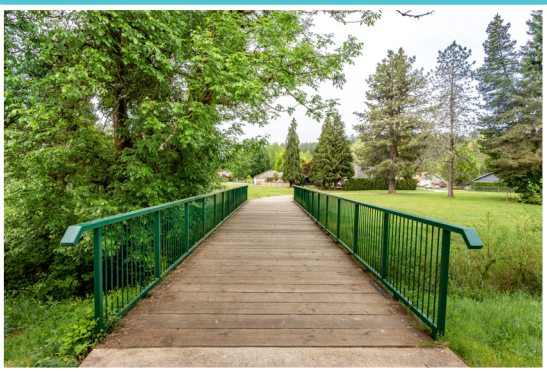
CITY OF Salem
AT YOUR SERVICE

# BATTLE CREEK BASIN PLAN

September 2019

WEST Consultants, Inc.

# TABLE OF CONTENTS

APPENDIX F–INITIAL MODELING ALTERNATIVES

APPENDIX G–ALTERNATIVES ANALYSIS RESULTS

APPENDIX H–CIP COST ESTIMATES

# BATTLE CREEK BASIN PLAN

## BATTLE CREEK BASIN DESCRIPTION

### *General Overview*

Battle Creek Basin is the primary drainage area in the City of Salem south of Kuebler Boulevard. For the purposes of the Battle Creek Basin Plan, the downstream limit of Battle Creek Basin is the Interstate 5 (I-5) crossing of Battle Creek, which coincides with the City of Salem Urban Growth Boundary (UGB). The City of Salem UGB encompasses approximately half of the total Battle Creek drainage area. Downstream of I-5, Battle Creek continues for another 3.5 miles before its confluence with McKinney Creek, which enters Mill Creek approximately 0.8 miles further downstream. The portion of Battle Creek Basin located upstream of I-5 has a drainage area of 10.1 square miles. The minimum and maximum basin elevations are 383 feet and 1,070 feet, respectively. The mean elevation for the basin is 616 feet. Unless otherwise stated, all elevations are in the National Geodetic Vertical Datum of 1929 (NGVD 29).

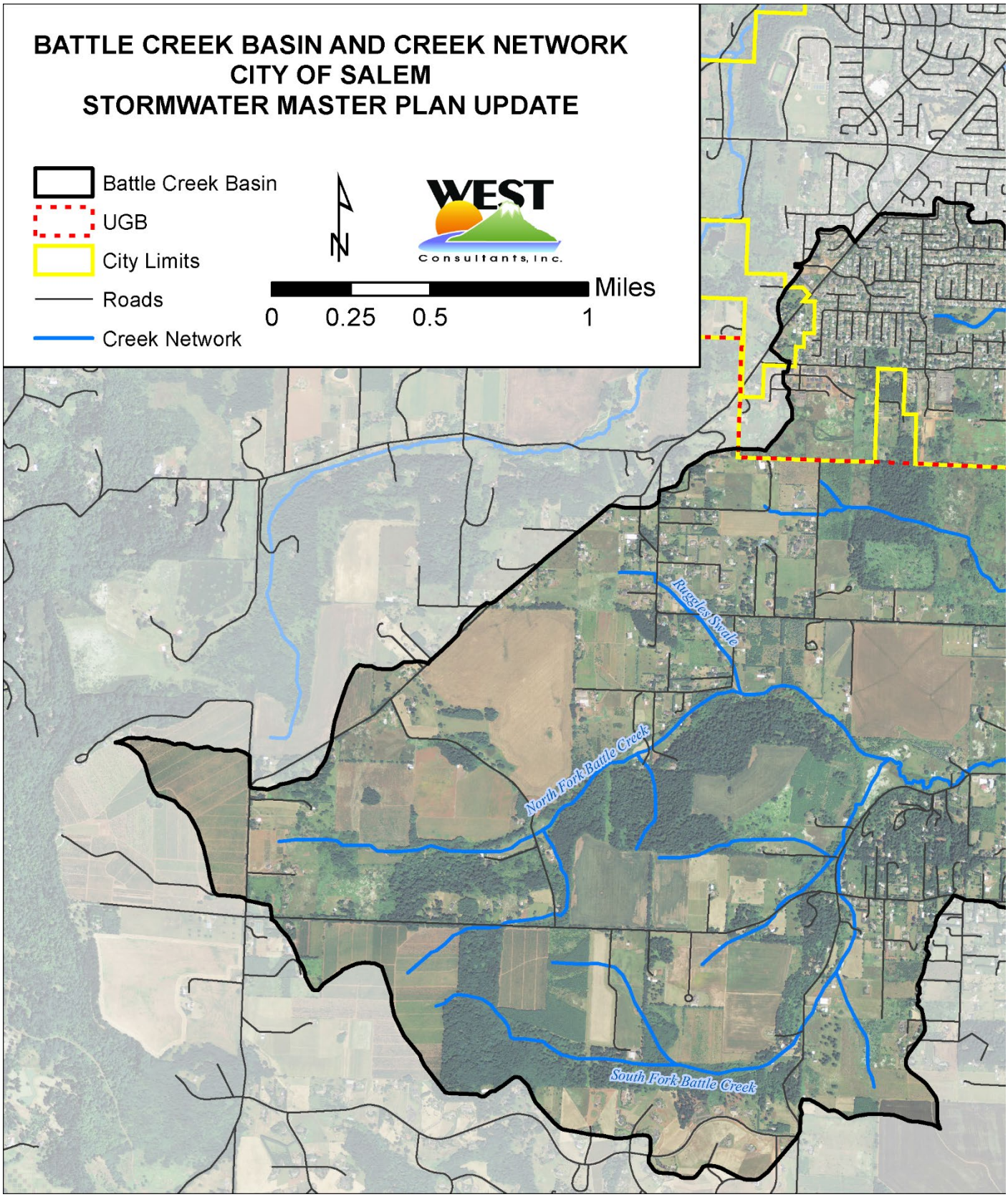
The largest tributary to Battle Creek is Waln Creek, which has a drainage area of 4.4 square miles, most of which is developed single family residential. Smaller tributaries include Scotch Creek, Powell Creek, Jory Creek, and Champion Swale. Generally, the Battle Creek Basin is narrow with steep side slopes. However, at the confluence of Waln Creek and Battle Creek, the basin and channel slopes become milder and the active floodplain becomes significantly larger.

In general, land use for most of the developed areas within the city limits is medium to low density residential. Land uses in the higher elevation portions of the basin, located outside of the city limits, are generally cropland and forest. **Figure 1** shows the extents of the Battle Creek Basin and the channel network.

### *Areas of Concern*

There are several areas of concern within the Battle Creek Basin that have a history of flooding during large rainfall events. The most recent major flood events occurred in January 2012 and February 1996. During the January 2012 storm event, photos were taken by the City of Salem to document the observed flooding (see **Appendix A**). Following the February 1996 event, the approximate observed flood extents were mapped by the City. The 1996 flood inundation extents and the 2012 observed flooding locations are shown in **Figure 2**.

Along Battle Creek, the majority of flood-prone areas are located near its confluence with Waln Creek. These areas include the Greenside Village Condominiums located north of Battle Creek Elementary School, single family homes located west of Battle Creek Elementary School along 13th Street and Packwood Court, and the Battle Creek Woods Townho-


BATTLE CREEK BASIN AND CREEK NETWORK
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
Battle Creek Basin
UGB
City Limits
Roads
Creek Network
N
WEST
Consultants, Inc.
Miles
0
0.25
0.5
1
Ruggles Swale
North Fork Battle Creek
South Fork Battle Creek

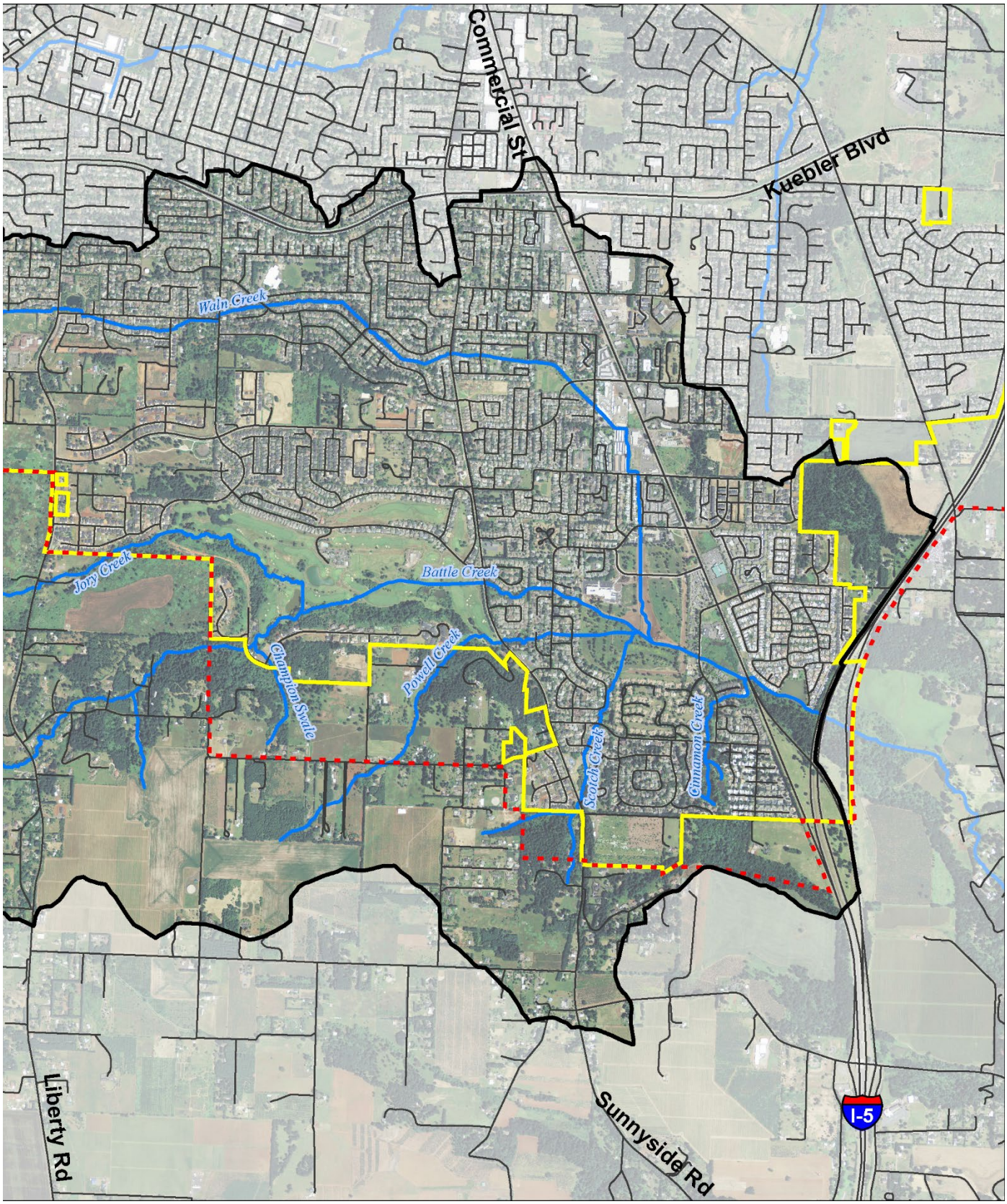



Figure 1–Battle Creek Basin and channel network.

mes located near the Fairway Avenue crossing of Battle Creek.

Along Waln Creek, the flood-prone area is generally located between Woodside Drive and Madras Avenue. Along Powell Creek, flooding has occurred at 13th Street. According to discussions with local residents, the flooding in 2012 was likely caused by debris blockage of culverts.

### *Findings of 2000 Stormwater Master Plan*

In the Stormwater Master Plan (SWMP) and Drainage System Improvement Plan (DSIP) developed for the City of Salem by Montgomery Watson (City of Salem 2000a, City of Salem 2000b), the Battle Creek Basin was modeled using a planning-level XP-SWMM model, which provided coupled hydrologic and hydraulic modeling of the watershed and stormwater system. In that effort, the Battle Creek Basin was divided into 82 subbasins. The primary purpose of the model was to detect areas within the storm sewer network that were at risk of surcharge during the 10-year 24-hour SCS Type-1A rainfall event. Models were developed for existing and full build-out conditions.

The findings of the 2000 DSIP included 22 recommended Capital Improvement Projects (CIPs) within the Battle Creek Basin. The recommendations included bridge and culvert replacements, capacity-increasing and erosion-preventing projects in waterways and ditches, restoration efforts primarily aimed a stabilizing waterway banks by using mostly natural materials, and construction of detention facilities. The total cost for the recommended CIPs was $15,798,089 in 2000 dollars (approximately $25,593,000 in 2017 dollars).

## BATTLE CREEK BASIN MODEL

### *Model Selection Process*

The 2000 SWMP XP-SWMM model was used to develop a planning-level model of Battle Creek Basin. However, the planning-level model lacks the detail needed to accurately model natural channels, hydraulic structures, complex 2-dimensional (2-D) flow, and overflow routing during high flow conditions. Since the Battle Creek Basin stormwater drainage system includes open channel conveyances (both natural channels and ditches), closed conduit stormwater systems (pipes and manholes), bridges and culverts, detention facilities, and complex two-dimensional flow conditions near the confluence of Waln Creek and Battle Creek, XP Solutions' XP-STORM with XP2D was selected as the most appropriate model. A detailed description of the model selection process is presented in the City of *Salem Stormwater Master Plan (SWMP)* (See Appendix F of the SWMP).

### *Model Development*

The XP-STORM model development process for the Battle Creek Basin is divided into two components: runoff and hydraulics. The runoff component simulates the hydrologic processes in the watershed, including precipitation, hydrologic abstractions, hydrologic routing, and watershed storage. The hydraulics component simulates the conveyance and storage for channels, floodplains, weirs, bridges, culverts, pipes, and detention facilities.

## *Runoff Component Development*

The development of the runoff component of the XP-SWMM model included:

- Subbasin delineations
- Watershed characteristics pre-processing
- Rainfall data collection and processing
- Design storm development

The following is a summary of each of the runoff model development components.

### *Subbasin Delineations*

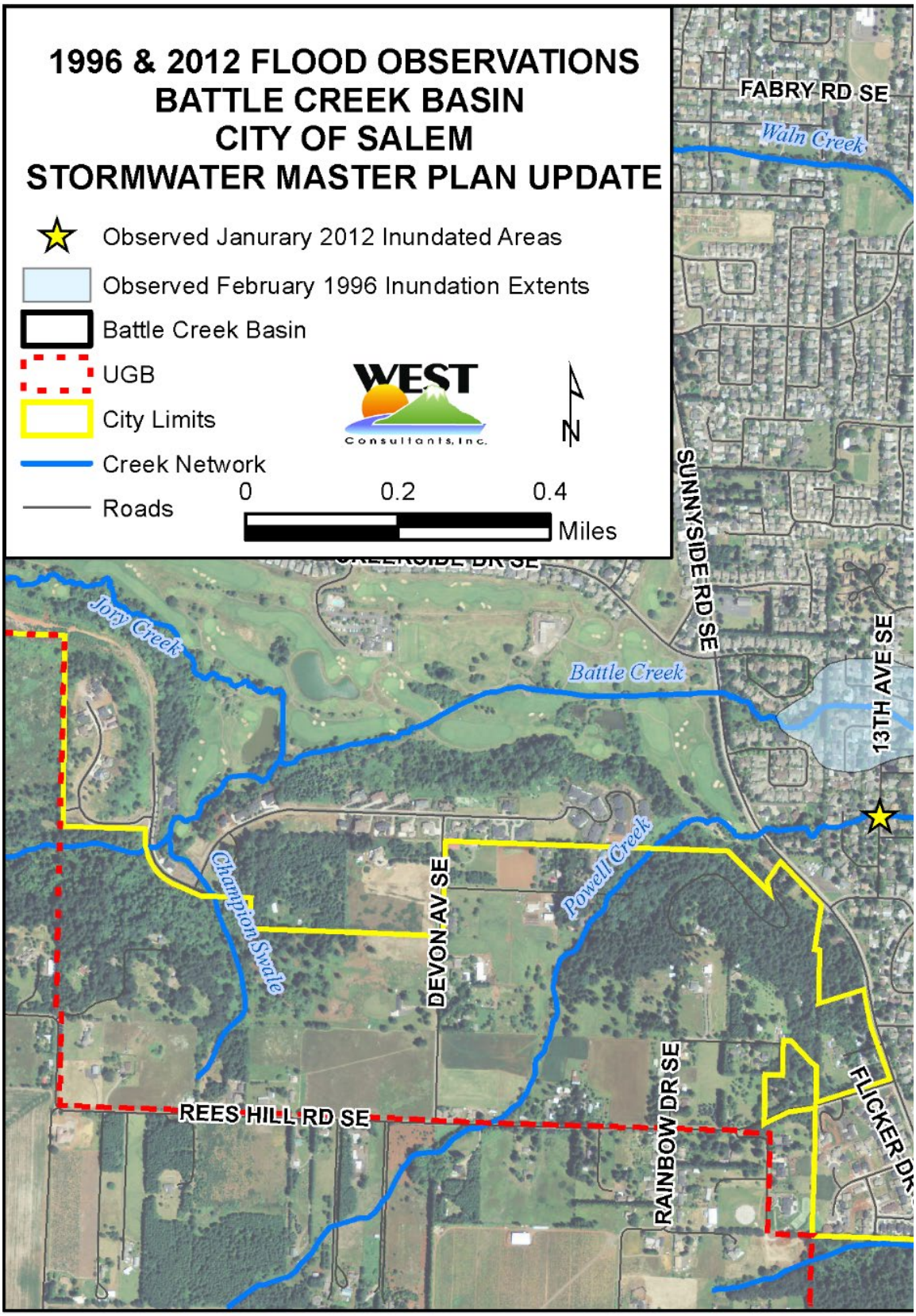
Since the development of the 2000 SWMP, high density topographic data for the Battle Creek Basin have become available from the Oregon LiDAR Consortium (Watershed Concepts 2009). This topographic data, along with updated storm sewer, land use, and 2-foot contour mapping provided by the City of Salem was used to update and revise the subbasin boundaries from the 2000 SWMP. Subbasins were divided along ridges according the high density LiDAR and 2-foot contour intervals while generally maintaining a minimum subbasin outlet pipe size of 15-24 inches. Subbasins were also delineated based on the locations of recognized flood water storage areas, stream confluences, clear distinctions in land use, and major bridges and culverts.

Eighty-eight (88) subbasins were defined within the Battle Creek Basin upstream of I-5. **Figure 3** shows the resultant subbasins delineations within the Battle Creek Basin upstream of I-5. An additional ten (10) subbasins were defined between I-5 and the confluence of McKinney Creek with Mill Creek. These additional 10 subbasins were used to develop the outfall conditions of the Battle Creek Model and to help evaluate potential impacts to the City of Turner as a result of watershed development within the City of Salem UGB and flood risk reduction alternatives. Since these subbasins are rural and relatively sparsely developed, their delineations were less detailed and cover larger areas than the subbasins located upstream of I-5. The model extents, including the subbasins downstream of I-5, are shown in **Figure 4**.

### *Watershed Characteristics Pre-Processing*

XP-STORM offers multiple runoff methods to simulate watershed hydrology, including the SCS Curve Number Method, the Rational Method, and the SWMM RUNOFF Method. The SWMM RUNOFF method was selected due to its ability to continuously simulate non-linear soil infiltration rates via the Horton Infiltration Method.

The pre-calibration watershed characteristics needed for the SWMM RUNOFF method were developed for each of the subbasins using the most current land cover, soil type, elevation, and impervious surface area coverage data that was either publicly available or provided by the City of Salem. Detailed descriptions for each of the watershed parameters used in the SWMM RUNOFF method and the processes used to develop the


1996 & 2012 FLOOD OBSERVATIONS
BATTLE CREEK BASIN
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
Observed Janurary 2012 Inundated Areas
Observed February 1996 Inundation Extents
Battle Creek Basin
UGB
City Limits
Creek Network
Roads
WEST
Consultants, Inc.
N
0
0.2
0.4
Miles
FABRY RD SE
Waln Creek
SUNNYSIDE RD SE
13TH AVE SE
Jory Creek
Battle Creek
Champion Swale
DEVON AV SE
Powell Creek
RAINBOW DR SE
FLICKER DR
REES HILL RD SE

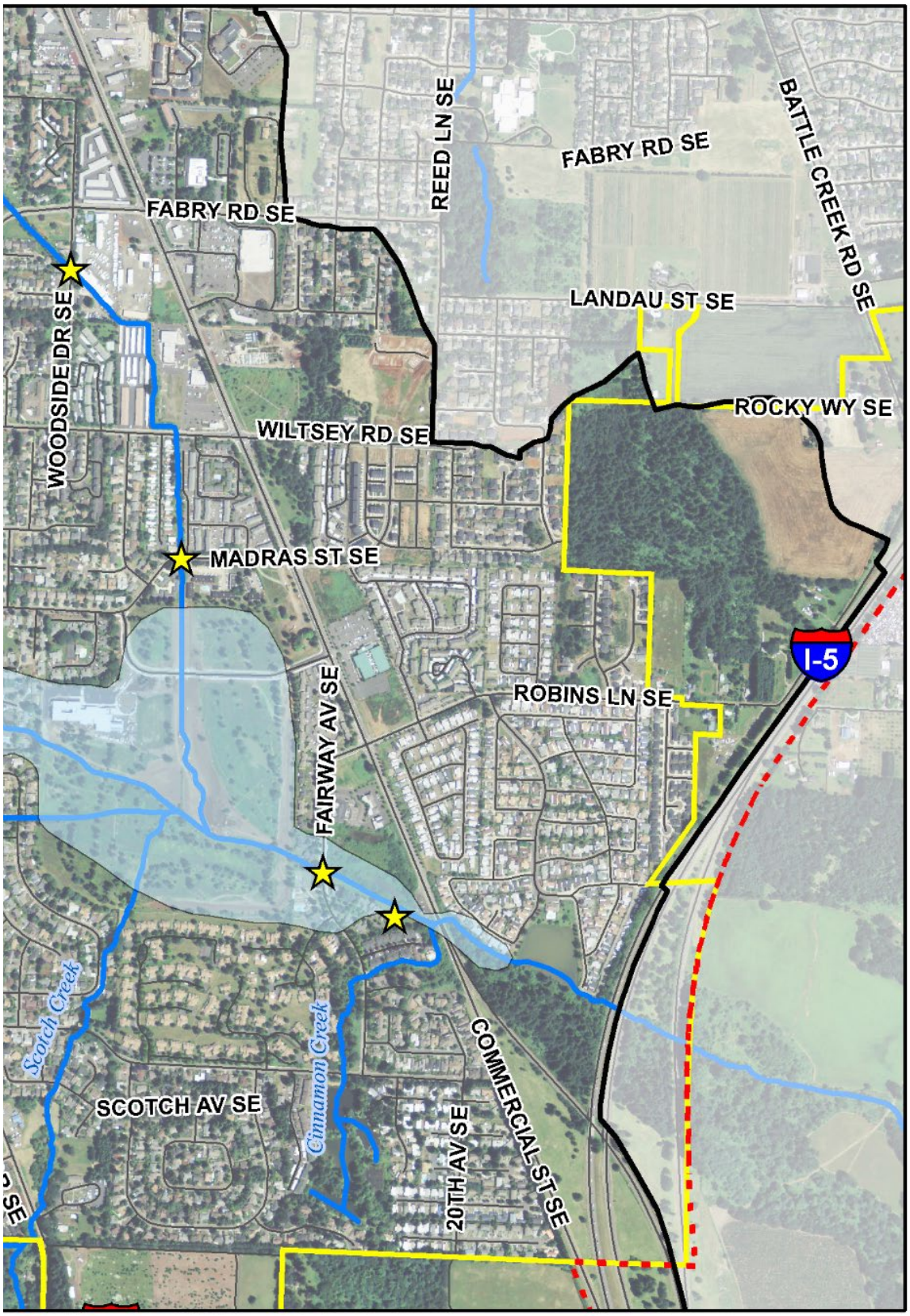
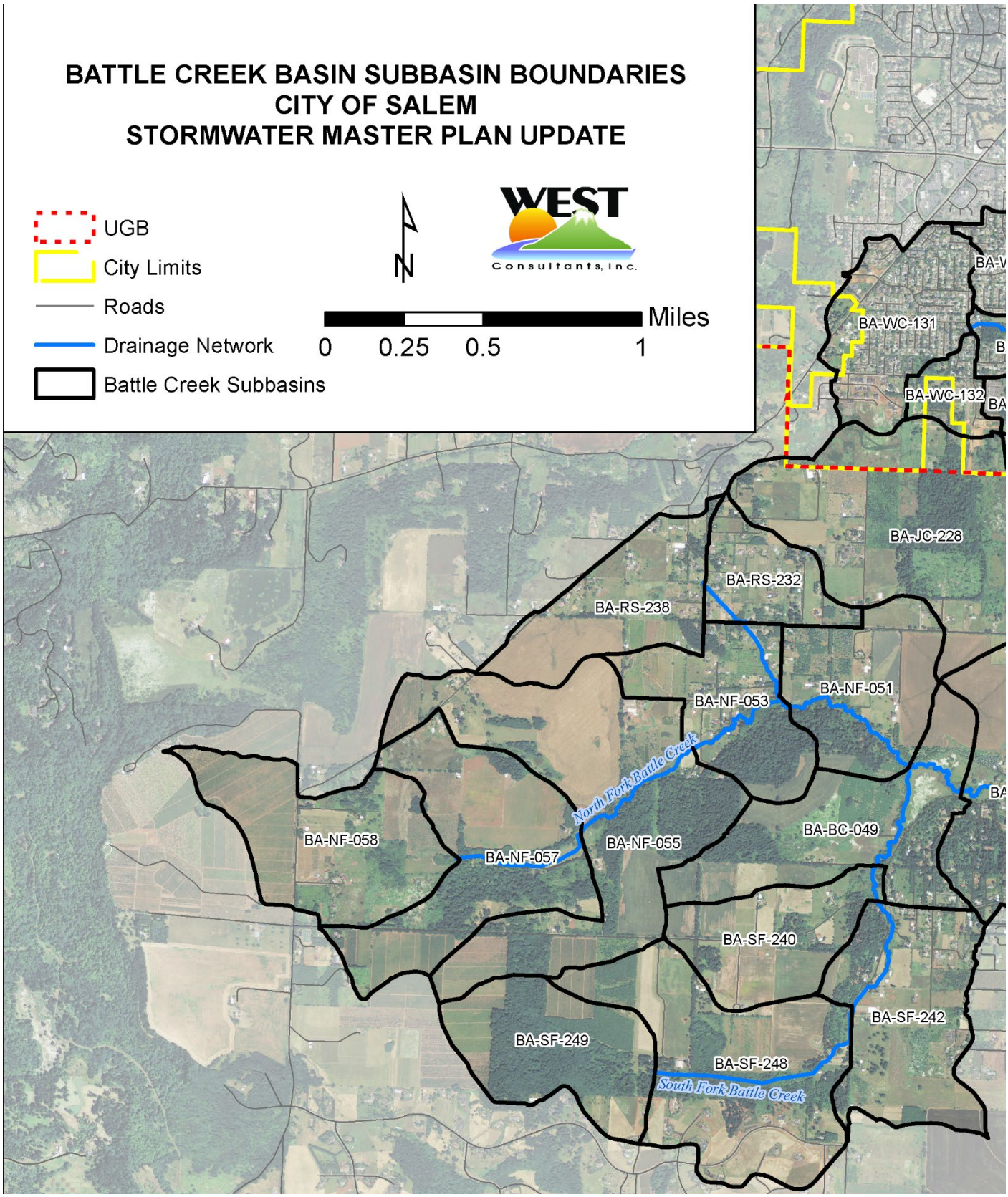



Figure 2–Approximate 1996 flood inundation extents and observed January 2012 flooding locations.


BATTLE CREEK BASIN SUBBASIN BOUNDARIES
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
UGB
City Limits
Roads
Drainage Network
Battle Creek Subbasins
WEST
Consultants, Inc.
Miles
0
0.25
0.5
1
BA-WC-131
BA-WC-132
BA-JC-228
BA-RS-232
BA-RS-238
BA-NF-053
BA-NF-051
North Fork Battle Creek
BA-NF-058
BA-NF-057
BA-NF-055
BA-BC-049
BA-SF-240
BA-SF-242
BA-SF-249
BA-SF-248
South Fork Battle Creek

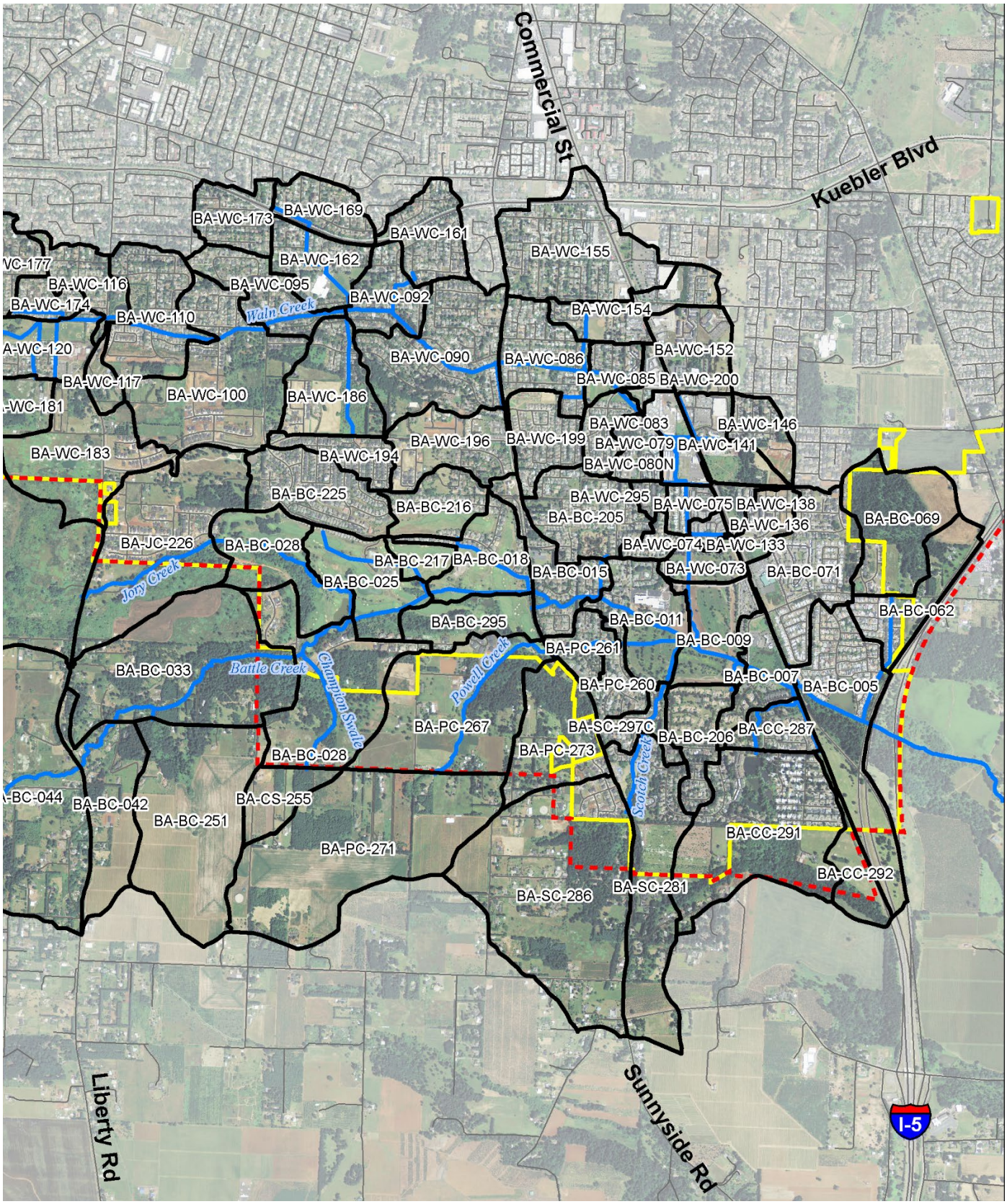
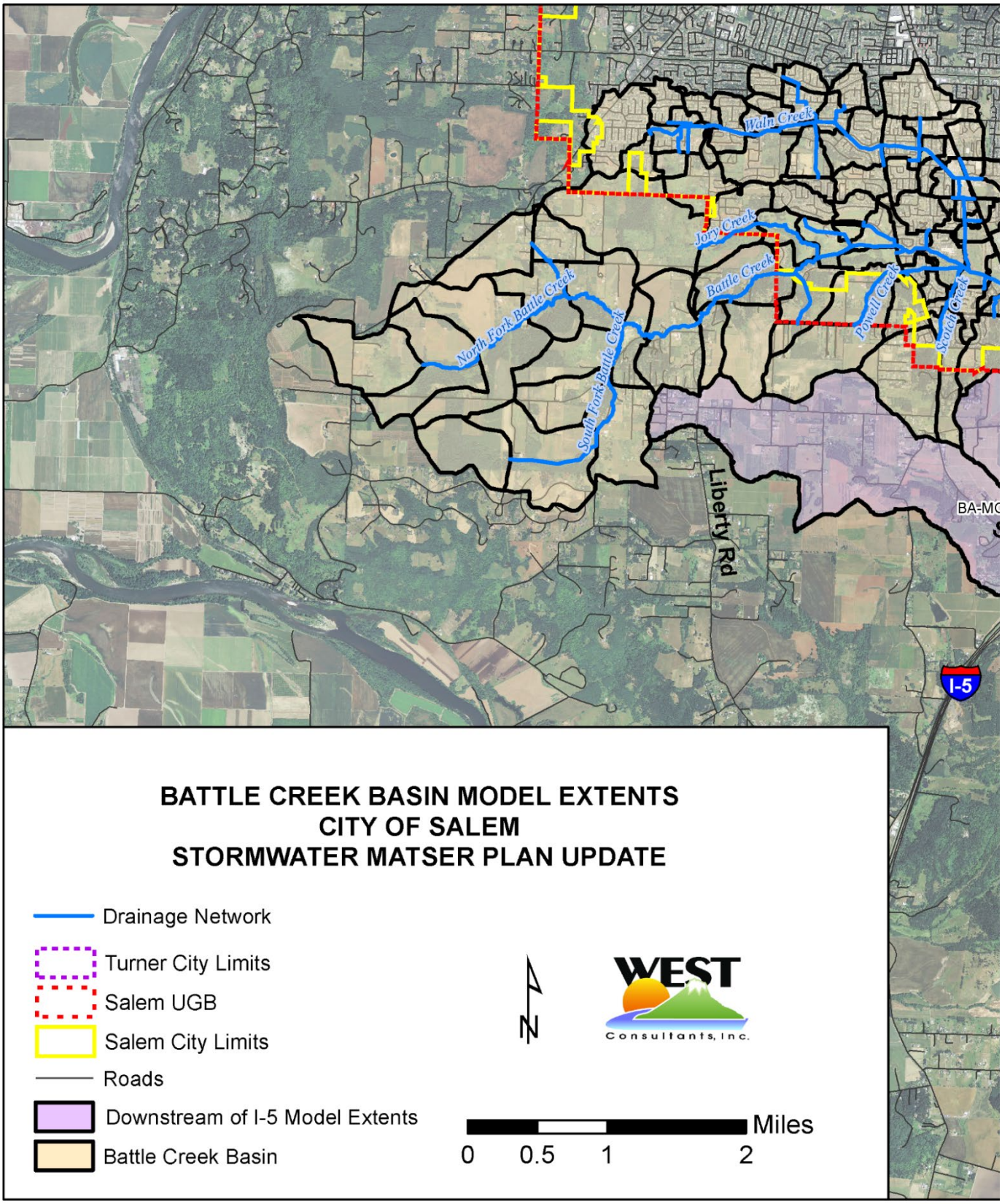



Figure 3–Battle Creek Subbasin boundaries.


Waln Creek
Jory Creek
Battle Creek
Powell Creek
Scotch Creek
North Fork Battle Creek
South Fork Battle Creek
Liberty Rd
I-5
BA-MC
BATTLE CREEK BASIN MODEL EXTENTS
CITY OF SALEM
STORMWATER MATSER PLAN UPDATE
Drainage Network
Turner City Limits
Salem UGB
Salem City Limits
Roads
Downstream of I-5 Model Extents
Battle Creek Basin
N
WEST
Consultants, Inc.
Miles
0
0.5
1
2

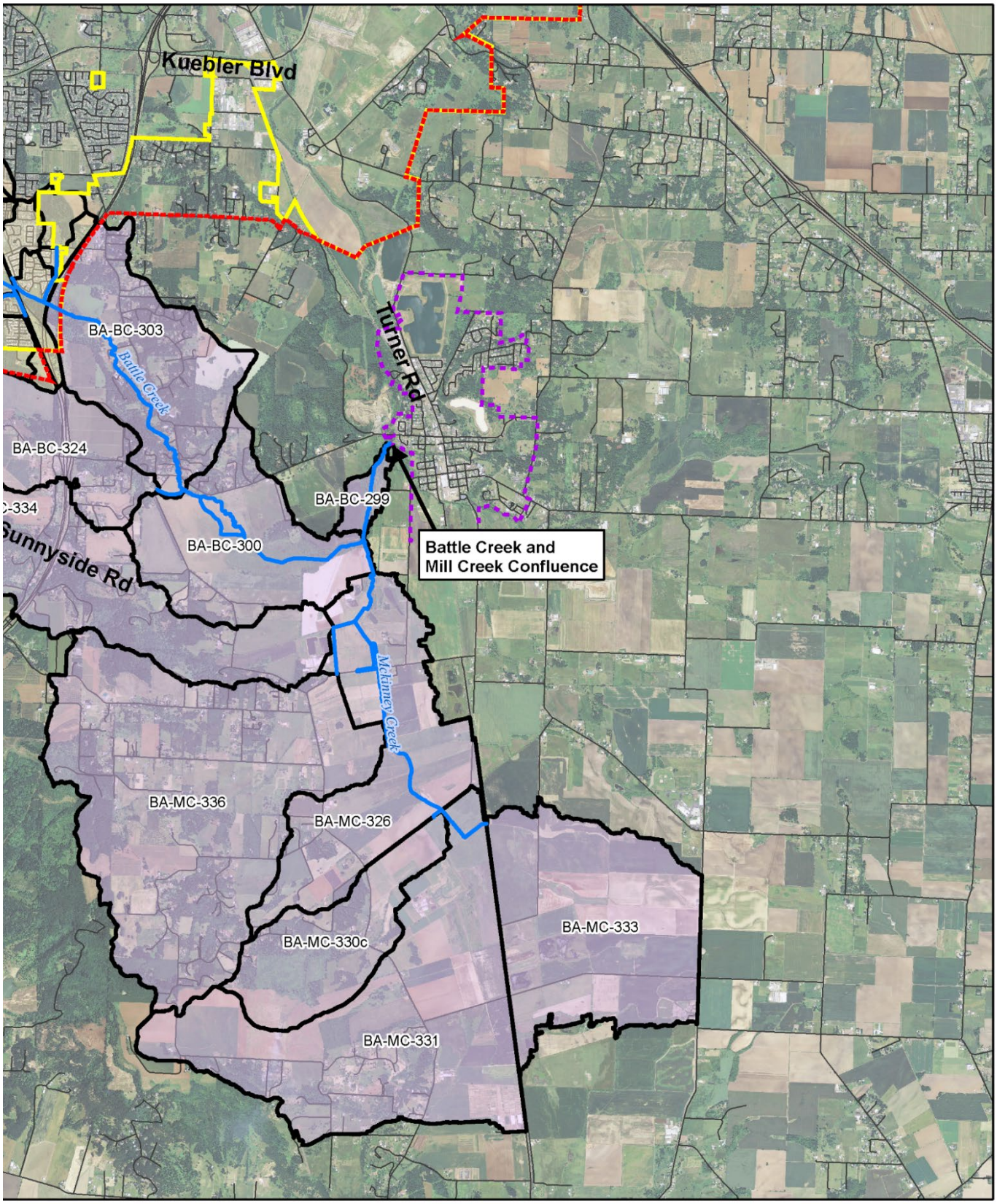



Figure 4–Battle Creek Basin model extents.

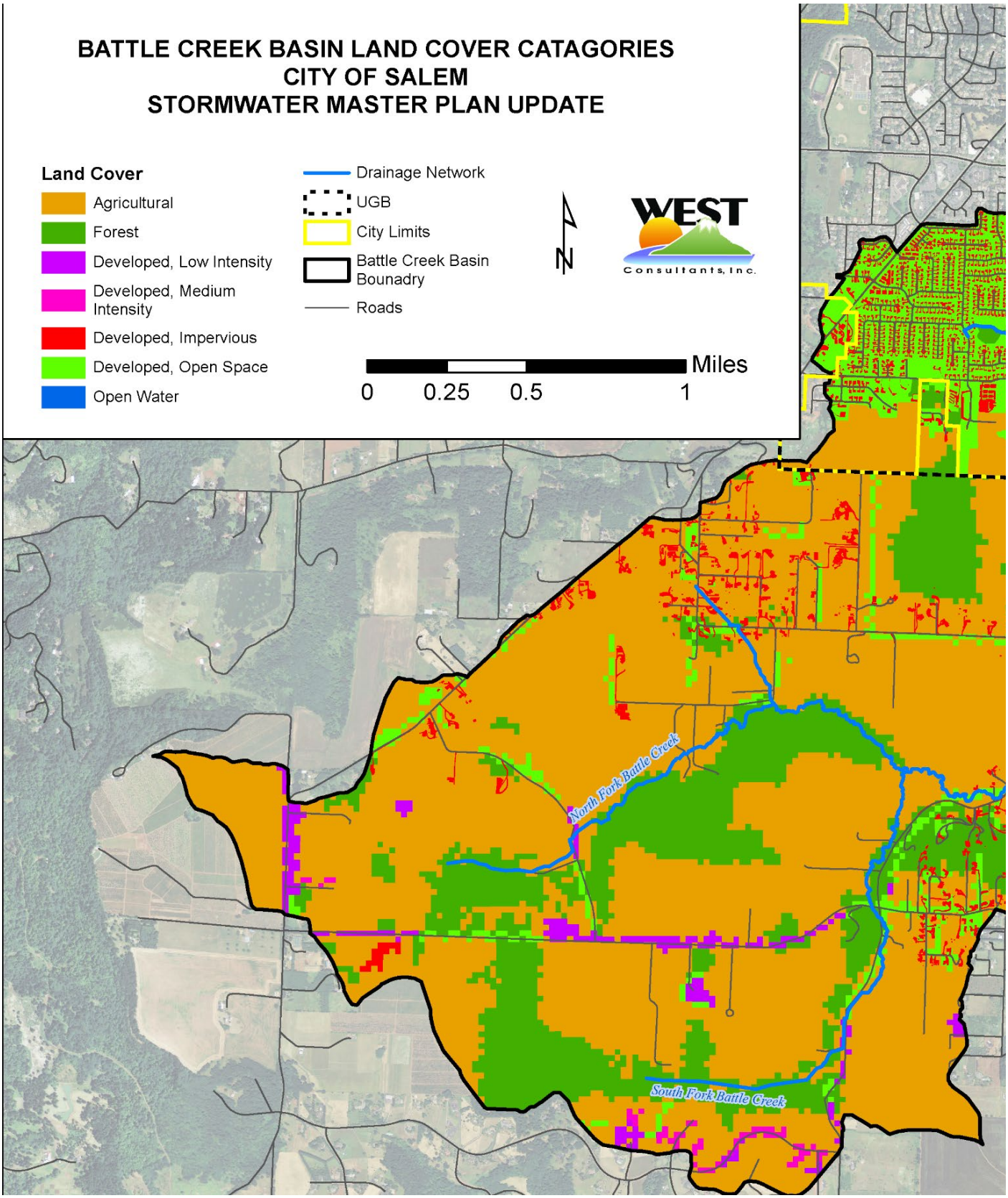
parameters are presented in **Appendix D**. A map of the Battle Creek Basin land cover classifications, which was developed from City's impervious surface data and 2011 National Land Cover Data (NRCD) is shown in **Figure 5**. A map of the hydrologic soil group classification for the Battle Creek Basin is shown in **Figure 6**. **Table 1** lists the Battle Creek subbasin name, drainage area, existing impervious surface percentage, full build-out impervious surface percentage, percent water cover, and average watershed slope.

### *Rainfall Data Collection and Processing*

Historic rainfall data are available for several gauges in and near the Battle Creek Basin, including gauges: RG8, RG10, RG11, and McNary Field. The RG8, RG10, and RG11 gauges are operated by the City of Salem and have been collecting data since the late 1990's. McNary Field is operated by the National Oceanic and Atmospheric Administration (NOAA) and has been collecting data since 1948. Gauges were assigned to individual subbasins within the model based on their proximity to the centroid of the subbasin. Detailed descriptions of each gauge, its location, period of record, and subbasin assignments are provided in **Appendix B**.

| Subbasin Name | Area (Acres) | Existing Directly Connected Impervious (%) | Full Build-out Directly Connected Impervious (%) | Average Slope (%) | Water Coverage (%) |
|---|---|---|---|---|---|
| BA-BC-005 | 95.0 | 31.2 | 36.2 | 10.3 | 4.0 |
| BA-BC-007 | 30.7 | 37.6 | 44.6 | 5.6 | 5.2 |
| BA-BC-009 | 43.5 | 11.8 | 11.9 | 3.0 | 1.2 |
| BA-BC-011 | 49.9 | 18 | 18 | 3.1 | 0.8 |
| BA-BC-015 | 40.1 | 36.4 | 36.4 | 7.7 | 0.0 |
| BA-BC-018 | 44.6 | 15.5 | 43.2 | 9.6 | 0.0 |
| BA-BC-025 | 49.6 | 11.7 | 50.3 | 12.2 | 17.9 |
| BA-BC-028-1 | 102.5 | 6.8 | 46.8 | 17.9 | 0.0 |
| BA-BC-028-2 | 57.7 | 3.9 | 47 | 16.9 | 29.2 |
| BA-BC-033 | 147.7 | 1.7 | 7.4 | 15.7 | 0.0 |
| BA-BC-042 | 63.8 | 6.2 | 6.2 | 16.4 | 0.0 |
| BA-BC-044 | 204.8 | 5.2 | 5.2 | 13.4 | 0.0 |
| BA-BC-049 | 197.0 | 0.9 | 0.9 | 14.3 | 0.0 |
| BA-BC-062 | 42.8 | 18.6 | 37.8 | 8.0 | 0.0 |
| BA-BC-069 | 70.0 | 4.4 | 48.2 | 10.6 | 0.0 |
| BA-BC-071 | 73.7 | 40.1 | 46.2 | 10.2 | 0.0 |
| BA-BC-205 | 54.4 | 32.7 | 36.4 | 7.2 | 0.0 |
| BA-BC-206 | 34.0 | 33.6 | 33.6 | 6.8 | 0.0 |
| BA-BC-216 | 33.3 | 19.4 | 38.4 | 14.7 | 0.0 |
| BA-BC-217 | 12.7 | 0.6 | 49.1 | 11.2 | 0.0 |
| BA-BC-225 | 56.0 | 36.7 | 40.0 | 15.6 | 0.0 |
| BA-BC-251 | 134.8 | 1.2 | 1.9 | 12.4 | 0.0 |

| Subbasin Name | Area (Acres) | Existing Directly Connected Impervious (%) | Full Build-out Directly Connected Impervious (%) | Average Slope (%) | Water Coverage (%) |
|---|---|---|---|---|---|
| BA-BC-295 | 35.5 | 8.6 | 50.5 | 23.5 | 0.0 |
| BA-BC-299 | 81.1 | 0.0 | 0.0 | 3.5 | 0.0 |
| BA-BC-300 | 893.3 | 0.5 | 0.5 | 23.5 | 0.0 |
| BA-BC-303 | 971.8 | 3.0 | 3.0 | 12.1 | 0.0 |
| BA-BC-324 | 596.2 | 5.5 | 5.5 | 12.6 | 0.0 |
| BA-CC-287 | 21.9 | 28.9 | 35.7 | 9.1 | 1.5 |
| BA-CC-291 | 130.2 | 18.2 | 38.2 | 13.6 | 0.0 |
| BA-CC-292 | 25.2 | 7.9 | 32.3 | 14.5 | 6.3 |
| BA-CS-255 | 26.0 | 2.9 | 2.9 | 9.1 | 0.0 |
| BA-JC-226 | 129.4 | 12.9 | 26.9 | 14.2 | 0.0 |
| BA-JC-228 | 351.0 | 1.6 | 9.1 | 9.7 | 0.0 |
| BA-MC-326 | 1111.4 | 1.0 | 1.0 | 4.2 | 0.0 |
| BA-MC-330C | 635.0 | 0.2 | 0.2 | 12.6 | 0.0 |
| BA-MC-331 | 1850.8 | 1.3 | 1.3 | 8.4 | 0.0 |
| BA-MC-333 | 1319.9 | 0.8 | 0.8 | 12.7 | 0.0 |
| BA-MC-334 | 2031.6 | 2.8 | 2.8 | 14.1 | 0.0 |
| BA-MC-336 | 2366.1 | 0.8 | 0.8 | 12.7 | 0.0 |
| BA-NF-051 | 141.5 | 0.9 | 0.9 | 13.2 | 0.0 |
| BA-NF-053 | 131.9 | 0.7 | 0.7 | 15.1 | 0.0 |
| BA-NF-055 | 335.4 | 0.9 | 0.9 | 14.8 | 0.0 |
| BA-NF-057 | 215.2 | 0.8 | 0.8 | 16.3 | 0.0 |
| BA-NF-058 | 183.7 | 1.5 | 1.5 | 13.9 | 0.0 |
| BA-PC-260 | 20.1 | 33.7 | 33.7 | 5.6 | 0.0 |
| BA-PC-261 | 18.7 | 31.6 | 31.6 | 4.9 | 0.0 |
| BA-PC-267 | 119.1 | 4.7 | 48.9 | 15.1 | 0.0 |
| BA-PC-271 | 180.5 | 1.7 | 1.7 | 9.2 | 0.0 |
| BA-PC-273 | 61.4 | 8.5 | 41.2 | 18.4 | 0.0 |
| BA-RS-232 | 77.0 | 6.5 | 6.5 | 11.1 | 0.0 |
| BA-RS-238 | 133.5 | 2.8 | 2.8 | 10.8 | 0.0 |
| BA-SC-281 | 96.3 | 13.6 | 23.7 | 12.3 | 0.0 |
| BA-SC-286 | 197.3 | 7.7 | 12.8 | 13.4 | 0.0 |
| BA-SC-297C | 17.6 | 32.4 | 32.4 | 6.3 | 0.0 |
| BA-SF-240 | 119.9 | 1.5 | 1.5 | 12.7 | 0.0 |
| BA-SF-242 | 180.7 | 1.4 | 1.4 | 14.0 | 0.0 |
| BA-SF-248 | 252.5 | 2.6 | 2.6 | 15.8 | 0.0 |
| BA-SF-249 | 146.3 | 0.7 | 0.7 | 14.6 | 0.0 |
| BA-WC-073 | 17.2 | 8.3 | 57.5 | 3.1 | 0.0 |
| BA-WC-074 | 9.6 | 40.1 | 40.1 | 11.4 | 0.0 |
| BA-WC-075 | 12.7 | 38.7 | 38.7 | 7.0 | 0.0 |


BATTLE CREEK BASIN LAND COVER CATAGORIES
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
Land Cover
Agricultural
Forest
Developed, Low Intensity
Developed, Medium Intensity
Developed, Impervious
Developed, Open Space
Open Water
Drainage Network
UGB
City Limits
Battle Creek Basin Bounadry
Roads
N
WEST
Consultants, Inc.
Miles
0
0.25
0.5
1
North Fork Battle Creek
South Fork Battle Creek

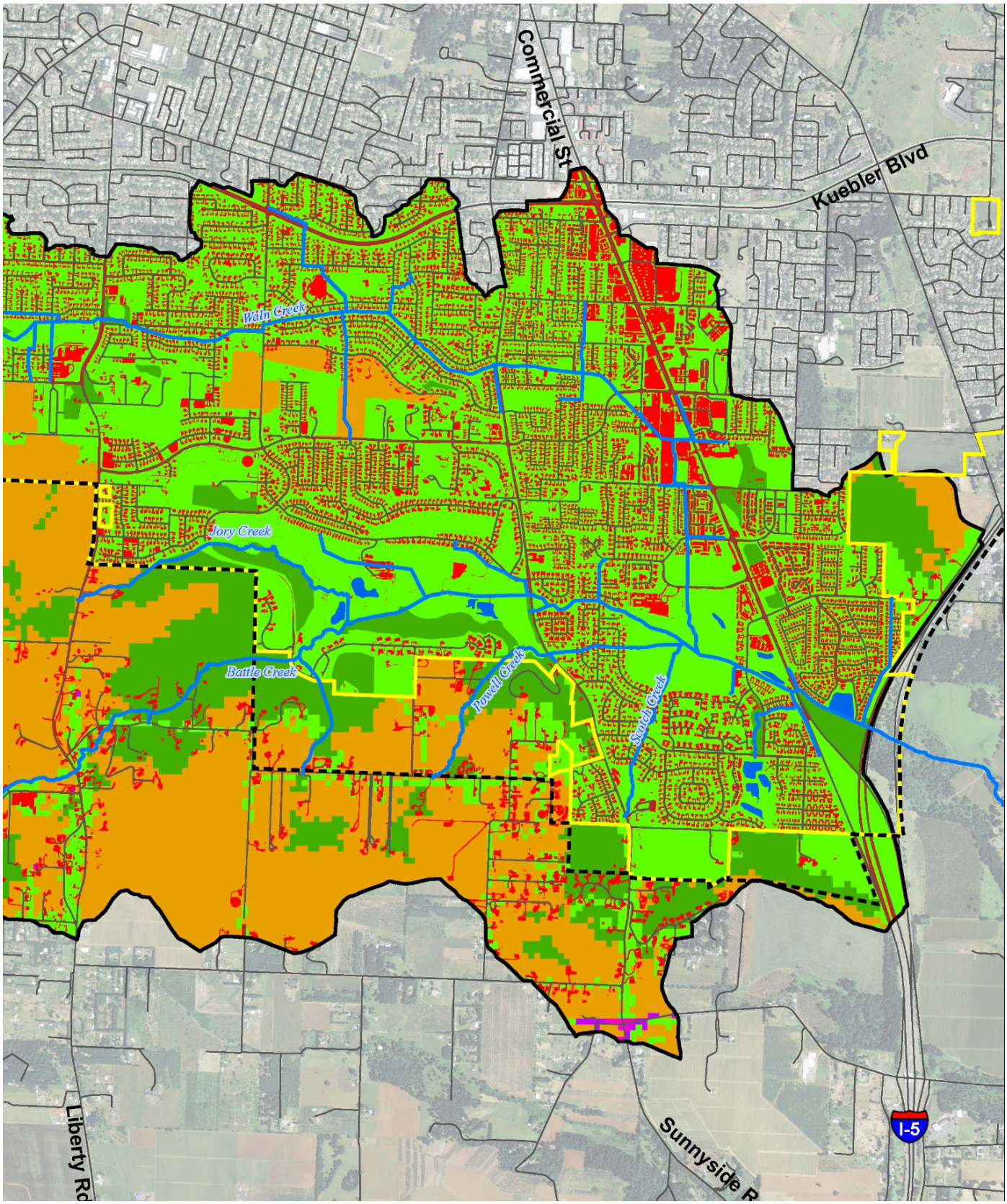
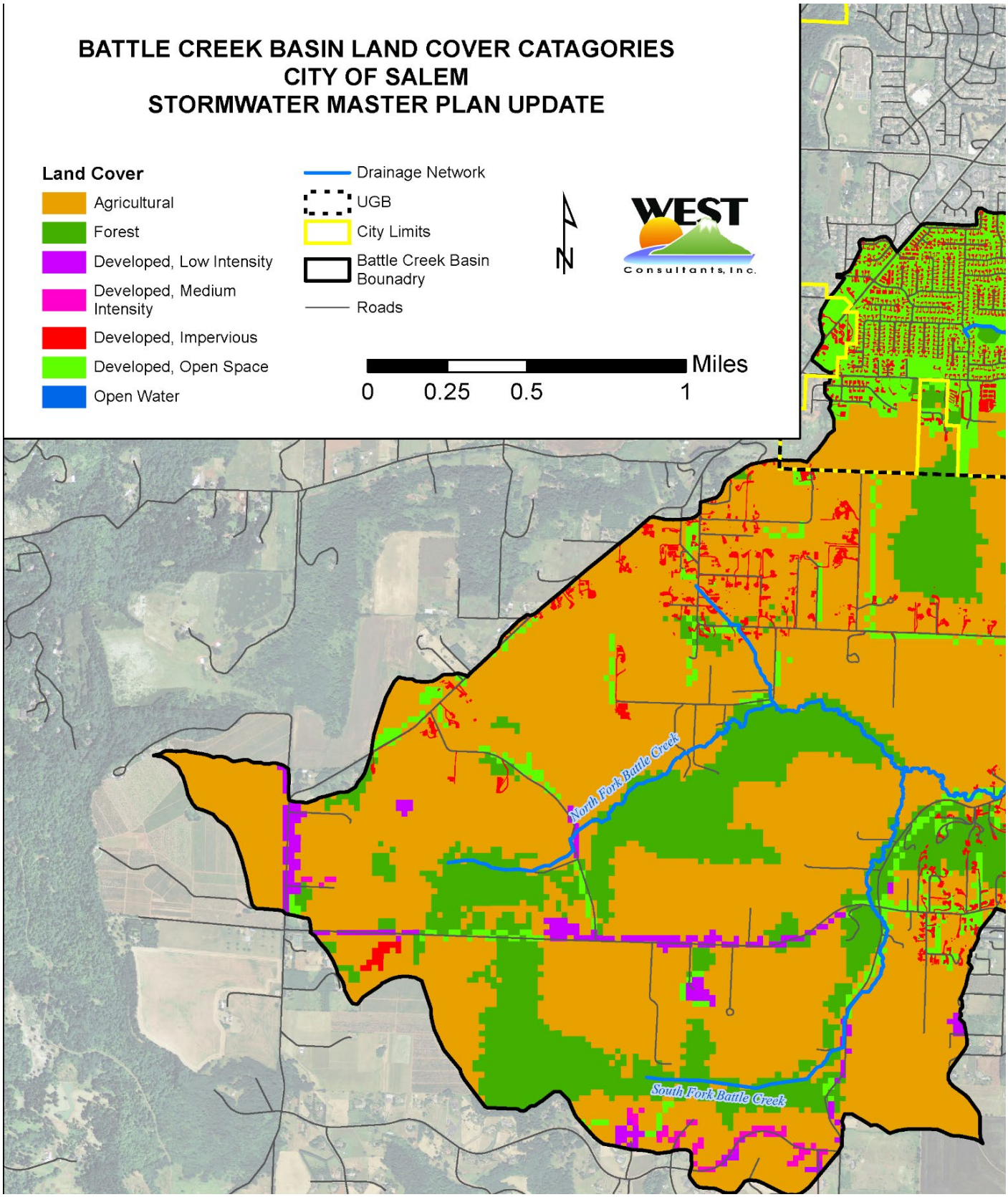



Figure 5–Battle Creek Basin and cover categories.


BATTLE CREEK BASIN LAND COVER CATAGORIES
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
Land Cover
Agricultural
Forest
Developed, Low Intensity
Developed, Medium Intensity
Developed, Impervious
Developed, Open Space
Open Water
Drainage Network
UGB
City Limits
Battle Creek Basin Bounadry
Roads
N
WEST
Consultants, Inc.
Miles
0
0.25
0.5
1
North Fork Battle Creek
South Fork Battle Creek

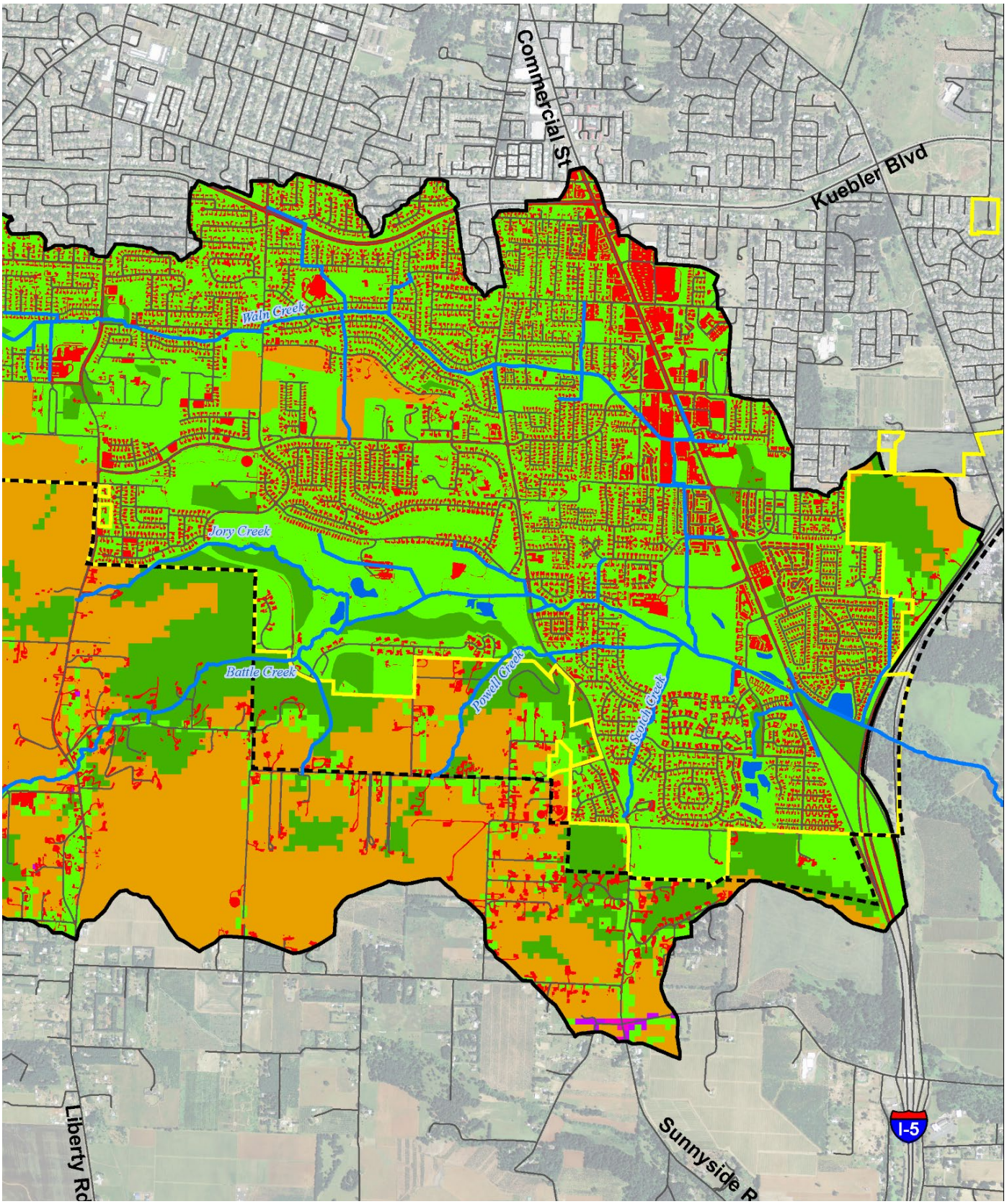



Figure 6–NRCS 2014 hydrologic soil groups for the Battle Creek Basin.

| Subbasin Name | Area (Acres) | Existing Directly Connected Impervious (%) | Full Build-out Directly Connected Impervious (%) | Average Slope (%) | Water Coverage (%) |
|---|---|---|---|---|---|
| BA-WC-079 | 22.0 | 57.7 | 71.3 | 4.1 | 0.0 |
| BA-WC-080N | 17.6 | 39.2 | 39.2 | 12.8 | 0.0 |
| BA-WC-083 | 19.3 | 36.7 | 40.3 | 7.7 | 0.0 |
| BA-WC-085 | 17.3 | 25.4 | 35.4 | 3.6 | 0.0 |
| BA-WC-086 | 48.2 | 33.4 | 35.2 | 4.8 | 0.0 |
| BA-WC-090 | 94.0 | 28.3 | 35.7 | 11.5 | 0.0 |
| BA-WC-092 | 32.6 | 28.9 | 28.9 | 5.2 | 0.0 |
| BA-WC-095 | 39.1 | 30.6 | 30.6 | 10.3 | 0.0 |
| BA-WC-100 | 117.3 | 19.2 | 44.3 | 12.2 | 0.0 |
| BA-WC-110 | 59.8 | 27.6 | 38.5 | 12.1 | 0.0 |
| BA-WC-116 | 28.6 | 35.5 | 37.7 | 9.9 | 0.0 |
| BA-WC-117 | 11.1 | 22.9 | 52.8 | 15.4 | 0.0 |
| BA-WC-120 | 48.5 | 24.0 | 26.9 | 5.2 | 0.0 |
| BA-WC-131 | 137.0 | 29.4 | 38.2 | 9.4 | 0.0 |
| BA-WC-132 | 35.4 | 12.5 | 43.6 | 13.2 | 0.0 |
| BA-WC-133 | 6.5 | 56.5 | 56.5 | 4.2 | 0.0 |
| BA-WC-136 | 19.4 | 38.7 | 62 | 10.7 | 0.0 |
| BA-WC-138 | 10.2 | 37.5 | 70.7 | 8.0 | 0.0 |
| BA-WC-141 | 31.7 | 35.2 | 67.8 | 7.0 | 0.0 |
| BA-WC-146 | 21.2 | 25.8 | 39.3 | 5.7 | 0.0 |
| BA-WC-152 | 38.5 | 38.7 | 56.8 | 9.2 | 0.0 |
| BA-WC-154 | 39.8 | 45 | 49.8 | 6.7 | 0.0 |
| BA-WC-155 | 92.9 | 49.8 | 49.8 | 4.2 | 0.0 |
| BA-WC-161 | 38.6 | 37.7 | 37.7 | 8.7 | 0.0 |
| BA-WC-162 | 37.7 | 33.3 | 33.3 | 4.9 | 0.0 |
| BA-WC-169 | 29.8 | 38.1 | 38.1 | 9.2 | 0.0 |
| BA-WC-173 | 31.1 | 35.5 | 35.5 | 12.0 | 0.0 |
| BA-WC-174 | 15.3 | 33.2 | 33.2 | 7.8 | 0.0 |
| BA-WC-177 | 37.2 | 34.7 | 34.7 | 9.9 | 0.0 |
| BA-WC-181 | 23.9 | 17.2 | 60.6 | 15.4 | 0.0 |
| BA-WC-183 | 82.1 | 12.6 | 41.5 | 11.2 | 0.0 |
| BA-WC-186 | 54.5 | 17.1 | 45.0 | 12.7 | 0.0 |
| BA-WC-194 | 22.3 | 44.4 | 44.4 | 10.1 | 0.0 |
| BA-WC-196 | 50.2 | 29.7 | 41.0 | 12.9 | 0.0 |
| BA-WC-199 | 34.4 | 33.4 | 39.7 | 6.9 | 0.0 |
| BA-WC-200 | 9.1 | 62.7 | 68.7 | 5.2 | 0.0 |
| BA-WC-295 | 6.4 | 45.2 | 45.2 | 14.5 | 0.0 |

Table 1–Battle Creek Basin watershed characteristics.

### *Design Storm Development*

While the City of Salem Design Standards recommends the 24-hour SCS Type-1A storm distribution (City of Salem 2014), preliminary model results suggested that this distribution was inadequate for a basin wide model. Therefore, an evaluation of available rainfall data was conducted to determine the most appropriate design storms for use in the City of Salem SWMP Update (See Appendix B). As a result of the evaluation, the following recommendations were made:

- The 100-year, 48-hour design storm should be used for evaluation of the flood risk within the Battle Creek basin.
- Both the 48-hour and 72-hour design storms should be used for evaluating the performance of the existing drainage system under existing and full build-out conditions.
- As part of the basin planning process, the 48-hour design storm should be used for evaluation of new and/or retrofit facilities or other best management practices that do not involve significant changes in flood storage. Both the 48-hour and 72-hour design storms should be used for evaluation of flood storage facilities.

## *Hydraulics Component Development*

The development of the Hydraulic component of the XP-SWMM model included:

- Data Collection and GIS Database Compilation
- Link Modeling Methods
- Node Modeling Methods
- Two-Dimensional Modeling
- Outfall Conditions

A detailed description of the hydraulic modeling methods used for developing the Battle Creek Basin model is presented in the City of Salem *Stormwater Master Plan (SWMP)* (See Appendix F of the SWMP).

A detailed description of the model selection process follows.

### *Data Collection and GIS Database Compilation*

Much of the required pipe and culvert data was available either in the City's Hanson asset management database, the City's storm sewer GIS data, or as-built drawings. However, site visits were required for some areas to verify and collect data for portions of the Battle Creek Basin drainage network, especially upstream of Lone Oak Road and downstream of I-5. A large portion of Battle Creek, Waln Creek, Powell Creek, and Scotch Creek were contained in available HEC-RAS models, which provided necessary channel, bridge, and control structure data. Data had to be gathered through field work for bridges, control structures, and channels not contained in the HEC-RAS mod-

els. Elevation data for areas located outside of the Urban Growth Boundary was developed from available LiDAR data. Dimensions of hydraulic structures located outside of the Urban Growth Boundary were either measured in the field with a tape measure or estimated.

The overlap of recent development activities near the confluence of Waln Creek and Battle Creek and multiple calibration/validation events required model adjustments according to the date of the calibration event. This included the modification of bridges, channels, and culverts as wells as the underlying DTM used in the 2D model. Date specific modifications came from the Battle Creek Elementary and Waln Creek HEC-RAS models and as-built topographic data. The three modeling scenarios include the following:

- *Pre2012* – Before construction of Battle Creek Elementary, Waln Creek realignment, construction of Waln Drive, and Woodside Road culvert replacement.
- *2012* – After grading of Battle Creek Elementary. Before Waln Creek realignment, construction of Waln Drive, and Woodside Road culvert replacement.
- *Existing (2015)* - After construction of Battle Creek Elementary, Waln Creek realignment, construction of Battle Creek Overflow Diversion Channel, construction of Waln Drive, and Woodside Road culvert replacement.

### *Link and Node Modeling Methods*

Nodes in the Battle Creek Basin XP-STORM model represent manholes, junctions, confluences, and storage areas. A description of the modeling methodologies and techniques used when developing the nodes is provided in the City of Salem Stormwater Master Plan (SWMP) (See Appendix E of the SWMP). For the node-naming convention, the first two letters in the node name indicate the primary drainage basin the node is located in (e.g., BA for Battle Creek). The third and fourth letters refer to the subbasin in which the node is located (e.g., BC for Battle Creek and WC for Waln Creek). The last three numbers are a unique identifier of the node. For example, BA-WC-076 is node number 076 located in the Waln Creek (WC) subbasin within the Battle Creek Basin (BA).

Links in the Battle Creek Basin XP-STORM model represent channels, pipes, bridges, culverts, and control structures. A description of the modeling methodologies and techniques used when developing the links is described in Appendix E of the SWMP. The link naming convention is based on the upstream node identifier, except it uses lower case lettering and no hyphen between the basin and creek identifiers. For example, bawc-076 is link 076, located just downstream of node number 076, along Waln Creek, in the Battle Creek Basin. For overflow links, an “o” was placed at the end of the link name. **Figure 7** shows the link and node network developed for the XP-STORM model.

### *Two-Dimensional Modeling*

The relatively flat area located upstream of Fairway Avenue contains the confluence of Battle Creek, Waln Creek, Powell Creek, and Scotch Creek. The complex flow interactions between the creeks, the broad flood extents, and the historic flooding that has occurred between 13th Street and Battle Creek Elementary necessitated the use of the two-dimensional (2-D) modeling component of XP-STORM. A grid with 12 by 12 feet cells was developed for this area totaling approximately 30,000 cells. The extent of the 2-D grid and the land cover types used to assign the 2-D overland roughness values is provided in **Figure 8**.

#### *Outfall Conditions*

Normal depth was used as the boundary condition at the model outfall based on the slope of the upstream link. For the purposes of the SWMP, the downstream extent of the Battle Creek Basin is I-5. However, the Battle Creek Basin model extended an additional 4.2 miles to the confluence with Mill Creek in order to understand how upstream basin modifications might influence peak flows near the City of Turner. As a result of this significant distance, the outfall conditions do not influence the model results for the area of interest located upstream of I-5.

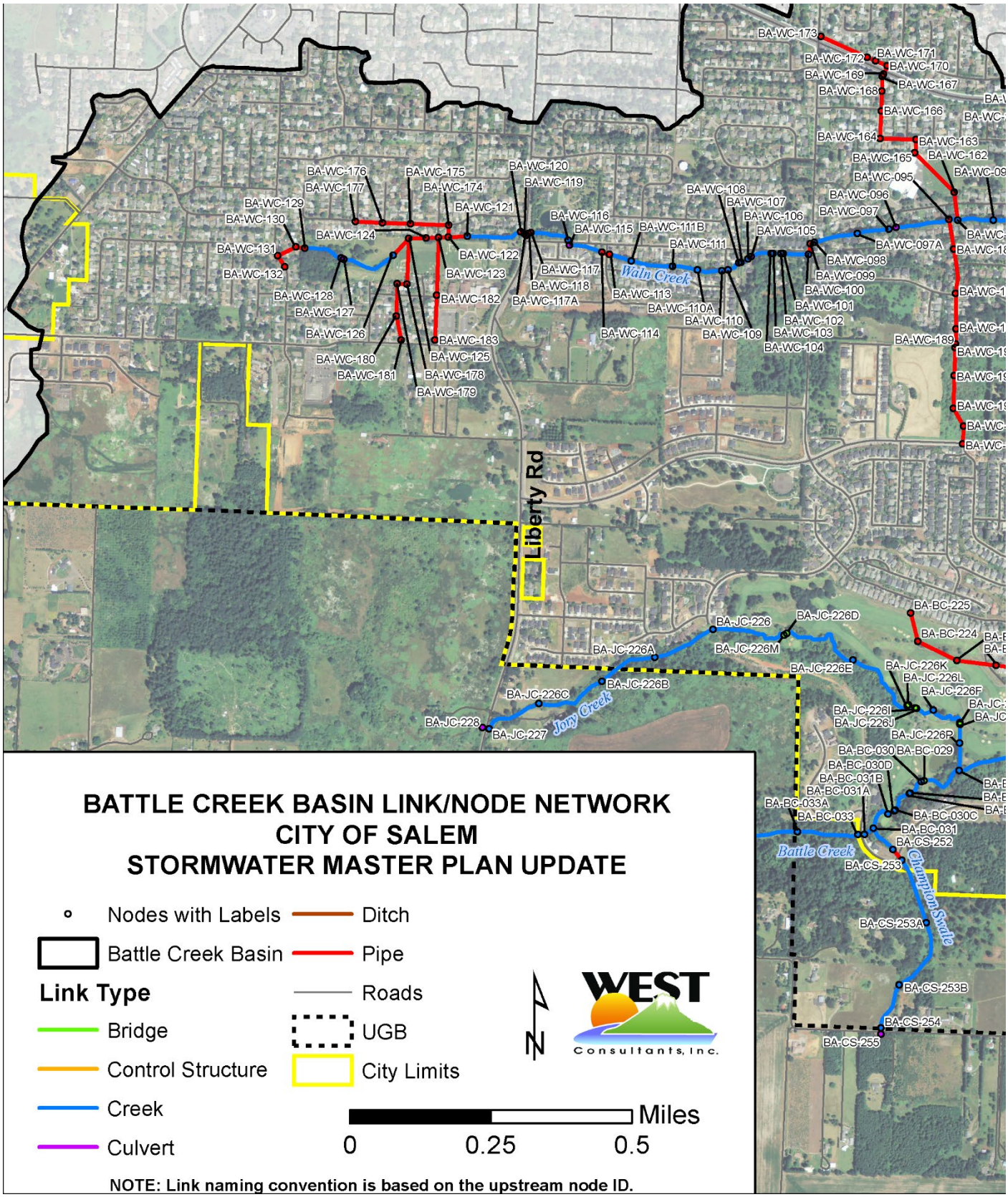
### *Quality Assurance Review*

Multiple reviews were conducted and documented as part of the Battle Creek Basin model development. QA/QC check sheets are provided in **Appendix C**. The existing conditions model has a hydraulic continuity of 1.7% and a runoff continuity of 0.003%, both of which are less than the maximum error of +/- 2% that XP Software's documentation recommends (XP Solutions 2014). Localized instabilities in the stage and/or flow were fixed where needed. All water was captured in the link/node network. No water "smoke stacks" (exceeds the node spill elevation) or spills out of the system and the maximum water surface elevation that can be reached at each node without spilling or "smoke stacking" was documented in the node notes within XP-STORM, as well as the "MAXWATER" field within the node's GIS attribute table. Channel cross sections were checked for vertical wall extrapolation and modified where necessary to contain all of the flow in the channel. 2-D Flow patterns and velocities were analyzed and checked for reasonableness. The final cumulative 2-D Mass Error was -0.04%, which is within XP Solutions documented acceptable range of +/- 1%.

## *Model Calibration/Verification*

### *Streamflow Data*

Streamflow data are available at two locations in the Battle Creek Basin. The most upstream gauge, BAT12, is located on Battle Creek just upstream of Lone Oak Road. The approximate elevation of the gauge is 437 feet. The contributing drainage area is 3.6 square miles and is located entirely upstream of the City of Salem UGB. Land cover is generally forest and agricultural. Stage recordings are made in 15-minute intervals. The period of record for the gauge is from October 2008 to present. According to discussions


BATTLE CREEK BASIN LINK/NODE NETWORK
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
Nodes with Labels
Battle Creek Basin
Link Type
Bridge
Control Structure
Creek
Culvert
Ditch
Pipe
Roads
UGB
City Limits
Miles
0
0.25
0.5
NOTE: Link naming convention is based on the upstream node ID.
WEST
Consultants, Inc.
Liberty Rd
Waln Creek
Jory Creek
Battle Creek
Champion Swale
BA-WC-173
BA-WC-172
BA-WC-171
BA-WC-170
BA-WC-169
BA-WC-168
BA-WC-167
BA-WC-166
BA-WC-164
BA-WC-163
BA-WC-165
BA-WC-162
BA-WC-095
BA-WC-096
BA-WC-097
BA-WC-097A
BA-WC-098
BA-WC-099
BA-WC-100
BA-WC-101
BA-WC-102
BA-WC-103
BA-WC-104
BA-WC-105
BA-WC-106
BA-WC-107
BA-WC-108
BA-WC-109
BA-WC-110
BA-WC-110A
BA-WC-111
BA-WC-111B
BA-WC-113
BA-WC-114
BA-WC-115
BA-WC-116
BA-WC-117
BA-WC-117A
BA-WC-118
BA-WC-119
BA-WC-120
BA-WC-121
BA-WC-122
BA-WC-123
BA-WC-124
BA-WC-125
BA-WC-126
BA-WC-127
BA-WC-128
BA-WC-129
BA-WC-130
BA-WC-131
BA-WC-132
BA-WC-174
BA-WC-175
BA-WC-176
BA-WC-177
BA-WC-178
BA-WC-179
BA-WC-180
BA-WC-181
BA-WC-182
BA-WC-183
BA-WC-189
BA-JC-226
BA-JC-226A
BA-JC-226B
BA-JC-226C
BA-JC-226D
BA-JC-226E
BA-JC-226M
BA-JC-227
BA-JC-228
BA-BC-224
BA-BC-225
BA-JC-226K
BA-JC-226L
BA-JC-226F
BA-JC-226I
BA-JC-226J
BA-JC-226R
BA-BC-029
BA-BC-030
BA-BC-030C
BA-BC-030D
BA-BC-031
BA-BC-031A
BA-BC-031B
BA-BC-033
BA-BC-033A
BA-CS-252
BA-CS-253
BA-CS-253A
BA-CS-253B
BA-CS-254
BA-CS-255

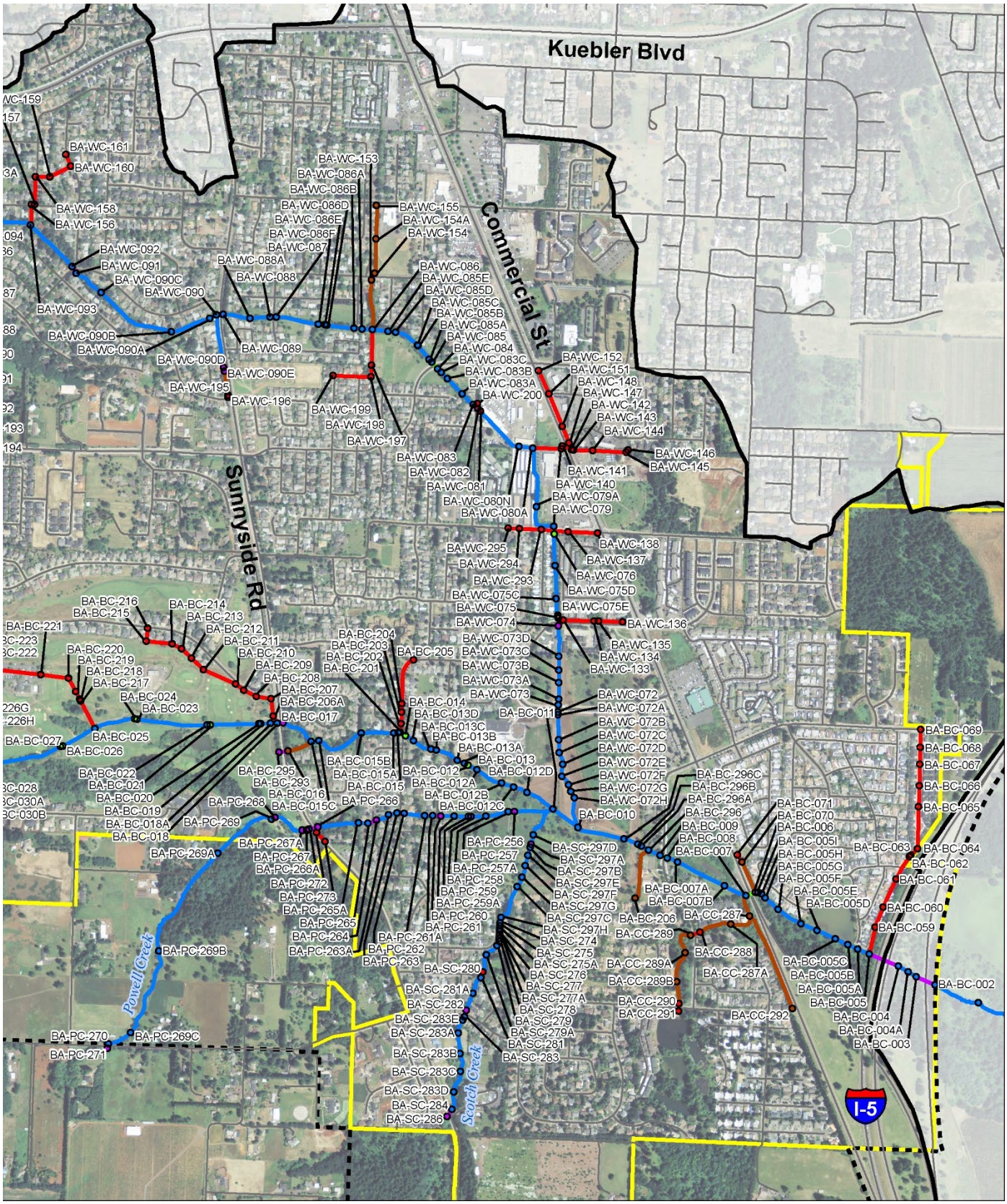



Figure 7–Battle Creek Basin XP-STORM link and node network.


Sunnyside Rd SE
Madras St SE
13th Ave SE
Battle Creek
Overflow Diversion
Powell Creek
BATTLE CREEK BASIN 2-D GRID EXTENTS & LAND COVER
CITY OF SALEM
STORMWATER MASTER PLAN UPDATE
Building
Forest
Grass
Paved
Prarie Grass
Water
2-D Grid Extent
1-D Channel
Roads
N
WEST
Consultants, Inc.
0
250
500
Feet

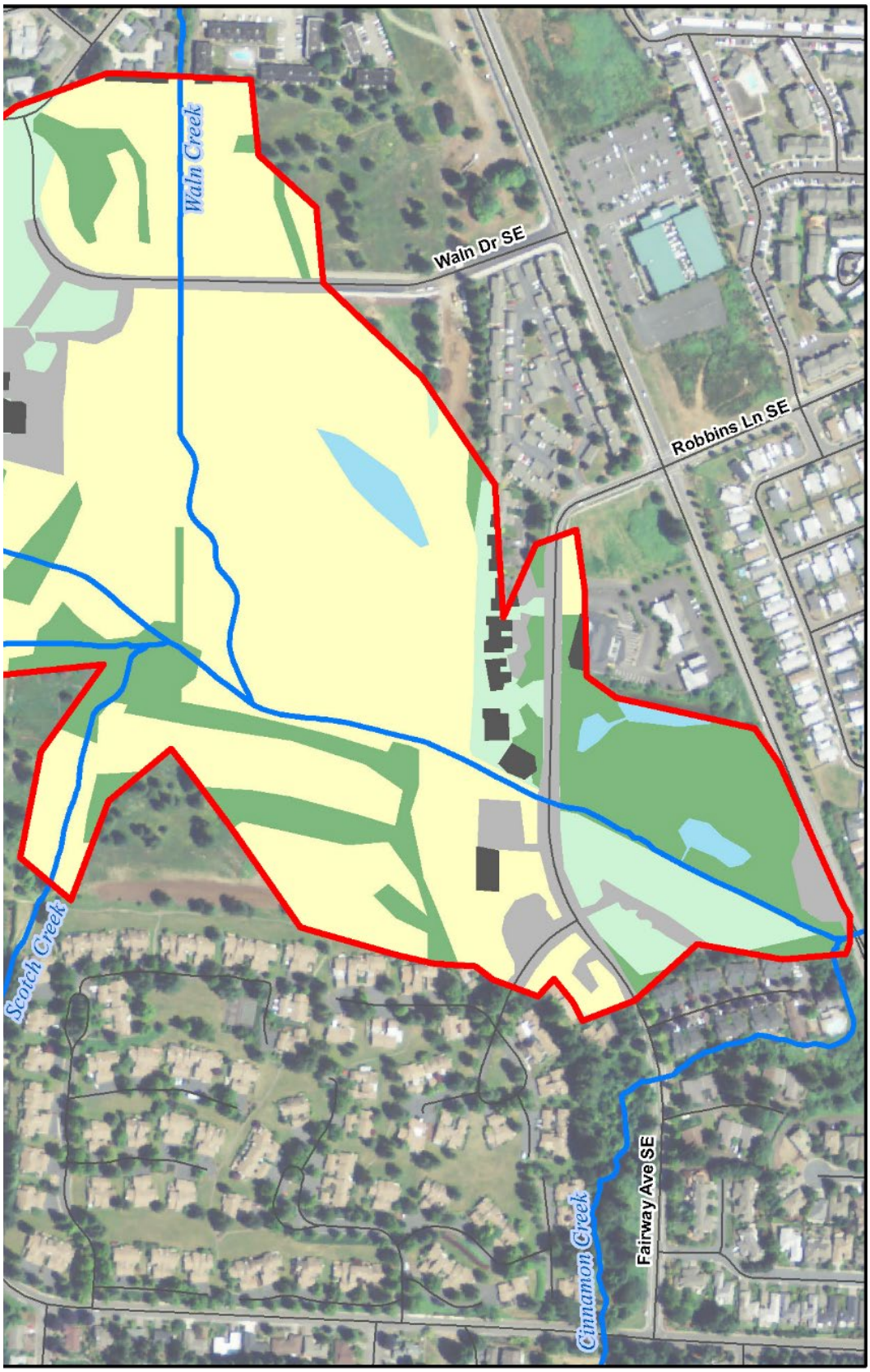



Figure 8–Battle Creek Basin 2-D grid extents and land cover.

with City staff, the gauge produced reliable data prior to the January 2012 flood. However, during the flood, significant erosion of the channel occurred which resulted in unreliable data for the flood event. Following the January 2012 flood event, the erosion was repaired and a new rating table was developed.

The other Battle Creek gauge, BAT3, is located near the outlet of the Battle Creek Basin at the Commercial Street crossing of Battle Creek. It has a contributing drainage area of 10 square miles, approximately half of which is located within the City of Salem UGB. The approximate elevation of the gauge is 378 feet. Stage recordings are made in 15-minute intervals. The period of record for the gauge is from October 2008 to present. According to discussions with City staff, prior to and during the January 2012 flood event, there was a significant amount of debris obstructing the downstream culvert and channel that likely increased backwater elevations, invalidating the stage-discharge rating table for the gauge for this flood event. After the 2012 flood event, the debris was cleared and the gauge rating table was checked and updated for reporting of subsequent flows.

### *Storm Events*

The available streamflow and precipitation data were evaluated in order to select the most appropriate storm events for calibration and verification of the XP-STORM model. Because of the short period of record for the streamflow gauges, the choices for calibration and verification events were limited. The follow events were selected:

#### *January 2009 (Verification Event #1)*

The January 2009 storm produced 3.3 inches of rainfall over 30 hours. At the BAT3 gauge, the recorded peak was 242 cubic feed per second (cfs) and at BAT12 it was 108 cfs. For this event, the grading for Battle Creek Elementary School and the realignment of Waln Creek were not included in the 2-D grid.

#### *December 2010 (Calibration Event)*

The December 2010 storm produced 4.3 inches of rainfall over 4 days. At BAT3 gauge, the recorded peak was 261 cfs and at BAT12 it was 98 cfs. Since the stream gauges were unreliable during the 2012 event, this event was used for calibration. For this event, the grading for Battle Creek Elementary School and the realignment of Waln Creek were not included in the 2-D grid.

#### *January 2012 (Verification Event #2)*

The January 2012 storm produced 7.2 inches of rainfall over 72-hours. At the BAT3 gauge, the recorded peak was 589 cfs and at BAT12 it was 329 cfs. While the magnitude of the storm would suggest it to be a primary candidate for model calibration, the washout of the channel at the BAT12 gauge and debris clogging downstream of the BAT3 introduced uncertainties in the streamflow data for this event. Therefore, this event was selected to be a secondary verification event. For this event, the grading for Battle Creek Elementary School was included but the Waln Creek realignment was not.

According to City staff, data for RG11, the primary rain gauge for the BAT12 drainage

area, was not producing reliable readings for the first half of the January 2012 storm event due to snow accumulation on the gauge. For the duration in which the rain gauge data are considered to be in error, the rainfall data from RG8 were used. A multiplier of 1.1 was used to transfer the data from RG8 to RG11. The 10-percent increase is based on precipitation depth relationship for the two gauges over the period in which both gauges were functional.

#### *December 2015 (Verification Events #3 and #4)*

Subsequent to the initial model calibration and verification efforts that occurred in the summer of 2015, two additional relevant storm events occurred. The first occurred on December 7, 2015, and the second followed shortly thereafter on December 17-18, 2015. The December 7 event produced 3.0 inches of rainfall over 23 hours. The December 17-18 event produced 3.5 inches of rainfall over 32 hours.

It should be noted that, similar to January 2012, the stage readings for the BAT3 gauge were affected by backwater from debris during both of the December storm events. City staff observed debris clogging the I-5 culvert inlet grate on December 7 and observed a pile of debris adjacent to the culvert following the December 17-18 event, presumably removed by ODOT crews. City staff also conducted a flow measurement at the gauge during the December 7 event. The stage-discharge rating curve was adjusted to account for the additional backwater caused by the debris. This same correction was assumed to apply for the December 17-18 event; however, no flow measurement was taken that could confirm that this same adjustment is appropriate. It is recommended that the City move the BAT3 gauge or install velocity measuring equipment at the current gauge location that will help to compensate for debris related backwater conditions.

As discussed above, there is uncertainty in the data used for model calibration and verification. In order to provide greater confidence in the model results, multiple large storm events with dependable streamflow measurements are needed. Because of the relatively short period of record for the streamflow gauges and the lack of reliable data for the January 2012 storm event, it is recommended that further calibration be conducted as additional precipitation and streamflow data for larger storm events become available.

### *Procedures*

Initial parameter sensitivity testing indicated that runoff volumes were most sensitive to the initial and critical infiltration rates and that the timing of the hydrograph peak was most sensitive to the subbasin width parameter. Calibration and verification of the Battle Creek Basin XP-STORM model was an iterative process. An initial calibration was performed and then tested with the verification events. Parameter adjustments were made and the model was rerun for the calibration event and then retested for the verification events. This process was iteratively repeated until the modeled results satisfactory matched the streamflow observations during the calibration and verification events.

To calibrate the volume, the critical and initial infiltration rates were adjusted in areas that were assigned as silty-clay-loam soils. As previously seen in **Figure 6**, silty-clay-loam

soils are the dominate soil type in Battle Creek Basin. Initially, these areas were generally assigned critical infiltrations rates of 0.1 inch/hour based on their hydrologic soil classification of "C" as suggested by Musgrave (1955). However, according to Akan (1993), silty-clay-loam soils should have critical infiltration rates in the range of 0.00-0.05 inch/hour. When the critical infiltration rates within that range were used, the model's volume results more closely matched the observations.

The initial infiltration rates were reduced during calibration to represent near saturated conditions resulting in initial infiltration rates that have nearly the same value as the critical infiltration rate. This is considered appropriate since larger flood events in Salem generally occur during the colder and wetter winter months when soils are likely to have little time to dry out between storm events.

The initial calibration model produced flashy hydrographs that did not mimic the shape of the hydrographs for the streamflow gauge data. The initial calibration hydrographs had much steeper rising and falling limbs and greater peak flows which suggested that the overland flow travel time to the channel was too quick. Overland flow roughness and channel roughness values had little influence on hydrograph shape. The parameter that had the greatest influence on the hydrograph shape was the subbasin width parameter, which was adjusted accordingly. This resulted in modeled and observed hydrographs that matched well for the calibration and verification events.

Minimal data were available for the calibration of the Manning's roughness values for the various stream channels. Stage data for the two streamflow gauges and flood photos for various locations in the Battle Creek Basin for the January 2012 storm event were available. Channel roughness values were modified accordingly to best match stage data and observed flooding. Observed versus modeled stage and discharge hydrograph plots for the BAT3 and BAT12 streamflow gauges are located in **Appendix D**.

### *Existing Conditions Results*

Model results indicate that the 48-hour design storm generally produces conservatively higher peak flows and water surface elevations when compared with the 72-hour storm. The model parameters selected during calibration were used with the 10-, 25-, 50-, and 100-year, 48-hour design storms to develop the peak discharges and water surface elevations for the Battle Creek Basin. **Table E.1** and **Table E.2** in **Appendix E** show the peak discharges for each link and the maximum water surface elevations for each node located within the UGB for the 10-, 25-, 50-, and 100-year 48-hour and 72-hour design storms, respectively. 2-D model inundation extents within the Battle Creek - Waln Creek confluence area are shown in **Figures E.1** to **E.4** in **Appendix E**. **Figures E.6** to **E.8** in **Appendix E** categorize the hydraulic conditions at bridges, culverts, and manholes as below the pipe crown elevation, between pipe crown and ground/overflow elevation, or above ground/overflow elevation.

### *Full Build-Out Conditions*

Full build-out conditions for the Battle Creek Basin were estimated and modeled to assist

in the development of the basin plan. To develop the full build-out conditions model, the percent impervious values for the existing undeveloped areas, golf courses, and agricultural areas within the UGB were modified according to the land use classifications provided in the July 2015 Salem Area Comprehensive Plan map. The Comprehensive Plan land use classifications were incorporated into the Battle Creek Basin land cover classifications using the category mapping shown in **Table 2**. The percent impervious for each of the subbasins was updated to reflect the full build-out land cover classification. A comparison of the existing condition and full build-out condition percent impervious for the primary subbasins is shown in **Table 3**.

| Comprehensive Plan Classification | SWMP Model Land Cover |
|---|---|
| Commercial Business District | Developed, Commercial |
| Commercial | Developed, Commercial |
| Community Service | Developed, Medium Intensity |
| Community Service Cemetery | Developed, Open Space |
| Community Service Education | Developed, Medium Intensity |
| Community Service Government | Developed, Medium Intensity |
| Community Service Hospital | Developed, Medium Intensity |
| Community Service Sewage | Developed, Medium Intensity |
| Developed, Medium Intensity | Developed, Medium Intensity |
| Employment Center | Developed, Medium Intensity |
| Farm Resource Management | Cultivated Crops |
| Industrial Commercial | Developed, Industrial |
| Developed, Medium High Intensity | Developed, Medium High Intensity |
| Mixed Use | Developed, Commercial |
| Developed, Open Space | Developed, Open Space |
| River-Oriented Mixed Use | Developed, Commericial |
| Single Family Residential | Developed, Medium Intensity |

Table 2–Land cover classifications.

| Primary Subbasin Name | Existing % Impervious | Full Build-Out % Impervious |
|---|---|---|
| Battle Creek (Upstream of Confluence Area) | 4 | 9 |
| Battle Creek (Upstream of I-5) | 13 | 21 |
| Jory Creek | 5 | 14 |
| Powell Creek | 7 | 25 |
| Scotch Creek | 11 | 17 |
| Waln Creek | 30 | 42 |

Table 3–Existing and full build-out percent impervious area.

Because requirements for detention and the implementation of green infrastructure will be specific to each future development and because the full-build out modeling is for planning purposes, it was assumed that the percentage of connected impervious surface

for each land cover type would be similar to current conditions.

Full build-out peak discharges for each link and maximum water surface elevations for each node located within the UGB for the 10-, 25-, 50-, and 100-year 48-hour and 72-hour design storms are provided in **Table E.1** and **Table E.2** in **Appendix E**, respectively. 2-D model inundation extents for the Battle Creek - Waln Creek confluence area are shown in **Figures E.9** to **E.12** in **Appendix E**. **Figures E.13** to **E.16** in **Appendix E** categorize the full build-out hydraulic conditions at bridges, culverts, and manholes as below the pipe crown elevation, between the pipe crown and the ground/overflow elevation, or above the ground/overflow elevation.

In general, the 100-year, 48-hour design storm peak discharge for Battle Creek is expected to increase by 123 cfs or approximately 16% at the I-5 culvert. Downstream of Creekside Golf Course, the 100-year, 48-hour design storm peak discharge for Battle Creek is expected to increase by 67 cfs or approximately 19%. Although the Waln Creek drainage basin is already mostly developed, the 100-year, 48-hour design storm peak discharge is expected to increase by about 44 cfs or approximately 14% at its confluence with Battle Creek. Given the significantly large amount of undeveloped areas remaining within the Battle Creek Basin, full build-out of the basin would be expected to significantly increase the peak flows, volumes, and flooding extents in the Battle Creek - Waln Creek confluence area. Limiting the amount of impervious surface and implementing green infrastructure should help offset the expected increases.

## ALTERNATIVES ANALYSIS

To develop the list of recommended stormwater capital improvement projects (CIPs) for the Battle Creek Basin Plan, an extensive alternatives analysis was performed using the calibrated XP-STORM model. A description of each alternative and associated model results is provided in **Appendix F**. Projects evaluated in the alternatives analysis were culvert and bridge replacements, channel vegetation and debris clearing, storage area creation, flow diversions, floodplain grading, and channel improvements.

The alternative that results in a significant reduction in flood risk to the Greenside Village Condominiums is Project No. BA-BC1, which includes the placement of a reinforced concrete box culvert beneath the Battle Creek Elementary School entrance driveway. For the 100-year, 48-hour storm, water surface elevations are expected to decrease by approximately 1.7 feet. Because this project is not located on City property, coordination with the Salem-Keizer School District would need to occur for planning and implementation of this project. Also, it should be recognized that if Project Nos. BA-BC2, BA-BC3 and BA-BC4 (discussed below) are implemented, overtopping at 13th Street would no longer be expected to occur. Therefore, BA-BC1 would not be needed.

The alternative that would result in the greatest reduction in peak discharge is Project No. BA-BC2, which consists of the creation of floodplain storage within the Battle Creek – Waln Creek confluence area. The alternatives that would results in the greatest reduction in flood risk along Battle Creek in the13th Street and Packwood Court area and the area surrounding Battle Creek Elementary School is implementation of Projects BA-BC 3 and

BA-BC4, which consist of channel improvements, including benching, along an approximately 2,200 feet-long reach of Battle Creek located upstream of the confluence with Waln Creek. The alternative that would result in the greatest reduction in flood risk to the area in the vicinity of Fairway Avenue is the implementation of Project No. BA-BC5, which consists of channel improvements, including benching, along an approximately 1,300 feet-long reach of Battle Creek from 220 feet upstream of Commercial Street SE to I-5. The alternative that would result in the greatest reduction in flood risk along Waln Creek between Woodside Avenue and Madras Street is Project No. BA-WC1, which consists of channel vegetation and debris clearing.

To reduce the potential for increasing flood risk for areas located downstream of each of the channel conveyance improvement project locations, including the City of Turner, various combinations of alternatives were evaluated. The selected combinations of conveyance improvement and flood storage alternatives were chosen based on their ability to both lower peak flood elevations in problematic areas and reduce the potential for downstream flow increases. Combination No. 1 components include floodplain storage (BA-BC2), channel benching along Battle Creek upstream of the Waln Creek confluence (BA-BC3), and channel clearing/reconstruction upstream of the Waln Creek confluence (BA-BC4). Combination 2 components include floodplain storage (BA-BC2), channel benching along Battle Creek upstream of the Waln Creek confluence (BA-BC3), channel clearing/reconstruction upstream of the Waln Creek confluence (BA-BC4), and channel benching/clearing along Battle Creek from 220-feet upstream of Commercial Street SE to I-5 (BA-BC5). The specific locations and extents of the components of Combination 1 and 2 are shown in **Figure 9**.

2-D model output inundation maps for Combinations 1 and 2 for existing conditions 25-, 50-, and 100-year, 48-hour design storms are shown in **Figures G.1** to **G.6** in **Appendix G**. Inundation maps for Combinations 1 and 2 for the full build-out conditions 25-, 50-, and 100-year, 48-hour design storms are shown in **Figures G.7** to **G.12** in **Appendix G**. A map showing the results of the various Waln Creek alternatives is shown in **Figure G.13** in **Appendix G**.


13th Street
Waln Creek
Waln Drive
Channel Clearing and Reconstruction
(Combinations 1 & 2)
Channel Benching
(Combinations 1 & 2)
Battle Creek
Channel Benching
(Combinations 1 & 2)
Powell Creek
Scotch Creek
Floodplain Storage
(Combinations 1 & 2)

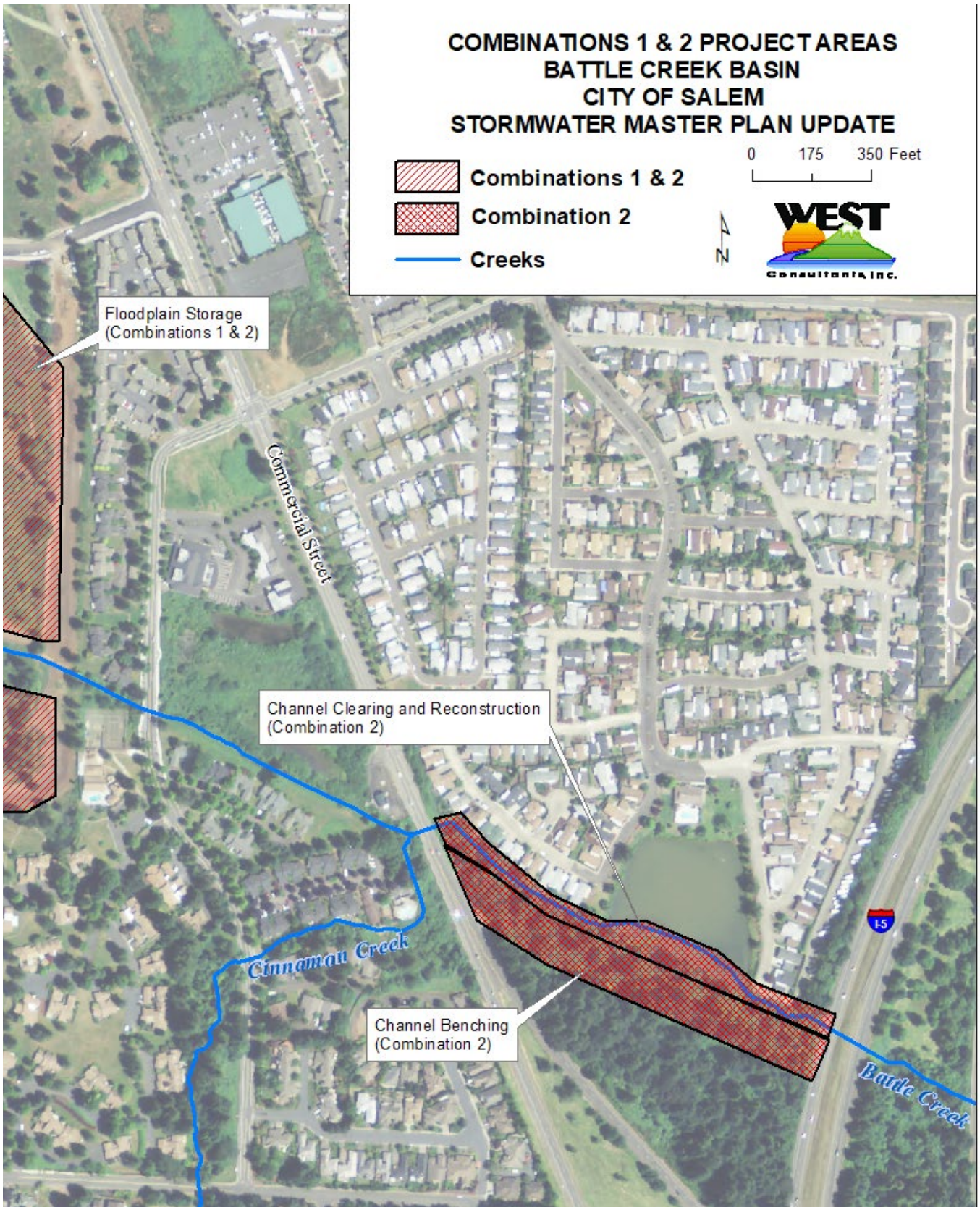



Figure 9–Components of Combinations 1 and 2.

# RECOMMENDED STORMWATER CAPITAL IMPROVEMENT PROJECTS

The recommended stormwater capital improvement projects were divided into two categories, short- and long-term. Short-term project are recommended for implementation within the next 10 years. Long-term projects are recommended to be implemented after 10 years. All cost estimates are in 2018 Dollars. Estimates originally provided in 2016 dollars (see Appendix H) were converted to 2018 values using the ratio of the Engineering News Record West Coast Cities (Seattle, San Francisco, Los Angeles) Construction Cost Index Average for 2016 to 2018, which was 1.09. Annual maintenance costs were assumed unchanged.

## *Short-Term CIPs*

The following are the recommended list of short-term (< 10 years) stormwater CIPs in recommended order of implementation. Detailed cost estimates are provided in Appendix H. Project locations are shown in **Figure 10**.

### *Project No. BA-BC1 - Install Box Culvert under Battle Creek Elementary School Driveway*

**Description:** Install 8-feet wide by 3.5-feet tall by 80-feet long reinforced concrete box culvert beneath the school driveway.

**Results:** Model output indicates that the flood risk for the Greenside Village Condominiums and Battle Creek Elementary School will be significantly reduced. For the 100-year, 48-hour storm, water surface elevations are expected to decrease by approximately 1.7 feet.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Construction Cost Estimate | $122,000 | $132,980 |
| Construction Contingency (30%) | $36,600 | $39,894 |
| **Construction Total:** | **$158,600** | **$172,874** |
| | | |
| Admin., Design, Permitting (25%) | $39,650 | $43,219 |
| Const. Survey and Management (13%) | $20,618 | $22,474 |
| **Rounded (nearest $1,000) Project Total:** | **$220,000** | **$239,000** |
| | | |
| **Annual Maintenance Cost:** | **N/A** | **N/A** |

### *Project No. BA-BC2 - Create Additional Floodplain Storage at Battle Creek-Waln Creek Confluence within City-Owned Property*

**Description:** Includes the creation of two large floodplain storage areas at the confluence of Waln Creek and Battle Creek. The project encompasses a 12-acre parcel located north of Battle Creek and east of Waln Creek and a 7.5-acre parcel located south of Battle Creek. Excavation depths average four to six feet and the total removal volume is approximately

150,600 cubic yards.

**Results:** Model output indicates that the project will have no appreciable effect on upstream flood risk. However, the project will significantly reduce flood risk to downstream properties and will offset increased peak flows that are expected to result from the future implementation of Project No. BA-BC3.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Construction Cost Estimate | $1,747,285 | $1,904,541 |
| Construction Contingency (30%) | $524,186 | $571,363 |
| **Construction Total:** | **$2,271,471** | **$2,475,903** |
| | | |
| Admin., Design, Permitting (25%) | $567,868 | $618,976 |
| Const. Survey and Management (13%) | $295,291 | $321,867 |
| **Rounded (nearest $1,000) Project Total:** | **$3,135,000** | **$3,417,000** |
| | | |
| **Annual Maintenance Cost:** | **$15,900** | **$15,900** |

### *Project No. BA-BC3 - Create Floodplain Benches along the Portion of the Battle Creek Channel Located South of the Elementary School*

**Description:** Includes the creation of floodplain benches along approximately 1,000 linear feet of Battle Creek to increase the conveyance capacity of the channel while maintaining the existing low flow channel characteristics. The project extends from the western extent of the City of Salem property to the confluence with Scotch and Powell Creeks. The channel modifications would be similar to the modifications that were implemented along the reach of Waln Creek located immediately upstream of Battle Creek.

**Results:** Model output indicates that the project will significantly reduce flood risk to Battle Creek Elementary School and Greenside Village Condominiums. For the 100-year, 48-hour storm, water surface elevations are expected to decrease by approximately 1.2 feet.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Construction Cost Estimate | $180,526 | $196,773 |
| Construction Contingency (30%) | $54,158 | $59,032 |
| **Construction Total:** | **$234,684** | **$255,806** |
| | | |
| Admin., Design, Permitting (25%) | $58,671 | $63,951 |
| Const. Survey and Management (13%) | $30,509 | $33,255 |
| **Rounded (nearest $1,000) Project Total:** | **$330,000** | **$353,000** |
| | | |
| **Annual Maintenance Cost:** | **$2,200** | **$2,200** |

## *Long-Term CIPs*

The following are the recommended list of long-term (> 10 years) stormwater CIPs in recommended order of implementation. Detailed cost estimates are provided in Appendix H. Project locations are shown in Figure 10.

### *Project No. BA-BC4 - Vegetation Clearing / Channel Reconstruction along Battle Creek between City Owned Property and Sunnyside Road*

**Description:** Clear woody vegetation and reconstruct/restore channel along Battle Creek between western extent of City-owned property and Sunnyside Road. Project will require the acquisition of an approximate 75-foot-wide stormwater maintenance easement along Battle Creek (total of approximately 1800 linear feet, or 3.1 acres) and the acquisition of at least three private properties adjacent to Battle Creek between the western extent of City of Salem property and 13th Avenue SE. Although not specifically modeled, the project was extended upstream to Sunnyside Road to help eliminate continued channel degradation and bank failures that have occurred along this reach due to hydromodifications.

**Results:** When combined with Project No. BA-BC3, the flood risk to properties along 13th Avenue SE and Packwood Court, Battle Creek Elementary School, and the Greenside Village Condominiums will be significantly reduced. For the 100-year, 48-hour storm, the water surface elevation at 13th Avenue SE is be expected to decrease by approximately 1.1 feet and no longer cause flooding in these areas.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Construction Cost Estimate | $555,061 | $605,016 |
| Construction Contingency (30%) | $166,518 | $181,505 |
| **Construction Total:** | **$721,579** | **$786,521** |
| | | |
| Admin., Design, Permitting (25%) | $180,395 | $196,631 |
| Const. Survey and Management (13%) | $93,805 | $102,247 |
| **Rounded (nearest $1,000) Project Total:** | **$1,000,000** | **$1,085,000** |
| | | |
| Easement Acquisition[1]: | | $1,200,000 |
| Easement Acquisition[2]: | | $1,240,000 |
| **Grand Total:** | | **$3,525,000** |
| | | |
| **Annual Maintenance Cost:** | **$2,900** | **$2,900** |

[1] Assumes three residential properties @ $400,000 each.
[2] Assumes approximately 3.1 acres @ $400,000 per acre.

### *Project No. BA-BC5 – Create Floodplain Benches along Battle Creek from just Upstream of Commercial Street SE to I-5*

**Description:** Includes the creation of floodplain benches along approximately 1,300 linear feet of Battle Creek to increase the conveyance capacity of the channel while maintaining

the existing low flow channel characteristics. The project extends from approximately 220 feet upstream of Commercial Street SE downstream to Interstate 5. The channel modifications would be similar to the modifications to that were implemented along the reach of Waln Creek located immediately upstream of Battle Creek. The project would require approximately 1,100 linear feet of easement, 100 feet in width, or approximately 2.5 acres, for the vegetated area south of the channel.

**Results:** The flood risk to properties in the vicinity of Fairway Avenue SE will be significantly reduced. For the 100-year, 48-hour storm, the water surface elevation upstream of Fairway Avenue SE is be expected to decrease by approximately 0.6 feet and result in only minor street flooding.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Construction Cost Estimate | $156,450 | $170,531 |
| Construction Contingency (30%) | $46,935 | $51,159 |
| **Construction Total:** | **$203,385** | **$221,690** |
| | | |
| Admin., Design, Permitting (25%) | $50,846 | $55,422 |
| Const. Survey and Management (13%) | $26,440 | $28,820 |
| **Rounded (nearest $1,000) Project Total:** | **$290,000** | **$306,000** |
| | | |
| Easement Acquisition[1]: | | $1,000,000 |
| **Grand Total:** | | **$1,306,000** |
| | | |
| **Annual Maintenance Cost:** | **$1,600** | **$1,600** |

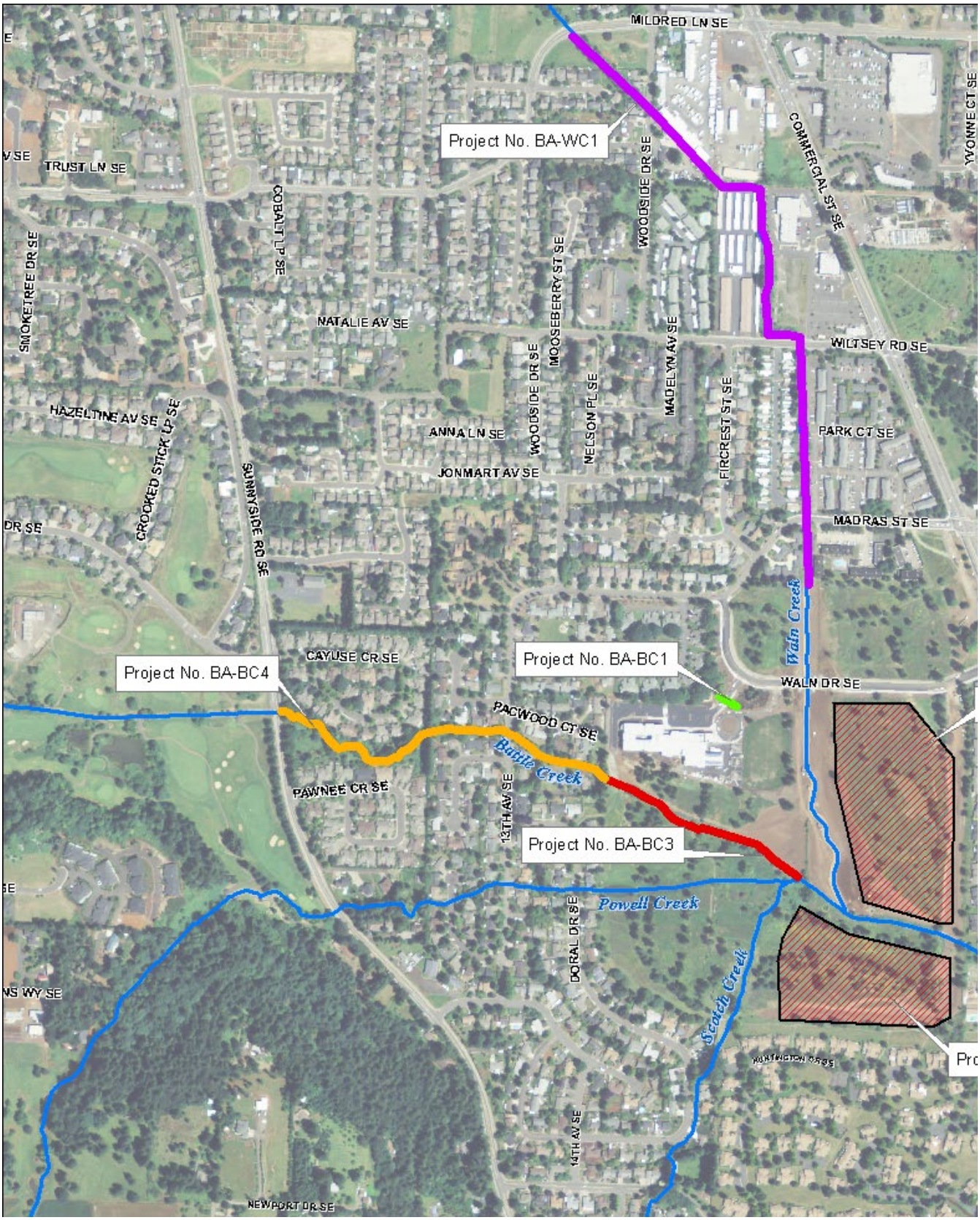
[1] Assumes approximately 2.5 acres @ $400,000 per acre.

### *Project No. BA-WC1 – Vegetation Clearing / Minor Channel Improvements along Waln Creek between the Northern Extent of City of Salem Property and Mildred Lane SE*

**Description:** Clear woody vegetation and conduct minor channel grading improvements along Waln Creek between the northern extent of City-owned property and Mildred Lane SE. Project will require the acquisition of approximately 3,120 linear feet of a 40-foot-wide stormwater maintenance easement along Waln Creek (approximately 2.9 acres).

**Results:** The flood risk to properties along Waln Creek will be somewhat reduced. For the 100-year, 48-hour storm, the water surface elevations along Waln Creek will be reduced by between approximately 0.5 and 0.7 feet.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Construction Cost Estimate | $252,046 | $274,730 |
| Construction Contingency (30%) | $75,614 | $82,419 |
| **Construction Total:** | **$327,660** | **$357,149** |
| | | |
| Admin., Design, Permitting (25%) | $81,915 | $89,287 |


Project No. BA-WC1
Project No. BA-BC4
Project No. BA-BC1
Project No. BA-BC3
MILDRED LN SE
TRUST LN SE
COBALT LP SE
SMOKETREE DR SE
NATALIE AV SE
WOODSIDE DR SE
MOOSEBERRY ST SE
NELSON PL SE
MADELYN AV SE
FIRCREST ST SE
COMMERCIAL ST SE
YVONNE CT SE
WILTSEY RD SE
PARK CT SE
HAZELTINE AV SE
CROOKED STICK LP SE
ANNA LN SE
JONMART AV SE
SUNNYSIDE RD SE
MADRAS ST SE
CAYUSE CR SE
WALN DR SE
Waln Creek
PACWOOD CT SE
Battle Creek
PAWNEE CR SE
13TH AV SE
Powell Creek
DORAL DR SE
Scotch Creek
14TH AV SE
NEWPORT DR SE

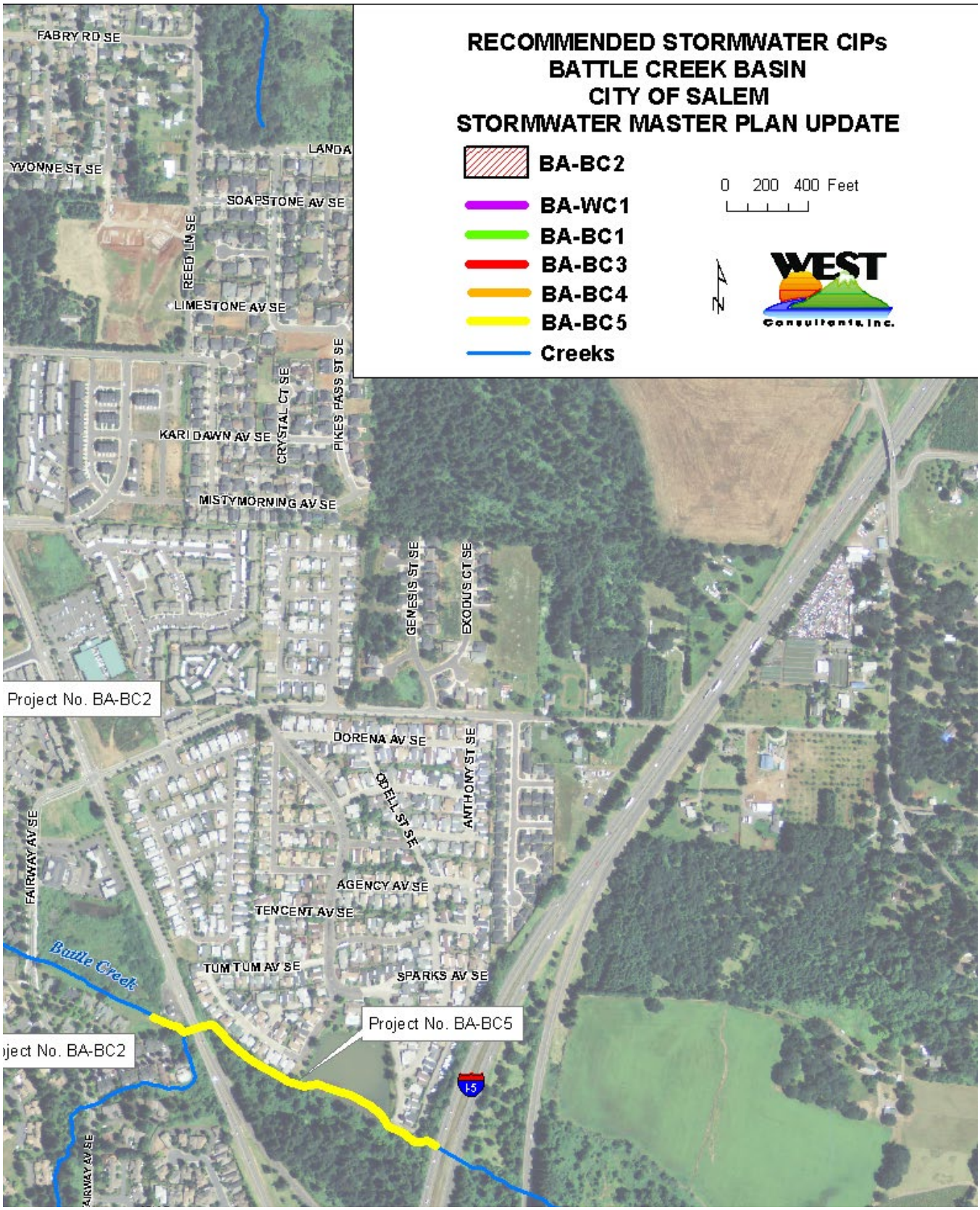



Figure 10–Locations of recommended short-term and long-term stormwater capital improvement projects.

| | 2016 Est. | 2018 Est. |
|---|---|---|
| Const. Survey and Management (13%) | $42,596 | $46,430 |
| **Rounded (nearest $1,000) Project Total:** | **$460,000** | **$493,000** |
| | | |
| Easement Acquisition[1]: | | $1,160,000 |
| **Grand Total:** | | **$1,653,000** |
| | | |
| **Annual Maintenance Cost:** | **$6,200** | **$6,200** |

[1] Assumes approximately 2.9 acres @ $400,000 per acre.

# REFERENCES


Akan, A.O. (1993). *Urban Stormwater Hydrology: A Guide to Engineering Calculations*. CRC Press, LLC. Originally published by Technomic Publishing Co., Inc., Lancaster, PA.

City of Salem (2000a). *Stormwater Master Plan*. Prepared for the City of Salem by Montgomery Watson Americas, Inc. Adopted by Salem City Council on September 25, 2000. Salem, Oregon.

City of Salem (2000b). *Drainage System Improvement Plan*. Technical Supplement to the 2000 *Stormwater Master Plan*. Prepared for the City of Salem by Montgomery Watson Americas, Inc. Salem, Oregon.

City of Salem (2014), *Administrative Rules Chapter 109 Division 004 Stormwater System,* City of Salem Department of Public Works, January 2014.

Engineers Australia. (2012). *Australian Rainfall and Runoff Project 15: Two Dimensional Modelling in Urban and Rural Floodplains, Stage 1&2 Report*. November 2012.

Huber, W.C. and R.E. Dickinson. (1988). *Storm Water Management Model User's Manual Version 4*. U.S. Environmental Protection Agency. August 1988.

Kidd, C.H.R. (1978). *Rainfall-runoff processes over urban surfaces.* Proc., Int. Workshop Institute of Hydrology, Wallingford, U.K.

Musgrave, G.W. (1955). "How much of the rain enters the soil?" *Yearbook of Agriculture 1955.* U.S. Department of Agriculture. Washington, DC. Pp. 151-159. https://naldc.nal.usda.gov/download/IND43894552/PDF. Accessed: July 11, 2018.

Natural Resources Conservation Service (NRCS) (2014). *Web Soil Survey (SSURGO).* Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed October 2014.

Sutherland, Roger. (2000). *Methods for Estimating the Effective Impervious Area of Urban Watersheds.* The Practice of Watershed Protection (Edited by T. R. Schueler and H. K. Holland). Center for Watershed Protection, Ellicott City, MD: 193-195.

U.S. Army Corps of Engineers (USACE) (1994). *EM 1110-2-1417, Flood Run-off Analysis.* August 1994.

XP Solutions (2014). *Reviewing XP Models* [Webinar]. March 19, 2014. Retrieved from xpsolutions.com/Resources/XP-Live-Webinars/reviewing-xp-models/

XP Solutions. *XP-2D Reference Manual for Integrated 1D/2D Modeling.*

Watershed Concepts (2009). *Lidar Remote Sensing Data Collection, Department of Geology and Mineral Industries, Willamette Valley Phase 1.* July, 2009.

# APPENDIX A
# JANUARY 2012 FLOOD PHOTOGRAPHS

Figure A.1–Across from the BAT3 flow gauge, looking downstream at Commercial Street Bridge.

Figure A.2–Across from the BAT3 flow gauge, looking upstream.

Figure A.3–Battle Creek at Fairway Avenue Bridge, looking downstream.

Figure A.4–Battle Creek at Fairway Avenue Bridge, looking south.

Figure A.5–Powell Creek flooding near Meriweather Street and 13th Avenue.

Figure A.6–Flooding at the Woodside Drive crossing over Waln Creek.


Figure A.7–Flooding at the Madras Street crossing over Waln Creek.

# APPENDIX B
# DESIGN STORM DEVELOPMENT

## INTRODUCTION

As part of the Stormwater Master Plan (SWMP) update for the City of Salem, an analysis of historic rainfall data and simulated runoff for Battle Creek was conducted. The purpose of the analysis is to evaluate and recommend design storms for use in the assessment of flood risk and for use in developing the Basin Plan for Battle Creek.

The General Design Standards found in Chapter 109 of the City of Salem's Public Works Administrative Rules provide design storm depths and temporal distribution. However, recorded stream flows and XP-STORM hydrologic and hydraulic model simulation results for the January 2012 event in the Battle Creek Basin suggest that the provided design storm significantly underestimates flood volumes and peak flows and may not be appropriate for the purpose of characterizing basin-wide flood risk. Consequently, alternative design storms were developed and modeled that included longer storm durations, adapted temporal distributions, and updated rainfall depths.

The purpose of this memo is to report on the methods used to developed the design storms, discuss the results of the analysis, and recommend design storm distributions and rainfall depths for use in the Stormwater Master Plan Update.

## BATTLE CREEK BASIN

The portion of Battle Creek Basin located upstream of Interstate 5 (I-5) has a drainage area of 10.1 square miles. The minimum and maximum basin elevations are 383 ft and 1,070 ft, respectively. The mean elevation for the basin is 616 ft. Unless otherwise noted, all elevations reported in this memo are based on the North American Vertical Datum of 1988 (NAVD 88). The largest tributary to Battle Creek is Waln Creek, which has a drainage area of 4.4 square miles and generally contains residential developments. Smaller tributaries include Scotch Creek, Powell Creek, Jory Creek, and Champion Swale. In general, land use for most of the developed areas within the City is medium to low density residential. Land uses for the higher elevation portions of the basin, located outside of the City limits, are generally cropland and forest.

## SUMMARY OF RAIN GAUGE DATA

The locations of the rain gauges in proximity to the Battle Creek Basin (upstream of I-5) are shown in **Figure B.1**. Pertinent rain gauges include:

### *McNary Field*

The rain gauge at McNary Field (Salem Airport) is operated by the National Oceanic and Atmospheric Administration (NOAA). It has a period of record spanning from July of 1948

to the present. The 66 year period of record makes this the longest continuous rainfall gauge in the vicinity of Salem. The elevation of the gauge is approximately 205 ft. The rainfall data is in available in 1-hour increments.

### *Rain Gauge 8*

Rain Gauge 8 (RG8) is operated by the City of Salem. It is the primary rain gauge in the Battle Creek Basin. It is located immediately upstream of the Commercial Street crossing of Battle Creek. Continuous rainfall data from the gauge is available in 15-minutes increments from 1996-1998 and 2002-Present. The elevation of the gauge is approximately 389 ft. Of the 88 subbasins within the Battle Creek Basin, 49 are assigned to RG8.

### *Rain Gauge 11*

Rain Gauge 11 (RG11) is operated by the City of Salem. It is the primary rain gauge for the undeveloped portions of the Battle Creek Basin located upstream of the City's urban grown boundary (UGB). The gauge is located within a residential neighborhood near the intersection of Skyline Road and Davis Road. Continuous rainfall data from the gauge is available in 15-minutes increments from 1998-2006 and 2008-Present. The elevation of the gauge is approximately 730 ft. Because of the higher elevation of RG11, there is a greater risk of snow accumulating on the rain gauge. When this occurs, errors are introduced into the rainfall measurements. Of the 88 subbasins within the Battle Creek Basin, 31 are assigned to RG11.

### *Rain Gauge 10*

Rain Gauge 10 (RG10) is operated by the City of Salem. It is within close proximity of a few subbasins in the north portion of Battle Basin near Waln Creek. It is located near the intersection of Liberty Road and Hrubetz Road. Continuous rainfall data is available in 15-minutes increments from 1997-Present. The elevation of the gauge is approximately 470 ft. Of the 88 subbasins within the Battle Creek Basin, 8 are assigned to RG10.

### *Rain Gauge 17*

Rain Gauge 17 (RG17) is operated by the City of Salem. It is within close proximity of a few subbasins in the undeveloped portions of the Battle Creek Basin. However, it was not used for the analysis since RG 11 is located in closer proximity to these subbasins.

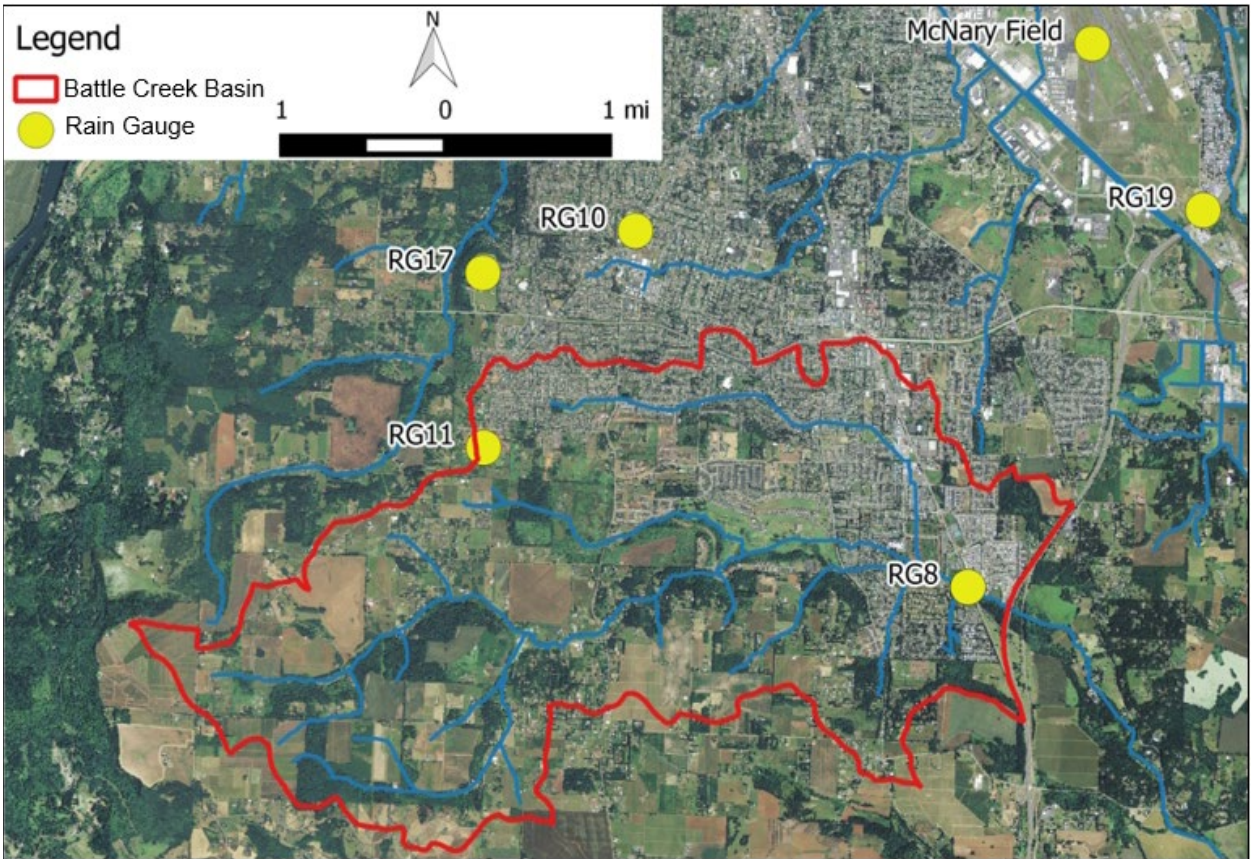



Figure B.1–Rain gauge locations relative to the Battle Creek Basin (upstream of I-5).

# DESIGN STORM RAINFALL DEPTHS

## *Relationships with McNary Field Rain Gauge*

Since the McNary Field rain gauge has a period of record of 66 years, which is substantially longer than the period of record of the other rain gauges, it was used to develop the design storm rainfall depths. However, a comparison of the rain gauge data suggested that RG8, RG10, and RG11 tend to have higher rainfall depths. This difference is likely due to orographic effects since the rainfall depths generally increase as the gauge elevation increases. A comparative analysis of the rain gauge data was performed to develop a relationship between RG8, RG10, and RG11 and McNary field.

In the analysis, the 1-day rainfall depths at RG8, RG10, and RG11 were compared to the 1-day rainfall depths at McNary Field for the overlapping periods of record. Scatter plots were developed for RG8, RG10, and RG11 1-day rainfall depths versus the McNary field 1-day rainfall depths. A linear trend line was fit to the data and the resulting slope was used to estimate the average rainfall depth difference between the City's rain gauges and the McNary Field gauge. **Figure B.2**, **Figure B.3**, and **Figure B.4** show the relation developed between McNary Field and RG8, RG10, and RG11, respectively.

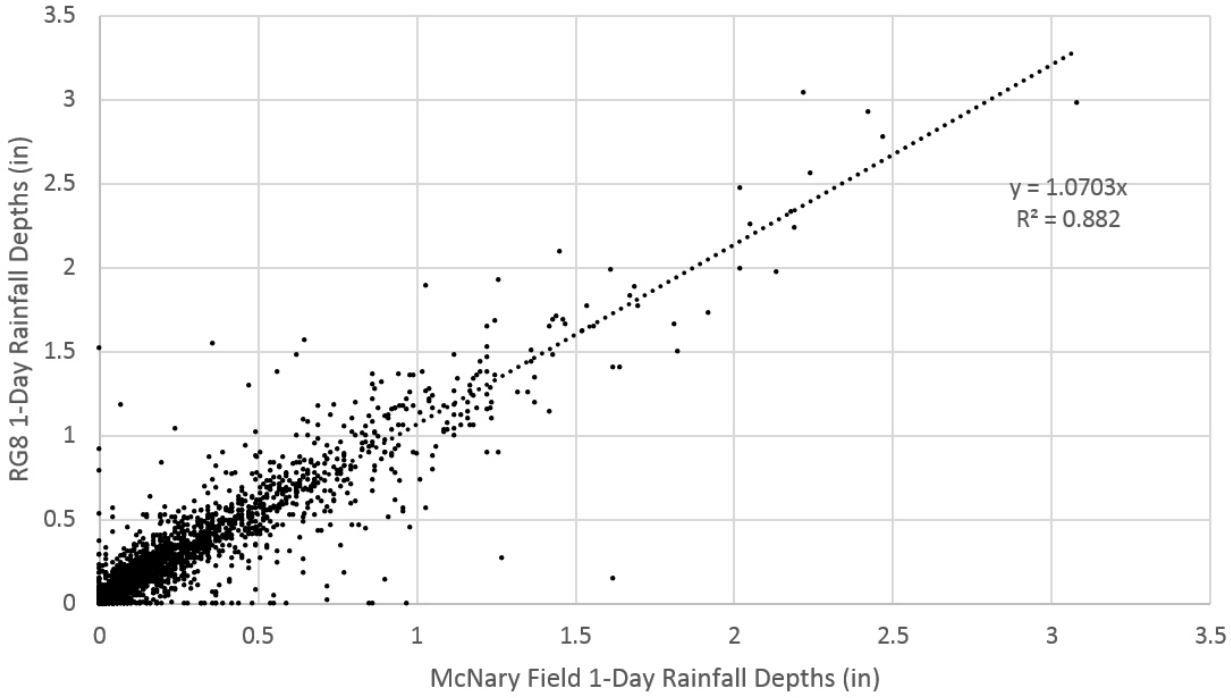



Figure B.2–Comparison of 1-day rainfall depths between RG8 and McNary Field.

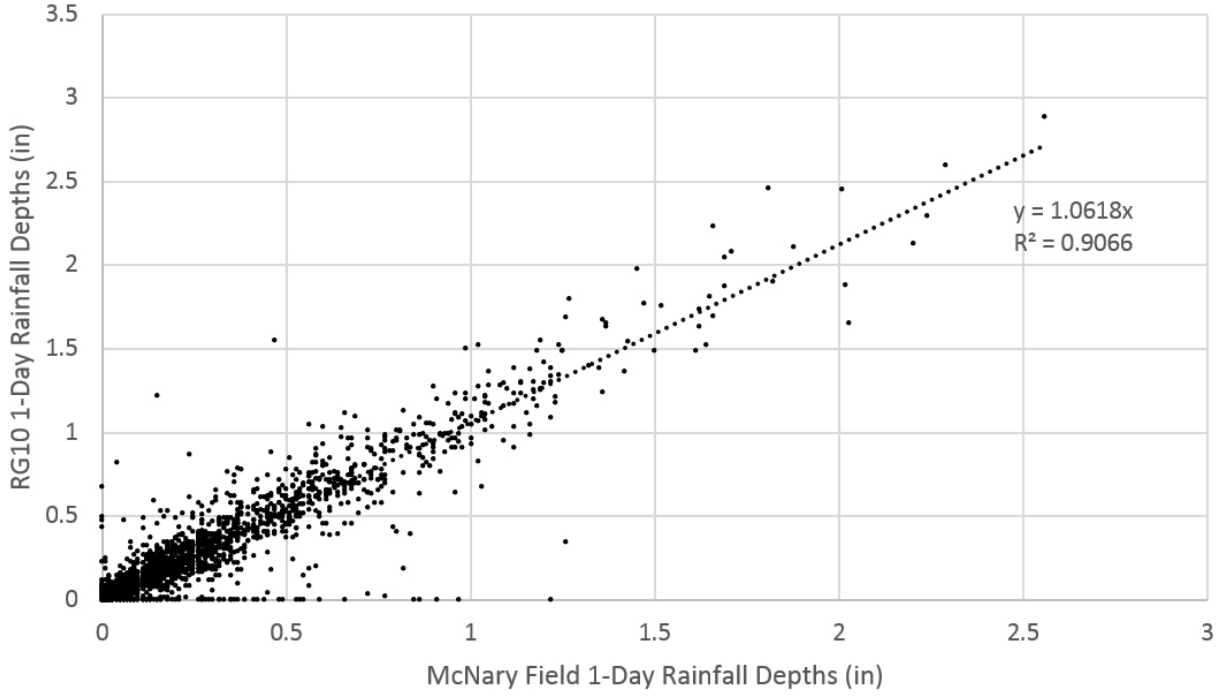



Figure B.3–Comparison of 1-day rainfall depths between RG10 and McNary Field.

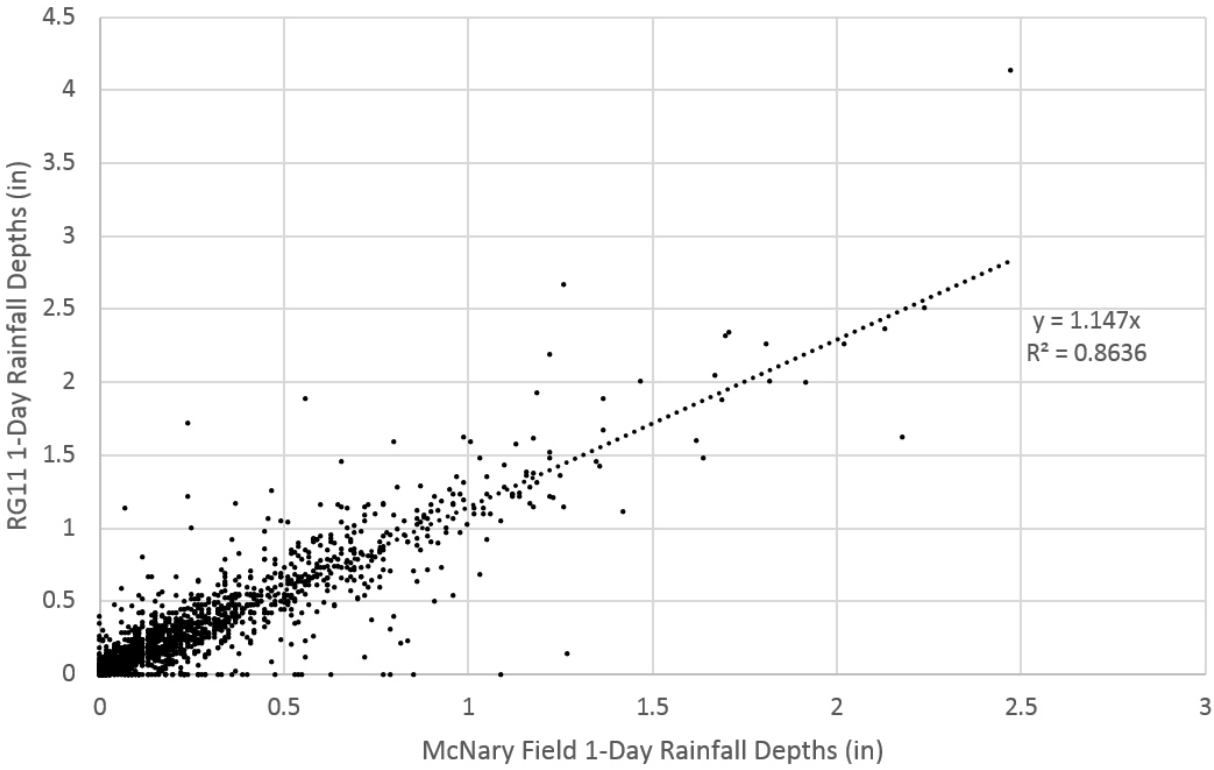



Figure B.4–Comparison of 1-day rainfall depths between RG11 and McNary Field.

RG8 and RG10 were found to have similar relations to the McNary Field gauge. The trend line slope for RG8 was 1.07. For RG10, the trend line slope was 1.06. Since RG10 would be applicable to only a few subbasins, and the relationship for RG10 is similar to that of RG8, the RG8 multiplier of 1.07 was used for the subbasins near RG10 when modeling design storms.

The RG11 relation was found to have a slope of 1.15, which is much greater than the other relations. However, RG11 also had the lowest R2 value, which suggests that there is more uncertainty in the RG11-McNary Field relation. Based on the slope of the linear trend lines, the design depths developed at the McNary Field gauge were increased by 7% for the sub-basins in the vicinity of RG8 (including those subbasins previously assigned to RG10), and 15% for the subbasins in the vicinity of RG11.

## *Frequency Analysis*

In order to estimate the rainfall depths for the 24-, 48-, and 72-hour duration design storms, a frequency analysis was performed on the 66 years of rainfall data available for the McNary Field gauge. The largest 24-, 48-, and 72- hour total rainfall depths for each year for the entire period of record were extracted from the data. The data were plotted on lognormal probability plots using both the Weibull and Hazen plotting positions. Linear trend lines were generated using the least squares method for both plotting positions. Visual inspection of the generated trend lines suggests that they tend to underestimate the larger less frequent events, so additional trend lines were visually fit to the data. The lognormal probability plot of the 24-hour annual maximum event depths, trend lines, and

24-hour City Design Standard depths are shown in **Figure B.5**. The lognormal probability plots of the 48- and 72-hour annual maximum event depths and trend lines are shown in **Figure B.6** and **Figure B.7**, respectively.

The resulting 2-, 5-, 10-, 25-, 50-, and 100-year depths for the 48-hour and 72-hour duration storms were extracted from the graphical fit trend lines. The graphical fit trend line for the 24-hour events produced results that are similar to the values in the City's Design Standards. Therefore, the City's Design Standard depths were selected for the 24-hour design storm. The resulting design storm depths and the adjusted depths for the City's RG8 and RG11 rain gauges are summarized in **Table B.1**.

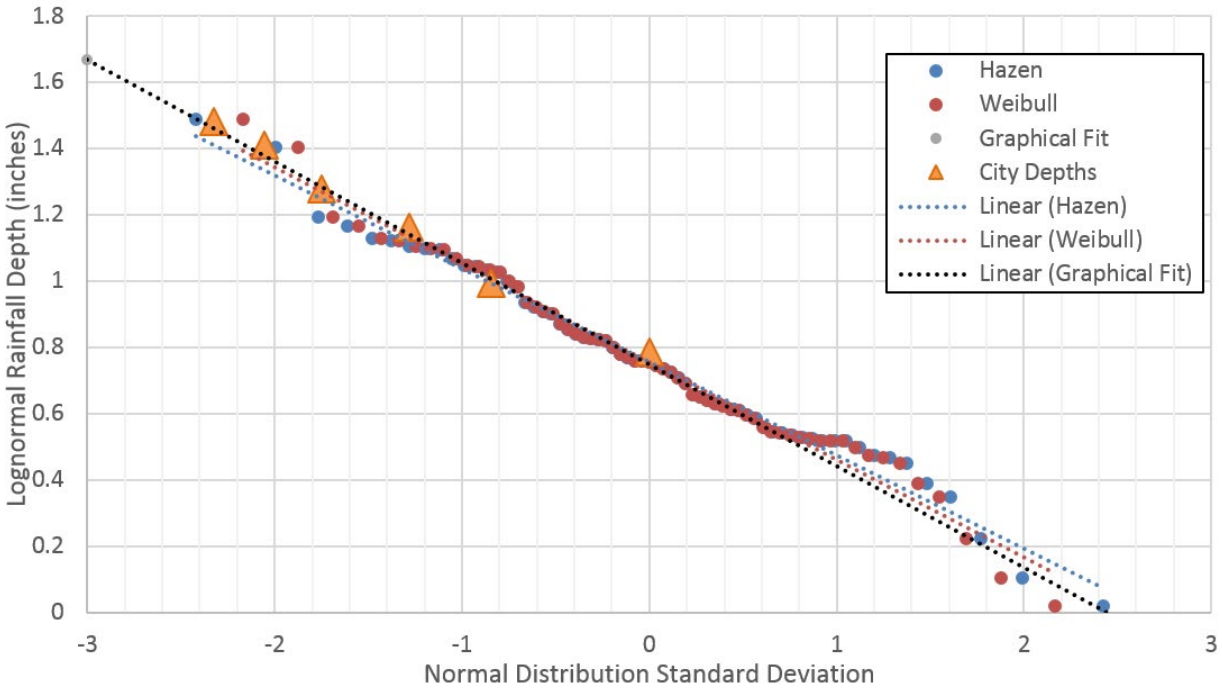



Figure B.5–Lognormal probability plots of the annual maximum 24-hour total rainfall depths.

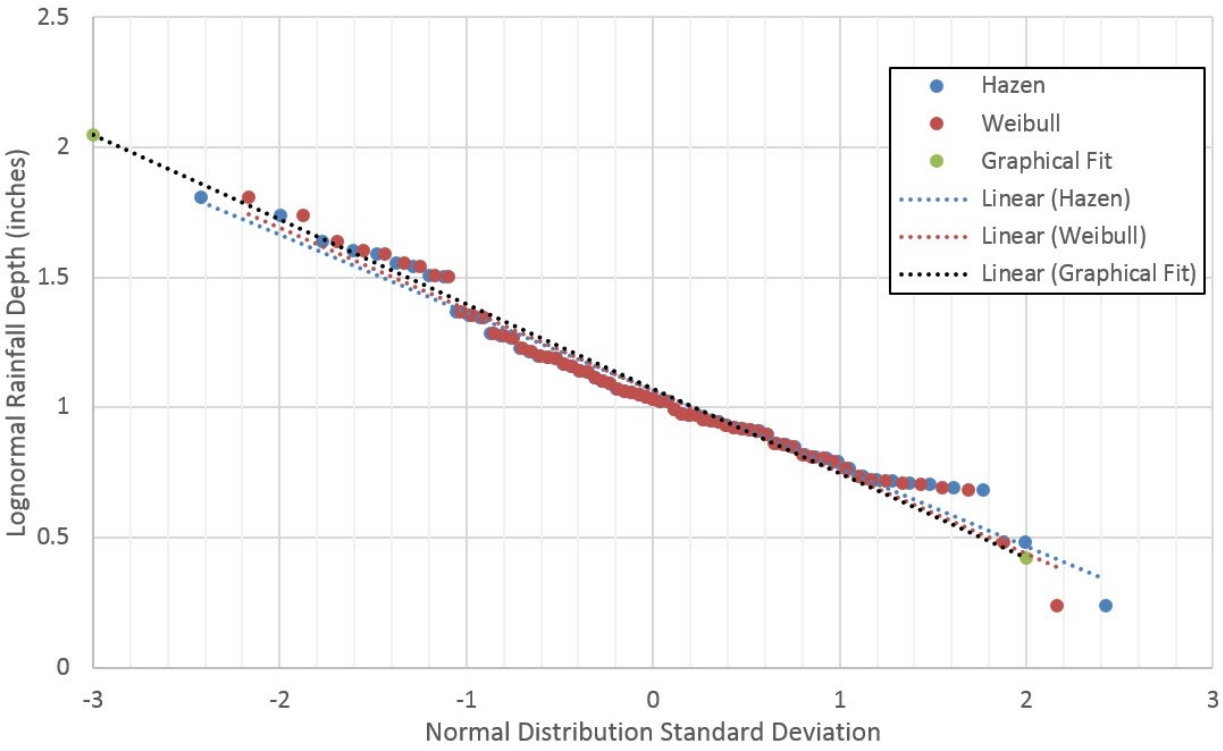



Figure B.6–Lognormal probability plots of the annual maximum 48-hour total rainfall depths.

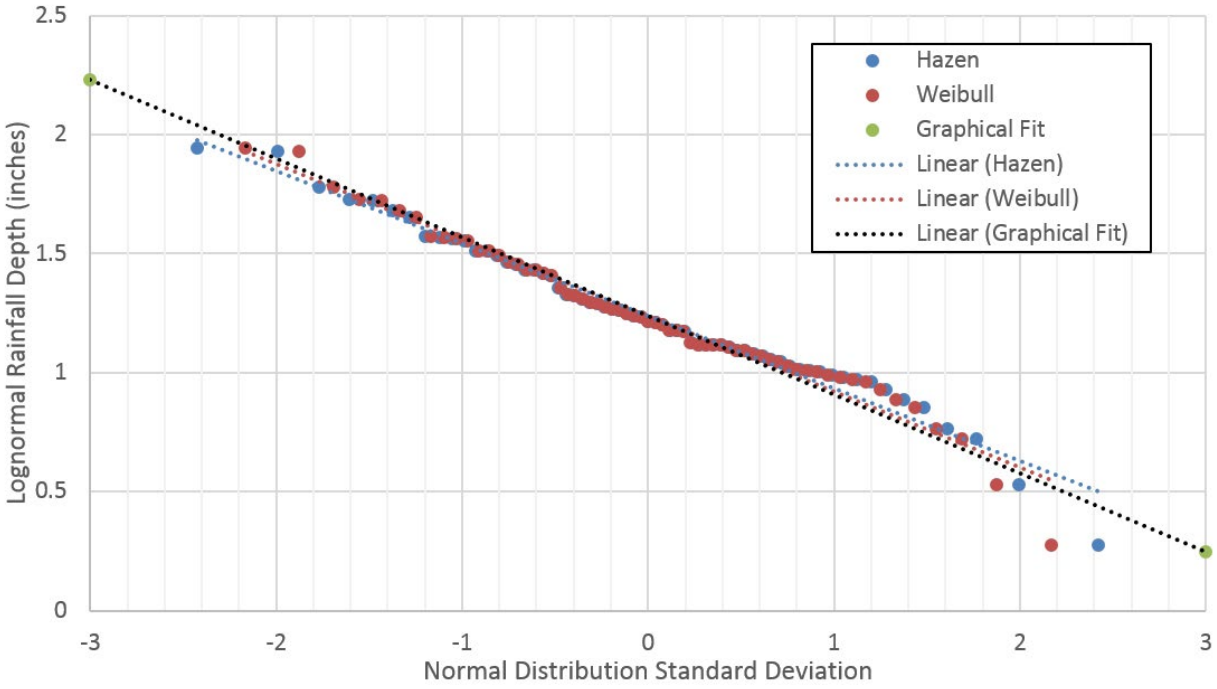



Figure B.7–Lognormal probability plots of the annual maximum 72-hour total rainfall depths.

| Return Period (year) | Exceedance Probability (%) | McNary Field Gauge | | | RG 8 | | | RG 11 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | City Design Standards | Graphical Fit | | City Design Standards +7% | Graphical Fit +7% | | City Design Standards +15% | Graphical Fit +15% | |
| | | 24-hr | 48-hr | 72-hr | 24-hr | 48-hr | 72-hr | 24-hr | 48-hr | 72-hr |
| 2 | 50 | 2.2 | 2.9 | 3.5 | 2.4 | 3.1 | 3.7 | 2.5 | 3.4 | 4.0 |
| 5 | 20 | 2.7 | 3.8 | 4.6 | 2.9 | 4.1 | 4.9 | 3.1 | 4.4 | 5.2 |
| 10 | 10 | 3.2 | 4.4 | 5.3 | 3.4 | 4.7 | 5.6 | 3.7 | 5.1 | 6.1 |
| 25 | 4 | 3.6 | 5.2 | 6.2 | 3.9 | 5.5 | 6.6 | 4.1 | 5.9 | 7.1 |
| 50 | 2 | 4.1 | 5.7 | 6.8 | 4.4 | 6.1 | 7.3 | 4.7 | 6.6 | 7.8 |
| 100 | 1 | 4.4 | 6.2 | 7.4 | 4.7 | 6.7 | 8.0 | 5.1 | 7.2 | 8.6 |

Table B.1–Design storm depths for McNary Field gauge and adjusted depths for RG 8 and RG 11.

# DESIGN STORM DURATIONS AND DISTRIBUTIONS

The City of Salem Design Standards (2014) requires the use of the 24-hour duration SCS Type 1-A rainfall distribution (**Figure B.8**) when the Engineered Method is required for design. However, hydrologic/hydraulic modeling results comparing actual rainfall distributions for large storm events with the SCS Type 1-A distribution suggest that a more appropriate storm may have a 48- or 72-hour duration. While the SCS Type 1-A distribution is typically used for 24-hour events in the Pacific Northwest region, there are no recommended SCS distributions for 48-hour and 72-hour duration storms.

To determine the appropriate storm distributions for the 48- and 72-hour events, the distributions of the three largest events on record were analyzed and compared with the SCS Type 1-A distributions. The three events analyzed included the February 1996, November 1996, and January 2012 storms. The November 1996 storm was approximately a 44-hour event with a rainfall depth of 4.15 inches at the McNary Field gauge. A normalized 48-hour storm distribution based on the November 1996 event is shown in **Figure B.9**. The January 2012 storm was approximately a 71-hour event with a rainfall depth of 6.9 inches at the McNary Field gauge. A normalized 72-hour storm distribution based on the January 2012 event is shown in **Figure B.10**. The February 1996 storm was approximately a 72-hr event with a rainfall depth of 6.97 inches at the McNary Field gauge. A normalized 72-hour storm distribution for the February 1996 event is shown in **Figure B.11**.

For the 48-hour event, the November 1996 storm distribution was selected due to the concentration of precipitation intensities into a more or less triangular distribution and its duration of nearly 48 hours. This concentration of high precipitation intensities results in larger peak flows when compared to the flatter storm distributions of February 1996 and January 2012 which more evenly distribute the precipitation over the duration of the storm. For the 72-hour event, the January 2012 storm distribution was selected because it produces larger peak flows when compared to the February 1996 storm distribution. This is likely because the January 2012 storm distribution has a longer period of larger intensities in the later portion of the distribution that contributes to the peak flow.

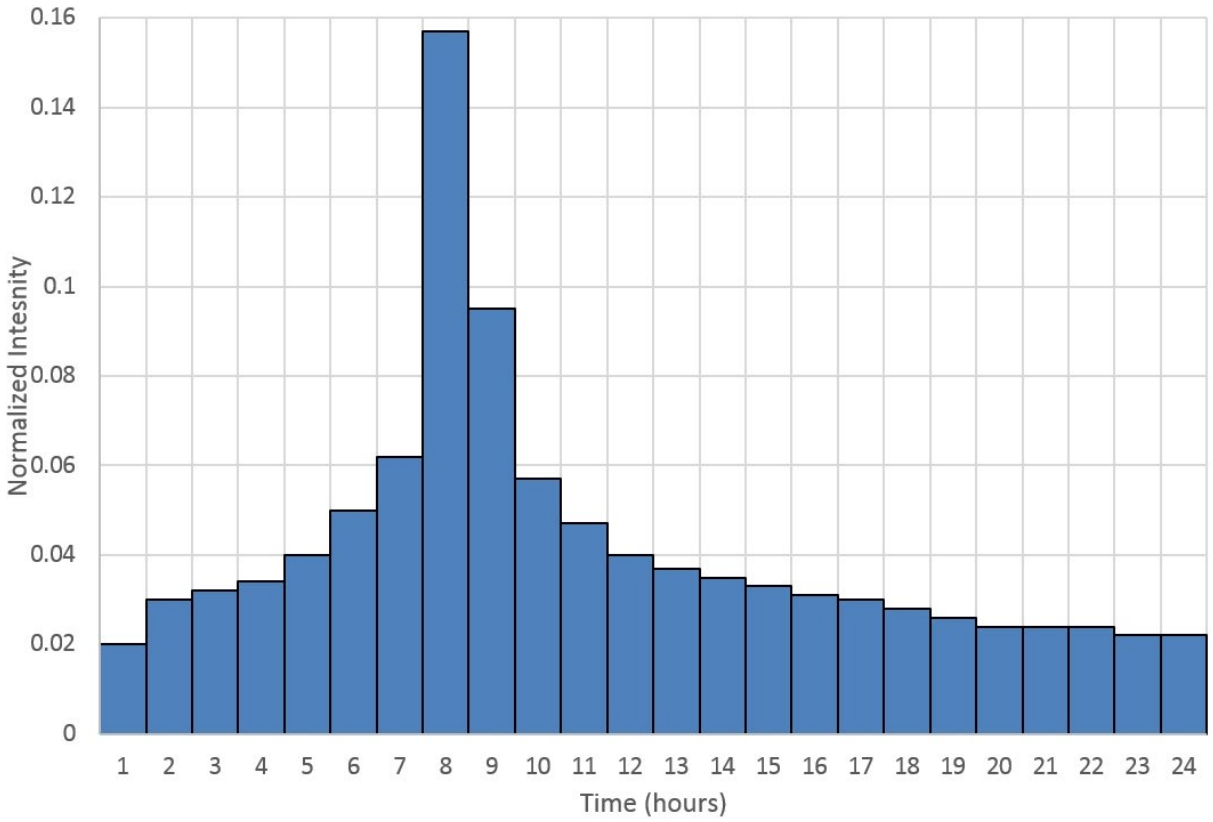



Figure B.8–Normalized 24-hour SCS Type 1-A storm distribution.

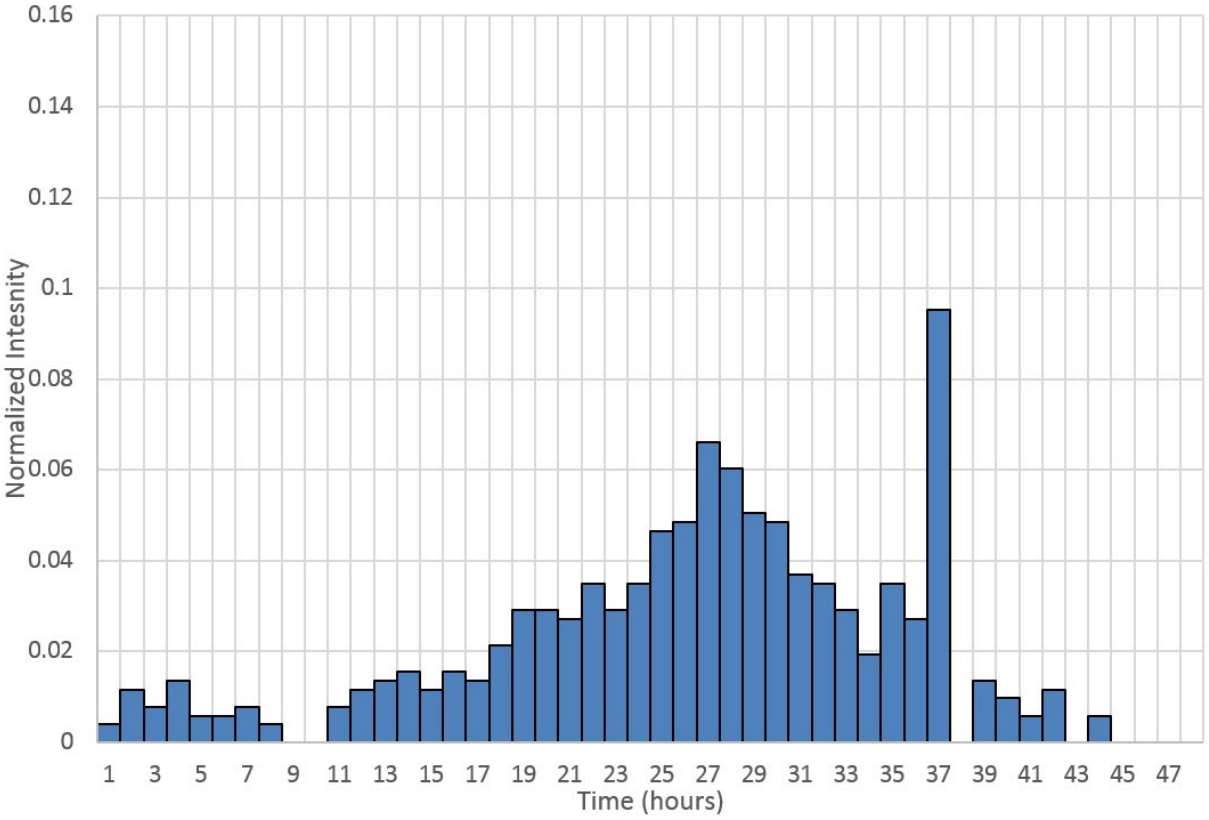



Figure B.9–Normalized 48-hour November 1996 storm distribution.

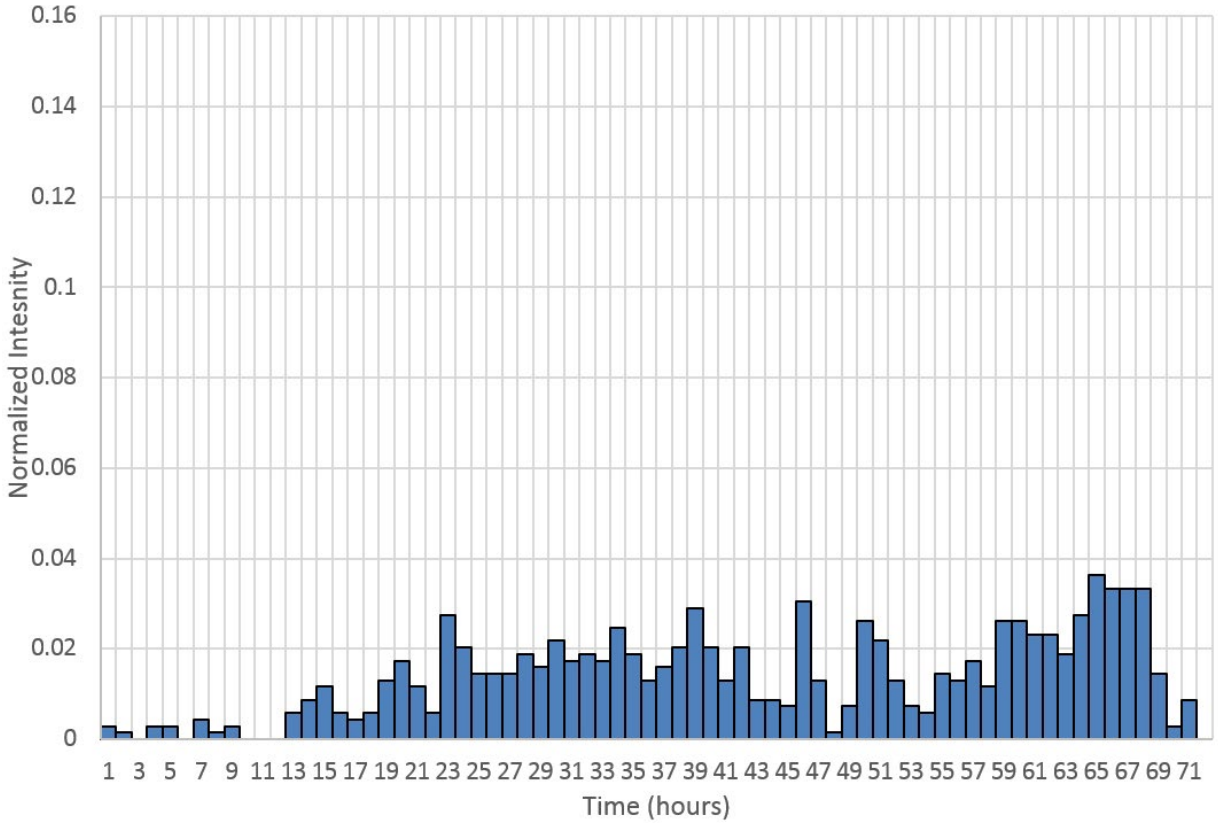



Figure B.10–Normalized 72-hour January 2012 storm distribution.

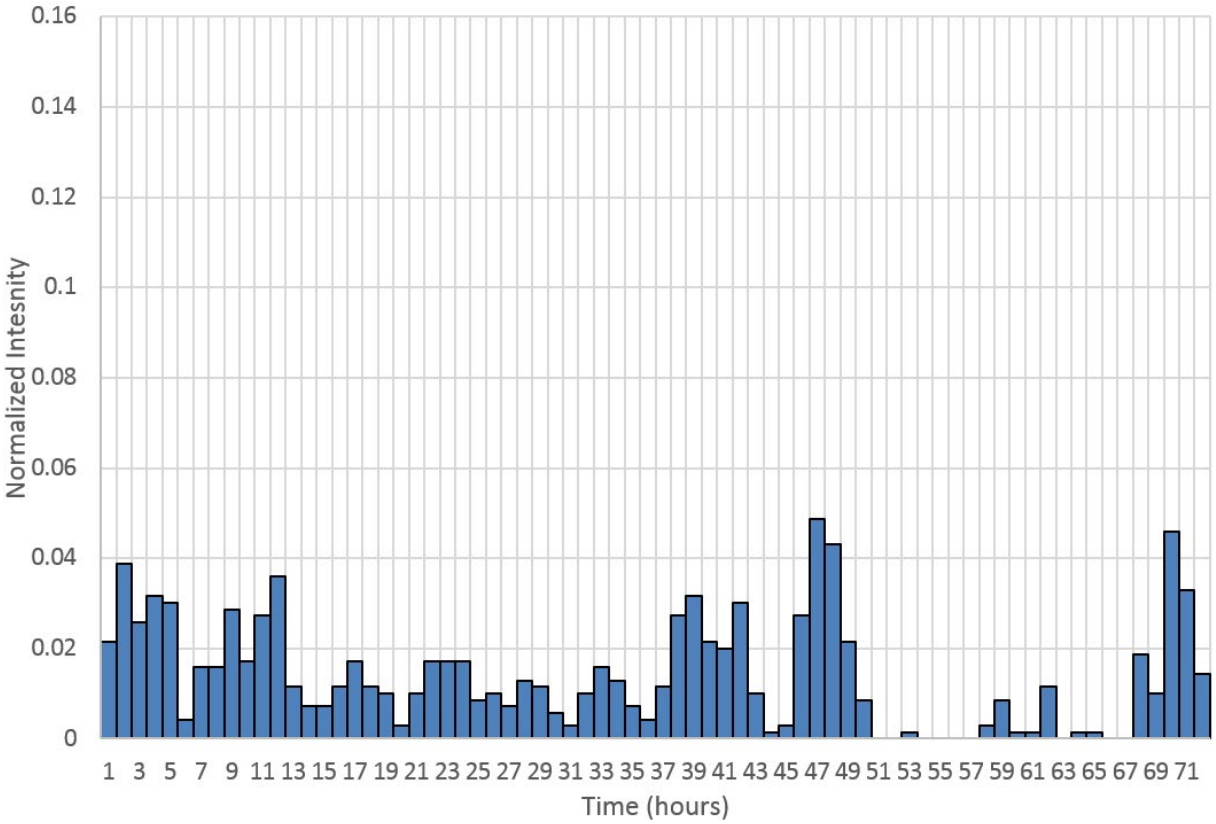



Figure B.11–Normalized 72-hour February 1996 storm distribution.

# XP-STORM MODEL RESULTS

## *Historic Storm Events*

The hydrographs shown in **Figure B.12** and **Figure B.13** were developed using the calibrated XP-STORM model for the Battle Creek basin. They represent the simulated flows for the three largest storm events on record using a combination of actual and estimated rainfall data. **Figure B.12** shows the simulated flows for the location of the Battle Creek 3 gauge (BC3), which is located at the Commercial Street crossing of Battle Creek. **Figure B.13** shows the simulated flows for the location of the Battle Creek 12 gauge (BC12), which is at the Lone Oak Road crossing of Battle Creek.

Because RG11 was not in operation during the February and November 1996 storm events, RG11 rainfall depths were estimated from the RG8 gauge data using a multiplier of 1.075, which was derived from the historical relationship between RG8 and RG11. The 72-hour total rainfall for the February 1996 event recorded at RG8 was 8.9 inches. Using the multiplier, the total rainfall for RG11 was estimated to be 9.6 inches. For November 1996, the 72-hour total rainfall recorded at RG8 was 5.9 inches. Again using the multiplier, the 72-hour total rainfall depth for RG11 was estimated to be 6.3 inches.

For the January 2012 event, both RG8 and RG11 were operational. The 72-hour total rainfall for RG8 was 7.2 inches. However, it is believed that RG11 was likely recording erroneous data for a significant portion of the storm event, due to snow accumulation on the gauge (personal communication with Justin Boyington, City of Salem). For the period of time the gauge was believed to be collecting erroneous data, the rainfall was estimated from the RG8 gauge data using a multiplier of 1.1. This multiplier was derived from the relationship between RG8 and RG11 for the portion of the storm event when both gauges were considered to be fully functional. The 72-hour total rainfall for RG11 was estimated to be 7.9 inches. Estimated total rainfall depths for the February 1996, November 1996 and January 2012 storm events are summarized in **Table B.2**. As seen in the table, the February 1996 storm event produced that greatest 72-hr total precipitation, exceeding the estimated 100-year storm totals of 8.0 and 8.6 inches shown in **Table B.1** for RG 8 and RG 11, respectively.

| Rain Gauge | February 1996 (in.) | November 1996 (in.) | January 2012 (in.) |
|---|---|---|---|
| RG 8 | 8.9[1] | 5.9[1] | 7.2[1] |
| RG 11 | 9.6[2] | 6.3[2] | 7.9[2] |

[1] Recorded by rain gauge [2] Estimated

Table B.2–Estimated 72-hour total rainfall for the Battle Creek Basin rain gauges.

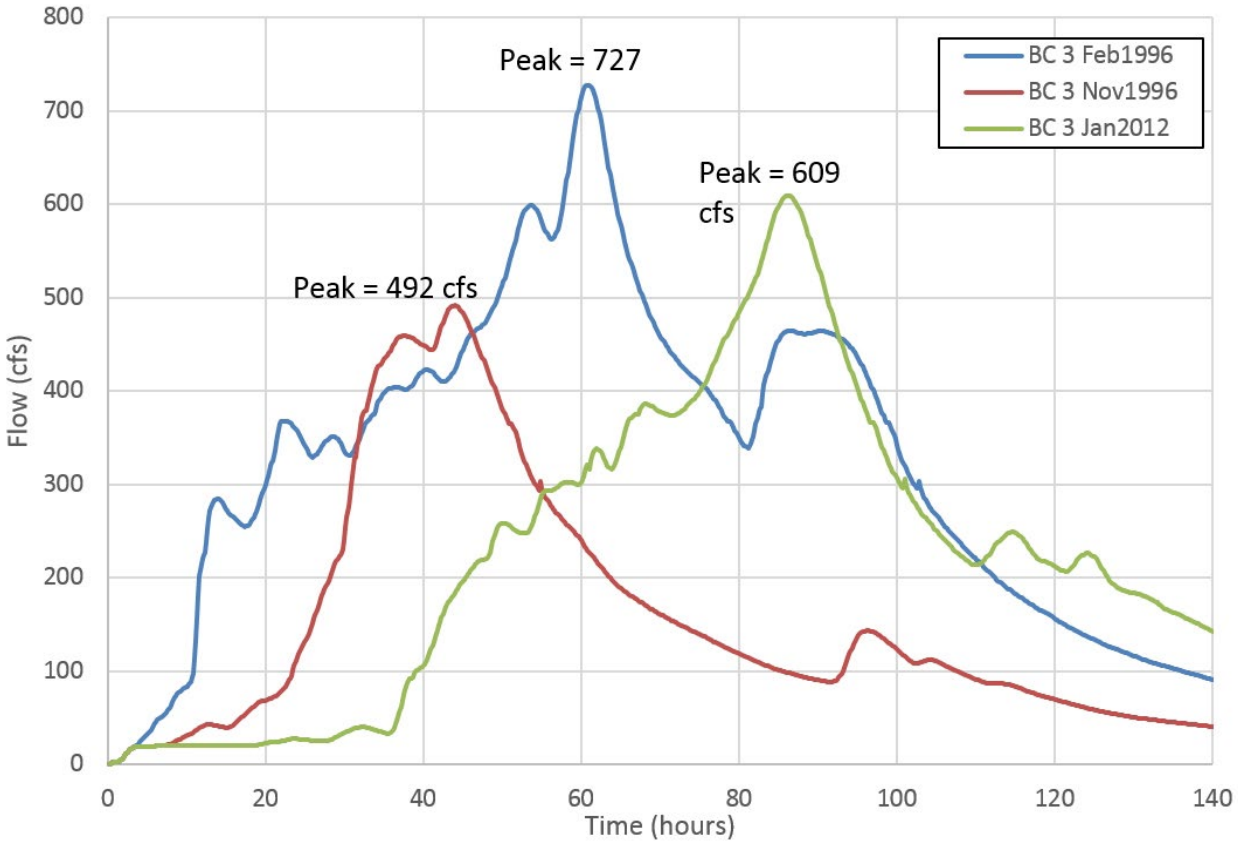



Figure B.12–Simulated hydrographs for Feb. and Nov. 1996 and Jan. 2012 storm events for the Battle Creek 3 stream gauge location.

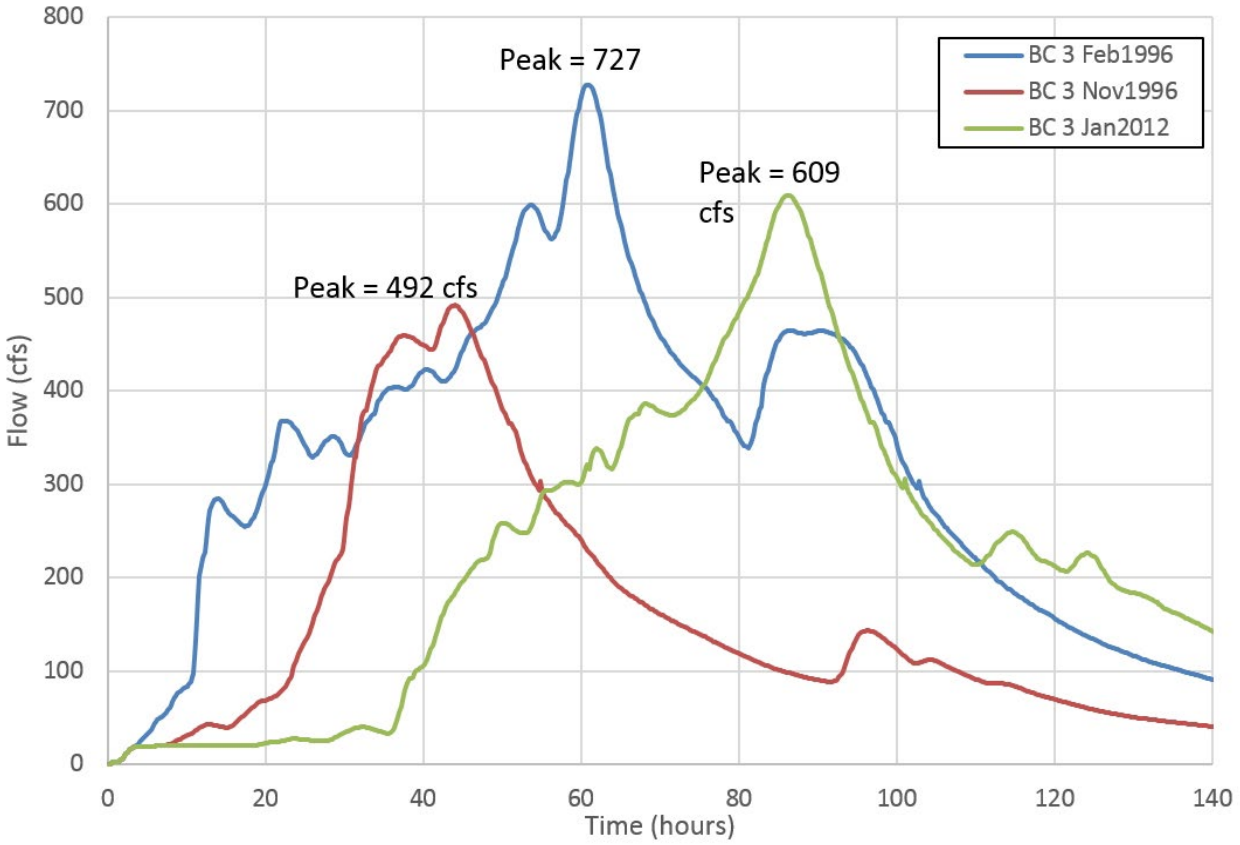



Figure B.13–Simulated hydrographs for Feb. and Nov. 1996 and Jan. 2012 storm events for the Battle Creek 12 stream gauge location.

## *Design Storm Events*

XP-STORM simulation results for the 24-, 48-, and 72-hour, 100-year design storm events for the BC3 and BC 12 stream gauge locations are shown in **Figure B.14** and **Figure B.15**, respectively. The 24-hour design storm is based on the rainfall depth published in the City's Design Standards (2014) and uses the SCS Type 1-A rainfall distribution. The 48-hour and 72-hour design storms are based on the total rainfall depths provided in **Table B.1**. The distribution for the 48-hour design storm is based on the November 1996 event shown in **Figure B.9**. The distribution for the 72-hour design event is based on the January 2012 event shown in **Figure B.10**.

The 2-, 5-, 10-, 25-, 50- and 100-year results for the three design storm events for various locations in within the Battle Creek Basin are summarized in **Table B.3**. A map of the locations for which the results are reported is shown in **Figure B.16**.

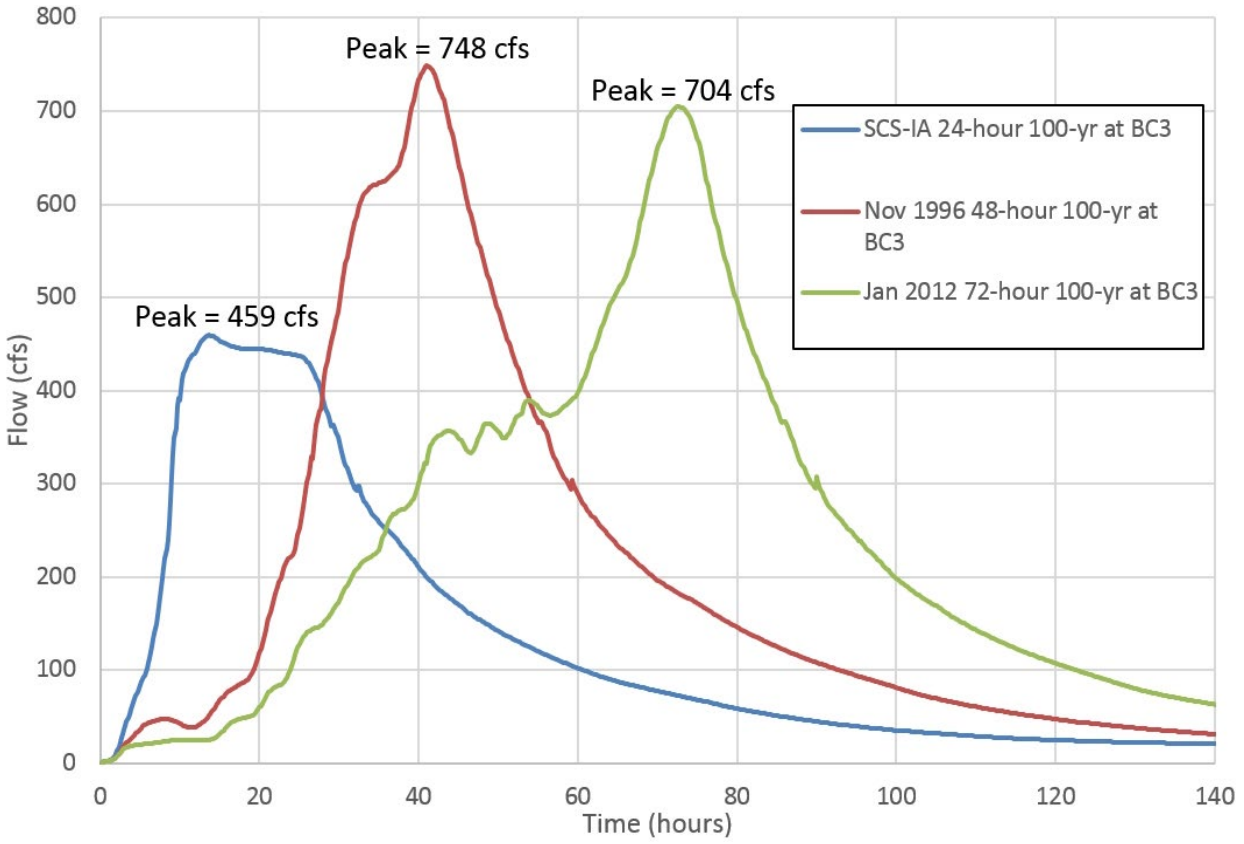



Figure B.14–Simulated hydrographs for the 100-year, 48-, and 72-hour design storms at the BC3 stream gauge location.

| Location | 2-year | | | 5-year | | | 10-year | | |
|---|---|---|---|---|---|---|---|---|---|
| | 24-hr SCS 1-A | 48-hr Nov. 1996 | 72-hr Jan. 2012 | 24-hr SCS 1-A | 48-hr Nov. 1996 | 72-hr Jan. 2012 | 24-hr SCS 1-A | 48-hr Nov. 1996 | 72-hr Jan. 2012 |
| 1 | 205 | 244 | 227 | 259 | 372 | 357 | 321 | 445 | 417 |
| 2 | 59 | 97 | 95 | 88 | 156 | 156 | 120 | 198 | 197 |
| 3 | 58 | 95 | 93 | 86 | 154 | 154 | 118 | 195 | 194 |
| 4 | 50 | 79 | 82 | 75 | 130 | 137 | 104 | 167 | 174 |
| 5 | 39 | 62 | 65 | 59 | 104 | 108 | 83 | 136 | 145 |
| 6 | 117 | 118 | 97 | 151 | 170 | 141 | 184 | 202 | 170 |
| 7 | 94 | 98 | 80 | 123 | 143 | 116 | 152 | 174 | 141 |
| 8 | 77 | 82 | 67 | 100 | 120 | 97 | 125 | 146 | 118 |
| 9 | 34 | 41 | 33 | 46 | 59 | 47 | 58 | 72 | 58 |
| 10 | 10 | 13 | 12 | 12 | 21 | 19 | 15 | 27 | 24 |

Maximum Discharge

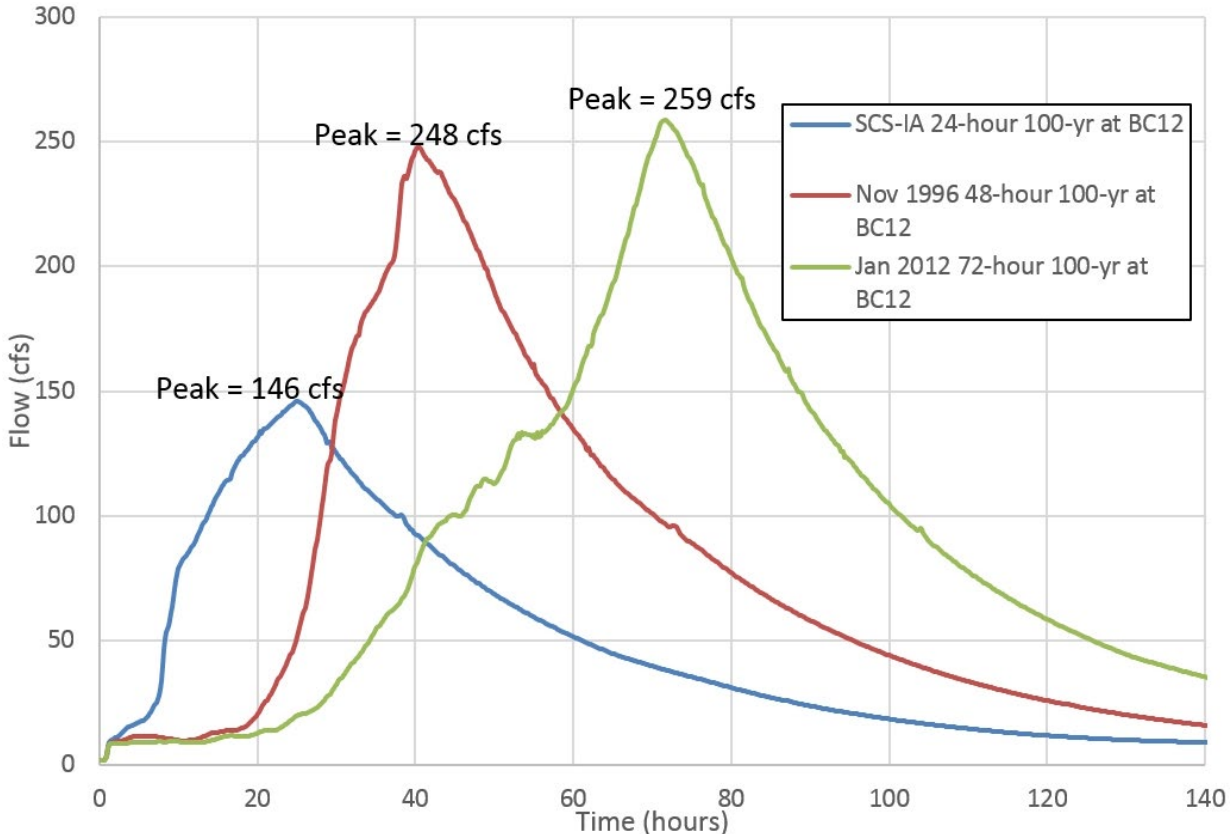



Figure B.15–Simulated hydrographs for the 100-year, 48-, and 72-hour design storms at the BC12 stream gauge location.

| 25-year | | | 50-year | | | 100-year | | |
|---|---|---|---|---|---|---|---|---|
| 24-hr SCS 1-A | 48-hr Nov. 1996 | 72-hr Jan. 2012 | 24-hr SCS 1-A | 48-hr Nov. 1996 | 72-hr Jan. 2012 | 24-hr SCS 1-A | 48-hr Nov. 1996 | 72-hr Jan. 2012 |
| 371 | 543 | 518 | 416 | 645 | 613 | 459 | 748 | 704 |
| 144 | 244 | 258 | 179 | 309 | 305 | 199 | 358 | 352 |
| 142 | 240 | 255 | 176 | 306 | 300 | 196 | 353 | 348 |
| 126 | 215 | 233 | 157 | 267 | 273 | 175 | 309 | 319 |
| 100 | 175 | 187 | 127 | 215 | 219 | 146 | 248 | 259 |
| 213 | 267 | 207 | 243 | 264 | 231 | 258 | 300 | 254 |
| 179 | 210 | 174 | 208 | 238 | 196 | 226 | 267 | 220 |
| 145 | 175 | 145 | 169 | 201 | 163 | 185 | 224 | 184 |
| 67 | 88 | 70 | 79 | 101 | 78 | 88 | 111 | 89 |
| 18 | 33 | 31 | 21 | 40 | 36 | 24 | 46 | 42 |

Table B.3–Simulated peak dischargets for the 2-, 5-, 10-, 25-, and 100-year storms for the Battle Creek Basin.


# CONCLUSIONS

An evaluation of available rainfall data was conducted to determine the most appropriate design storms for use in the City of Salem Stormwater Master Plan Update. As seen in **Figure B.12** and **Figure B.13**, the 24-hour duration SCS Type 1-A distribution design storm (as presented in the City's Stormwater Design Standards) does not produce the magnitude of flooding observed within the Battle Creek basin when compared to historic floods of longer duration. The three largest recorded storm events have durations of between 44 and 72 hours. Both the volume and peak flow for the 24-hour SCS Type 1-A event are significantly less than both the 48-hour and 72-hour design storm events. Therefore, use of the 24-hour duration SCS Type 1-A distribution design storm would likely underestimate the flood risk within the Battle Creek basin.

As seen in **Figure B.14**, the 100-yr, 48-hour design storm produces the highest peak flow at the location of the BC3 stream gauge. This value is slightly larger than the modeled February 1996 storm event shown in **Figure B.12**. Also, with minor exceptions, the 48-hour design storm produces the largest peak flows throughout the basin. It is noted that there are several locations (as seen in **Table B.3**) where the peak flows for the 72-hour design storm exceed the 48-hour design storm. It should also be noted that the 72-hour design storm produces the largest runoff volume of the three design storms evaluated. This can be visually observed in **Figure B.14**. Because the 72-hr storm produces the largest volume of runoff, it will be important for evaluating the performance of flow control facilities.

# RECOMMENDATIONS

The following recommendations are made:

- The 100-yr, 48-hr design storm should be used for evaluation of the flood risk within the Battle Creek basin.
- Both the 48-hr and 72-hr design storms should be used for evaluating the performance of the existing drainage system under existing and full build-out conditions.
- Both the 48-hr and 72-hr design storms should be used for evaluation of new and/or retrofit facilities or other best management practices as part of the basin planning process.

# REFERENCES

City of Salem (2014), *Administrative Rules Chapter 109 Division 004 Stormwater System*, City of Salem Department of Public Works, January 2014.

# APPENDIX C
# QA/QC DOCUMENTATION

# WEST Consultants, Inc.

■ Response Required - Needs Revision
✓ Complete
n/a Not Applicable

## QA/QC - XPSTORM and/or XPSWMM Review Checklist

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Project Title: | Salem SWMP - Battle Basin | | | | | |
| | Project No.: | CITY002017 | Project Task: | 0000060000 | Date Submitted for Review: | 2/17/2015 | Date of Final Review: | 3/14/2018 |

| | | | | |
|---|---|---|---|---|
| | Preparer Name: | Erik McCarthy | Reviewer Name: | James Heyen/Erik McCarthy |
| | Preparer Company: | WEST Consultants | Reviewer Company: | WEST Consultants |

## Model Components

| | | Modeled Y/N | Method Used | 1D/2D/Combined | |
|---|---|---|---|---|---|
| | Runoff | Y | SWMM RUNOFF | | Note: The Full Buildout 100-yr 48-hour event was used for this final QAQC since it was the largest event modeled. |
| | Sanitary | N | N/A | | |
| | Hydraulics | Y | Dynamic Wave/ Finite Difference | Combined | |

| Item No. | Review Item | Comments | Status |
|---|---|---|---|
| | **1. Basic Documentation** | | |
| 1.1 | Model version documented? | XP-STORM 2014 SP1 | ✓ |
| 1.2 | Vertical and horizontal datum of project provided? | Vertical Datum: NGVD29 Horizontal Datum: NAD 1983 State plane Oregon North HARN International feet 3601 | ✓ |
| 1.3 | Topographic information provided (vertical and horizontal datum, what kind)? If multiple data sets are used, are the extents for each one known? | 3-ft LiDAR used from 2011 Oregon LiDAR consortium. Converted to project coordinates and Datum. Near the confluence of Battle Creek and Waln Creek, topographic data came from grading contours from Otak to represent resent development in the area. | ✓ |
| 1.4 | Soil data information used documented and provided? | Based on SURRGO data downloaded in Oct 2014 | ✓ |
| 1.5 | Land use information documented and provided? | For area within city, land use based on impervious data provided by city. Pervious areas within city were assumed to be turf. Outside of the city, land use based on NCLD land cover dataset. | ✓ |
| 1.6 | Documentation on techniques and procedures provided? | P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Salem Stormwater Master Plan Model documentation.docx | ✓ |
| 1.7 | Have modeling errors and warning been addressed? | Yes. Wave celerity warning ignored in .out file ignored. | ✓ |
| 1.8 | What configuration parameters are used? | MINLEN=10, which allows links to be shorter than the default length of 32 ft. Shortening the allowable link length did not cause instabilities and it reduced the extra storage in shorter links. | ✓ |
| | **2. RUNOFF** | | |
| 2.1 | Maximum event modeled (Search for "Rainfall input summary from Runoff" in .out) | Jan 2012 Event Distribution with 48-hour design storm - Full Buildout | ✓ |
| 2.2 | Was topology performed on sub watersheds? | Topology performed on sub watersheds and saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\GIS\Subbasins\Corrected_Topology\Battle_Updated.shp | ✓ |
| 2.3 | What infiltration method is being used? Is it consistent for each sub catchment? (See Table R3) | Horton, Yes | ✓ |
| 2.4 | How many sub catchments are being modeled? Is it consistent with GIS? (see Table R3) | 98, yes | ✓ |
| 2.5 | Does the total basin area in GIS match the total area in the *.out file? (see Table R3) | GIS = 18344 ac, XP = 18344, each subbasin was compared individually. Some errors were found during the initial review. These were fixed and rechecked. | ✓ |
| 2.6 | Does the runoff volume seem reasonable? (see Table R9) | For the pre-calibrated existing conditions model, runoff depths range from 0.78-3.7 inch mostly depending on % impervious. % Imperv ranges from 0-50%. Calibration was performed to match observed values. | ✓ |
| 2.7 | Is the % Continuity error reasonable? (see Table R5) | Yes, -0.0004, recommended to be +/- 2%. | ✓ |
| 2.8 | Do the infiltration parameters seem reasonable? (Table R2) | During the calibration process, the initial infiltration rate was set to 0.040 in/hr for silty-clay-loams soils (most of the model). While this is outside of the recommended range provided by XP for C soils, it is assumed that during the wet months, the soils are saturated and in does not require much rainfall to reach the minimum infiltration. Other infiltration parameters fall within recommended ranges. | ✓ |
| 2.9 | Are the runoff parameters reasonable? (See Table R1) | Yes, based on assumptions in P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Battle\Runoff\XPSWMM_Runoff_Battle.xlsm | ✓ |

| Item No. | Review Item | Comments | |
|---|---|---|---|
| | **3. 1D Hydraulics** | | |
| 3.1 | Is a baseflow being used in the model? If so, where? | Yes, interpolated along network based on stream gage baseflow data prior to the Jan 2012 event. | ✔ |
| 3.2 | Weir coefficient | Default of 3.0 being used for all weirs except bridge weirs which used 2.6. | ✔ |
| 3.3 | How are bridges being modeled? | If the max modeled stage does not reach the low chord, the bridges are modeled as natural channels. If the stage reaches the low chord and the overflow can be modeled as a weir, a bridge link was used. If The overflow could not be accurately modeled as a weir, a multi link was used in which the bridge opening was modeled as a user defined conduit and the overflow was modeled as a natural cross section. | ✔ |
| 3.4 | Is the model losing any water? (See Table E20) | Overflows and 2D grid used to capture all water. Overflow links are orange in XP. If overflow was a street, then overflow was modeled as a trapezoid. Otherwise, natural cross sections used to represent overflows. Method for capturing water: Node spill crests were raised to 100 ft above invert. Max accounted water elevations were tracked in P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Battle\Hydraulics\NodeFlooding.xlsx. If the node max water elevation from XP exceeded the max accounted water levels, an overflow conduit was added and the max water accounted water level was raised. Check were made for the Existing conditions 48-hour and 72-hour events as well has the Full Build-Out Conditions 48-hour event. | ✔ |
| 3.5 | Was node storage used properly? Where the storage curves adjusted to the node invert elevation? | For nodes in which the channel cross sections did not adequately capture all storage, storage curves were developed and input into the nodes. The areas that storage curves were developed for are in this shapefile: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Battle\Hydraulics\Storage\BA_Storage.shp. These polygons were used with lidar to develop storage 1'ft storage curves. The stages used in the curved were adjusted based on the node invert elevation. Note that most of the curves were developed in GEOHMS, which over calculated the storage areas by an average of 13%. The areas in the resulting curves were decreased by 13% to not over count storage. | ✔ |
| 3.6 | What was done to prevent the double counting of storage? | Tributary lengths were shortened near confluences. Overflow length were shortened to the 100-yr stage when connecting to channel. If node storage was used at a channel, the area used in node storage curve did not include the natural cross section area. | ✔ |
| 3.7 | How were natural channels modeled? Were bank station and overbank flow distances used correctly? | If HEC-RAS model had available cross section data, that was imported into SWMM. If no RAS data was available, if channel was within UGB, and channel had more than 1 sq mile of runoff area, then channels were surveyed and overbanks were extracted from lidar. Otherwise, channels and overbanks were both extracted from lidar. Banks station were set at top of banks, not top of normal water level. Because of that, channel roughness values are a composite value of the channel and bank vegetation. Overbank lengths were estimated used lidar. May need to revise after initial model runs. | ✔ |
| 3.8 | Model Stability | Most instabilities were fixed. However, near node BA-SF-247 there is an instability related to the overflow link in basf-246e that was ultimately ignored after attempting to fixed it. Since this is a rural area outside of the City's UGB and the instability dampens out after a few links, it was decided that it was not worth spending more time debugging this instability. Minor instabilities near 13th street but it does not seem to affect peak WSE or peak Flows for any of the events. | ✔ |
| 3.9 | Check node % Continuity (Table E18). | Overall continuity excellent. Some nodes near BA-SF-247 had instabilities (see above). | ✔ |
| 3.10 | Are any channel walls being vertically extrapolated? (See "*" in Table E10) | If the HGL exceeds side walls of conduit, then by default XP-SWMM extrapolates the side wall vertically. If this is the case then either the channel needs to be extended, or there needs to be connected to a 2D grid. For some overflow channels this is okay. All of these issues have been addressed. Note that for links. (see E10 tab in P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Battle\Hydraulics\NodeFlooding.xlsx) | ✔ |
| 3.11 | User defined conduits | User defined conduits were developed in HEC-RAS and were used to represent bridge openings. | ✔ |
| 3.12 | Were any initial depths used? | No, baseflows filled in storage areas up to the downstream link invert elevation. | ✔ |
| 3.13 | Conduit Sizes | Conduit Sizes checked. No unreasonable sizes. Natural cross section diameters set to 0. | ✔ |

| Item No. | Review Item | Comments | |
|---|---|---|---|
| | **4. 2D Hydraulics** | | |
| 4.1 | Have the 2D errors and warning been addressed? | Yes | ✔ |
| 4.2 | What time step was used? Does it make sense? | 2 seconds - XP2D documentation recommends 1/4 to 1/2 timestep to cell size (meters) ratio. Cell size is 12 ft (4m) (total of 30000 cells). | ✔ |
| 4.3 | What overland roughness assumptions were used? Was 0.3 used for buildings? | Based on ARR Project 15 (pg 10-158). Created tables of roughness depending on depth. As the depth was low, the n values were high (similar to recommended values in XP2D documentation.) As the depth increased, the n values decreased to the lower values recommended in ARR Project 15. As per recent research, buildings were modeled with roughness of 0.3 so account for storage. | ✔ |
| 4.4 | Were any gullies or ridges used? | Ridges were used to "burn in" correct elevations, including at banks and berms. Gullies were also used for similar reasons. | ✔ |
| 4.5 | Were there any unusual or problematic flow patterns? Does the grid cover the flood extents? Are the 2D velocities reasonable? | Flow patterns check, and grid extended to capture flood extents. Max 2D velocities are about 2.7 ft/s, which was generally reasonable. | ✔ |
| 4.6 | Were 1D channels made inactive in the grid to avoid double counting storage? If yes, were 1D/2D interfaces used at the boundary? | Yes | ✔ |
| | Were there any major mass errors in the *.flt file? (Search for error) | Both CE and ME were good. Final ME = -0.04%. Recommended less than 1%. | ✔ |
| | Are spill crests at the nodes that are connect to the 2D model at the ground elevation? Have thick ridge lines been added at the for the connected 1D channel banks? | Yes. Most 1D channel banks used ridges except the Waln Creek's right bank at the confluence since there is not a right bank at that location. | ✔ |
| | Was there any DTM manipulation? | Yes, a few ridge and gully lines were added and fill was used at the confluence to fix DTM interpolation errors. | ✔ |
| | Do the inactive areas in the 2D area that represent channels fully cover elements ? | Yes | ✔ |

**Additional Comments:**

Model documentation saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Salem%20Stormwater%20Master%20Plan%20Model%20documentation.docx
Model saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\Battle\SWMM\QAQC_submission
GIS Map saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\GIS\BaseMap.qgs
Sub watersheds saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\GIS\Subbasins\Corrected_Topology\Battle_Updated.shp
Nodes shapefile saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\GIS\Link_Node_Network\Updated\Nodes.shp
Link shapefile saved here: P:\CityofSalem\StormwaterMasterPlan\6_BasinPlanning_Modeling\GIS\Link_Node_Network\Updated\backup\Links_with_US_DS_Nodes.sl

# APPENDIX D
# CALIBRATION/VERIFICATION PLOTS

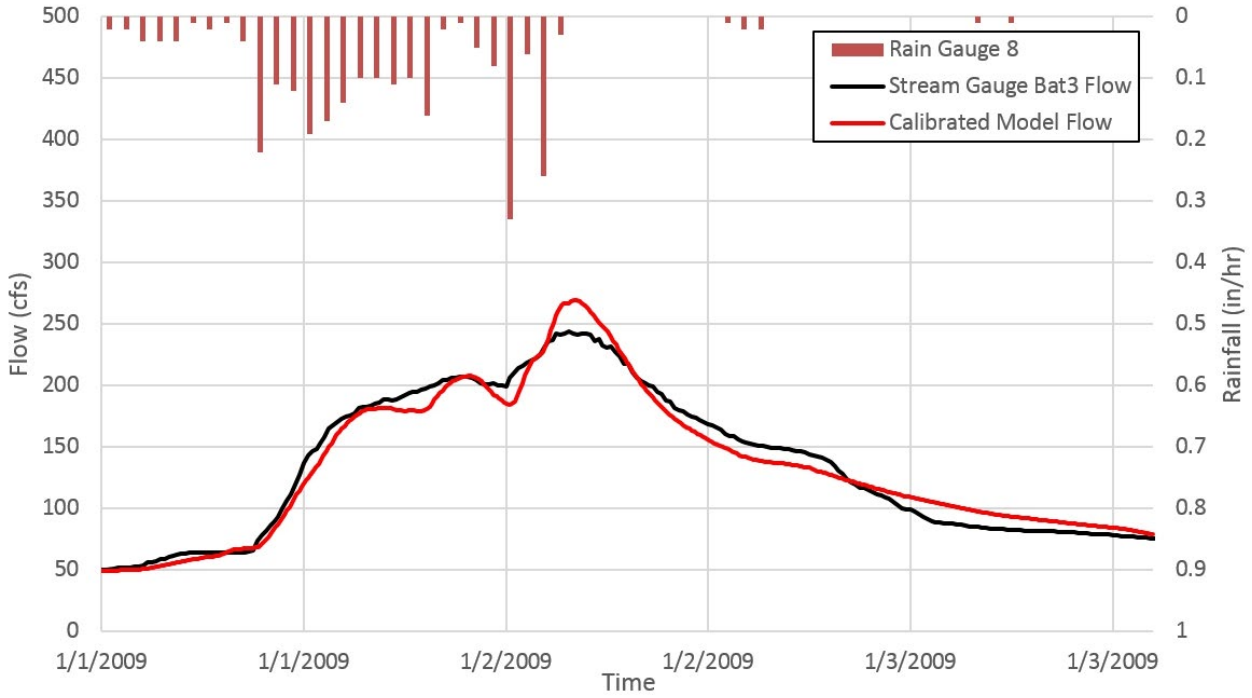



Figure D.1–January 2009 storm event flow hydrographs at Bat3 stream gauge.

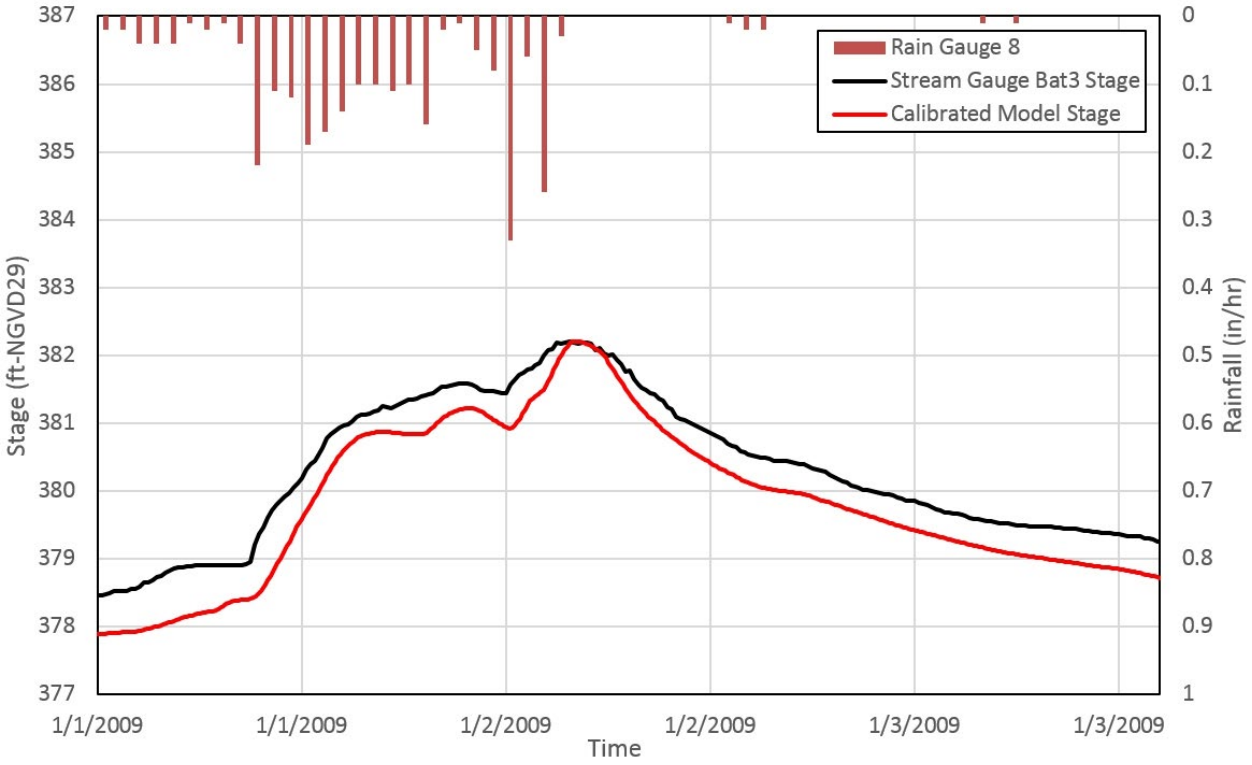



Figure D.2–January 2009 storm event stage hydrographs at Bat3 stream gauge.

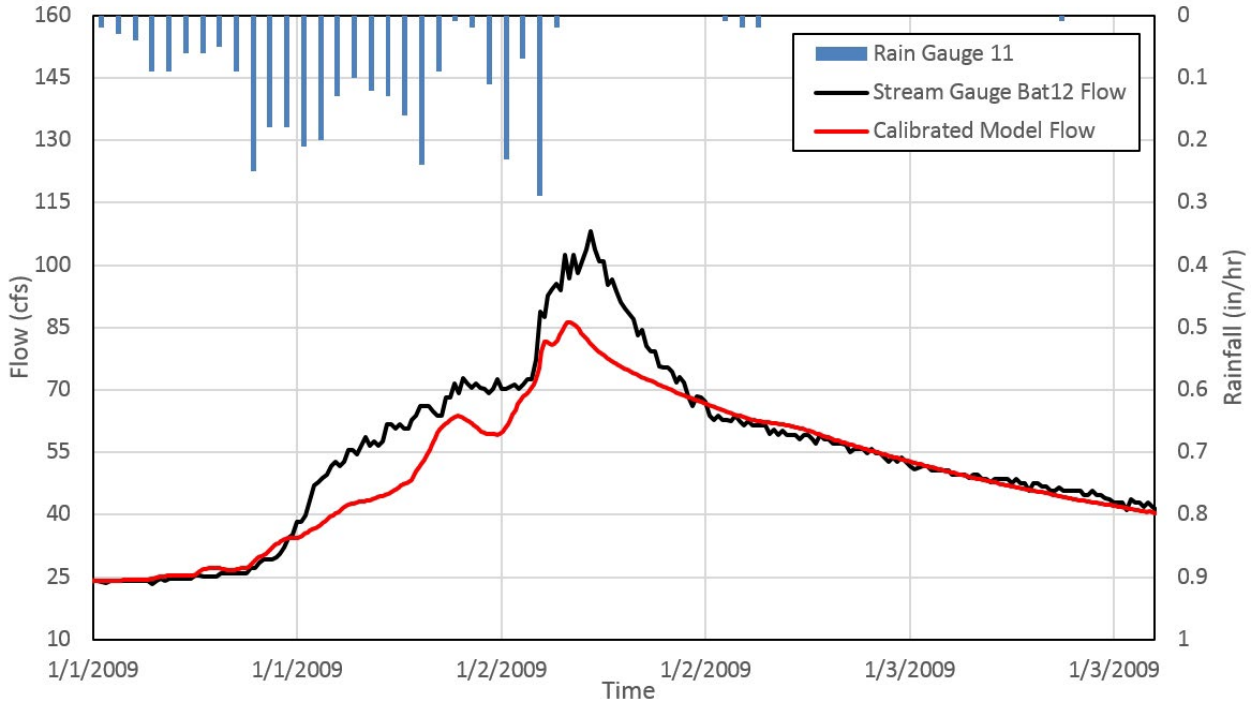



Figure D.3–January 2009 storm event flow hydrographs at Bat12 stream gauge.

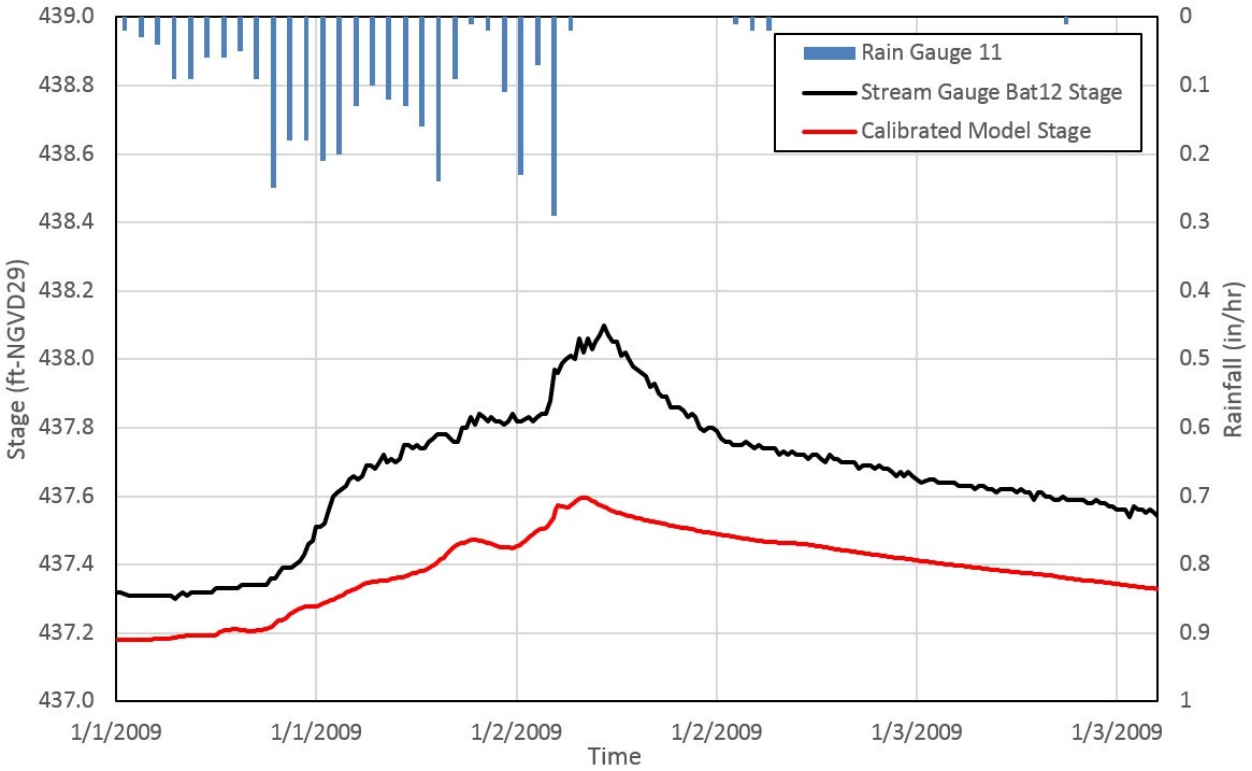



Figure D.4–January 2009 storm event stage hydrographs at Bat12 stream gauge.

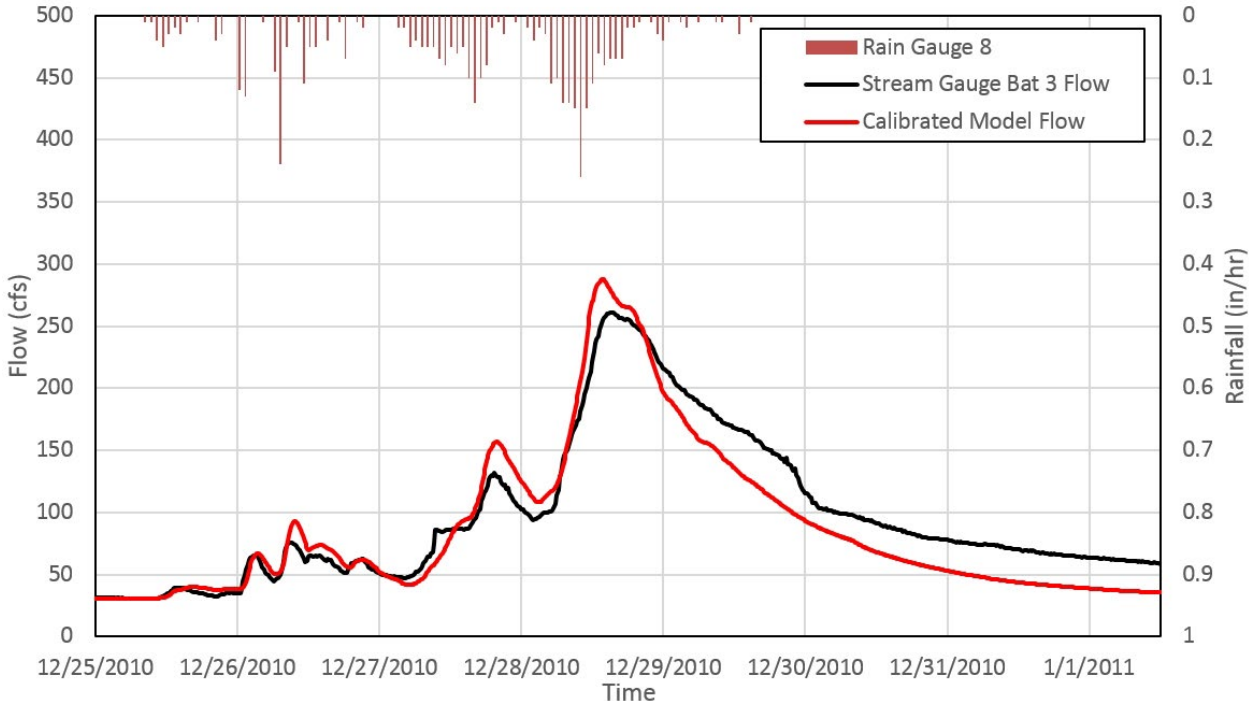



Figure D.5–December 2010 storm event flow hydrographs at Bat3 stream gauge.

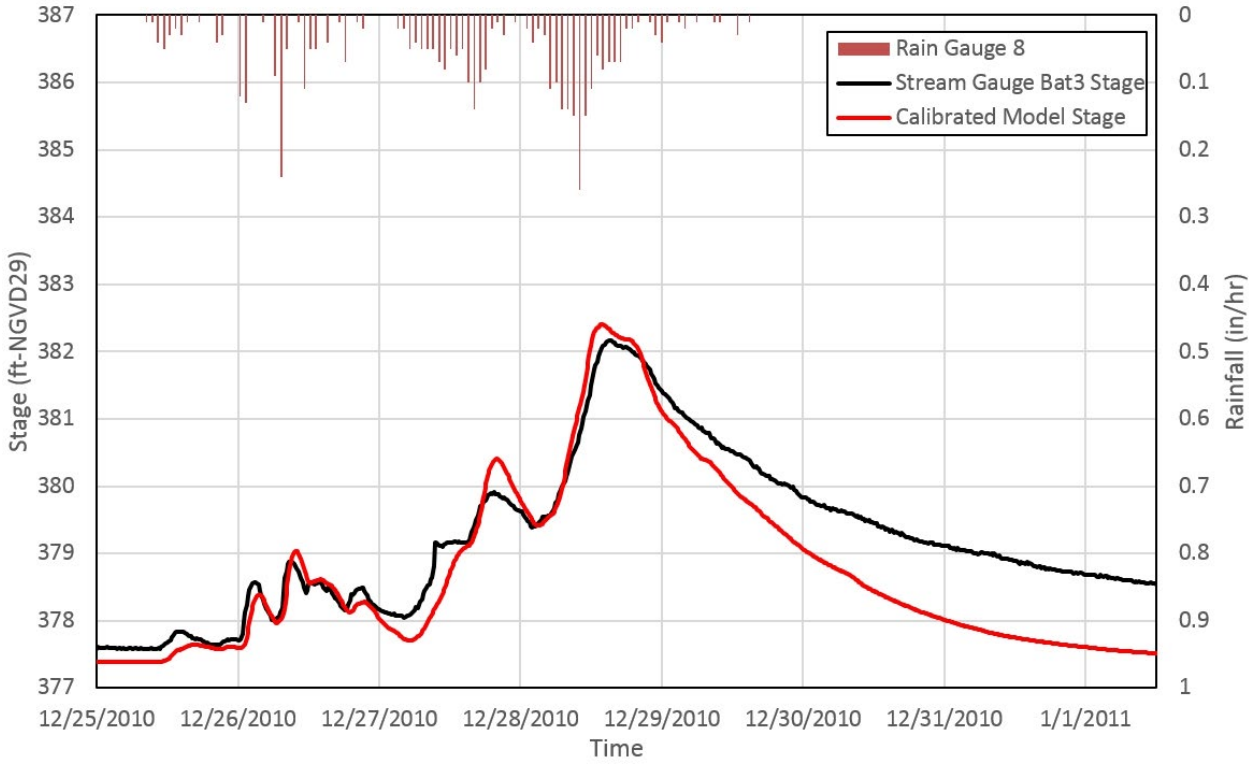



Figure D.6–December 2010 storm event stage hydrographs at Bat3 stream gauge.

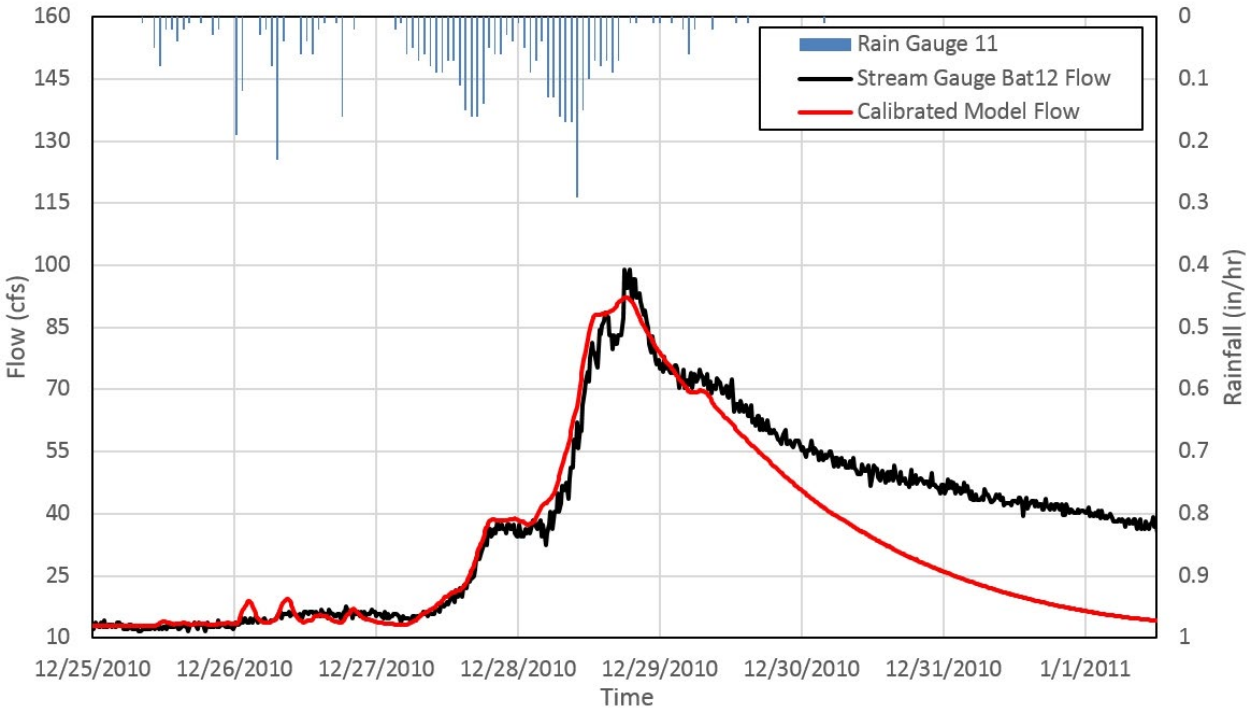



Figure D.7–December 2010 storm event flow hydrographs at Bat12 stream gauge.

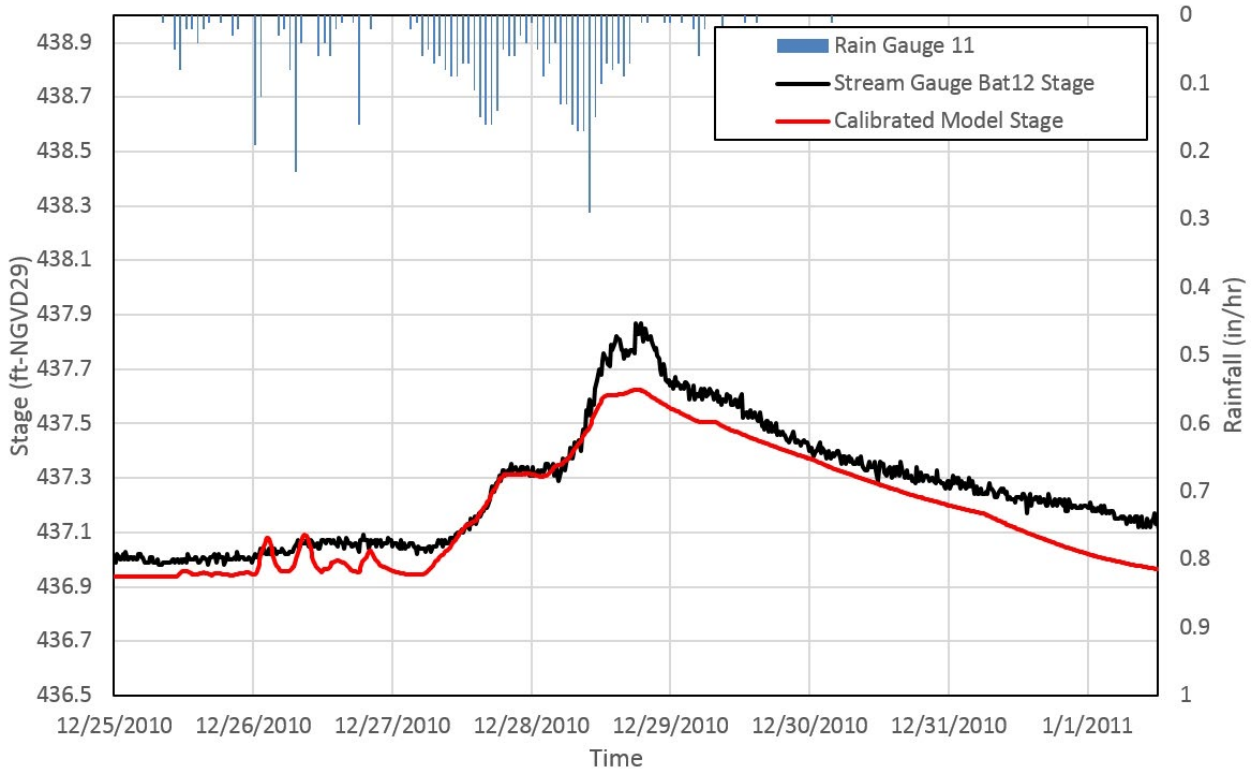



Figure D.8–December 2010 storm event stage hydrographs at Bat12 stream gauge.

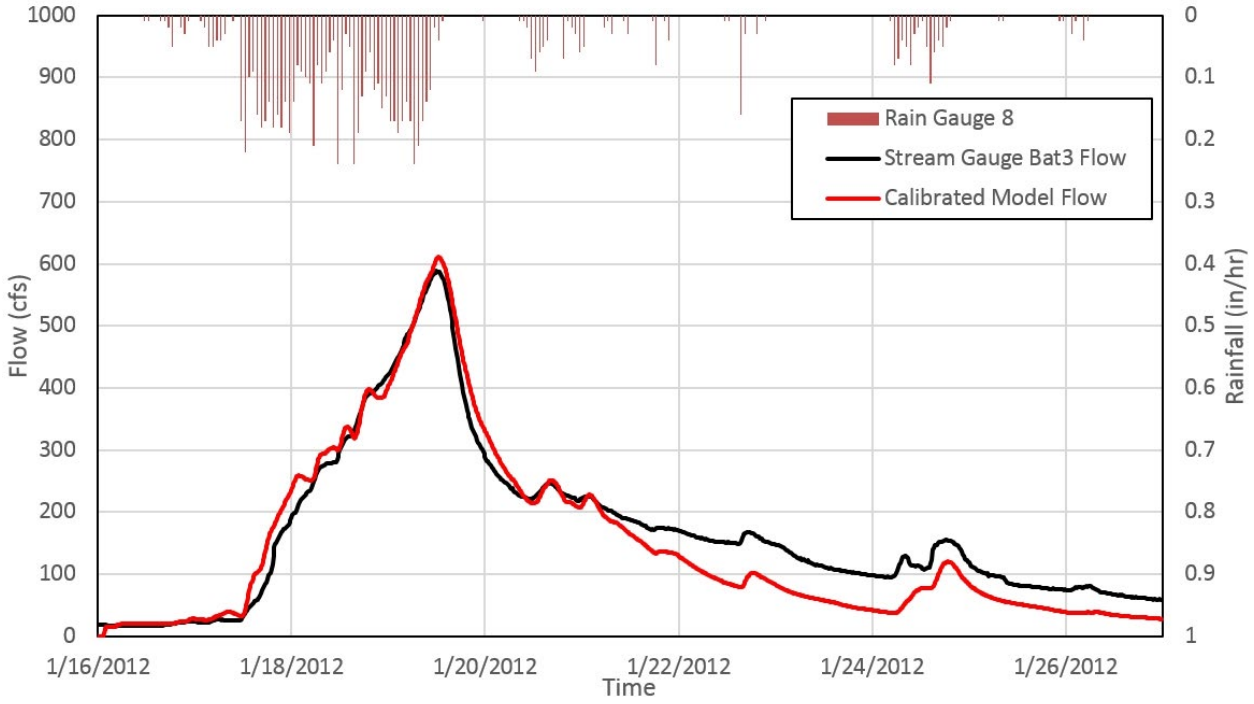



Figure D.9–January 2012 storm event flow hydrographs at Bat3 stream gauge.

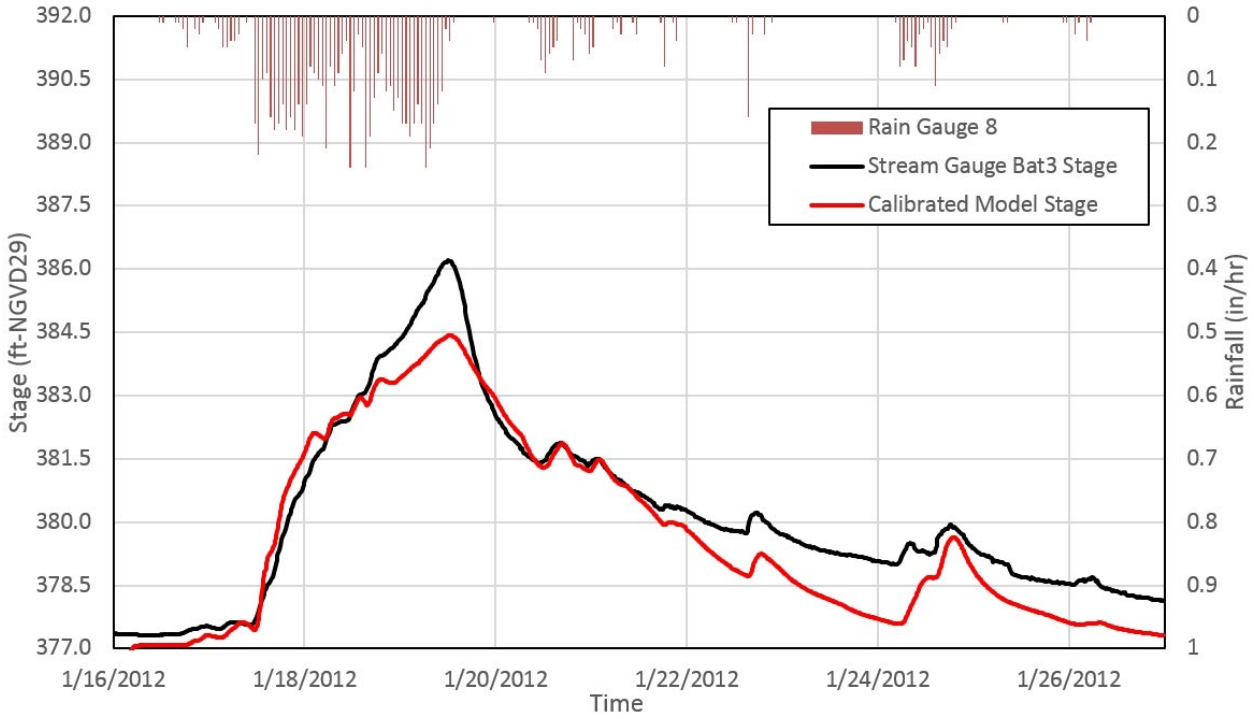



Figure D.10–January 2012 storm event stage hydrographs at Bat3 stream gauge.

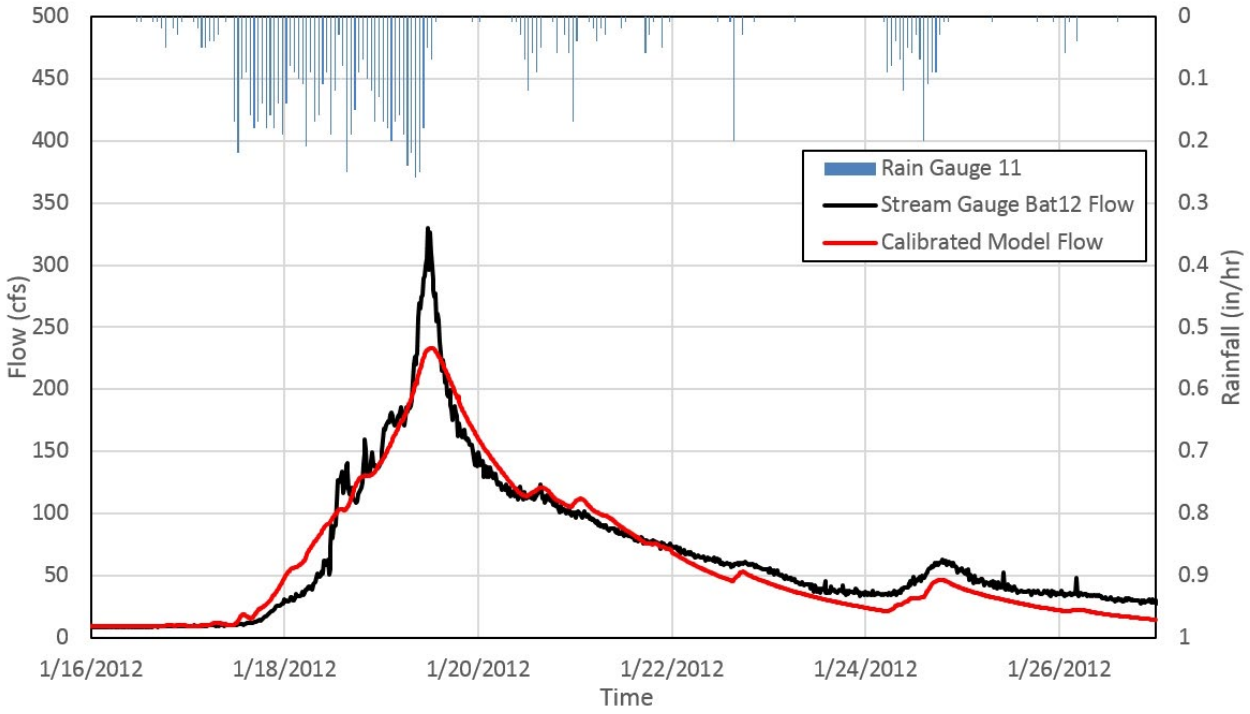



Figure D.11–January 2012 storm event flow hydrographs at Bat12 stream gauge.

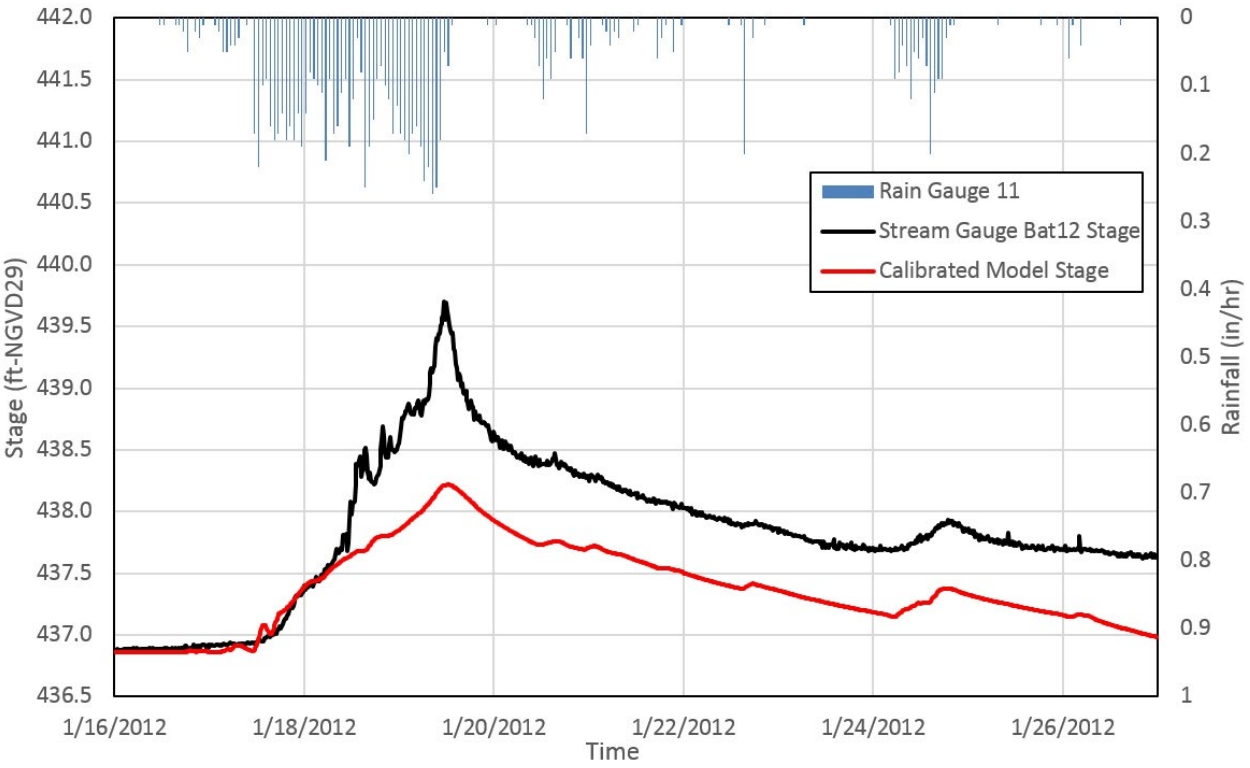



Figure D.12–January 2012 storm event stage hydrographs at Bat12 stream gauge.

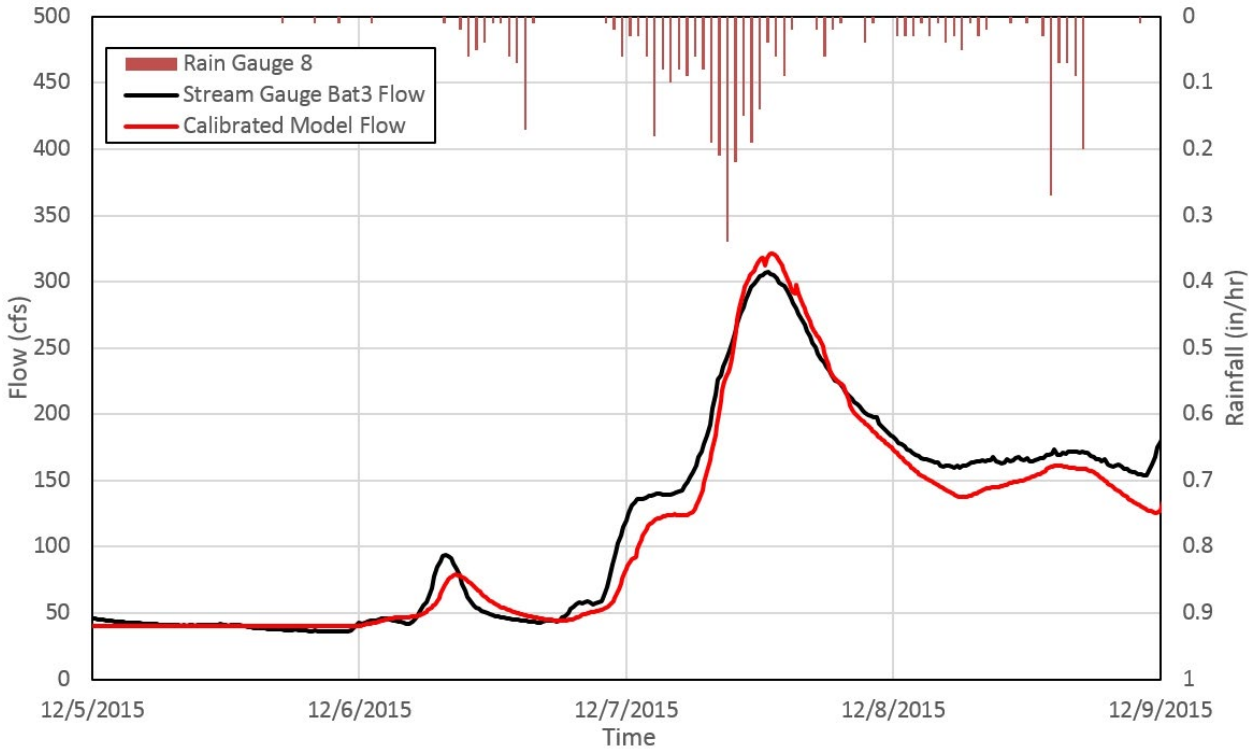



Figure D.13–December 7, 2015 storm event flow hydrographs at Bat3 stream gauge.

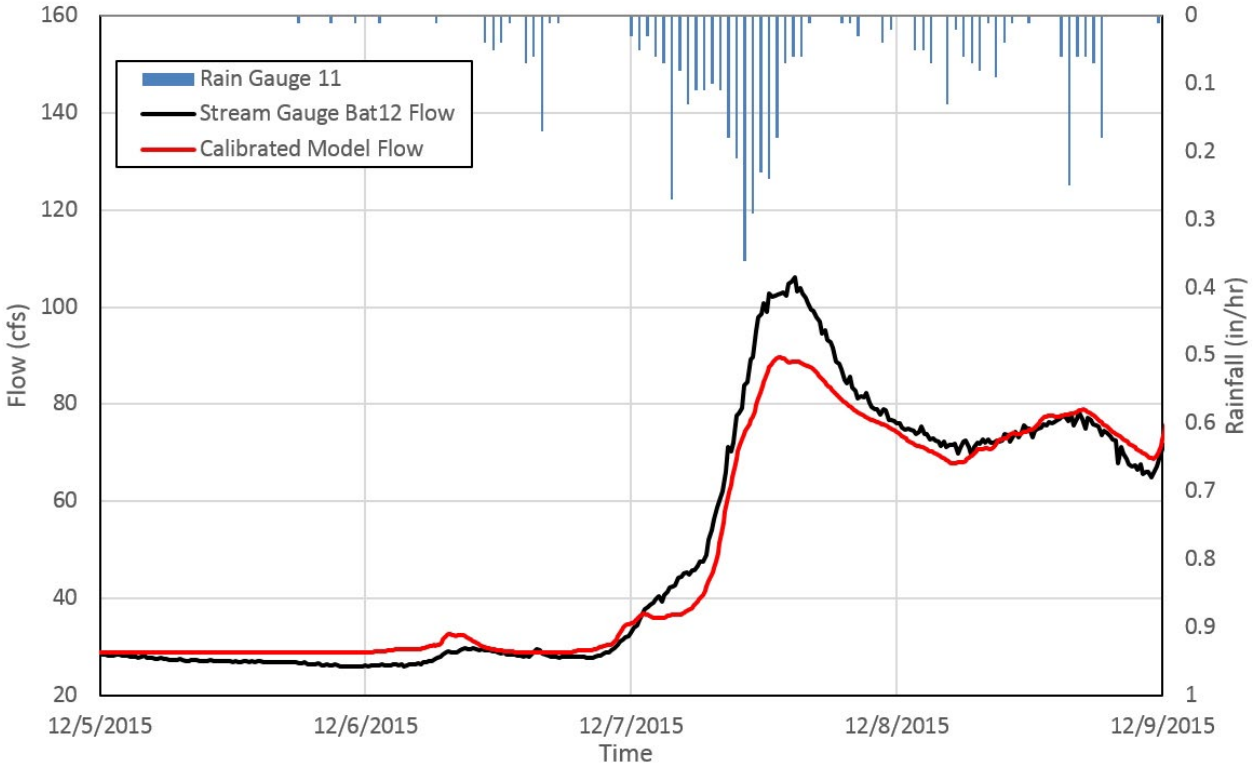



Figure D.14–December 7, 2015 storm event flow hydrographs at Bat12 stream gauge.

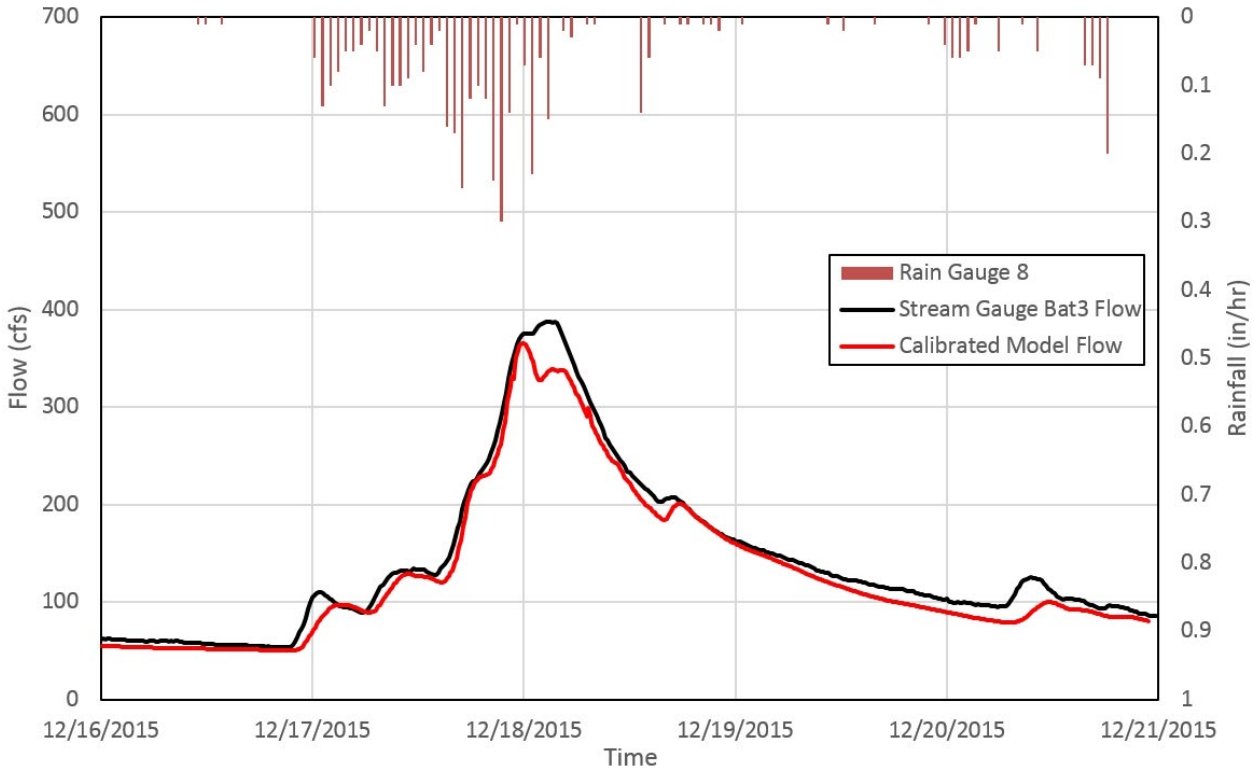



Figure D.15–December 17, 2015 storm event flow hydrographs at Bat3 stream gauge.

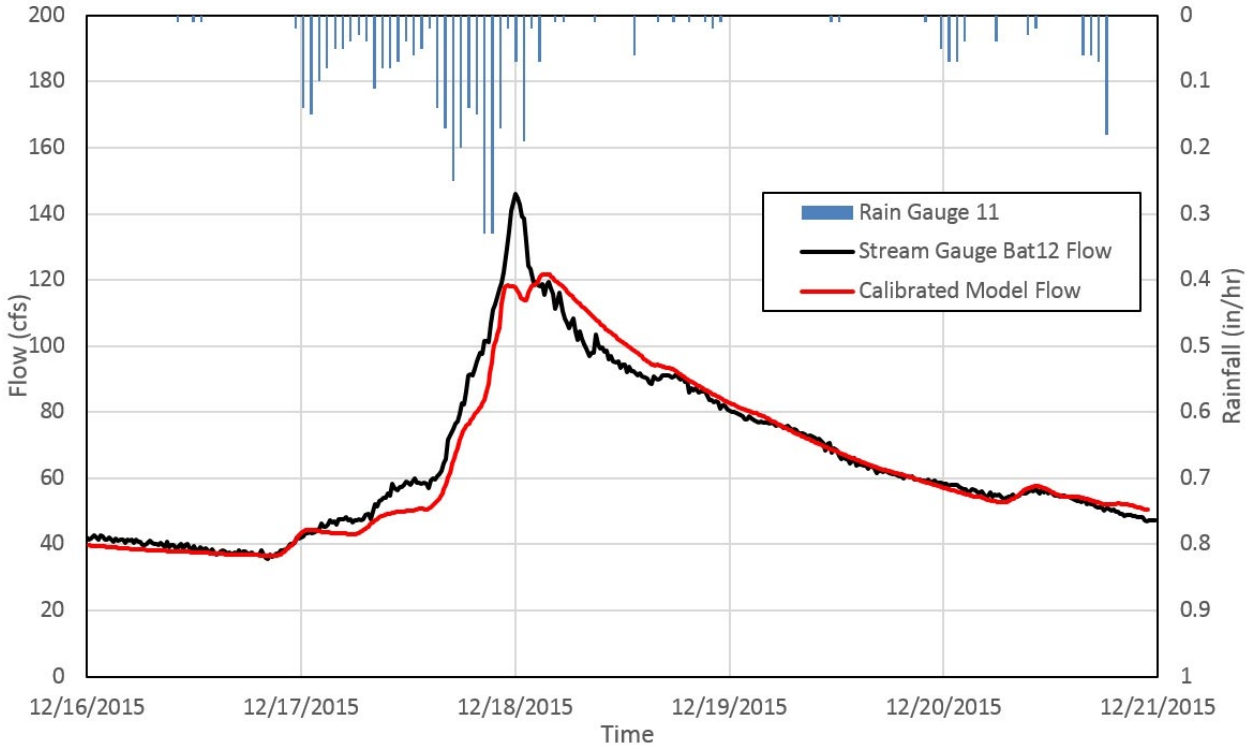



Figure D.16–December 17, 2015 storm event flow hydrographs at Bat12 stream gauge.

# APPENDIX E – EXISTING CONDITIONS AND FULL BUILD-OUT MODEL RESULTS

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| babc-002 | 470.5 | 593.6 | 698.4 | 786.3 | 449.7 | 567.5 | 660.9 | 744.1 | 577.0 | 691.0 | 795.6 | 906.8 | 527.5 | 644.1 | 736.1 | 832.5 |
| babc-003 | 470.5 | 593.6 | 698.5 | 786.3 | 449.7 | 567.5 | 660.9 | 744.3 | 577.0 | 691.0 | 795.6 | 906.8 | 527.6 | 644.1 | 736.1 | 832.5 |
| babc-004 | 470.5 | 593.9 | 698.8 | 786.5 | 449.8 | 567.6 | 661.2 | 745.6 | 577.2 | 691.3 | 795.9 | 907.1 | 527.7 | 644.1 | 736.5 | 833.0 |
| babc-005 | 470.5 | 594.0 | 699.0 | 786.7 | 449.8 | 567.7 | 661.3 | 746.0 | 577.4 | 691.5 | 796.1 | 907.5 | 527.8 | 644.6 | 736.8 | 833.5 |
| babc-006 | 455.1 | 576.3 | 680.0 | 762.9 | 435.6 | 550.3 | 642.1 | 725.0 | 555.2 | 664.9 | 766.4 | 877.8 | 508.3 | 621.8 | 712.1 | 808.2 |
| babc-008[1] | 426.3 | 534.9 | 625.3 | 668.7 | 409.0 | 513.7 | 595.3 | 649.7 | 500.3 | 599.5 | 645.9 | 681.0 | 463.7 | 552.3 | 626.2 | 665.6 |
| babc-009[1] | 430.6 | 545.5 | 643.9 | 690.0 | 411.6 | 523.4 | 612.9 | 671.3 | 522.5 | 628.7 | 684.7 | 702.4 | 478.8 | 587.9 | 659.6 | 705.3 |
| babc-010[1] | 392.6 | 394.7 | 402.0 | 405.5 | 384.9 | 397.6 | 395.5 | 397.1 | 398.7 | 405.9 | 408.4 | 408.4 | 398.3 | 398.2 | 397.3 | 397.9 |
| babc-011[1] | 102.4 | 101.8 | 101.3 | 100.5 | 127.7 | 132.8 | 134.0 | 101.2 | 126.6 | 132.8 | 135.5 | 137.7 | 129.9 | 135.0 | 137.4 | 139.4 |
| babc-012[1] | 211.0 | 258.6 | 319.9 | 339.5 | 207.1 | 266.8 | 314.9 | 336.5 | 255.2 | 301.0 | 339.1 | 346.4 | 235.4 | 294.8 | 330.8 | 341.0 |
| babc-014[1] | 212.0 | 264.8 | 301.5 | 321.1 | 210.6 | 273.1 | 305.9 | 322.6 | 256.8 | 296.2 | 327.1 | 349.5 | 236.1 | 296.9 | 313.3 | 337.0 |
| babc-015 | 216.5 | 262.4 | 298.6 | 306.5 | 212.9 | 270.0 | 296.1 | 307.7 | 257.0 | 302.4 | 318.2 | 326.2 | 236.1 | 300.6 | 308.3 | 322.2 |
| babc-016 | 198.3 | 243.8 | 310.3 | 358.5 | 197.1 | 257.7 | 304.3 | 351.7 | 243.3 | 296.6 | 374.1 | 426.3 | 225.8 | 288.7 | 341.2 | 393.0 |
| babc-017 | 194.9 | 239.5 | 305.6 | 352.8 | 194.1 | 254.3 | 299.9 | 347.0 | 235.5 | 284.7 | 357.2 | 395.1 | 220.3 | 281.8 | 330.7 | 376.4 |
| babc-018 | 194.9 | 239.5 | 305.6 | 352.8 | 194.1 | 254.3 | 299.9 | 347.0 | 235.5 | 284.8 | 357.3 | 395.2 | 220.3 | 281.8 | 330.7 | 376.4 |
| babc-019 | 183.8 | 226.9 | 290.7 | 336.2 | 185.7 | 245.5 | 288.9 | 335.5 | 221.0 | 268.0 | 338.5 | 386.4 | 209.6 | 270.1 | 316.6 | 362.9 |
| babc-021 | 183.7 | 226.9 | 290.7 | 336.3 | 185.6 | 245.5 | 288.9 | 335.5 | 221.7 | 268.8 | 338.9 | 387.3 | 209.7 | 270.2 | 316.7 | 362.8 |
| babc-023 | 183.7 | 226.9 | 290.7 | 336.3 | 185.6 | 245.5 | 288.9 | 335.5 | 220.9 | 268.3 | 338.5 | 386.4 | 209.6 | 270.2 | 316.6 | 362.8 |
| babc-025 | 183.7 | 227.3 | 290.9 | 336.6 | 185.7 | 245.9 | 288.9 | 335.5 | 221.7 | 268.8 | 338.9 | 387.3 | 209.7 | 270.2 | 316.7 | 363.1 |
| babc-026 | 167.0 | 214.2 | 267.1 | 308.3 | 173.4 | 233.0 | 272.7 | 318.8 | 197.4 | 240.3 | 307.0 | 353.1 | 193.0 | 252.2 | 294.9 | 338.6 |
| babc-028 | 167.0 | 214.3 | 267.1 | 308.5 | 173.4 | 233.0 | 272.7 | 318.8 | 197.3 | 240.5 | 307.3 | 353.5 | 193.0 | 252.3 | 294.9 | 338.6 |
| babc-029 | 133.1 | 157.4 | 179.6 | 193.1 | 138.9 | 164.1 | 181.1 | 197.1 | 134.1 | 158.3 | 180.3 | 193.8 | 139.8 | 164.9 | 181.8 | 197.6 |
| babc-031 | 138.4 | 177.7 | 218.2 | 251.6 | 146.9 | 189.8 | 221.9 | 261.8 | 139.8 | 179.3 | 219.8 | 253.3 | 148.3 | 191.2 | 223.4 | 263.3 |
| babc-059 | 10.3 | 13.2 | 15.6 | 18.0 | 8.4 | 10.9 | 12.6 | 14.4 | 21.1 | 24.2 | 25.9 | 27.7 | 15.2 | 18.5 | 20.8 | 23.0 |
| babc-060 | 10.3 | 13.3 | 15.6 | 18.0 | 8.5 | 10.9 | 12.6 | 14.4 | 21.1 | 24.3 | 25.9 | 27.7 | 15.2 | 18.5 | 20.8 | 23.0 |
| babc-061 | 10.3 | 13.3 | 15.6 | 18.0 | 8.5 | 10.9 | 12.7 | 14.5 | 21.1 | 24.3 | 25.9 | 27.7 | 15.2 | 18.5 | 20.8 | 23.1 |
| babc-062 | 10.3 | 13.3 | 15.6 | 18.0 | 8.5 | 10.9 | 12.7 | 14.5 | 21.1 | 24.3 | 26.0 | 27.8 | 15.2 | 18.5 | 20.8 | 23.1 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| babc-063 | 4.9 | 6.4 | 7.7 | 9.0 | 4.3 | 5.7 | 6.7 | 7.8 | 13.7 | 15.3 | 15.8 | 16.4 | 9.8 | 11.8 | 13.3 | 14.7 |
| babc-064 | 4.9 | 6.5 | 7.7 | 9.1 | 4.3 | 5.7 | 6.7 | 7.8 | 13.9 | 15.3 | 15.8 | 16.4 | 9.8 | 11.9 | 13.3 | 14.7 |
| babc-065 | 4.9 | 6.5 | 7.7 | 9.1 | 4.3 | 5.7 | 6.7 | 7.8 | 13.9 | 15.3 | 15.8 | 16.4 | 9.8 | 11.9 | 13.3 | 14.7 |
| babc-066 | 4.9 | 6.5 | 7.7 | 9.1 | 4.3 | 5.7 | 6.7 | 7.8 | 13.9 | 15.3 | 15.8 | 16.4 | 9.8 | 11.9 | 13.3 | 14.7 |
| babc-067 | 4.9 | 6.5 | 7.7 | 9.0 | 4.3 | 5.7 | 6.7 | 7.8 | 13.9 | 15.3 | 15.8 | 16.4 | 9.8 | 11.9 | 13.3 | 14.7 |
| babc-068 | 4.9 | 6.5 | 7.7 | 9.1 | 4.3 | 5.7 | 6.7 | 7.8 | 13.9 | 15.3 | 15.8 | 16.4 | 9.8 | 11.9 | 13.3 | 14.7 |
| babc-069 | 4.9 | 6.5 | 7.8 | 9.1 | 4.3 | 5.7 | 6.7 | 7.8 | 13.9 | 15.3 | 15.8 | 16.4 | 9.8 | 11.9 | 13.3 | 14.7 |
| babc-070 | 11.9 | 14.6 | 16.7 | 18.9 | 8.9 | 11.0 | 12.4 | 13.8 | 13.1 | 15.9 | 18.2 | 20.4 | 9.6 | 11.7 | 13.2 | 14.8 |
| babc-071 | 11.9 | 14.7 | 16.8 | 19.0 | 9.0 | 11.0 | 12.4 | 13.9 | 13.1 | 16.0 | 18.2 | 20.5 | 9.6 | 11.8 | 13.3 | 14.8 |
| babc-201 | 9.3 | 9.2 | 11.1 | 10.5 | 6.2 | 8.8 | 7.5 | 7.4 | 7.2 | 8.6 | 9.1 | 9.3 | 5.2 | 10.1 | 8.1 | -8.2 |
| babc-202 | 8.4 | 10.6 | 10.2 | -14.6 | 5.7 | 6.9 | 7.4 | -14.2 | 8.8 | 9.6 | -16.9 | -20.8 | 5.5 | 7.1 | -13.9 | -19.1 |
| babc-203 | 8.3 | 10.6 | 12.2 | 10.6 | 5.4 | 6.9 | 7.8 | 7.8 | 8.8 | 11.1 | 10.2 | 11.3 | 5.5 | 7.2 | 7.7 | 7.3 |
| babc-204 | 8.4 | 10.6 | 12.3 | 14.1 | 5.4 | 6.8 | 7.8 | 8.9 | 8.8 | 11.1 | 12.9 | 14.7 | 5.5 | 7.1 | 8.2 | 9.4 |
| babc-205 | 8.4 | 10.6 | 12.3 | 14.1 | 5.2 | 6.7 | 7.8 | 8.9 | 8.8 | 11.1 | 12.9 | 14.7 | 5.5 | 7.1 | 8.2 | 9.3 |
| babc-206 | 5.3 | 6.3 | 6.9 | 7.5 | 4.0 | 4.7 | 5.0 | 5.6 | 5.1 | 6.0 | 6.5 | 7.7 | 3.9 | 4.5 | 5.0 | 5.4 |
| babc-206a | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-207 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-208 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-209 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-210 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-211 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-212 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-213 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-214 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-215 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-216 | 6.3 | 7.7 | 8.8 | 9.9 | 4.1 | 5.0 | 5.7 | 6.3 | 7.4 | 9.0 | 10.2 | 11.4 | 4.8 | 5.8 | 6.5 | 7.2 |
| babc-217 | 14.6 | 17.2 | 19.1 | 20.6 | 9.7 | 11.7 | 13.1 | 14.7 | 16.1 | 18.8 | 20.8 | 22.3 | 10.5 | 12.6 | 14.1 | 15.7 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| babc-218 | 12.5 | 14.7 | 16.3 | 17.4 | 8.2 | 9.9 | 11.1 | 12.4 | 12.9 | 15.0 | 16.6 | 17.4 | 8.5 | 10.2 | 11.4 | 12.7 |
| babc-219 | 12.5 | 14.7 | 16.3 | 17.4 | 8.2 | 9.9 | 11.1 | 12.4 | 12.9 | 15.0 | 16.6 | 17.4 | 8.5 | 10.2 | 11.4 | 12.7 |
| babc-220 | 12.7 | 15.4 | 17.7 | 19.8 | 8.2 | 9.9 | 11.1 | 12.4 | 13.2 | 15.9 | 18.2 | 20.3 | 8.5 | 10.2 | 11.4 | 12.8 |
| babc-221 | 12.7 | 15.4 | 17.7 | 19.7 | 8.2 | 9.9 | 11.1 | 12.4 | 13.2 | 15.8 | 18.2 | 20.3 | 8.5 | 10.2 | 11.4 | 12.8 |
| babc-221of | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| babc-222 | 12.8 | 15.4 | 17.7 | 19.8 | 8.2 | 9.9 | 11.1 | 12.4 | 13.2 | 15.9 | 18.2 | 20.3 | 8.5 | 10.2 | 11.4 | 12.8 |
| babc-223 | 12.8 | 15.4 | 17.8 | 19.8 | 8.2 | 9.9 | 11.1 | 12.4 | 13.2 | 15.9 | 18.2 | 20.3 | 8.5 | 10.2 | 11.4 | 12.8 |
| babc-224 | 12.8 | 15.4 | 17.7 | 19.8 | 8.2 | 9.9 | 11.1 | 12.4 | 13.2 | 15.8 | 18.2 | 20.3 | 8.5 | 10.2 | 11.4 | 12.8 |
| babc-225 | 12.8 | 15.4 | 17.7 | 19.8 | 8.2 | 9.9 | 11.1 | 12.4 | 13.2 | 15.9 | 18.2 | 20.3 | 8.5 | 10.2 | 11.4 | 12.8 |
| babc-293 | 4.2 | 5.4 | 6.2 | 7.2 | 3.2 | 4.1 | 4.6 | 5.3 | 8.7 | 13.6 | 18.3 | 31.5 | 5.2 | 7.9 | 11.1 | 16.4 |
| babc-295 | 4.2 | 5.4 | 6.2 | 7.4 | 3.2 | 4.1 | 4.7 | 5.4 | 8.7 | 13.6 | 18.3 | 31.6 | 5.2 | 7.9 | 11.1 | 16.4 |
| babc-296[1] | 427.6 | 541.5 | 639.2 | 678.7 | 408.5 | 519.8 | 608.3 | 664.4 | 519.3 | 623.5 | 664.4 | 669.8 | 475.7 | 584.2 | 650.2 | 671.5 |
| bacc-287 | 18.1 | 22.7 | 26.2 | 29.7 | 14.7 | 18.5 | 21.0 | 23.6 | 26.4 | 32.4 | 36.8 | 41.8 | 20.5 | 25.1 | 28.3 | 31.2 |
| bacc-288 | 12.7 | 16.1 | 18.8 | 21.5 | 10.3 | 13.1 | 15.1 | 17.1 | 19.4 | 23.9 | 27.4 | 31.0 | 15.0 | 18.4 | 20.9 | 23.4 |
| bacc-289 | 12.8 | 16.2 | 18.8 | 21.6 | 10.3 | 13.1 | 15.1 | 17.2 | 19.4 | 24.0 | 27.5 | 31.1 | 15.0 | 18.5 | 20.9 | 23.4 |
| bacc-290 | 12.8 | 16.2 | 18.9 | 21.7 | 10.3 | 13.1 | 15.1 | 17.2 | 19.5 | 24.0 | 27.6 | 31.2 | 15.0 | 18.5 | 20.9 | 23.4 |
| bacc-291 | 12.8 | 16.2 | 18.9 | 21.7 | 10.3 | 13.1 | 15.1 | 17.2 | 19.5 | 24.1 | 27.6 | 31.2 | 15.0 | 18.5 | 20.9 | 23.4 |
| bacc-292 | 2.1 | 2.7 | 3.2 | 3.7 | 1.8 | 2.3 | 2.7 | 3.1 | 3.6 | 4.5 | 5.1 | 5.8 | 2.8 | 3.5 | 3.9 | 4.4 |
| bacs-252 | 2.3 | 3.1 | 3.7 | 4.3 | 1.9 | 2.6 | 3.0 | 3.5 | 2.6 | 3.4 | 4.0 | 4.6 | 2.2 | 2.8 | 3.2 | 3.7 |
| bacs-253 | 2.3 | 3.1 | 3.7 | 4.4 | 1.9 | 2.6 | 3.0 | 3.5 | 2.6 | 3.4 | 4.0 | 4.6 | 2.2 | 2.8 | 3.3 | 3.7 |
| bacs-254 | 2.3 | 3.1 | 3.7 | 4.4 | 1.9 | 2.6 | 3.0 | 3.5 | 2.6 | 3.4 | 4.0 | 4.6 | 2.2 | 2.8 | 3.3 | 3.7 |
| bacs-255 | 2.3 | 3.1 | 3.7 | 4.4 | 1.9 | 2.6 | 3.0 | 3.5 | 2.6 | 3.4 | 4.0 | 4.6 | 2.2 | 2.8 | 3.3 | 3.7 |
| bajc-226 | 26.6 | 33.8 | 40.4 | 46.5 | 24.4 | 31.2 | 36.2 | 42.1 | 38.8 | 48.2 | 56.9 | 64.6 | 33.0 | 41.1 | 47.0 | 53.9 |
| bajc-227 | 11.3 | 14.9 | 18.3 | 21.4 | 11.5 | 15.5 | 18.4 | 22.0 | 18.9 | 24.0 | 28.7 | 32.9 | 16.8 | 21.6 | 25.1 | 29.3 |
| bajc-228 | 11.3 | 14.9 | 18.4 | 21.5 | 11.5 | 15.5 | 18.4 | 22.0 | 19.1 | 24.2 | 28.9 | 33.1 | 16.8 | 21.6 | 25.1 | 29.4 |
| bapc-256[1] | 25.4 | 32.8 | 38.8 | 45.2 | 22.3 | 29.4 | 34.3 | 40.8 | 43.5 | 50.7 | 55.5 | 65.0 | 35.6 | 43.3 | 47.4 | 55.5 |
| bapc-257[1] | 25.6 | 32.9 | 38.9 | 45.3 | 22.4 | 29.4 | 34.4 | 40.0 | 43.6 | 50.8 | 55.6 | 60.0 | 35.7 | 43.4 | 47.4 | 51.3 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bapc-258[1] | 26.1 | 33.4 | 39.4 | 45.7 | 22.6 | 29.6 | 34.4 | 40.1 | 44.0 | 51.1 | 56.0 | 60.1 | 35.9 | 43.5 | 47.5 | 51.4 |
| bapc-259[1] | 26.2 | 33.4 | 38.25 | 43.1 | 22.6 | 29.6 | 34.4 | 38.5 | 42.3 | 49.2 | 54.2 | 58.4 | 35.9 | 41.9 | 45.6 | 48.9 |
| bapc-260[1] | 26.6 | 34.1 | 39.5 | 45.8 | 22.7 | 29.8 | 34.8 | 40.2 | 44.2 | 51.2 | 55.9 | 60.0 | 36.3 | 43.6 | 47.6 | 51.1 |
| bapc-261 | 23.2 | 30.6 | 34.8 | 40.4 | 20.2 | 26.9 | 31.4 | 36.3 | 40.8 | 47.1 | 51.2 | 54.7 | 33.8 | 40.5 | 44.1 | 47.2 |
| bapc-262[1] | 19.5 | 25.7 | 30.2 | 35.3 | 17.6 | 23.6 | 27.9 | 32.5 | 37.6 | 43.1 | 46.8 | 49.8 | 31.2 | 37.5 | 40.7 | 43.4 |
| bapc-263[1] | 19.5 | 25.7 | 30.3 | 35.4 | 17.6 | 23.6 | 28.0 | 32.5 | 37.8 | 43.3 | 47.0 | 50.2 | 31.2 | 37.5 | 40.7 | 43.5 |
| bapc-264[1] | 19.5 | 25.8 | 30.4 | 35.5 | 17.6 | 23.6 | 28.0 | 32.5 | 37.9 | 43.5 | 47.4 | 50.7 | 31.2 | 37.5 | 40.7 | 43.5 |
| bapc-265[1] | 19.6 | 25.8 | 30.4 | 35.6 | 17.6 | 23.6 | 28.0 | 32.5 | 37.9 | 43.5 | 47.4 | 50.7 | 31.2 | 37.5 | 40.7 | 43.5 |
| bapc-266 | 19.6 | 25.8 | 30.4 | 35.6 | 17.6 | 23.6 | 28.0 | 32.5 | 37.9 | 43.6 | 47.5 | 50.8 | 31.2 | 37.5 | 40.8 | 43.5 |
| bapc-267 | 13.0 | 17.7 | 21.1 | 25.2 | 12.1 | 16.8 | 20.2 | 23.8 | 27.6 | 34.2 | 40.2 | 45.9 | 22.8 | 29.0 | 33.5 | 38.0 |
| bapc-268 | 7.1 | 9.5 | 11.7 | 13.9 | 7.1 | 9.8 | 11.8 | 13.9 | 7.5 | 10.0 | 12.2 | 14.5 | 7.7 | 10.4 | 12.4 | 14.5 |
| bapc-269 | 7.1 | 9.5 | 11.7 | 14.0 | 7.1 | 9.8 | 11.8 | 13.9 | 7.5 | 10.0 | 12.2 | 14.5 | 7.7 | 10.4 | 12.4 | 14.5 |
| bapc-270 | 7.2 | 9.8 | 11.9 | 14.1 | 7.1 | 9.8 | 11.8 | 13.9 | 7.7 | 10.2 | 12.4 | 14.7 | 7.7 | 10.4 | 12.4 | 14.5 |
| bapc-271 | 7.3 | 9.9 | 11.9 | 14.2 | 7.2 | 9.8 | 11.8 | 13.9 | 7.7 | 10.3 | 12.4 | 14.7 | 7.7 | 10.4 | 12.5 | 14.6 |
| bapc-272 | 5.6 | 7.3 | 8.6 | 9.9 | 4.6 | 5.9 | 6.8 | 7.8 | 10.7 | 13.2 | 15.2 | 17.2 | 7.5 | 9.3 | 10.5 | 11.8 |
| bapc-273 | 5.6 | 7.3 | 8.6 | 10.0 | 4.6 | 5.9 | 6.8 | 7.8 | 10.8 | 13.7 | 16.1 | 18.7 | 7.5 | 9.3 | 10.7 | 12.1 |
| basc-274 | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 38.0 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| basc-276 | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 38.0 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| basc-278 | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 38.0 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| basc-279 | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 38.0 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| basc-280 | 24.7 | 32.2 | 37.5 | 43.2 | 20.1 | 26.1 | 30.2 | 34.6 | 30.0 | 38.1 | 44.4 | 51.0 | 23.8 | 30.2 | 34.9 | 39.6 |
| basc-281 | 24.7 | 32.5 | 37.6 | 43.2 | 20.1 | 26.2 | 30.2 | 34.6 | 30.0 | 38.1 | 44.4 | 51.0 | 23.8 | 30.2 | 34.9 | 39.6 |
| basc-282 | 13.2 | 17.2 | 20.4 | 23.7 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.1 | 24.8 | 28.7 | 13.6 | 17.5 | 20.4 | 23.3 |
| basc-283 | 13.2 | 17.2 | 20.4 | 23.8 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.1 | 24.8 | 28.7 | 13.6 | 17.5 | 20.4 | 23.6 |
| basc-284 | 13.3 | 17.3 | 20.5 | 23.8 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.2 | 24.9 | 28.8 | 13.6 | 17.5 | 20.4 | 23.4 |
| basc-286 | 13.3 | 18.3 | 20.5 | 23.8 | 11.2 | 14.8 | 18.3 | 20.1 | 17.8 | 21.3 | 25.0 | 28.8 | 13.6 | 18.4 | 20.4 | 23.4 |
| basc-297a[1] | 28.2 | 36.0 | 42.0 | 48.3 | 22.7 | 29.1 | 33.7 | 38.4 | 33.4 | 42.2 | 49.0 | 56.0 | 26.4 | 33.3 | 38.3 | 43.4 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| basc-297b[1] | 28.9 | 36.3 | 42.5 | 49.2 | 23.8 | 29.6 | 33.9 | 38.7 | 33.7 | 42.7 | 49.9 | 57.3 | 27.2 | 33.6 | 38.7 | 44.0 |
| basc-297c | 28.2 | 36.0 | 42.0 | 48.3 | 22.7 | 29.1 | 33.7 | 38.4 | 33.4 | 42.2 | 49.0 | 56.0 | 26.4 | 33.3 | 38.3 | 43.4 |
| bawc-072[1] | 191.0 | 239.8 | 272.2 | 306.5 | 167.3 | 203.0 | 233.0 | 261.1 | 230.7 | 278.5 | 319.8 | 352.7 | 187.4 | 230.0 | 257.4 | 288.8 |
| bawc-073[1] | 191.0 | 239.8 | 272.2 | 306.5 | 167.3 | 203.0 | 233.0 | 261.1 | 230.7 | 278.5 | 319.9 | 352.7 | 187.4 | 230.0 | 257.4 | 288.8 |
| bawc-074 | 189.5 | 238.0 | 269.9 | 304.2 | 165.9 | 201.4 | 231.1 | 258.8 | 227.9 | 274.9 | 315.8 | 348.3 | 185.2 | 227.6 | 254.5 | 285.8 |
| bawc-075 | 185.7 | 233.0 | 266.0 | 303.7 | 163.0 | 197.7 | 227.1 | 254.6 | 223.9 | 268.0 | 308.3 | 339.2 | 182.0 | 224.6 | 250.6 | 281.0 |
| bawc-076 | 183.5 | 220.7 | 247.8 | 277.9 | 160.7 | 193.4 | 214.3 | 238.0 | 210.5 | 249.1 | 283.5 | 302.5 | 179.4 | 211.6 | 234.5 | 259.8 |
| bawc-079 | 183.5 | 220.8 | 247.8 | 278.9 | 160.7 | 193.9 | 214.4 | 238.0 | 210.6 | 249.1 | 283.8 | 306.8 | 179.4 | 211.7 | 234.5 | 259.8 |
| bawc-080a | 178.0 | 224.5 | 255.3 | 289.2 | 155.5 | 189.1 | 216.6 | 242.8 | 211.4 | 255.6 | 293.5 | 324.5 | 173.7 | 213.7 | 239.0 | 268.7 |
| bawc-080n | 167.8 | 211.4 | 240.7 | 272.4 | 145.5 | 177.1 | 202.7 | 227.4 | 196.6 | 236.3 | 271.5 | 300.7 | 162.0 | 199.3 | 223.1 | 250.8 |
| bawc-081 | 172.6 | 210.0 | 239.7 | 269.8 | 144.8 | 175.9 | 200.1 | 225.2 | 195.8 | 235.4 | 267.7 | 296.5 | 162.1 | 197.1 | 220.9 | 247.8 |
| bawc-082 | 177.0 | 212.8 | 242.5 | 271.2 | 144.4 | 176.6 | 199.2 | 225.0 | 198.2 | 238.2 | 268.1 | 295.6 | 163.0 | 196.5 | 220.8 | 247.1 |
| bawc-083 | 177.5 | 213.3 | 244.5 | 274.1 | 144.4 | 176.7 | 199.3 | 225.5 | 198.8 | 240.6 | 272.1 | 303.8 | 163.1 | 196.7 | 221.5 | 247.7 |
| bawc-084 | 174.6 | 215.3 | 239.6 | 268.2 | 141.4 | 173.4 | 195.6 | 221.1 | 196.5 | 235.5 | 265.1 | 292.7 | 161.4 | 193.2 | 217.3 | 245.0 |
| bawc-085 | 174.7 | 219.6 | 239.7 | 268.2 | 141.4 | 173.4 | 195.6 | 221.1 | 196.1 | 235.5 | 265.1 | 292.7 | 160.7 | 193.3 | 217.3 | 244.2 |
| bawc-086 | 172.7 | 207.2 | 236.5 | 264.6 | 139.4 | 171.2 | 192.9 | 218.0 | 194.0 | 232.6 | 261.8 | 290.1 | 157.7 | 190.8 | 214.3 | 239.6 |
| bawc-087 | 145.4 | 174.6 | 201.1 | 223.5 | 118.3 | 144.6 | 163.0 | 184.0 | 167.1 | 201.1 | 225.4 | 254.0 | 136.0 | 164.0 | 184.1 | 205.0 |
| bawc-088 | 147.6 | 178.3 | 203.7 | 224.4 | 120.8 | 146.7 | 165.3 | 187.0 | 169.2 | 203.9 | 225.6 | 255.6 | 137.7 | 166.0 | 190.1 | 205.8 |
| bawc-089 | 145.7 | 175.1 | 201.4 | 224.1 | 118.4 | 144.7 | 163.0 | 183.7 | 167.6 | 201.5 | 225.6 | 253.9 | 136.0 | 164.0 | 184.3 | 205.3 |
| bawc-090 | 145.7 | 175.1 | 201.5 | 224.2 | 118.4 | 144.7 | 163.1 | 183.7 | 167.6 | 201.5 | 225.6 | 254.0 | 136.0 | 164.0 | 184.3 | 205.3 |
| bawc-090d | 7.9 | 9.8 | 11.2 | 12.7 | 5.8 | 7.2 | 8.1 | 9.1 | 9.0 | 11.0 | 12.5 | 14.1 | 6.5 | 8.0 | 9.0 | 10.0 |
| bawc-090e | 8.0 | 9.8 | 11.3 | 12.8 | 5.9 | 7.2 | 8.2 | 9.1 | 9.0 | 11.0 | 12.6 | 14.2 | 6.5 | 8.0 | 9.0 | 10.0 |
| bawc-091 | 124.7 | 149.5 | 173.5 | 191.4 | 100.9 | 123.5 | 139.1 | 157.1 | 144.5 | 174.2 | 196.0 | 221.9 | 116.8 | 140.9 | 158.5 | 176.5 |
| bawc-092 | 124.7 | 149.5 | 173.5 | 191.4 | 100.9 | 123.5 | 139.1 | 157.1 | 144.5 | 174.2 | 196.0 | 221.9 | 116.8 | 140.9 | 158.5 | 176.5 |
| bawc-093 | 120.9 | 144.8 | 168.2 | 185.3 | 98.1 | 119.8 | 134.9 | 152.3 | 140.9 | 169.6 | 191.1 | 216.3 | 114.1 | 137.3 | 154.3 | 171.6 |
| bawc-094 | 114.7 | 138.0 | 160.1 | 174.7 | 93.4 | 114.0 | 128.3 | 144.9 | 135.3 | 162.4 | 174.5 | 184.4 | 109.4 | 131.5 | 147.7 | 164.0 |
| bawc-095 | 100.9 | 121.7 | 140.8 | 151.5 | 83.3 | 101.1 | 113.5 | 128.3 | 122.7 | 145.3 | 154.8 | 161.2 | 99.2 | 118.6 | 132.9 | 147.4 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bawc-096 | 86.2 | 104.4 | 120.4 | 127.1 | 70.5 | 85.4 | 95.7 | 108.4 | 106.2 | 124.8 | 129.9 | 133.7 | 84.6 | 100.9 | 112.9 | 124.8 |
| bawc-097 | 86.2 | 104.4 | 120.3 | 127.1 | 70.5 | 85.4 | 95.7 | 108.4 | 106.2 | 124.8 | 129.9 | 133.7 | 84.6 | 100.8 | 112.9 | 124.8 |
| bawc-098 | 86.2 | 104.4 | 120.4 | 132.3 | 70.5 | 85.4 | 95.7 | 108.4 | 106.2 | 125.8 | 142.8 | 160.9 | 84.6 | 100.9 | 112.9 | 126.1 |
| bawc-099 | 86.2 | 104.4 | 120.4 | 132.3 | 70.5 | 85.4 | 95.7 | 108.4 | 106.2 | 125.8 | 142.8 | 160.9 | 84.6 | 100.9 | 112.9 | 126.1 |
| bawc-100 | 86.2 | 104.4 | 120.4 | 132.3 | 70.5 | 85.4 | 95.7 | 108.4 | 106.2 | 125.8 | 142.8 | 164.7 | 84.6 | 100.9 | 112.9 | 126.1 |
| bawc-101 | 72.3 | 88.2 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.3 | 103.0 | 118.7 | 134.9 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-102 | 72.3 | 88.2 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.3 | 103.1 | 118.7 | 134.9 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-103 | 72.3 | 88.2 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.3 | 103.1 | 118.7 | 134.9 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-104 | 72.3 | 88.2 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.3 | 103.1 | 118.7 | 135.2 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-105 | 72.3 | 88.3 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.4 | 103.1 | 118.8 | 135.0 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-106 | 72.3 | 88.3 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.4 | 103.1 | 118.8 | 135.0 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-107 | 72.3 | 88.3 | 101.0 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.4 | 103.1 | 118.8 | 135.0 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-108 | 74.6 | 91.5 | 105.0 | 115.3 | 59.2 | 72.1 | 81.0 | 92.0 | 90.6 | 107.2 | 123.6 | 140.6 | 69.7 | 83.7 | 93.9 | 105.2 |
| bawc-109 | 72.3 | 88.3 | 101.1 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.4 | 103.1 | 118.8 | 135.0 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-110 | 72.3 | 88.3 | 101.1 | 110.7 | 57.7 | 69.9 | 78.3 | 88.7 | 87.4 | 103.1 | 118.8 | 135.0 | 67.7 | 80.8 | 90.5 | 101.2 |
| bawc-111 | 63.9 | 78.2 | 89.0 | 97.7 | 50.6 | 61.3 | 68.8 | 77.8 | 77.7 | 91.3 | 105.6 | 119.2 | 59.7 | 71.3 | 79.7 | 89.1 |
| bawc-113 | 63.9 | 78.3 | 89.1 | 97.7 | 50.7 | 61.3 | 68.8 | 77.8 | 77.8 | 91.4 | 105.8 | 119.3 | 59.7 | 71.3 | 79.7 | 89.1 |
| bawc-114 | 63.9 | 78.3 | 88.9 | 91.7 | 50.7 | 61.3 | 68.8 | 77.8 | 77.8 | 89.9 | 93.7 | 97.0 | 59.7 | 71.3 | 79.7 | 89.0 |
| bawc-115 | 64.2 | 78.9 | 89.0 | 91.5 | 50.7 | 61.4 | 68.9 | 77.9 | 78.4 | 89.9 | 93.0 | 95.1 | 59.7 | 71.6 | 79.8 | 89.0 |
| bawc-116 | 64.2 | 78.9 | 89.0 | 91.5 | 50.7 | 61.4 | 68.9 | 77.9 | 78.4 | 89.9 | 93.0 | 95.1 | 59.7 | 71.6 | 79.8 | 89.0 |
| bawc-117 | 59.6 | 73.3 | 82.8 | 90.9 | 46.9 | 56.9 | 63.9 | 72.2 | 73.6 | 85.8 | 99.3 | 111.7 | 55.8 | 67.0 | 74.6 | 83.4 |
| bawc-118 | 19.9 | 21.3 | 22.8 | 24.9 | 17.6 | 19.2 | 20.3 | 20.9 | 21.3 | 23.2 | 25.3 | 25.3 | 19.1 | 20.5 | 21.3 | 22.7 |
| bawc-119 | 19.9 | 21.3 | 22.8 | 24.9 | 17.6 | 19.2 | 20.3 | 20.9 | 21.3 | 23.2 | 25.3 | 25.3 | 19.1 | 20.5 | 21.3 | 22.7 |
| bawc-120 | 19.9 | 21.3 | 22.8 | 24.9 | 17.6 | 19.2 | 20.3 | 20.9 | 21.3 | 23.2 | 25.3 | 25.3 | 19.1 | 20.5 | 21.3 | 22.7 |
| bawc-120x | 39.3 | 50.9 | 58.2 | 63.7 | 28.1 | 36.2 | 42.0 | 49.3 | 51.0 | 60.2 | 64.7 | 64.8 | 35.2 | 44.5 | 51.1 | 58.2 |
| bawc-121 | 52.1 | 63.9 | 72.3 | 79.5 | 39.3 | 47.9 | 53.9 | 61.0 | 64.8 | 74.5 | 87.8 | 97.4 | 47.5 | 57.0 | 63.6 | 71.2 |
| bawc-122 | 52.8 | 64.6 | 73.7 | 82.5 | 39.3 | 48.0 | 54.0 | 61.1 | 65.4 | 76.0 | 88.8 | 97.5 | 47.6 | 57.0 | 63.7 | 71.4 |
| bawc-123 | 41.8 | 51.5 | 58.4 | 65.7 | 31.7 | 38.8 | 43.8 | 49.7 | 54.6 | 62.8 | 73.8 | 80.8 | 39.9 | 47.9 | 53.6 | 60.0 |
| bawc-124 | 32.3 | 39.6 | 43.9 | 49.9 | 24.0 | 29.2 | 32.9 | 37.1 | 39.5 | 45.0 | 52.8 | 57.5 | 28.5 | 34.1 | 38.2 | 42.7 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bawc-125 | 32.3 | 39.6 | 43.9 | 49.9 | 24.0 | 29.2 | 32.9 | 37.1 | 39.5 | 45.0 | 52.8 | 57.5 | 28.5 | 34.1 | 38.2 | 42.7 |
| bawc-126 | 27.6 | 34.0 | 37.4 | 43.0 | 20.9 | 25.4 | 28.6 | 32.3 | 33.2 | 38.1 | 44.7 | 48.7 | 24.3 | 29.1 | 32.6 | 36.5 |
| bawc-127 | 27.6 | 34.3 | 37.9 | 44.0 | 20.9 | 25.4 | 28.6 | 32.3 | 33.5 | 38.8 | 45.8 | 51.5 | 24.3 | 29.1 | 32.6 | 36.6 |
| bawc-128 | 27.8 | 34.0 | 39.6 | 44.5 | 20.9 | 25.4 | 28.6 | 32.3 | 33.4 | 40.3 | 46.5 | 51.8 | 24.3 | 29.2 | 32.6 | 36.6 |
| bawc-129 | 27.8 | 34.0 | 39.6 | 44.6 | 20.9 | 25.4 | 28.6 | 32.3 | 33.4 | 40.3 | 46.5 | 51.9 | 24.3 | 29.2 | 32.6 | 36.6 |
| bawc-130 | 27.8 | 34.0 | 39.6 | 44.6 | 20.9 | 25.4 | 28.6 | 32.3 | 33.4 | 40.3 | 46.5 | 51.9 | 24.3 | 29.2 | 32.6 | 36.6 |
| bawc-131 | 27.8 | 34.1 | 39.7 | 44.6 | 20.9 | 25.4 | 28.6 | 32.3 | 33.4 | 40.4 | 46.5 | 52.0 | 24.3 | 29.2 | 32.6 | 36.6 |
| bawc-132 | 5.2 | 6.5 | 7.6 | 8.6 | 3.8 | 4.7 | 5.4 | 6.1 | 8.1 | 9.7 | 11.1 | 12.4 | 5.5 | 6.6 | 7.3 | 8.2 |
| bawc-133 | 5.3 | 6.4 | 7.3 | 10.0 | 3.6 | 4.3 | 4.9 | 5.4 | 6.0 | 7.3 | 11.6 | 12.6 | 4.1 | 4.9 | 5.5 | 6.1 |
| bawc-134 | 3.6 | 4.5 | 5.1 | 8.5 | 2.5 | 3.1 | 3.5 | 3.9 | 4.4 | 5.3 | 10.1 | 10.1 | 3.0 | 3.6 | 4.1 | 4.5 |
| bawc-135 | 3.6 | 4.5 | 5.1 | 5.8 | 2.5 | 3.1 | 3.5 | 3.9 | 4.4 | 5.3 | 6.0 | 6.7 | 3.0 | 3.6 | 4.1 | 4.5 |
| bawc-136 | 3.7 | 4.5 | 5.1 | 5.8 | 2.5 | 3.1 | 3.5 | 3.9 | 4.4 | 5.3 | 6.0 | 6.7 | 3.0 | 3.6 | 4.1 | 4.5 |
| bawc-137 | -2.5 | -8.7 | -11.4 | -13.5 | -2.4 | -2.6 | -7.6 | -10.5 | -6.9 | -11.5 | -13.7 | -14.3 | -2.6 | -7.1 | -10.2 | -12.4 |
| bawc-138 | 1.9 | 2.3 | 2.7 | 3.0 | 1.3 | 1.6 | 1.8 | 2.0 | 2.5 | 2.9 | 3.3 | 3.7 | 1.7 | 2.0 | 2.2 | 2.5 |
| bawc-140 | 15.2 | 18.8 | 21.5 | 24.3 | 11.1 | 13.5 | 15.3 | 17.1 | 18.7 | 22.6 | 25.6 | 28.7 | 13.2 | 16.0 | 18.0 | 20.0 |
| bawc-141 | 15.3 | 18.8 | 21.5 | 24.3 | 11.1 | 13.6 | 15.4 | 17.1 | 18.7 | 22.6 | 25.6 | 28.7 | 13.3 | 16.0 | 18.0 | 20.0 |
| bawc-142 | 3.5 | 4.3 | 4.9 | 5.6 | 2.5 | 3.1 | 3.5 | 3.9 | 4.0 | 4.9 | 5.6 | 6.3 | 2.8 | 3.4 | 3.9 | 4.3 |
| bawc-143 | 3.5 | 4.3 | 4.9 | 5.6 | 2.5 | 3.1 | 3.5 | 3.9 | 4.0 | 4.9 | 5.6 | 6.3 | 2.8 | 3.4 | 3.9 | 4.3 |
| bawc-144 | 3.5 | 4.3 | 4.9 | 5.6 | 2.5 | 3.1 | 3.5 | 3.9 | 4.0 | 4.9 | 5.6 | 6.3 | 2.8 | 3.4 | 3.9 | 4.3 |
| bawc-145 | 3.5 | 4.3 | 5.0 | 5.6 | 2.5 | 3.1 | 3.5 | 3.9 | 4.0 | 4.9 | 5.6 | 6.3 | 2.8 | 3.4 | 3.9 | 4.3 |
| bawc-146 | 3.5 | 4.3 | 5.0 | 5.6 | 2.5 | 3.1 | 3.5 | 3.9 | 4.0 | 4.9 | 5.6 | 6.3 | 2.8 | 3.4 | 3.9 | 4.3 |
| bawc-147 | 7.1 | 8.7 | 9.9 | 11.1 | 5.0 | 6.1 | 6.9 | 7.7 | 8.1 | 9.8 | 11.1 | 12.4 | 5.7 | 6.9 | 7.7 | 8.5 |
| bawc-148 | 7.1 | 8.7 | 9.9 | 11.2 | 5.0 | 6.1 | 6.9 | 7.7 | 8.1 | 9.8 | 11.1 | 12.4 | 5.7 | 6.9 | 7.7 | 8.5 |
| bawc-151 | 7.1 | 8.7 | 9.9 | 11.2 | 5.0 | 6.1 | 6.9 | 7.7 | 8.1 | 9.8 | 11.1 | 12.4 | 5.7 | 6.9 | 7.7 | 8.5 |
| bawc-152 | 7.1 | 8.7 | 9.9 | 11.2 | 5.0 | 6.1 | 6.9 | 7.7 | 8.1 | 9.8 | 11.1 | 12.4 | 5.7 | 6.9 | 7.7 | 8.5 |
| bawc-153 | 17.8 | 22.1 | 25.4 | 28.8 | 11.8 | 15.2 | 17.7 | 20.3 | 18.2 | 22.5 | 25.9 | 29.3 | 12.1 | 15.5 | 18.1 | 20.7 |
| bawc-154 | 17.9 | 22.2 | 25.5 | 29.0 | 11.9 | 15.2 | 17.7 | 20.3 | 18.2 | 22.6 | 26.0 | 29.5 | 12.1 | 15.6 | 18.1 | 20.7 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bawc-155 | 12.5 | 15.5 | 17.9 | 20.3 | 7.9 | 10.2 | 12.0 | 13.8 | 12.5 | 15.5 | 17.9 | 20.3 | 7.9 | 10.3 | 12.0 | 13.8 |
| bawc-156 | 6.9 | 8.5 | 9.8 | 13.1 | 4.8 | 5.9 | 6.7 | 7.5 | 6.9 | 8.5 | 19.8 | 35.3 | 4.8 | 5.9 | 6.7 | 7.9 |
| bawc-157 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 | 6.9 | 8.5 | 9.8 | 11.0 | 4.8 | 5.9 | 6.7 | 7.5 |
| bawc-158 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 |
| bawc-159 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 |
| bawc-160 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 |
| bawc-161 | 7.0 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 | 6.9 | 8.6 | 9.8 | 11.1 | 4.8 | 5.9 | 6.7 | 7.5 |
| bawc-162 | 14.9 | 17.7 | 19.8 | 23.3 | 10.1 | 12.9 | 14.8 | 16.6 | 14.6 | 17.5 | 19.9 | 23.6 | 10.2 | 12.9 | 14.8 | 16.7 |
| bawc-163 | 10.1 | 11.9 | 13.2 | 16.9 | 6.8 | 8.6 | 9.8 | 10.9 | 9.8 | 11.8 | 13.3 | 17.3 | 6.8 | 8.6 | 9.8 | 11.0 |
| bawc-164 | 10.1 | 11.9 | 14.0 | 16.9 | 6.8 | 8.6 | 9.8 | 10.9 | 9.9 | 11.9 | 14.1 | 17.0 | 6.8 | 8.6 | 9.8 | 11.0 |
| bawc-165 | 10.3 | 12.1 | 14.2 | 17.0 | 6.8 | 8.6 | 9.8 | 11.0 | 10.2 | 12.1 | 14.3 | 17.0 | 6.8 | 8.6 | 9.8 | 11.0 |
| bawc-166 | 10.5 | 12.7 | 14.5 | 17.0 | 6.8 | 8.6 | 9.8 | 11.0 | 10.4 | 12.6 | 14.6 | 17.1 | 6.8 | 8.6 | 9.8 | 11.0 |
| bawc-167 | 10.5 | 13.0 | 14.9 | 17.1 | 6.8 | 8.6 | 9.8 | 11.1 | 10.5 | 13.0 | 14.9 | 17.1 | 6.8 | 8.6 | 9.8 | 11.1 |
| bawc-168 | 10.5 | 13.1 | 15.1 | 17.1 | 6.8 | 8.6 | 9.8 | 11.1 | 10.5 | 13.1 | 15.1 | 17.1 | 6.8 | 8.6 | 9.8 | 11.1 |
| bawc-169 | 10.5 | 13.1 | 15.1 | 17.1 | 6.8 | 8.6 | 9.8 | 11.1 | 10.5 | 13.1 | 15.1 | 17.1 | 6.8 | 8.6 | 9.8 | 11.1 |
| bawc-170 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 |
| bawc-171 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 |
| bawc-172 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 |
| bawc-173 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 | 5.3 | 6.6 | 7.7 | 8.7 | 3.3 | 4.2 | 4.9 | 5.5 |
| bawc-174 | 11.1 | 13.3 | 15.4 | 17.1 | 7.6 | 11.0 | 10.2 | 11.4 | 11.1 | 13.4 | 15.3 | 17.1 | 9.8 | 9.1 | 10.2 | 11.4 |
| bawc-175 | 7.6 | 9.2 | 10.6 | 11.8 | 5.3 | 6.4 | 7.1 | 8.0 | 7.6 | 9.2 | 10.5 | 11.8 | 5.3 | 6.4 | 7.1 | 8.0 |
| bawc-176 | 7.6 | 9.2 | 10.6 | 11.8 | 5.3 | 6.4 | 7.1 | 8.0 | 7.6 | 9.2 | 10.6 | 11.8 | 5.3 | 6.4 | 7.1 | 8.0 |
| bawc-177 | 7.6 | 9.2 | 10.6 | 11.8 | 5.3 | 6.4 | 7.1 | 8.0 | 7.6 | 9.2 | 10.6 | 11.8 | 5.3 | 6.4 | 7.1 | 8.0 |
| bawc-178 | 4.7 | 5.7 | 6.6 | 7.4 | 3.1 | 3.8 | 4.3 | 4.8 | 6.5 | 7.7 | 8.8 | 9.7 | 4.2 | 5.0 | 5.6 | 6.2 |
| bawc-179 | 4.7 | 5.7 | 6.7 | 7.5 | 3.1 | 3.8 | 4.3 | 4.8 | 6.5 | 7.7 | 8.8 | 9.7 | 4.2 | 5.0 | 5.6 | 6.2 |
| bawc-180 | 4.7 | 5.7 | 6.7 | 7.5 | 3.1 | 3.8 | 4.3 | 4.8 | 6.5 | 7.7 | 8.8 | 9.7 | 4.2 | 5.0 | 5.6 | 6.2 |
| bawc-181 | 4.7 | 5.7 | 6.7 | 7.5 | 3.1 | 3.8 | 4.3 | 4.8 | 6.5 | 7.7 | 8.8 | 9.8 | 4.2 | 5.0 | 5.6 | 6.2 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bawc-182 | 9.7 | 12.2 | 14.4 | 16.4 | 7.7 | 9.6 | 11.0 | 12.6 | 15.5 | 18.8 | 21.7 | 24.3 | 11.4 | 13.8 | 15.4 | 17.3 |
| bawc-183 | 9.7 | 12.2 | 14.5 | 16.5 | 7.7 | 9.6 | 11.0 | 12.6 | 15.5 | 18.8 | 21.8 | 24.3 | 11.5 | 13.8 | 15.4 | 17.3 |
| bawc-186 | 12.0 | 14.9 | 17.2 | 19.5 | 8.7 | 10.7 | 12.1 | 13.6 | 15.2 | 18.5 | 21.0 | 23.6 | 10.6 | 12.9 | 14.5 | 16.1 |
| bawc-187 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-188 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-189 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-190 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-191 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-192 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-193 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-194 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 | 4.9 | 5.9 | 6.7 | 7.5 | 3.3 | 3.9 | 4.4 | 4.9 |
| bawc-195 | 8.0 | 9.9 | 11.3 | 12.8 | 5.9 | 7.2 | 8.2 | 9.1 | 9.1 | 11.1 | 12.7 | 14.3 | 6.5 | 8.0 | 9.0 | 10.0 |
| bawc-196 | 8.0 | 9.9 | 11.4 | 12.9 | 5.9 | 7.2 | 8.2 | 9.1 | 9.1 | 11.1 | 12.7 | 14.3 | 6.5 | 8.0 | 9.0 | 10.0 |
| bawc-197 | 5.5 | 6.5 | 7.6 | 8.4 | 4.2 | 5.1 | 5.8 | 6.4 | 5.9 | 6.9 | 8.0 | 8.8 | 4.4 | 5.4 | 6.3 | 6.8 |
| bawc-198 | 5.8 | 7.1 | 8.2 | 9.2 | 4.2 | 5.2 | 5.9 | 6.5 | 6.2 | 7.6 | 8.6 | 9.7 | 4.5 | 5.5 | 6.1 | 6.8 |
| bawc-199 | 5.8 | 7.1 | 8.2 | 9.2 | 4.2 | 5.2 | 5.9 | 6.5 | 6.2 | 7.6 | 8.6 | 9.7 | 4.5 | 5.5 | 6.2 | 6.8 |
| bawc-200 | 2.1 | 2.6 | 2.9 | 3.2 | 1.4 | 1.7 | 1.9 | 2.1 | 2.2 | 2.6 | 2.9 | 3.3 | 1.5 | 1.8 | 2.0 | 2.2 |
| bawc-293 | 1.7 | 2.1 | 2.2 | 1.8 | 1.0 | 1.2 | 1.4 | 1.5 | 1.7 | 2.1 | -2.8 | -14.7 | 1.0 | 1.2 | 1.4 | 1.7 |
| bawc-294 | 1.7 | 2.1 | 2.3 | 2.6 | 1.0 | 1.2 | 1.4 | 1.5 | 1.7 | 2.1 | 2.3 | 2.6 | 1.0 | 1.2 | 1.4 | 1.5 |
| bawc-295 | 1.7 | 2.1 | 2.3 | 2.6 | 1.0 | 1.2 | 1.4 | 1.5 | 1.7 | 2.1 | 2.3 | 2.6 | 1.0 | 1.2 | 1.4 | 1.5 |
| bawc-117a | 39.3 | 50.9 | 58.2 | 63.7 | 28.1 | 36.2 | 42.0 | 49.3 | 51.0 | 60.2 | 64.7 | 64.8 | 35.2 | 44.5 | 51.1 | 58.2 |
| bawc-090a | 124.6 | 149.4 | 173.5 | 191.7 | 100.8 | 123.4 | 139.0 | 157.1 | 144.4 | 174.2 | 196.2 | 221.8 | 116.8 | 140.8 | 158.4 | 176.5 |
| bawc-088a | 145.9 | 175.5 | 201.6 | 223.9 | 118.3 | 144.7 | 163.0 | 184.1 | 167.4 | 201.4 | 225.5 | 254.2 | 136.0 | 164.1 | 184.3 | 205.2 |
| bawc-085a | 172.1 | 208.2 | 236.2 | 264.3 | 139.3 | 170.9 | 192.7 | 217.9 | 193.4 | 232.4 | 261.6 | 288.6 | 158.3 | 190.6 | 214.0 | 240.4 |
| bawc-085B | 172.2 | 207.3 | 236.3 | 264.4 | 139.3 | 171.0 | 192.8 | 217.9 | 193.5 | 232.4 | 261.6 | 289.0 | 157.8 | 190.6 | 214.1 | 240.0 |
| bawc-085d | 172.5 | 207.3 | 236.4 | 264.5 | 139.3 | 171.1 | 192.9 | 218.0 | 193.8 | 232.5 | 261.7 | 289.4 | 157.7 | 190.7 | 214.2 | 239.6 |
| bawc-085e | 172.6 | 207.2 | 236.4 | 264.5 | 139.4 | 171.1 | 192.9 | 218.0 | 193.9 | 232.5 | 261.7 | 289.8 | 157.7 | 190.8 | 214.2 | 239.6 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bawc-086a | 145.2 | 174.1 | 200.2 | 222.6 | 118.3 | 144.6 | 162.7 | 183.5 | 166.7 | 200.1 | 225.2 | 248.4 | 135.9 | 163.7 | 183.2 | 204.6 |
| bawc-086b | 145.2 | 174.0 | 200.1 | 222.5 | 118.3 | 144.6 | 162.7 | 183.5 | 166.7 | 200.0 | 225.1 | 249.2 | 135.9 | 163.7 | 183.3 | 204.5 |
| bawc-086d | 145.3 | 174.0 | 200.0 | 222.4 | 118.3 | 144.6 | 162.8 | 183.5 | 166.8 | 200.0 | 225.0 | 250.1 | 135.9 | 163.8 | 183.4 | 204.5 |
| bawc-086f | 145.3 | 174.0 | 200.2 | 222.6 | 118.3 | 144.6 | 162.8 | 183.5 | 166.9 | 200.3 | 225.0 | 251.4 | 135.9 | 163.8 | 183.5 | 204.6 |
| bawc-083a | 173.8 | 209.6 | 239.2 | 267.6 | 141.2 | 173.0 | 195.3 | 221.0 | 195.2 | 235.2 | 264.6 | 291.6 | 159.7 | 192.9 | 217.1 | 243.2 |
| bawc-083b | 174.2 | 211.2 | 239.5 | 267.9 | 141.3 | 173.2 | 195.4 | 221.1 | 195.5 | 235.4 | 264.9 | 292.4 | 159.9 | 193.1 | 217.2 | 243.6 |
| bawc-083c | 175.8 | 212.4 | 239.6 | 268.1 | 141.3 | 173.3 | 195.5 | 221.1 | 195.9 | 235.5 | 265.0 | 292.5 | 162.1 | 193.2 | 217.2 | 246.2 |
| bawc-079a | 177.9 | 224.2 | 255.1 | 288.8 | 155.4 | 189.0 | 216.5 | 242.7 | 211.3 | 255.5 | 293.5 | 324.5 | 173.7 | 213.6 | 239.0 | 268.6 |
| bawc-075e | 183.5 | 230.7 | 262.2 | 296.5 | 160.7 | 195.0 | 223.4 | 250.4 | 219.5 | 265.1 | 304.3 | 336.0 | 179.4 | 220.4 | 246.5 | 276.9 |
| bawc-075b | 183.5 | 230.7 | 262.2 | 300.5 | 160.7 | 195.1 | 223.4 | 250.4 | 219.5 | 265.1 | 304.3 | 336.0 | 179.4 | 220.4 | 246.5 | 276.9 |
| bawc-075c | 183.5 | 230.7 | 260.8 | 292.5 | 160.7 | 195.0 | 223.4 | 250.2 | 219.5 | 263.0 | 299.9 | 319.7 | 179.4 | 220.4 | 246.5 | 274.3 |
| bawc-075d | 183.5 | 230.7 | 260.8 | 292.9 | 160.7 | 195.0 | 223.4 | 250.2 | 219.5 | 263.1 | 299.9 | 319.7 | 179.4 | 220.4 | 246.5 | 274.3 |
| bawc-073a[1] | 189.3 | 237.6 | 269.7 | 303.7 | 165.7 | 201.0 | 230.7 | 258.6 | 227.5 | 274.7 | 315.5 | 348.0 | 185.0 | 227.2 | 254.2 | 285.3 |
| bawc-073b[1] | 189.3 | 237.6 | 269.7 | 303.8 | 165.7 | 201.1 | 230.8 | 258.6 | 227.6 | 274.7 | 315.6 | 348.1 | 185.0 | 227.3 | 254.3 | 285.4 |
| bawc-073c [1] | 189.3 | 237.7 | 269.7 | 303.8 | 165.8 | 201.2 | 230.9 | 258.7 | 227.7 | 274.8 | 315.6 | 348.1 | 185.1 | 227.3 | 254.3 | 285.5 |
| bawc-073d[1] | 189.3 | 237.7 | 269.8 | 303.9 | 165.8 | 201.2 | 230.9 | 258.7 | 227.8 | 274.8 | 315.7 | 348.2 | 185.1 | 227.5 | 254.4 | 285.5 |
| bawc-072h[1] | 196.6 | 196.5 | 201.5 | 209.9 | 194.2 | 197.4 | 195.3 | 201.3 | 200.2 | 205.5 | 212.0 | 240.1 | 200.5 | 198.8 | 201.1 | 223.4 |
| bawc-072g[1] | 148.5 | 148.1 | 155.0 | 165.2 | 146.5 | 148.1 | 149.3 | 156.4 | 141.9 | 145.5 | 160.8 | 177.9 | 143.5 | 142.5 | 148.8 | 167.5 |
| bawc-072f[1] | 145.1 | 155.1 | 165.8 | 174.9 | 139.8 | 152.5 | 159.8 | 166.3 | 150.3 | 159.5 | 172.4 | 189.6 | 146.5 | 154.9 | 162.7 | 178.6 |
| bawc-072e[1] | 133.4 | 146.2 | 153.8 | 157.0 | 122.3 | 135.3 | 136.1 | 138.3 | 151.0 | 154.5 | 154.0 | 153.3 | 132.0 | 133.6 | 135.4 | 140.1 |
| bawc-072d[1] | 187.5 | 215.8 | 224.5 | 226.3 | 166.1 | 175.0 | 169.9 | 166.1 | 208.2 | 209.9 | 206.2 | 204.9 | 170.0 | 161.9 | 162.1 | 176.9 |
| bawc-072c[1] | 190.3 | 220.8 | 235.9 | 241.3 | 166.9 | 188.7 | 188.0 | 184.0 | 216.9 | 225.5 | 224.3 | 226.5 | 178.2 | 186.2 | 180.1 | 177.9 |
| bawc-072b[1] | 190.5 | 221.8 | 238.5 | 245.7 | 167.1 | 191.9 | 196.6 | 200.2 | 218.8 | 231.4 | 240.3 | 247.8 | 180.0 | 195.3 | 196.0 | 197.8 |
| bawc-072a[1] | 190.8 | 228.5 | 247.1 | 265.8 | 167.2 | 198.7 | 215.9 | 229.5 | 225.0 | 254.3 | 275.4 | 288.7 | 184.9 | 215.2 | 227.2 | 237.4 |
| babc-018a | 183.8 | 226.9 | 290.7 | 336.3 | 185.7 | 245.5 | 288.9 | 335.5 | 221.0 | 268.1 | 338.5 | 386.4 | 209.6 | 270.1 | 316.7 | 362.9 |
| babc-013a[1] | 211.1 | 258.9 | 322.6 | 354.6 | 207.6 | 267.2 | 317.1 | 348.8 | 255.7 | 305.0 | 354.7 | 374.6 | 235.6 | 309.0 | 339.1 | 360.3 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| babc-013b[1] | 210.8 | 258.0 | 298.4 | 321.3 | 206.7 | 266.3 | 294.8 | 317.0 | 256.2 | 293.4 | 324.7 | 350.5 | 235.5 | 288.1 | 311.2 | 335.0 |
| babc-013c[1] | 211.2 | 258.9 | 294.6 | 295.6 | 207.3 | 267.6 | 289.7 | 295.3 | 256.6 | 294.4 | 317.3 | 329.8 | 235.7 | 289.3 | 307.4 | 324.0 |
| babc-013d[1] | 211.3 | 259.0 | 299.4 | 320.3 | 207.8 | 268.4 | 296.7 | 318.0 | 256.7 | 294.9 | 327.0 | 349.4 | 235.6 | 290.2 | 313.0 | 336.8 |
| babc-015a[1] | 200.4 | 244.2 | 310.3 | 358.5 | 202.0 | 259.3 | 306.1 | 353.1 | 243.2 | 302.8 | 374.6 | 424.3 | 226.1 | 298.1 | 341.4 | 393.3 |
| babc-015b[1] | 198.2 | 243.7 | 310.1 | 358.5 | 197.3 | 257.8 | 304.4 | 351.9 | 245.3 | 296.8 | 374.0 | 424.2 | 228.3 | 288.9 | 341.1 | 392.8 |
| babc-015c | 198.3 | 243.7 | 310.2 | 358.4 | 197.2 | 257.7 | 304.3 | 351.8 | 243.5 | 296.5 | 374.0 | 426.2 | 227.1 | 289.2 | 341.2 | 392.9 |
| bapc-263a[1] | 19.5 | 25.8 | 30.3 | 35.5 | 17.6 | 23.6 | 28.0 | 32.5 | 37.8 | 43.4 | 47.1 | 50.4 | 31.2 | 37.5 | 40.7 | 43.5 |
| bapc-265a[1] | 19.6 | 25.8 | 30.4 | 35.6 | 17.6 | 23.6 | 28.0 | 32.5 | 37.9 | 43.6 | 47.4 | 50.8 | 31.2 | 37.5 | 40.7 | 43.5 |
| bapc-266a | 14.0 | 18.7 | 22.1 | 25.8 | 13.1 | 17.8 | 21.2 | 24.7 | 27.4 | 30.5 | 32.3 | 33.7 | 23.8 | 28.3 | 30.2 | 31.7 |
| bapc-257a[1] | 25.9 | 33.1 | 39.2 | 45.5 | 22.5 | 29.5 | 34.5 | 40.0 | 43.8 | 51.0 | 55.8 | 59.9 | 35.8 | 43.4 | 47.5 | 51.3 |
| bapc-259a[1] | 26.3 | 33.6 | 39.5 | 45.8 | 22.7 | 29.7 | 34.9 | 40.2 | 44.1 | 51.2 | 55.9 | 60.0 | 36.0 | 43.6 | 47.6 | 51.1 |
| bapc-261a[1] | 19.7 | 25.6 | 30.2 | 35.2 | 17.6 | 23.6 | 27.9 | 32.5 | 37.5 | 43.1 | 46.7 | 49.8 | 31.3 | 37.5 | 40.7 | 43.4 |
| basc-279a | 24.7 | 31.9 | 37.3 | 43.2 | 20.1 | 26.0 | 30.2 | 34.6 | 30.0 | 38.1 | 44.4 | 51.0 | 23.8 | 30.2 | 34.9 | 39.6 |
| basc-281a | 13.2 | 17.2 | 20.4 | 23.7 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.1 | 24.8 | 28.7 | 13.6 | 17.5 | 20.4 | 23.3 |
| basc-283a | 13.2 | 17.2 | 20.4 | 23.7 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.1 | 24.8 | 28.7 | 13.6 | 17.5 | 20.4 | 23.3 |
| basc-283b | 13.3 | 17.2 | 20.4 | 23.7 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.2 | 24.9 | 28.7 | 13.6 | 17.5 | 20.4 | 23.4 |
| basc-283c | 13.3 | 17.3 | 20.4 | 23.8 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.2 | 24.9 | 28.8 | 13.6 | 17.5 | 20.4 | 23.4 |
| basc-283d | 13.3 | 17.3 | 20.4 | 23.8 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.2 | 24.9 | 28.8 | 13.6 | 17.5 | 20.4 | 23.4 |
| basc-283e | 13.2 | 17.2 | 20.4 | 23.7 | 11.2 | 14.8 | 17.4 | 20.1 | 16.5 | 21.1 | 24.8 | 28.7 | 13.6 | 17.5 | 20.4 | 23.3 |
| basc-297d[1] | 28.3 | 36.0 | 42.0 | 48.2 | 22.7 | 29.1 | 33.7 | 38.4 | 33.4 | 42.1 | 49.0 | 56.0 | 26.4 | 33.3 | 38.3 | 43.4 |
| basc-297e[1] | 28.2 | 36.0 | 42.0 | 48.3 | 22.7 | 29.1 | 33.7 | 38.4 | 33.4 | 42.2 | 49.0 | 56.0 | 26.4 | 33.3 | 38.3 | 43.4 |
| basc-297f[1] | 28.2 | 36.0 | 42.0 | 48.3 | 22.7 | 29.1 | 33.7 | 38.4 | 33.4 | 42.2 | 49.0 | 56.0 | 26.4 | 33.3 | 38.3 | 43.4 |
| basc-297g[1] | 28.2 | 36.0 | 42.0 | 48.3 | 22.7 | 29.1 | 33.7 | 38.4 | 33.4 | 42.2 | 49.0 | 56.0 | 26.4 | 33.3 | 38.3 | 43.4 |
| basc-297h | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 37.9 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| basc-275a | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 38.0 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| basc-277a | 24.7 | 31.8 | 37.2 | 43.0 | 20.1 | 26.0 | 30.2 | 34.6 | 29.9 | 38.0 | 44.3 | 50.7 | 23.8 | 30.2 | 34.8 | 39.6 |
| babc-296c[1] | 424.3 | 537.2 | 606.1 | 605.0 | 405.5 | 517.3 | 589.1 | 606.2 | 517.9 | 589.7 | 607.9 | 622.0 | 473.6 | 566.7 | 604.4 | 609.7 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| babc-296a[1] | 419.7 | 512.3 | 570.8 | 590.3 | 402.9 | 497.1 | 554.8 | 582.8 | 489.3 | 556.9 | 582.9 | 587.9 | 454.8 | 533.5 | 573.0 | 587.4 |
| babc-296b[1] | 424.3 | 535.3 | 588.5 | 580.5 | 405.5 | 516.2 | 579.8 | 585.9 | 518.6 | 584.4 | 595.1 | 606.9 | 473.8 | 566.2 | 594.3 | 593.1 |
| babc-007a[1] | 431.1 | 539.1 | 635.3 | 704.7 | 411.8 | 520.1 | 591.7 | 673.3 | 522.0 | 614.2 | 707.9 | 802.0 | 478.7 | 582.6 | 651.6 | 745.3 |
| babc-007b[1] | 193.4 | 225.9 | 261.8 | 296.3 | 194.5 | 216.5 | 248.5 | 278.1 | 223.3 | 267.5 | 311.5 | 355.1 | 204.6 | 250.7 | 289.1 | 330.1 |
| babc-004a | 470.5 | 593.7 | 698.5 | 786.3 | 449.7 | 567.5 | 661.0 | 744.7 | 577.0 | 691.1 | 795.6 | 906.8 | 527.6 | 644.2 | 736.2 | 832.6 |
| babc-005h | 455.1 | 576.3 | 680.0 | 762.9 | 435.6 | 550.3 | 642.1 | 725.0 | 555.2 | 664.9 | 766.4 | 877.7 | 508.3 | 621.8 | 712.1 | 808.2 |
| babc-005i | 455.1 | 576.3 | 680.0 | 762.9 | 435.6 | 550.3 | 642.1 | 725.0 | 555.2 | 664.9 | 766.4 | 877.7 | 508.3 | 621.8 | 712.1 | 808.2 |
| babc-005g | 455.1 | 576.3 | 679.9 | 762.9 | 435.6 | 550.3 | 642.0 | 724.9 | 555.2 | 664.9 | 766.4 | 877.4 | 508.3 | 621.7 | 712.1 | 808.1 |
| babc-005f | 455.0 | 576.1 | 679.7 | 762.7 | 435.5 | 550.2 | 641.8 | 724.7 | 555.0 | 664.6 | 766.2 | 876.4 | 508.2 | 621.6 | 711.8 | 807.7 |
| babc-005e | 454.9 | 575.7 | 679.2 | 762.5 | 435.3 | 550.1 | 641.4 | 724.1 | 554.6 | 664.1 | 765.8 | 874.5 | 507.9 | 621.3 | 711.3 | 806.7 |
| babc-005a | 454.8 | 573.8 | 676.7 | 761.3 | 434.3 | 549.2 | 639.6 | 721.4 | 552.9 | 662.8 | 764.6 | 869.1 | 506.7 | 620.1 | 709.3 | 803.8 |
| babc-005b | 454.8 | 573.9 | 676.8 | 761.3 | 434.3 | 549.3 | 639.6 | 721.6 | 552.9 | 662.8 | 764.6 | 869.1 | 506.6 | 620.1 | 709.3 | 803.8 |
| babc-005c | 454.8 | 574.1 | 677.1 | 761.5 | 434.3 | 549.4 | 639.8 | 722.1 | 553.0 | 662.9 | 764.7 | 869.7 | 506.7 | 620.2 | 709.4 | 804.1 |
| babc-005d | 454.8 | 574.8 | 678.1 | 762.0 | 434.7 | 549.7 | 640.5 | 723.1 | 553.8 | 663.5 | 765.2 | 871.8 | 507.2 | 620.7 | 710.2 | 805.3 |
| bawc-154a | 12.4 | 15.4 | 17.8 | 20.1 | 7.9 | 10.2 | 12.0 | 13.8 | 12.4 | 15.4 | 17.8 | 20.2 | 7.9 | 10.3 | 12.0 | 13.8 |
| bacc-289b | 12.8 | 16.2 | 18.9 | 21.6 | 10.3 | 13.1 | 15.1 | 17.2 | 19.5 | 24.0 | 27.6 | 31.2 | 15.0 | 18.5 | 20.9 | 23.4 |
| bacc-289a | 12.8 | 16.2 | 18.9 | 21.6 | 10.3 | 13.1 | 15.1 | 17.2 | 19.5 | 24.0 | 27.6 | 31.2 | 15.0 | 18.5 | 20.9 | 23.4 |
| bacc-287a | 12.5 | 15.8 | 18.3 | 20.8 | 10.3 | 13.0 | 15.0 | 16.9 | 19.0 | 23.3 | 26.6 | 30.1 | 14.9 | 18.3 | 20.7 | 22.8 |
| bawc-097a | 86.2 | 104.4 | 120.4 | 132.3 | 70.5 | 85.4 | 95.7 | 108.4 | 106.2 | 125.8 | 142.7 | 160.9 | 84.6 | 100.8 | 112.9 | 126.1 |
| bawc-093a | 114.7 | 138.0 | 160.0 | 174.7 | 93.4 | 114.0 | 128.2 | 144.9 | 135.3 | 162.3 | 174.6 | 184.4 | 109.4 | 131.5 | 147.7 | 164.0 |
| bawc-090c | 124.7 | 149.5 | 173.4 | 191.4 | 100.9 | 123.4 | 139.1 | 157.1 | 144.5 | 174.2 | 196.0 | 221.8 | 116.8 | 140.9 | 158.5 | 176.5 |
| bawc-090b | 124.6 | 149.4 | 173.4 | 191.4 | 100.8 | 123.4 | 139.1 | 157.1 | 144.5 | 174.1 | 196.0 | 221.7 | 116.8 | 140.8 | 158.4 | 176.5 |
| bajc-226f | 26.1 | 33.4 | 40.0 | 46.0 | 24.3 | 31.1 | 36.1 | 42.0 | 38.5 | 47.8 | 56.3 | 63.8 | 32.9 | 41.0 | 46.9 | 53.8 |
| bajc-226c | 11.2 | 14.8 | 18.2 | 21.3 | 11.5 | 15.4 | 18.4 | 22.0 | 18.8 | 23.8 | 28.5 | 32.7 | 16.7 | 21.6 | 25.1 | 29.3 |
| bajc-226b | 11.1 | 14.7 | 18.1 | 21.2 | 11.5 | 15.4 | 18.4 | 21.9 | 18.7 | 23.7 | 28.4 | 32.6 | 16.7 | 21.5 | 25.1 | 29.3 |
| bajc-226a | 11.1 | 14.7 | 18.1 | 21.2 | 11.5 | 15.4 | 18.4 | 21.9 | 18.7 | 23.7 | 28.4 | 32.6 | 16.7 | 21.5 | 25.1 | 29.3 |
| bajc-226d | 26.2 | 33.7 | 40.3 | 46.3 | 24.3 | 31.1 | 36.1 | 42.1 | 38.7 | 48.1 | 56.7 | 64.2 | 33.0 | 41.1 | 46.9 | 53.8 |

| Link Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| bajc-226e | 26.2 | 33.5 | 40.1 | 46.1 | 24.3 | 31.1 | 36.1 | 42.1 | 38.6 | 47.9 | 56.5 | 64.0 | 33.0 | 41.0 | 46.9 | 53.8 |
| babc-033a | 126.8 | 162.9 | 200.4 | 231.1 | 134.7 | 174.5 | 203.9 | 241.5 | 126.9 | 163.0 | 200.5 | 231.2 | 134.8 | 174.6 | 203.9 | 241.6 |
| bacs-253b | 2.3 | 3.1 | 3.7 | 4.4 | 1.9 | 2.6 | 3.0 | 3.5 | 2.6 | 3.4 | 4.0 | 4.6 | 2.2 | 2.8 | 3.3 | 3.7 |
| bacs-253a | 2.3 | 3.1 | 3.7 | 4.4 | 1.9 | 2.6 | 3.0 | 3.5 | 2.6 | 3.4 | 4.0 | 4.6 | 2.2 | 2.8 | 3.3 | 3.7 |
| bapc-269c | 7.2 | 9.7 | 11.8 | 14.1 | 7.1 | 9.8 | 11.8 | 13.9 | 7.6 | 10.2 | 12.3 | 14.6 | 7.7 | 10.4 | 12.4 | 14.5 |
| bapc-269b | 7.1 | 9.6 | 11.8 | 14.0 | 7.1 | 9.8 | 11.8 | 13.9 | 7.5 | 10.0 | 12.2 | 14.5 | 7.7 | 10.4 | 12.4 | 14.5 |
| bapc-269a | 7.1 | 9.5 | 11.7 | 14.0 | 7.1 | 9.8 | 11.8 | 13.9 | 7.5 | 10.0 | 12.2 | 14.5 | 7.7 | 10.4 | 12.4 | 14.5 |
| bawc-111b | 63.9 | 78.2 | 89.0 | 97.7 | 50.6 | 61.3 | 68.8 | 77.8 | 77.8 | 91.3 | 105.7 | 119.3 | 59.7 | 71.3 | 79.7 | 89.1 |
| bawc-110a | 63.9 | 78.2 | 89.0 | 97.7 | 50.6 | 61.3 | 68.8 | 77.8 | 77.7 | 91.3 | 105.5 | 119.2 | 59.7 | 71.3 | 79.7 | 89.1 |
| babc-031a | 136.5 | 175.2 | 215.1 | 248.0 | 145.1 | 187.4 | 219.0 | 258.6 | 137.7 | 176.5 | 216.5 | 249.5 | 146.3 | 188.5 | 220.3 | 259.8 |
| bapc-267a | 7.1 | 9.5 | 11.9 | 14.1 | 7.1 | 9.8 | 11.8 | 13.9 | 7.6 | 10.2 | 12.4 | 14.6 | 7.9 | 10.5 | 12.5 | 14.6 |
| babc-030a | 133.1 | 157.4 | 179.6 | 193.1 | 138.9 | 164.1 | 181.1 | 197.1 | 134.1 | 158.3 | 180.3 | 193.8 | 139.8 | 164.9 | 181.8 | 197.6 |
| bajc-226l | 26.1 | 33.5 | 40.1 | 46.0 | 24.3 | 31.1 | 36.1 | 42.0 | 38.6 | 47.9 | 56.4 | 63.9 | 32.9 | 41.0 | 46.9 | 53.8 |
| bajc-226j | 26.1 | 33.5 | 40.0 | 46.0 | 24.3 | 31.1 | 36.1 | 42.0 | 38.6 | 47.9 | 56.4 | 63.8 | 32.9 | 41.0 | 46.9 | 53.8 |
| bajc-226h | 26.0 | 33.3 | 39.9 | 45.9 | 24.3 | 31.1 | 36.1 | 42.0 | 38.4 | 47.7 | 56.2 | 63.7 | 32.9 | 41.0 | 46.8 | 53.7 |
| babc-030c | 133.1 | 157.4 | 179.6 | 193.2 | 138.9 | 164.1 | 181.1 | 197.1 | 134.1 | 158.3 | 180.3 | 193.8 | 139.8 | 164.9 | 181.8 | 197.6 |
| babc-012a[1] | 211.0 | 258.5 | 320.9 | 345.4 | 207.0 | 266.8 | 315.6 | 341.5 | 255.1 | 301.0 | 343.5 | 354.3 | 235.3 | 294.8 | 333.3 | 346.7 |
| babc-012b[1] | 211.0 | 258.5 | 320.9 | 345.3 | 207.0 | 266.8 | 315.6 | 341.5 | 255.1 | 300.9 | 343.5 | 353.6 | 235.3 | 294.6 | 333.3 | 346.5 |
| babc-012c[1] | 152.2 | 171.0 | 201.0 | 210.1 | 151.3 | 176.2 | 199.3 | 209.6 | 177.6 | 198.6 | 219.3 | 220.7 | 168.5 | 195.0 | 215.6 | 219.6 |
| babc-012d[1] | 72.0 | 71.5 | 70.7 | 69.7 | 92.6 | 94.1 | 94.8 | 72.9 | 92.0 | 94.6 | 96.2 | 97.1 | 93.8 | 96.1 | 97.0 | 98.4 |
| babc-031B | 133.1 | 157.4 | 179.6 | 193.2 | 138.9 | 164.1 | 181.1 | 197.1 | 134.1 | 158.3 | 180.3 | 193.8 | 139.8 | 164.9 | 181.8 | 197.6 |
| bajc-226p | 26.0 | 44.3 | 71.3 | 96.1 | 24.3 | 54.7 | 74.8 | 103.2 | 38.4 | 52.0 | 90.1 | 117.4 | 32.9 | 64.0 | 85.5 | 113.3 |

Table E.1–Peak flows for existing and full build-out conditions.

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-BC-002 | 378.10 | 378.64 | 379.01 | 379.27 | 378.02 | 378.54 | 378.89 | 379.15 | 378.58 | 378.98 | 379.30 | 379.58 | 378.37 | 378.83 | 379.13 | 379.40 |
| BA-BC-003 | 379.27 | 380.07 | 380.69 | 381.19 | 379.14 | 379.91 | 380.47 | 380.95 | 379.97 | 380.64 | 381.24 | 381.84 | 379.65 | 380.37 | 380.90 | 381.45 |
| BA-BC-004 | 379.45 | 380.26 | 380.83 | 381.29 | 379.32 | 380.10 | 380.64 | 381.07 | 380.16 | 380.79 | 381.34 | 381.91 | 379.86 | 380.55 | 381.02 | 381.53 |
| BA-BC-005 | 380.44 | 381.38 | 382.08 | 382.66 | 380.29 | 381.19 | 381.83 | 382.39 | 381.26 | 382.03 | 382.73 | 383.49 | 380.90 | 381.72 | 382.33 | 382.97 |
| BA-BC-006 | 383.22 | 383.78 | 384.23 | 384.59 | 383.12 | 383.67 | 384.07 | 384.42 | 383.69 | 384.17 | 384.62 | 385.12 | 383.47 | 383.99 | 384.37 | 384.79 |
| BA-BC-007 | 383.28 | 383.86 | 384.33 | 384.71 | 383.17 | 383.74 | 384.16 | 384.53 | 383.77 | 384.27 | 384.73 | 385.26 | 383.54 | 384.08 | 384.48 | 384.91 |
| BA-BC-008 | 383.85 | 384.45 | 384.92 | 385.28 | 383.74 | 384.33 | 384.75 | 385.12 | 384.35 | 384.86 | 385.30 | 385.78 | 384.12 | 384.67 | 385.05 | 385.47 |
| BA-BC-009 | 383.97 | 384.60 | 385.09 | 385.44 | 383.86 | 384.47 | 384.91 | 385.28 | 384.49 | 385.01 | 385.46 | 385.91 | 384.25 | 384.82 | 385.22 | 385.62 |
| BA-BC-010 | 385.56 | 385.91 | 386.14 | 386.29 | 385.48 | 385.85 | 386.07 | 386.21 | 385.86 | 386.11 | 386.30 | 386.51 | 385.73 | 386.02 | 386.19 | 386.38 |
| BA-BC-011 | 385.60 | 385.94 | 386.17 | 386.32 | 385.53 | 385.89 | 386.10 | 386.25 | 385.89 | 386.14 | 386.33 | 386.55 | 385.77 | 386.05 | 386.22 | 386.41 |
| BA-BC-012 | 388.75 | 389.32 | 390.05 | 390.27 | 388.70 | 389.42 | 390.00 | 390.24 | 389.29 | 389.87 | 390.27 | 390.36 | 389.06 | 389.78 | 390.19 | 390.30 |
| BA-BC-013 | 388.75 | 389.32 | 390.05 | 390.27 | 388.70 | 389.42 | 390.00 | 390.24 | 389.29 | 389.87 | 390.27 | 390.36 | 389.06 | 389.78 | 390.19 | 390.30 |
| BA-BC-014 | 391.19 | 391.94 | 392.54 | 392.76 | 391.13 | 392.05 | 392.50 | 392.74 | 391.86 | 392.41 | 392.82 | 393.03 | 391.57 | 392.35 | 392.68 | 392.91 |
| BA-BC-015 | 391.38 | 392.12 | 392.77 | 393.04 | 391.33 | 392.24 | 392.72 | 393.00 | 392.07 | 392.81 | 393.14 | 393.37 | 391.75 | 392.78 | 392.97 | 393.24 |
| BA-BC-016 | 393.33 | 394.05 | 394.86 | 395.32 | 393.29 | 394.22 | 394.79 | 395.25 | 394.03 | 394.71 | 395.46 | 395.92 | 393.75 | 394.62 | 395.17 | 395.62 |
| BA-BC-017 | 395.62 | 396.07 | 396.63 | 396.99 | 395.61 | 396.20 | 396.59 | 396.94 | 396.03 | 396.48 | 397.07 | 397.48 | 395.88 | 396.45 | 396.84 | 397.26 |
| BA-BC-018 | 397.68 | 398.23 | 398.99 | 399.49 | 397.67 | 398.40 | 398.92 | 399.43 | 398.18 | 398.75 | 399.54 | 399.93 | 398.00 | 398.72 | 399.26 | 399.74 |
| BA-BC-019 | 397.78 | 398.34 | 399.09 | 399.60 | 397.77 | 398.52 | 399.03 | 399.54 | 398.29 | 398.86 | 399.64 | 400.04 | 398.10 | 398.83 | 399.37 | 399.84 |
| BA-BC-020 | 397.82 | 398.38 | 399.15 | 399.66 | 397.81 | 398.57 | 399.09 | 399.60 | 398.33 | 398.91 | 399.71 | 400.11 | 398.15 | 398.88 | 399.43 | 399.91 |
| BA-BC-021 | 399.84 | 400.23 | 400.74 | 401.08 | 399.86 | 400.38 | 400.72 | 401.06 | 400.19 | 400.58 | 401.10 | 401.42 | 400.08 | 400.58 | 400.93 | 401.27 |
| BA-BC-022 | 400.28 | 400.67 | 401.21 | 401.57 | 400.30 | 400.83 | 401.19 | 401.55 | 400.63 | 401.03 | 401.59 | 401.93 | 400.52 | 401.04 | 401.41 | 401.76 |
| BA-BC-023 | 404.85 | 405.37 | 406.05 | 406.24 | 404.87 | 405.71 | 406.04 | 406.24 | 405.26 | 405.95 | 406.25 | 406.48 | 405.13 | 405.96 | 406.16 | 406.36 |
| BA-BC-024 | 404.90 | 405.43 | 406.13 | 406.34 | 404.93 | 405.77 | 406.12 | 406.34 | 405.32 | 406.02 | 406.35 | 406.60 | 405.19 | 406.03 | 406.25 | 406.47 |
| BA-BC-025 | 405.49 | 405.92 | 406.68 | 406.86 | 405.52 | 406.37 | 406.67 | 406.86 | 405.85 | 406.58 | 406.87 | 407.06 | 405.77 | 406.59 | 406.78 | 406.96 |
| BA-BC-026 | 407.77 | 408.24 | 408.79 | 409.15 | 407.83 | 408.48 | 408.83 | 409.24 | 408.09 | 408.59 | 409.14 | 409.64 | 408.04 | 408.67 | 409.01 | 409.47 |
| BA-BC-027 | 407.89 | 408.38 | 408.95 | 409.33 | 407.95 | 408.62 | 409.00 | 409.43 | 408.23 | 408.74 | 409.32 | 409.83 | 408.17 | 408.83 | 409.19 | 409.66 |
| BA-BC-028 | 414.83 | 415.27 | 415.71 | 416.01 | 414.89 | 415.44 | 415.75 | 416.08 | 415.12 | 415.50 | 416.00 | 416.30 | 415.08 | 415.59 | 415.91 | 416.21 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-BC-029 | 419.62 | 419.80 | 419.94 | 420.02 | 419.66 | 419.84 | 419.95 | 420.03 | 419.63 | 419.80 | 419.94 | 420.03 | 419.67 | 419.85 | 419.95 | 420.05 |
| BA-BC-030 | 419.94 | 420.16 | 420.34 | 420.45 | 419.98 | 420.21 | 420.36 | 420.47 | 419.95 | 420.16 | 420.35 | 420.46 | 420.00 | 420.22 | 420.36 | 420.49 |
| BA-BC-031 | 433.92 | 434.23 | 434.55 | 434.79 | 433.99 | 434.33 | 434.57 | 434.85 | 433.93 | 434.25 | 434.56 | 434.80 | 434.00 | 434.34 | 434.58 | 434.86 |
| BA-BC-033 | 437.83 | 437.99 | 438.15 | 438.27 | 437.86 | 438.04 | 438.16 | 438.31 | 437.83 | 437.99 | 438.15 | 438.28 | 437.87 | 438.04 | 438.17 | 438.32 |
| BA-BC-059 | 381.20 | 381.53 | 382.18 | 382.78 | 381.06 | 381.38 | 381.95 | 382.49 | 381.90 | 382.32 | 383.03 | 383.87 | 381.54 | 381.96 | 382.50 | 383.15 |
| BA-BC-060 | 381.59 | 381.82 | 382.25 | 382.84 | 381.46 | 381.66 | 382.05 | 382.56 | 382.29 | 382.62 | 383.24 | 384.13 | 381.92 | 382.23 | 382.64 | 383.30 |
| BA-BC-061 | 383.04 | 383.18 | 383.29 | 383.43 | 382.95 | 383.07 | 383.16 | 383.26 | 383.52 | 383.67 | 383.82 | 384.39 | 383.27 | 383.42 | 383.54 | 383.76 |
| BA-BC-062 | 384.10 | 384.26 | 384.37 | 384.49 | 383.99 | 384.13 | 384.22 | 384.31 | 384.63 | 384.77 | 384.84 | 384.99 | 384.35 | 384.51 | 384.61 | 384.71 |
| BA-BC-063 | 385.01 | 385.18 | 385.30 | 385.43 | 384.94 | 385.10 | 385.21 | 385.31 | 385.94 | 386.12 | 386.18 | 386.26 | 385.52 | 385.70 | 385.90 | 386.06 |
| BA-BC-064 | 385.27 | 385.46 | 385.61 | 385.81 | 385.20 | 385.37 | 385.49 | 385.62 | 386.74 | 387.11 | 387.23 | 387.40 | 385.92 | 386.27 | 386.64 | 386.97 |
| BA-BC-065 | 398.02 | 398.09 | 398.15 | 398.21 | 397.98 | 398.06 | 398.11 | 398.15 | 398.45 | 398.54 | 398.57 | 398.62 | 398.24 | 398.34 | 398.42 | 398.50 |
| BA-BC-066 | 401.61 | 401.72 | 401.80 | 401.88 | 401.57 | 401.67 | 401.73 | 401.80 | 402.23 | 402.39 | 402.70 | 403.44 | 401.93 | 402.07 | 402.18 | 402.31 |
| BA-BC-067 | 408.02 | 408.10 | 408.16 | 408.23 | 407.98 | 408.06 | 408.11 | 408.17 | 408.44 | 408.50 | 408.54 | 408.66 | 408.26 | 408.35 | 408.41 | 408.48 |
| BA-BC-068 | 414.39 | 414.48 | 414.56 | 414.63 | 414.35 | 414.44 | 414.50 | 414.56 | 414.99 | 416.98 | 417.48 | 418.18 | 414.67 | 414.81 | 414.92 | 416.20 |
| BA-BC-069 | 421.05 | 421.15 | 421.22 | 421.29 | 421.02 | 421.10 | 421.16 | 421.22 | 421.61 | 424.99 | 425.95 | 427.27 | 421.33 | 421.46 | 421.56 | 423.72 |
| BA-BC-070 | 383.49 | 383.94 | 384.33 | 384.68 | 383.35 | 383.79 | 384.18 | 384.51 | 383.84 | 384.29 | 384.70 | 385.18 | 383.63 | 384.10 | 384.46 | 384.85 |
| BA-BC-071 | 384.90 | 385.14 | 385.33 | 385.60 | 384.72 | 384.91 | 385.07 | 385.19 | 385.03 | 385.29 | 385.53 | 386.23 | 384.80 | 385.03 | 385.14 | 385.32 |
| BA-BC-201 | 391.42 | 392.13 | 392.80 | 393.06 | 391.38 | 392.27 | 392.76 | 393.03 | 392.08 | 392.95 | 393.13 | 393.37 | 391.75 | 392.95 | 392.97 | 393.24 |
| BA-BC-202 | 391.48 | 392.21 | 392.74 | 392.82 | 391.36 | 392.28 | 392.70 | 392.79 | 392.13 | 392.66 | 392.81 | 392.87 | 391.78 | 392.59 | 392.75 | 392.82 |
| BA-BC-203 | 391.49 | 392.27 | 392.77 | 392.87 | 391.36 | 392.31 | 392.72 | 392.81 | 392.17 | 392.71 | 392.83 | 392.90 | 391.80 | 392.63 | 392.76 | 392.83 |
| BA-BC-204 | 391.55 | 392.33 | 392.85 | 393.01 | 391.37 | 392.33 | 392.76 | 392.87 | 392.21 | 392.77 | 392.94 | 393.05 | 391.82 | 392.66 | 392.81 | 392.89 |
| BA-BC-205 | 395.16 | 395.36 | 395.54 | 395.71 | 394.92 | 395.07 | 395.20 | 395.29 | 395.22 | 395.44 | 395.60 | 395.78 | 394.97 | 395.12 | 395.23 | 395.32 |
| BA-BC-206 | 384.30 | 384.93 | 385.45 | 385.79 | 384.19 | 384.80 | 385.26 | 385.64 | 384.81 | 385.37 | 385.79 | 386.16 | 384.57 | 385.16 | 385.57 | 385.93 |
| BA-BC-206A | 398.25 | 398.40 | 399.13 | 399.71 | 398.06 | 398.18 | 398.98 | 399.53 | 398.36 | 398.86 | 399.79 | 400.26 | 398.14 | 398.72 | 399.38 | 399.90 |
| BA-BC-207 | 401.74 | 401.82 | 401.87 | 401.91 | 401.60 | 401.66 | 401.69 | 401.71 | 401.80 | 401.88 | 401.93 | 402.06 | 401.65 | 401.71 | 401.72 | 401.78 |
| BA-BC-208 | 406.08 | 406.16 | 406.23 | 406.29 | 405.94 | 406.00 | 406.05 | 406.09 | 406.14 | 406.23 | 406.30 | 406.35 | 405.99 | 406.05 | 406.10 | 406.13 |
| BA-BC-209 | 412.22 | 412.28 | 412.32 | 412.36 | 412.11 | 412.16 | 412.19 | 412.22 | 412.27 | 412.33 | 412.37 | 412.42 | 412.14 | 412.20 | 412.23 | 412.26 |
| BA-BC-210 | 417.70 | 417.76 | 417.81 | 417.85 | 417.59 | 417.64 | 417.67 | 417.70 | 417.75 | 417.81 | 417.86 | 417.91 | 417.63 | 417.68 | 417.71 | 417.74 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-BC-211 | 429.72 | 429.78 | 429.83 | 429.88 | 429.60 | 429.65 | 429.69 | 429.72 | 429.77 | 429.84 | 429.89 | 429.94 | 429.64 | 429.69 | 429.73 | 429.76 |
| BA-BC-212 | 433.51 | 433.60 | 433.66 | 433.72 | 433.37 | 433.44 | 433.48 | 433.52 | 433.58 | 433.67 | 433.73 | 433.80 | 433.42 | 433.48 | 433.53 | 433.57 |
| BA-BC-213 | 435.83 | 435.92 | 435.98 | 436.05 | 435.69 | 435.75 | 435.79 | 435.84 | 435.90 | 435.99 | 436.06 | 436.13 | 435.73 | 435.80 | 435.84 | 435.89 |
| BA-BC-214 | 438.31 | 438.39 | 438.45 | 438.51 | 438.17 | 438.23 | 438.27 | 438.31 | 438.38 | 438.46 | 438.53 | 438.59 | 438.21 | 438.28 | 438.32 | 438.36 |
| BA-BC-215 | 442.52 | 442.61 | 442.68 | 442.74 | 442.38 | 442.44 | 442.49 | 442.53 | 442.59 | 442.69 | 442.76 | 442.83 | 442.42 | 442.49 | 442.54 | 442.58 |
| BA-BC-216 | 450.33 | 450.41 | 450.47 | 450.53 | 450.19 | 450.25 | 450.29 | 450.33 | 450.39 | 450.48 | 450.54 | 450.61 | 450.24 | 450.30 | 450.34 | 450.38 |
| BA-BC-217 | 407.20 | 407.34 | 407.46 | 407.54 | 406.98 | 407.11 | 407.19 | 407.29 | 407.29 | 407.43 | 407.55 | 407.64 | 407.04 | 407.15 | 407.25 | 407.35 |
| BA-BC-218 | 408.39 | 408.67 | 408.86 | 409.06 | 407.92 | 408.12 | 408.23 | 408.37 | 408.45 | 408.71 | 408.90 | 409.06 | 407.95 | 408.14 | 408.26 | 408.43 |
| BA-BC-219 | 409.55 | 410.23 | 410.79 | 411.26 | 408.61 | 408.95 | 409.19 | 409.50 | 409.67 | 410.34 | 410.90 | 411.39 | 408.69 | 409.01 | 409.25 | 409.62 |
| BA-BC-220 | 413.23 | 413.31 | 413.38 | 413.45 | 413.12 | 413.16 | 413.19 | 413.22 | 413.24 | 413.32 | 413.40 | 413.46 | 413.12 | 413.16 | 413.19 | 413.23 |
| BA-BC-221 | 420.69 | 420.76 | 420.83 | 420.88 | 420.54 | 420.60 | 420.64 | 420.68 | 420.70 | 420.78 | 420.84 | 420.90 | 420.55 | 420.61 | 420.64 | 420.69 |
| BA-BC-222 | 430.64 | 430.70 | 430.76 | 430.80 | 430.51 | 430.56 | 430.60 | 430.63 | 430.65 | 430.71 | 430.77 | 430.81 | 430.52 | 430.57 | 430.60 | 430.64 |
| BA-BC-223 | 433.02 | 433.13 | 433.22 | 433.29 | 432.82 | 432.90 | 432.95 | 433.01 | 433.04 | 433.15 | 433.23 | 433.31 | 432.83 | 432.91 | 432.96 | 433.02 |
| BA-BC-224 | 438.70 | 438.77 | 438.83 | 438.88 | 438.56 | 438.62 | 438.65 | 438.69 | 438.71 | 438.78 | 438.85 | 438.90 | 438.57 | 438.63 | 438.66 | 438.70 |
| BA-BC-225 | 445.66 | 445.73 | 445.79 | 445.84 | 445.52 | 445.58 | 445.61 | 445.65 | 445.67 | 445.75 | 445.81 | 445.86 | 445.53 | 445.59 | 445.62 | 445.66 |
| BA-BC-293 | 394.65 | 394.74 | 394.94 | 395.36 | 394.55 | 394.64 | 394.87 | 395.28 | 394.95 | 395.17 | 395.66 | 396.27 | 394.73 | 394.90 | 395.33 | 395.75 |
| BA-BC-295 | 395.42 | 395.52 | 395.87 | 395.99 | 395.33 | 395.41 | 395.47 | 395.56 | 396.12 | 396.58 | 397.01 | 397.86 | 395.51 | 396.04 | 396.35 | 396.83 |
| BA-BC-296 | 384.25 | 384.91 | 385.44 | 385.78 | 384.13 | 384.79 | 385.26 | 385.63 | 384.80 | 385.36 | 385.78 | 386.15 | 384.55 | 385.15 | 385.56 | 385.92 |
| BA-CC-287 | 384.24 | 384.44 | 384.62 | 384.87 | 384.13 | 384.32 | 384.51 | 384.74 | 384.52 | 384.76 | 384.98 | 385.39 | 384.34 | 384.57 | 384.78 | 385.10 |
| BA-CC-288 | 385.63 | 385.76 | 385.86 | 385.96 | 385.52 | 385.65 | 385.73 | 385.81 | 385.88 | 386.02 | 386.14 | 386.29 | 385.72 | 385.85 | 385.94 | 386.04 |
| BA-CC-289 | 385.69 | 385.85 | 385.96 | 386.09 | 385.57 | 385.71 | 385.81 | 385.90 | 385.98 | 386.17 | 386.32 | 386.52 | 385.80 | 385.95 | 386.06 | 386.18 |
| BA-CC-290 | 407.18 | 407.25 | 407.31 | 407.36 | 407.12 | 407.19 | 407.23 | 407.27 | 407.32 | 407.40 | 407.46 | 407.52 | 407.23 | 407.30 | 407.35 | 407.39 |
| BA-CC-291 | 411.47 | 411.68 | 411.83 | 411.99 | 411.31 | 411.49 | 411.61 | 411.73 | 411.87 | 412.12 | 412.31 | 412.50 | 411.60 | 411.81 | 411.95 | 412.08 |
| BA-CC-292 | 442.02 | 442.05 | 442.07 | 442.10 | 442.00 | 442.03 | 442.05 | 442.07 | 442.09 | 442.13 | 442.15 | 442.18 | 442.05 | 442.08 | 442.11 | 442.13 |
| BA-CS-252 | 451.86 | 451.90 | 451.93 | 451.96 | 451.84 | 451.88 | 451.90 | 451.92 | 451.88 | 451.92 | 451.95 | 451.97 | 451.86 | 451.89 | 451.91 | 451.93 |
| BA-CS-253 | 470.23 | 470.27 | 470.30 | 470.32 | 470.21 | 470.25 | 470.27 | 470.28 | 470.25 | 470.28 | 470.31 | 470.33 | 470.23 | 470.26 | 470.28 | 470.29 |
| BA-CS-254 | 608.01 | 608.06 | 608.09 | 608.11 | 607.98 | 608.03 | 608.05 | 608.07 | 608.03 | 608.07 | 608.10 | 608.12 | 608.00 | 608.04 | 608.07 | 608.08 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-CS-255 | 613.53 | 613.56 | 613.58 | 613.60 | 613.44 | 613.54 | 613.56 | 613.57 | 613.54 | 613.57 | 613.59 | 613.60 | 613.52 | 613.55 | 613.56 | 613.58 |
| BA-JC-226 | 476.95 | 477.10 | 477.22 | 477.31 | 476.90 | 477.05 | 477.15 | 477.24 | 477.19 | 477.33 | 477.44 | 477.53 | 477.09 | 477.23 | 477.31 | 477.40 |
| BA-JC-227 | 537.19 | 537.29 | 537.37 | 537.44 | 537.20 | 537.31 | 537.38 | 537.45 | 537.39 | 537.49 | 537.58 | 537.66 | 537.34 | 537.44 | 537.51 | 537.60 |
| BA-JC-228 | 538.27 | 538.35 | 538.42 | 538.47 | 538.27 | 538.36 | 538.42 | 538.48 | 538.43 | 538.52 | 538.61 | 538.68 | 538.38 | 538.48 | 538.54 | 538.62 |
| BA-PC-256 | 385.61 | 385.95 | 386.18 | 386.34 | 385.53 | 385.89 | 386.11 | 386.26 | 385.91 | 386.16 | 386.35 | 386.57 | 385.78 | 386.07 | 386.24 | 386.43 |
| BA-PC-257 | 385.63 | 385.97 | 386.19 | 386.35 | 385.56 | 385.91 | 386.13 | 386.28 | 385.94 | 386.19 | 386.37 | 386.59 | 385.82 | 386.10 | 386.27 | 386.45 |
| BA-PC-258 | 385.64 | 385.98 | 386.21 | 386.37 | 385.58 | 385.93 | 386.15 | 386.30 | 385.97 | 386.22 | 386.40 | 386.62 | 385.85 | 386.13 | 386.29 | 386.48 |
| BA-PC-259 | 386.51 | 387.47 | 387.96 | 388.13 | 386.22 | 387.10 | 387.75 | 388.02 | 388.03 | 388.18 | 388.25 | 388.30 | 387.60 | 388.05 | 388.15 | 388.21 |
| BA-PC-260 | 387.29 | 387.75 | 388.12 | 388.29 | 387.17 | 387.51 | 387.93 | 388.16 | 388.20 | 388.36 | 388.44 | 388.50 | 387.85 | 388.21 | 388.31 | 388.38 |
| BA-PC-261 | 388.22 | 388.53 | 388.87 | 389.25 | 388.11 | 388.36 | 388.65 | 388.96 | 389.20 | 389.62 | 389.95 | 390.27 | 388.70 | 389.19 | 389.43 | 389.65 |
| BA-PC-262 | 388.78 | 389.03 | 389.25 | 389.54 | 388.71 | 388.93 | 389.12 | 389.33 | 389.53 | 389.86 | 390.13 | 390.41 | 389.20 | 389.53 | 389.71 | 389.89 |
| BA-PC-263 | 388.99 | 389.28 | 389.53 | 389.83 | 388.90 | 389.18 | 389.39 | 389.63 | 389.86 | 390.24 | 390.54 | 390.85 | 389.50 | 389.86 | 390.06 | 390.26 |
| BA-PC-264 | 390.62 | 390.84 | 390.98 | 391.14 | 390.55 | 390.77 | 390.91 | 391.04 | 391.19 | 391.36 | 391.49 | 391.62 | 391.00 | 391.19 | 391.28 | 391.37 |
| BA-PC-265 | 391.09 | 391.38 | 391.59 | 391.82 | 391.00 | 391.28 | 391.48 | 391.68 | 391.92 | 392.20 | 392.41 | 392.68 | 391.63 | 391.90 | 392.06 | 392.20 |
| BA-PC-266 | 397.87 | 398.14 | 398.31 | 398.35 | 397.77 | 398.05 | 398.22 | 398.35 | 398.35 | 398.35 | 398.36 | 398.36 | 398.34 | 398.35 | 398.35 | 398.35 |
| BA-PC-267 | 399.29 | 399.57 | 400.12 | 400.97 | 399.23 | 399.52 | 399.81 | 400.85 | 401.16 | 401.57 | 401.83 | 402.04 | 400.74 | 401.27 | 401.53 | 401.74 |
| BA-PC-268 | 405.64 | 405.73 | 405.79 | 405.85 | 405.64 | 405.74 | 405.79 | 405.84 | 405.66 | 405.75 | 405.80 | 405.86 | 405.66 | 405.76 | 405.81 | 405.86 |
| BA-PC-269 | 405.97 | 406.10 | 406.21 | 406.32 | 405.97 | 406.12 | 406.22 | 406.31 | 405.99 | 406.13 | 406.24 | 406.34 | 406.00 | 406.15 | 406.24 | 406.34 |
| BA-PC-270 | 556.55 | 556.61 | 556.65 | 556.70 | 556.55 | 556.61 | 556.65 | 556.69 | 556.56 | 556.62 | 556.66 | 556.71 | 556.56 | 556.62 | 556.66 | 556.70 |
| BA-PC-271 | 558.52 | 559.32 | 559.48 | 559.52 | 558.51 | 558.67 | 559.48 | 559.51 | 558.54 | 559.41 | 559.49 | 559.52 | 558.55 | 559.43 | 559.49 | 559.52 |
| BA-PC-272 | 398.57 | 399.31 | 399.92 | 400.51 | 398.40 | 398.80 | 399.26 | 399.70 | 400.85 | 402.16 | 403.34 | 404.56 | 399.58 | 400.25 | 400.79 | 401.39 |
| BA-PC-273 | 408.10 | 408.12 | 408.12 | 408.13 | 408.06 | 408.10 | 408.11 | 408.12 | 408.13 | 408.15 | 408.16 | 408.16 | 408.12 | 408.13 | 408.13 | 408.14 |
| BA-SC-274 | 404.16 | 404.29 | 404.38 | 404.47 | 404.06 | 404.18 | 404.26 | 404.34 | 404.26 | 404.39 | 404.49 | 404.59 | 404.14 | 404.26 | 404.34 | 404.42 |
| BA-SC-275 | 404.86 | 405.08 | 405.23 | 405.38 | 404.70 | 404.90 | 405.03 | 405.15 | 405.02 | 405.25 | 405.41 | 405.57 | 404.83 | 405.03 | 405.16 | 405.29 |
| BA-SC-276 | 405.29 | 405.42 | 405.50 | 405.59 | 405.21 | 405.32 | 405.39 | 405.46 | 405.39 | 405.52 | 405.61 | 405.71 | 405.28 | 405.39 | 405.47 | 405.54 |
| BA-SC-277 | 406.10 | 406.30 | 406.44 | 406.58 | 405.96 | 406.14 | 406.26 | 406.38 | 406.25 | 406.46 | 406.61 | 406.76 | 406.08 | 406.26 | 406.38 | 406.50 |
| BA-SC-278 | 407.85 | 407.95 | 408.02 | 408.08 | 407.78 | 407.87 | 407.93 | 407.98 | 407.92 | 408.03 | 408.10 | 408.16 | 407.83 | 407.93 | 407.99 | 408.04 |
| BA-SC-279 | 408.84 | 409.09 | 409.24 | 409.43 | 408.66 | 408.89 | 409.04 | 409.18 | 409.03 | 409.26 | 409.47 | 409.66 | 408.81 | 409.04 | 409.19 | 409.32 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-SC-280 | 417.48 | 417.58 | 417.65 | 417.72 | 417.41 | 417.50 | 417.56 | 417.61 | 417.55 | 417.66 | 417.73 | 417.80 | 417.47 | 417.56 | 417.62 | 417.67 |
| BA-SC-281 | 418.92 | 419.12 | 419.28 | 419.44 | 418.75 | 418.96 | 419.08 | 419.21 | 419.07 | 419.29 | 419.45 | 419.64 | 418.88 | 419.08 | 419.21 | 419.34 |
| BA-SC-282 | 426.63 | 426.74 | 426.82 | 426.89 | 426.56 | 426.67 | 426.74 | 426.81 | 426.72 | 426.83 | 426.92 | 427.00 | 426.64 | 426.74 | 426.82 | 426.88 |
| BA-SC-283 | 427.07 | 427.21 | 427.31 | 427.45 | 427.00 | 427.13 | 427.21 | 427.30 | 427.18 | 427.33 | 427.48 | 427.59 | 427.08 | 427.22 | 427.31 | 427.44 |
| BA-SC-284 | 449.29 | 449.38 | 449.44 | 449.50 | 449.23 | 449.32 | 449.38 | 449.43 | 449.36 | 449.46 | 449.52 | 449.59 | 449.30 | 449.38 | 449.44 | 449.50 |
| BA-SC-286 | 450.34 | 450.76 | 450.89 | 451.03 | 450.26 | 450.38 | 450.76 | 450.88 | 450.62 | 450.92 | 451.07 | 451.22 | 450.34 | 450.77 | 450.89 | 451.01 |
| BA-SC-297A | 388.06 | 388.15 | 388.22 | 388.28 | 387.98 | 388.07 | 388.13 | 388.18 | 388.12 | 388.22 | 388.29 | 388.36 | 388.04 | 388.12 | 388.18 | 388.23 |
| BA-SC-297B | 388.09 | 388.18 | 388.24 | 388.30 | 388.00 | 388.10 | 388.16 | 388.21 | 388.16 | 388.25 | 388.31 | 388.37 | 388.06 | 388.15 | 388.21 | 388.26 |
| BA-SC-297C | 395.21 | 395.31 | 395.37 | 395.44 | 395.12 | 395.23 | 395.28 | 395.33 | 395.28 | 395.38 | 395.45 | 395.53 | 395.18 | 395.28 | 395.33 | 395.39 |
| BA-WC-072 | 386.14 | 386.39 | 386.53 | 386.65 | 386.03 | 386.28 | 386.43 | 386.55 | 386.33 | 386.51 | 386.65 | 386.80 | 386.19 | 386.40 | 386.53 | 386.66 |
| BA-WC-073 | 386.21 | 386.47 | 386.62 | 386.75 | 386.10 | 386.35 | 386.51 | 386.63 | 386.41 | 386.60 | 386.75 | 386.90 | 386.26 | 386.48 | 386.61 | 386.76 |
| BA-WC-074 | 387.15 | 387.46 | 387.73 | 388.28 | 386.99 | 387.24 | 387.44 | 387.67 | 387.38 | 387.75 | 388.31 | 388.40 | 387.13 | 387.41 | 387.63 | 387.88 |
| BA-WC-075 | 387.99 | 388.22 | 388.53 | 389.31 | 387.72 | 388.08 | 388.16 | 388.50 | 388.06 | 388.62 | 389.38 | 389.57 | 387.97 | 388.13 | 388.43 | 388.79 |
| BA-WC-076 | 392.10 | 392.61 | 392.77 | 392.96 | 391.89 | 392.23 | 392.54 | 392.72 | 392.49 | 392.78 | 393.00 | 393.14 | 392.07 | 392.51 | 392.70 | 392.84 |
| BA-WC-079 | 392.64 | 393.39 | 393.76 | 394.10 | 392.30 | 392.83 | 393.27 | 393.63 | 393.20 | 393.78 | 394.14 | 394.26 | 392.58 | 393.22 | 393.58 | 393.91 |
| BA-WC-080A | 395.18 | 395.69 | 396.05 | 396.27 | 394.70 | 395.36 | 395.63 | 395.91 | 395.59 | 396.05 | 396.30 | 396.44 | 395.06 | 395.60 | 395.86 | 396.14 |
| BA-WC-080N | 395.56 | 396.03 | 396.32 | 396.52 | 395.00 | 395.73 | 395.97 | 396.20 | 395.93 | 396.31 | 396.54 | 396.69 | 395.43 | 395.95 | 396.16 | 396.40 |
| BA-WC-081 | 395.76 | 396.13 | 396.38 | 396.58 | 395.50 | 395.87 | 396.07 | 396.28 | 396.03 | 396.38 | 396.60 | 396.74 | 395.68 | 396.05 | 396.24 | 396.46 |
| BA-WC-082 | 395.77 | 396.13 | 396.39 | 396.59 | 395.52 | 395.88 | 396.08 | 396.28 | 396.04 | 396.38 | 396.60 | 396.74 | 395.69 | 396.06 | 396.25 | 396.47 |
| BA-WC-083 | 395.90 | 396.34 | 396.63 | 396.87 | 395.61 | 396.02 | 396.26 | 396.51 | 396.21 | 396.62 | 396.88 | 397.06 | 395.81 | 396.24 | 396.47 | 396.72 |
| BA-WC-084 | 396.28 | 396.76 | 396.96 | 397.09 | 395.96 | 396.37 | 396.64 | 396.89 | 396.58 | 396.94 | 397.09 | 397.59 | 396.17 | 396.60 | 396.87 | 397.00 |
| BA-WC-085 | 396.44 | 396.95 | 397.22 | 397.38 | 396.09 | 396.54 | 396.83 | 397.10 | 396.77 | 397.19 | 397.36 | 397.88 | 396.31 | 396.79 | 397.08 | 397.25 |
| BA-WC-086 | 397.71 | 398.13 | 398.43 | 398.67 | 397.32 | 397.73 | 398.00 | 398.27 | 397.98 | 398.40 | 398.64 | 399.03 | 397.55 | 397.97 | 398.24 | 398.46 |
| BA-WC-087 | 399.58 | 400.04 | 400.47 | 400.71 | 399.23 | 399.57 | 399.85 | 400.21 | 399.90 | 400.46 | 400.73 | 400.93 | 399.45 | 399.85 | 400.20 | 400.53 |
| BA-WC-088 | 399.95 | 400.39 | 400.83 | 401.13 | 399.55 | 399.94 | 400.21 | 400.56 | 400.26 | 400.83 | 401.15 | 401.41 | 399.80 | 400.21 | 400.56 | 400.92 |
| BA-WC-089 | 401.51 | 401.86 | 402.18 | 402.43 | 401.18 | 401.50 | 401.72 | 401.97 | 401.77 | 402.18 | 402.45 | 402.72 | 401.40 | 401.73 | 401.97 | 402.24 |
| BA-WC-090 | 402.34 | 402.66 | 404.29 | 404.57 | 402.06 | 402.33 | 402.53 | 402.76 | 402.58 | 404.29 | 404.58 | 404.92 | 402.24 | 402.54 | 404.07 | 404.33 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-090D | 415.32 | 415.38 | 415.42 | 415.46 | 415.25 | 415.30 | 415.33 | 415.36 | 415.35 | 415.41 | 415.45 | 415.50 | 415.27 | 415.32 | 415.35 | 415.38 |
| BA-WC-090E | 415.60 | 415.76 | 415.91 | 416.07 | 415.43 | 415.54 | 415.62 | 415.70 | 415.69 | 415.88 | 416.05 | 416.21 | 415.49 | 415.60 | 415.69 | 415.78 |
| BA-WC-091 | 414.61 | 414.84 | 415.05 | 415.20 | 414.35 | 414.59 | 414.74 | 414.91 | 414.80 | 415.06 | 415.23 | 415.43 | 414.53 | 414.76 | 414.92 | 415.08 |
| BA-WC-092 | 414.72 | 414.99 | 415.24 | 415.43 | 414.45 | 414.71 | 414.88 | 415.07 | 414.94 | 415.25 | 415.48 | 415.75 | 414.63 | 414.90 | 415.08 | 415.27 |
| BA-WC-093 | 416.85 | 417.10 | 417.33 | 417.50 | 416.58 | 416.83 | 417.00 | 417.18 | 417.06 | 417.35 | 417.55 | 417.78 | 416.77 | 417.02 | 417.19 | 417.37 |
| BA-WC-094 | 423.03 | 423.38 | 423.68 | 423.87 | 422.68 | 423.02 | 423.23 | 423.47 | 423.34 | 423.71 | 423.86 | 423.98 | 422.94 | 423.28 | 423.51 | 423.73 |
| BA-WC-095 | 423.50 | 423.84 | 424.14 | 424.31 | 423.17 | 423.50 | 423.71 | 423.94 | 423.83 | 424.18 | 424.32 | 424.43 | 423.44 | 423.77 | 423.99 | 424.20 |
| BA-WC-096 | 427.30 | 427.60 | 427.85 | 427.95 | 427.02 | 427.29 | 427.47 | 427.67 | 427.63 | 427.91 | 427.99 | 428.05 | 427.28 | 427.55 | 427.74 | 427.92 |
| BA-WC-097 | 428.39 | 428.73 | 429.00 | 429.13 | 428.08 | 428.38 | 428.57 | 428.81 | 428.77 | 429.08 | 429.18 | 429.26 | 428.36 | 428.67 | 428.88 | 429.08 |
| BA-WC-098 | 435.26 | 435.53 | 435.76 | 435.92 | 434.99 | 435.24 | 435.40 | 435.59 | 435.56 | 435.83 | 436.06 | 436.28 | 435.23 | 435.48 | 435.66 | 435.84 |
| BA-WC-099 | 436.61 | 437.08 | 437.50 | 437.81 | 436.18 | 436.59 | 436.86 | 437.19 | 437.13 | 437.64 | 438.12 | 438.65 | 436.56 | 436.99 | 437.30 | 437.64 |
| BA-WC-100 | 437.52 | 438.11 | 438.70 | 439.17 | 437.00 | 437.49 | 437.82 | 438.25 | 438.18 | 438.92 | 439.64 | 440.40 | 437.46 | 438.00 | 438.41 | 438.93 |
| BA-WC-101 | 442.50 | 442.68 | 442.80 | 442.87 | 442.35 | 442.48 | 442.57 | 442.68 | 442.67 | 442.82 | 442.93 | 443.04 | 442.46 | 442.60 | 442.70 | 442.80 |
| BA-WC-102 | 444.95 | 445.11 | 445.19 | 445.24 | 444.60 | 444.91 | 445.02 | 445.12 | 445.11 | 445.20 | 445.29 | 445.35 | 444.88 | 445.05 | 445.13 | 445.19 |
| BA-WC-103 | 445.29 | 445.51 | 445.65 | 445.74 | 444.96 | 445.26 | 445.39 | 445.52 | 445.51 | 445.67 | 445.82 | 445.96 | 445.21 | 445.42 | 445.54 | 445.65 |
| BA-WC-104 | 446.76 | 447.10 | 447.22 | 447.29 | 446.21 | 446.68 | 446.94 | 447.11 | 447.09 | 447.23 | 447.33 | 447.42 | 446.60 | 447.00 | 447.13 | 447.22 |
| BA-WC-105 | 449.09 | 449.32 | 449.54 | 449.70 | 448.86 | 449.05 | 449.19 | 449.32 | 449.31 | 449.63 | 449.78 | 449.94 | 449.02 | 449.22 | 449.35 | 449.55 |
| BA-WC-106 | 449.51 | 449.72 | 449.91 | 450.05 | 449.29 | 449.47 | 449.59 | 449.73 | 449.71 | 449.96 | 450.14 | 450.31 | 449.44 | 449.63 | 449.75 | 449.91 |
| BA-WC-107 | 449.95 | 450.19 | 450.37 | 450.50 | 449.71 | 449.91 | 450.04 | 450.19 | 450.18 | 450.41 | 450.60 | 450.78 | 449.87 | 450.09 | 450.22 | 450.37 |
| BA-WC-108 | 452.10 | 452.19 | 452.26 | 452.31 | 452.01 | 452.09 | 452.13 | 452.19 | 452.18 | 452.27 | 452.36 | 452.42 | 452.07 | 452.15 | 452.20 | 452.26 |
| BA-WC-109 | 452.84 | 453.06 | 453.23 | 453.35 | 452.63 | 452.81 | 452.93 | 453.07 | 453.05 | 453.25 | 453.45 | 453.63 | 452.78 | 452.94 | 453.09 | 453.23 |
| BA-WC-110 | 454.34 | 454.75 | 455.06 | 455.30 | 453.94 | 454.28 | 454.50 | 454.76 | 454.73 | 455.11 | 455.59 | 455.96 | 454.22 | 454.56 | 454.81 | 455.06 |
| BA-WC-111 | 458.16 | 458.41 | 458.57 | 458.70 | 457.93 | 458.12 | 458.25 | 458.40 | 458.40 | 458.61 | 458.83 | 459.06 | 458.09 | 458.29 | 458.43 | 458.58 |
| BA-WC-113 | 465.25 | 465.50 | 465.67 | 465.80 | 464.99 | 465.20 | 465.34 | 465.49 | 465.49 | 465.71 | 465.92 | 466.21 | 465.17 | 465.38 | 465.53 | 465.67 |
| BA-WC-114 | 468.93 | 470.30 | 470.51 | 470.56 | 467.50 | 468.64 | 469.51 | 470.29 | 470.29 | 470.53 | 470.59 | 470.63 | 468.45 | 469.82 | 470.34 | 470.51 |
| BA-WC-115 | 474.15 | 474.39 | 474.55 | 474.58 | 473.90 | 474.10 | 474.23 | 474.38 | 474.38 | 474.56 | 474.61 | 474.64 | 474.07 | 474.27 | 474.41 | 474.55 |
| BA-WC-116 | 475.40 | 475.76 | 476.01 | 476.07 | 475.06 | 475.33 | 475.52 | 475.74 | 475.75 | 476.03 | 476.11 | 476.16 | 475.29 | 475.58 | 475.78 | 476.01 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-117 | 479.06 | 479.21 | 479.29 | 479.36 | 478.89 | 479.02 | 479.11 | 479.20 | 479.21 | 479.32 | 479.43 | 479.53 | 479.01 | 479.15 | 479.22 | 479.30 |
| BA-WC-118 | 479.94 | 480.20 | 480.41 | 480.70 | 479.62 | 479.86 | 480.03 | 480.16 | 480.20 | 480.48 | 480.79 | 480.87 | 479.83 | 480.08 | 480.21 | 480.42 |
| BA-WC-119 | 480.61 | 480.96 | 481.29 | 481.74 | 480.16 | 480.49 | 480.72 | 480.90 | 480.96 | 481.39 | 481.85 | 481.93 | 480.45 | 480.79 | 480.97 | 481.29 |
| BA-WC-120 | 481.67 | 482.18 | 482.69 | 483.40 | 481.00 | 481.49 | 481.83 | 482.08 | 482.18 | 482.84 | 483.56 | 483.62 | 481.43 | 481.93 | 482.19 | 482.68 |
| BA-WC-121 | 482.53 | 482.89 | 483.22 | 483.71 | 482.12 | 482.40 | 482.64 | 482.82 | 482.90 | 483.32 | 483.88 | 483.98 | 482.37 | 482.71 | 482.89 | 483.21 |
| BA-WC-122 | 485.00 | 485.45 | 485.85 | 486.62 | 484.51 | 484.82 | 485.04 | 485.31 | 485.48 | 485.97 | 487.24 | 488.25 | 484.81 | 485.15 | 485.41 | 485.75 |
| BA-WC-123 | 488.99 | 489.26 | 489.45 | 489.64 | 488.70 | 488.90 | 489.04 | 489.20 | 489.34 | 489.58 | 489.96 | 491.35 | 488.94 | 489.16 | 489.31 | 489.50 |
| BA-WC-124 | 490.01 | 490.48 | 490.73 | 491.14 | 489.59 | 489.86 | 490.05 | 490.30 | 490.50 | 490.83 | 491.53 | 493.24 | 489.84 | 490.14 | 490.40 | 490.70 |
| BA-WC-125 | 493.69 | 493.90 | 494.02 | 494.22 | 493.48 | 493.61 | 493.70 | 493.82 | 493.90 | 494.06 | 494.36 | 495.03 | 493.59 | 493.74 | 493.85 | 493.99 |
| BA-WC-126 | 496.46 | 496.72 | 496.86 | 497.16 | 496.18 | 496.37 | 496.50 | 496.65 | 496.68 | 496.91 | 497.26 | 497.59 | 496.32 | 496.52 | 496.66 | 496.83 |
| BA-WC-127 | 503.47 | 503.78 | 504.07 | 504.14 | 503.25 | 503.38 | 503.53 | 503.76 | 503.78 | 504.08 | 504.16 | 504.20 | 503.34 | 503.56 | 503.76 | 503.78 |
| BA-WC-128 | 504.69 | 504.80 | 504.87 | 504.93 | 504.54 | 504.65 | 504.71 | 504.77 | 504.79 | 504.88 | 504.95 | 505.01 | 504.62 | 504.72 | 504.78 | 504.83 |
| BA-WC-129 | 511.29 | 511.43 | 511.54 | 511.64 | 511.10 | 511.23 | 511.31 | 511.39 | 511.41 | 511.56 | 511.68 | 511.78 | 511.20 | 511.32 | 511.40 | 511.48 |
| BA-WC-130 | 511.75 | 512.01 | 512.24 | 512.43 | 511.44 | 511.65 | 511.79 | 511.94 | 511.99 | 512.26 | 512.50 | 512.71 | 511.60 | 511.81 | 511.95 | 512.12 |
| BA-WC-131 | 512.74 | 512.97 | 513.18 | 513.37 | 512.48 | 512.65 | 512.77 | 512.91 | 512.95 | 513.21 | 513.45 | 513.69 | 512.61 | 512.79 | 512.92 | 513.06 |
| BA-WC-132 | 513.38 | 513.51 | 513.65 | 513.79 | 513.25 | 513.34 | 513.40 | 513.47 | 513.64 | 513.82 | 514.04 | 514.34 | 513.40 | 513.50 | 513.57 | 513.66 |
| BA-WC-133 | 387.16 | 387.47 | 387.75 | 388.29 | 387.00 | 387.25 | 387.45 | 387.69 | 387.41 | 387.78 | 388.32 | 388.41 | 387.15 | 387.42 | 387.65 | 387.90 |
| BA-WC-134 | 387.17 | 387.49 | 387.77 | 388.30 | 387.01 | 387.27 | 387.47 | 387.71 | 387.44 | 387.83 | 388.34 | 388.42 | 387.16 | 387.45 | 387.67 | 387.94 |
| BA-WC-135 | 387.17 | 387.50 | 387.78 | 388.31 | 387.01 | 387.27 | 387.48 | 387.72 | 387.45 | 387.84 | 388.36 | 388.44 | 387.16 | 387.45 | 387.68 | 387.95 |
| BA-WC-136 | 387.17 | 387.50 | 387.79 | 388.32 | 387.01 | 387.28 | 387.49 | 387.73 | 387.46 | 387.86 | 388.39 | 388.48 | 387.17 | 387.46 | 387.69 | 387.97 |
| BA-WC-137 | 392.64 | 392.91 | 392.93 | 392.94 | 392.31 | 392.83 | 392.90 | 392.92 | 392.90 | 392.94 | 392.95 | 392.96 | 392.59 | 392.90 | 392.92 | 392.94 |
| BA-WC-138 | 392.65 | 392.92 | 392.97 | 393.00 | 392.32 | 392.84 | 392.92 | 392.95 | 392.93 | 392.98 | 393.02 | 393.27 | 392.61 | 392.92 | 392.96 | 392.98 |
| BA-WC-140 | 395.24 | 395.79 | 396.18 | 396.47 | 394.80 | 395.44 | 395.74 | 396.06 | 395.74 | 396.29 | 396.65 | 396.87 | 395.15 | 395.73 | 396.02 | 396.37 |
| BA-WC-141 | 395.71 | 396.12 | 396.43 | 396.81 | 395.42 | 395.75 | 396.03 | 396.30 | 396.08 | 396.59 | 396.99 | 397.33 | 395.62 | 396.05 | 396.32 | 396.65 |
| BA-WC-142 | 396.23 | 396.46 | 396.77 | 397.23 | 396.05 | 396.17 | 396.31 | 396.52 | 396.38 | 396.81 | 397.32 | 397.89 | 396.12 | 396.31 | 396.53 | 396.89 |
| BA-WC-143 | 396.28 | 396.43 | 396.77 | 397.34 | 396.15 | 396.23 | 396.29 | 396.45 | 396.37 | 396.82 | 397.42 | 398.00 | 396.20 | 396.29 | 396.46 | 396.91 |
| BA-WC-144 | 396.96 | 397.07 | 397.20 | 397.68 | 396.82 | 396.90 | 396.96 | 397.01 | 397.03 | 397.21 | 397.76 | 398.46 | 396.87 | 396.95 | 397.01 | 397.19 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-145 | 404.48 | 404.52 | 404.56 | 404.59 | 404.41 | 404.45 | 404.48 | 404.50 | 404.51 | 404.56 | 404.59 | 404.63 | 404.44 | 404.47 | 404.50 | 404.52 |
| BA-WC-146 | 407.52 | 407.57 | 407.62 | 407.66 | 407.44 | 407.49 | 407.51 | 407.54 | 407.55 | 407.61 | 407.66 | 407.70 | 407.47 | 407.51 | 407.54 | 407.57 |
| BA-WC-147 | 396.17 | 396.39 | 396.62 | 396.95 | 395.99 | 396.10 | 396.25 | 396.45 | 396.32 | 396.71 | 397.08 | 397.46 | 396.05 | 396.25 | 396.46 | 396.75 |
| BA-WC-148 | 397.90 | 397.98 | 398.05 | 398.12 | 397.78 | 397.84 | 397.88 | 397.93 | 397.95 | 398.05 | 398.11 | 398.18 | 397.82 | 397.88 | 397.93 | 397.99 |
| BA-WC-151 | 402.80 | 402.87 | 402.92 | 402.97 | 402.71 | 402.76 | 402.80 | 402.83 | 402.85 | 402.92 | 402.97 | 403.02 | 402.74 | 402.80 | 402.83 | 402.87 |
| BA-WC-152 | 405.27 | 405.37 | 405.45 | 405.52 | 405.13 | 405.21 | 405.26 | 405.31 | 405.34 | 405.44 | 405.52 | 405.60 | 405.18 | 405.26 | 405.31 | 405.36 |
| BA-WC-153 | 399.25 | 399.46 | 399.60 | 399.75 | 398.99 | 399.17 | 399.30 | 399.44 | 399.30 | 399.51 | 399.66 | 399.82 | 399.02 | 399.21 | 399.35 | 399.49 |
| BA-WC-154 | 399.79 | 399.99 | 400.14 | 400.29 | 399.49 | 399.66 | 399.79 | 399.91 | 399.81 | 400.01 | 400.16 | 400.31 | 399.50 | 399.68 | 399.80 | 399.93 |
| BA-WC-155 | 402.44 | 402.55 | 402.63 | 402.73 | 402.25 | 402.35 | 402.42 | 402.49 | 402.44 | 402.55 | 402.63 | 402.73 | 402.25 | 402.35 | 402.42 | 402.49 |
| BA-WC-156 | 417.05 | 417.28 | 417.47 | 417.74 | 416.80 | 417.01 | 417.15 | 417.32 | 417.18 | 417.45 | 418.04 | 418.92 | 416.91 | 417.14 | 417.30 | 417.48 |
| BA-WC-157 | 417.27 | 417.46 | 417.62 | 417.81 | 417.07 | 417.20 | 417.30 | 417.44 | 417.32 | 417.54 | 418.07 | 418.95 | 417.09 | 417.25 | 417.40 | 417.55 |
| BA-WC-158 | 421.88 | 421.97 | 422.04 | 422.11 | 421.74 | 421.81 | 421.86 | 421.91 | 421.88 | 421.97 | 422.04 | 422.11 | 421.74 | 421.81 | 421.86 | 421.91 |
| BA-WC-159 | 423.19 | 423.35 | 423.46 | 423.58 | 422.97 | 423.09 | 423.17 | 423.24 | 423.19 | 423.34 | 423.46 | 423.57 | 422.97 | 423.09 | 423.17 | 423.24 |
| BA-WC-160 | 424.57 | 424.69 | 424.79 | 424.89 | 424.39 | 424.49 | 424.55 | 424.61 | 424.57 | 424.69 | 424.79 | 424.89 | 424.39 | 424.48 | 424.55 | 424.61 |
| BA-WC-161 | 425.67 | 425.83 | 425.94 | 426.06 | 425.47 | 425.58 | 425.65 | 425.72 | 425.67 | 425.82 | 425.94 | 426.06 | 425.47 | 425.58 | 425.65 | 425.72 |
| BA-WC-162 | 423.56 | 424.13 | 424.63 | 425.21 | 422.93 | 423.43 | 423.78 | 424.16 | 423.83 | 424.45 | 424.84 | 425.36 | 423.20 | 423.69 | 424.06 | 424.42 |
| BA-WC-163 | 424.98 | 426.20 | 427.16 | 427.44 | 424.30 | 424.65 | 425.08 | 425.90 | 425.22 | 426.46 | 427.32 | 427.45 | 424.37 | 424.80 | 425.39 | 426.17 |
| BA-WC-164 | 425.09 | 426.23 | 427.20 | 427.50 | 424.55 | 424.81 | 425.16 | 425.94 | 425.29 | 426.49 | 427.36 | 427.52 | 424.58 | 424.91 | 425.44 | 426.20 |
| BA-WC-165 | 425.30 | 426.32 | 427.29 | 427.65 | 424.81 | 425.05 | 425.34 | 426.03 | 425.44 | 426.57 | 427.45 | 427.67 | 424.83 | 425.12 | 425.57 | 426.28 |
| BA-WC-166 | 425.87 | 426.48 | 427.38 | 427.78 | 425.61 | 425.74 | 425.85 | 426.24 | 425.90 | 426.69 | 427.53 | 427.80 | 425.61 | 425.74 | 425.93 | 426.42 |
| BA-WC-167 | 426.75 | 426.92 | 427.51 | 427.93 | 426.50 | 426.63 | 426.71 | 426.79 | 426.75 | 426.99 | 427.65 | 427.95 | 426.51 | 426.63 | 426.71 | 426.84 |
| BA-WC-168 | 428.94 | 429.03 | 429.12 | 429.24 | 428.79 | 428.86 | 428.91 | 428.96 | 428.94 | 429.03 | 429.13 | 429.24 | 428.79 | 428.87 | 428.92 | 428.96 |
| BA-WC-169 | 429.85 | 430.02 | 430.14 | 430.26 | 429.58 | 429.72 | 429.81 | 429.89 | 429.85 | 430.02 | 430.14 | 430.26 | 429.58 | 429.72 | 429.81 | 429.89 |
| BA-WC-170 | 429.92 | 430.10 | 430.22 | 430.35 | 429.64 | 429.78 | 429.87 | 429.96 | 429.92 | 430.10 | 430.22 | 430.35 | 429.64 | 429.78 | 429.87 | 429.96 |
| BA-WC-171 | 430.10 | 430.29 | 430.43 | 430.56 | 429.80 | 429.95 | 430.05 | 430.14 | 430.10 | 430.29 | 430.43 | 430.56 | 429.81 | 429.95 | 430.05 | 430.14 |
| BA-WC-172 | 430.19 | 430.37 | 430.51 | 430.65 | 429.89 | 430.04 | 430.13 | 430.23 | 430.19 | 430.38 | 430.51 | 430.65 | 429.90 | 430.04 | 430.13 | 430.23 |
| BA-WC-173 | 433.67 | 433.76 | 433.83 | 433.91 | 433.51 | 433.59 | 433.64 | 433.69 | 433.67 | 433.76 | 433.83 | 433.91 | 433.52 | 433.59 | 433.64 | 433.69 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-174 | 486.24 | 486.33 | 486.42 | 487.05 | 486.10 | 486.18 | 486.16 | 486.14 | 486.07 | 486.30 | 487.57 | 488.68 | 486.03 | 486.03 | 486.03 | 486.08 |
| BA-WC-175 | 490.56 | 490.63 | 490.69 | 490.75 | 490.45 | 490.51 | 490.54 | 490.58 | 490.56 | 490.63 | 490.73 | 490.88 | 490.45 | 490.51 | 490.54 | 490.58 |
| BA-WC-176 | 499.85 | 499.91 | 499.96 | 500.01 | 499.74 | 499.79 | 499.83 | 499.86 | 499.84 | 499.91 | 499.96 | 499.99 | 499.74 | 499.79 | 499.83 | 499.86 |
| BA-WC-177 | 503.50 | 503.59 | 503.67 | 503.73 | 503.36 | 503.43 | 503.47 | 503.52 | 503.50 | 503.59 | 503.67 | 503.73 | 503.36 | 503.43 | 503.47 | 503.52 |
| BA-WC-178 | 496.58 | 496.66 | 496.73 | 496.79 | 496.43 | 496.50 | 496.54 | 496.59 | 496.72 | 496.81 | 496.88 | 496.92 | 496.54 | 496.60 | 496.65 | 496.70 |
| BA-WC-179 | 497.35 | 497.42 | 497.49 | 497.54 | 497.20 | 497.27 | 497.31 | 497.35 | 497.48 | 497.56 | 497.63 | 497.69 | 497.31 | 497.37 | 497.41 | 497.46 |
| BA-WC-180 | 500.54 | 500.62 | 500.69 | 500.75 | 500.40 | 500.46 | 500.50 | 500.55 | 500.68 | 500.77 | 500.85 | 500.91 | 500.50 | 500.56 | 500.61 | 500.66 |
| BA-WC-181 | 502.26 | 502.35 | 502.43 | 502.50 | 502.11 | 502.18 | 502.22 | 502.27 | 502.42 | 502.52 | 502.62 | 502.70 | 502.22 | 502.29 | 502.34 | 502.39 |
| BA-WC-182 | 491.52 | 491.67 | 491.82 | 491.96 | 491.39 | 491.51 | 491.60 | 491.70 | 491.88 | 492.10 | 492.35 | 493.96 | 491.63 | 491.78 | 491.88 | 492.01 |
| BA-WC-183 | 503.46 | 503.55 | 503.62 | 503.68 | 503.37 | 503.44 | 503.49 | 503.54 | 503.65 | 503.75 | 503.83 | 503.92 | 503.52 | 503.60 | 503.65 | 503.71 |
| BA-WC-186 | 425.99 | 426.20 | 426.33 | 426.50 | 425.77 | 425.93 | 426.04 | 426.13 | 426.21 | 426.41 | 426.61 | 426.88 | 425.92 | 426.09 | 426.18 | 426.29 |
| BA-WC-187 | 444.20 | 444.25 | 444.28 | 444.31 | 444.12 | 444.16 | 444.18 | 444.20 | 444.20 | 444.25 | 444.28 | 444.31 | 444.12 | 444.16 | 444.18 | 444.20 |
| BA-WC-188 | 465.35 | 465.39 | 465.42 | 465.45 | 465.28 | 465.31 | 465.33 | 465.35 | 465.35 | 465.39 | 465.42 | 465.45 | 465.28 | 465.31 | 465.33 | 465.35 |
| BA-WC-189 | 473.52 | 473.57 | 473.60 | 473.64 | 473.44 | 473.47 | 473.50 | 473.52 | 473.52 | 473.57 | 473.60 | 473.64 | 473.44 | 473.47 | 473.50 | 473.52 |
| BA-WC-190 | 474.75 | 474.82 | 474.87 | 474.92 | 474.63 | 474.68 | 474.72 | 474.75 | 474.75 | 474.82 | 474.87 | 474.92 | 474.63 | 474.68 | 474.72 | 474.75 |
| BA-WC-191 | 483.41 | 483.46 | 483.50 | 483.53 | 483.33 | 483.37 | 483.39 | 483.41 | 483.41 | 483.46 | 483.50 | 483.53 | 483.33 | 483.37 | 483.39 | 483.41 |
| BA-WC-192 | 505.34 | 505.38 | 505.41 | 505.43 | 505.27 | 505.30 | 505.32 | 505.34 | 505.34 | 505.38 | 505.41 | 505.43 | 505.27 | 505.30 | 505.32 | 505.34 |
| BA-WC-193 | 515.33 | 515.39 | 515.43 | 515.46 | 515.24 | 515.28 | 515.31 | 515.33 | 515.33 | 515.39 | 515.43 | 515.46 | 515.24 | 515.28 | 515.31 | 515.33 |
| BA-WC-194 | 528.34 | 528.39 | 528.42 | 528.45 | 528.26 | 528.30 | 528.32 | 528.34 | 528.34 | 528.39 | 528.42 | 528.45 | 528.26 | 528.30 | 528.32 | 528.34 |
| BA-WC-195 | 419.01 | 419.07 | 419.11 | 419.14 | 418.94 | 418.98 | 419.01 | 419.04 | 419.04 | 419.10 | 419.14 | 419.18 | 418.96 | 419.01 | 419.04 | 419.07 |
| BA-WC-196 | 422.98 | 423.04 | 423.09 | 424.31 | 422.90 | 422.95 | 422.98 | 423.02 | 423.02 | 423.09 | 424.29 | 424.45 | 422.92 | 422.98 | 423.01 | 423.05 |
| BA-WC-197 | 397.95 | 398.40 | 398.75 | 399.10 | 397.71 | 397.96 | 398.24 | 398.56 | 398.17 | 398.66 | 399.02 | 399.46 | 397.80 | 398.17 | 398.50 | 398.77 |
| BA-WC-198 | 398.40 | 398.58 | 398.85 | 399.21 | 398.25 | 398.36 | 398.48 | 398.68 | 398.46 | 398.77 | 399.12 | 399.58 | 398.28 | 398.43 | 398.63 | 398.86 |
| BA-WC-199 | 400.81 | 400.93 | 401.03 | 401.12 | 400.66 | 400.76 | 400.82 | 400.88 | 400.85 | 400.97 | 401.07 | 401.13 | 400.69 | 400.78 | 400.85 | 400.91 |
| BA-WC-200 | 395.76 | 396.13 | 396.39 | 396.59 | 395.50 | 395.87 | 396.08 | 396.28 | 396.04 | 396.38 | 396.60 | 396.75 | 395.68 | 396.05 | 396.25 | 396.46 |
| BA-WC-293 | 392.69 | 393.47 | 393.74 | 393.78 | 392.36 | 392.90 | 393.37 | 393.70 | 393.32 | 393.75 | 393.79 | 393.91 | 392.63 | 393.30 | 393.68 | 393.76 |
| BA-WC-294 | 394.37 | 394.49 | 394.58 | 394.64 | 394.24 | 394.31 | 394.38 | 394.43 | 394.40 | 394.54 | 394.59 | 394.65 | 394.25 | 394.34 | 394.40 | 394.44 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-295 | 403.75 | 403.78 | 403.80 | 403.81 | 403.69 | 403.71 | 403.73 | 403.74 | 403.75 | 403.78 | 403.80 | 403.82 | 403.69 | 403.71 | 403.73 | 403.74 |
| BA-WC-117A | 479.90 | 480.39 | 480.72 | 481.18 | 479.49 | 479.79 | 480.02 | 480.33 | 480.39 | 480.86 | 481.28 | 481.34 | 479.76 | 480.12 | 480.40 | 480.73 |
| BA-WC-090A | 404.25 | 404.33 | 404.69 | 404.91 | 404.03 | 404.24 | 404.29 | 404.35 | 404.32 | 404.70 | 404.94 | 405.23 | 404.17 | 404.30 | 404.58 | 404.72 |
| BA-WC-088A | 400.34 | 400.75 | 401.15 | 401.43 | 399.97 | 400.33 | 400.58 | 400.90 | 400.63 | 401.14 | 401.45 | 401.72 | 400.20 | 400.59 | 400.90 | 401.23 |
| BA-WC-085A | 396.45 | 396.96 | 397.23 | 397.40 | 396.10 | 396.55 | 396.84 | 397.12 | 396.78 | 397.20 | 397.38 | 397.91 | 396.33 | 396.80 | 397.09 | 397.26 |
| BA-WC-085B | 396.80 | 397.27 | 397.55 | 397.74 | 396.44 | 396.87 | 397.15 | 397.42 | 397.10 | 397.52 | 397.72 | 398.19 | 396.67 | 397.11 | 397.39 | 397.58 |
| BA-WC-085C | 396.81 | 397.28 | 397.56 | 397.75 | 396.45 | 396.88 | 397.16 | 397.43 | 397.11 | 397.53 | 397.73 | 398.20 | 396.67 | 397.12 | 397.40 | 397.59 |
| BA-WC-085D | 397.26 | 397.70 | 397.99 | 398.21 | 396.88 | 397.30 | 397.57 | 397.84 | 397.54 | 397.96 | 398.19 | 398.61 | 397.11 | 397.54 | 397.81 | 398.02 |
| BA-WC-085E | 397.40 | 397.84 | 398.13 | 398.36 | 397.02 | 397.44 | 397.70 | 397.98 | 397.68 | 398.10 | 398.34 | 398.75 | 397.25 | 397.67 | 397.94 | 398.16 |
| BA-WC-086A | 397.88 | 398.30 | 398.59 | 398.83 | 397.49 | 397.90 | 398.16 | 398.43 | 398.15 | 398.56 | 398.82 | 399.18 | 397.73 | 398.14 | 398.40 | 398.63 |
| BA-WC-086B | 397.96 | 398.49 | 398.69 | 398.89 | 397.57 | 397.98 | 398.40 | 398.57 | 398.39 | 398.67 | 398.88 | 399.21 | 397.81 | 398.37 | 398.55 | 398.72 |
| BA-WC-086D | 398.89 | 399.31 | 399.61 | 399.84 | 398.56 | 398.89 | 399.18 | 399.42 | 399.21 | 399.60 | 399.85 | 400.12 | 398.77 | 399.18 | 399.41 | 399.68 |
| BA-WC-086E | 398.90 | 399.31 | 399.61 | 399.85 | 398.56 | 398.90 | 399.18 | 399.42 | 399.21 | 399.60 | 399.85 | 400.12 | 398.78 | 399.18 | 399.41 | 399.69 |
| BA-WC-086F | 399.06 | 399.51 | 399.82 | 400.05 | 398.72 | 399.06 | 399.34 | 399.63 | 399.38 | 399.81 | 400.06 | 400.32 | 398.94 | 399.34 | 399.62 | 399.89 |
| 0.2153 in | 396.12 | 396.60 | 396.78 | 396.89 | 395.81 | 396.22 | 396.48 | 396.73 | 396.42 | 396.77 | 396.89 | 397.37 | 396.02 | 396.45 | 396.71 | 396.82 |
| BA-WC-083B | 396.22 | 396.70 | 396.89 | 397.02 | 395.91 | 396.32 | 396.58 | 396.83 | 396.52 | 396.88 | 397.02 | 397.52 | 396.12 | 396.55 | 396.81 | 396.93 |
| BA-WC-083C | 396.25 | 396.74 | 396.94 | 397.06 | 395.94 | 396.35 | 396.62 | 396.86 | 396.56 | 396.92 | 397.06 | 397.57 | 396.15 | 396.58 | 396.84 | 396.97 |
| BA-WC-079A | 393.25 | 393.93 | 394.29 | 394.63 | 392.93 | 393.42 | 393.82 | 394.16 | 393.76 | 394.31 | 394.67 | 394.84 | 393.19 | 393.78 | 394.11 | 394.44 |
| BA-WC-075E | 388.48 | 389.24 | 389.43 | 390.06 | 388.27 | 389.00 | 389.20 | 389.36 | 389.17 | 389.44 | 390.10 | 390.16 | 388.44 | 389.18 | 389.34 | 389.50 |
| BA-WC-075B | 388.46 | 389.22 | 389.40 | 390.04 | 388.25 | 388.98 | 389.18 | 389.34 | 389.15 | 389.42 | 390.08 | 390.14 | 388.42 | 389.16 | 389.31 | 389.48 |
| BA-WC-075C | 389.29 | 389.98 | 390.21 | 390.65 | 389.00 | 389.67 | 389.92 | 390.13 | 389.89 | 390.22 | 390.70 | 390.81 | 389.24 | 389.90 | 390.10 | 390.30 |
| BA-WC-075D | 391.34 | 392.00 | 392.18 | 392.39 | 391.10 | 391.56 | 391.93 | 392.13 | 391.88 | 392.20 | 392.43 | 392.52 | 391.30 | 391.89 | 392.11 | 392.25 |
| BA-WC-073A | 386.28 | 386.54 | 386.69 | 386.82 | 386.16 | 386.41 | 386.57 | 386.69 | 386.47 | 386.67 | 386.82 | 386.96 | 386.32 | 386.54 | 386.67 | 386.82 |
| BA-WC-073B | 386.48 | 386.73 | 386.88 | 387.02 | 386.36 | 386.59 | 386.75 | 386.87 | 386.66 | 386.87 | 387.02 | 387.15 | 386.50 | 386.72 | 386.85 | 386.99 |
| BA-WC-073C | 386.67 | 386.92 | 387.07 | 387.21 | 386.54 | 386.76 | 386.92 | 387.04 | 386.85 | 387.06 | 387.22 | 387.35 | 386.67 | 386.89 | 387.02 | 387.17 |
| BA-WC-073D | 386.87 | 387.12 | 387.27 | 387.41 | 386.75 | 386.96 | 387.11 | 387.24 | 387.06 | 387.27 | 387.44 | 387.56 | 386.87 | 387.09 | 387.22 | 387.36 |
| BA-WC-072H | 385.61 | 385.94 | 386.17 | 386.32 | 385.54 | 385.89 | 386.10 | 386.24 | 385.90 | 386.14 | 386.33 | 386.54 | 385.78 | 386.05 | 386.22 | 386.41 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-072G | 385.62 | 385.95 | 386.17 | 386.33 | 385.55 | 385.90 | 386.11 | 386.25 | 385.90 | 386.14 | 386.33 | 386.55 | 385.78 | 386.06 | 386.22 | 386.41 |
| BA-WC-072F | 385.63 | 385.96 | 386.18 | 386.33 | 385.56 | 385.91 | 386.11 | 386.26 | 385.91 | 386.15 | 386.34 | 386.55 | 385.79 | 386.06 | 386.23 | 386.42 |
| BA-WC-072E | 385.65 | 385.97 | 386.19 | 386.34 | 385.58 | 385.92 | 386.12 | 386.26 | 385.92 | 386.16 | 386.35 | 386.56 | 385.80 | 386.07 | 386.24 | 386.42 |
| BA-WC-072D | 385.70 | 386.00 | 386.21 | 386.36 | 385.62 | 385.94 | 386.14 | 386.28 | 385.95 | 386.18 | 386.36 | 386.57 | 385.83 | 386.09 | 386.25 | 386.43 |
| BA-WC-072C | 385.76 | 386.05 | 386.24 | 386.38 | 385.68 | 385.98 | 386.17 | 386.30 | 386.00 | 386.21 | 386.38 | 386.59 | 385.88 | 386.12 | 386.28 | 386.45 |
| BA-WC-072B | 385.85 | 386.12 | 386.29 | 386.43 | 385.76 | 386.04 | 386.22 | 386.34 | 386.06 | 386.26 | 386.43 | 386.62 | 385.94 | 386.17 | 386.32 | 386.48 |
| BA-WC-072A | 386.11 | 386.36 | 386.50 | 386.62 | 386.00 | 386.25 | 386.41 | 386.52 | 386.30 | 386.48 | 386.62 | 386.77 | 386.16 | 386.37 | 386.50 | 386.64 |
| BA-BC-018A | 397.73 | 398.28 | 399.04 | 399.54 | 397.72 | 398.46 | 398.98 | 399.48 | 398.23 | 398.80 | 399.59 | 399.98 | 398.05 | 398.77 | 399.31 | 399.79 |
| BA-BC-013A | 388.79 | 389.36 | 390.09 | 390.30 | 388.73 | 389.46 | 390.04 | 390.27 | 389.33 | 389.91 | 390.31 | 390.40 | 389.10 | 389.85 | 390.22 | 390.34 |
| BA-BC-013B | 389.85 | 390.49 | 391.15 | 391.40 | 389.80 | 390.60 | 391.11 | 391.36 | 390.46 | 391.00 | 391.42 | 391.60 | 390.20 | 390.93 | 391.30 | 391.49 |
| BA-BC-013C | 390.26 | 390.93 | 391.55 | 391.77 | 390.20 | 391.04 | 391.51 | 391.74 | 390.90 | 391.44 | 391.84 | 392.02 | 390.62 | 391.37 | 391.72 | 391.91 |
| BA-BC-013D | 391.06 | 391.77 | 392.37 | 392.62 | 391.00 | 391.89 | 392.34 | 392.59 | 391.73 | 392.28 | 392.70 | 392.91 | 391.44 | 392.22 | 392.56 | 392.78 |
| BA-BC-015A | 391.75 | 392.49 | 393.16 | 393.48 | 391.70 | 392.63 | 393.11 | 393.44 | 392.46 | 393.06 | 393.60 | 393.88 | 392.16 | 392.98 | 393.40 | 393.71 |
| BA-BC-015B | 392.77 | 393.51 | 394.28 | 394.71 | 392.73 | 393.67 | 394.22 | 394.65 | 393.53 | 394.16 | 394.84 | 395.22 | 393.25 | 394.07 | 394.57 | 394.99 |
| BA-BC-015C | 393.00 | 393.74 | 394.53 | 394.97 | 392.96 | 393.90 | 394.46 | 394.91 | 393.71 | 394.38 | 395.11 | 395.53 | 393.43 | 394.29 | 394.83 | 395.27 |
| BA-PC-263A | 389.45 | 389.67 | 389.85 | 390.08 | 389.38 | 389.59 | 389.75 | 389.93 | 390.12 | 390.42 | 390.68 | 390.95 | 389.85 | 390.12 | 390.28 | 390.44 |
| BA-PC-265A | 393.98 | 394.17 | 394.29 | 394.42 | 393.92 | 394.11 | 394.23 | 394.35 | 394.47 | 394.59 | 394.67 | 394.75 | 394.31 | 394.46 | 394.53 | 394.59 |
| BA-PC-266A | 399.27 | 399.56 | 400.11 | 400.97 | 399.22 | 399.50 | 399.80 | 400.85 | 401.16 | 401.56 | 401.82 | 402.03 | 400.74 | 401.27 | 401.53 | 401.74 |
| BA-PC-257A | 385.63 | 385.97 | 386.19 | 386.35 | 385.56 | 385.91 | 386.13 | 386.28 | 385.95 | 386.19 | 386.37 | 386.60 | 385.83 | 386.10 | 386.27 | 386.46 |
| BA-PC-259A | 386.56 | 387.49 | 387.97 | 388.14 | 386.28 | 387.12 | 387.76 | 388.03 | 388.04 | 388.19 | 388.27 | 388.32 | 387.62 | 388.06 | 388.16 | 388.23 |
| BA-PC-261A | 388.38 | 388.66 | 388.96 | 389.31 | 388.29 | 388.52 | 388.77 | 389.04 | 389.27 | 389.67 | 389.99 | 390.30 | 388.83 | 389.27 | 389.49 | 389.70 |
| BA-SC-279A | 410.88 | 410.93 | 410.96 | 411.00 | 410.85 | 410.89 | 410.92 | 410.95 | 410.92 | 410.97 | 411.00 | 411.04 | 410.88 | 410.92 | 410.95 | 410.98 |
| BA-SC-281A | 424.41 | 424.47 | 424.52 | 424.56 | 424.37 | 424.43 | 424.47 | 424.51 | 424.46 | 424.53 | 424.58 | 424.62 | 424.42 | 424.48 | 424.52 | 424.56 |
| BA-SC-283E | 427.30 | 427.43 | 427.53 | 427.64 | 427.23 | 427.35 | 427.44 | 427.52 | 427.41 | 427.55 | 427.68 | 427.78 | 427.31 | 427.44 | 427.53 | 427.63 |
| BA-SC-283A | 430.93 | 431.07 | 431.17 | 431.25 | 430.84 | 430.99 | 431.07 | 431.16 | 431.04 | 431.19 | 431.28 | 431.37 | 430.94 | 431.08 | 431.17 | 431.24 |
| BA-SC-283B | 432.30 | 432.39 | 432.45 | 432.52 | 432.25 | 432.33 | 432.39 | 432.44 | 432.37 | 432.47 | 432.54 | 432.62 | 432.31 | 432.39 | 432.45 | 432.51 |
| BA-SC-283C | 434.79 | 434.94 | 435.05 | 435.15 | 434.71 | 434.85 | 434.94 | 435.03 | 434.91 | 435.07 | 435.18 | 435.29 | 434.80 | 434.95 | 435.04 | 435.14 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-SC-283D | 443.57 | 443.66 | 443.73 | 443.79 | 443.52 | 443.61 | 443.67 | 443.72 | 443.65 | 443.75 | 443.82 | 443.88 | 443.58 | 443.67 | 443.73 | 443.79 |
| BA-SC-297D | 387.11 | 387.18 | 387.23 | 387.27 | 387.05 | 387.12 | 387.16 | 387.20 | 387.16 | 387.23 | 387.28 | 387.32 | 387.09 | 387.16 | 387.20 | 387.24 |
| BA-SC-297E | 389.08 | 389.18 | 389.25 | 389.31 | 389.00 | 389.10 | 389.16 | 389.21 | 389.15 | 389.25 | 389.31 | 389.37 | 389.06 | 389.15 | 389.21 | 389.26 |
| BA-SC-297F | 390.45 | 390.57 | 390.63 | 390.69 | 390.35 | 390.47 | 390.54 | 390.60 | 390.53 | 390.64 | 390.70 | 390.76 | 390.42 | 390.53 | 390.60 | 390.65 |
| BA-SC-297G | 392.50 | 392.58 | 392.64 | 392.69 | 392.43 | 392.51 | 392.56 | 392.61 | 392.56 | 392.64 | 392.69 | 392.74 | 392.48 | 392.55 | 392.61 | 392.65 |
| BA-SC-297H | 403.03 | 403.16 | 403.25 | 403.34 | 402.94 | 403.06 | 403.14 | 403.21 | 403.13 | 403.26 | 403.36 | 403.45 | 403.02 | 403.14 | 403.21 | 403.29 |
| BA-SC-275A | 404.77 | 404.91 | 405.02 | 405.14 | 404.67 | 404.79 | 404.88 | 404.97 | 404.87 | 405.04 | 405.16 | 405.30 | 404.75 | 404.88 | 404.97 | 405.07 |
| BA-SC-277A | 406.51 | 406.63 | 406.73 | 406.83 | 406.43 | 406.53 | 406.61 | 406.68 | 406.60 | 406.74 | 406.85 | 406.97 | 406.49 | 406.61 | 406.69 | 406.77 |
| BA-BC-296C | 384.49 | 385.15 | 385.64 | 385.95 | 384.36 | 385.03 | 385.48 | 385.81 | 385.03 | 385.57 | 385.95 | 386.28 | 384.78 | 385.37 | 385.75 | 386.08 |
| BA-BC-296B | 384.38 | 385.03 | 385.54 | 385.86 | 384.26 | 384.91 | 385.37 | 385.72 | 384.92 | 385.46 | 385.86 | 386.21 | 384.67 | 385.26 | 385.65 | 385.99 |
| BA-BC-296A | 384.34 | 384.99 | 385.51 | 385.84 | 384.22 | 384.87 | 385.33 | 385.69 | 384.88 | 385.43 | 385.84 | 386.19 | 384.63 | 385.22 | 385.62 | 385.97 |
| BA-BC-007B | 383.73 | 384.33 | 384.80 | 385.17 | 383.63 | 384.21 | 384.63 | 385.00 | 384.24 | 384.74 | 385.20 | 385.70 | 384.01 | 384.56 | 384.94 | 385.38 |
| BA-BC-007A | 383.66 | 384.27 | 384.75 | 385.13 | 383.55 | 384.15 | 384.57 | 384.95 | 384.17 | 384.68 | 385.15 | 385.65 | 383.94 | 384.50 | 384.89 | 385.33 |
| BA-BC-004A | 379.31 | 380.12 | 380.74 | 381.23 | 379.18 | 379.95 | 380.53 | 381.00 | 380.01 | 380.70 | 381.28 | 381.87 | 379.69 | 380.44 | 380.95 | 381.48 |
| BA-BC-005H | 383.07 | 383.61 | 384.04 | 384.40 | 382.98 | 383.50 | 383.89 | 384.23 | 383.53 | 383.99 | 384.42 | 384.92 | 383.32 | 383.81 | 384.18 | 384.59 |
| BA-BC-005I | 383.08 | 383.63 | 384.06 | 384.41 | 382.99 | 383.52 | 383.91 | 384.24 | 383.54 | 384.01 | 384.44 | 384.94 | 383.33 | 383.83 | 384.20 | 384.61 |
| BA-BC-005G | 382.98 | 383.51 | 383.93 | 384.28 | 382.89 | 383.40 | 383.78 | 384.11 | 383.43 | 383.88 | 384.31 | 384.81 | 383.22 | 383.71 | 384.07 | 384.47 |
| BA-BC-005F | 382.66 | 383.15 | 383.55 | 383.90 | 382.58 | 383.04 | 383.41 | 383.73 | 383.07 | 383.50 | 383.93 | 384.45 | 382.87 | 383.34 | 383.69 | 384.10 |
| BA-BC-005E | 381.86 | 382.42 | 382.93 | 383.39 | 381.76 | 382.30 | 382.74 | 383.17 | 382.33 | 382.88 | 383.43 | 384.08 | 382.11 | 382.66 | 383.12 | 383.63 |
| BA-BC-005D | 381.08 | 381.84 | 382.50 | 383.07 | 380.97 | 381.68 | 382.26 | 382.80 | 381.73 | 382.45 | 383.13 | 383.86 | 381.43 | 382.16 | 382.74 | 383.36 |
| BA-BC-005C | 381.08 | 381.84 | 382.50 | 383.07 | 380.97 | 381.68 | 382.26 | 382.80 | 381.73 | 382.44 | 383.12 | 383.85 | 381.43 | 382.15 | 382.74 | 383.36 |
| BA-BC-005B | 381.08 | 381.84 | 382.50 | 383.07 | 380.97 | 381.68 | 382.26 | 382.80 | 381.73 | 382.44 | 383.12 | 383.85 | 381.43 | 382.15 | 382.74 | 383.36 |
| BA-BC-005A | 381.08 | 381.83 | 382.49 | 383.07 | 380.96 | 381.67 | 382.26 | 382.80 | 381.72 | 382.44 | 383.12 | 383.85 | 381.42 | 382.15 | 382.74 | 383.35 |
| BA-WC-154A | 400.62 | 400.74 | 400.83 | 400.94 | 400.42 | 400.53 | 400.60 | 400.68 | 400.62 | 400.75 | 400.84 | 400.95 | 400.42 | 400.53 | 400.61 | 400.68 |
| BA-CC-289B | 399.23 | 399.31 | 399.37 | 399.43 | 399.16 | 399.24 | 399.29 | 399.33 | 399.39 | 399.48 | 399.55 | 399.61 | 399.28 | 399.36 | 399.42 | 399.47 |
| BA-CC-289A | 391.30 | 391.39 | 391.45 | 391.51 | 391.24 | 391.31 | 391.36 | 391.41 | 391.46 | 391.56 | 391.63 | 391.70 | 391.36 | 391.44 | 391.50 | 391.55 |
| BA-CC-287A | 384.64 | 384.73 | 384.82 | 384.96 | 384.59 | 384.66 | 384.74 | 384.85 | 384.79 | 384.93 | 385.08 | 385.41 | 384.70 | 384.80 | 384.91 | 385.14 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-WC-097A | 430.18 | 430.49 | 430.73 | 430.90 | 429.88 | 430.16 | 430.34 | 430.55 | 430.52 | 430.81 | 431.03 | 431.23 | 430.15 | 430.43 | 430.62 | 430.82 |
| BA-WC-093A | 420.82 | 421.14 | 421.41 | 421.58 | 420.49 | 420.81 | 421.01 | 421.22 | 421.10 | 421.44 | 421.58 | 421.68 | 420.74 | 421.05 | 421.26 | 421.46 |
| BA-WC-090C | 412.76 | 412.97 | 413.16 | 413.29 | 412.54 | 412.75 | 412.89 | 413.03 | 412.93 | 413.16 | 413.32 | 413.50 | 412.69 | 412.90 | 413.04 | 413.18 |
| BA-WC-090B | 405.82 | 406.00 | 406.18 | 406.31 | 405.62 | 405.81 | 405.93 | 406.05 | 405.97 | 406.19 | 406.34 | 406.51 | 405.76 | 405.94 | 406.08 | 406.20 |
| BA-JC-226F | 424.85 | 425.03 | 425.13 | 425.21 | 424.79 | 424.98 | 425.06 | 425.14 | 425.11 | 425.23 | 425.32 | 425.40 | 425.01 | 425.13 | 425.20 | 425.27 |
| BA-JC-226C | 528.36 | 528.46 | 528.54 | 528.61 | 528.37 | 528.48 | 528.55 | 528.62 | 528.56 | 528.65 | 528.72 | 528.78 | 528.51 | 528.61 | 528.67 | 528.73 |
| BA-JC-226B | 519.13 | 519.22 | 519.30 | 519.36 | 519.14 | 519.24 | 519.30 | 519.37 | 519.31 | 519.41 | 519.49 | 519.55 | 519.27 | 519.36 | 519.43 | 519.50 |
| BA-JC-226A | 511.09 | 511.15 | 511.20 | 511.25 | 511.10 | 511.16 | 511.21 | 511.25 | 511.21 | 511.28 | 511.34 | 511.38 | 511.18 | 511.25 | 511.29 | 511.35 |
| BA-JC-226D | 442.77 | 443.04 | 443.19 | 443.31 | 442.61 | 442.96 | 443.09 | 443.23 | 443.16 | 443.34 | 443.49 | 443.61 | 443.02 | 443.21 | 443.32 | 443.44 |
| BA-JC-226E | 435.51 | 435.76 | 435.93 | 436.07 | 435.45 | 435.68 | 435.83 | 435.98 | 435.89 | 436.11 | 436.28 | 436.41 | 435.74 | 435.96 | 436.09 | 436.23 |
| BA-CS-253B | 594.20 | 594.22 | 594.24 | 594.26 | 594.19 | 594.21 | 594.22 | 594.23 | 594.21 | 594.23 | 594.25 | 594.27 | 594.20 | 594.21 | 594.23 | 594.24 |
| BA-CS-253A | 538.19 | 538.22 | 538.25 | 538.27 | 538.16 | 538.20 | 538.22 | 538.24 | 538.20 | 538.23 | 538.26 | 538.28 | 538.18 | 538.21 | 538.23 | 538.25 |
| BA-PC-269C | 550.73 | 550.76 | 550.79 | 550.81 | 550.73 | 550.76 | 550.79 | 550.81 | 550.74 | 550.77 | 550.79 | 550.81 | 550.74 | 550.77 | 550.79 | 550.81 |
| BA-PC-269B | 515.03 | 515.07 | 515.10 | 515.12 | 515.03 | 515.07 | 515.10 | 515.12 | 515.04 | 515.07 | 515.10 | 515.13 | 515.04 | 515.08 | 515.10 | 515.13 |
| BA-PC-269A | 464.48 | 464.55 | 464.60 | 464.65 | 464.48 | 464.55 | 464.60 | 464.65 | 464.49 | 464.56 | 464.61 | 464.66 | 464.50 | 464.57 | 464.61 | 464.66 |
| BA-WC-111B | 463.63 | 463.82 | 463.95 | 464.06 | 463.43 | 463.59 | 463.70 | 463.82 | 463.81 | 463.98 | 464.22 | 464.37 | 463.57 | 463.73 | 463.84 | 463.95 |
| BA-WC-110A | 456.64 | 456.93 | 457.10 | 457.22 | 456.40 | 456.59 | 456.73 | 456.93 | 456.92 | 457.13 | 457.34 | 457.59 | 456.56 | 456.80 | 456.96 | 457.10 |
| BA-BC-031A | 435.81 | 435.98 | 436.13 | 436.25 | 435.85 | 436.03 | 436.15 | 436.29 | 435.82 | 435.98 | 436.14 | 436.25 | 435.86 | 436.03 | 436.15 | 436.29 |
| BA-PC-267A | 399.35 | 399.62 | 400.14 | 400.99 | 399.31 | 399.58 | 399.85 | 400.87 | 401.17 | 401.57 | 401.83 | 402.05 | 400.74 | 401.28 | 401.54 | 401.75 |
| BA-BC-030A | 423.17 | 423.35 | 423.49 | 423.57 | 423.21 | 423.39 | 423.50 | 423.60 | 423.18 | 423.35 | 423.50 | 423.58 | 423.22 | 423.40 | 423.51 | 423.60 |
| BA-JC-226L | 426.53 | 426.75 | 426.93 | 427.08 | 426.47 | 426.69 | 426.83 | 426.98 | 426.89 | 427.12 | 427.31 | 427.45 | 426.74 | 426.96 | 427.10 | 427.25 |
| BA-JC-226K | 426.54 | 426.77 | 426.95 | 427.10 | 426.48 | 426.70 | 426.85 | 427.01 | 426.92 | 427.15 | 427.34 | 427.49 | 426.76 | 426.98 | 427.12 | 427.28 |
| BA-JC-226J | 425.98 | 426.20 | 426.36 | 426.50 | 425.92 | 426.13 | 426.26 | 426.41 | 426.33 | 426.53 | 426.70 | 426.84 | 426.18 | 426.38 | 426.51 | 426.65 |
| BA-JC-226I | 426.03 | 426.25 | 426.42 | 426.57 | 425.96 | 426.18 | 426.32 | 426.47 | 426.39 | 426.61 | 426.79 | 426.93 | 426.24 | 426.45 | 426.58 | 426.73 |
| BA-JC-226H | 420.19 | 420.45 | 420.61 | 420.72 | 420.12 | 420.39 | 420.52 | 420.65 | 420.57 | 420.75 | 420.88 | 420.97 | 420.44 | 420.63 | 420.73 | 420.85 |
| BA-JC-226G | 420.30 | 420.54 | 420.71 | 420.83 | 420.23 | 420.49 | 420.62 | 420.75 | 420.67 | 420.86 | 421.01 | 421.12 | 420.53 | 420.73 | 420.85 | 420.98 |
| BA-JC-226M | 442.81 | 443.08 | 443.24 | 443.36 | 442.64 | 443.00 | 443.13 | 443.28 | 443.20 | 443.40 | 443.55 | 443.69 | 443.06 | 443.25 | 443.37 | 443.50 |

| Node Name | Existing Conditions Peak Discharge (cfs) | | | | | | | | Full Build-Out Peak Discharge (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-hr Design Storm | | | | 72-hr Design Storm | | | | 48-hr Design Storm | | | | 72-hr Design Storm | | | |
| | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| BA-BC-030D | 427.47 | 427.62 | 427.75 | 427.82 | 427.50 | 427.66 | 427.76 | 427.85 | 427.47 | 427.62 | 427.75 | 427.83 | 427.51 | 427.66 | 427.76 | 427.85 |
| BA-BC-030C | 427.05 | 427.17 | 427.27 | 427.33 | 427.08 | 427.20 | 427.27 | 427.34 | 427.06 | 427.17 | 427.27 | 427.33 | 427.08 | 427.20 | 427.28 | 427.34 |
| BA-BC-030B | 423.27 | 423.47 | 423.63 | 423.72 | 423.32 | 423.52 | 423.64 | 423.75 | 423.28 | 423.47 | 423.63 | 423.73 | 423.33 | 423.53 | 423.65 | 423.75 |
| BA-BC-012A | 387.61 | 388.12 | 388.72 | 388.97 | 387.56 | 388.19 | 388.67 | 388.93 | 388.10 | 388.57 | 388.99 | 389.11 | 387.90 | 388.50 | 388.88 | 389.03 |
| BA-BC-012B | 387.18 | 387.65 | 388.21 | 388.42 | 387.14 | 387.72 | 388.16 | 388.39 | 387.65 | 388.08 | 388.44 | 388.55 | 387.47 | 388.01 | 388.36 | 388.49 |
| BA-BC-012C | 386.46 | 386.77 | 387.10 | 387.23 | 386.43 | 386.80 | 387.07 | 387.20 | 386.80 | 387.07 | 387.29 | 387.40 | 386.68 | 387.01 | 387.22 | 387.34 |
| BA-BC-012D | 385.67 | 385.97 | 386.18 | 386.32 | 385.61 | 385.93 | 386.12 | 386.25 | 385.93 | 386.15 | 386.33 | 386.53 | 385.82 | 386.07 | 386.23 | 386.40 |
| BA-BC-031B | 429.61 | 429.81 | 429.98 | 430.08 | 429.66 | 429.87 | 429.99 | 430.10 | 429.62 | 429.82 | 429.99 | 430.08 | 429.67 | 429.87 | 430.00 | 430.11 |
| BA-JC-226P | 417.61 | 418.10 | 418.46 | 418.70 | 417.54 | 418.27 | 418.50 | 418.76 | 417.98 | 418.23 | 418.64 | 418.88 | 417.85 | 418.38 | 418.60 | 418.84 |

[1] Link located in 2-D model area. Reported flow does not account for overbank conveyance.

Note: Negative flow values indicate the flow direction is opposite its normal direction.

Table E.2–Maximum water surface elevation for existing and full build-out conditions.

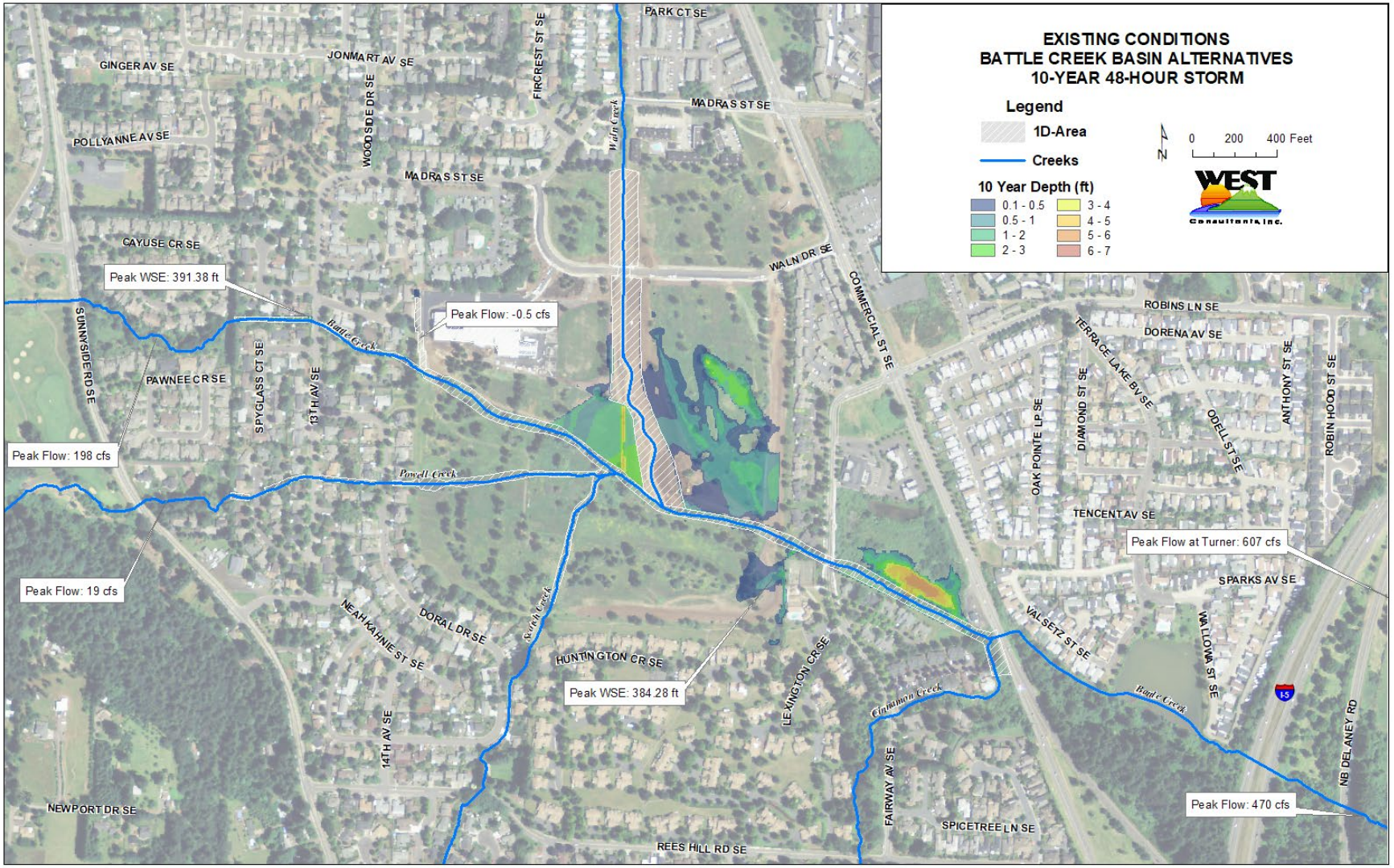



Figure E.1–2-D model flooding extents for existing condition 10-year, 48-hour storm.

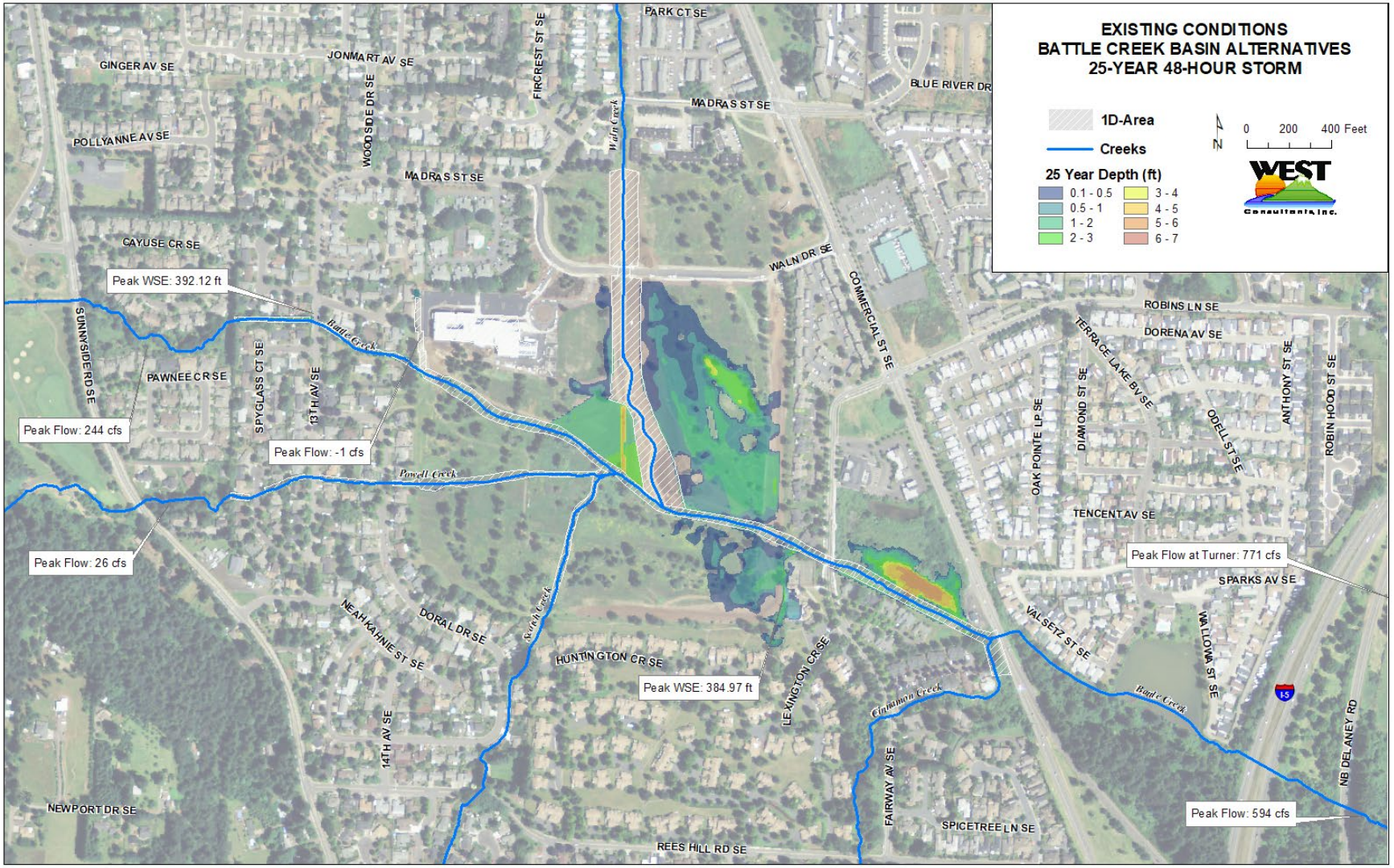



Figure E.2–2-D model flooding extents for existing condition 25-year, 48-hour sorm.

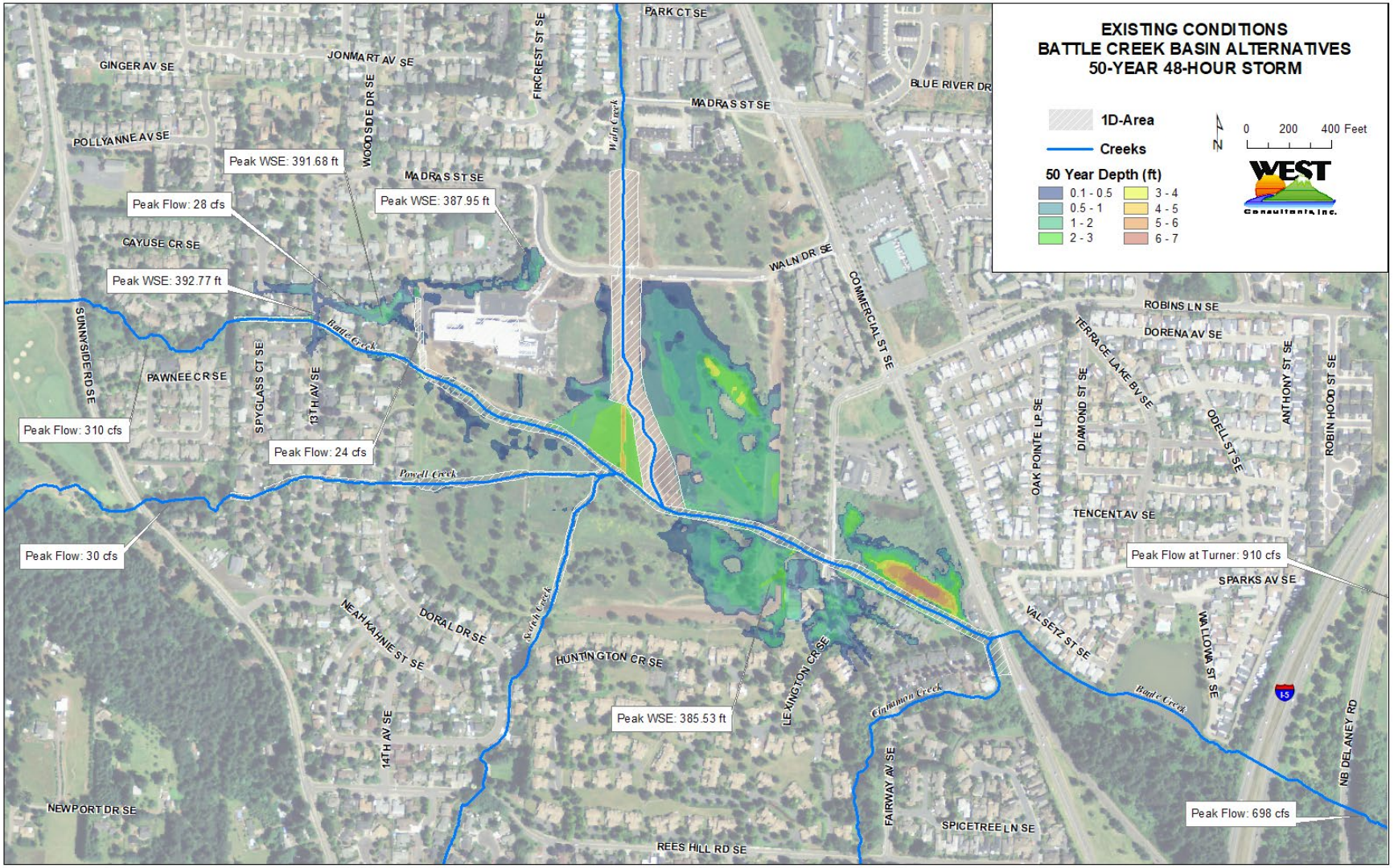



Figure E.3–2-D model flooding extents for existing condition 25-year, 48-hour sorm.

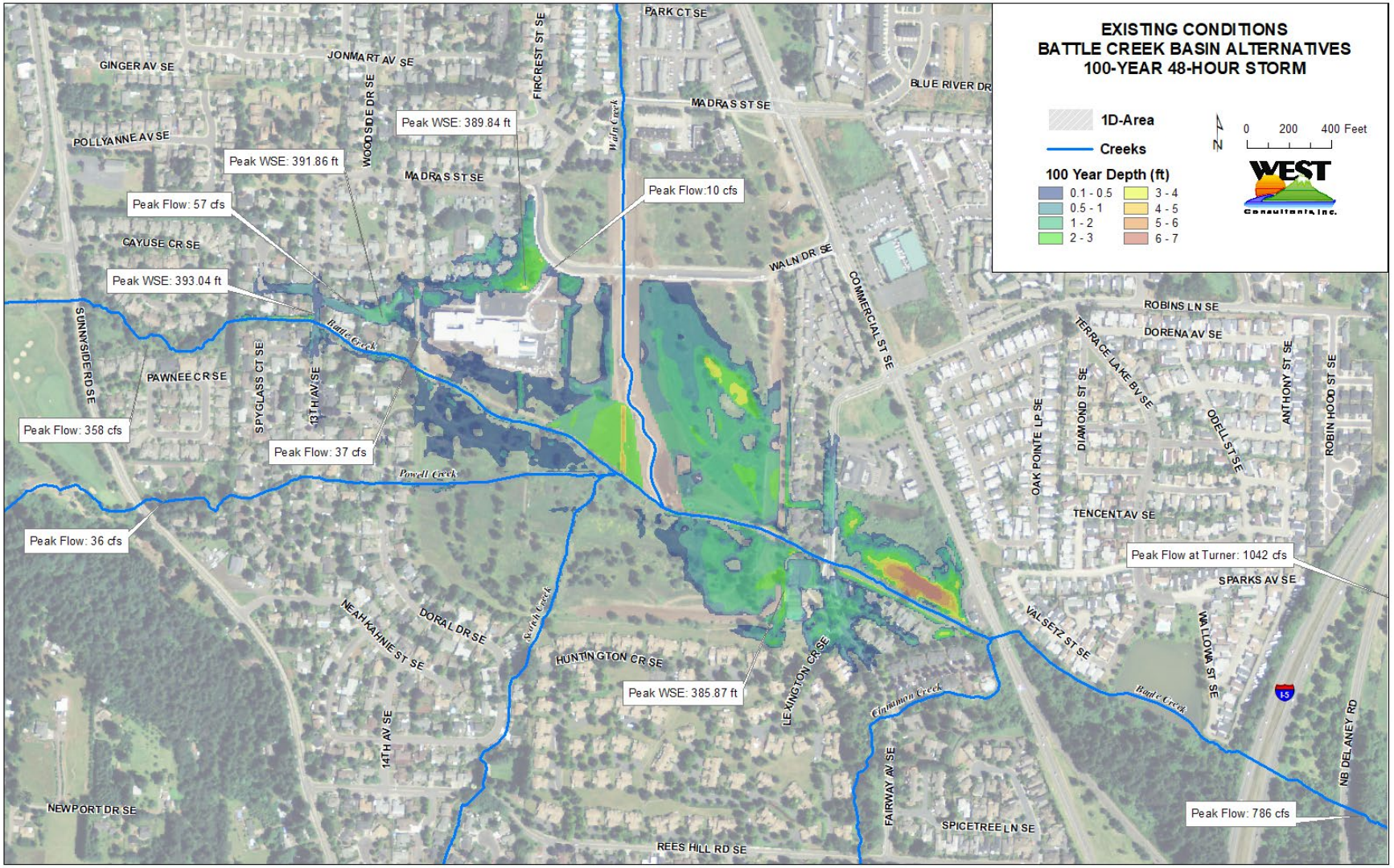



Figure E.4 – 2-D model flooding extents for existing condition 100-year, 48-hour sorm.

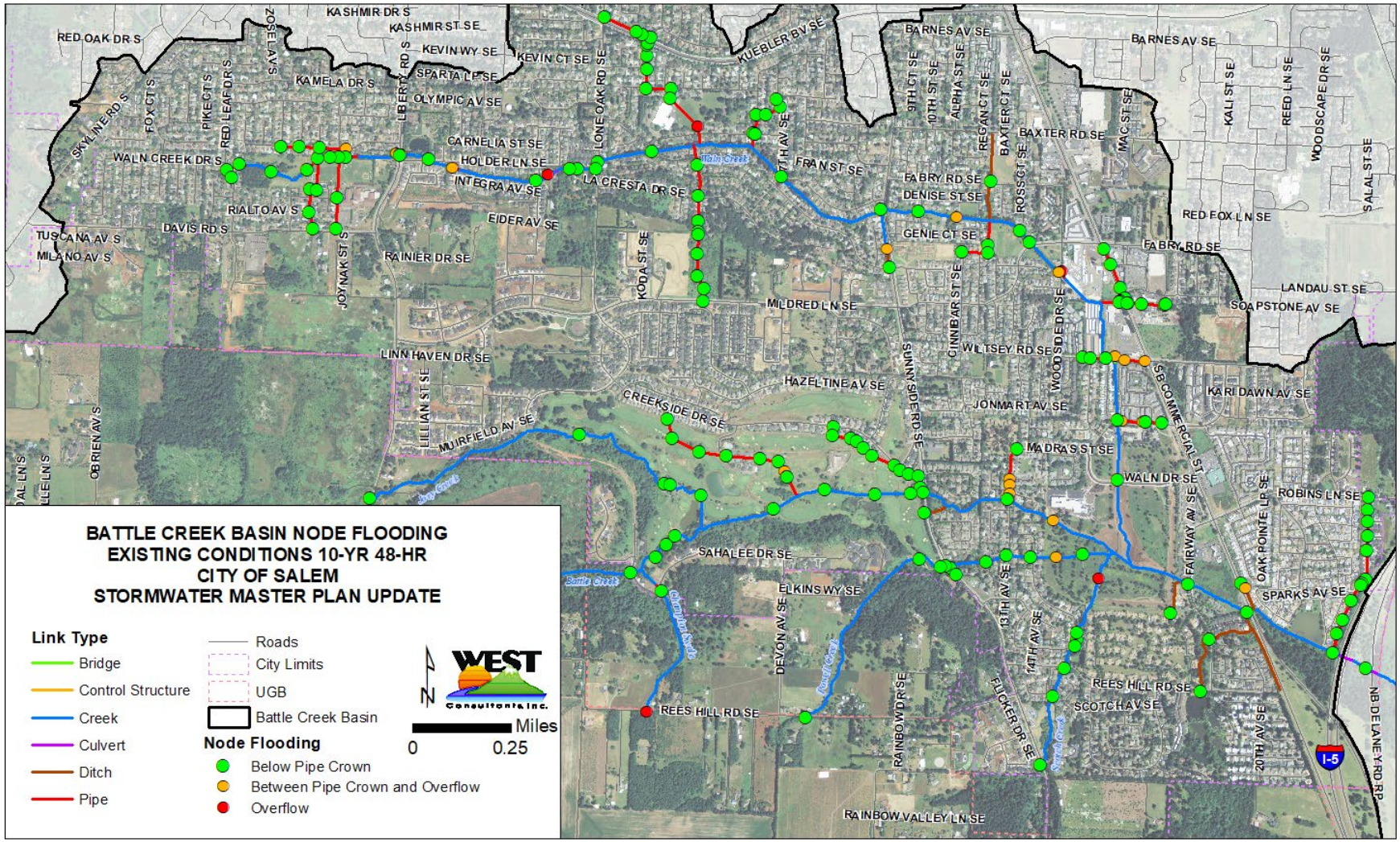



Figure E.5–Color coded node results for existing conditions 10-year, 48-hour sorm.

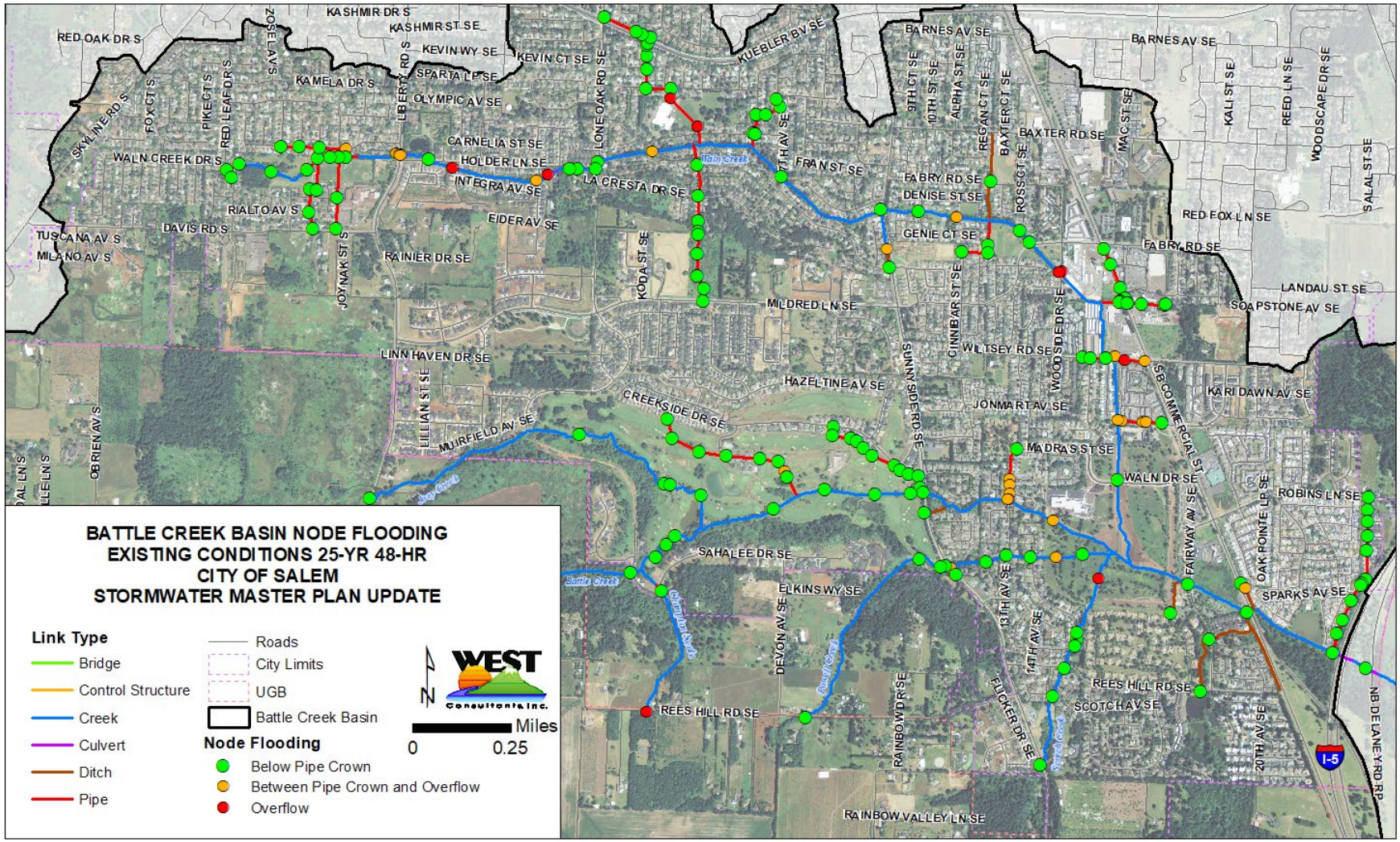



Figure E.6–Color coded node results for existing conditions 25-year, 48-hour storm.

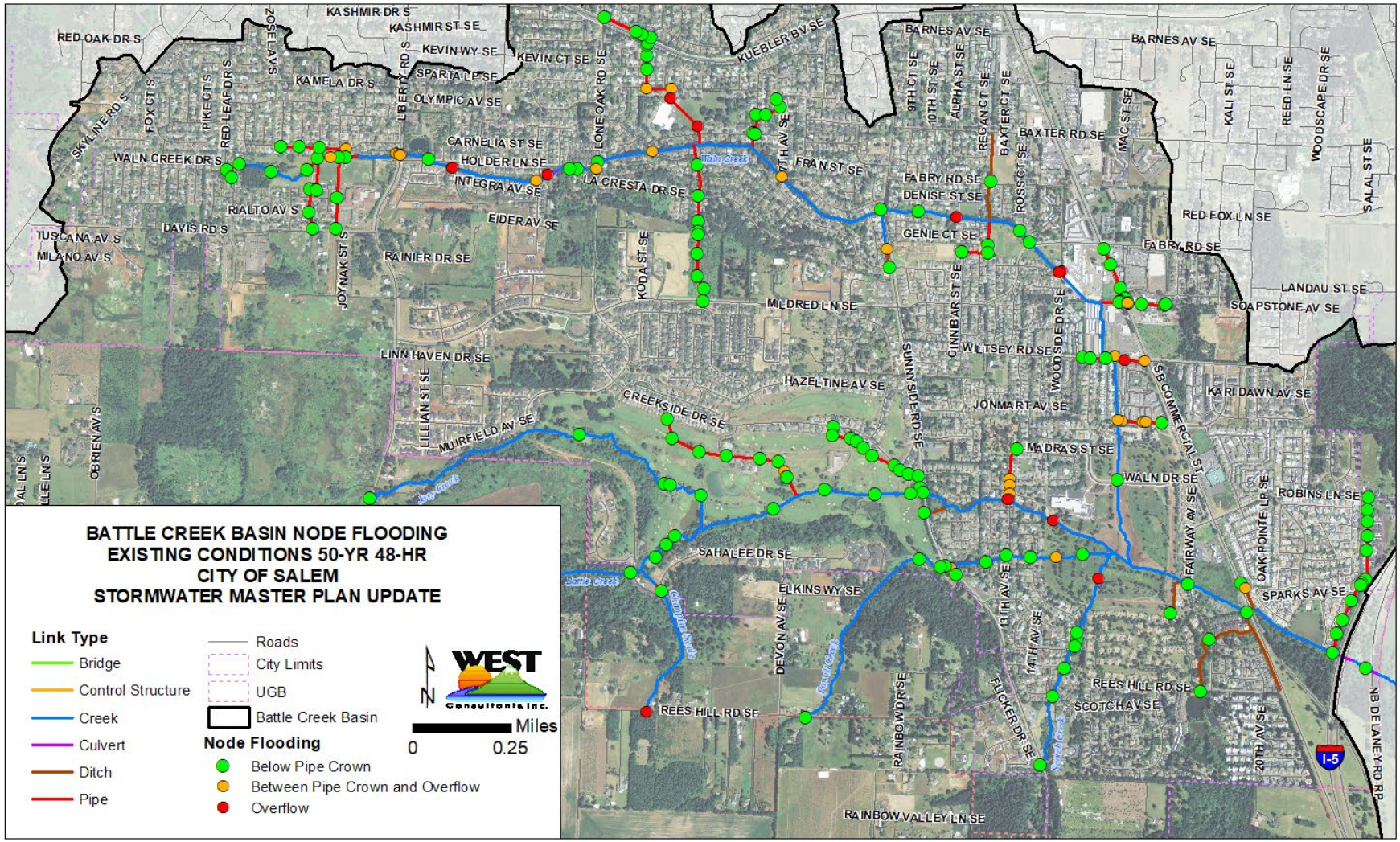



Figure E.7–Color coded node results for existing conditions 50-year, 48-hour storm.

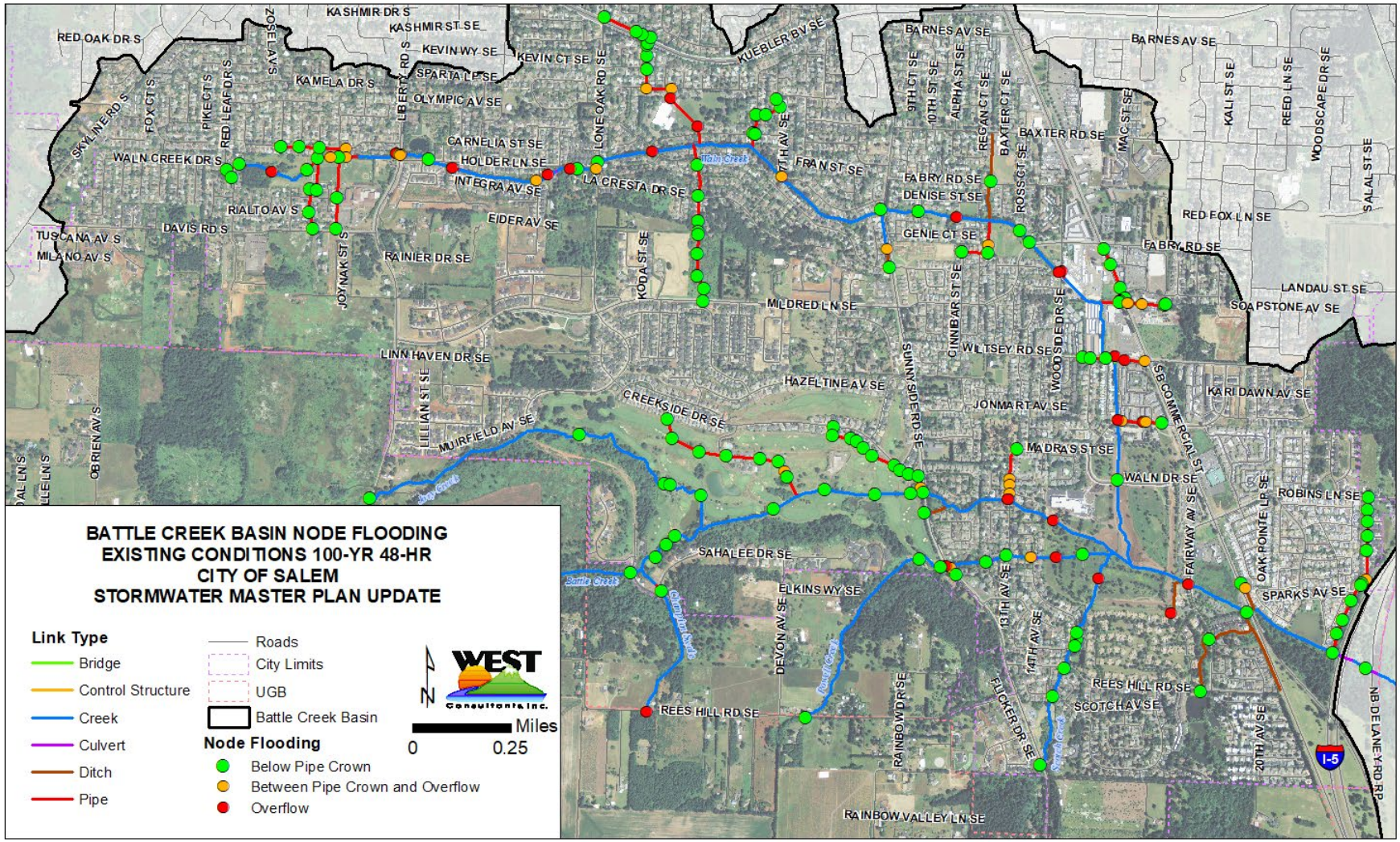



Figure E.8–Color coded node results for existing conditions 100-year, 48-hour storm.

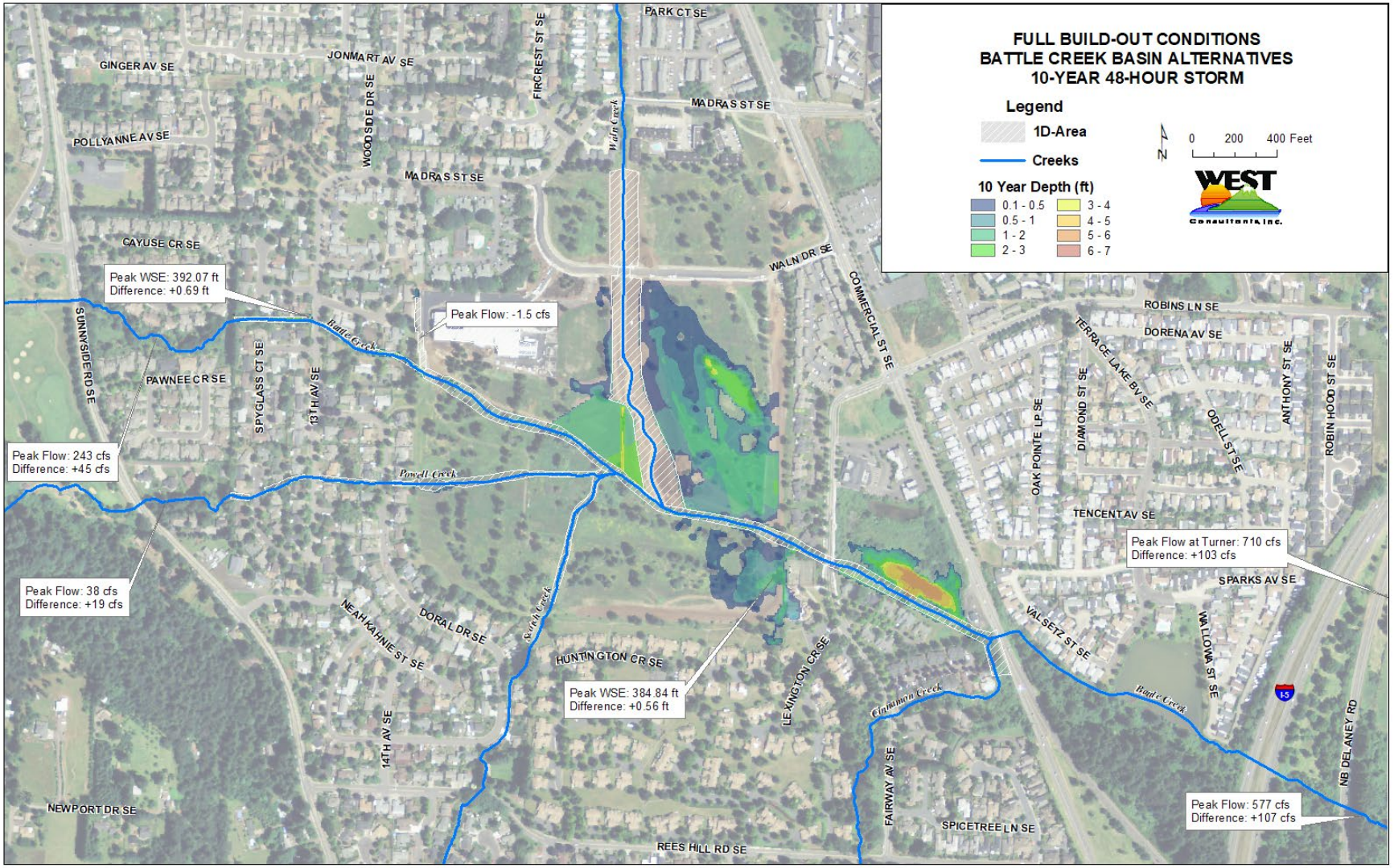



Figure E.9–2-D model flooding extents for full build-out condition 10-year, 48-hour storm.

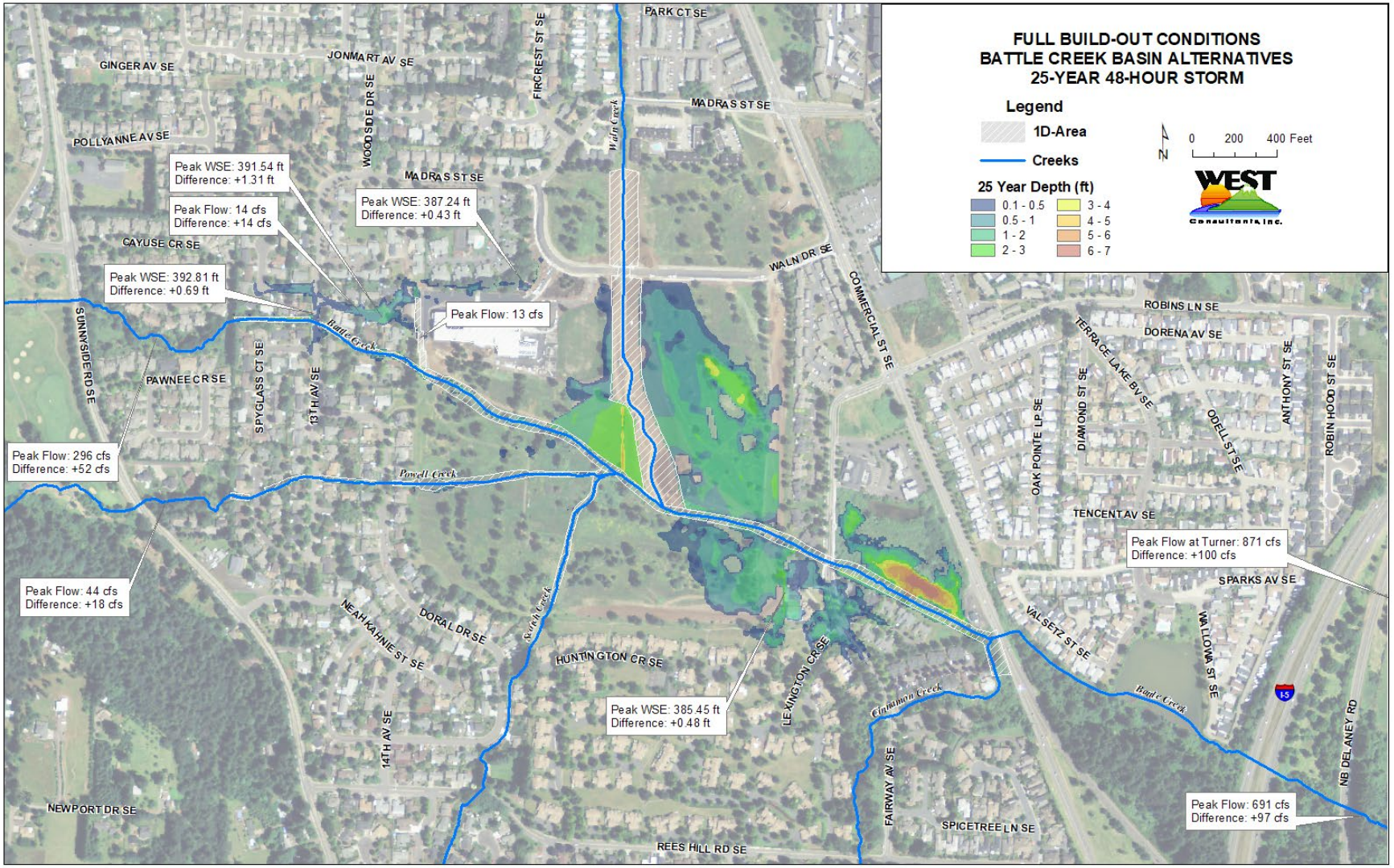



Figure E.10–2-D model flooding extents for full build-out condition 25-year, 48-hour storm.

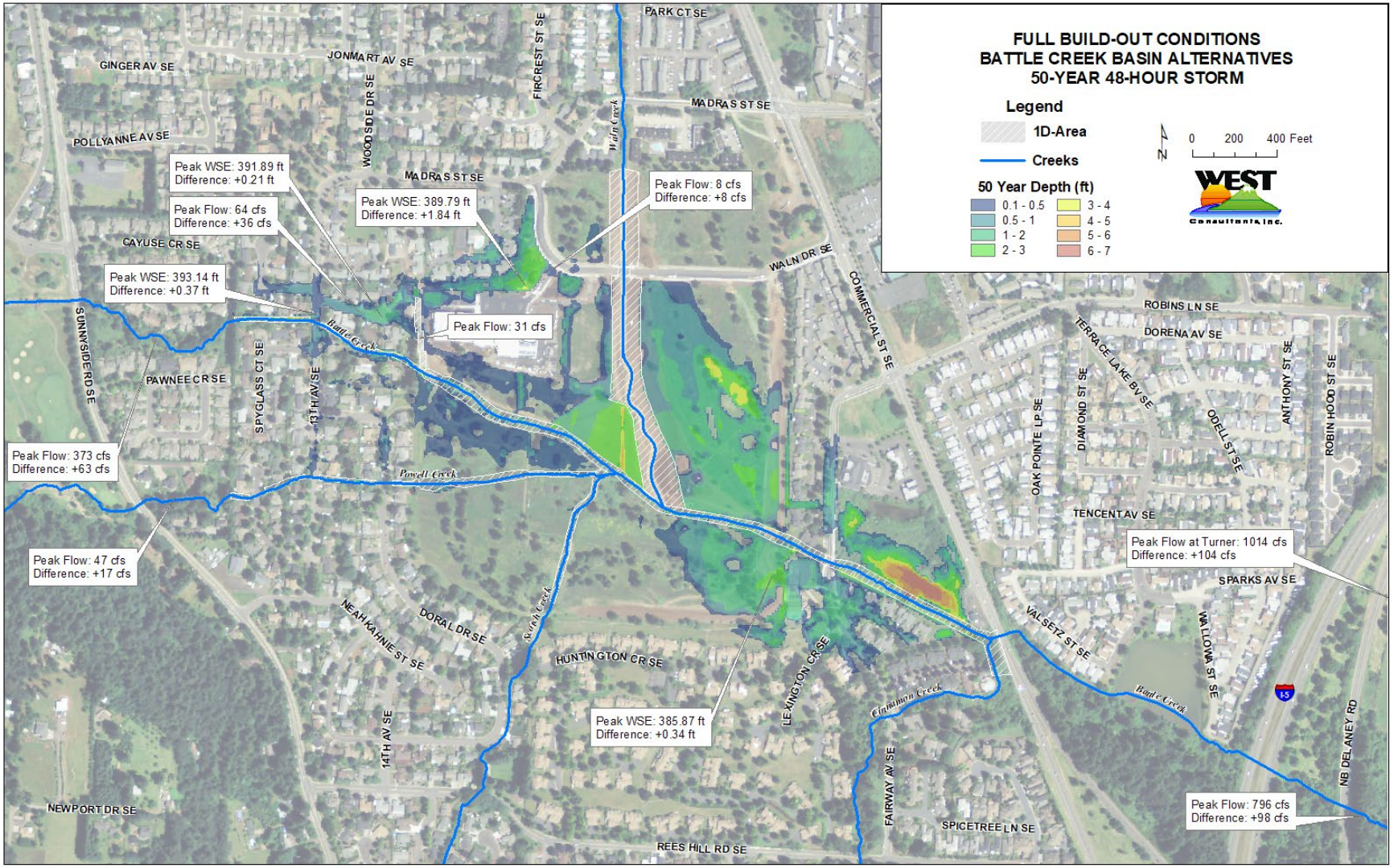



Figure E.11–2-D model flooding extents for full build-out condition 50-year, 48-hour storm.

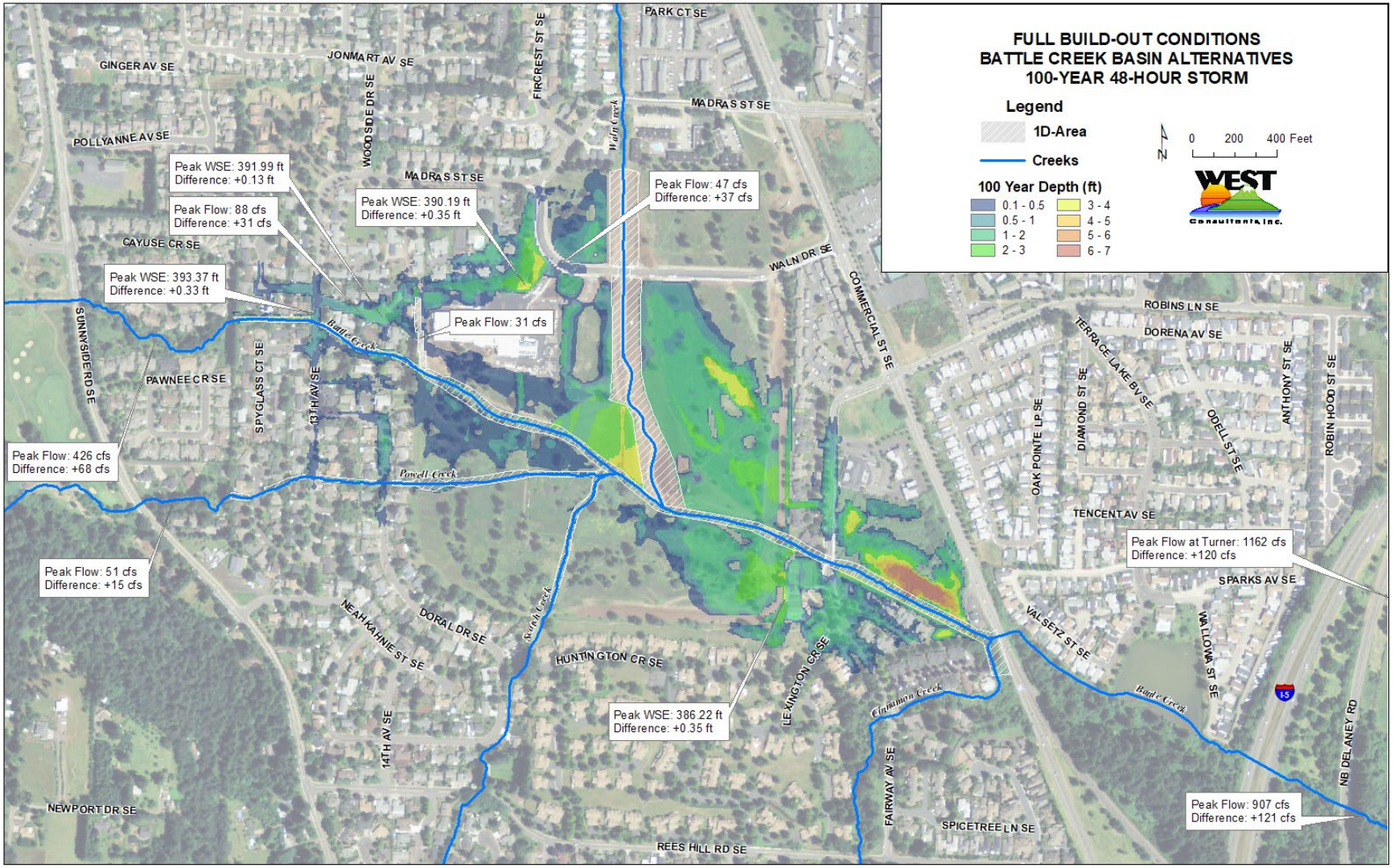



Figure E.12–2-D model flooding extents for full build-out condition 100-year, 48-hour storm.

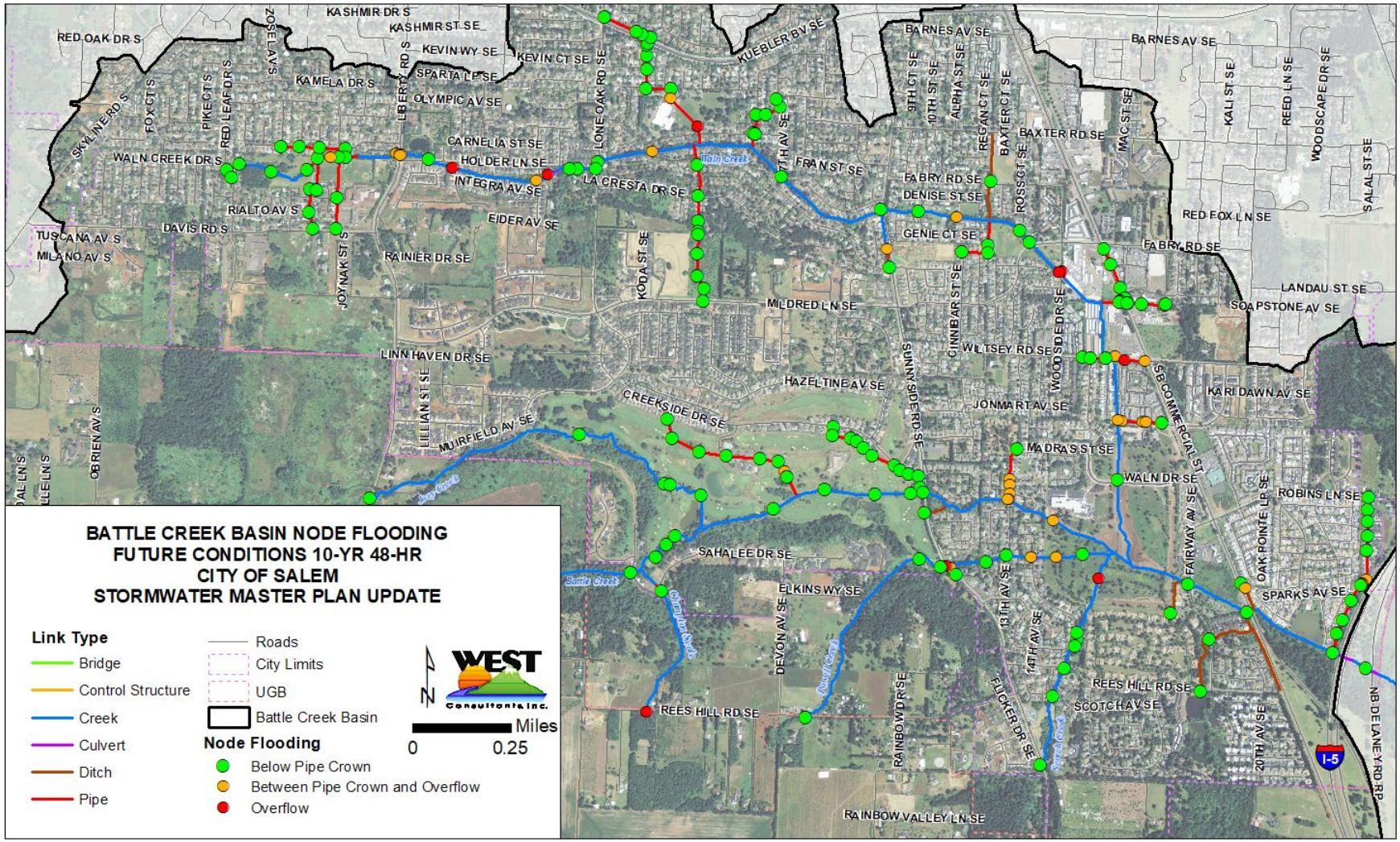



Figure E.13–Color coded node results for full build-out conditions 10-year, 48-hour storm.

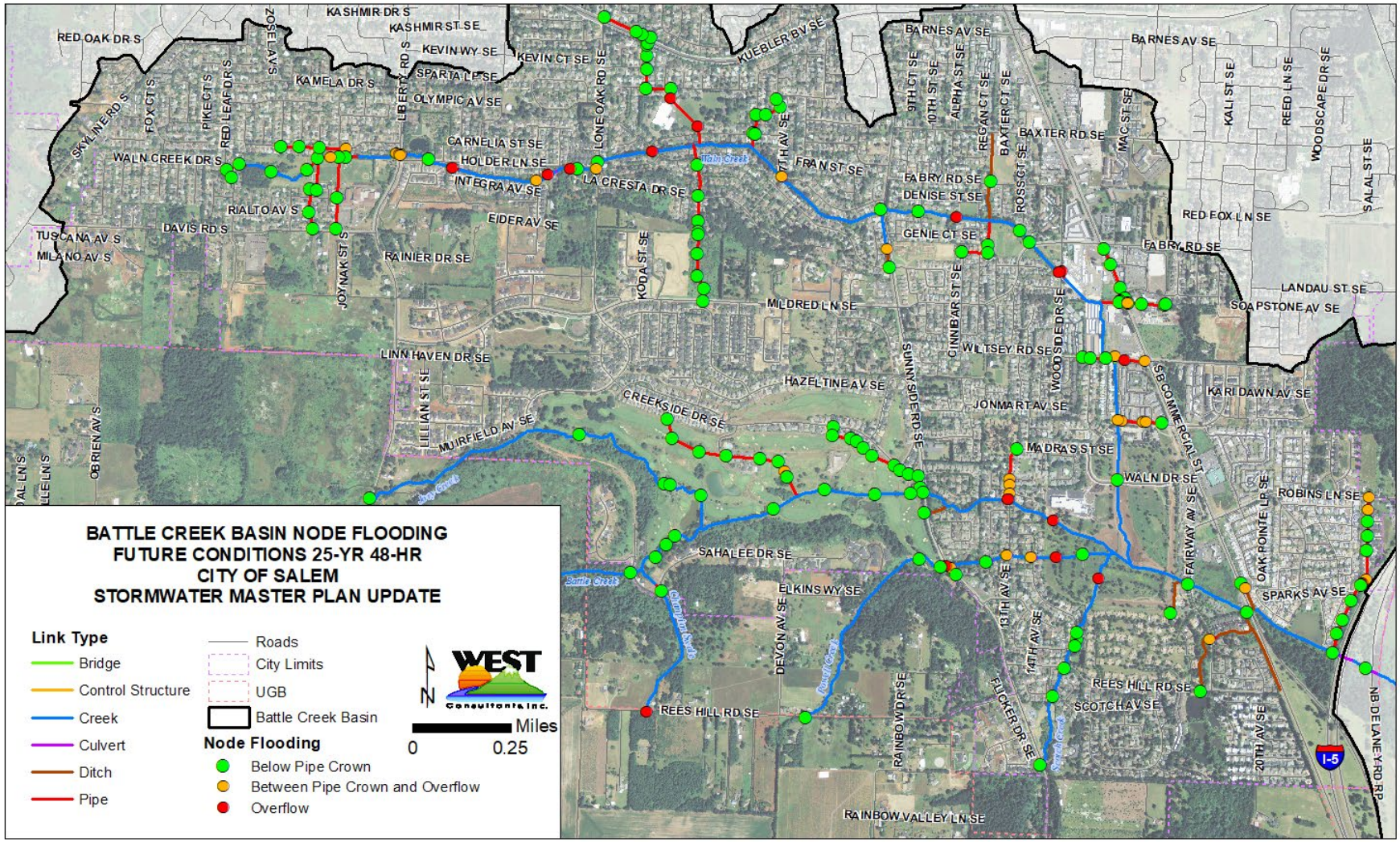



Figure E.14–Color coded node results for full build-out conditions 25-year, 48-hour storm.

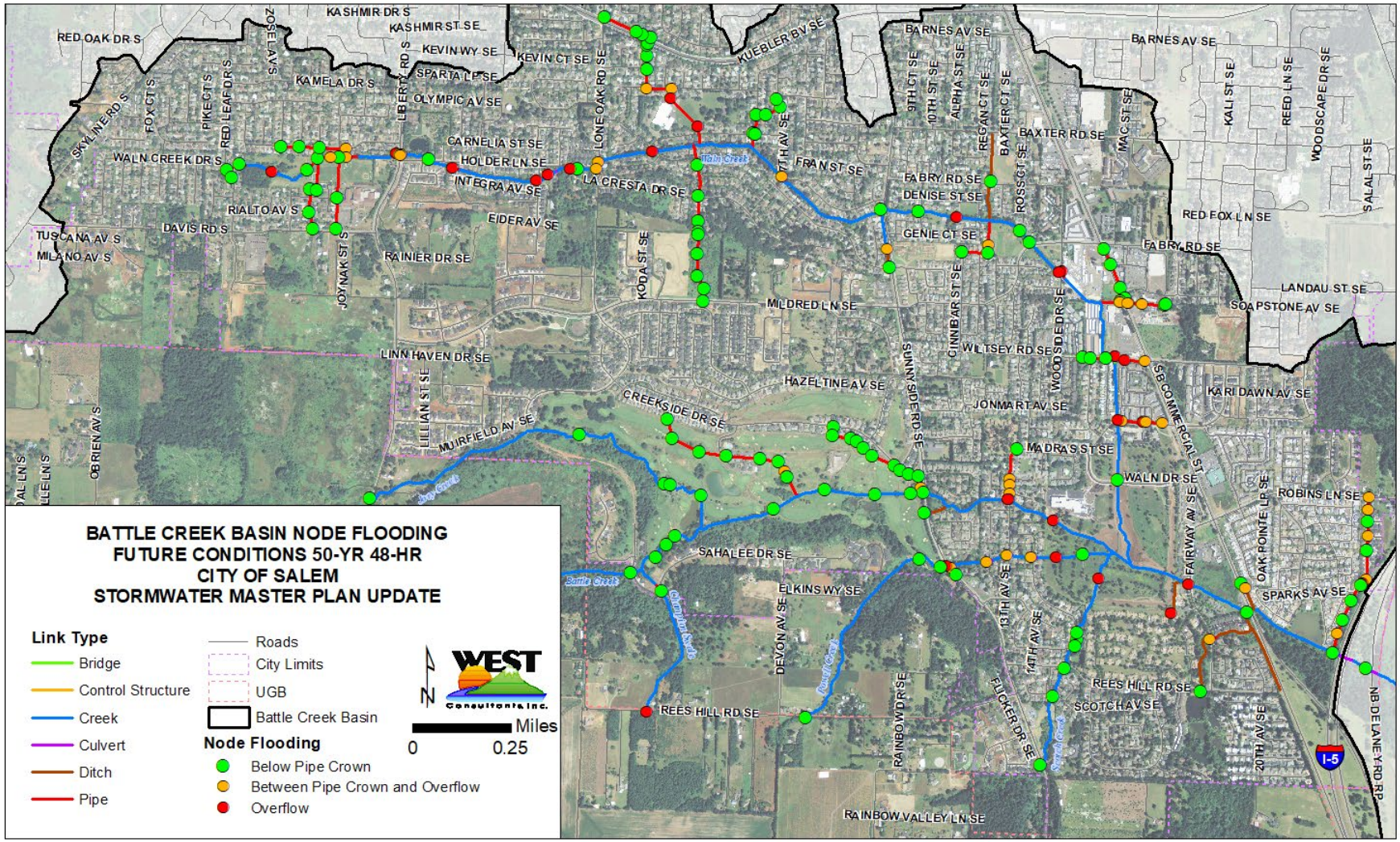



Figure E.15–Color coded node results for full build-out conditions 50-year, 48-hour storm.

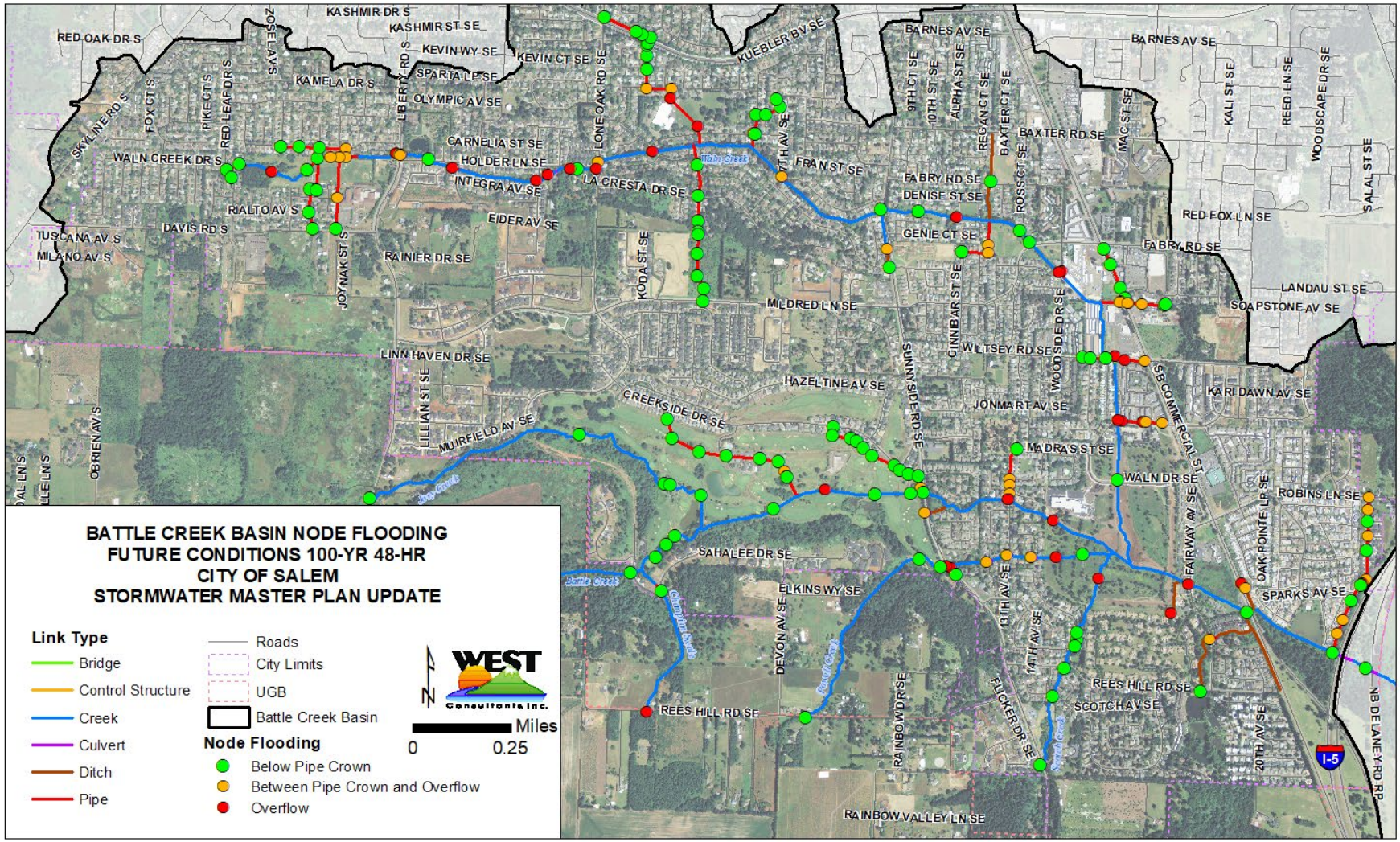



Figure E.16–Color coded node results for full build-out conditions 100-year, 48-hour storm.

# APPENDIX F
# INITIAL MODELING ALTERNATIVES

## *B1_1 Utilize Available Golf Course Storage*

Upstream of Sunnyside Road's crossing of Battle Creek, Creekside Golf Course provides 6 acre-feet of existing storage. However, the culvert under Sunnyside is large enough to convey high flows without backing up and utilizing the storage. For this alternative, an outlet structure was placed upstream of Sunnyside Road to constrict the flows during large events and backup water into the existing storage area. This was modeled by placing a structure upstream of Sunnyside Road's culvert (link babc-018) with an orifice flow area of 30 square feet and a spill crest elevation at 400.5 feet. A structure was also placed upstream of Sunnyside Road's crossing of Powell Creek (link babc-295) with an orifice diameter of 1 foot. The existing turfed spillway between Battle Creek and the storage area was not modified. These structures were optimized to make the largest flow reduction for the 100-year event.

**Results:** This reduced peak flows upstream of 13th Avenue by approximately 14 cubic feed per second (cfs) for the 100-year event, but it did not reduce the stage enough to prevent overtopping at 13th Avenue for the 100-year and 50-year events. The 13th Avenue Bridge did not overtop for both the 10-year existing conditions model and this alternative. Upstream of Fairway Avenue, the peak flood elevation slightly decreased. The peak flow downstream of I-5 was lowered by 8 cfs, 8 cfs, and 3 cfs for the 25-, 50-, and 100-year events, respectively.

## *B1_2 Triple Golf Course Storage*

The available storage volume at Creekside Golf Course upstream of Sunnyside Rd was tripled from 6 acre-feet to 18 acre-feet to understand the potential upper limit of golf course storage. Outlet structure modifications at Sunnyside Road are similar to what was described in B1_1.

**Results:** While the alternative reduced the flows by about 22 cfs for the 100-year event, it still did not reduce the stage at 13th enough to eliminate overtopping for the 100-year and 50-year events. The 50-year peak WSE upstream of 13th Avenue decreased from 392.77 ft to 392.58 ft (-0.19 ft). Since 13th Avenue crests at approximately 292.30 ft, the 50-year peak flow is still about 0.3 ft higher than it would need to be to prevent the 13th Avenue flooding. The additional storage decreased flooding at Fairway Avenue by 0.09 ft and 0.09 ft for the 100-year event and 50-year event, respectively.

## *B2_1 Battle Creek Channel Clearing around 13th Avenue*

Modified 900 ft of Battle Creek starting at the hedge row 370 feet upstream of 13th Avenue and ending 630 ft downstream of 13th Avenue at the beginning of the park. Channel modifications included vegetation clearing which decreased the channel composite Manning's

roughness value from 0.08 to 0.04 (similar to what Otak suggested in “Proposed Conditions 1").

**Results:** This eliminated overtopping at 13th Avenue for the 50-year and 100-year events. However, water still backed up through Battle Creek Elementary School’s west relief sidewalk channel and flooded the Greenside Village Condominiums during the 100-year event (although the flooding extents decreased). Eliminating the sidewalk channel or reducing the backwater would help prevent flooding in the area north of the school if this alternative were implemented. This alternative increased the stage near Fairway Avenue by 0.00 ft, 0.01 ft, and 0.02 ft for the 25-, 50-, and 100-year events, respectively. The peak flow downstream of I-5 was increased by 0 cfs, 3 cfs, and 5 cfs for the 25-, 50-, and 100-year events, respectively.

### *B2_2 Battle Creek Channel Clearing South of School*

Modified the roughness for a 1000 ft section of Battle Creek south of Battle Creek Elementary School and upstream of the Waln Creek confluence. The composite channel roughness was lowered from 0.06 to 0.04 (similar to what Otak suggested in “Proposed Conditions 2").

**Results:** The channel modification reduced the backwater at the sidewalk relief channel, west of Battle Creek Elementary School. This allowed the sidewalk relief channel to more effectively drain some of the 13th Avenue overflow waters which reduced the flooding during the 50-year and 100-year events north of the school and at Greenside Village Condominiums. This alternative increased the 100-year flood elevation at Fairway Avenue by 0.05 ft and the 100-year peak flows downstream of I-5 by 11 cfs.

### *B2_12 Battle Creek Channel Clearing around 13th Avenue & South of School*

This alternative is a combination “B2_1” and “B2_2”. 1900 ft of channel would undergo vegetation clearing from the Waln Creek confluence to the hedge row 370 ft upstream of the 13th Avenue Bridge.

**Results:** Flooding at 13th Avenue, the Greenside Village Condominiums, and in the vicinity of Battle Creek Elementary School was eliminated for the 50-year and 100-year events. The Peak 100-year WSE at Fairway Avenue increased by 0.07 ft and the 100-year peak flow downstream of I-5 increased by 16 cfs.

### *B4 Floodplain Grading South of School*

The Battle Creek banks were modified in the reach of Battle Creek south of the Battle Creek Elementary School, upstream of the Waln Creek confluence. The overbanks were lowered and the roughness values were decreased. The overbanks were modified by creating an interpolated cross section surface in RAS using Otak’s “Proposed Conditions 4” school reach geometry. This surface was merged with the Present Conditions DTM. The roughness values also came from Otak’s “Proposed Conditions 4”.

**Results:** While the additional floodplain storage south of the school helped reduce flooding at 13th Avenue and near Battle Creek Elementary School by about 0.33 ft, this alternative was not as effective as “B2_2” (Battle Creek Channel Clearing South of School).

## *B4_chan Add Channel Benches along Battle Creek South of School with Sparse Vegetation*

This alternative modified the Battle Creek channel south of the Battle Creek Elementary School, upstream of the Waln Creek confluence. The channel modifications created overflow benches similar to what was constructed on Waln Creek upstream of the confluence (see a representative channel cross section modification in Figure F.1. The channel was given a composite roughness of 0.04.

**Results:** This significantly reduced flooding near Battle Creek Elementary School and at the Greenside Village Condominiums for the 50-year and 100-year. While overtopping still occurred at 13th Avenue during the 50-year and 100-year events, the decrease in Battle Creek's backwater south of the school allowed the school's sidewalk relief channel to more efficiently drain the 13th Avenue flooding. The Peak 100-year WSE at Fairway Avenue increased by 0.05 ft and the 100-year peak flow downstream of I-5 increased by 13 cfs.

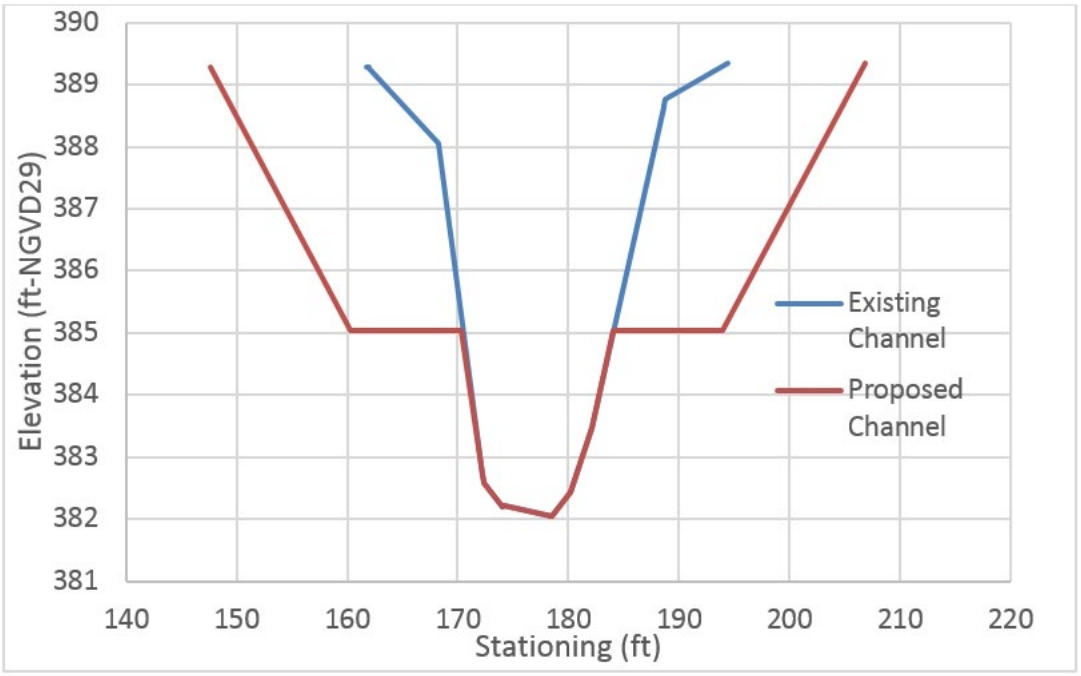



Figure F.1–Channel benching geometry.

## *B4_chan_tree Add Channel Benches along Battle Creek South of School with Dense Vegetation*

Similar to alternative "B4_chan", but increased the channel roughness in the modified section of Battle Creek to simulate long term tree and shrub growth.

**Results:** The results were similar with the lower roughness. However, since the benched channel had higher roughness values there was a little less flood reduction in the vicinity of Battle Creek Elementary School and at the Greenside Village Condominiums compared to alternative "B4_Chan".

### *B5 Add Box Culvert at School Entrance*

This alternative added an 8'x 3.5' box culvert under the Battle Creek Elementary School entrance.

**Results:** This alternative decreased the flooding extents at Greenside Village Condominiums for the 50-year and 100-year events. Other areas were not affected.

### *B6 Add Storage near Battle Creek and Waln Creek Confluence*

Created large storage areas in the park that contains the Waln Creek and Battle Creek confluence by lowering the 2D grid cell elevations to 381 ft and creating a ridge between the storage area and the channel that would only overtop flows at or above the 25-year event. This is an upper bound of this alternative's potential.

**Results:** The added storage lowered the flooding near Fairway Avenue by 0.24 ft, 0.38 ft, and 0.19 ft for the 25-, 50-, and 100-year events, respectively. The peak flow downstream of I-5 was lowered by 51 cfs, 80 cfs, and 45 cfs for the 25-, 50-, and 100-year events, respectively. There were no significant changes upstream of the confluence.

### *B7 Add Storage in Wetland Upstream of Commercial Street north of Battle Creek*

Created a storage area at the northwest corner of Battle Creek and Commercial Street by lowering the grid cell elevations to 387.5 ft and creating a ridge between the creek and the storage area with an elevation of 383 ft.

**Results:** The flood reduction impacts were marginal. The peak flow downstream of I-5 stayed within +/- 3 cfs of the original peak flow for each of the design events. The flooding near Fairway Avenue was also largely unaffected. There was no significant changes upstream of the confluence.

### *B8 Battle Creek Channel Clearing Between Commercial Street & I-5*

Lowered channel roughness between Commercial Street and I-5 from 0.06 to 0.04 and decreased right overbank roughness from 0.1 to 0.06.

**Results:** The channel clearing lowered the flooding near Fairway Avenue by 0.48 ft, 0.47 ft, and 0.46 ft for the 25-, 50-, and 100-year events, respectively. This resulted in a smaller inundation area in area residential area along Fairview Ave. The peak flow downstream of I-5 changed by +1 cfs, +8 cfs, and +5 cfs for the 25-, 50-, and 100-year events, respectively. There were no significant changes upstream of the confluence.

### *B9_10 Double Size of Battle Creek Culverts at I-5*

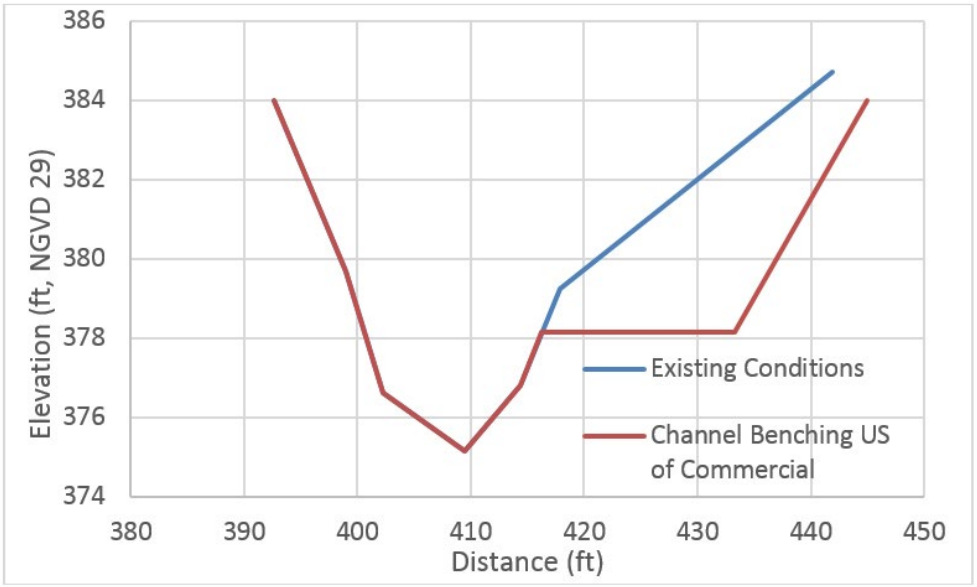
Doubled capacity of I-5 culverts.

**Results:** Small decrease of flooding at Fairway Avenue (about 0.09-ft for the 100-year event). The 100-year peak flow increased by 12 cfs downstream of I-5.

## *B11 Battle Creek Channel Benching from 220 ft Upstream of Commercial Street to I-5*

Increased the channel size and created overflow benches similar to what was constructed on Waln Creek upstream of the confluence (see a representative channel cross section modifications in Figure F.2.) The channel was given a roughness of 0.04. The channel modification was made from 220 ft upstream of Commercial Street to I-5.

**Results:** The channel clearing and benching lowered the flooding near Fairway Avenue by 0.93 ft, 0.88 ft, and 0.83 ft for the 25-, 50-, and 100-year events, respectively. This resulted in a significantly smaller inundation area in area residential area along Fairview Avenue. The peak flow downstream of I-5 changed by -6 cfs, +9 cfs, and +7 cfs for the 25-, 50-, and 100-year events, respectively. There were no significant changes upstream of the confluence.



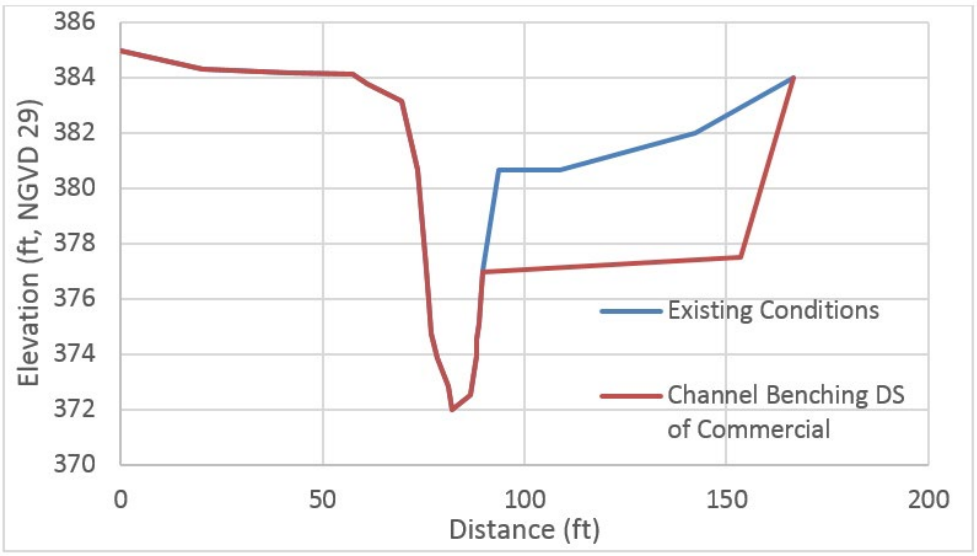




Figure F.2–Channel benching geometry.

### *W1 Upsize Waln Creek at Madras Street Culvert*

Upsized Waln Creek culvert at Madras Street from 10 ft span to 16 ft span.

**Results:** No significant flood mitigation due to influence of upstream inline weir.

### *W2 Remove Weir Upstream of Madras Street*

Removed weir upstream of Madras Street. Site visit suggests sediment has filled in area upstream of weir. Assumed channel would erode to geometry conditions in Otak's model.

**Results:** This alternative slightly decrease in 100-year flood elevation along Waln Creek upstream of weir (0.03 ft).

### *W3 Upsize Waln Creek at Wiltsey Road Culvert*

Doubled the size of Wiltsey Road culvert.

**Results:** This alternative slightly lowered 100-year flood elevations upstream of Woodside Drive, but slightly increased flooding near trailer park downstream of Wiltsey Road.

### *W4 Waln Creek Vegetation Clearing*

Reduced channel vegetation in Waln Creek from approximately 0.065 to 0.04 from Madras Street to Mildred Lane.

**Results:** This alternative eliminated flooding upstream of Woodside Drive for the 100-year event and decreased flooding near the trailer park downstream of Wiltsey Road by 0.7 ft for the 100-year event. There were minimal impacts downstream of the Battle Creek confluence.

### *W5 Mildred Storage*

Added 10 ac-ft of storage area upstream of Woodside Drive in undeveloped parcel.

**Results:** While it only decreased peak flood elevation by 0.1 ft at Woodside Rd and 0.13 near the trailer park for the 100-year event, this is due to the two peaks of the design flood event. The first peak decreased much more and the additional storage had less influence on the second peak. The additional storage decreased peak flows downstream of I-5 by 15 cfs for the 100-year event.

### *COMBINATION 1 – Battle Creek Channel Clearing Around 13th Avenue, Battle Creek Channel Benching South of School & Confluence Storage*

This is a combination of alternatives "B2_1", "B2_2", "B4_chan", and "B6". Maximized storage at Waln Creek and Battle Creek confluence. Reduced channel roughness from hedge row upstream of 13th Avenue to Waln Creek confluence. Added benches in channel south of school.

**Results:** Eliminated flooding near 13th Avenue and north and west of the school for the

50-year and 100-year events. Combination 1 lowered the flooding near Fairway Avenue by 0.24 ft, 0.36 ft, and 0.13 ft for the 25-, 50-, and 100-year events, respectively. This resulted in a smaller inundation area in area residential area along Fairview Ave. The peak flow downstream of I-5 decreased by 44 cfs, 58 cfs, and 38 cfs for the 25-, 50-, and 100-year events, respectively. This combinations effectively decreased the risk of flooding near 13th Avenue, at the Greenside Village Condominiums, and in the vicinity of Battle Creek Elementary School, while also decreasing the downstream peak flows at I-5. This alternative did not have a significant impact to the residential flooding near Fairway Avenue.

### *COMBINATION 2 – Battle Creek Channel Clearing Around 13th, Battle Creek Channel Benching South of School, Battle Creek Channel Benching/Clearing between Commercial and I-5 & Confluence Storage*

This is a combination of alternatives “B2_1”, “B2_2”, “B4_chan”, “B6”, and “B11”. Maximized storage at Waln Creek and Battle Creek confluence. Reduced roughness to 0.04 from hedge row upstream of 13th Avenue to Waln Creek confluence. Added benches in channel south of Battle Creek Elementary School. Added benches from 220 ft upstream of Commercial Avenue to I-5 and reduced channel roughness to 0.04.

**Results:** Eliminated flooding near 13th Avenue and north and west of the school for the 50-year and 100-year events. Combination 1 lowered the flooding near Fairway Avenue by 0.91 ft, 1.15 ft, and 1.01 ft for the 25-, 50-, and 100-year events, respectively. This resulted in a significantly smaller inundation area in area residential area along Fairview Ave. The peak flow downstream of I-5 decreased by 19 cfs, 63 cfs, and 45 cfs for the 25-, 50-, and 100-year events, respectively. This combinations effectively decreased the risk of flooding near 13th Avenue, at the Greenside Village Condominiums, and in the vicinity of Battle Creek Elementary School, while also decreasing the downstream peak flows at I-5. Unlike Combinations 1, this alternative also significantly decreased the risk of residential flooding near Fairway Avenue.

# APPENDIX G
# ALTERNATIVES ANALYSIS RESULTS

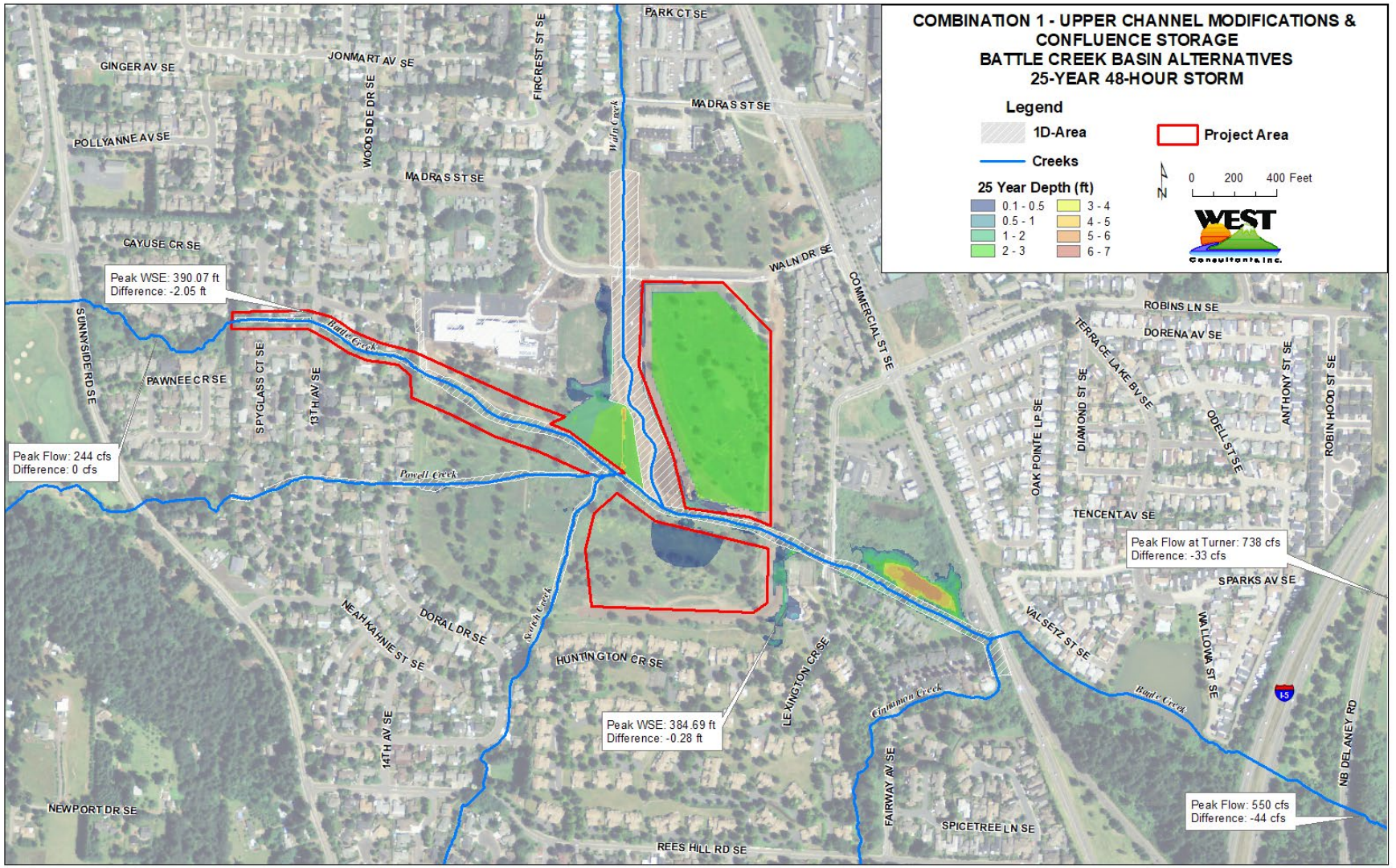



Figure G.1–2-D model results for existing conditions 25-yr, 48-hour storm for Combination 1.

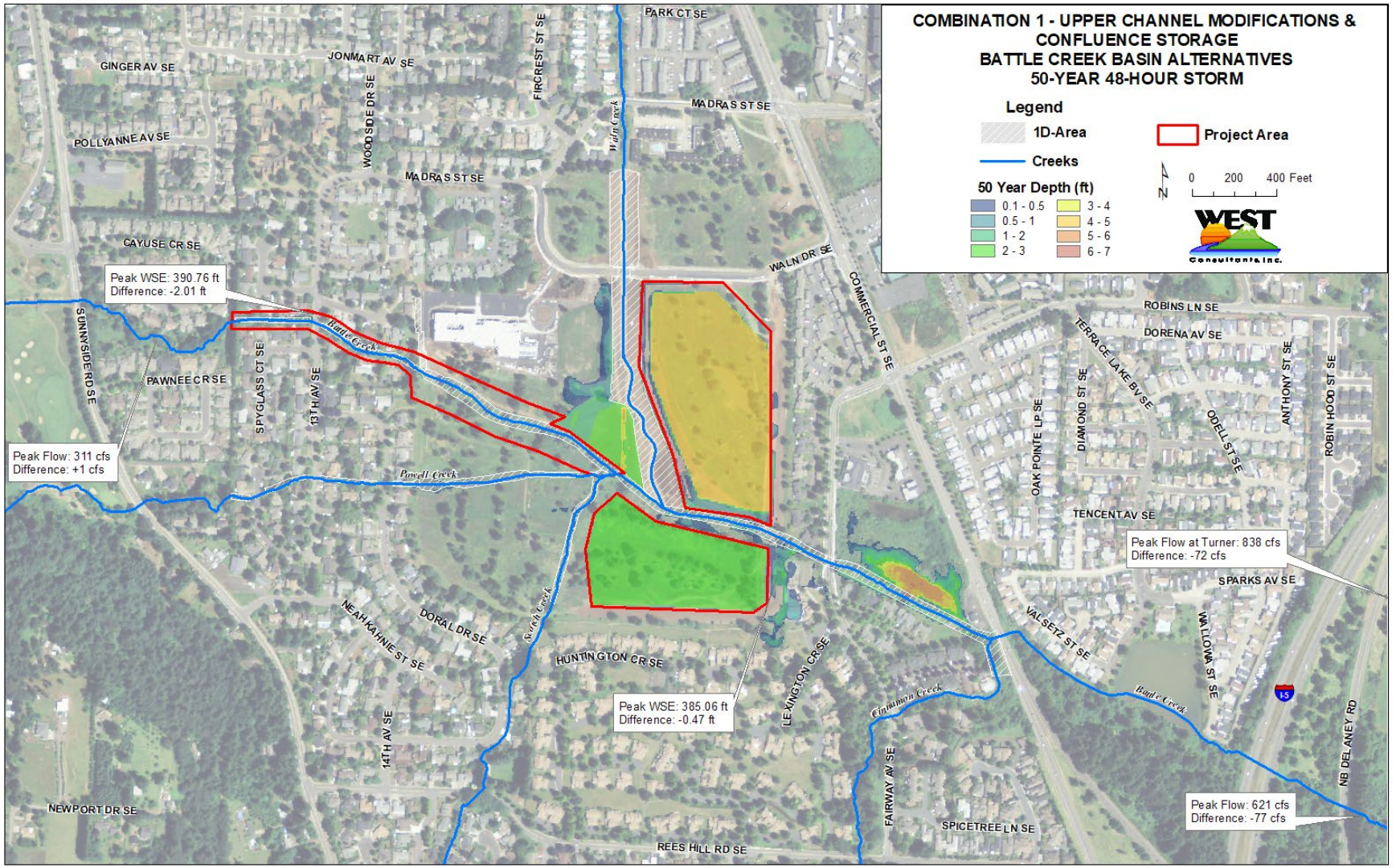



Figure G.2–2-D model results for existing conditions 50-yr, 48-hour storm for Combination 1.

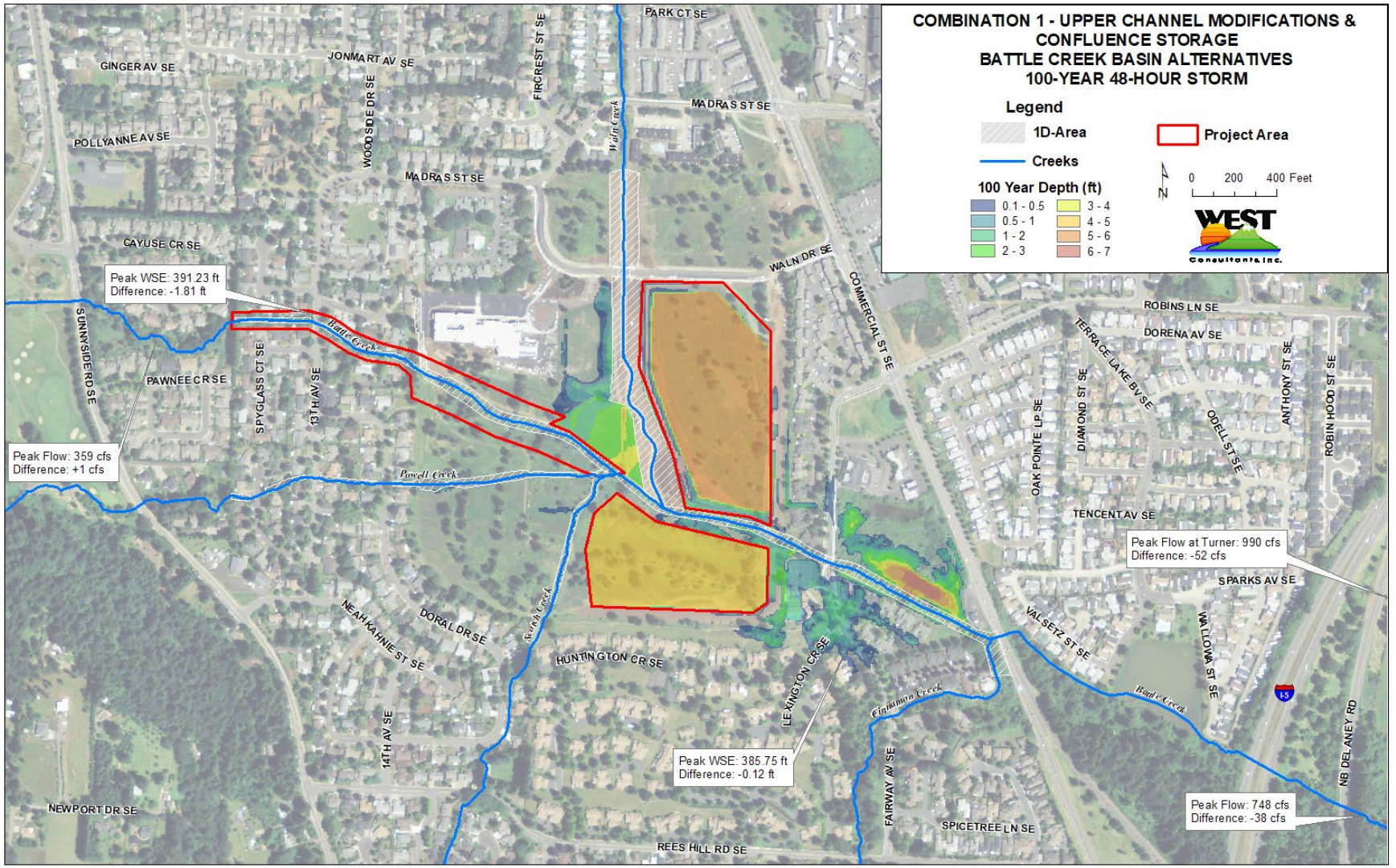



Figure G.3–2-D model results for existing conditions 100-yr, 48-hour storm for Combination 1.

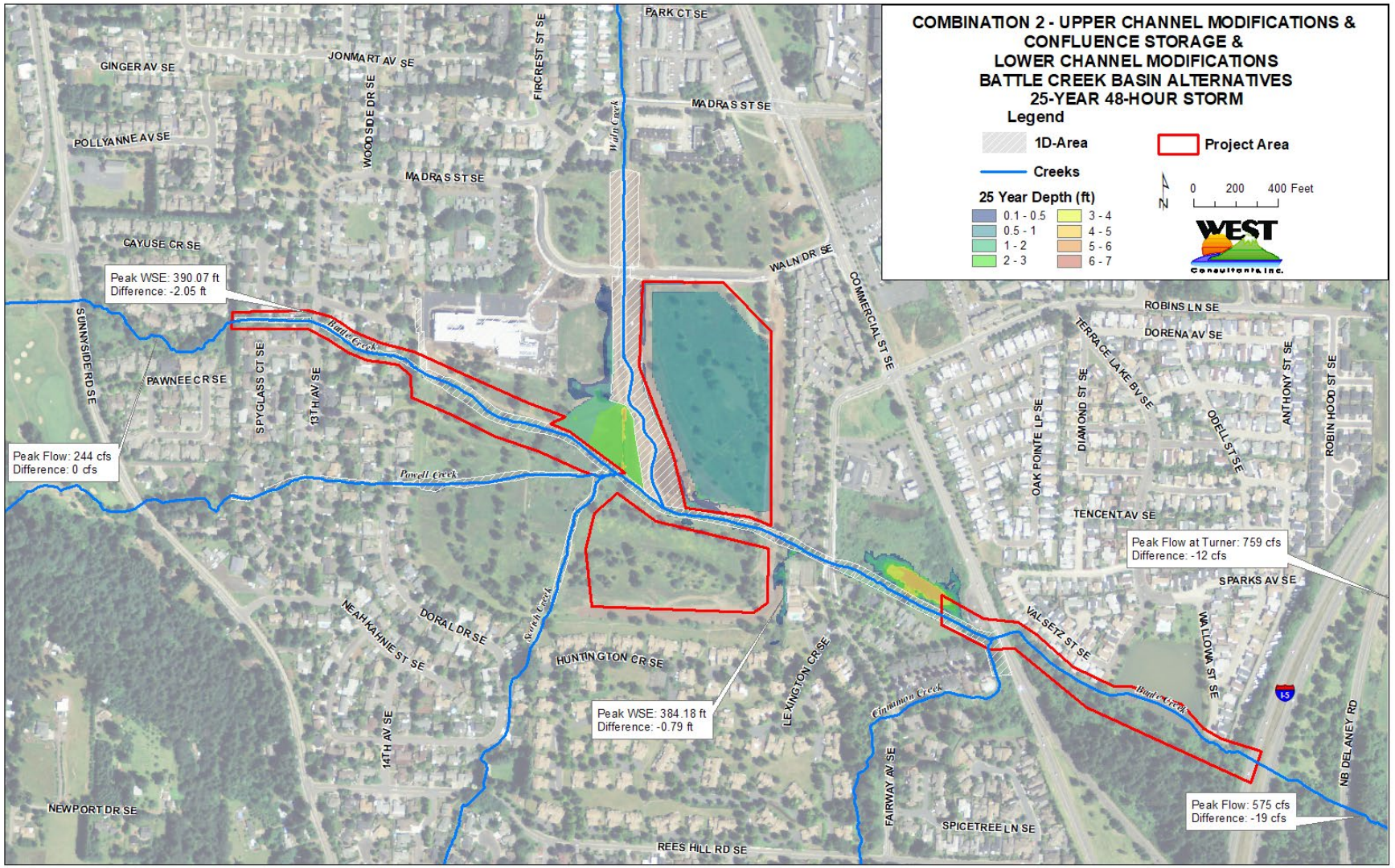



Figure G.4–2-D model results for existing conditions 25-yr, 48-hour storm for Combination 2.

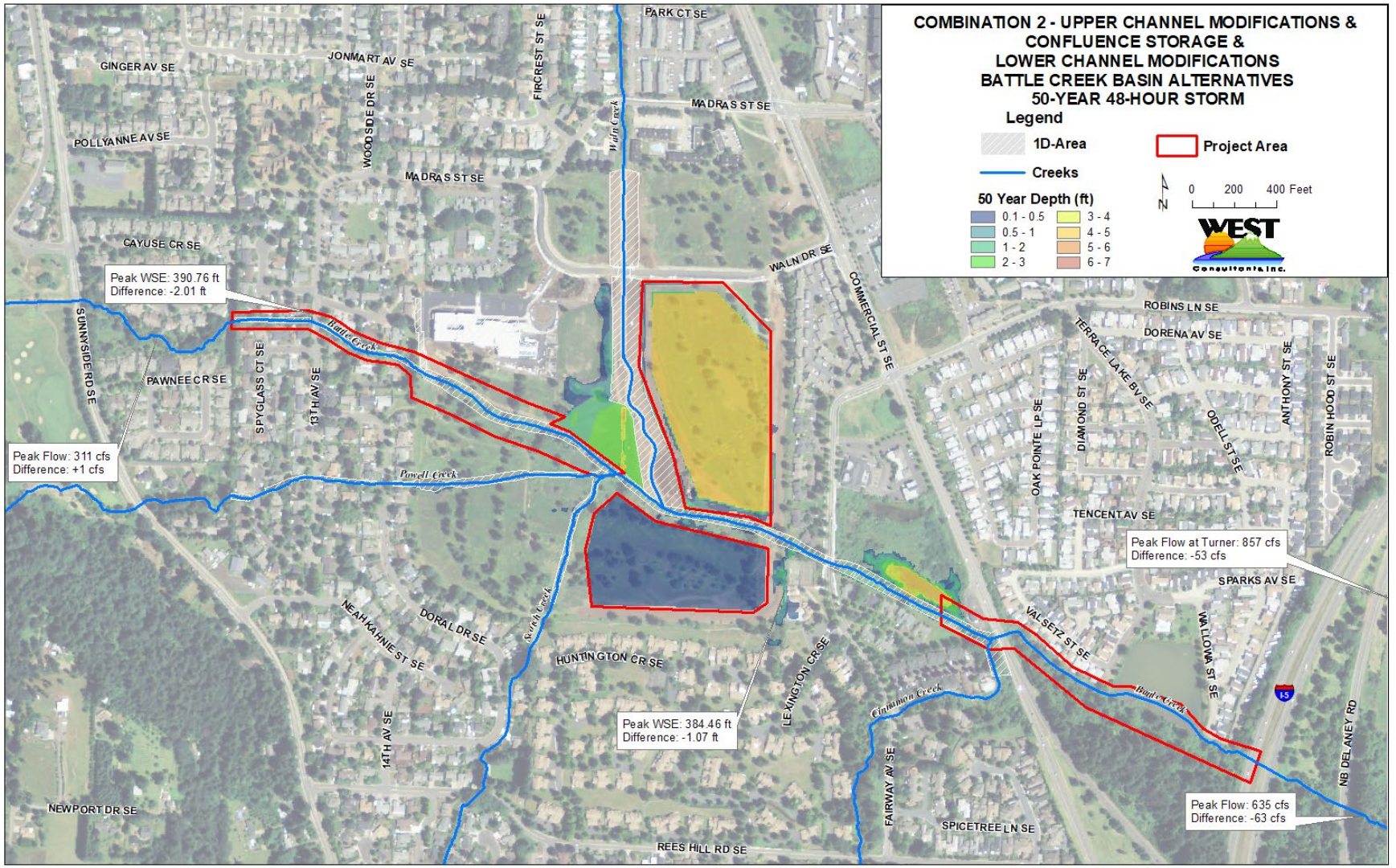



Figure G.5–2-D model results for existing conditions 50-yr, 48-hour storm for Combination 2.

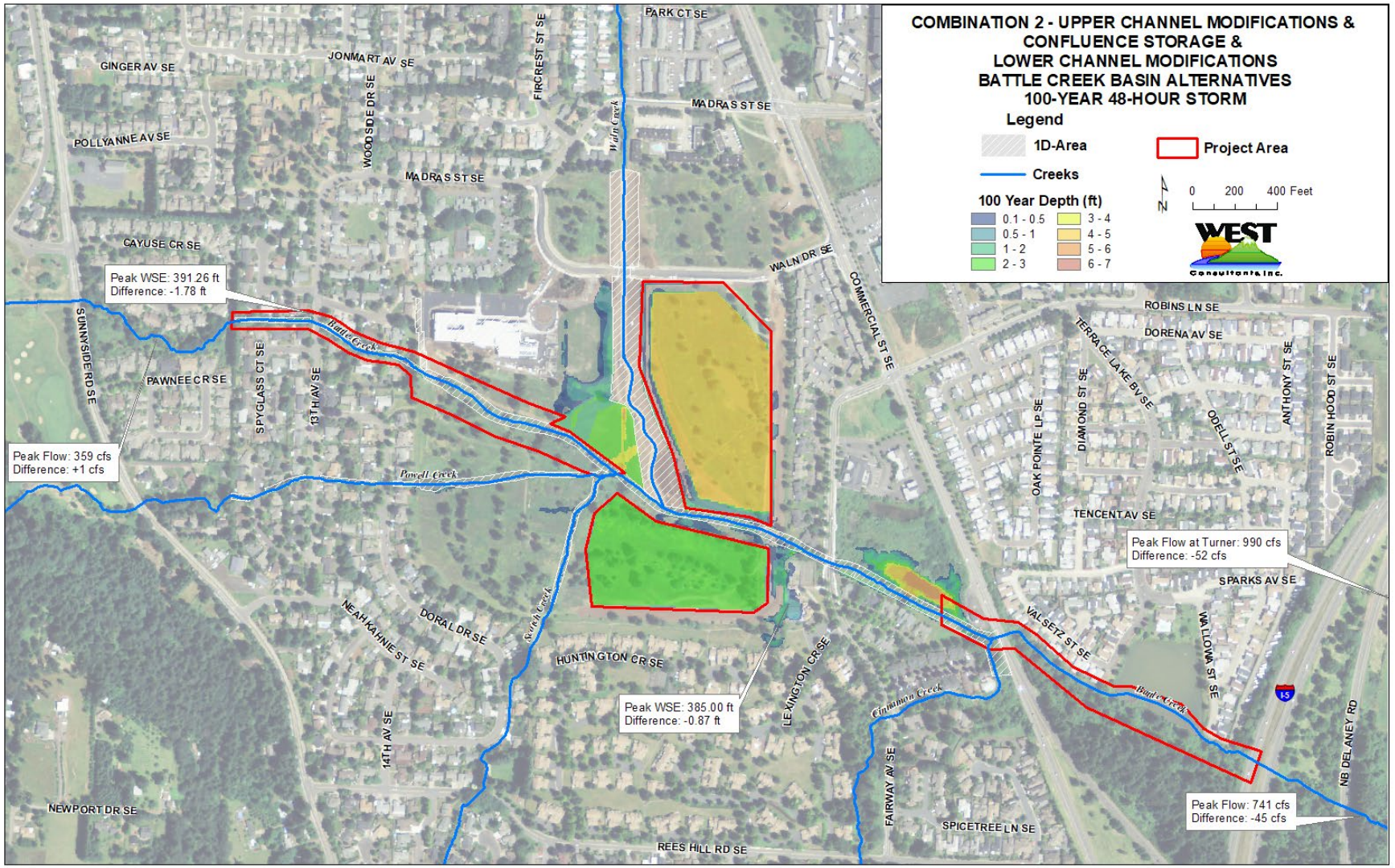



Figure G.6–2-D model results for existing conditions 100-yr, 48-hour storm for Combination 2.

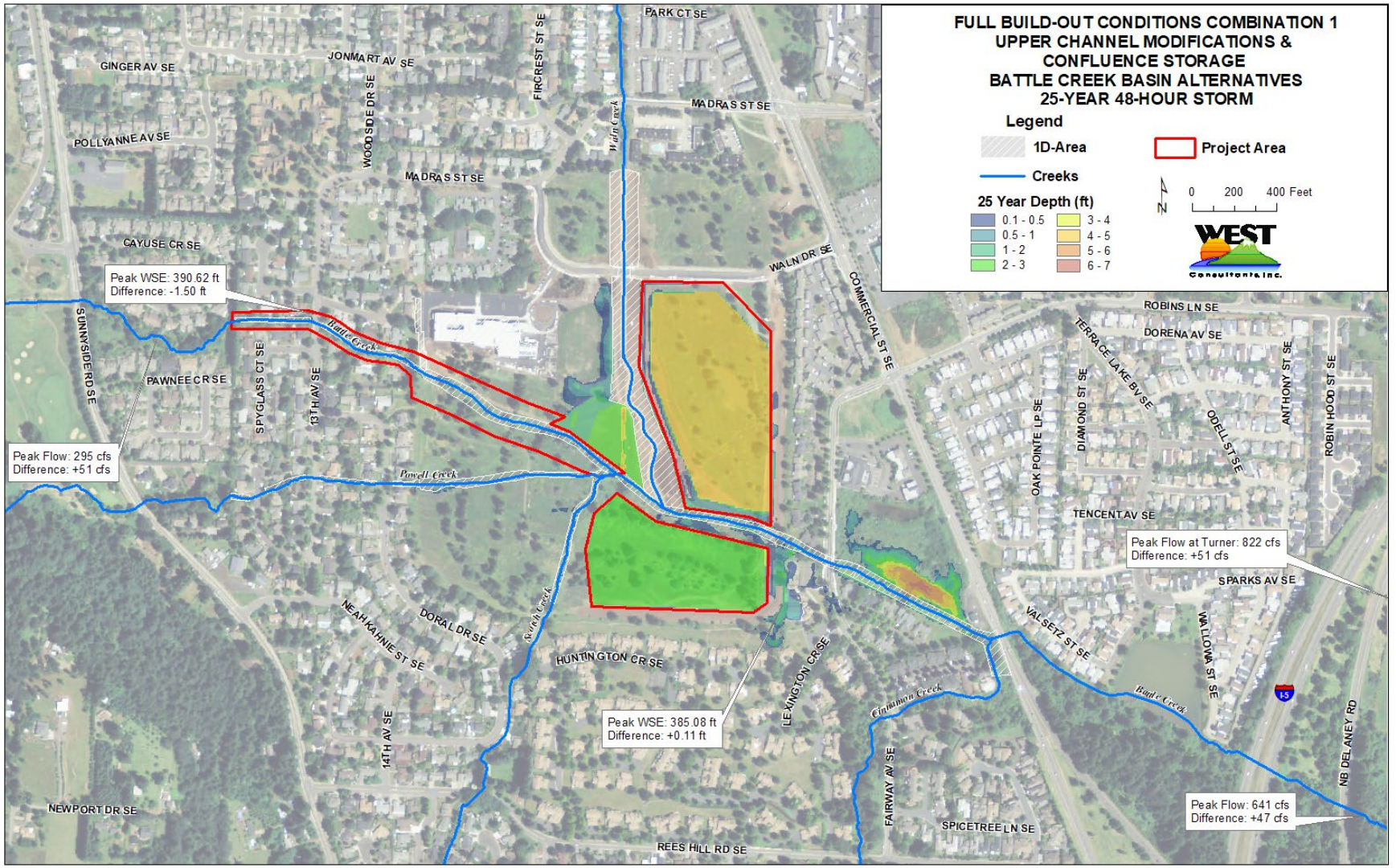



Figure G.7–2-D model results for full build-out conditions 25-yr, 48-hour storm for Combination 1.

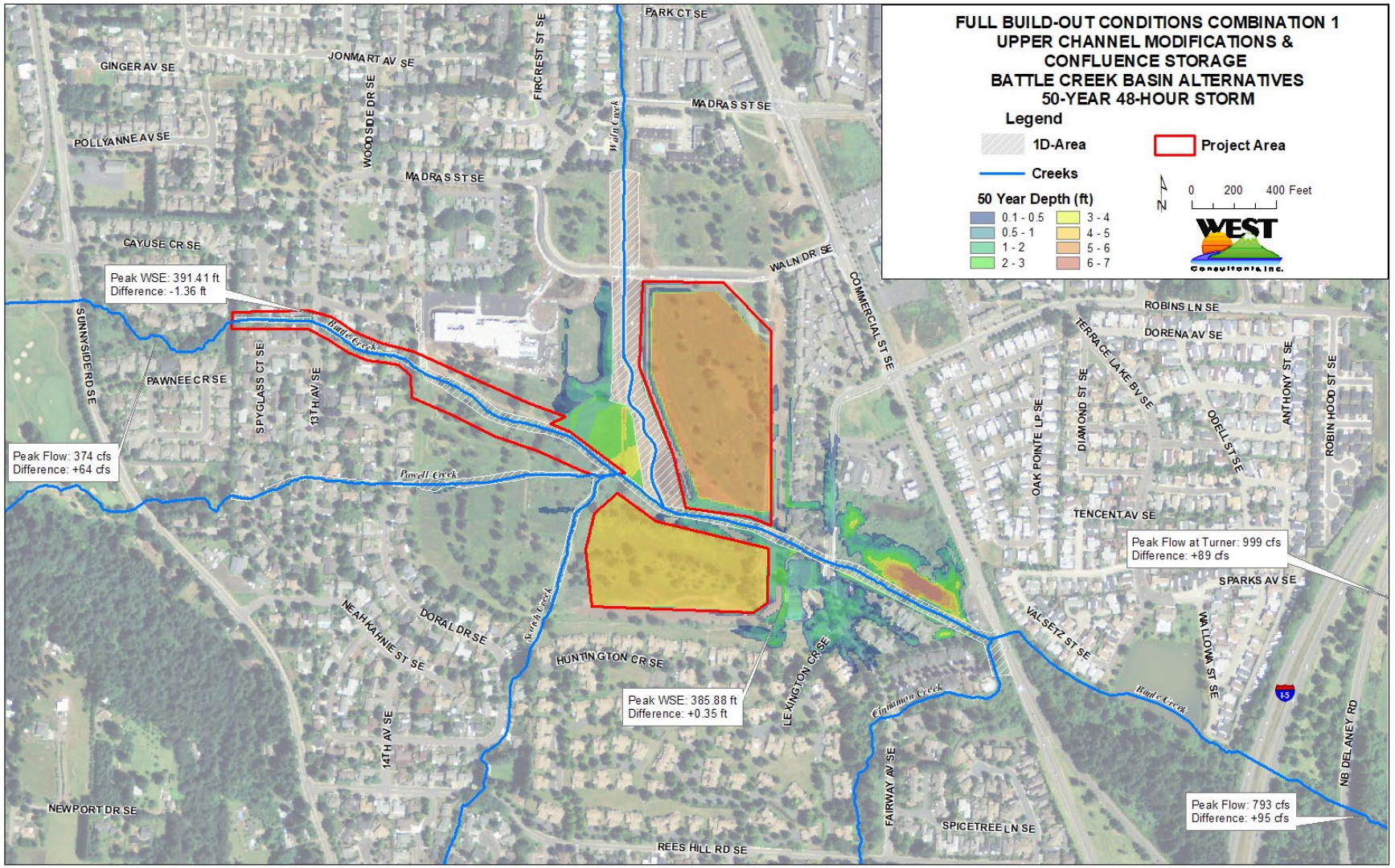



Figure G.8–2-D model results for full build-out conditions 50-yr, 48-hour storm for Combination 1.

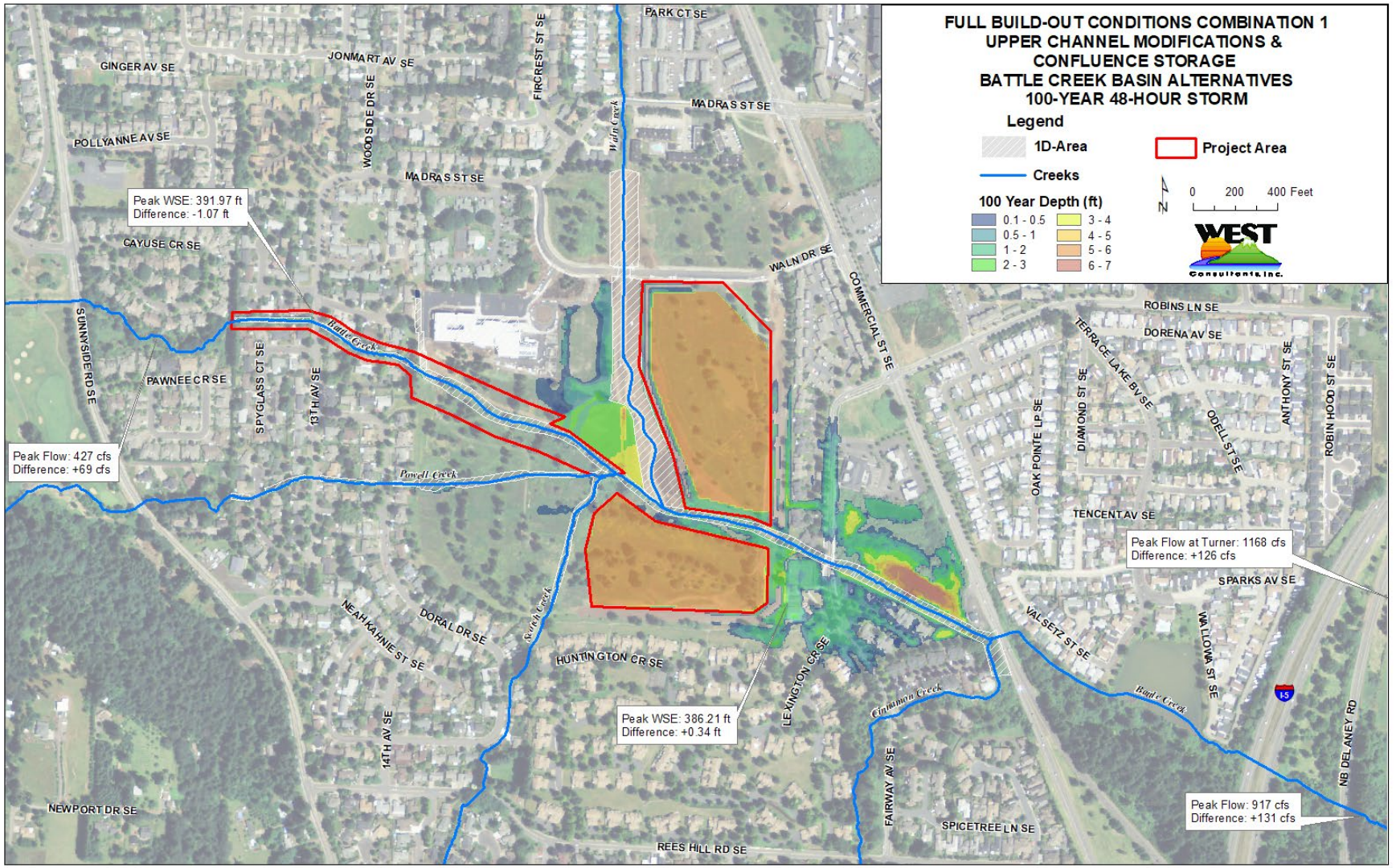



Figure G.9–2-D model results for full build-out conditions 100-yr, 48-hour storm for Combination 1.

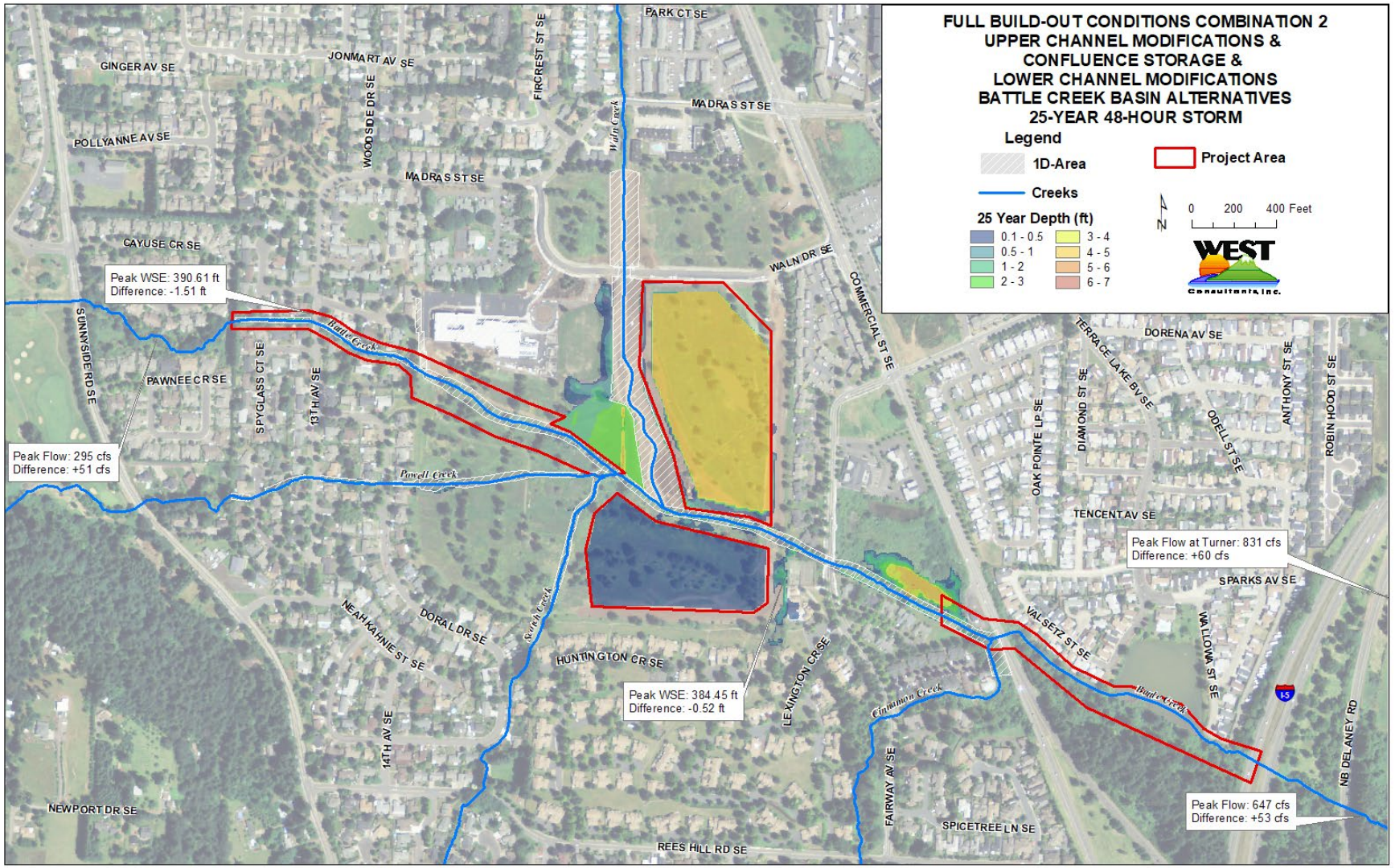



Figure G.10 – 2-D model results for full build-out conditions 25-yr, 48-hour storm for Combination 2.

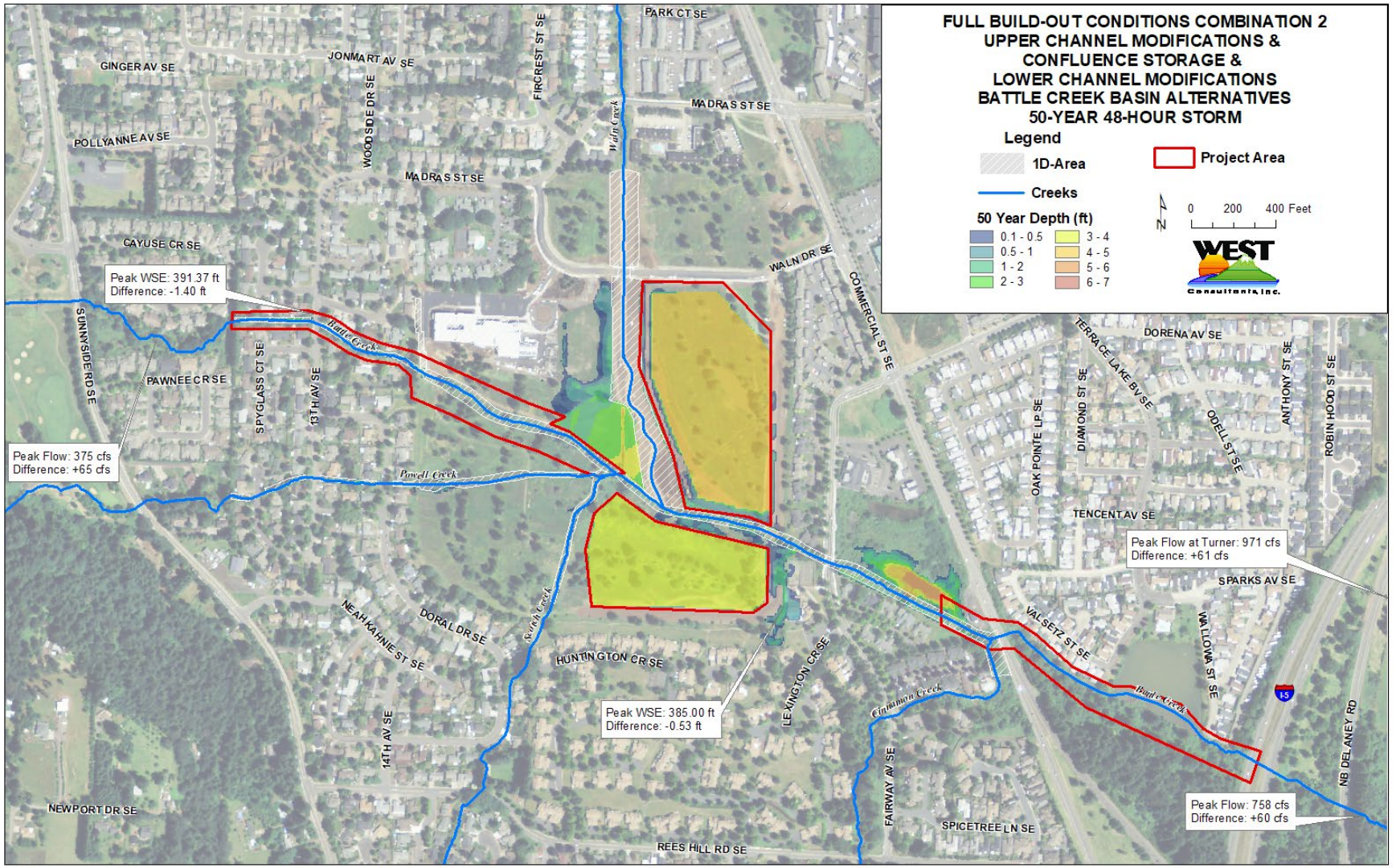



Figure G.11–2-D model results for full build-out conditions 50-yr, 48-hour storm for Combination 2.

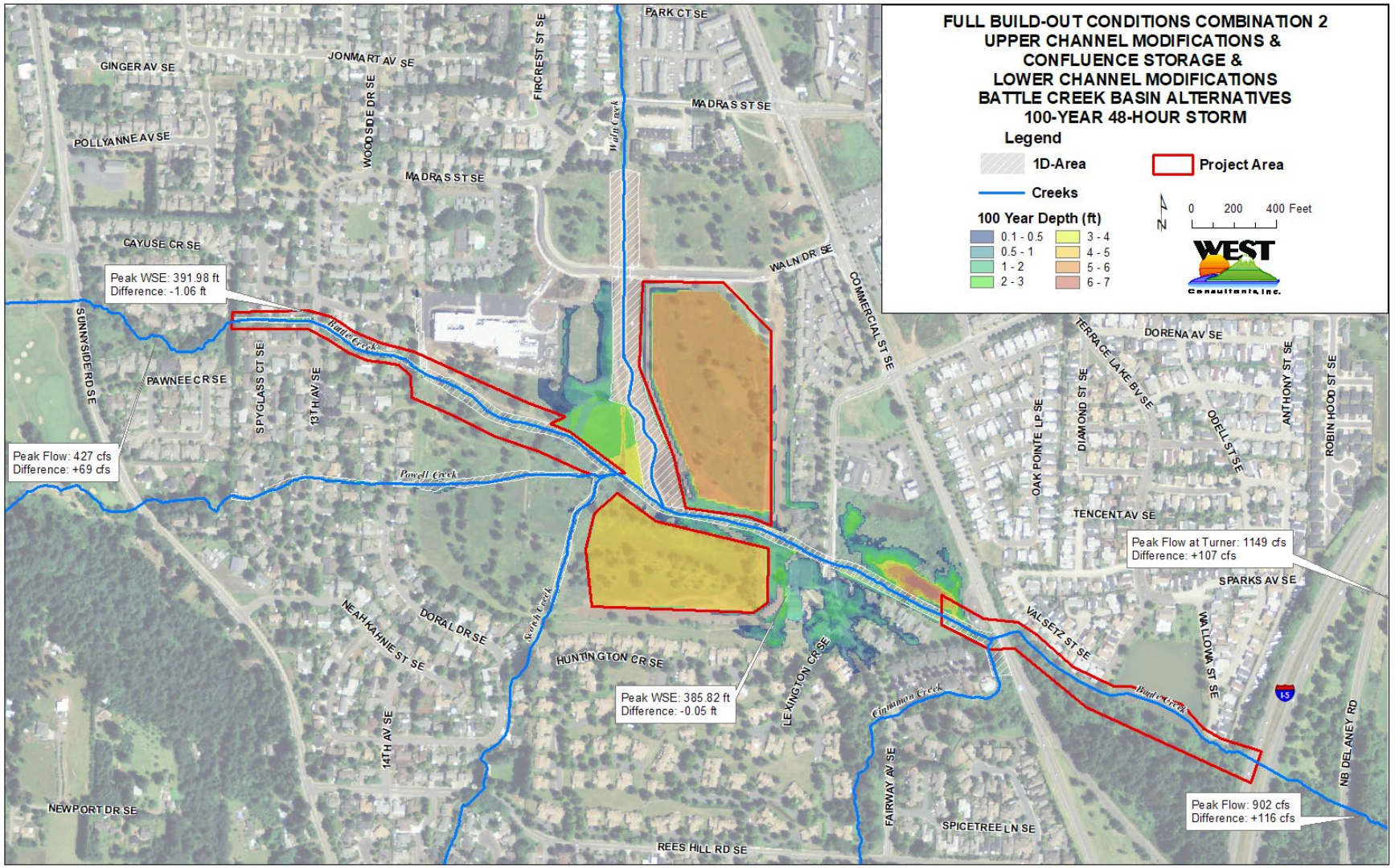



Figure G.12–2-D model results for full build-out conditions 100-yr, 48-hour storm for Combination 2.

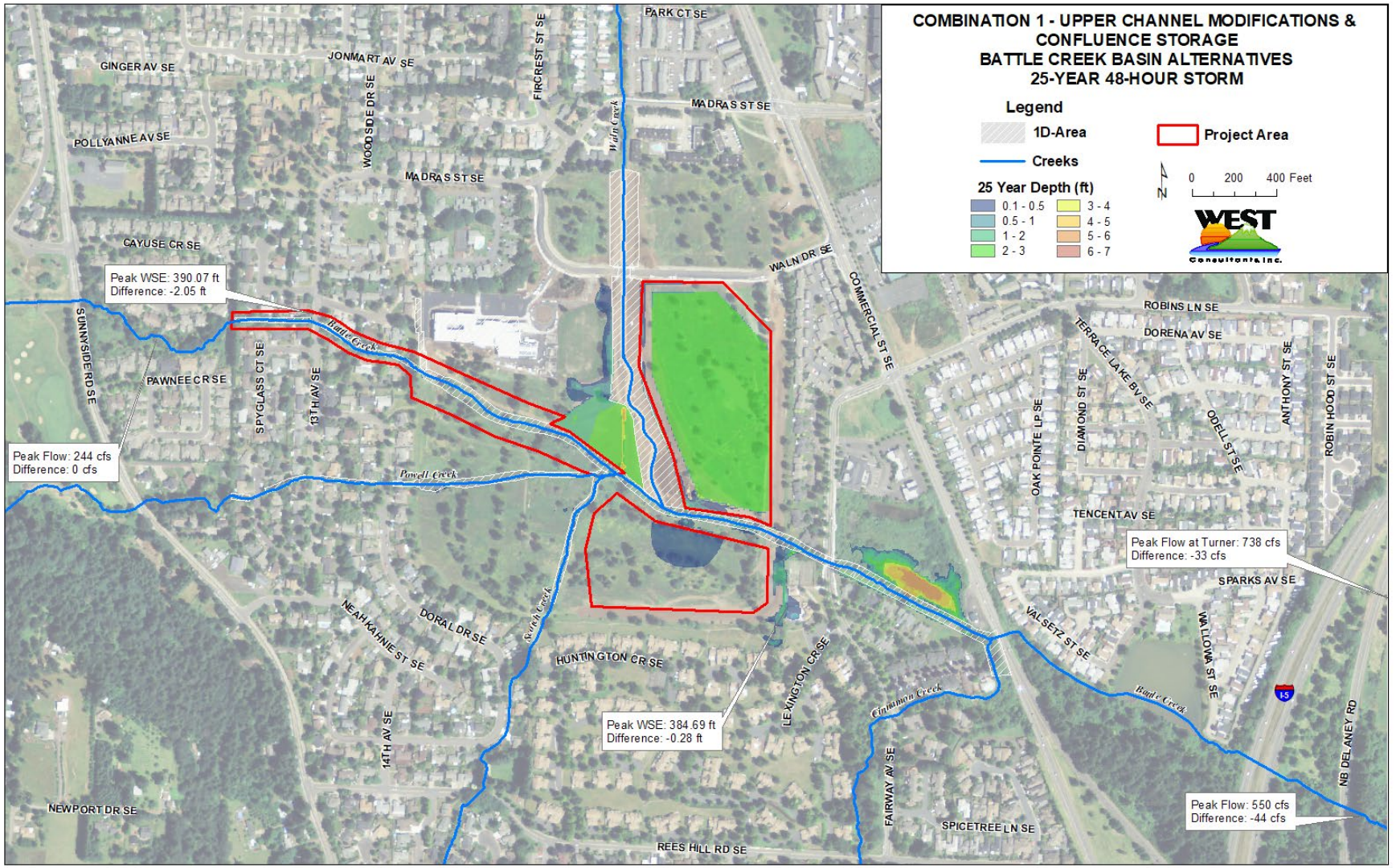



Figure G.13–1-D model results for existing conditions 100-yr, 48-hour storm for Waln Creek.

# APPENDIX H
# CIP COST ESTIMATES

## *Project BA-BC1 - Add Box Culvert at School Driveway Entrance*

**Description:** Project includes the installation of an 8'x3.5' box culvert under Battle Creek Elementary entrance opening a flow path to drain the closed depression.

**Results:** Modeling indicates the installation of this box culvert significantly decreases flooding in the condominiums north of the school for the 25, 50, and 100-yr events. Water stored in the closed depression will flow under the school entrance road and into Waln Creek.

**2015 Project Cost Estimate: $220,000**
**Yearly Maintenance Cost: N/A**

Looking east between school and apartments.

Looking west between school and apartments.

Looking north between school and apartments.

Proposed culvert location at access road.

**Battle Creek Property Improvements - Salem, OR**
Conceptual Cost Estimate
Estimator: Otak, Inc.
Date of Estimate: Jan 2016

| | | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|---|
| | **Alternative BA-BC1 - Add Box Culvert at School Entrance** | | | | |
| 1A | Mobilization (10%) | 1 | LS | $11,100 | $11,100 |
| 2A | Erosion Control Measures (5%) | 1 | LS | $5,300 | $5,300 |
| 3A | Earthwork | | | | |
| | a. General Excavation and Offsite Haul | 200 | CY | $20 | $4,000 |
| 4A | HMA | 20 | TON | $100 | $2,000 |
| 5A | Import Backfill | 100 | CY | $35 | $3,500 |
| 6A | Concrete Box Culvert (8'x3.5'x80') | 1 | LS | $90,000 | $90,000 |
| 7A | Concrete Curb | 50 | LF | $40 | $2,000 |
| 8A | Concrete Sidewalk | 30 | SY | $70 | $2,100 |
| 9A | Landscaping | 1 | LS | $2,000 | $2,000 |
| | | | | | |
| | | | | **Subtotal** | **$122,000** |
| | | | | Construction Contingency (30%) | $36,600 |
| | | | | **Construction Total** | **$158,600** |
| | | | | Admin., Design, and Permitting (25%) | $39,650 |
| | | | | Construction Survey and Management (13%) | $20,618 |
| | | | **RoundedTotal** | | **$220,000** |

Notes:
1. Costs are in 2016 dollars
2. Assumes construction work occurs during summer months

| | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|
| **EASE OF ACCESS FOR MAINTENANCE** | | | | |
| Easy Access | NA | AC | $750 | NA |
| Regular Access | NA | AC | $1,000 | NA |
| Difficult Access | NA | AC | $2,000 | NA |
| | | **RoundedTotal** | | **NA** |

## *Project BA-BC2 - Add Storage at Confluence*

**Description:** Project creates two large storage areas downstream of the Waln Creek-Battle Creek confluence by lowering the overbank area north and south of Battle Creek and installing two floodgates to retain water before reentering Battle Creek. A combined 19.5 acres of floodplain grading is split into a 12 acre parcel north of Battle Creek and a 7.5 acre parcel south of Battle Creek (see location below).

**Results:** This project has no appreciable effect on upstream flooding. However it does attenuate the peak flows significantly decreasing the flow rate downstream at culverts under I-5 and Delaney Rd and the flood stage at Fairway Ave.

**2015 Project Cost Estimate: $3,140,000**
**Yearly Maintenance Cost: $15,900**

View of floodplain area east of Waln Creek looking southeast.

Aerial view of approximate project limits.

View of floodplain area east of Waln Creek.

**Battle Creek Property Improvements - Salem, OR**
Conceptual Cost Estimate
Estimator: Otak, Inc.
Date of Estimate: Jan 2016

| | | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|---|
| | **Alternative BA-BC2 - Add Storage at Confluence** | | | | |
| 1A | Mobilization (10%) | 1 | LS | $158,844 | $158,844 |
| 2A | Erosion Control Measures (3%) | 1 | LS | $50,892 | $50,892 |
| 3A | Clearing and Grubbing (Stockpile Strippings) | 1 | LS | $40,000 | $40,000 |
| 4A | Tree Removal | 104 | EA | $500 | $52,000 |
| 5A | Work Area Isolation/Stream Channel Dewatering | 1 | LS | $15,000 | $15,000 |
| 6A | Earthwork | | | | |
| | a. General Excavation and Offsite Haul | 100,400 | CY | $8 | $803,200 |
| | b. General Excavation and Onsite Haul | 50,200 | CY | $4 | $200,800 |
| | c. Embankment Compaction | 50,500 | CY | $2 | $101,000 |
| 7A | Streambed Gravel | 60 | CY | $50 | $3,000 |
| 8A | Tide Gate | 2 | EA | $14,000 | $28,000 |
| 9A | Landscape and Irrigation | 20.3 | AC | $14,500 | $294,549 |
| | | | | | |
| | | | | **Subtotal** | **$1,747,285** |
| | | | | Construction Contingency (30%) | $524,186 |
| | | | | **Construction Total** | **$2,271,471** |
| | | | | Admin., Design, and Permitting (25%) | $567,868 |
| | | | | Construction Survey and Management (13%) | $295,291 |
| | | | | **RoundedTotal** | **$3,140,000** |

Notes:
1. Top soil material to be stripped and stockpiled onsite as noted above.
2. Assumes construction work occurs during summer months
3. Costs are in 2016 dollars
4. Assumes that ~1/3 of excavated material remains onsite, with remaining material hauled offsite

| | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|
| **EASE OF ACCESS FOR MAINTENANCE** | | | | |
| Easy Access | 21 | AC | $750 | $15,750 |
| Regular Access | 0 | AC | $1,000 | $0 |
| Difficult Access | 0.07 | AC | $2,000 | $148 |
| | | | **RoundedTotal** | **$15,900** |

## *Project BA-BC3 - Add Channel Benches South of School*

**Description:** The project includes approximately 1,000 linear feet of Battle Creek channel grading to increase the channel size and create overflow benches similar to Waln Creek just upstream of the Battle Creek confluence. The project extends along Battle Creek from the western extent of City of Salem property to the confluence with Scotch Creek and Powell Creek.

**Results:** Modeling indicates stream channel benches significantly reduces flooding in the apartments north of the school for the 25, 50, and 100-yr events due to a decrease in back-water effect south of the school. This project will not eliminate overtopping 13th avenue, but will more effectively drain the 13th Ave overflow. Combining this project with adding floodplain storage to the Battle Creek overbanks (Project BA-BC-2) would increase overall effectiveness.

**2015 Project Cost Estimate: $330,000**
**Yearly Maintenance Cost: $2,200**

Upstream end of project facing downstream.

Upstream end of project facing upstream.

View of channel facing downstream.

Aerial view of approximate project length.

**Battle Creek Property Improvements - Salem, OR**
Conceptual Cost Estimate
Estimator: Otak, Inc.
Date of Estimate: Jan 2016

| | | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|---|
| | **Alternative BA-BC3 Chan - Add Channel Benches South of School** | | | | |
| 1A | Mobilization (10%) | 1 | LS | $16,411 | $16,411 |
| 2A | Erosion Control Measures (5%) | 1 | LS | $8,596 | $8,596 |
| 3A | Clearing and Grubbing (Stockpile Strippings) | 1 | LS | $20,000 | $20,000 |
| 4A | Tree Removal | 18 | EA | $250 | $4,500 |
| 5A | Work Area Isolation/Stream Channel Dewatering | 1 | LS | $25,000 | $25,000 |
| 6A | Earthwork | | | | |
| | a. General Excavation and Offsite Haul | 5,000 | CY | $12 | $60,000 |
| 7A | Stream Plantings | 10,200 | EA | $3 | $30,600 |
| 8A | Landscape and Irrigation | 1.1 | AC | $14,500 | $15,418 |
| | | | | | |
| | | | | **Subtotal** | **$180,526** |
| | | | | Construction Contingency (30%) | $54,158 |
| | | | | **Construction Total** | **$234,684** |
| | | | | Admin., Design, and Permitting (25%) | $58,671 |
| | | | | Construction Survey and Management (13%) | $30,509 |
| | | | **RoundedTotal** | | **$330,000** |

Notes:
1. Top soil material to be stripped and stockpiled onsite as noted above.
2. Assumes construction work occurs during summer months
3. Costs are in 2016 dollars

| | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|
| **EASE OF ACCESS FOR MAINTENANCE** | | | | |
| Easy Access | 2 | AC | $750 | $1,500 |
| Regular Access | 0 | AC | $1,000 | $0 |
| Difficult Access | 0.31 | AC | $2,000 | $624 |
| | | **RoundedTotal** | | **$2,200** |

## *Project BA-BC4 - Add Channel Benches to Battle Creek between Sunnyside Rd and School Property*

**Description:** The project includes approximately 1,800 linear feet of Battle Creek channel grading to increase the channel size and create overflow benches similar to Waln Creek just upstream of the Battle Creek confluence. The project extends along Battle Creek from Sunnyside Road to the western extent of City of Salem property (see below). Properties and easements will need to be acquired by the City to provide room for channel grading and maintenance.

**Results:** Clearing this channel eliminates overtopping at 13th Ave. Although not specifically modeled, incorporating channel benching would further reduce flood risk by creating additional in-channel storage and greater conveyance. It is also expected to help reduce the potential for continued channel degradation and bank failures that have occurred along this reach due to hydromodifications.

**2015 Project Cost Estimate: $1,000,000**
**Yearly Maintenance Cost: $2,900**

Aerial view of approximate project limits.

**Battle Creek Property Improvements - Salem, OR**
Conceptual Cost Estimate
Estimator: Otak, Inc.
Date of Estimate: Jan 2016

| | | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|---|
| | **Alternative BA-BC3 Chan - Add Channel Benches South of School** | | | | |
| 1A | Mobilization (10%) | 1 | LS | $16,411 | $16,411 |
| 2A | Erosion Control Measures (5%) | 1 | LS | $8,596 | $8,596 |
| 3A | Clearing and Grubbing (Stockpile Strippings) | 1 | LS | $20,000 | $20,000 |
| 4A | Tree Removal | 18 | EA | $250 | $4,500 |
| 5A | Work Area Isolation/Stream Channel Dewatering | 1 | LS | $25,000 | $25,000 |
| 6A | Earthwork | | | | |
| | a. General Excavation and Offsite Haul | 5,000 | CY | $12 | $60,000 |
| 7A | Stream Plantings | 10,200 | EA | $3 | $30,600 |
| 8A | Landscape and Irrigation | 1.1 | AC | $14,500 | $15,418 |
| | | | | | |
| | | | | **Subtotal** | **$180,526** |
| | | | | Construction Contingency (30%) | $54,158 |
| | | | | **Construction Total** | **$234,684** |
| | | | | Admin., Design, and Permitting (25%) | $58,671 |
| | | | | Construction Survey and Management (13%) | $30,509 |
| | | | | **RoundedTotal** | **$330,000** |

Notes:
1. Top soil material to be stripped and stockpiled onsite as noted above.
2. Assumes construction work occurs during summer months
3. Costs are in 2016 dollars

| | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|
| **EASE OF ACCESS FOR MAINTENANCE** | | | | |
| Easy Access | 2 | AC | $750 | $1,500 |
| Regular Access | 0 | AC | $1,000 | $0 |
| Difficult Access | 0.31 | AC | $2,000 | $624 |
| | | | **RoundedTotal** | **$2,200** |

## *Project BA-BC5 – Create Floodplain Benches along Battle Creek between Commercial and I-5*

**Description:** The project includes approximately 1,300 linear feet of Battle Creek channel grading to increase the channel size and create overflow benches similar to Waln Creek just upstream of the Battle Creek confluence. The project extends along Battle Creek from approximately 220 ft upstream of Commercial Street SE to Interstate 5 (see below). Easements will need to be acquired by the City to provide room for channel grading and maintenance.

**Results:** Creating the floodplain benches reduces flood risk for the areas in the vicinity of Fairway Drive SE. Reduction in flood elevations range from 0.8 ft to 0.5 ft for the 10- and 100-year flood events, respectively for existing conditions and from 0.7 ft to 0.3 ft for the 10- and 100-year flood events, respectively for full build-out conditions.

**2015 Project Cost Estimate: $290,000**
**Yearly Maintenance Cost: $1,600**

Aerial view of approximate project limits.

**Battle Creek Property Improvements - Salem, OR**
Conceptual Cost Estimate
Estimator: Otak, Inc.
Date of Estimate: Jan 2016

| | | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|---|
| | **Alternative BA-BC5 - Create Floodplain Benches on Battle Creek b/w Commercial St and I-5** | | | | |
| 1A | Mobilization (10%) | 1 | LS | $15,000 | $15,000 |
| 2A | Erosion Control Measures (5%) | 1 | LS | $7,000 | $7,000 |
| 3A | Clearing and Grubbing (Stockpile Strippings) | 1 | LS | $15,000 | $15,000 |
| 4A | Tree Removal | 40 | EA | $250 | $10,000 |
| 5A | Earthwork | | | | |
| | a. General Excavation and Offsite Haul | 9,000 | CY | $12 | $108,000 |
| 6A | Landscape and Irrigation | 0.1 | AC | $14,500 | $1,450 |
| | | | | | |
| | | | | **Subtotal** | **$156,450** |
| | | | | Construction Contingency (30%) | $46,935 |
| | | | | **Construction Total** | **$203,385** |
| | | | | Admin., Design, and Permitting (25%) | $50,846 |
| | | | | Construction Survey and Management (13%) | $26,440 |
| | | | | **RoundedTotal** | **$290,000** |

Notes:
1. Top soil material to be stripped and stockpiled onsite as noted above.
2. Assumes construction work occurs during summer months
3. Costs are in 2016 dollars

| | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|
| **EASE OF ACCESS FOR MAINTENANCE** | | | | |
| Easy Access | 1 | AC | $750 | $750 |
| Regular Access | 0 | AC | $1,000 | $0 |
| Difficult Access | 0.42 | AC | $2,000 | $836 |
| | | | **RoundedTotal** | **$1,600** |

## *Project BA-WC1 - Waln Creek Channel Clearing between Mildred Lane and School Property*

**Description:** This project consists of vegetation removal and minor channel grading to increase conveyance capacity within Waln Creek. A total of 3,300 feet of stream channel will be cleared and planted with native vegetation (see below for project extents). Easements will need to be acquired by the City to provide room for channel clearing and maintenance.

**Results:** Modeling indicates the clearing of this channel lowers the water surface elevation within the channel for the 100-yr event and eliminates flooding upstream of Woodside and decreased flooding near the Park Court SE trailer park by 0.7 feet.

**2016 Project Cost Estimate: $460,000**
**Yearly Maintenance Cost: $6,200**

View of northern extent of project.

View of southern extent of project.

**Battle Creek Property Improvements - Salem, OR**
Conceptual Cost Estimate
Estimator: Otak, Inc.
Date of Estimate: Jan 2016

| | | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|---|
| | **Alternative BA-WC1 - Waln Creek Channel Clearing Between Mildred Lane and School Property** | | | | |
| 1A | Mobilization (10%) | 1 | LS | $22,913 | $22,913 |
| 2A | Erosion Control Measures (5%) | 1 | LS | $12,002 | $12,002 |
| 3A | Clearing and Grubbing (Stockpile Strippings) | 1 | LS | $40,000 | $40,000 |
| 4A | Tree Removal | 20 | EA | $250 | $5,000 |
| 5A | Work Area Isolation/Stream Channel Dewatering | 1 | LS | $10,000 | $10,000 |
| 6A | Earthwork | | | | |
| | a. General Excavation and Offsite Haul | 4,700 | CY | $12 | $56,400 |
| | b. Stream Channel Excavation and Offsite Haul | 1,000 | CY | $15 | $15,000 |
| 7A | Streambed Gravel | 475 | CY | $50 | $23,750 |
| 8A | Stream Bank Treatments | | | | |
| | a. Type A Bank | 1,950 | LF | $15 | $29,250 |
| 9A | Stream Plantings | 8,800 | EA | $3 | $26,400 |
| 10A | Landscape and Irrigation | 0.8 | AC | $14,500 | $11,330 |
| | | | | | |
| | | | | **Subtotal** | **$252,046** |
| | | | | Construction Contingency (30%) | $75,614 |
| | | | | **Construction Total** | **$327,660** |
| | | | | Admin., Design, and Permitting (25%) | $81,915 |
| | | | | Construction Survey and Management (13%) | $42,596 |
| | | | | **RoundedTotal** | **$460,000** |

Notes:
1. Top soil material to be stripped and stockpiled onsite as noted above.
2. Assumes construction work occurs during summer months
3. Costs are in 2016 dollars
4. Grading occurs on 25% of the stream length

| | Quantity | Unit | Unit Cost | Total Item Cost |
|---|---|---|---|---|
| **EASE OF ACCESS FOR MAINTENANCE** | | | | |
| Easy Access | 0 | AC | $750 | $0 |
| Regular Access | 0 | AC | $1,000 | $0 |
| Difficult Access | 3.10 | AC | $2,000 | $6,198 |
| | | **RoundedTotal** | | **$6,200** |