 | 50.10 | 0.37 | 0.08 | 3.9794 | 0.00164 | 0.620 | 0 |
| C2 | C102 | Rainfall | 2090637 | 1242 | 2682 | 0.0167 | 47.34 | 0.37 | 0.08 | 3.7238 | 0.00146 | 0.663 | 0 |
| C3 | C103 | Rainfall | 2333691 | 880 | 2677 | 0.0114 | 53.85 | 0.37 | 0.09 | 4.6066 | 0.00133 | 0.763 | 0 |
| C4 | C104 | Rainfall | 2892885 | 1562 | 3366 | 0.0104 | 57.23 | 0.35 | 0.08 | 4.6818 | 0.00140 | 0.745 | 0 |
| C5 | C105 | Rainfall | 4007631 | 2276 | 3755 | 0.0129 | 54.87 | 0.35 | 0.07 | 4.9003 | 0.00092 | 0.920 | 0 |
| C6 | C106 | Rainfall | 1599639 | 1283 | 2619 | 0.0107 | 32.77 | 0.37 | 0.1 | 4.9478 | 0.00082 | 0.958 | 0 |
| C7 | C107 | Rainfall | 2806975 | 3178 | 5949 | 0.0010 | 10.51 | 0.4 | 0.1 | 3.3593 | 0.00164 | 0.578 | 0 |
| C8 | C108 | Rainfall | 3047923 | 3037 | 6796 | 0.0004 | 6.05 | 0.4 | 0.1 | 3.0232 | 0.00179 | 0.506 | 0 |
| C9 | C109 | Rainfall | 2225515 | 1595 | 3248 | 0.0197 | 27.86 | 0.39 | 0.09 | 4.8646 | 0.00085 | 0.940 | 0 |
| C10 | C110 | Rainfall | 4300731 | 1633 | 2551 | 0.0109 | 27.72 | 0.38 | 0.09 | 4.5419 | 0.00138 | 0.744 | 0 |
| C11 | C111 | Rainfall | 3225578 | 1589 | 3232 | 0.0103 | 51.90 | 0.35 | 0.07 | 4.7763 | 0.00119 | 0.821 | 0 |
| C12 | C112 | Rainfall | 3053873 | 1005 | 2976 | 0.0135 | 50.34 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| C13 | C113 | Rainfall | 892870 | 592 | 1658 | 0.0110 | 56.40 | 0.35 | 0.07 | 4.5133 | 0.00177 | 0.611 | 0 |
| C14 | C114 | Rainfall | 2083016 | 1210 | 3010 | 0.0130 | 7.83 | 0.4 | 0.09 | 4.1988 | 0.00167 | 0.623 | 0 |
| C15 | C115 | Rainfall | 3161784 | 1489 | 3104 | 0.0067 | 28.67 | 0.39 | 0.1 | 4.2939 | 0.00179 | 0.590 | 0 |
| C16 | C116 | Rainfall | 2069144 | 1208 | 3394 | 0.0146 | 52.84 | 0.35 | 0.07 | 4.4740 | 0.00180 | 0.598 | 0 |
| C17 | C117 | Rainfall | 1799951 | 1480 | 2596 | 0.0116 | 54.51 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| C18 | C118 | Rainfall | 4442857 | 2963 | 4993 | 0.0094 | 56.17 | 0.35 | 0.08 | 4.6300 | 0.00151 | 0.704 | 0 |
| C19 | C119 | Rainfall | 5562889 | 1434 | 4103 | 0.0154 | 71.76 | 0.35 | 0.08 | 4.6421 | 0.00149 | 0.714 | 0 |
| C20 | C120 | Rainfall | 3749615 | 1334 | 3156 | 0.0096 | 53.05 | 0.35 | 0.07 | 4.5238 | 0.00175 | 0.619 | 0 |
| MC1 | MC101 | Rainfall | 1081361 | 947 | 2386 | 0.0084 | 55.09 | 0.38 | 0.1 | 3.0444 | 0.00178 | 0.511 | 0 |
| MC2 | MC102 | Rainfall | 4169831 | 2251 | 3792 | 0.0155 | 53.54 | 0.35 | 0.07 | 3.4181 | 0.00180 | 0.528 | 0 |
| MC3 | MC103 | Rainfall | 2227422 | 1244 | 3214 | 0.0056 | 62.82 | 0.35 | 0.08 | 3.4127 | 0.00157 | 0.603 | 0 |
| MC4 | MC104 | Rainfall | 3158723 | 1433 | 3086 | 0.0126 | 49.64 | 0.36 | 0.07 | 4.2093 | 0.00180 | 0.581 | 0 |
| MC5 | MC105 | Rainfall | 5561641 | 2366 | 4758 | 0.0135 | 53.44 | 0.36 | 0.07 | 4.9934 | 0.00071 | 0.995 | 0 |
| MC6 | MC106 | Rainfall | 3241824 | 1507 | 4127 | 0.0121 | 55.44 | 0.35 | 0.07 | 4.9981 | 0.00070 | 0.999 | 0 |
| MC7 | MC107 | Rainfall | 2047611 | 1646 | 3301 | 0.0136 | 43.26 | 0.36 | 0.08 | 4.5088 | 0.00178 | 0.607 | 0 |
| MC8 | MC108 | Rainfall | 3992537 | 1584 | 4880 | 0.0100 | 49.80 | 0.37 | 0.07 | 4.2530 | 0.00157 | 0.659 | 0 |
| MC9 | MC109 | Rainfall | 4143915 | 2634 | 5635 | 0.0073 | 52.57 | 0.37 | 0.08 | 4.6137 | 0.00149 | 0.710 | 0 |
| MC10 | MC110 | Rainfall | 501942 | 786 | 2264 | 0.0163 | 61.76 | 0.35 | 0.08 | 4.5000 | 0.00180 | 0.600 | 0 |
| MC11 | MC111 | Rainfall | 3668805 | 2576 | 3982 | 0.0096 | 57.86 | 0.35 | 0.07 | 4.5724 | 0.00164 | 0.658 | 0 |
| MC12 | MC112 | Rainfall | 1847030 | 2242 | 3792 | 0.0070 | 57.21 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| MC13 | MC113 | Rainfall | 975403 | 830 | 1675 | 0.0127 | 57.35 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| MC14 | MC114 | Rainfall | 3408854 | 1699 | 3852 | 0.0065 | 54.01 | 0.35 | 0.08 | 4.6348 | 0.00150 | 0.708 | 0 |
| MC15 | MC115 | Rainfall | 5084672 | 2707 | 5467 | 0.0118 | 58.92 | 0.35 | 0.07 | 4.7655 | 0.00122 | 0.812 | 0 |
| MC16 | MC116 | Rainfall | 1856928 | 2146 | 3640 | 0.0083 | 52.27 | 0.35 | 0.08 | 4.7013 | 0.00136 | 0.761 | 0 |
| MC17 | MC117 | Rainfall | 2137883 | 851 | 2624 | 0.0069 | 61.57 | 0.35 | 0.08 | 3.6023 | 0.00147 | 0.651 | 0 |
| MC18 | MC118 | Rainfall | 1058618 | 794 | 2131 | 0.0184 | 80.67 | 0.35 | 0.1 | 3.1875 | 0.00180 | 0.513 | 0 |
| MC19 | MC119 | Rainfall | 2354890 | 2077 | 3520 | 0.0095 | 46.73 | 0.35 | 0.07 | 3.5829 | 0.00180 | 0.539 | 0 |
| MC20 | MC120 | Rainfall | 4445128 | 1625 | 4052 | 0.0112 | 55.33 | 0.35 | 0.08 | 4.5975 | 0.00142 | 0.732 | 0 |

# CUHP SUBCATCHMENTS

| | | | | | | | | Maximum Depression Storage (Watershed inches) | | Horton's Infiltration Parameters | | | DCIA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subcatchment Name | EPA SWMM Target Node | Raingage | Area ($ft^2$) | Length to Centroid (ft) | Length (ft) | Slope (ft/ft) | Percent Imperviousness | Pervious | Impervious | Initial Rate (in/hr) | Decay Coefficient (1/seconds) | Final Rate (in/hr) | Level 0, 1, or 2 |
| MC21 | MC121 | Rainfall | 2063274 | 842 | 2012 | 0.0075 | 61.98 | 0.35 | 0.08 | 4.9743 | 0.00076 | 0.979 | 0 |
| MC22 | MC122 | Rainfall | 5150094 | 1906 | 3929 | 0.0163 | 52.40 | 0.35 | 0.08 | 4.5000 | 0.00180 | 0.600 | 0 |
| MV1 | MV101 | Rainfall | 3230515 | 1617 | 3278 | 0.0130 | 58.93 | 0.35 | 0.07 | 4.5094 | 0.00178 | 0.608 | 0 |
| LN1 | LN101 | Rainfall | 5351940 | 3119 | 4898 | 0.0152 | 54.21 | 0.36 | 0.08 | 4.7136 | 0.00133 | 0.771 | 0 |
| SV1 | SV101 | Rainfall | 4697999 | 2022 | 3690 | 0.0138 | 53.04 | 0.35 | 0.07 | 3.8388 | 0.00144 | 0.677 | 0 |
| SV2 | SV102 | Rainfall | 1506012 | 1110 | 2586 | 0.0177 | 49.30 | 0.36 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| SV3 | SV103 | Rainfall | 4215088 | 1328 | 3447 | 0.0302 | 55.48 | 0.35 | 0.07 | 3.0000 | 0.00180 | 0.500 | 0 |
| SV4 | SV104 | Rainfall | 1737962 | 1245 | 2368 | 0.0165 | 52.17 | 0.35 | 0.07 | 3.0000 | 0.00180 | 0.500 | 0 |
| SV5 | SV105 | Rainfall | 2831558 | 912 | 3277 | 0.0194 | 57.60 | 0.35 | 0.07 | 3.0000 | 0.00180 | 0.500 | 0 |
| SV6 | SV106 | Rainfall | 3383892 | 1824 | 3832 | 0.0234 | 59.62 | 0.36 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| SV7 | SV107 | Rainfall | 2301289 | 1501 | 2761 | 0.0235 | 42.41 | 0.38 | 0.09 | 3.0000 | 0.00180 | 0.500 | 0 |
| SL1 | SL101 | Rainfall | 432600 | 478 | 1203 | 0.0153 | 13.32 | 0.4 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| SL2 | SL102 | Rainfall | 1754961 | 1692 | 3042 | 0.0144 | 47.93 | 0.36 | 0.07 | 3.0000 | 0.00180 | 0.500 | 0 |
| SL3 | SL103 | Rainfall | 1457777 | 1071 | 3016 | 0.0114 | 55.25 | 0.35 | 0.07 | 3.0000 | 0.00180 | 0.500 | 0 |
| SL4 | SL104 | Rainfall | 1485485 | 1827 | 3070 | 0.0066 | 44.63 | 0.37 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| SL5 | SL105 | Rainfall | 2240726 | 798 | 2696 | 0.0155 | 64.12 | 0.35 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| MP1 | MP101 | Rainfall | 1413128 | 1495 | 3100 | 0.0132 | 43.29 | 0.37 | 0.08 | 4.5487 | 0.00158 | 0.678 | 0 |
| MP2 | MP102 | Rainfall | 3256543 | 724 | 2999 | 0.0154 | 50.27 | 0.36 | 0.07 | 4.6037 | 0.00157 | 0.683 | 0 |
| MP3 | MP103 | Rainfall | 2433441 | 627 | 2987 | 0.0101 | 53.50 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| MP4 | MP104 | Rainfall | 552296 | 1091 | 1795 | 0.0050 | 50.47 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| MP5 | MP105 | Rainfall | 915103 | 370 | 1414 | 0.0063 | 56.99 | 0.36 | 0.09 | 4.8581 | 0.00101 | 0.886 | 0 |
| MP6 | MP106 | Rainfall | 425741 | 460 | 1436 | 0.0140 | 56.64 | 0.35 | 0.08 | 4.5429 | 0.00171 | 0.634 | 0 |
| MP7 | MP107 | Rainfall | 1823597 | 865 | 2273 | 0.0146 | 50.30 | 0.36 | 0.08 | 4.5000 | 0.00180 | 0.600 | 0 |
| T1 | T101 | Rainfall | 996493 | 855 | 1770 | 0.0101 | 20.65 | 0.39 | 0.07 | 4.2222 | 0.00180 | 0.581 | 0 |
| T2 | T102 | Rainfall | 795962 | 648 | 2048 | 0.0174 | 52.74 | 0.36 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| T3 | T103 | Rainfall | 2720484 | 1596 | 3307 | 0.0118 | 51.70 | 0.36 | 0.07 | 4.5724 | 0.00164 | 0.658 | 0 |
| T4 | T104 | Rainfall | 4148240 | 2201 | 4099 | 0.0095 | 53.90 | 0.36 | 0.07 | 4.4956 | 0.00179 | 0.603 | 0 |
| T5 | T105 | Rainfall | 3696735 | 2121 | 3888 | 0.0253 | 61.19 | 0.35 | 0.08 | 4.5464 | 0.00170 | 0.637 | 0 |
| T6 | T106 | Rainfall | 1155482 | 1160 | 3104 | 0.0194 | 54.99 | 0.35 | 0.07 | 4.5000 | 0.00180 | 0.600 | 0 |
| T7 | T107 | Rainfall | 2336549 | 1210 | 3864 | 0.0203 | 58.70 | 0.36 | 0.08 | 4.4607 | 0.00175 | 0.615 | 0 |
| T8 | T108 | Rainfall | 2088597 | 1146 | 2748 | 0.0213 | 48.21 | 0.35 | 0.07 | 4.4569 | 0.00180 | 0.597 | 0 |
| SR1 | SR101 | Rainfall | 873633 | 928 | 1926 | 0.0242 | 33.20 | 0.37 | 0.08 | 3.0000 | 0.00180 | 0.500 | 0 |
| SR2 | SR102 | Rainfall | 2000837 | 1151 | 2644 | 0.0205 | 49.11 | 0.35 | 0.08 | 3.2695 | 0.00180 | 0.518 | 0 |
| H1 | H101 | Rainfall | 258649 | 589 | 1547 | 0.0172 | 17.41 | 0.4 | 0.07 | 3.0000 | 0.00180 | 0.500 | 0 |
| P1 | P101 | Rainfall | 1018887 | 1061 | 2359 | 0.0210 | 38.79 | 0.37 | 0.09 | 3.0366 | 0.00180 | 0.502 | 0 |
| P2 | P102 | Rainfall | 1856719 | 625 | 2208 | 0.0225 | 51.17 | 0.35 | 0.07 | 3.1579 | 0.00180 | 0.511 | 0 |
| P3 | P103 | Rainfall | 886751 | 640 | 1789 | 0.0292 | 45.00 | 0.35 | 0.07 | 3.0375 | 0.00180 | 0.503 | 0 |

# EPA SWMM 5.2

## INPUT PARAMETERS

# WEST TOLL GATE CREEK TRIBUTARIES Major Drainageway Plan

# EPA SWMM 5.2

## 100-YEAR FUTURE CONDITIONS OUTPUT

PDF

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## Table B-3 - Baseline Peak Flows and Volumes

| Drainagway | Design Point | Drainage Area (acres) | Drainage Area (sm) | Future Percent Imperviousness | Future Conditions Peak Flow (cfs) | | | | | | | Future Condtions Runoff Volume (acre-feet) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $Q_2$ | $Q_5$ | $Q_{10}$ | $Q_{25}$ | $Q_{50}$ | $Q_{100}$ | $Q_{500}$ | $V_2$ | $V_5$ | $V_{10}$ | $V_{25}$ | $V_{50}$ | $V_{100}$ | $V_{500}$ |
| Helena Circle Tributary | HC101 | 184 | 0.3 | 54 | 74 | 112 | 152 | 248 | 311 | 388 | 568 | 7 | 10 | 13 | 20 | 25 | 31 | 45 |
| | HC102 | 155 | 0.2 | 53 | 62 | 93 | 127 | 209 | 262 | 327 | 480 | 6 | 8 | 11 | 17 | 21 | 26 | 37 |
| | HC103 | 25 | 0.0 | 57 | 14 | 19 | 25 | 39 | 49 | 61 | 89 | 1 | 1 | 2 | 3 | 3 | 4 | 6 |
| | HC104 | 18 | 0.0 | 59 | 8 | 11 | 15 | 24 | 30 | 37 | 54 | 1 | 1 | 1 | 2 | 2 | 3 | 4 |
| Woodrim Tributary | W101 | 353 | 0.6 | 56 | 143 | 205 | 276 | 449 | 560 | 696 | 1,016 | 14 | 19 | 26 | 38 | 48 | 59 | 86 |
| | W102 | 37 | 0.1 | 45 | 11 | 18 | 25 | 42 | 53 | 66 | 97 | 1 | 2 | 2 | 4 | 5 | 6 | 9 |
| | W103 | 292 | 0.5 | 60 | 137 | 194 | 258 | 414 | 516 | 638 | 925 | 12 | 17 | 22 | 33 | 40 | 49 | 72 |
| | W104T | 228 | 0.4 | 57 | 103 | 146 | 196 | 318 | 397 | 492 | 715 | 9 | 12 | 17 | 24 | 30 | 37 | 55 |
| | W104 | 23 | 0.0 | 57 | 11 | 16 | 21 | 33 | 41 | 50 | 73 | 1 | 1 | 2 | 3 | 3 | 4 | 6 |
| | W105T | 204 | 0.3 | 57 | 94 | 133 | 178 | 288 | 360 | 446 | 648 | 8 | 11 | 15 | 22 | 27 | 33 | 49 |
| | W105 | 5 | 0.0 | 75 | 3 | 5 | 6 | 9 | 10 | 13 | 18 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | W106 | 199 | 0.3 | 57 | 91 | 128 | 173 | 280 | 350 | 434 | 631 | 8 | 11 | 14 | 21 | 26 | 33 | 48 |
| | W107 | 93 | 0.1 | 55 | 39 | 54 | 73 | 120 | 151 | 188 | 275 | 3 | 5 | 6 | 9 | 12 | 15 | 22 |
| | W108 | 2 | 0.0 | 84 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Cherry Creek Spillway | C101 | 1379 | 2.2 | 44 | 339 | 482 | 645 | 1,152 | 1,492 | 1,929 | 2,946 | 40 | 56 | 76 | 122 | 155 | 199 | 301 |
| | C102T | 1271 | 2.0 | 44 | 341 | 483 | 645 | 1,113 | 1,432 | 1,834 | 2,778 | 36 | 51 | 69 | 110 | 141 | 181 | 275 |
| | C102 | 48 | 0.1 | 47 | 17 | 24 | 33 | 59 | 75 | 94 | 140 | 1 | 2 | 3 | 4 | 6 | 7 | 11 |
| | C103 | 54 | 0.1 | 54 | 24 | 35 | 44 | 73 | 93 | 118 | 177 | 2 | 3 | 3 | 5 | 6 | 8 | 12 |
| | C104 | 158 | 0.2 | 56 | 59 | 79 | 101 | 167 | 215 | 276 | 420 | 6 | 8 | 10 | 15 | 18 | 23 | 35 |
| | C105 | 92 | 0.1 | 55 | 35 | 47 | 59 | 94 | 122 | 155 | 237 | 3 | 4 | 6 | 8 | 10 | 13 | 19 |
| | C106T | 1011 | 1.6 | 41 | 256 | 363 | 489 | 840 | 1,078 | 1,378 | 2,086 | 27 | 38 | 52 | 86 | 111 | 143 | 218 |
| | C106 | 37 | 0.1 | 33 | 4 | 6 | 8 | 15 | 22 | 32 | 55 | 1 | 1 | 1 | 2 | 2 | 3 | 6 |
| | C107 | 64 | 0.1 | 11 | 1 | 1 | 4 | 11 | 15 | 21 | 35 | 0 | 1 | 1 | 4 | 5 | 7 | 12 |
| | C108 | 70 | 0.1 | 6 | 0 | 1 | 4 | 10 | 14 | 20 | 32 | 0 | 1 | 2 | 4 | 6 | 8 | 13 |
| | C109 | 150 | 0.2 | 28 | 13 | 21 | 29 | 73 | 106 | 151 | 256 | 2 | 3 | 4 | 8 | 12 | 16 | 27 |
| | C110 | 99 | 0.2 | 28 | 13 | 20 | 26 | 65 | 92 | 125 | 200 | 1 | 2 | 3 | 6 | 8 | 11 | 18 |
| | C111 | 690 | 1.1 | 51 | 247 | 348 | 467 | 782 | 984 | 1,232 | 1,813 | 24 | 33 | 44 | 68 | 85 | 107 | 159 |
| | C112 | 616 | 1.0 | 51 | 225 | 317 | 427 | 707 | 886 | 1,105 | 1,619 | 21 | 30 | 40 | 61 | 77 | 96 | 143 |
| | C113 | 459 | 0.7 | 51 | 166 | 231 | 304 | 495 | 618 | 768 | 1,125 | 16 | 22 | 29 | 45 | 57 | 72 | 106 |
| | C114 | 120 | 0.2 | 20 | 6 | 11 | 20 | 52 | 75 | 107 | 177 | 2 | 2 | 4 | 8 | 11 | 15 | 24 |
| | C115 | 73 | 0.1 | 29 | 9 | 13 | 22 | 48 | 64 | 85 | 130 | 1 | 2 | 3 | 5 | 7 | 10 | 15 |
| | C116T | 319 | 0.5 | 62 | 157 | 218 | 283 | 448 | 555 | 684 | 989 | 13 | 18 | 24 | 35 | 43 | 53 | 77 |
| | C116 | 48 | 0.1 | 53 | 19 | 27 | 38 | 62 | 78 | 96 | 140 | 2 | 2 | 3 | 5 | 6 | 8 | 11 |
| | C117 | 271 | 0.4 | 63 | 140 | 193 | 248 | 388 | 481 | 591 | 852 | 12 | 16 | 21 | 30 | 37 | 45 | 66 |
| | C118 | 230 | 0.4 | 65 | 128 | 174 | 220 | 340 | 419 | 514 | 739 | 10 | 14 | 18 | 26 | 32 | 39 | 56 |
| | C119 | 128 | 0.2 | 72 | 98 | 134 | 169 | 248 | 305 | 370 | 529 | 6 | 9 | 11 | 15 | 19 | 23 | 32 |
| | C120 | 86 | 0.1 | 53 | 40 | 55 | 76 | 124 | 156 | 194 | 282 | 3 | 4 | 6 | 9 | 11 | 14 | 20 |
| Meadowood Creek | MC101 | 1670 | 2.6 | 55 | 428 | 621 | 836 | 1,438 | 1,856 | 2,424 | 3,719 | 63 | 87 | 113 | 167 | 209 | 261 | 387 |
| | MC102T | 1646 | 2.6 | 55 | 427 | 617 | 830 | 1,429 | 1,844 | 2,406 | 3,688 | 62 | 85 | 111 | 164 | 206 | 256 | 381 |
| | MC102 | 96 | 0.1 | 54 | 41 | 61 | 82 | 130 | 162 | 199 | 288 | 4 | 5 | 7 | 10 | 13 | 16 | 23 |
| | MC103 | 51 | 0.1 | 63 | 24 | 33 | 44 | 69 | 85 | 104 | 149 | 2 | 3 | 4 | 6 | 7 | 9 | 13 |
| | MC104T | 1499 | 2.3 | 55 | 409 | 587 | 784 | 1,354 | 1,741 | 2,263 | 3,447 | 56 | 76 | 100 | 148 | 185 | 231 | 344 |
| | MC104 | 73 | 0.1 | 50 | 29 | 42 | 59 | 98 | 123 | 153 | 224 | 2 | 3 | 5 | 7 | 9 | 11 | 17 |
| | MC105 | 128 | 0.2 | 53 | 47 | 61 | 76 | 113 | 150 | 195 | 305 | 4 | 6 | 7 | 10 | 13 | 16 | 25 |
| | MC106 | 74 | 0.1 | 55 | 30 | 38 | 48 | 71 | 94 | 122 | 189 | 3 | 4 | 5 | 6 | 8 | 10 | 15 |
| | MC107 | 1224 | 1.9 | 55 | 362 | 516 | 688 | 1,203 | 1,538 | 1,982 | 2,977 | 46 | 64 | 83 | 124 | 155 | 194 | 285 |
| | MC108T | 1177 | 1.8 | 56 | 357 | 508 | 675 | 1,177 | 1,503 | 1,932 | 2,897 | 44 | 62 | 80 | 120 | 150 | 187 | 275 |
| | MC108 | 92 | 0.1 | 50 | 31 | 43 | 58 | 101 | 128 | 162 | 239 | 3 | 4 | 6 | 9 | 11 | 14 | 21 |
| | MC109 | 95 | 0.1 | 53 | 26 | 36 | 46 | 82 | 104 | 133 | 197 | 3 | 5 | 6 | 9 | 11 | 14 | 22 |
| | MC110T | 990 | 1.5 | 56 | 342 | 485 | 640 | 1,098 | 1,393 | 1,766 | 2,626 | 38 | 52 | 68 | 101 | 126 | 157 | 231 |
| | MC110 | 12 | 0.0 | 62 | 5 | 7 | 9 | 15 | 18 | 22 | 32 | 0 | 1 | 1 | 1 | 2 | 2 | 3 |
| | MC111 | 84 | 0.1 | 58 | 32 | 44 | 58 | 96 | 120 | 149 | 217 | 3 | 5 | 6 | 9 | 11 | 14 | 20 |
| | MC112T | 895 | 1.4 | 56 | 313 | 443 | 585 | 1,001 | 1,271 | 1,611 | 2,396 | 34 | 47 | 61 | 91 | 114 | 141 | 208 |
| | MC112 | 42 | 0.1 | 57 | 13 | 18 | 24 | 39 | 49 | 61 | 88 | 2 | 2 | 3 | 5 | 6 | 7 | 10 |
| | MC113T | 700 | 1.1 | 56 | 258 | 363 | 477 | 809 | 1,026 | 1,297 | 1,926 | 26 | 37 | 47 | 71 | 88 | 110 | 162 |
| | MC113 | 22 | 0.0 | 57 | 11 | 16 | 22 | 34 | 42 | 52 | 75 | 1 | 1 | 2 | 2 | 3 | 4 | 5 |
| | MC114 | 78 | 0.1 | 54 | 27 | 38 | 50 | 85 | 108 | 136 | 200 | 3 | 4 | 5 | 8 | 10 | 12 | 18 |
| | MC115T | 677 | 1.1 | 56 | 250 | 352 | 461 | 782 | 992 | 1,253 | 1,860 | 25 | 35 | 46 | 68 | 85 | 106 | 157 |
| | MC115 | 117 | 0.2 | 59 | 45 | 61 | 76 | 127 | 160 | 201 | 298 | 5 | 6 | 8 | 12 | 14 | 18 | 27 |
| | MC116 | 43 | 0.1 | 52 | 11 | 15 | 19 | 34 | 44 | 56 | 84 | 1 | 2 | 3 | 4 | 5 | 6 | 9 |
| | MC117 | 395 | 0.6 | 56 | 171 | 240 | 318 | 521 | 656 | 820 | 1,206 | 15 | 21 | 28 | 41 | 51 | 63 | 93 |
| | MC118 | 24 | 0.0 | 81 | 21 | 29 | 36 | 51 | 61 | 74 | 103 | 1 | 2 | 2 | 3 | 4 | 5 | 7 |
| | MC119T | 322 | 0.5 | 54 | 135 | 189 | 251 | 412 | 521 | 653 | 964 | 12 | 16 | 21 | 32 | 40 | 50 | 74 |
| | MC119 | 54 | 0.1 | 47 | 15 | 22 | 30 | 52 | 65 | 81 | 120 | 2 | 3 | 3 | 5 | 7 | 9 | 13 |
| | MC120 | 102 | 0.2 | 55 | 45 | 62 | 80 | 135 | 171 | 214 | 315 | 4 | 5 | 7 | 10 | 13 | 16 | 23 |
| | MC121 | 47 | 0.1 | 62 | 28 | 37 | 46 | 66 | 85 | 108 | 163 | 2 | 3 | 3 | 4 | 5 | 7 | 10 |
| | MC122 | 118 | 0.2 | 52 | 53 | 75 | 104 | 171 | 215 | 267 | 388 | 4 | 6 | 8 | 12 | 15 | 19 | 28 |

## Table B-3 - Baseline Peak Flows and Volumes

| Drainagway | Design Point | Drainage Area (acres) | Drainage Area (sm) | Future Percent Imperviousness | Future Conditions Peak Flow (cfs) | | | | | | | Future Condtions Runoff Volume (acre-feet) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $Q_2$ | $Q_5$ | $Q_{10}$ | $Q_{25}$ | $Q_{50}$ | $Q_{100}$ | $Q_{500}$ | $V_2$ | $V_5$ | $V_{10}$ | $V_{25}$ | $V_{50}$ | $V_{100}$ | $V_{500}$ |
| Mission Viejo Tributary | MV101 | 74 | 0.1 | 59 | 38 | 52 | 70 | 111 | 137 | 169 | 244 | 3 | 4 | 6 | 8 | 10 | 12 | 18 |
| Los Ninos Tributary | LN101 | 123 | 0.2 | 54 | 42 | 58 | 73 | 128 | 163 | 207 | 309 | 4 | 6 | 8 | 12 | 15 | 19 | 28 |
| Summer Valley Tributary | SV101 | 475 | 0.7 | 54 | 199 | 297 | 404 | 670 | 841 | 1,051 | 1,543 | 18 | 26 | 34 | 51 | 64 | 79 | 115 |
| | SV102T | 367 | 0.6 | 54 | 178 | 267 | 362 | 575 | 718 | 885 | 1,281 | 14 | 20 | 27 | 40 | 50 | 61 | 90 |
| | SV102 | 35 | 0.1 | 49 | 14 | 21 | 29 | 46 | 58 | 72 | 104 | 1 | 2 | 2 | 4 | 5 | 6 | 8 |
| | SV103 | 332 | 0.5 | 54 | 165 | 247 | 334 | 529 | 660 | 814 | 1,177 | 12 | 18 | 25 | 37 | 45 | 56 | 81 |
| | SV104T | 235 | 0.4 | 54 | 113 | 168 | 228 | 362 | 451 | 555 | 802 | 9 | 13 | 17 | 26 | 32 | 39 | 57 |
| | SV104 | 40 | 0.1 | 52 | 18 | 27 | 36 | 58 | 72 | 88 | 128 | 1 | 2 | 3 | 4 | 5 | 7 | 10 |
| | SV105 | 65 | 0.1 | 58 | 41 | 60 | 80 | 120 | 149 | 183 | 262 | 3 | 4 | 5 | 7 | 9 | 11 | 16 |
| | SV106 | 78 | 0.1 | 60 | 42 | 61 | 80 | 124 | 153 | 186 | 267 | 3 | 5 | 6 | 9 | 11 | 13 | 19 |
| | SV107 | 53 | 0.1 | 42 | 17 | 26 | 38 | 65 | 83 | 103 | 153 | 1 | 2 | 3 | 5 | 6 | 8 | 12 |
| Summer Lake Tributary | SL101 | 169 | 0.3 | 52 | 36 | 53 | 72 | 121 | 157 | 241 | 419 | 6 | 9 | 12 | 18 | 23 | 28 | 41 |
| | SL102T | 159 | 0.2 | 54 | 36 | 52 | 70 | 116 | 150 | 237 | 413 | 6 | 9 | 12 | 17 | 22 | 27 | 39 |
| | SL102 | 108 | 0.2 | 49 | 29 | 45 | 62 | 106 | 133 | 167 | 246 | 4 | 5 | 8 | 11 | 14 | 18 | 26 |
| | SL103 | 68 | 0.1 | 50 | 21 | 31 | 43 | 69 | 86 | 108 | 157 | 2 | 3 | 5 | 7 | 9 | 11 | 16 |
| | SL104 | 34 | 0.1 | 45 | 7 | 11 | 16 | 28 | 35 | 44 | 65 | 1 | 2 | 2 | 3 | 4 | 5 | 8 |
| | SL105O | 51 | 0.1 | 64 | 7 | 8 | 9 | 19 | 31 | 82 | 177 | 2 | 3 | 4 | 6 | 8 | 9 | 13 |
| | SL305 | 51 | 0.1 | 64 | 38 | 54 | 71 | 103 | 127 | 155 | 220 | 2 | 3 | 4 | 6 | 8 | 9 | 13 |
| | SL105 | 51 | 0.1 | 64 | 38 | 54 | 71 | 103 | 127 | 155 | 220 | 2 | 3 | 4 | 6 | 8 | 9 | 13 |
| Marina Park Tributary | MP101 | 248 | 0.4 | 51 | 90 | 129 | 178 | 317 | 407 | 519 | 780 | 8 | 12 | 16 | 24 | 30 | 38 | 57 |
| | MP102 | 216 | 0.3 | 52 | 87 | 123 | 171 | 297 | 381 | 484 | 725 | 7 | 10 | 14 | 21 | 27 | 33 | 50 |
| | MP103 | 141 | 0.2 | 53 | 59 | 83 | 114 | 192 | 245 | 309 | 460 | 5 | 7 | 9 | 14 | 18 | 22 | 33 |
| | MP104 | 13 | 0.0 | 50 | 3 | 5 | 6 | 11 | 14 | 17 | 25 | 0 | 1 | 1 | 1 | 2 | 2 | 3 |
| | MP105 | 21 | 0.0 | 57 | 12 | 16 | 20 | 31 | 40 | 51 | 77 | 1 | 1 | 1 | 2 | 2 | 3 | 5 |
| | MP106 | 10 | 0.0 | 57 | 5 | 7 | 9 | 14 | 18 | 22 | 32 | 0 | 1 | 1 | 1 | 1 | 2 | 2 |
| | MP107 | 42 | 0.1 | 50 | 19 | 27 | 38 | 61 | 77 | 97 | 142 | 1 | 2 | 3 | 4 | 5 | 7 | 10 |
| Tower Road Tributary | T101O | 660 | 1.0 | 52 | 80 | 103 | 148 | 552 | 784 | 1,074 | 1,685 | 23 | 33 | 44 | 67 | 83 | 104 | 154 |
| | T301 | 660 | 1.0 | 52 | 226 | 317 | 433 | 747 | 946 | 1,194 | 1,771 | 23 | 33 | 44 | 67 | 83 | 104 | 154 |
| | T101 | 660 | 1.0 | 52 | 226 | 317 | 433 | 747 | 946 | 1,194 | 1,771 | 23 | 33 | 44 | 67 | 83 | 104 | 154 |
| | T102 | 389 | 0.6 | 55 | 140 | 193 | 260 | 431 | 539 | 673 | 987 | 15 | 20 | 27 | 41 | 51 | 63 | 92 |
| | T103 | 62 | 0.1 | 52 | 23 | 32 | 44 | 74 | 94 | 117 | 172 | 2 | 3 | 4 | 6 | 8 | 10 | 14 |
| | T104 | 308 | 0.5 | 56 | 113 | 155 | 208 | 339 | 423 | 526 | 769 | 12 | 16 | 22 | 33 | 41 | 50 | 74 |
| | T105 | 111 | 0.2 | 60 | 54 | 75 | 100 | 160 | 198 | 244 | 354 | 5 | 6 | 8 | 12 | 15 | 19 | 27 |
| | T106 | 27 | 0.0 | 55 | 10 | 15 | 20 | 32 | 41 | 50 | 73 | 1 | 1 | 2 | 3 | 3 | 4 | 6 |
| | T107T | 102 | 0.2 | 54 | 37 | 47 | 60 | 92 | 112 | 136 | 193 | 4 | 5 | 7 | 10 | 13 | 16 | 24 |
| | T107 | 54 | 0.1 | 59 | 27 | 37 | 49 | 79 | 98 | 121 | 175 | 2 | 3 | 4 | 6 | 7 | 9 | 13 |
| | T108O | 48 | 0.1 | 48 | 11 | 12 | 14 | 17 | 23 | 39 | 65 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| | T308 | 48 | 0.1 | 48 | 19 | 28 | 39 | 66 | 83 | 104 | 152 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| | T108 | 48 | 0.1 | 48 | 19 | 28 | 39 | 66 | 83 | 104 | 152 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| Smokey Ridge Tributary | SR101 | 66 | 0.1 | 44 | 22 | 35 | 50 | 84 | 106 | 133 | 195 | 2 | 3 | 4 | 7 | 8 | 10 | 15 |
| | SR102 | 46 | 0.1 | 49 | 19 | 30 | 41 | 67 | 83 | 103 | 149 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| Himalaya Tributary | H101 | 6 | 0.01 | 17 | 0 | 1 | 1 | 3 | 4 | 5 | 8 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| Park View Tributary | P101 | 86 | 0.1 | 46 | 36 | 56 | 78 | 129 | 162 | 202 | 296 | 3 | 4 | 6 | 9 | 11 | 14 | 20 |
| | P102 | 63 | 0.1 | 49 | 33 | 51 | 70 | 110 | 138 | 171 | 249 | 2 | 3 | 4 | 7 | 8 | 10 | 15 |
| | P103 | 20 | 0.0 | 45 | 9 | 14 | 19 | 31 | 39 | 49 | 71 | 1 | 1 | 1 | 2 | 3 | 3 | 5 |

## Table B-4 - Baseline Peak Flows and Volumes Along the Drainageways

| Design Point | Location | Total Drainage Area (acres) | Total Drainage Area ($mi^2$) | Length (feet) | Future Peak Flows (cfs) | | | | | | | Future Runoff Volumes (acre-feet) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $Q_2$ | $Q_5$ | $Q_{10}$ | $Q_{25}$ | $Q_{50}$ | $Q_{100}$ | $Q_{500}$ | $V_2$ | $V_5$ | $V_{10}$ | $V_{25}$ | $V_{50}$ | $V_{100}$ | $V_{500}$ |
| **Helena Circle Tributary** | | | | | | | | | | | | | | | | | | |
| HC101 | Confluence with WTGC | 184 | 0.3 | 0 | 74 | 112 | 152 | 248 | 311 | 388 | 568 | 7 | 10 | 13 | 20 | 25 | 31 | 45 |
| HC102 | S Chambers Rd | 155 | 0.2 | 1,677 | 62 | 93 | 127 | 209 | 262 | 327 | 480 | 6 | 8 | 11 | 17 | 21 | 26 | 37 |
| **Woodrim Tributary** | | | | | | | | | | | | | | | | | | |
| W101 | Confluence with WTGC | 353 | 0.6 | 0 | 143 | 205 | 276 | 449 | 560 | 696 | 1,016 | 14 | 19 | 26 | 38 | 48 | 59 | 86 |
| W103 | | 292 | 0.5 | 548 | 137 | 194 | 258 | 414 | 516 | 638 | 925 | 12 | 17 | 22 | 33 | 40 | 49 | 72 |
| W104T | S Helena Street | 228 | 0.4 | 1,371 | 103 | 146 | 196 | 318 | 397 | 492 | 715 | 9 | 12 | 17 | 24 | 30 | 37 | 55 |
| W105T | Downstream of S Chambers Rd | 204 | 0.3 | 2,505 | 94 | 133 | 178 | 288 | 360 | 446 | 648 | 8 | 11 | 15 | 22 | 27 | 33 | 49 |
| W106 | Upstream of S Chambers Rd | 199 | 0.3 | 2,623 | 91 | 128 | 173 | 280 | 350 | 434 | 631 | 8 | 11 | 14 | 21 | 26 | 33 | 48 |
| W107 | | 93 | 0.1 | 3,562 | 39 | 54 | 73 | 120 | 151 | 188 | 275 | 3 | 5 | 6 | 9 | 12 | 15 | 22 |
| **Cherry Creek Spillway** | | | | | | | | | | | | | | | | | | |
| C101 | Confluence with WTGC | 1,379 | 2.2 | 0 | 339 | 482 | 645 | 1,152 | 1,492 | 1,929 | 2,946 | 40 | 56 | 76 | 122 | 155 | 199 | 301 |
| C102T | E Illif Ave | 1,271 | 2.0 | 3,145 | 341 | 483 | 645 | 1,113 | 1,432 | 1,834 | 2,778 | 36 | 51 | 69 | 110 | 141 | 181 | 275 |
| C106T | | 1,011 | 1.6 | 4,103 | 256 | 363 | 489 | 840 | 1,078 | 1,378 | 2,086 | 27 | 38 | 52 | 86 | 111 | 143 | 218 |
| C111 | E Yale Ave | 690 | 1.1 | 5,746 | 247 | 348 | 467 | 782 | 984 | 1,232 | 1,813 | 24 | 33 | 44 | 68 | 85 | 107 | 159 |
| C112 | | 616 | 1.0 | 6,896 | 225 | 317 | 427 | 707 | 886 | 1,105 | 1,619 | 21 | 30 | 40 | 61 | 77 | 96 | 143 |
| C113 | S Chambers Road | 459 | 0.7 | 7,864 | 166 | 231 | 304 | 495 | 618 | 768 | 1,125 | 16 | 22 | 29 | 45 | 57 | 72 | 106 |
| **Meadowood Creek** | | | | | | | | | | | | | | | | | | |
| MC101 | Confluence with WTGC | 1,670 | 2.6 | 0 | 428 | 621 | 836 | 1,438 | 1,856 | 2,424 | 3,719 | 63 | 87 | 113 | 167 | 209 | 261 | 387 |
| MC102T | E Illif Ave | 1,646 | 2.6 | 1,351 | 427 | 617 | 830 | 1,429 | 1,844 | 2,406 | 3,688 | 62 | 85 | 111 | 164 | 206 | 256 | 381 |
| MC104T | E Yale Ave | 1,499 | 2.3 | 3,740 | 409 | 587 | 784 | 1,354 | 1,741 | 2,263 | 3,447 | 56 | 76 | 100 | 148 | 185 | 231 | 344 |
| MC107 | | 1,224 | 1.9 | 5,211 | 362 | 516 | 688 | 1,203 | 1,538 | 1,982 | 2,977 | 46 | 64 | 83 | 124 | 155 | 194 | 285 |
| MC108T | E Dartmouth Ave | 1,177 | 1.8 | 6,702 | 357 | 508 | 675 | 1,177 | 1,503 | 1,932 | 2,897 | 44 | 62 | 80 | 120 | 150 | 187 | 275 |
| MC110T | E Hampden Ave | 990 | 1.5 | 9,569 | 342 | 485 | 640 | 1,098 | 1,393 | 1,766 | 2,626 | 38 | 52 | 68 | 101 | 126 | 157 | 231 |
| MC112T | Confluence with Mission Viejo Tributary | 895 | 1.4 | 10,040 | 313 | 443 | 585 | 1,001 | 1,271 | 1,611 | 2,396 | 34 | 47 | 61 | 91 | 114 | 141 | 208 |
| MC113T | | 700 | 1.1 | 11,111 | 258 | 363 | 477 | 809 | 1,026 | 1,297 | 1,926 | 26 | 37 | 47 | 71 | 88 | 110 | 162 |
| MC115T | Confluence with Los Ninos Tributary | 677 | 1.1 | 11,862 | 250 | 352 | 461 | 782 | 992 | 1,253 | 1,860 | 25 | 35 | 46 | 68 | 85 | 106 | 157 |
| MC117 | | 395 | 0.6 | 13,914 | 171 | 240 | 318 | 521 | 656 | 820 | 1,206 | 15 | 21 | 28 | 41 | 51 | 63 | 93 |
| MC119T | E Quincy Ave | 322 | 0.5 | 15,317 | 135 | 189 | 251 | 412 | 521 | 653 | 964 | 12 | 16 | 21 | 32 | 40 | 50 | 74 |
| MC122 | | 118 | 0.2 | 17,540 | 53 | 75 | 104 | 171 | 215 | 267 | 388 | 4 | 6 | 8 | 12 | 15 | 19 | 28 |
| **Mission Viejo Tributary** | | | | | | | | | | | | | | | | | | |
| MV101 | Confluence with Meadowood Creek | 74 | 0.1 | 0 | 38 | 52 | 70 | 111 | 137 | 169 | 244 | 3 | 4 | 6 | 8 | 10 | 12 | 18 |
| **Los Ninos Tributary** | | | | | | | | | | | | | | | | | | |
| LN101 | Confluence with Meadowood Creek | 123 | 0.2 | 0 | 42 | 58 | 73 | 128 | 163 | 207 | 309 | 4 | 6 | 8 | 12 | 15 | 19 | 28 |
| **Summer Valley Ranch Tributary** | | | | | | | | | | | | | | | | | | |
| SV101 | Confluence with WTGC | 475 | 0.7 | 0 | 199 | 297 | 404 | 670 | 841 | 1,051 | 1,543 | 18 | 26 | 34 | 51 | 64 | 79 | 115 |
| SV102T | Downstream of S Tower Rd | 367 | 0.6 | 2,611 | 178 | 267 | 362 | 575 | 718 | 885 | 1,281 | 14 | 20 | 27 | 40 | 50 | 61 | 90 |
| SV103 | Upstream of S Tower Rd | 332 | 0.5 | 2,846 | 165 | 247 | 334 | 529 | 660 | 814 | 1,177 | 12 | 18 | 25 | 37 | 45 | 56 | 81 |
| SV104T | | 235 | 0.4 | 3,556 | 113 | 168 | 228 | 362 | 451 | 555 | 802 | 9 | 13 | 17 | 26 | 32 | 39 | 57 |
| **Summer Lake Tributary** | | | | | | | | | | | | | | | | | | |
| SL101 | Confluence with WTGC | 169 | 0.3 | 0 | 36 | 53 | 72 | 121 | 157 | 241 | 419 | 6 | 9 | 12 | 18 | 23 | 28 | 41 |
| SL102T | | 159 | 0.2 | 632 | 36 | 52 | 70 | 116 | 150 | 237 | 413 | 6 | 9 | 12 | 17 | 22 | 27 | 39 |
| SL102 | | 108 | 0.2 | 699 | 29 | 45 | 62 | 106 | 133 | 167 | 246 | 4 | 5 | 8 | 11 | 14 | 18 | 26 |
| SL103 | | 68 | 0.1 | 2,345 | 21 | 31 | 43 | 69 | 86 | 108 | 157 | 2 | 3 | 5 | 7 | 9 | 11 | 16 |
| SL104 | | 34 | 0.1 | 2,589 | 7 | 11 | 16 | 28 | 35 | 44 | 65 | 1 | 2 | 2 | 3 | 4 | 5 | 8 |
| **Marina Park Tributary** | | | | | | | | | | | | | | | | | | |
| MP101 | Confluence with Tower Road Tributary | 248 | 0.4 | 0 | 90 | 129 | 178 | 317 | 407 | 519 | 780 | 8 | 12 | 16 | 24 | 30 | 38 | 57 |
| MP102 | | 216 | 0.3 | 1,430 | 87 | 123 | 171 | 297 | 381 | 484 | 725 | 7 | 10 | 14 | 21 | 27 | 33 | 50 |
| MP103 | E Smoky Hill Rd | 141 | 0.2 | 3,135 | 59 | 83 | 114 | 192 | 245 | 309 | 460 | 5 | 7 | 9 | 14 | 18 | 22 | 33 |
| **Tower Road Tributary** | | | | | | | | | | | | | | | | | | |
| T101O | Confluence with WTGC | 660 | 1.0 | 0 | 80 | 103 | 148 | 552 | 784 | 1,074 | 1,685 | 23 | 33 | 44 | 67 | 83 | 104 | 154 |
| T301 | Meadow Point Pond | 660 | 1.0 | 0 | 226 | 317 | 433 | 747 | 946 | 1,194 | 1,771 | 23 | 33 | 44 | 67 | 83 | 104 | 154 |
| T101 | Confleunce with Marina Park Tributary | 660 | 1.0 | 0 | 226 | 317 | 433 | 747 | 946 | 1,194 | 1,771 | 23 | 33 | 44 | 67 | 83 | 104 | 154 |
| T102 | | 389 | 0.6 | 1,609 | 140 | 193 | 260 | 431 | 539 | 673 | 987 | 15 | 20 | 27 | 41 | 51 | 63 | 92 |
| T104 | S Tower Rd | 308 | 0.5 | 2,655 | 113 | 155 | 208 | 339 | 423 | 526 | 769 | 12 | 16 | 22 | 33 | 41 | 50 | 74 |
| T107T | S Danube St | 102 | 0.2 | 6,003 | 37 | 47 | 60 | 92 | 112 | 136 | 193 | 4 | 5 | 7 | 10 | 13 | 16 | 24 |
| T108O | | 48 | 0.1 | 6,317 | 11 | 12 | 14 | 17 | 23 | 39 | 65 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| T308 | Smokey Ridge Pond | 48 | 0.1 | 6,317 | 19 | 28 | 39 | 66 | 83 | 104 | 152 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| T108 | | 48 | 0.1 | 6,317 | 19 | 28 | 39 | 66 | 83 | 104 | 152 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| **Smokey Ridge Tributary** | | | | | | | | | | | | | | | | | | |
| SR101 | Confluence with WTGC | 66 | 0.1 | 0 | 22 | 35 | 50 | 84 | 106 | 133 | 195 | 2 | 3 | 4 | 7 | 8 | 10 | 15 |
| SR102 | E Chenango Dr | 46 | 0.1 | 1,413 | 19 | 30 | 41 | 67 | 83 | 103 | 149 | 2 | 2 | 3 | 5 | 6 | 7 | 11 |
| **Himalaya Tributary** | | | | | | | | | | | | | | | | | | |
| H101 | Confluence with WTGC | 6 | 0.0 | 0 | 0 | 1 | 1 | 3 | 4 | 5 | 8 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **Park View Tributary** | | | | | | | | | | | | | | | | | | |
| P101 | Confluence with WTGC | 86 | 0.1 | 0 | 36 | 56 | 78 | 129 | 162 | 202 | 296 | 3 | 4 | 6 | 9 | 11 | 14 | 20 |
| P102 | E Berry Dr | 63 | 0.1 | 2,016 | 33 | 51 | 70 | 110 | 138 | 171 | 249 | 2 | 3 | 4 | 7 | 8 | 10 | 15 |

**Figure B-3A**
**Helena Circle Tributary**
**Baseline Peak Discharge vs. Drainageway Station**

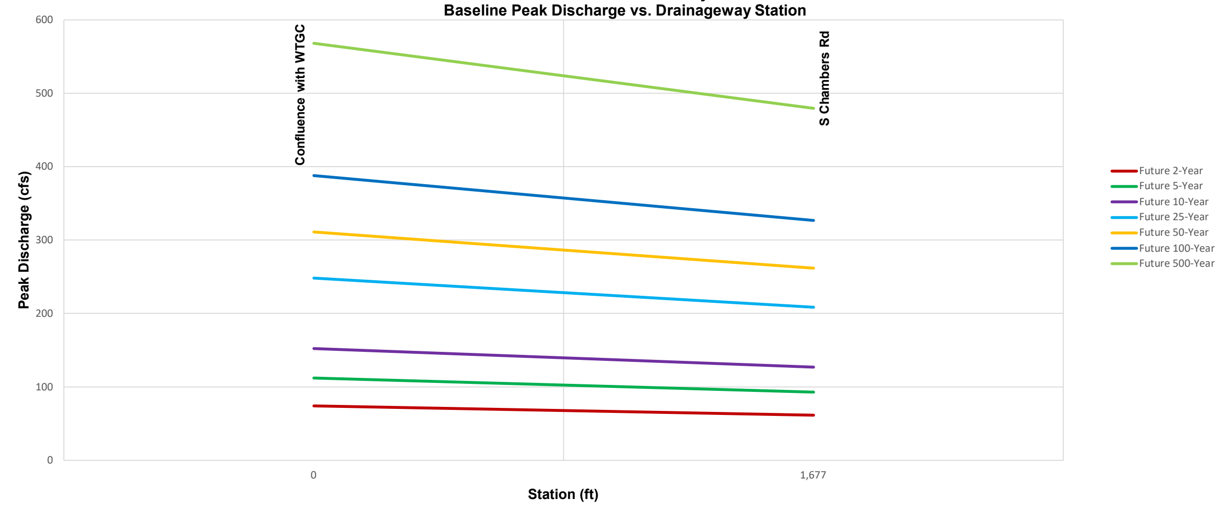



**Figure B-3B**
**Woodrim Tributary**
**Baseline Peak Discharge vs. Drainageway Station**

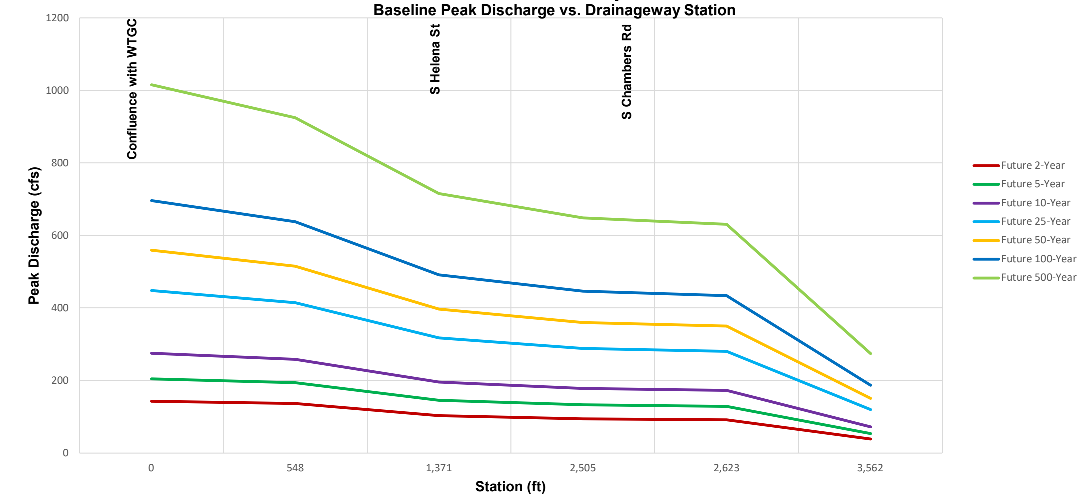



**Figure B-3C**
**Cherry Creek Spillway**
**Baseline Peak Discharge vs. Drainageway Station**

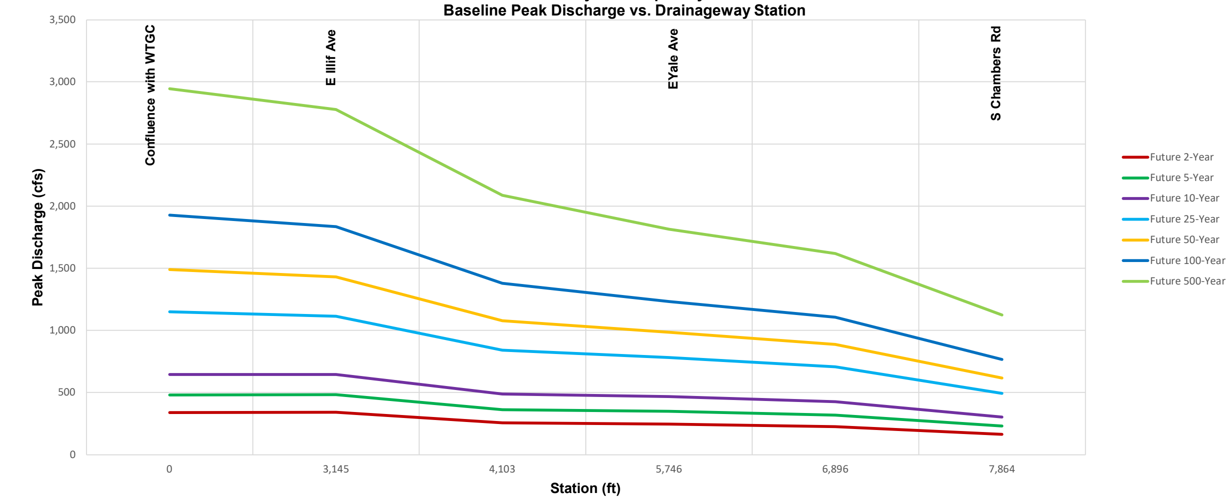



**Figure B-3D**
**Meadowood Creek**
**Baseline Peak Discharge vs. Drainageway Station**

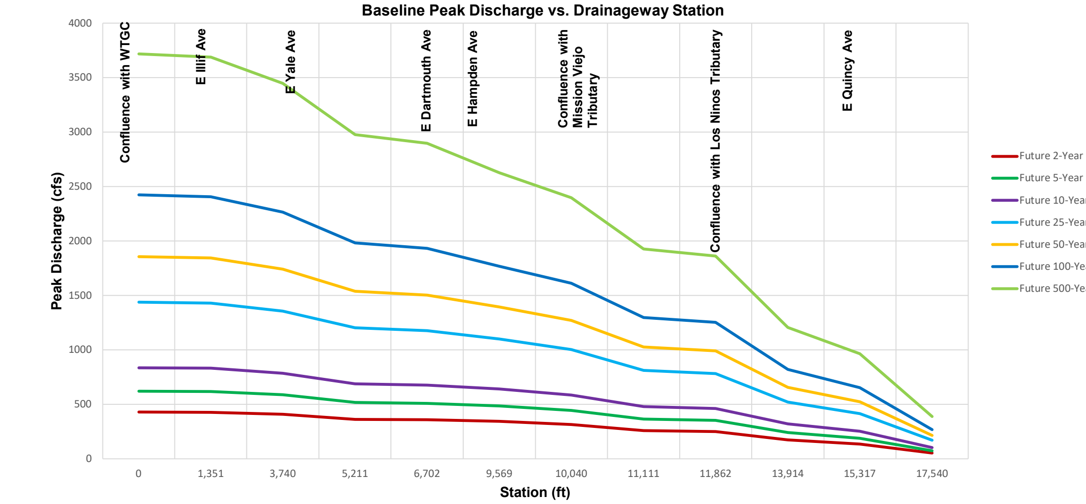



**Figure B-3E**
**Summer Valley Ranch Tributary**
**Baseline Peak Discharge vs. Drainageway Station**

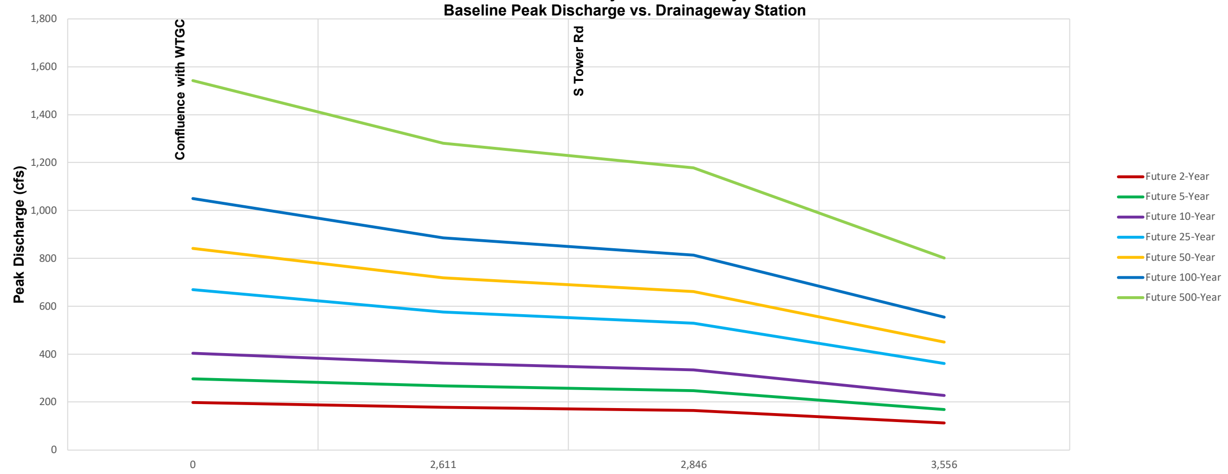
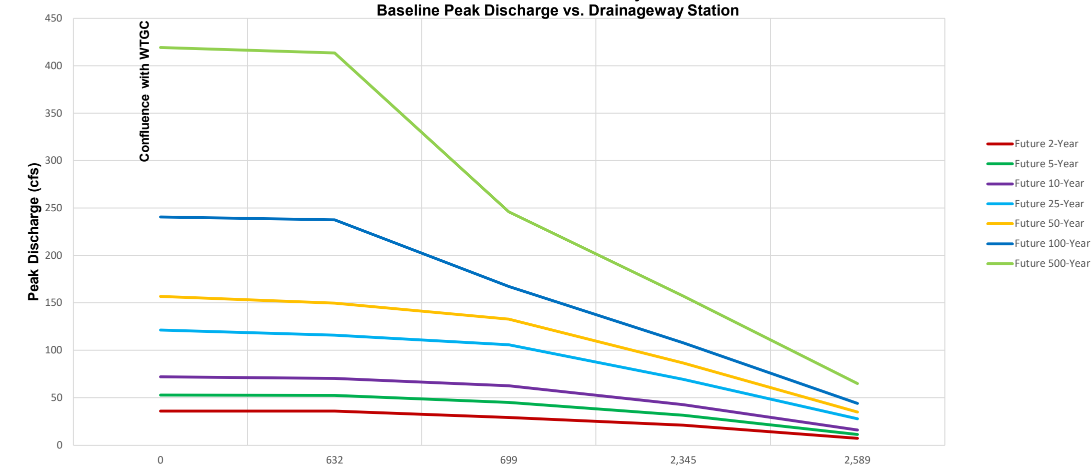



**Figure B-3F**
**Summer Lake Tributary**
**Baseline Peak Discharge vs. Drainageway Station**



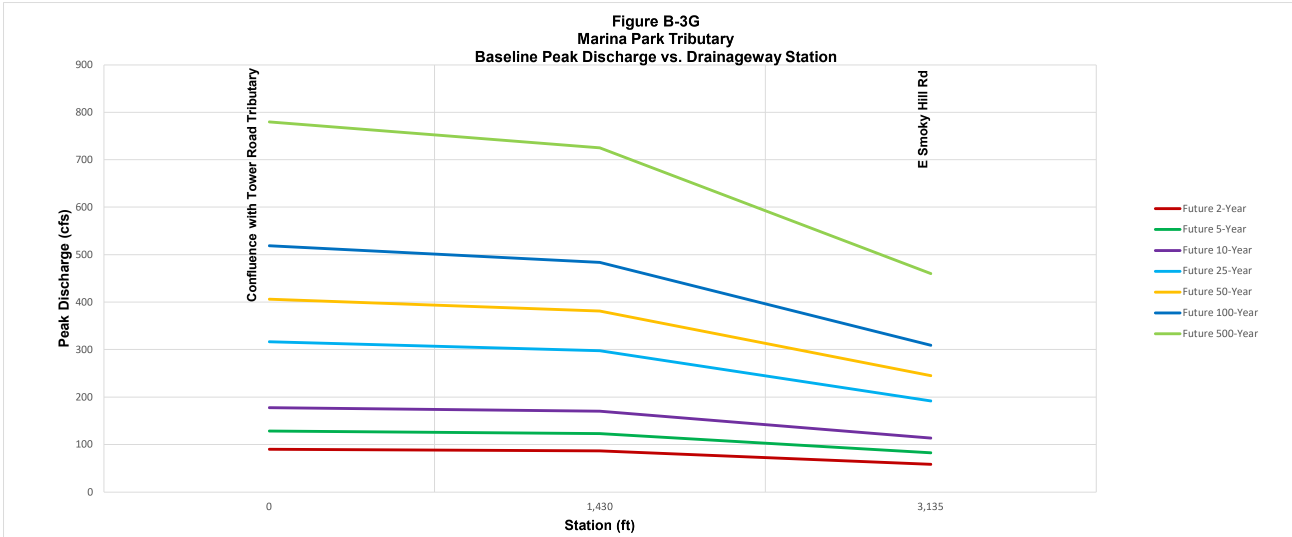



Figure B-3G
Marina Park Tributary
Baseline Peak Discharge vs. Drainageway Station

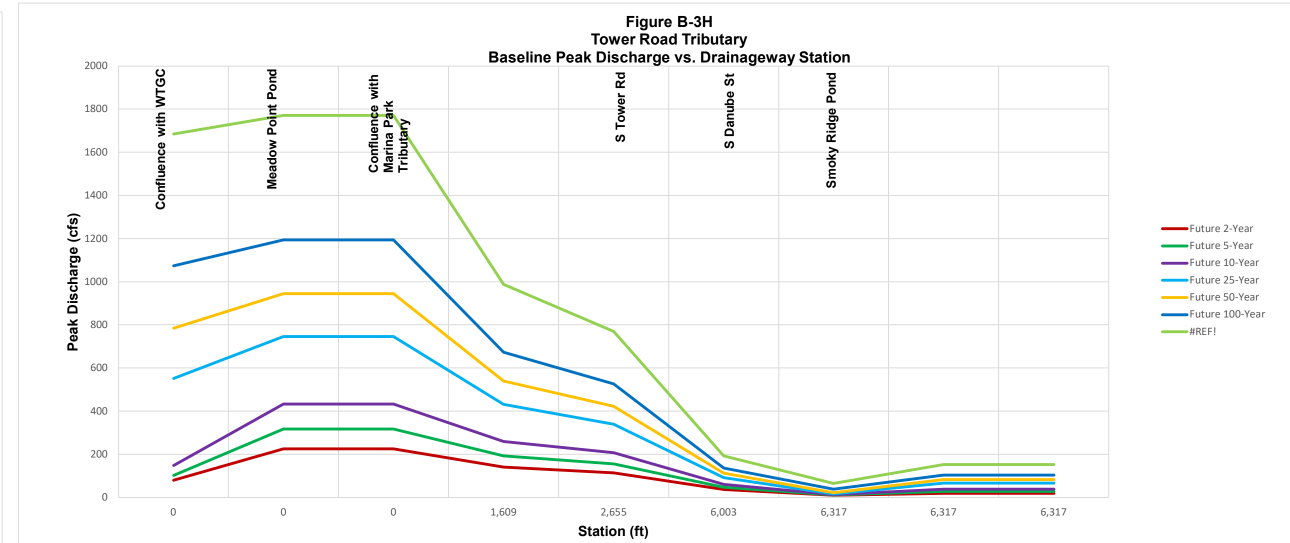



Figure B-3H
Tower Road Tributary
Baseline Peak Discharge vs. Drainageway Station

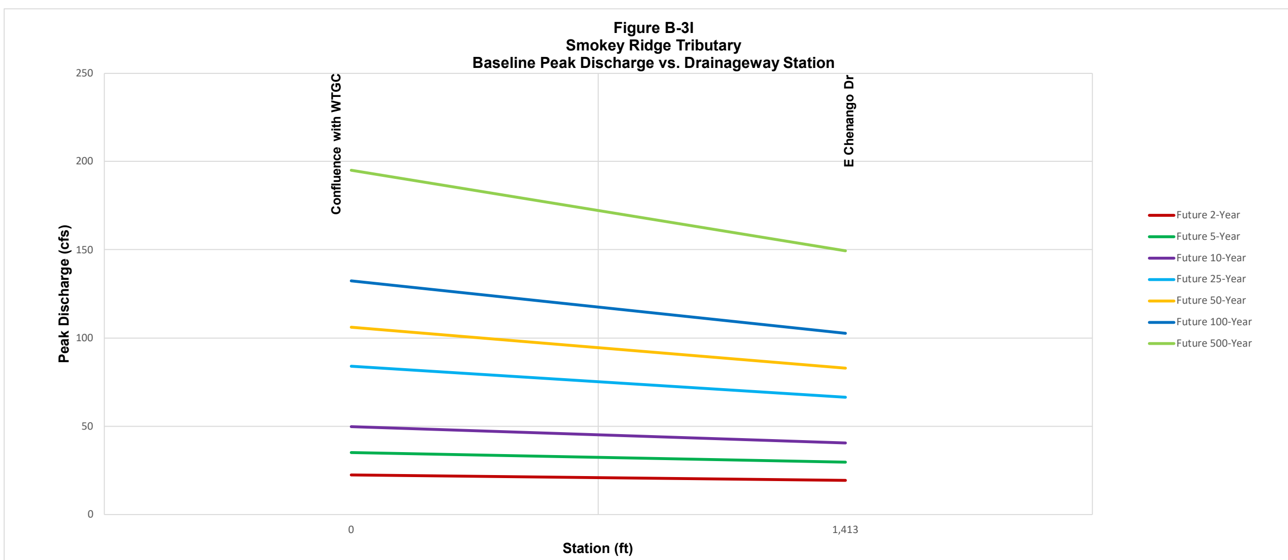



Figure B-3I
Smokey Ridge Tributary
Baseline Peak Discharge vs. Drainageway Station

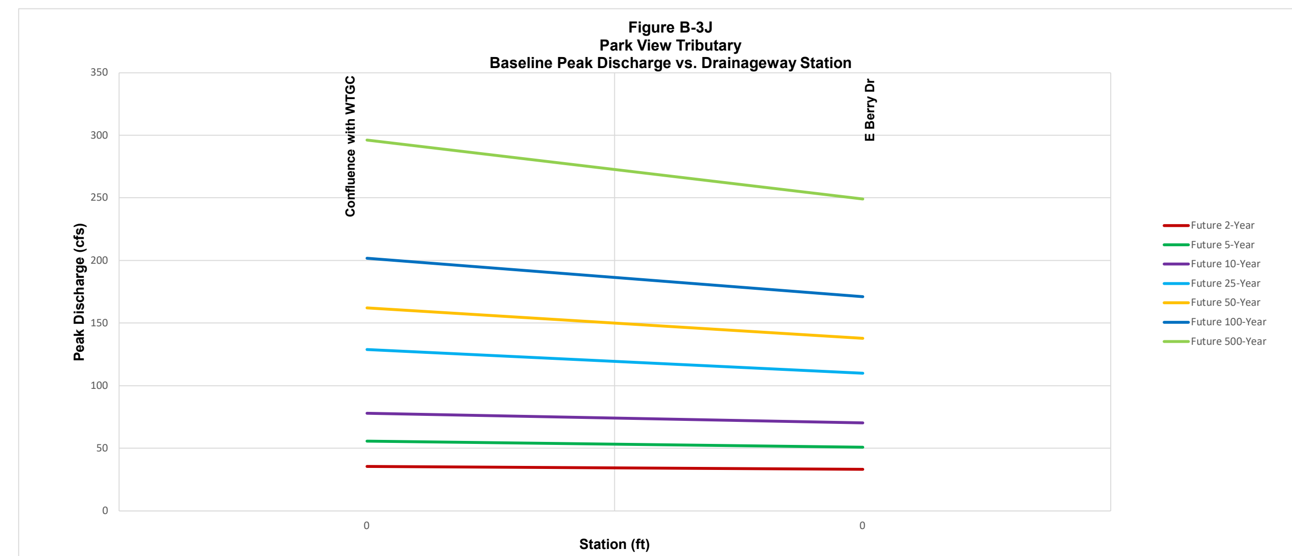
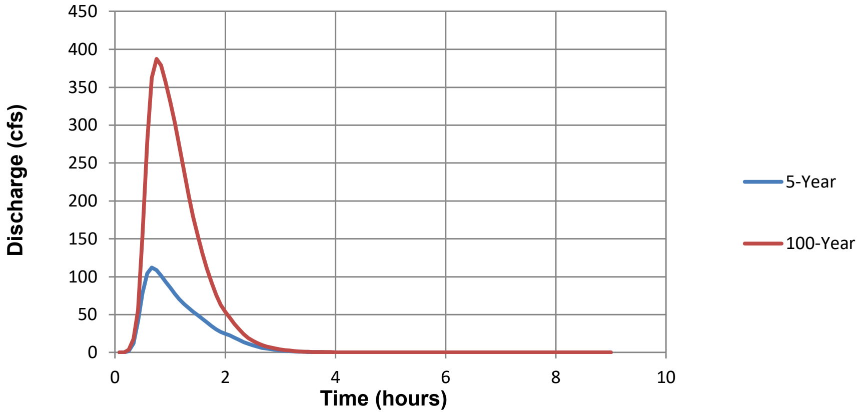


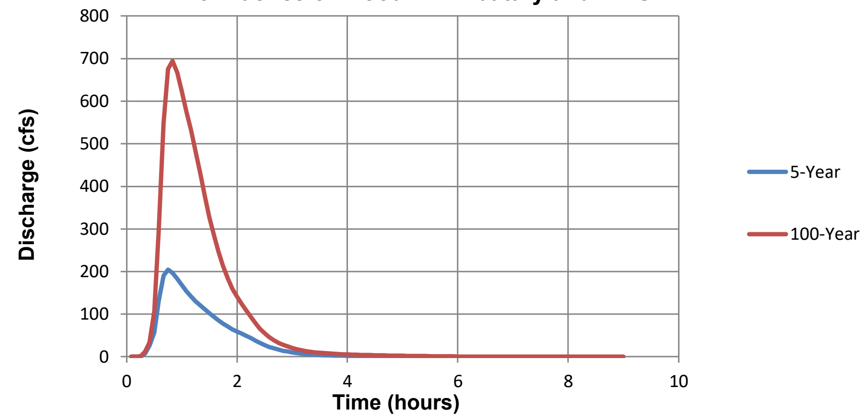

Figure B-3J
Park View Tributary
Baseline Peak Discharge vs. Drainageway Station

## Figure B-4 - Baseline Hydrographs

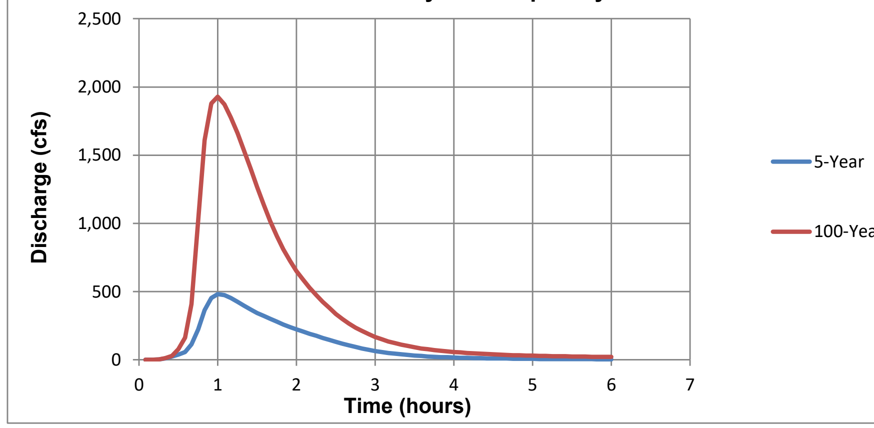
**West Toll Gate Creek Hydrographs - Helena Circle Tributary**
**Design Point HC101**
**Confluence of Helena Circle Tributary and WTGC**



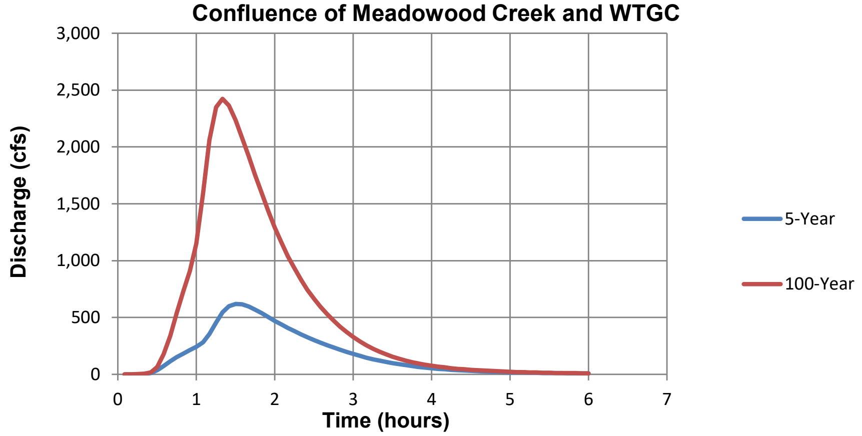

**West Toll Gate Creek Hydrographs - Woodrim Tributary**
**Design Point W101**
**Confluence of Woodrim Tributary and WTGC**



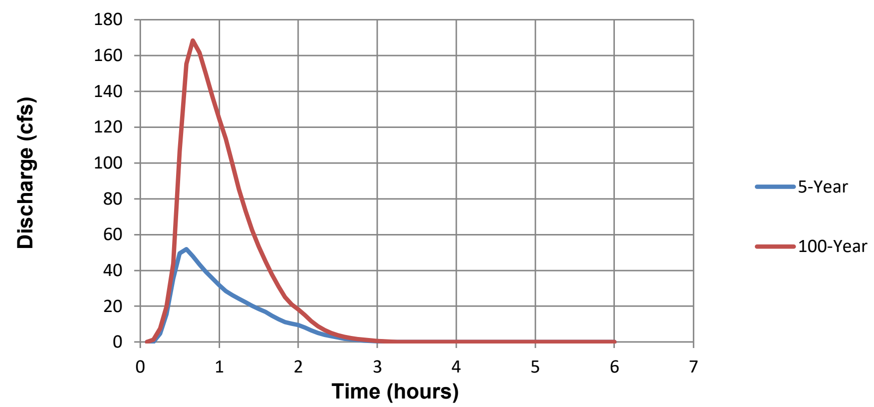

**West Toll Gate Creek Hydrographs - Cherry Creek Spillway**
**Design Point C101**
**Confluence of Cherry Creek Spillway and WTGC**



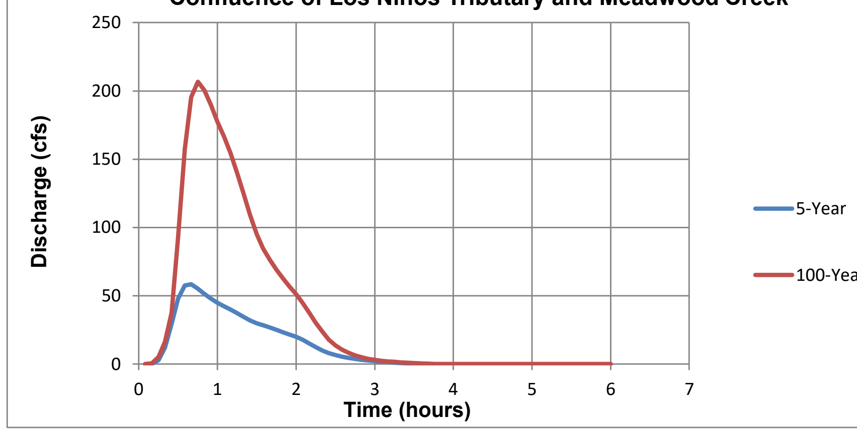

**West Toll Gate Creek Hydrographs - Meadowood Creek**
**Design Point MC101**
**Confluence of Meadowood Creek and WTGC**



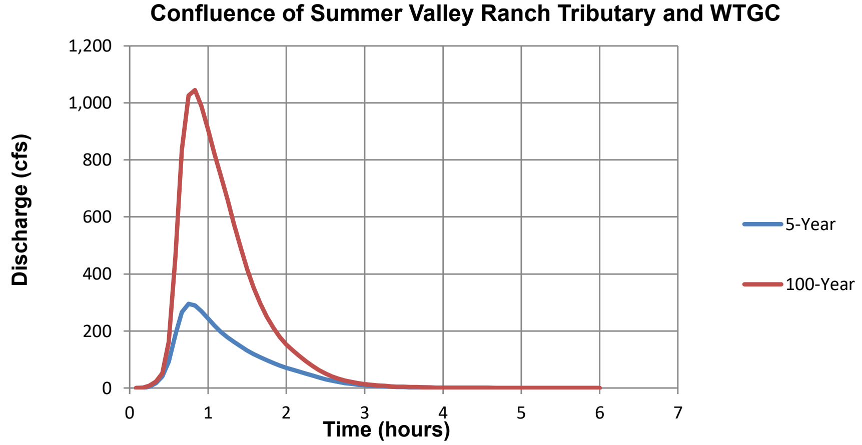

**West Toll Gate Creek Hydrographs - Mission Viejo Tributary**
**Design Point MV101**
**Confluence of Mission Viejo Tributary and Meadowood Creek**



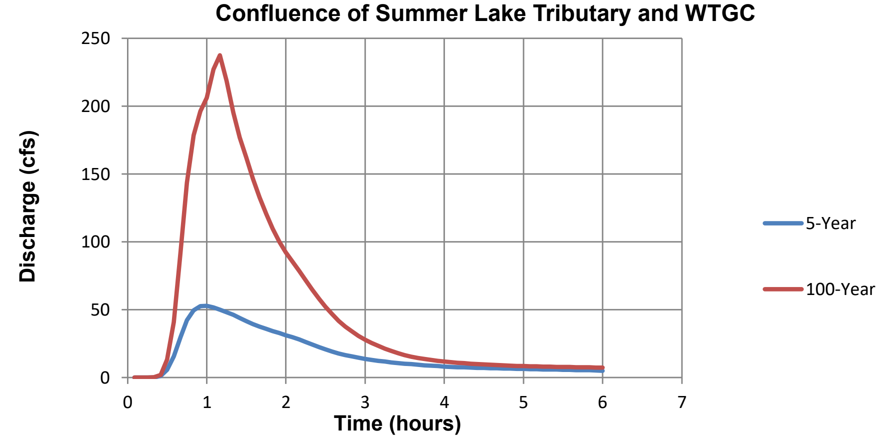

**West Toll Gate Creek Hydrographs - Los Ninos Tributary**
**Design Point LN101**
**Confluence of Los Ninos Tributary and Meadwood Creek**




**West Toll Gate Creek Hydrographs - Summer Valley Ranch Tributary**
**Design Point SV101**
**Confluence of Summer Valley Ranch Tributary and WTGC**




**West Toll Gate Creek Hydrographs - Summer Lake Tributary**
**Design Point SL101**
**Confluence of Summer Lake Tributary and WTGC**




**West Toll Gate Creek Hydrographs - Marina Park Tributary**
**Design Point MP101**
**Confluence of Marina ParkTributary and Tower Road Tributary**

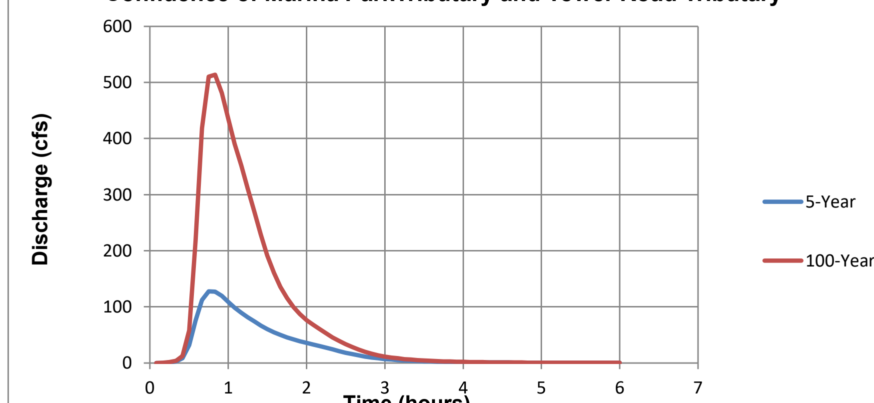


**Figure B-4 - Baseline Hydrographs**