

Lots 1-3, Block 1, Care Unit of Aurora Subdivision Filing No 2
Aurora, Colorado

AUMHC Safety Net Campus

Master Drainage Report

June 28, 2022

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<i>APPROVED FOR ONE YEAR FROM THIS DATE</i>	
<i>City Engineer</i>	<i>Date</i>
<i>Water Department</i>	<i>Date</i>

Certifications

I hereby certify that the Master Drainage Study for the AUMHC Safety Net Campus was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Aurora Standards for the Owners thereof.

Joe C. Coco, P.E.

Colorado No. 33392

For and on behalf of CKE Engineering Inc

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A. INTRODUCTION

1. Location

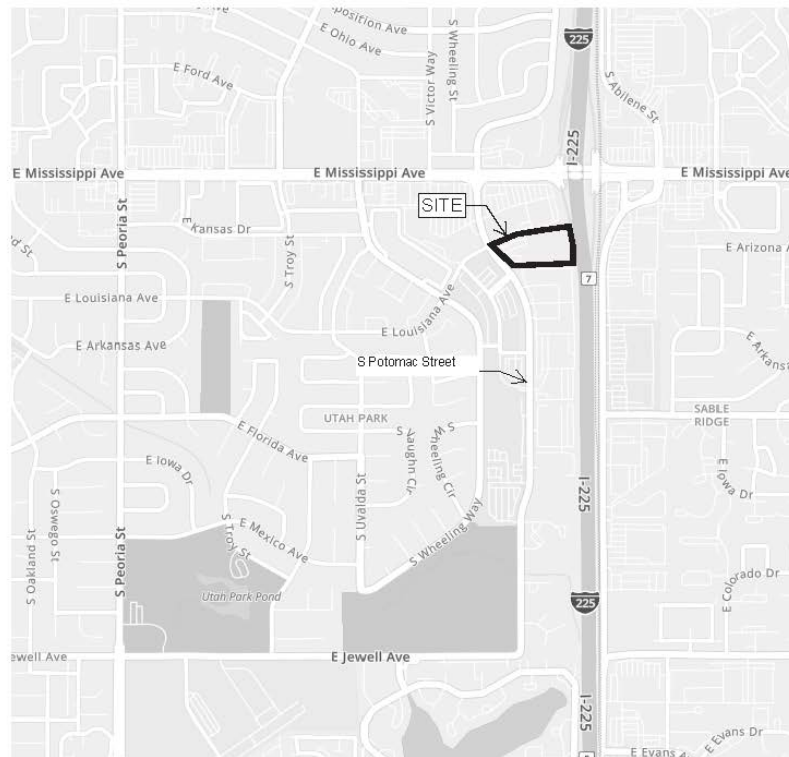
a. Property Information

The proposed AUMHC Safety Net Campus is located in the NE1/4 of Section 24, Township 4 South, Range 67 West of the Sixth Principal Meridian, City of Aurora, County of Arapahoe, State of Colorado.

The site is located at the southeast corner of Potomac Street and East Louisiana Avenue. More specifically the site address is 1290 S. Potomac Street.

b. Vicinity Map

Vicinity Map



c. Surrounding Developments

The site is bounded by the Potomac East shopping center to the north, Utah Park Business Center to the south, I-225 to the east and S. Potomac Street to the west.

2. Proposed Development

a. Land uses and associated densities and imperviousness

The current property is currently developed with the Aurora Mental Health Center. The proposed project is to demolish the existing facilities on-site and redevelop the property. The proposed development will result in a 3 building multi-use campus which includes a maximum 50,000 sf mental health facility, a maximum 30,000 sf clinic, and a 40-unit affordable housing facility with associated parking and drives. A courtyard or quad area with amenities to serve the project will be located between the proposed buildings in the center of the development. Multiple water quality/ stormwater detention facilities constructed throughout the site to serve the proposed development. Upon completion, the site will be approximately 70% impervious.

b. Requested Variances

A variance is being requested from the City of Aurora Storm Drainage Design and Technical Criteria Manual to allow underground detention. This facility will be located beneath the Aurora Mental Health parking lot and serve the easterly 2.6 acres of the site being the Aurora Mental Health Center buildings and the Clinic building, as wells as their associated parking lots. Please refer to the documents submitted to the City of Aurora Water Department and Public Works Department with regards to this variance request located in Appendix D of this report.

B. HISTORIC DRAINAGE

1. Property Description

The site is approximately 7.034 acres and is fully developed with the existing 1-story Aurora Mental Health Center Facility. The site is fully landscaped and has an overall impervious area of approximately 49%.

On site soils are classified as Bresser-Truckton Sand Loams, 3%-5% (BvC) and Truckton Loamy Sand, 0%-3% (TrC) as determined from the Soil Conservation Service, "Soil Survey for Arapahoe County, Colorado". These soils have low to moderate runoff potential consistent with the characteristics of Hydrologic Soil Group A and B soils. Approximately 64% of the site classifies as Hydrologic Soil Group A and 36% of the site classifies as Soul Group B.

The natural topography of the site generally slopes from southeast to northwest at slopes ranging from approximately 1% to 10%. The majority of the site drains to an existing stormwater detention facility located at the northeast corner of the site adjacent to S. Potomac Street. This facility discharges into the existing storm sewer system in S. Potomac Street.

Due to grades on-site, the north landscape perimeter and a portion of the east landscape perimeter of the site drain off-site undetained into the property to the north. The west landscape perimeter and site access drain west off-site undetained into S. Potomac Street.

The site is not located in any airport influence zones.

2. Overall Basin Description

a. Off-site Basins

Based on the existing topography, there are no off-site basins being conveyed through the property that impact this site.

b. Major Drainageways

The site is located in the Westerly Creek drainage basin. The site is located at the east edge at the top of the Westerly Creek basin. Interstate 1-225 acts as the division between the Westerly Creek and the Toll Gate Creek Basins at this location.

As such, the site is not located in the 100-year floodplain of Westerly Creek as designated by the FEMA FIRM Flood Insurance Rate Map 08005C0179L dated September 4, 2020. Refer to the FEMA FIRM Map located in Appendix A of this report.

c. Wetlands and Irrigation Ditches

There are no wetlands or irrigation ditches located on-site or adjacent to the subject property.

d. Major Drainageway studies and reports

Due to the proximity of the site within the Westerly Creek drainage basin, there are no major drainageway studies, plans or reports that impact this site.

e. Drainage Patterns Through Property

The existing site generally follows the drainage patterns described in item B.1 above.

f. Outfalls Downstream from Property

All runoff from the site is captured and conveyed by means of the existing storm sewer in S. Potomac Street. Stormwater is conveyed by storm sewer north and west in E. Louisiana Avenue into the Utah Park – Expo Park drainage system. Runoff ultimately discharges into Westerly Creek.

C. DRAINAGE DESIGN CRITERIA

1. References

a. Existing Drainage Reports for Surrounding Properties

1. Final Drainage Study for Careunit of Aurora, (COA #870019). This report is the final drainage study for current development of the subject property.
2. Final Drainage Report for Lot 2, Block 1, Potomac East Subdivision Filing No 4

Refer to Appendix D for copies of pertinent information from these reports.

b. USDCM

This drainage report was designed in compliance with the City of Aurora's Storm Drainage Design and Technical Criteria Manual (hereafter called CRITERIA) and the Mile High Flood District's Urban Storm Drainage Criteria Manual (hereafter called MANUAL).

c. City Master Plan and Flood Studies

n/a

2. Hydrologic Criteria

a. Rainfall Source and P1

Rainfall intensities were determined from equation 5.5 in the CRITERIA and using 1-hour rainfall value of 0.96 and 2.58 for the 2-year and 100-year storm events respectively. Rainfall depths were determined from the Rainfall Depth – Duration Frequency Maps, figures 5-1 and 5-6 from Volume 1 of the MANUAL.

b. Calculation Method

The design rainfall for runoff generated on-site was based on the Rational Method for the 2 and 100-year rainfall events under developed conditions as established in the CRITERIA and MANUAL. The runoff results are summarized in a table on the Drainage Plan and also in Appendix B.

c. Detention Volume Computation Method

The required EURV storage volume for the detention ponds were derived from the MANUAL. The 100-year storage volume for the detention ponds were derived from the empirical formula, $V=KA$. The necessary water quality volumes were calculated using the MANUAL. Release from the site will be based on the allowable release of 0.626 cfs/ acre in the 100-year storm event based on the site having 64% Hydrologic Type A soils and 36% Hydrologic Type B soils.

The outlet structure will be designed in accordance with the CRITERIA and MANUAL for the EURV and 100-year storm events.

A drainage easement will be provided for the water quality/ detention facilities.

d. Design Frequencies

Runoff calculations have been provided for the 2-year and 100-year storm events. Stormwater detention is being provided for the WQCV, EURV and 100-year storm events.

3. Hydraulic Criteria

a. References Other Than USDCM

n/a

b. Pipe and Inlet Design Storm Frequencies

Storm sewer and inlets will be sized to capture and convey the 100-year storm event under full flowing conditions per the Manning's Formula.

c. Water Surface Profile Method

Water Surface profiles will be determined based on UDSewer Modeling software or the Manning's Formula.

d. Major drainageways

n/a

D. DRAINAGE PLAN

1. General Concept

a. Drainage Concept

The proposed site's grading and drainage plan has been designed as follows. The west half of the site (denoted as the A basins) drain west to the proposed Water Quality/ Stormwater Detention Facility A located at the west end of the site adjacent to Potomac Street. The courtyard between the Aurora Mental Health building and the Clinic building (denoted as the B basins) drain to the proposed Water Quality/ Stormwater Detention Facility B in the courtyard area. The east portion of the site (denoted as the C basins) drain east to its respective water quality facility and underground Stormwater Detention Facility C located at the east portion of the site. The north, west, and a portion of the east perimeter of the site will continue to drain off-site as noted in the Careunit of Aurora Final Drainage Study.

b. Conveyance of Off-site Drainage Basins to the property

There are no off-site basins draining on or through the site that impact the drainage design of this property.

c. Coordination with Surrounding Developments

n/a

d. Coordination and Compliance with other Existing Master Drainage Reports

n/a

e. Conveyance elements to Pass Major Flows to the Major Drainageway

The overall release from the site shall exit the site at or below the current and historic rates as defined in the Final Drainage Study for Careunit of Aurora. As such, the downstream infrastructure will not see an increase in runoff exiting this property.

2. Specific Details

a. Basin Descriptions

There are 16 on-site basins as part of this project described below.

Basin A1 is approximately 0.27 acres in size and encompasses the proposed parking lot and landscape area south of the proposed Clinic. Basin A1 is captured via Storm Inlet B-2.3 (5' Type R) at Design Point 7 and conveyed west to the south portion of Detention Pond A,

Basin A6, at Design Point 4. Runoff is then conveyed northwest beneath the access drive for the project to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A1 will be treated and detained in Detention Pond A. Basin A1 has a time of concentration (T_c) of 5.0 minutes, an imperviousness of 75%, and a 2-year and 100-year developed flow of 0.59 cfs and 1.71 cfs respectively. In the event of failure of Storm Inlet B-2.3, Basin A1 will overflow into Basin A2 to the west.

Basin A2 is approximately 0.54 acres in size and encompasses the proposed parking lot and landscape area southwest of the proposed Clinic as well as the east portion of the Quad serving the proposed buildings. Basin A2 is captured via Storm Inlet B-2.2 (5' Type R) at Design Point 6 and conveyed west to the south portion of Detention Pond A, Basin A6, at Design Point 4. Runoff is then conveyed northwest beneath the access drive for the project to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A2 will be treated and detained Detention Pond A. Basin A2 has a time of concentration (T_c) of 5.0 minutes, an imperviousness of 65%, and a 2-year and 100-year developed flow of 1.01 cfs and 3.13 cfs respectively. In the event of failure of Storm Inlet B-2.2, Basin A2 will overflow into Basin A3 to the west.

Basin A3 is approximately 0.20 acres in size and encompasses the proposed parking lot and drive at the southwest portion of the site adjacent to the south portion of Detention Pond A. Basin A3 is captured via Storm Inlet B-2 (5' Type R) at Design Point 5 and conveyed west to the south portion of Detention Pond A, Basin A6, at Design Point 4. Runoff is then conveyed northwest beneath the access drive for the project to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A3 will be treated and detained in Detention Pond A. Basin A3 has a time of concentration (T_c) of 5.0 minutes, an imperviousness of 79%, and a 2-year and 100-year developed flow of 0.47 cfs and 1.36 cfs respectively. In the event of failure of Storm Inlet B-2.0, Basin A3 will overflow into Basin A7 to the west.

Basin A4 is approximately 0.44 acres in size and encompasses the roof and amenity area for the affordable housing facility at the northwest portion of the site. Basin A4 is captured via Storm Inlet B-4 (Type C) at Design Point 9 and conveyed south and west to the south portion of Detention Pond A, Basin A6, at Design Point 4. Runoff is then conveyed northwest beneath the access drive for the project to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A4 will be treated and detained in Detention Pond A. Basin A4 has a time of concentration (T_c) of 5.0 minutes, an imperviousness of 58%, and a 2-year and 100-year developed flow of 0.78 cfs and 2.51 cfs respectively. In the event of failure of Storm Inlet B-4, Basin A4 will overflow into Basin A8 to the west.

Basin A5 is approximately 0.20 acres in size and encompasses the southwest portion of the Quad area serving the proposed buildings. Basin A5 is captured via Storm Inlet B-3 (Type C) at Design Point 8 and conveyed west to the south portion of Detention Pond A, Basin A6, at Design Point 4. Runoff is then conveyed northwest beneath the access drive for the project to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A5 will be treated and detained in Detention Pond A. Basin A5 has a time of concentration (T_c) of 5.0 minutes, an imperviousness of 5%, and a 2-year and 100-year developed flow of 0.11 cfs and 0.38 cfs respectively. In the event of failure of Storm Inlet B-3, Basin A5 will overflow into Basin A3 to the south.

Basin A6 is approximately 0.25 acres in size and is the southern portion of Detention Pond A at Design Point 4. Runoff is then conveyed northwest beneath the access drive for the project to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A6 will be treated and detained in Detention Pond A. Basin A6 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 36%, and a 2-year and 100-year developed flow of 0.29 cfs and 1.03 cfs respectively. In the event of failure of Detention Pond A, Basin A6 will overflow into S. Potomac Street to the west.

Basin A7 is approximately 0.12 acres in size and encompasses the access drive and a small portion of the Quad area, the southern portion of Detention Pond A at Design Point 4. Basin A7 is captured via on-grade Storm Inlet A-2 (10' Type R) at Design Point 3 and conveyed north to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A7 will be treated and detained in Detention Pond A. Basin A7 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 77%, and a 2-year and 100-year developed flow of 0.27 cfs and 0.80 cfs respectively. In the event of failure of Storm Inlet A-2, Basin A7 will overflow into S. Potomac Street to the west.

Basin A8 is approximately 1.24 acres in size and encompasses the parking lots and drives along the north portion of the site, the parking lot between the Aurora Mental Health and affordable housing facilities and the area north and west around the affordable housing facility. Basin A8 is captured via Storm Inlet C-2 (15' Type R) at Design Point 10 and conveyed west to the north portion of Detention Pond A, Basin A9, at Design Point 2. Runoff from Basin A8 will be treated and detained in Detention Pond A. Basin A8 has a time of concentration (Tc) of 7.4 minutes, an imperviousness of 88%, and a 2-year and 100-year developed flow of 2.83 cfs and 8.17 cfs respectively. In the event of failure of Storm Inlet C-2, Basin A8 will overflow into Basin A7 to the south.

Basin A9 is approximately 0.30 acres in size and is the northern portion of Detention Pond A at Design Point 2. Runoff from Basin A9 will be treated and detained in Detention Pond A. Basin A9 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 47%, and a 2-year and 100-year developed flow of 0.45 cfs and 1.42 cfs respectively. In the event of failure Detention Pond A, Basin A9 will overflow into S. Potomac Street to the west.

Basin B1 is approximately 0.38 acres in size and is the courtyard between the Aurora Mental Health and the Clinic buildings. Basin B1 flows directly into Detention Pond B at Design Point 11 where runoff will be treated and detained. Basin B1 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 67%, and a 2-year and 100-year developed flow of 0.76 cfs and 2.24 cfs respectively. In the event of failure of Detention Pond B, Basin B1 will overflow into Basin A5 to the west.

Basin C1 is approximately 0.55 acres in size and encompasses the Aurora Mental Health Center roof. Basin C1 is piped to Water Quality Facility C1 at Design Point 13 to be treated. Runoff will then discharge into the underground detention facility, Detention Pond C at Design Point 12, where flows will be detained. Basin C1 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 90%, and a 2-year and 100-year developed flow of 1.44 cfs and 4.35 cfs respectively. In the event of failure of Basin C1, Basin C1 will overflow into Basin C3 to the north.

Basin C2 is approximately 1.42 acres in size and is located in the southeastern portion of the site. Basin C2 encompasses the Clinic building roof, the parking lot east of the Clinic, Water Quality Facility C1, and the southern portion of the Aurora Mental Health Center parking lot. Basin C2 is conveyed to Water Quality Facility C1 at Design Point 13 to be treated. Runoff will then discharge into the underground detention facility, Detention Pond C at Design Point 12, where flows will be detained. Basin C2 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 82%, and a 2-year and 100-year developed flow of 3.44 cfs and 10.09 cfs respectively. In the event of failure of Water Quality Facility C1, Basin C2 will overflow into Basin C3 to the west.

Basin C3 is approximately 0.62 acres in size and encompasses the parking lot east of the Aurora Mental Health Center facility located in the northeast portion of the site. Basin C3 drains to Water Quality Facility C2 at Design Point 14 to be treated. Runoff will then discharge into the underground detention facility, Detention Pond C at Design Point 12, where flows will be detained. Basin C3 has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 85%, and a 2-year and 100-year developed flow of 1.52 cfs and 4.41 cfs respectively. In the event of failure of Water Quality Facility C3, Basin C3 will overflow into Basin C2 to the east. In the event of failure of both water quality facilities C1 and C2 and Detention Pond C, runoff will overflow into Basin A8.

Basin D is approximately 0.13 acres in size and encompasses the Potomac Street frontage and the west portion of the access drive into the property. Basin D drains directly into the south flowline of Potomac Street and is conveyed north to an existing 5' Type R inlet at the southeast corner of the S. Potomac Street and E. Louisiana Avenue intersection located adjacent to the northwest corner of the site. (Design Point 15). Runoff from Basin D has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 52%, and a 2-year and 100-year developed flow of 0.23 cfs and 0.67 cfs respectively. Basin D is similar to existing Basin 6 from the Final Drainage Study for Careunit. Basin 6 is 0.10 acres in size and has a 2-year and 100-year developed flow of 0.3 cfs and 1.0 cfs respectively.

Basin E is approximately 0.20 acres in size and is the northern landscape perimeter of the site. Basin E drains directly into the south access drive of the shopping center to the north of this property. Runoff from Basin E has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 2%, and a 2-year and 100-year developed flow of 0.10 cfs and 0.35 cfs respectively.

Basin F is approximately 0.17 acres in size and is a portion of the east landscape perimeter of the site. Basin F drains east to the east property line and is conveyed north to the Pond, shopping center to the north of this property. Runoff from Basin F has a time of concentration (Tc) of 5.0 minutes, an imperviousness of 15%, and a 2-year and 100-year developed flow of 0.14 cfs and 0.46 cfs respectively.

Basins E and F are similar to existing Basin 1 as defined in the Final Drainage Study for Careunit. Basins E and F have a similar size and drainage patterns as Basin 1. Basin 1 is 0.36 acres in size and has a 2-year and 100-year developed flow of 0.0 cfs and 0.5 cfs respectively.

Please refer to the Drainage Map located at the back of this report.

Runoff exiting the site shall not exceed existing and historic conditions. Per the Final Drainage Study for Careunit, the existing site discharges at the historic rate of 5.6 cfs in the 100-year storm event. The total release from the proposed site is 5.58 cfs in the 100-year storm event (4.1 cfs release from Detention Ponds A, B and C, and 1.48 cfs from Basins D, E and F). Please refer to the Outlet Structure Release Rate Calculations in Appendix B of this report.

b. TOD and Urban Center Developments

n/a

c. Detention Ponding Plan

Three detention ponds will be utilized to serve the proposed development.

Detention Pond A is an extended detention basin facility located near the westerly property boundary adjacent to S. Potomac Street at Design Points 2 and 4. Detention Pond A captures Basins A1-A9 which results in 3.56 acres at 67% impervious.

As with phased developments, specifics such as building outlines and concrete patios are assumed, but the details unknown at this time. As such, Detention Pond A has been sized for an impervious percentage 75% to allow some leeway in proposed building outlines and adjacent improvements, such as patios and walkways.

Water quality will be incorporated into the proposed detention pond design. The proposed pond has been sized to capture a water quality volume of 0.11 acre-feet resulting in a stage of 5579.75.

In the EURV and 100-year storm events, the proposed facility is designed to capture 0.45 acre-feet resulting in a stage of 5581.96 and 0.75 acre-feet resulting in a stage of 5583.28 respectively. The outlet structure for this extended detention basin is a modified Type C inlet. The water quality/ detention pond outlet structure will control the release of stormwater to 2.23 cfs in the 100-year storm event.

A micro-pool will be provided in the outlet structure.

The outfall for Detention Pond A will connect to the existing 18" RCP storm sewer which captures release from the existing stormwater detention facility on-site near the northwest corner of the site at Design Point 1.

Detention Pond B is located in the Courtyard between the Aurora Mental Health and the Clinic buildings at Design Point 11. Pond B is a rain garden with additional volume to capture the EURV and 100-year Storm Events. Detention Pond B captures Basin B1 which is the tributary courtyard area. Basin B1 is 0.38 acres in size and 67% impervious. Specifics such as building outlines and concrete patios are assumed, but the details unknown at this time. As such, Detention Pond B has been sized for an impervious percentage 90% to allow some leeway in proposed building outlines and adjacent improvements in the courtyard area.

Water quality will be incorporated into the proposed detention pond design as a rain garden. This facility has been sized to capture a water quality volume of 0.01 acre-feet resulting in a stage of 5590.70.

In the EURV and 100-year storm events, the proposed facility is designed to capture 0.06 acre-feet resulting in a stage of 5591.32 and 0.09 acre-feet resulting in a stage of 5591.74 respectively. The outlet structure for this extended detention basin is a modified Type C inlet. The water quality/ detention pond outlet structure will control the release of stormwater to 0.24 cfs in the 100-year storm event.

A micro-pool will be provided in the outlet structure.

The outfall for Detention Pond B will consist of a storm sewer which will connect to the outfall from Detention Pond C. These flows will be conveyed to the existing 18" RCP storm sewer at Design Point 1 near the northwest corner of the site.

Detention Pond C is an underground detention facility located in the parking lot east of the Aurora Mental Health building in the northeast portion of the property at Design Point 12. Detention Pond C captures Basins C1-C3 which results in 2.60 acres at 84% impervious. As with phased developments, specifics such as building outlines and concrete patios are assumed, but the details unknown at this time. Detention Pond C captures both the Aurora Mental Health building roof and the Clinic roof. As such, Detention Pond C has been sized to include 5,000 sf of additional roof resulting in 2.73 ac at an impervious percentage 90%. This will allow some leeway in proposed building footprints and adjacent improvements, such as patios and walkways.

Water quality will be provided above ground in one of two facilities.

Water Quality Facility C1 is located between the Aurora Mental Health parking lot and the Clinic parking lot at Design Point 13. This facility will capture Basins C1 and C2 which results in 1.98 acres at 84% impervious, and sized for 2.09 acres at 90% impervious to include the 5,000 sf of additional roof as noted above. The proposed facility has been sized to capture 0.08 acre-feet resulting in a stage of 5590.40.

Water Quality Facility C2 is a rain garden located in an island in the Aurora Mental Health parking lot at Design Point 14. This facility will capture Basin C3 which results in 0.62 acres at 85% impervious, and is sized at 90% impervious. The proposed facility has been sized to capture 0.017 acre-feet resulting in a stage of 5590.30.

Detention Pond C is designed to capture 0.33 acre-feet resulting in a stage of 5581.59 in the EURV event and 0.59 acre-feet resulting in a stage of 5583.74 in the 100-year storm event. The outlet structure for this facility will be located in a vault controlling the release of stormwater to 1.63 cfs in the 100-year storm event.

The outfall for Detention Pond C will consist of a storm sewer which will connect to the outfall for Detention Pond B and convey these flows to the existing 18" RCP storm sewer which captures release from the existing on-site stormwater detention facility at Design Point 1 near the northwest corner of the site.

d. Emergency Overflow Paths for Inlets and Detention Pond

Emergency overflow paths for Inlets is provided in the "Basin Description" section of this report above.

All detention ponds shall have an emergency overflow weir capable of passing a minimum of the 100-year developed inflow into the facility.

At Detention Pond A, the weir invert will be set 1.0' above the 100-year calculated water surface elevation ($1.2 \times \text{WQCV} + 100\text{-yr volume}$). The weir shall provide a 1.0' of freeboard above the water surface of the 100-year developed runoff entering the facility passing over the weir. Runoff will be conveyed west from the emergency overflow weir to S. Potomac Street.

At Detention Pond B, the weir invert will be set at the 100-year water surface. This will minimize the depth of the proposed facility in the courtyard, where there is ample pedestrian traffic. The weir will not have 1.0' of freeboard, however, there will be 1.0' of freeboard from the water surface of the 100-year developed runoff entering the facility passing over the weir, to the finished floor of the adjacent buildings in the courtyard. This will ensure that the adjacent buildings will experience flooding in the event that Detention Pond B fails. Runoff passing the emergency overflow weir from Pond B will be conveyed west into Basin A5 and captured at Design Point 8 and conveyed west into the south portion of Detention Pond A.

At Detention Pond C, the emergency overflow weir will be located in the outlet structure vault set at the 100-year water surface. As this is an underground detention facility, there will not be any increase in volume by setting this weir 1.0' above the 100-year water surface. 1.0' of freeboard will be provided above the water surface of the 100-year developed runoff entering the facility passing over the weir to the top of the outlet structure vault. The outfall line for Detention Pond C will be sized for the 100-year emergency overflow from this facility to the site outfall at Design Point 1. Additionally, an overflow weir between Basin C3 and Basin A8 will be provided capable of passing the 100-year developed inflow into Detention Pond C without flooding the proposed buildings on-site. If this secondary emergency overflow weir is activated, runoff will overflow into Basin A8 and conveyed to Inlet C-2 (Design Point 10) and conveyed to the north portion of Detention Pond A (Design Point 2) via Storm Line C. In the event runoff exceeds the capacity of Inlet C-2, runoff will continue west in the site access drive to S. Potomac Street.

e. Detention Pond Maintenance and Access

Maintenance of the proposed water quality and detention facilities is the responsibility of the property owner. However, access and drainage easements will be provided to the City of Aurora for access and maintenance of the facility in the event of an emergency or neglect of the facility.

Access to all of the water quality and detention pond can be achieved from the access drive into the site from S. Potomac Street and this ring road that extends around the project. An 8' wide access drive of all-weather surface with a 2' recovery zone on each side shall be constructed from the access drive lot to the bottom of Detention Pond A.

Detention Pond B is only 2' in depth and will have the ability to access the facility by foot. A truck can access the courtyard and park adjacent to this facility.

Detention Pond C and its water quality facilities can be access from the adjacent ring road around the project and the underground detention facility accessed by means of manholes in the facility.

f. Stormwater Quality Control Plan

Permanent BMP's

Water Quality is being provided as noted in section c above. Refer to the Drainage Map for location and facility information.

g. Swales

n/a

h. Inlets and Storm Sewer

All storm sewer and inlets have been sized to capture and convey the 100-year storm event without flooding. Flowmaster results have been added to Appendix C to show the preliminary pipe sizing has adequate capacity. Detailed Inlet sizing and storm sewer calculations will be prepared in the Final Drainage Reports for each phase of construction.

Storm Sewer Line A conveys runoff from the south portion of Detention Pond A (Design Point 4) beneath the access drive to the north portion of Detention Pond A (Design Point 2). Storm Line A conveys runoff from Basins A1 – A7. Storm Line A is 30" RCP and conveys 10.02 cfs in the 100-year storm event.

Storm Sewer Line B conveys runoff from Basins A1 - A5 to the south portion of Detention Pond A (Design Point 4). Storm Line B is 18" RCP and conveys 8.44 cfs in the 100-year storm event.

Storm Sewer Line C conveys runoff from Basin A8 to the north portion of Detention Pond A (Design Point 2). Storm Line C is 24" RCP and conveys 8.17 cfs in the 100-year storm event. In the event Detention Pond C fails and its emergency overflow weir in the outlet structure fails, the secondary emergency overflow weir between Basins C3 and A8 is activated. Storm Line C has also been sized to convey the emergency overflow from Design Point 12, Detention Pond C (Q100=18.78 cfs) in this worst-case scenario.

Storm Sewer Line D conveys runoff from outfall of Detention Ponds A, B and C to the existing site outfall at Design Point 1. Additionally, Storm Sewer Line D has been sized to convey the emergency overflow from Detention Pond C being 18.78 cfs in the 100-year storm event. Storm Line D is 30" RCP and conveys 4.10 cfs from the 100-year detention pond release from Detention Ponds A, B and C or 18.78 cfs in the emergency overflow condition for Detention Pond C.

E. CONCLUSIONS

1. Compliance with Standards

The proposed drainage plan meets the requirements of the CRITERIA, and MANUAL. Pollutants will be handled by means of the water quality facilities serving Detention Ponds A, B, C, and other non-structural BMP's as defined in this report and the MANUAL.

2. Summary of Concept

The proposed site is designed to prevent stormwater from impacting the proposed buildings on-site, the properties adjacent to this site and the downstream major drainageway.

With exception of the landscape perimeter of the site, the proposed improvements will drain to either Detention Pond A, B or C to be treated for water quality and detained on-site. Release from the proposed facilities will discharge into the existing site outfall near the northwest corner of the site adjacent to S. Potomac Street. The proposed drainage system will adequately accommodate the 100-year event and convey it to the existing storm sewer system located in S. Potomac Street west of the site.

Water quality will be enhanced in this development by means of the on-site extended detention basin facilities and rain gardens as defined in this report.

The effect of the proposed development on adjacent properties upstream and downstream will be minimal.

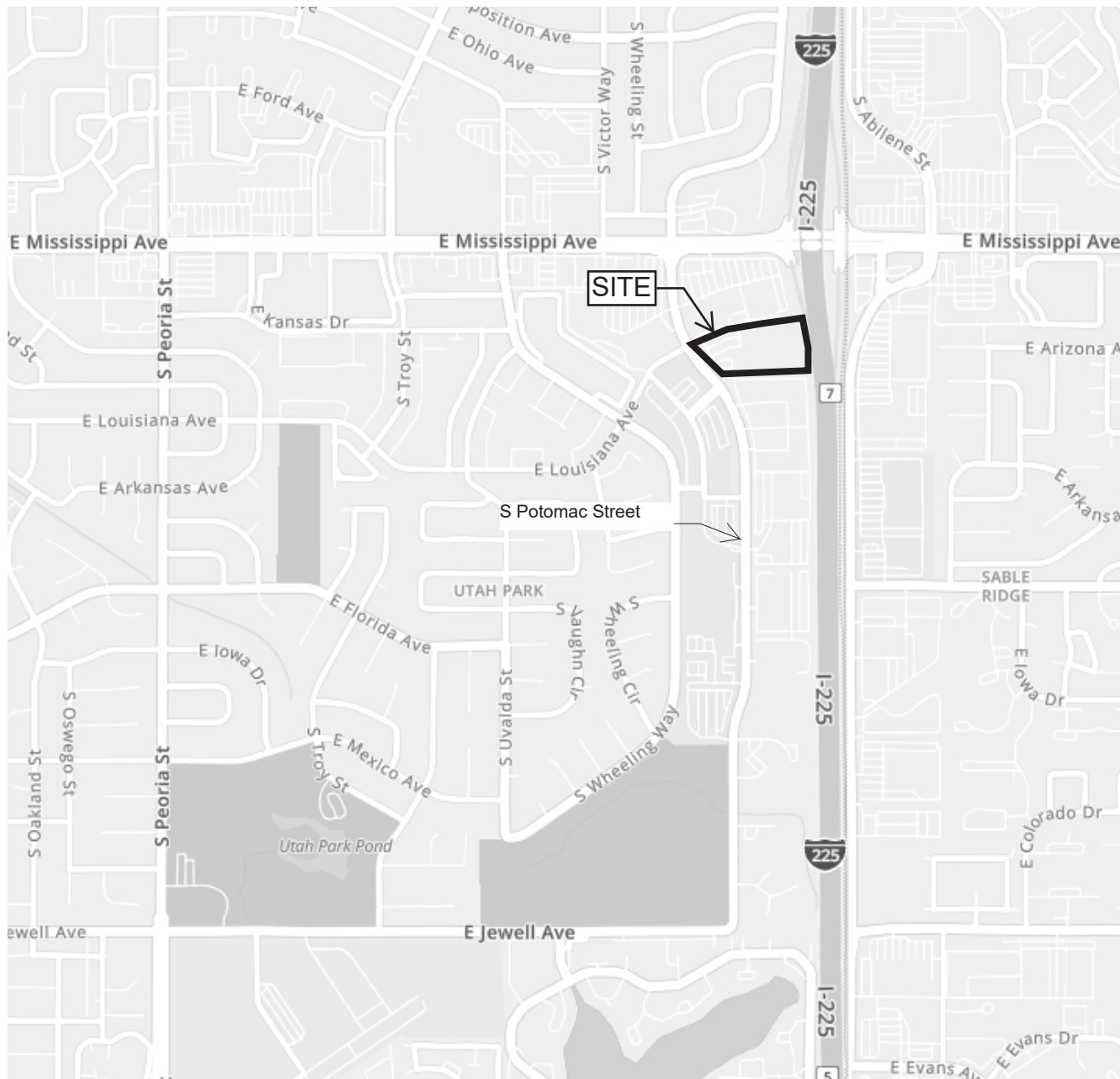
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2. Mile High Flood District Drainage Criteria Manual (UDFCDCM), Vol. 1, 2 and 3 prepared by Wright-McLaughlin Engineers, March 1969, with current revisions.
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4. Final Drainage Report for Lot 2, Block 1, Potomac East Subdivision Filing No 4.
5. FEMA FIRM Panel No 08005C0179L dated September 4, 2020
6. Soil Survey for Arapahoe County, NRCS

APPENDIX A

VICINITY MAP
SCS SOILS MAP
FEMA FIRM MAP

Vicinity Map





United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Arapahoe County, Colorado**



June 23, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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BvC—Bresser-Truckton sandy loams, 3 to 5 percent slopes.....	13
TrC—Truckton loamy sand, 0 to 3 percent slopes.....	14
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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map




MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole

 Slide or Slip


 Sodic Spot


 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 17, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes	2.5	36.6%
TrC	Truckton loamy sand, 0 to 3 percent slopes	4.4	63.4%
Totals for Area of Interest		6.9	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Arapahoe County, Colorado

BvC—Bresser-Truckton sandy loams, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34y5

Elevation: 4,500 to 6,800 feet

Mean annual precipitation: 12 to 18 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 125 to 180 days

Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Bresser and similar soils: 55 percent

Truckton and similar soils: 30 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser

Setting

Landform: Playas, drainageways, stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Noncalcareous sandy alluvium and/or noncalcareous sandy eolian deposits

Typical profile

H1 - 0 to 6 inches: sandy loam

H2 - 6 to 26 inches: sandy clay loam

H3 - 26 to 32 inches: gravelly sandy loam

H4 - 32 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 3 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Description of Truckton

Setting

Landform: Ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 20 inches: sandy loam
H3 - 20 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Nunn

Percent of map unit: 8 percent
Hydric soil rating: No

Ascalon

Percent of map unit: 7 percent
Hydric soil rating: No

TrC—Truckton loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2yvr1
Elevation: 4,200 to 5,600 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 125 to 155 days

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Farmland classification: Farmland of statewide importance

Map Unit Composition

Truckton and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Terraces, interfluves

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Wind re-worked alluvium derived from arkose

Typical profile

A - 0 to 6 inches: loamy sand

Bt1 - 6 to 10 inches: sandy loam

Bt2 - 10 to 16 inches: sandy loam

C - 16 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 1 percent

Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: R067BY024CO - Sandy Plains

Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 8 percent

Landform: Interfluves, hills

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Ecological site: R067BY015CO - Deep Sand

Hydric soil rating: No

Bresser

Percent of map unit: 5 percent

Custom Soil Resource Report

Landform: Terraces, interfluves
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Dunes, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

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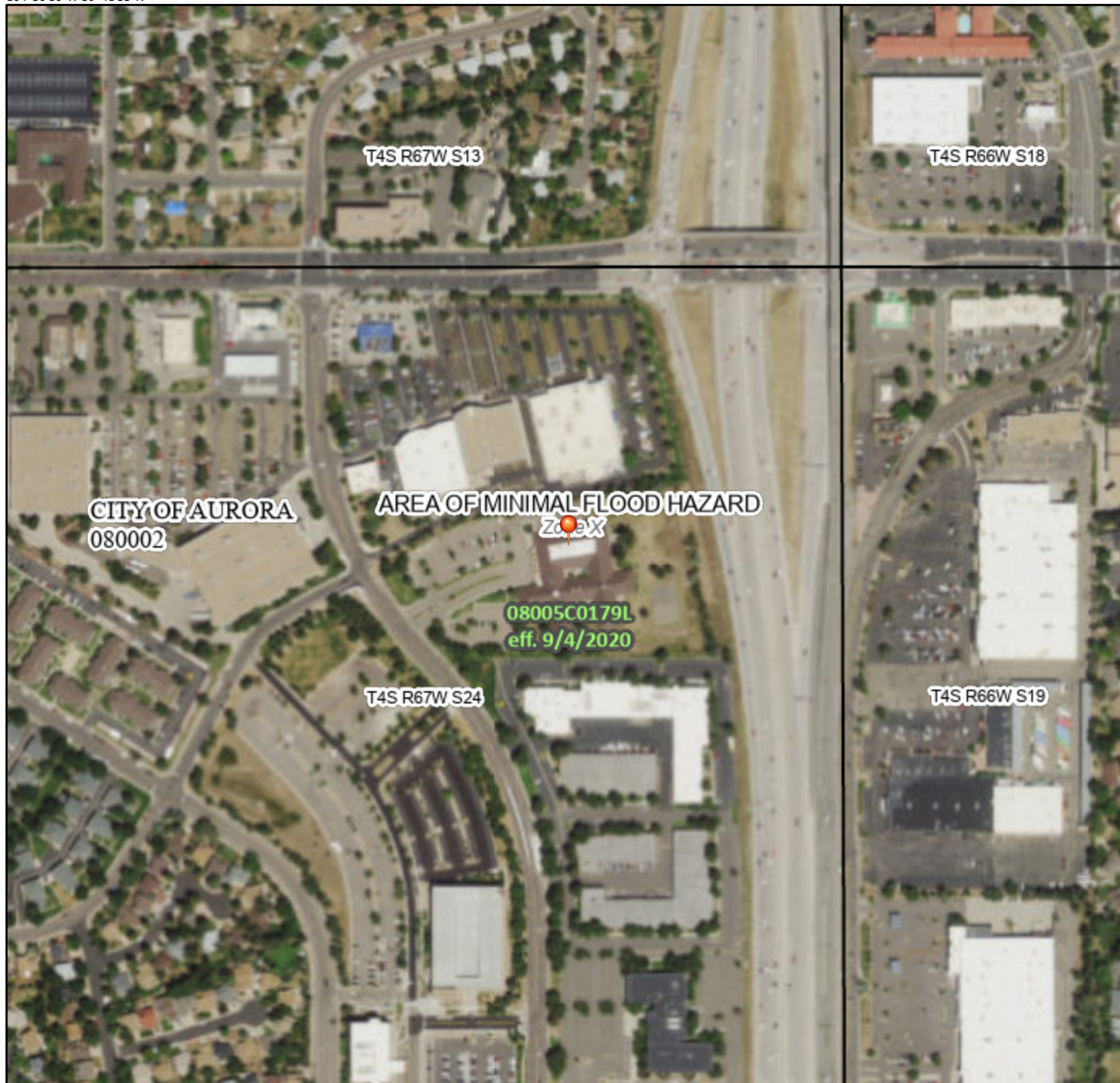
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National Flood Hazard Layer FIRMette



104°50'10"W 39°41'55"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/25/2022 at 12:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

HYDROLOGIC CALCULATIONS

RUNOFF CALCULATIONS

WEIGHTED C-VALUE CALCULATION

JOB NO: _____
PROJECT: _____ AuMHC
DATE: _____ 6/24/2022

Soil Type (A-D): 64%A / 36%B

BASIN	TOTAL AREA (AC)	TOTAL AREA (SF)	AREA LANDSCAPE (SF)	AREA PAVEMENT (SF)	GRAVEL/ CRUSHER FINES (SF)	AREA Roof Top (SF)	C2	C5	C10	C100	I (%)
ON-SITE BASINS											
A1	0.27	11665	2982	8683	0	0	0.67	0.68	0.70	0.73	75%
A2	0.54	23502	7504	14487	1511	0	0.58	0.59	0.62	0.66	65%
A3	0.20	8843	1883	6960	0	0	0.71	0.72	0.74	0.76	79%
A4	0.443	19280	6499	2045	1386	9350	0.54	0.58	0.62	0.65	58%
A5	0.20	8539	8258	281	0	0	0.17	0.18	0.20	0.22	5%
A6	0.25	10765	6167	3208	1390	0	0.36	0.39	0.42	0.48	36%
A7	0.12	5230	1211	4019	0	0	0.70	0.71	0.73	0.76	77%
A8	1.24	54131	6404	47206	0	521	0.78	0.79	0.81	0.84	88%
A9	0.30	12906	6505	5686	715	0	0.47	0.48	0.51	0.55	47%
B1	0.38	16341	5495	10410	0	436	0.63	0.64	0.66	0.68	67%
C1	0.55	24075	0	0	0	24075	0.80	0.85	0.90	0.90	90%
C2	1.42	62066	9659	36859	0	15548	0.74	0.76	0.79	0.81	82%
C3	0.62	26927	4209	22718	0	0	0.76	0.77	0.79	0.82	85%
D	0.13	5805	2832	2973	0	0	0.52	0.53	0.55	0.57	52%
E	0.20	8758	8758	0	0	0	0.15	0.16	0.18	0.20	2%
F	0.17	7589	6561	1028	0	0	0.25	0.26	0.28	0.30	15%
Total	7.03	306422	84927	166563	5002	49930	0.63	0.65	0.68	0.70	70%
EXISTING BASINS											
EX1	0.44	19124	19011	113	0	0	0.10	0.11	0.13	0.15	3%
EX2	0.38	16506	16506	0	0	0	0.10	0.11	0.13	0.15	2%
EX3	0.02	810	713	97	0	0	0.19	0.20	0.22	0.24	14%
EX4	0.09	3790	1753	2037	0	0	0.51	0.52	0.54	0.57	55%
Total	0.92	40230	37983	2247	0	0	0.14	0.15	0.17	0.19	7%

C Values are based on Table 1 of the City of Aurora Storm Drainage Criteria Manual.

Surface	Soil Type	i	C2	C5	C10	C100	Remarks
landscape	A/B	2%	0.05	0.06	0.08	0.10	Lawns <=2%
	A/B	2%	0.10	0.11	0.13	0.15	Lawns 2% to 7%
	A/B	2%	0.15	0.16	0.18	0.20	Lawns > 7%
roof		90%	0.80	0.85	0.90	0.90	
pavement		100%	0.87	0.88	0.90	0.93	
crushed asphalt/ gravel		40%	0.15	0.25	0.35	0.65	

SUBDIVISION: AuMHC
CALCULATED BY: JCC DATE: 6/24/2022
Rev: _____

[illegible]

JOB NO: 0
PROJECT: AuMHC
DESIGN STORM: 2 Year

[illegible]

CALCULATED BY: JCC
DATE: 6/24/2022
Rev:
CHECKED BY: JCC

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 0
PROJECT: AuMHC
DESIGN STORM: 2 Year

P1 = 0.96

[illegible]

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: _____ 0
PROJECT: AuMHC
DESIGN STORM: 100 Year

[illegible]

JOB NO: _____ 0
PROJECT: AuMHC
DESIGN STORM: 100 Year

[illegible]

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
<u>Business:</u>					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
<u>Residential:</u>					
Single-Family (**)	(*)	.40	.45	.50	.60
Multi-Unit (detached)	60	.45	.50	.60	.70
Multi-Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60
Apartments	80	.65	.70	.70	.80
<u>Industrial:</u>					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
<u>Parks, Cemeteries</u>	5	.10	.10	.35	.60
<u>Playgrounds</u>	10	.15	.25	.35	.65
<u>Schools</u>	50	.45	.50	.60	.70
<u>Railroad Yard Areas</u>	15	.40	.45	.50	.60
<u>Undeveloped Areas:</u>					
Historic Flow Analysis, Greenbelts, Agricultural	2	(See "Lawns")			
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

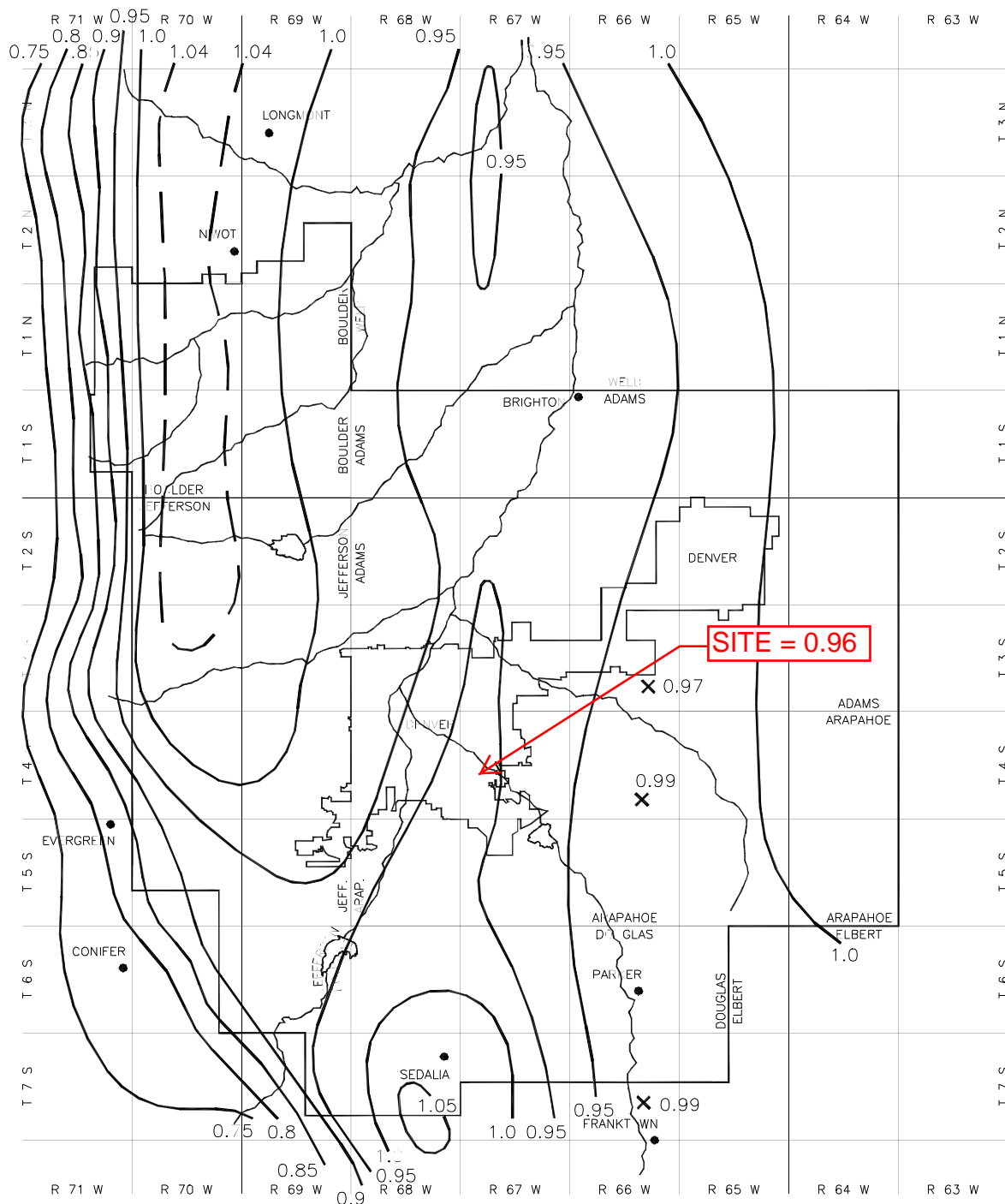


Figure 5-1. Rainfall depth-duration-frequency: 2-year, 1-hour rainfall

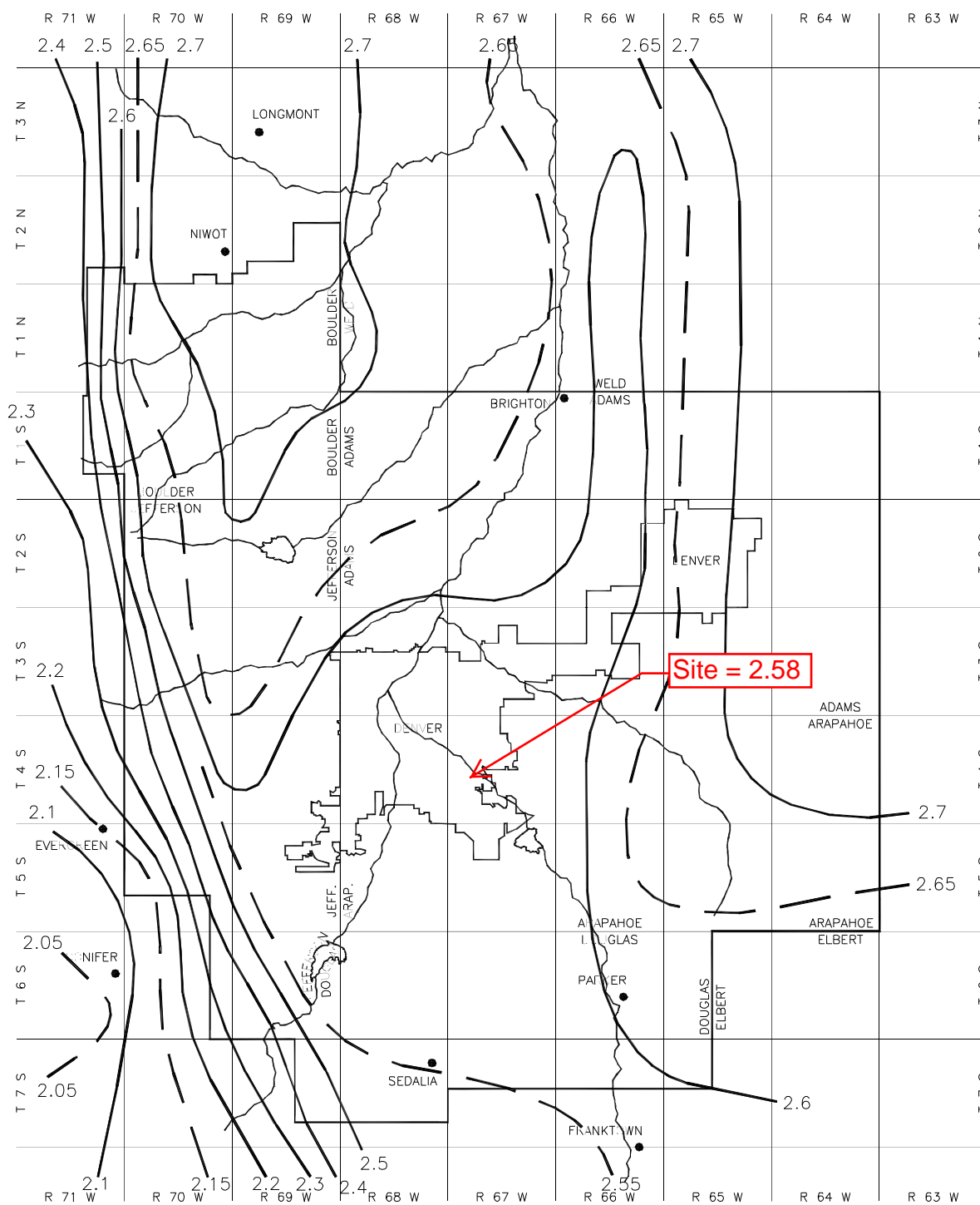


Figure 5-6. Rainfall depth-duration-frequency: 100-year, 1-hour rainfall

APPENDIX C

HYDRAULIC CALCULATIONS

AuMHC

Date: 6/25/2022

Outlet Structure Release Rate Calculations

A. Allowable Release Rates:

Soil Type:	64% A	36% B
100-yr Release Rate	0.50 cfs	0.85 cfs
Composite Release Rate	0.626	cfs

B. Pond A

Area: 3.56 Acres

100-Year Release: 2.23 cfs

C. Pond B

Area: 0.38 Acres

100-Year Release: 0.24 cfs

D. Pond C

Area: 2.60 Acres

100-Year Release: 1.63 cfs

E. Confirm Overall Release from the Site:

Total Detention Pond Release: 4.10 cfs
(Ponds A, B and C)

On-site Basins Flowing off-site Undetained: 1.48 cfs
(Basins D, E and F)

Total Proposed Release From Site **5.58** cfs

Historical and Current 100-yr Release from Site: **5.60** cfs Per Final Drainage Study for
Care Unit of Aurora

The proposed site release is slightly less than the historical and current release from the site conforming with the Final Drainage Report for Care Unit of Aurora.

DETENTION POND CALCULATIONS

AuMHC

Detention Volume Calculations

6/25/2022

DETENTION POND A

1. Water Quality Volume

Tributary Area (Basin A1-A9)

Impervious % = 75.0%

Required Storage (Fig. SQ-2) = 0.30 watershed inches

WQCV = (Storage/12) * Area * 1.2 Area_{WQ} = A

WQCV = 4,645 cubic feet Area_{WQ} = 3.56 acres

0.107 acre-feet

2. EURV

$$EURV = 1.68 * i^{1.28}$$

1.162 Watershed-inches

Impervious % = 75.0%

A = 3.56 acres

V_{EURV} = 0.345 acre-feet

V_{EURV} = 15,023 cubic-feet

3. 100-Year Storm Event

$$V = KA$$

$$K_{100} = (1.78 * I - 0.002 * I^2 - 3.56) / 900$$

Impervious % = 75.0%

A = 3.56 acres

$$K_{100} = 0.131878$$

V₁₀₀ = 0.469 acre-feet

V₁₀₀ = 20,451 cubic-feet

Summary

Event	Total Required Volume		Notes:
	acre-feet	cubic feet	
Water Quality	0.11	4,645	1.2 * WQCV
EURV Storm Event	0.45	19,668	1.2 * WQ + EURV
100-Year Storm Event	0.75	32,607	1.2 * WQCV + 1/2 EURV + 100-Year

AuMHC

Stage Storage Calculations

DATE:

6/25/2022

DETENTION POND A

Prismoidal Method: $V = (A1 + A2 + (A1 * A2)^{0.5}) * (h/3)$

BOTTOM ELEVATION = 77.00

NORTH

CONTOUR	h	AREA (SF)	VOLUME (CF)	SUM VOLUME (CF)	VOLUME (ACRE-FT)
77.61		49			0.00
78.00	0.39	179	42	42	0.00
79.00	1	3514	1495	1537	0.04
79.75	0.75	4079	2845	4382	0.10
80.00	0.25	4357	1054	5436	0.12
81.00	1	5272	4807	10243	0.24
81.96	0.96	6203	5502	15745	0.36
82.00	0.04	6269	249	15995	0.37
83.00	1	7344	6799	22794	0.52
83.28	0.28	7700	2106	24900	0.57
84.00	0.72	8471	5819	30720	0.71

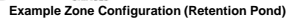
SOUTH

CONTOUR	h	AREA (SF)	VOLUME (CF)	SUM VOLUME (CF)	VOLUME (ACRE-FT)
79.00		55			0.00
79.75	0.75	966	313	313	0.01
80.00	0.25	1091	257	570	0.01
81.00	1	1741	1403	1973	0.05
81.96	0.96	2404	1981	3954	0.09
82.00	0.04	2442	97	4051	0.09
83.00	1	3186	2806	6857	0.16
83.28	0.28	3411	923	7780	0.18
84.00	0.72	4015	2670	10451	0.24

	VOLUME (ac-ft)	MIN ELEVATION
1.2 * WATER QUALITY CAPTURE VOLUME REQ'D =	0.11	79.75
1.2 * WQCV + EURV REQ'D =	0.45	81.96
1.2* WQCV + 1/2 EURV + 100YR VOLUME REQ'D =	0.75	83.28

MHFD-Detention, Version 4.05 (January 2022)

Basin ID: Pond A 0-Stage = 77.61

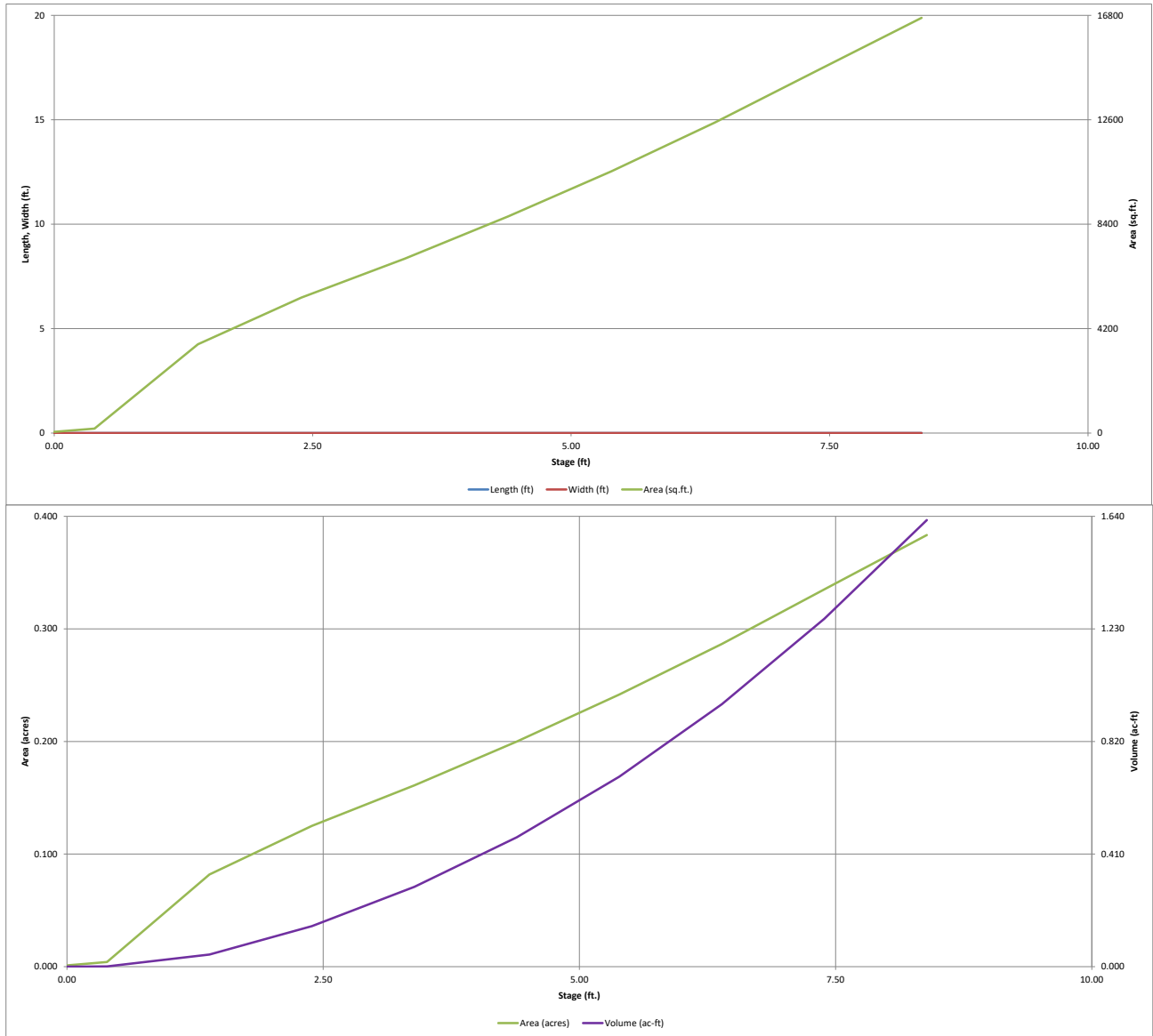


Initial Surcharge Area (A_{ISV}) =	user	ft ²
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{1LOOR}) =	user	ft
Length of Basin Floor (L_{1LOOR}) =	user	ft
Width of Basin Floor (W_{1LOOR}) =	user	ft
Area of Basin Floor (A_{1LOOR}) =	user	ft ²
Volume of Basin Floor (V_{1LOOR}) =	user	ft ³
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft ²
Volume of Main Basin (V_{MAIN}) =	user	ft ³
Calculated Total Basin Volume (V_{TOTAL}) =	user	acre-feet

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

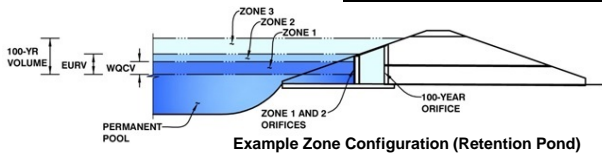


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: AUMHC

Basin ID: Pond A 0-Stage = 77.61



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	2.05	0.107	Orifice Plate
Zone 2 (User)	4.30	0.345	Orifice Plate
Zone 3 (User)	6.27	0.469	Weir&Pipe (Restrict)
Total (all zones)		0.921	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = N/A ft (distance below the filtration media surface)
Underdrain Orifice Diameter = N/A inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 4.35 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = 18.00 inches
Orifice Plate: Orifice Area per Row = 0.73 sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate
WQ Orifice Area per Row = 5.069E-03 ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.50	3.00					
Orifice Area (sq. inches)	0.73	0.73	0.73					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = N/A ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = N/A ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = N/A inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = N/A ft²
Vertical Orifice Centroid = N/A feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, H_o = 4.35 ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = 2.92 feet
Overflow Weir Grate Slope = 4.00 H:V
Horiz. Length of Weir Sides = 2.92 feet
Overflow Grate Type = Close Mesh Grate
Debris Clogging % = 50%

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = 5.08 feet
Overflow Weir Slope Length = 3.01 feet
Grate Open Area / 100-yr Orifice Area = 35.91
Overflow Grate Open Area w/o Debris = 6.95 ft²
Overflow Grate Open Area w/ Debris = 3.48 ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = 0.20 ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = 18.00 inches
Restrictor Plate Height Above Pipe Invert = 3.00 inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = 0.19 ft²
Outlet Orifice Centroid = 0.15 feet
Half-Central Angle of Restrictor Plate on Pipe = 0.84 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 6.67 ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = 100.00 feet
Spillway End Slopes = 20.00 H:V
Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = 0.12 feet
Stage at Top of Freeboard = 7.79 feet
Basin Area at Top of Freeboard = 0.35 acres
Basin Volume at Top of Freeboard = 1.40 acre-ft

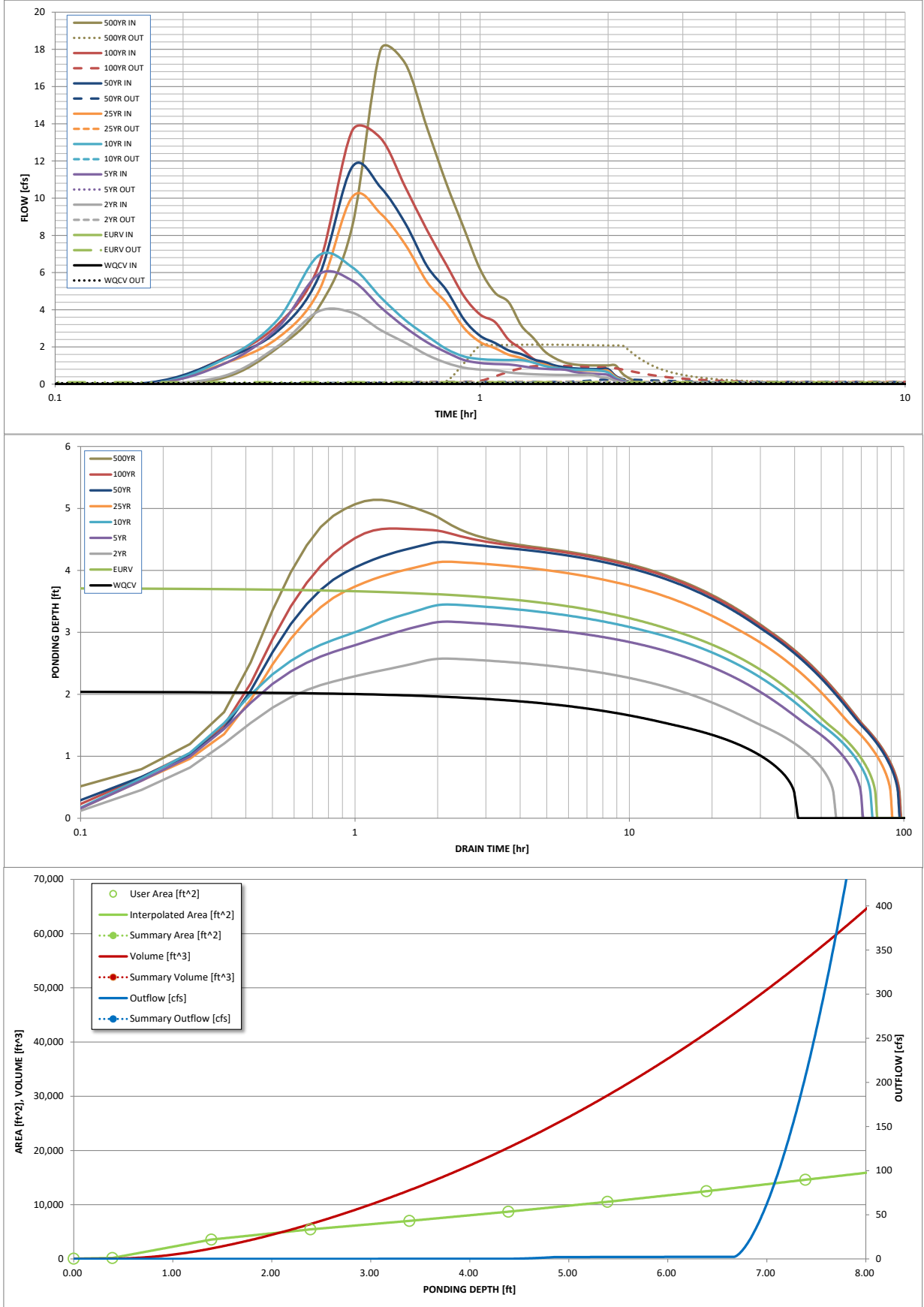
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	0.96	1.35	1.55	1.99	2.24	2.58	3.25
One-Hour Rainfall Depth (in)	N/A	N/A	0.96	1.35	1.55	1.99	2.24	2.58	3.25
CUHP Runoff Volume (acre-ft)	0.107	0.345	0.181	0.268	0.313	0.439	0.506	0.608	0.797
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.181	0.268	0.313	0.439	0.506	0.608	0.797
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.0	0.1	0.1	2.3	3.2	4.7	7.3
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.02	0.04	0.64	0.89	1.32	2.06
Peak Inflow Q (cfs)	N/A	N/A	3.9	5.9	6.9	10.1	11.7	13.6	18.0
Peak Outflow Q (cfs)	0.1	0.1	0.1	0.1	0.1	0.1	0.3	1.0	2.1
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	1.0	0.7	0.1	0.1	0.2	0.3
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.3
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	39	73	53	65	71	82	87	86	84
Time to Drain 99% of Inflow Volume (hours)	40	77	55	69	74	87	93	93	92
Maximum Ponding Depth (ft)	2.05	3.72	2.58	3.17	3.45	4.14	4.46	4.68	5.14
Area at Maximum Ponding Depth (acres)	0.11	0.17	0.13	0.15	0.16	0.19	0.20	0.21	0.23
Maximum Volume Stored (acre-ft)	0.108	0.346	0.171	0.256	0.299	0.422	0.483	0.529	0.630

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.04	0.35
	0:15:00	0.00	0.00	0.44	1.10	1.35	1.11	1.36	1.41	1.94
	0:20:00	0.00	0.00	2.03	3.01	3.45	2.47	2.84	3.18	4.11
	0:25:00	0.00	0.00	3.91	5.90	6.91	4.97	5.75	6.35	8.47
	0:30:00	0.00	0.00	3.84	5.57	6.29	10.06	11.68	13.63	17.98
	0:35:00	0.00	0.00	2.91	4.14	4.67	9.17	10.58	13.22	17.24
	0:40:00	0.00	0.00	2.23	3.05	3.45	7.50	8.65	10.60	13.79
	0:45:00	0.00	0.00	1.57	2.25	2.59	5.50	6.35	8.28	10.78
	0:50:00	0.00	0.00	1.14	1.71	1.89	4.36	5.05	6.41	8.36
	0:55:00	0.00	0.00	0.88	1.30	1.49	3.02	3.47	4.72	6.18
	1:00:00	0.00	0.00	0.78	1.14	1.35	2.26	2.60	3.74	4.92
	1:05:00	0.00	0.00	0.75	1.08	1.31	1.94	2.22	3.34	4.41
	1:10:00	0.00	0.00	0.63	1.06	1.30	1.58	1.82	2.39	3.15
	1:15:00	0.00	0.00	0.57	0.97	1.30	1.41	1.61	1.90	2.49
	1:20:00	0.00	0.00	0.53	0.88	1.16	1.17	1.33	1.37	1.78
	1:25:00	0.00	0.00	0.51	0.82	0.98	1.05	1.19	1.09	1.39
	1:30:00	0.00	0.00	0.50	0.79	0.88	0.89	1.00	0.92	1.16
	1:35:00	0.00	0.00	0.50	0.78	0.82	0.80	0.91	0.84	1.06
	1:40:00	0.00	0.00	0.50	0.66	0.78	0.76	0.85	0.81	1.02
	1:45:00	0.00	0.00	0.50	0.60	0.76	0.73	0.82	0.80	1.01
	1:50:00	0.00	0.00	0.50	0.56	0.76	0.72	0.81	0.80	1.01
	1:55:00	0.00	0.00	0.38	0.54	0.72	0.72	0.81	0.80	1.01
	2:00:00	0.00	0.00	0.32	0.50	0.63	0.72	0.81	0.80	1.01
	2:05:00	0.00	0.00	0.17	0.27	0.35	0.39	0.44	0.44	0.55
	2:10:00	0.00	0.00	0.09	0.15	0.19	0.22	0.24	0.24	0.30
	2:15:00	0.00	0.00	0.04	0.07	0.09	0.11	0.12	0.12	0.15
	2:20:00	0.00	0.00	0.02	0.03	0.04	0.05	0.06	0.05	0.07
	2:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

AuMHC
Detention Volume Calculations
6/25/2021

DETENTION POND B

1. **Water Quality Volume**

Tributary Area (Basin B1)

Ref: Rain Garden Spreadsheet

$$\text{WQCV} = \begin{array}{ll} 437 & \text{cubic feet} \\ 0.010 & \text{acre-feet} \end{array}$$

2. **EURV**

$$\text{EURV} = 1.68 * i^{1.28}$$

1.468 Watershed-inches

$$\begin{array}{ll} \text{Impervious \%} = & 90.0\% \\ A = & 0.38 \text{ acres} \end{array}$$

$$V_{\text{EURV}} = \begin{array}{ll} 0.046 & \text{acre-feet} \end{array}$$

$$V_{\text{EURV}} = \begin{array}{ll} 2,025 & \text{cubic-feet} \end{array}$$

3. **100-Year Storm Event**

$$V = KA$$

$$K_{100} = (1.78 * I - 0.002 * I^2 - 3.56) / 900$$

$$\begin{array}{ll} \text{Impervious \%} = & 90.0\% \\ A = & 0.38 \text{ acres} \end{array}$$

$$K_{100} = 0.156044$$

$$V_{100} = \begin{array}{ll} 0.059 & \text{acre-feet} \end{array}$$

$$V_{100} = \begin{array}{ll} 2,583 & \text{cubic-feet} \end{array}$$

Summary

Event	Total Required Volume		Notes:
	acre-feet	cubic feet	
Water Quality	0.01	437	Rain Garden WQCV
EURV Storm Event	0.06	2,462	Rain Garden WQ + EURV
100-Year Storm Event	0.09	4,032	Rain Garden WQ+1/2 EURV+100-Year

AuMHC

Stage Storage Calculations

DATE: 6/25/2022

DETENTION POND B

Prismoidal Method: $V = (A1 + A2 + (A1 * A2)^{0.5}) * (h/3)$

BOTTOM ELEVATION = 90.55

NORTH

CONTOUR	h	AREA (SF)	VOLUME (CF)	SUM VOLUME (CF)	VOLUME (ACRE-FT)
90.55		2737			0.00
91.05	0.5	3265	1499	1499	0.03
91.55	0.5	3801	1765	3263	0.07
92.05	0.5	4342	2034	5298	0.12
92.55	0.5	4891	2307	7605	0.17

	VOLUME (ac-ft)	MIN ELEVATION
1.2 * WATER QUALITY CAPTURE VOLUME REQ'D =	0.01	90.70
1.2 * WQCV + EURV REQ'D =	0.06	91.32
1.2* WQCV + 1/2 EURV + 100YR VOLUME REQ'D =	0.09	91.74

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: J Coco
Company: CKE Engineering Inc
Date: June 25, 2022
Project: AuMHC
Location: Pond B

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
(100% if all paved and roofed areas upstream of rain garden)
- B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)
- C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time
($WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)
- D) Contributing Watershed Area (including rain garden area)
- E) Water Quality Capture Volume (WQCV) Design Volume
 $Vol = (WQCV / 12) * Area$
- F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)

$I_a = 90.0$ %

$i = 0.900$

WQCV = 0.32 watershed inches

Area = 16,341 sq ft

$V_{WQCV} = 437$ cu ft

$d_6 =$ in

$V_{WQCV \text{ OTHER}} =$ cu ft

$V_{WQCV \text{ USER}} =$ cu ft

2. Basin Geometry

- A) WQCV Depth (12-inch maximum)
- B) Rain Garden Side Slopes ($Z = 4$ min., horiz. dist per unit vertical)
(Use "0" if rain garden has vertical walls)
- C) Minimum Flat Surface Area
- D) Actual Flat Surface Area
- E) Area at Design Depth (Top Surface Area)
- F) Rain Garden Total Volume
($V_T = ((A_{Top} + A_{Actual}) / 2) * Depth$)

$D_{WQCV} = 2.0$ in

$Z = 4.00$ ft / ft

$A_{Min} = 294$ sq ft

$A_{Actual} = 3266$ sq ft

$A_{Top} = 3802$ sq ft

$V_T = 589$ cu ft

3. Growing Media

Choose One
☒ 18" Rain Garden Growing Media
☐ Other (Explain):

4. Underdrain System

- A) Are underdrains provided?
- B) Underdrain system orifice diameter for 12 hour drain time
- i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
- ii) Volume to Drain in 12 Hours
- iii) Orifice Diameter, 3/8" Minimum

Choose One
☒ YES
☐ NO

$y = 2.2$ ft

$Vol_{12} = 437$ cu ft

$D_o = 1/2$ in

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: J Coco
Company: CKE Engineering Inc
Date: June 25, 2022
Project: AuMHC
Location: Pond B

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

☒ YES
☐ NO

PROVIDE A 30 MIL (MIN) PVC LINER WITH CDOT CLASS B GEOTEXTILE ABOVE IT. USE THE SAME GEOTEXTILE BELOW THE LINER IF THE SUBGRADE IS ANGULAR

6. Inlet / Outlet Control

A) Inlet Control

Choose One

☐ Sheet Flow- No Energy Dissipation Required
☒ Concentrated Flow- Energy Dissipation Provided

7. Vegetation

Choose One

☐ Seed (Plan for frequent weed control)
☒ Plantings
☐ Sand Grown or Other High Infiltration Sod

8. Irrigation

A) Will the rain garden be irrigated?

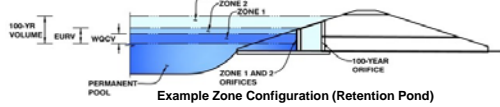
Choose One

☐ YES
☐ NO

Notes: _____

MHFD-Detention, Version 4.05 (January 2022)

Basin ID: Pond B 0-Stage=90.55



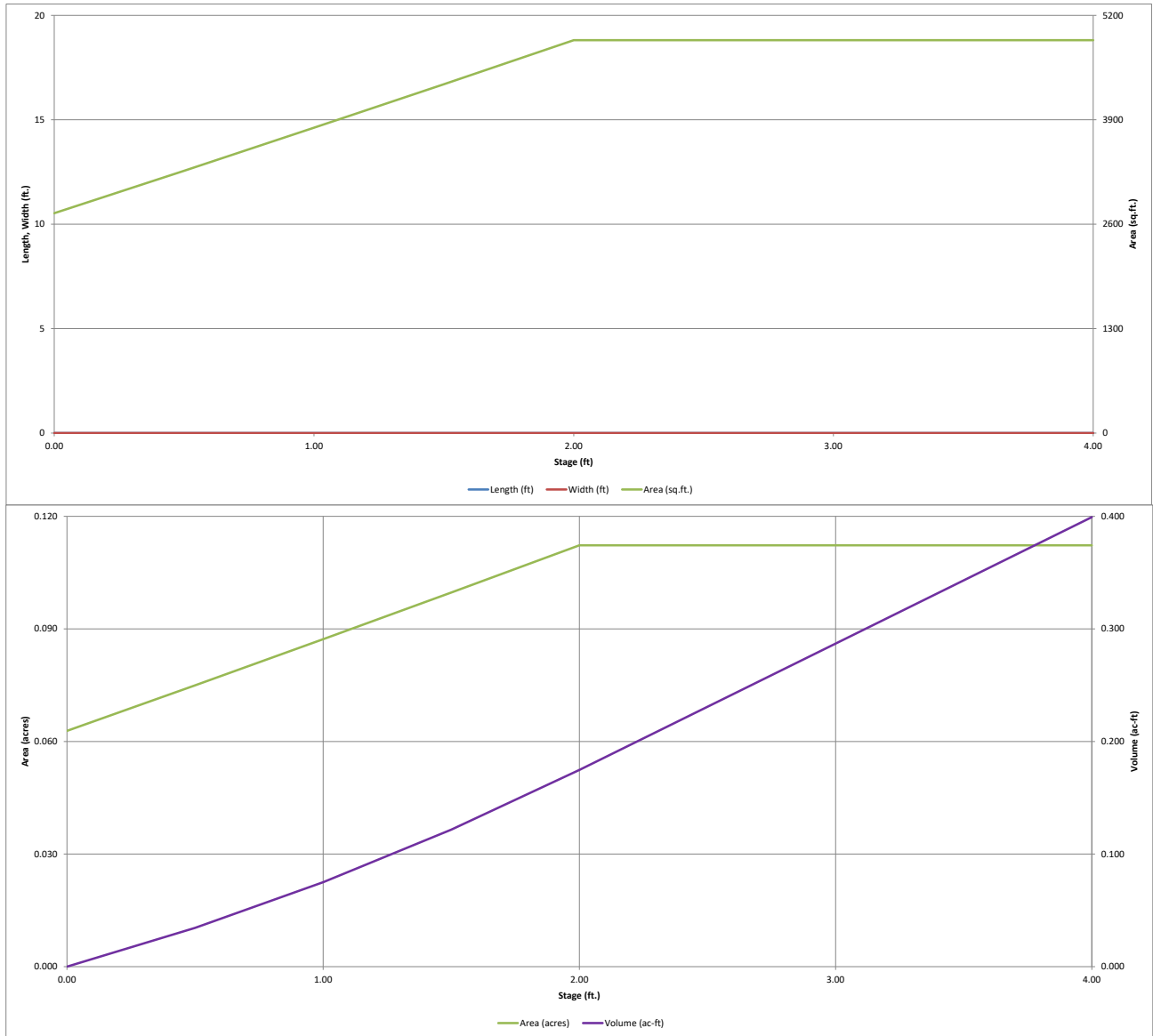
Example Zone Configuration (Retention Pond)

Initial Surcharge Area (A_{ISV})	=	user	ft ²
Surcharge Volume Length (L_{ISV})	=	user	ft
Surcharge Volume Width (W_{ISV})	=	user	ft
Depth of Basin Floor (H_{LFloor})	=	user	ft
Length of Basin Floor (L_{LFloor})	=	user	ft
Width of Basin Floor (W_{LFloor})	=	user	ft
Area of Basin Floor (A_{LFloor})	=	user	ft ²
Volume of Basin Floor (V_{LFloor})	=	user	ft ³
Depth of Main Basin (H_{Main})	=	user	ft
Length of Main Basin (L_{Main})	=	user	ft
Width of Main Basin (W_{Main})	=	user	ft
Area of Main Basin (A_{Main})	=	user	ft ²
Volume of Main Basin (V_{Main})	=	user	ft ³
Calculated Total Basin Volume (V_{Total})	=	user	acre-feet

6/29/2022, 4:00 PM

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

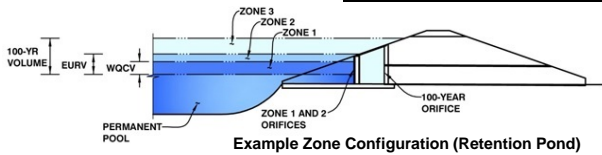


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: AUMHC

Basin ID: Pond B 0-Stage=90.55



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.16	0.010	Orifice Plate
Zone 2 (EURV)	0.66	0.036	Orifice Plate
Zone 3 (User)	1.33	0.059	Weir&Pipe (Restrict)
Total (all zones)		0.105	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = N/A ft (distance below the filtration media surface)
Underdrain Orifice Diameter = N/A inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 0.78 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = 0.44 sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate
WQ Orifice Area per Row = 3.056E-03 ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.37	0.57					
Orifice Area (sq. inches)	0.44	0.44	0.44					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = Not Selected Not Selected inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = Not Selected Not Selected ft²
Vertical Orifice Centroid = Not Selected Not Selected feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, H_o = Zone 3 Weir Not Selected ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = 2.92 N/A feet
Overflow Weir Grate Slope = 0.00 N/A H:V
Horiz. Length of Weir Sides = 2.92 N/A feet
Overflow Grate Type = Close Mesh Grate N/A
Debris Clogging % = 50% N/A %

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = Zone 3 Weir Not Selected feet
Overflow Weir Slope Length = 2.92 N/A feet
Grate Open Area / 100-yr Orifice Area = 222.25 N/A
Overflow Grate Open Area w/o Debris = 6.74 N/A ft²
Overflow Grate Open Area w/ Debris = 3.37 N/A ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = Zone 3 Restrictor Not Selected ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = 18.00 N/A inches
Restrictor Plate Height Above Pipe Invert = 0.85 inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = Zone 3 Restrictor Not Selected ft²
Outlet Orifice Centroid = 0.04 N/A feet
Half-Central Angle of Restrictor Plate on Pipe = 0.44 N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 1.50 ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = 20.00 feet
Spillway End Slopes = 0.00 H:V
Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = 0.07 feet
Stage at Top of Freeboard = 2.57 feet
Basin Area at Top of Freeboard = 0.11 acres
Basin Volume at Top of Freeboard = 0.24 acre-ft

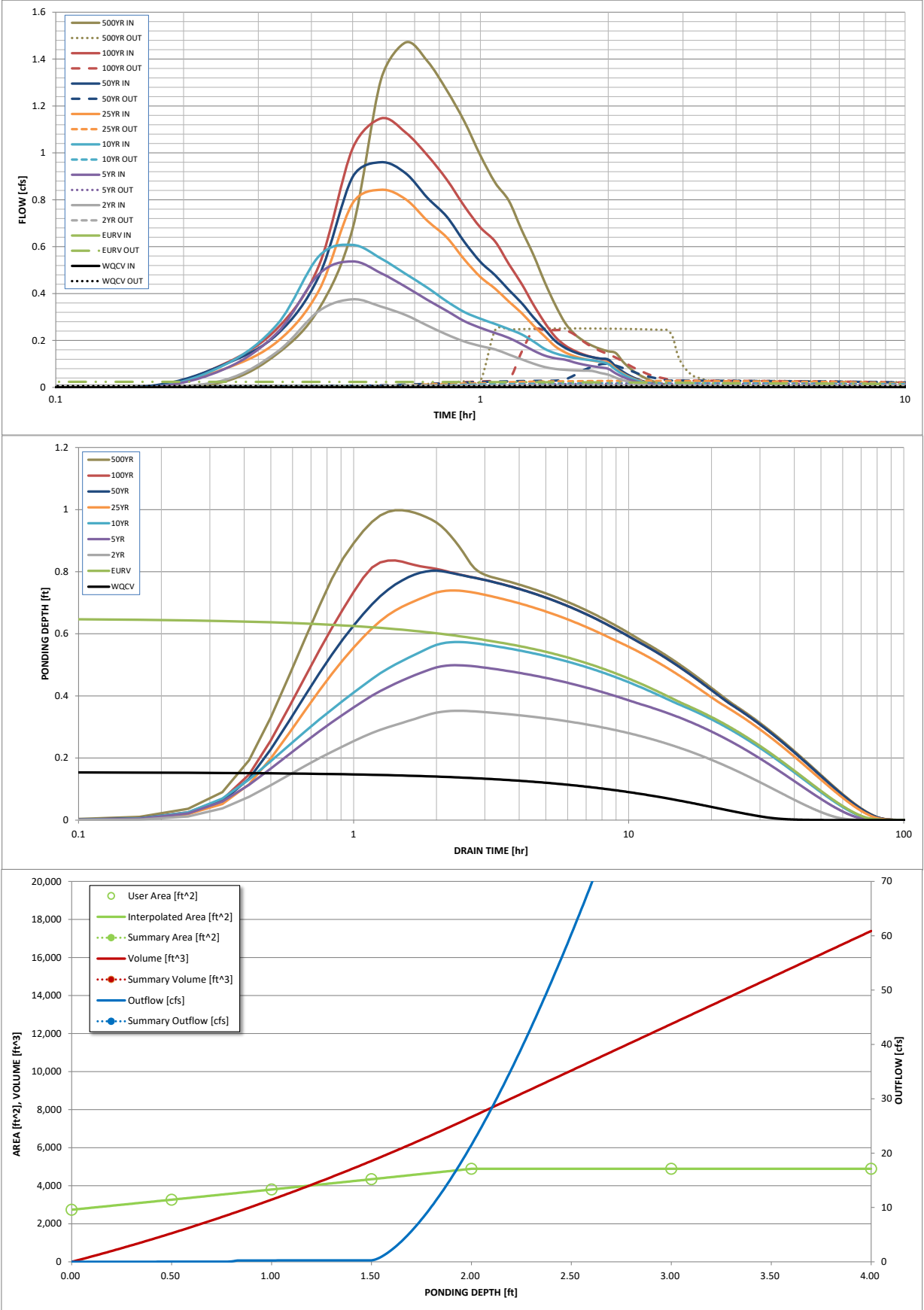
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	0.96	1.35	1.55	1.99	2.24	2.58	3.25
One-Hour Rainfall Depth (in)	N/A	N/A	0.96	1.35	1.55	1.99	2.24	2.58	3.25
CUHP Runoff Volume (acre-ft)	0.010	0.046	0.025	0.037	0.043	0.057	0.065	0.076	0.098
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.025	0.037	0.043	0.057	0.065	0.076	0.098
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.0	0.0	0.0	0.1	0.2	0.3	0.4
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.00	0.01	0.02	0.34	0.48	0.74	1.17
Peak Inflow Q (cfs)	N/A	N/A	0.4	0.5	0.6	0.8	1.0	1.1	1.5
Peak Outflow Q (cfs)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.24	0.3
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	3.6	2.5	0.2	0.6	0.9	0.6
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	35	67	56	64	67	71	72	70	68
Time to Drain 99% of Inflow Volume (hours)	41	74	61	70	73	78	79	78	77
Maximum Ponding Depth (ft)	0.16	0.66	0.35	0.50	0.57	0.74	0.80	0.84	1.00
Area at Maximum Ponding Depth (acres)	0.07	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.09
Maximum Volume Stored (acre-ft)	0.010	0.047	0.023	0.034	0.040	0.052	0.058	0.061	0.074

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03
	0:15:00	0.00	0.00	0.03	0.08	0.10	0.08	0.10	0.10	0.15
	0:20:00	0.00	0.00	0.15	0.24	0.27	0.20	0.23	0.25	0.34
	0:25:00	0.00	0.00	0.33	0.48	0.56	0.41	0.47	0.52	0.68
	0:30:00	0.00	0.00	0.38	0.54	0.61	0.79	0.90	1.02	1.31
	0:35:00	0.00	0.00	0.34	0.49	0.55	0.84	0.96	1.15	1.47
	0:40:00	0.00	0.00	0.31	0.43	0.48	0.80	0.91	1.09	1.39
	0:45:00	0.00	0.00	0.26	0.37	0.43	0.71	0.81	0.99	1.27
	0:50:00	0.00	0.00	0.23	0.33	0.37	0.64	0.73	0.89	1.13
	0:55:00	0.00	0.00	0.20	0.28	0.32	0.55	0.62	0.77	0.99
	1:00:00	0.00	0.00	0.18	0.25	0.29	0.47	0.54	0.68	0.87
	1:05:00	0.00	0.00	0.16	0.23	0.27	0.42	0.48	0.62	0.80
	1:10:00	0.00	0.00	0.14	0.21	0.25	0.37	0.42	0.53	0.67
	1:15:00	0.00	0.00	0.12	0.18	0.23	0.32	0.36	0.44	0.56
	1:20:00	0.00	0.00	0.10	0.16	0.20	0.26	0.30	0.35	0.45
	1:25:00	0.00	0.00	0.09	0.14	0.16	0.22	0.25	0.28	0.35
	1:30:00	0.00	0.00	0.08	0.12	0.15	0.18	0.20	0.22	0.27
	1:35:00	0.00	0.00	0.07	0.12	0.13	0.15	0.17	0.18	0.23
	1:40:00	0.00	0.00	0.07	0.11	0.13	0.13	0.15	0.16	0.20
	1:45:00	0.00	0.00	0.07	0.10	0.12	0.12	0.14	0.14	0.18
	1:50:00	0.00	0.00	0.07	0.09	0.12	0.11	0.13	0.13	0.16
	1:55:00	0.00	0.00	0.06	0.09	0.11	0.11	0.12	0.12	0.15
	2:00:00	0.00	0.00	0.05	0.08	0.10	0.11	0.12	0.12	0.15
	2:05:00	0.00	0.00	0.04	0.06	0.08	0.08	0.09	0.09	0.11
	2:10:00	0.00	0.00	0.03	0.04	0.06	0.06	0.07	0.06	0.08
	2:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.06
	2:20:00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.04
	2:25:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.03
	2:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	2:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:40:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

AuMHC

Detention Volume Calculations

6/25/2022

WATER QUALITY FACILITY C1

1. Water Quality Volume Tributary Area (Basins C1 and C2)

Impervious % = 90.0%

Required Storage (Fig. SQ-2) = 0.40 watershed inches

WQCV = (Storage/12) * Area * 1.2 Area_{WQ} = A

WQCV = 3,585 cubic feet Area_{WQ} = 2.05 acres
0.082 acre-feet

AuMHC

Stage Storage Calculations

DATE: 6/25/2022

WATER QUALITY FACILITY C1

Prismoidal Method: $V = (A1 + A2 + (A1 * A2)^{0.5}) * (h/3)$

BOTTOM ELEVATION = 87.30

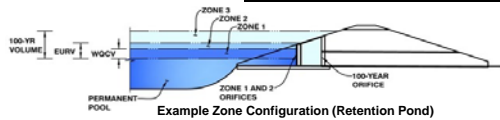
NORTH

CONTOUR	h	AREA (SF)	VOLUME (CF)	SUM VOLUME (CF)	VOLUME (ACRE-FT)
87.30		0			0.00
88.00	0.7	355	83	83	0.00
89.00	1	1142	711	794	0.02
90.00	1	2047	1573	2367	0.05
91.00	1	4224	3070	5437	0.12

	VOLUME (ac-ft)	MIN ELEVATION
1.2 * WATER QUALITY CAPTURE VOLUME REQ'D =	0.08	90.40

MHFD-Detention, Version 4.05 (January 2022)

Basin ID: WQ Pond C1 0-Stage=87.30

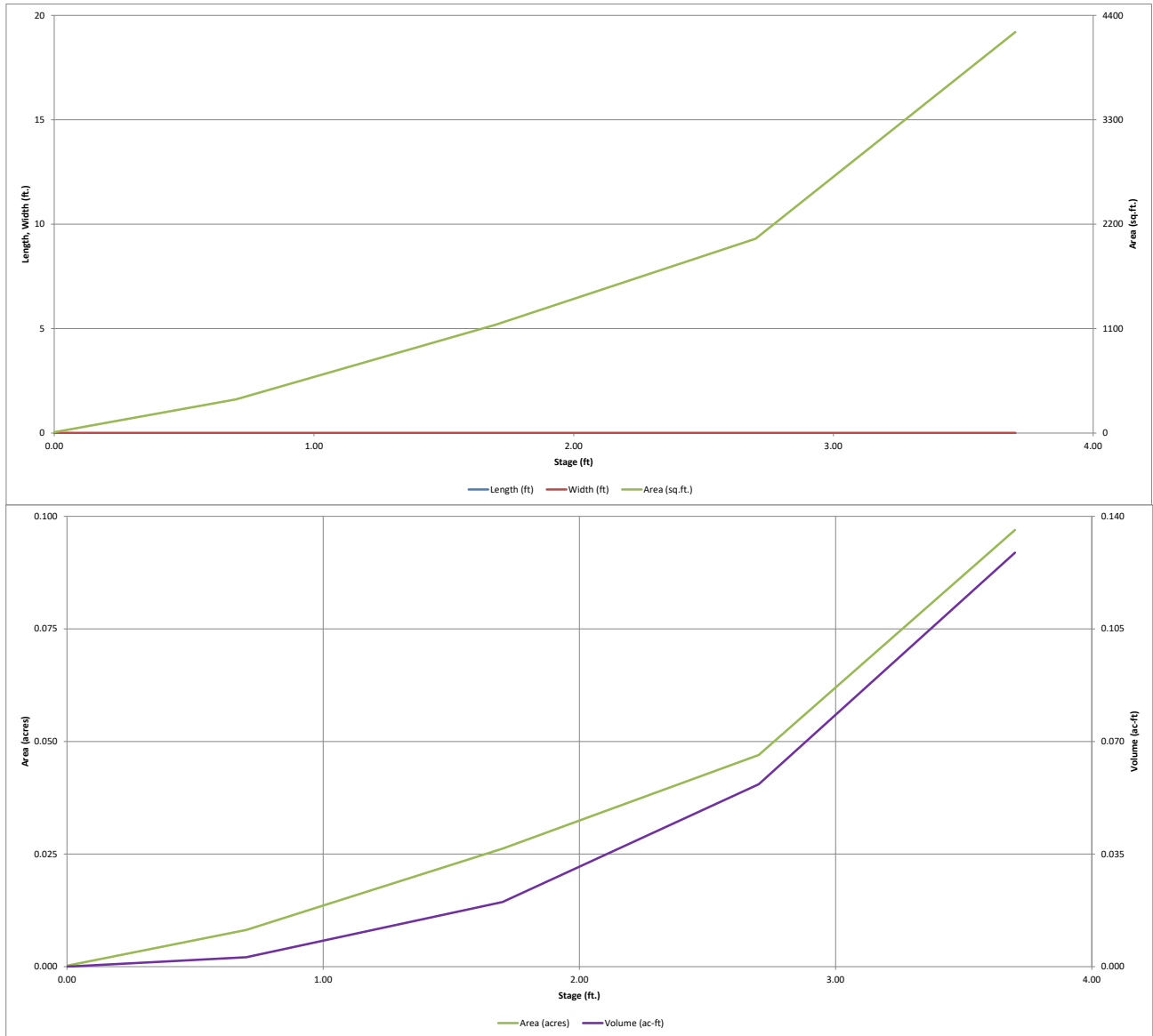


Total detention volume is less than 100-year volume.

6/29/2022, 4:15 PM

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Depotion, Version 4.05 (January 2022)

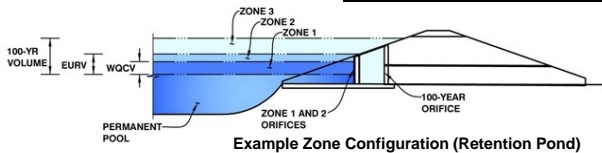


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: AUMHC

Basin ID: WQ Pond C1 O-Stage=87.30



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.14	0.082	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.082	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 5/8 inch)

Calculated Parameters for Plate
WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	<input type="text" value="0.00"/>	<input type="text" value="1.05"/>	<input type="text" value="2.09"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Orifice Area (sq. inches)	<input type="text" value="0.31"/>	<input type="text" value="0.31"/>	<input type="text" value="0.31"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Orifice Area (sq. inches)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = feet
Overflow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area =
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

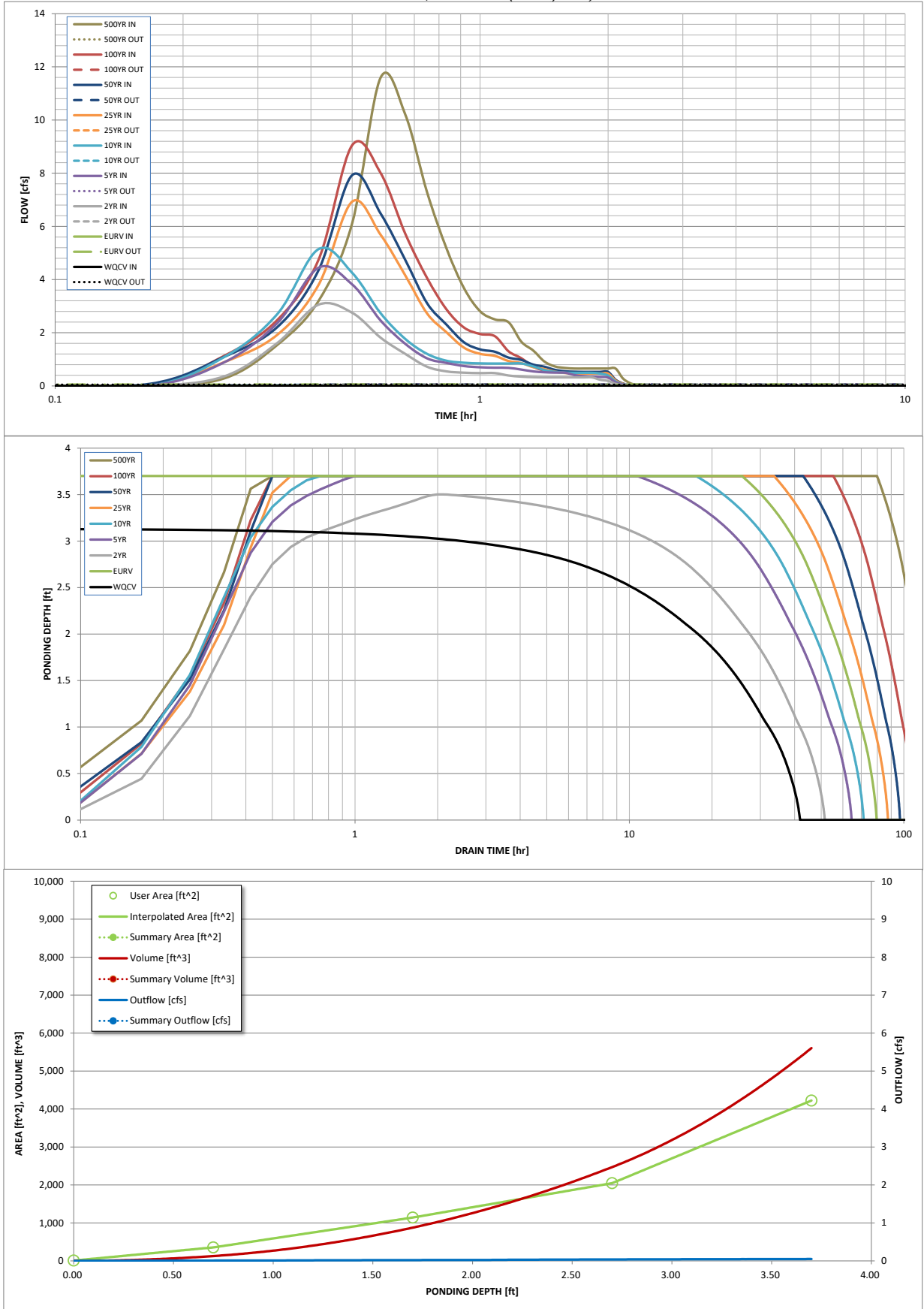
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	0.96	1.35	1.55	1.99	2.25	2.58	3.25
One-Hour Rainfall Depth (in)	N/A	N/A	0.96	1.35	1.55	1.99	2.25	2.58	3.25
CUHP Runoff Volume (acre-ft)	0.082	0.235	0.117	0.171	0.200	0.266	0.305	0.356	0.458
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.117	0.171	0.200	0.266	0.305	0.356	0.458
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.0	0.1	0.1	1.5	2.1	3.2	5.0
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.03	0.05	0.74	1.04	1.56	2.45
Peak Inflow Q (cfs)	N/A	N/A	3.1	4.4	5.1	6.9	7.9	9.1	11.6
Peak Outflow Q (cfs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.0
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.9	0.5	0.0	0.0	0.0	0.0
Structure Controlling Flow	Plate	N/A	Plate	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	37	69	45	56	62	76	84	96	118
Time to Drain 99% of Inflow Volume (hours)	40	75	49	61	67	82	91	103	>120
Maximum Ponding Depth (ft)	3.14	3.70	3.50	3.70	3.70	3.70	3.70	3.70	3.70
Area at Maximum Ponding Depth (acres)	0.07	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.10
Maximum Volume Stored (acre-ft)	0.082	0.129	0.110	0.129	0.129	0.129	0.129	0.129	0.129

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.28
	0:15:00	0.00	0.00	0.36	0.89	1.09	0.89	1.09	1.13	1.54
	0:20:00	0.00	0.00	1.62	2.36	2.70	1.92	2.21	2.48	3.20
	0:25:00	0.00	0.00	3.06	4.45	5.14	3.80	4.35	4.75	6.12
	0:30:00	0.00	0.00	2.75	3.82	4.25	6.93	7.93	9.05	11.60
	0:35:00	0.00	0.00	1.81	2.46	2.73	5.68	6.48	8.01	10.21
	0:40:00	0.00	0.00	1.20	1.58	1.77	4.15	4.74	5.72	7.29
	0:45:00	0.00	0.00	0.72	1.04	1.21	2.73	3.11	4.06	5.17
	0:50:00	0.00	0.00	0.55	0.86	0.95	2.02	2.30	2.88	3.67
	0:55:00	0.00	0.00	0.50	0.75	0.87	1.44	1.64	2.19	2.81
	1:00:00	0.00	0.00	0.48	0.70	0.85	1.21	1.37	1.95	2.50
	1:05:00	0.00	0.00	0.48	0.68	0.84	1.13	1.28	1.87	2.39
	1:10:00	0.00	0.00	0.39	0.68	0.84	0.93	1.06	1.30	1.66
	1:15:00	0.00	0.00	0.35	0.61	0.84	0.86	0.98	1.04	1.33
	1:20:00	0.00	0.00	0.33	0.54	0.73	0.70	0.80	0.72	0.92
	1:25:00	0.00	0.00	0.32	0.51	0.59	0.63	0.72	0.58	0.73
	1:30:00	0.00	0.00	0.32	0.50	0.53	0.53	0.60	0.53	0.68
	1:35:00	0.00	0.00	0.32	0.50	0.50	0.49	0.55	0.52	0.65
	1:40:00	0.00	0.00	0.32	0.41	0.49	0.47	0.53	0.52	0.65
	1:45:00	0.00	0.00	0.32	0.36	0.49	0.46	0.53	0.52	0.65
	1:50:00	0.00	0.00	0.32	0.35	0.49	0.46	0.53	0.52	0.65
	1:55:00	0.00	0.00	0.23	0.34	0.46	0.46	0.53	0.52	0.65
	2:00:00	0.00	0.00	0.19	0.31	0.39	0.46	0.53	0.52	0.65
	2:05:00	0.00	0.00	0.08	0.14	0.17	0.20	0.23	0.23	0.28
	2:10:00	0.00	0.00	0.03	0.05	0.06	0.08	0.09	0.09	0.11
	2:15:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.02	0.03
	2:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: J Coco
Company: CKE Engineering Inc
Date: June 25, 2022
Project: AuMHC
Location: Water Quality Facility C2

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
(100% if all paved and roofed areas upstream of rain garden)
- B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)
- C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time
($WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)
- D) Contributing Watershed Area (including rain garden area)
- E) Water Quality Capture Volume (WQCV) Design Volume
 $Vol = (WQCV / 12) * Area$
- F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)

$I_a = 90.0$ %

$i = 0.900$

WQCV = 0.32 watershed inches

Area = 26,927 sq ft

$V_{WQCV} = 721$ cu ft

$d_6 =$ in

$V_{WQCV \text{ OTHER}} =$ cu ft

$V_{WQCV \text{ USER}} =$ cu ft

2. Basin Geometry

- A) WQCV Depth (12-inch maximum)
- B) Rain Garden Side Slopes ($Z = 4$ min., horiz. dist per unit vertical)
(Use "0" if rain garden has vertical walls)
- C) Minimum Flat Surface Area
- D) Actual Flat Surface Area
- E) Area at Design Depth (Top Surface Area)
- F) Rain Garden Total Volume
($V_T = ((A_{Top} + A_{Actual}) / 2) * Depth$)

$D_{WQCV} = 12.0$ in

$Z = 4.00$ ft / ft

$A_{Min} = 485$ sq ft

$A_{Actual} = 521$ sq ft

$A_{Top} = 946$ sq ft

$V_T = 734$ cu ft

3. Growing Media

Choose One
☒ 18" Rain Garden Growing Media
☐ Other (Explain):

4. Underdrain System

- A) Are underdrains provided?
- B) Underdrain system orifice diameter for 12 hour drain time
- i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
- ii) Volume to Drain in 12 Hours
- iii) Orifice Diameter, 3/8" Minimum

Choose One
☒ YES
☐ NO

$y = 3.0$ ft

$Vol_{12} = 721$ cu ft

$D_o = 9/16$ in

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: J Coco
 Company: CKE Engineering Inc
 Date: June 25, 2022
 Project: AuMHC
 Location: Water Quality Facility C2

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

☒ YES
☐ NO

PROVIDE A 30 MIL (MIN) PVC LINER WITH CDOT CLASS B GEOTEXTILE ABOVE IT. USE THE SAME GEOTEXTILE BELOW THE LINER IF THE SUBGRADE IS ANGULAR

6. Inlet / Outlet Control

A) Inlet Control

Choose One

☐ Sheet Flow- No Energy Dissipation Required
☒ Concentrated Flow- Energy Dissipation Provided

7. Vegetation

Choose One

☐ Seed (Plan for frequent weed control)
☒ Plantings
☐ Sand Grown or Other High Infiltration Sod

8. Irrigation

A) Will the rain garden be irrigated?

Choose One

☐ YES
☐ NO

Notes: _____

AuMHC
Detention Volume Calculations
6/25/2022

DETENTION POND C

1. EURV

$$EURV = 1.68 * i^{1.28}$$

1.468 Watershed-inches

Impervious % = 90.0%
A = 2.73 acres

V_{EURV} = 0.334 acre-feet V_{EURV} = 14,548 cubic-feet

2. 100-Year Storm Event

$$V = KA$$

$$K_{100} = (1.78 * I - 0.002 * I^2 - 3.56) / 900$$

Impervious % = 90.0%
A = 2.73 acres

$K_{100} = 0.156044$

V=KA Results V₁₀₀ = 0.426 acre-feet V₁₀₀ = 18,557 cubic-feet

Summary

Event	Total Required Volume		Notes:
	acre-feet	cubic feet	
EURV Storm Event	0.33	14,548	EURV
100-Year Storm Event	0.59	25,831	1/2 EURV + 100-Year

Underground Detention System:

Pipe Diameter 5 ft
Area 19.63 ft²
Required Length (Min) 1316 ft

Pipe Field
Main 89 lf
Laterals 95 lf
No Laterals 12.91 Use 13 Laterals
Distance Between Laterals 2 lf
Main Length 89

Underground pipe field size: 95 Long X 89 Wide
Total Pipe Length 1324 lf
Pipe Slope 0.5%
Capacity of System 25996 ft³

AuMHC

Stage Storage Calculations

DATE: 6/25/2022

DETENTION POND C

REQUIRED VOLUMES:

EVENT	VOLUME (ft ³)	VOLUME (ac-ft)
EURV=	14,548	0.33
1/2 EURV + V100=	25,831	0.59

Invert elevation at Bottom of System	78.40
Invert Elevation at Top of System	79.32
Invert Elevation at Mid-point of System	78.86
Pipe Diameter (feet)	5.0

Elevation	Stage in Pipe (FT)	Area (FT ²)	Volume (FT ³)	Volume (AC-FT)	
78.86	0.00	0.00	0	0.00	
79.86	1.00	2.80	3701	0.08	
80.86	2.00	7.33	9711	0.22	
81.59	2.73	10.99	14548	0.33	EURV
81.86	3.00	12.30	16286	0.37	
82.86	4.00	16.84	22295	0.51	
83.74	4.88	19.51	25831	0.59	1/2 EURV + V100
83.86	5	19.63	25997	0.60	

STORM SEWER CALCULATIONS

Storm Line A - 100-year Storm Event

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.00500 ft/ft
Diameter 2.50 ft
Discharge 10.02 ft³/s

Q100

Results

Normal Depth 1.01 ft
Flow Area 1.87 ft²
Wetted Perimeter 3.45 ft
Hydraulic Radius 0.54 ft
Top Width 2.45 ft
Critical Depth 1.06 ft
Percent Full 40.5 %
Critical Slope 0.00429 ft/ft
Velocity 5.37 ft/s
Velocity Head 0.45 ft
Specific Energy 1.46 ft
Froude Number 1.08
Maximum Discharge 31.20 ft³/s
Discharge Full 29.00 ft³/s
Slope Full 0.00060 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 40.55 %
Downstream Velocity Infinity ft/s

Storm Line B - 100-Year Storm Event

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.01000 ft/ft
Diameter 1.50 ft
Discharge 8.44 ft³/s

Q100

Results

Normal Depth 1.02 ft
Flow Area 1.28 ft²
Wetted Perimeter 2.90 ft
Hydraulic Radius 0.44 ft
Top Width 1.40 ft
Critical Depth 1.13 ft
Percent Full 67.9 %
Critical Slope 0.00776 ft/ft
Velocity 6.61 ft/s
Velocity Head 0.68 ft
Specific Energy 1.70 ft
Froude Number 1.22
Maximum Discharge 11.30 ft³/s
Discharge Full 10.50 ft³/s
Slope Full 0.00646 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 67.88 %
Downstream Velocity Infinity ft/s

Storm Line C - 100-Year Storm Event

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.01000 ft/ft
Diameter 2.00 ft
Discharge 8.17 ft³/s

Q100 Basin A8

Results

Normal Depth 0.83 ft
Flow Area 1.23 ft²
Wetted Perimeter 2.80 ft
Hydraulic Radius 0.44 ft
Top Width 1.97 ft
Critical Depth 1.02 ft
Percent Full 41.6 %
Critical Slope 0.00491 ft/ft
Velocity 6.62 ft/s
Velocity Head 0.68 ft
Specific Energy 1.51 ft
Froude Number 1.47
Maximum Discharge 24.33 ft³/s
Discharge Full 22.62 ft³/s
Slope Full 0.00130 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 41.56 %
Downstream Velocity Infinity ft/s

Storm Line C - Emergency Overflow Condition

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	18.78	ft³/s

Q100 Emergency
Overflow Pond C

Results

Normal Depth	1.39	ft
Flow Area	2.33	ft²
Wetted Perimeter	3.94	ft
Hydraulic Radius	0.59	ft
Top Width	1.84	ft
Critical Depth	1.56	ft
Percent Full	69.5	%
Critical Slope	0.00760	ft/ft
Velocity	8.05	ft/s
Velocity Head	1.01	ft
Specific Energy	2.40	ft
Froude Number	1.26	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00689	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	69.55	%
Downstream Velocity	Infinity	ft/s

Storm Line D - 100-Year Detention Pond Release

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.00500 ft/ft
Diameter 2.50 ft
Discharge 4.10 ft³/s

100-Year Detention
Pond Release

Results

Normal Depth 0.64 ft
Flow Area 0.98 ft²
Wetted Perimeter 2.64 ft
Hydraulic Radius 0.37 ft
Top Width 2.18 ft
Critical Depth 0.67 ft
Percent Full 25.4 %
Critical Slope 0.00415 ft/ft
Velocity 4.18 ft/s
Velocity Head 0.27 ft
Specific Energy 0.91 ft
Froude Number 1.10
Maximum Discharge 31.20 ft³/s
Discharge Full 29.00 ft³/s
Slope Full 0.00010 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 25.40 %
Downstream Velocity Infinity ft/s

Storm Line D - Emergency Overflow Condition

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	2.50	ft
Discharge	18.78	ft³/s

Storm Line D
Emergency
Overflow Condition
Pond C

Results

Normal Depth	1.46	ft
Flow Area	2.99	ft²
Wetted Perimeter	4.36	ft
Hydraulic Radius	0.69	ft
Top Width	2.46	ft
Critical Depth	1.47	ft
Percent Full	58.6	%
Critical Slope	0.00495	ft/ft
Velocity	6.28	ft/s
Velocity Head	0.61	ft
Specific Energy	2.08	ft
Froude Number	1.01	
Maximum Discharge	31.20	ft³/s
Discharge Full	29.00	ft³/s
Slope Full	0.00210	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	58.59	%
Downstream Velocity	Infinity	ft/s

APPENDIX D

UNDERGROUND DETENTION REQUEST

May 27, 2022

Haley Busch Johansen
City Engineer
City of Aurora
15151 E. Alameda Parkway
Aurora, CO 80012

Re: Aurora Mental Health Center Stormwater Detention

Dear Haley,

The Aurora Mental Health project is located at Lot 1, Block 1, Care Unit of Colorado Subdivision Filing No 1. More specifically the site is located at 1290 S. Potomac Street in the City of Aurora.

The site is approximately 7.03 acres in size and is currently considering redevelopment of the subject property into a 3-building multi-use site. The proposed uses include the Aurora Mental Health Center, a health clinic, and an affordable housing facility. Parking has been located around the outside of these facilities with the bulk of the parking located at the east end of the site which acts as a buffer to I-225 to the east. The proposed parking count meets the requirements of the parking study prepared for these facilities, and also requires a reduction from the City of Aurora parking criteria. A courtyard area has been created between these facilities that provide essential uses for mental health and at-risk individuals.

We are requesting to provide underground stormwater detention to serve a portion of the site.

The existing site drains from the southeast corner of the property to an existing stormwater detention facility located at the low point of the site at the northwest corner of the property. The site outfall is an existing storm sewer inlet located in S. Potomac Street near the northwest corner of the property.

The proposed stormwater management plan includes 3 water quality/ stormwater detention facilities on-site. Please refer to Exhibit 1. All required detention volumes noted below have been calculated meeting the City of Aurora criteria for sites greater than 5 acres in size ($1.2WQ + 1/2EURV + V100$). Water quality volumes for rain garden facilities have been determined based on Mile High Flood District rain garden criteria.

Detention Pond 1 is located along the S. Potomac Street frontage and captures Basin 1 being the westerly 3.75 acres of the site. Detention Pond 1 is an extended detention basin which captures the water quality, EURV and 100-year storm events for Basin 1. Detention Pond 1 has a capacity of 0.74 ac-ft.

Detention Pond 2 is located in the plaza area between the Aurora Mental Health Center and the health clinic facility. Detention Pond 2 captures Basin 2 being the 0.45-acre plaza between the 2 buildings. This facility will utilize a rain garden to provide water quality, as well as capture the

CKE ENGINEERING INC.

EURV and 100-year storm events. This facility has a capacity of 0.10 ac-ft. Note due the proximity of this facility to the surrounding buildings, and having mental health and at-risk patients, this facility will have a maximum depth of 18" for safety concerns.

Detention Pond 3 is located in the parking lot at the east end of the site and captures Basin 3 being the easterly 2.83 acres of the site. This facility captures the roofs of the Aurora Mental Health Center and health clinic buildings, as well as the adjacent parking lot and drives east of these buildings. Detention Pond 3 will provide water quality above ground by means of a rain garden or EDB facility. An underground detention facility in the parking lot is proposed to capture the EURV and 100-year storm events.

We have considered alternative stormwater management plans which do not require underground detention, but result in negative impacts to the site.

Alternative 1-

Detention Pond 1 is enlarged by shifting the drive east to capture the required stormwater detention volumes in this facility. This alternative results in a 30% reduction in the courtyard amenity area for the development, and the affordable housing facility. Additionally, this increases the distance to 200 feet from the affordable housing to Potomac Street, contradictory to the concept encouraged by the Planning Department. Please refer to Exhibit 2.

Alternative 2-

Detention Pond 1 is enlarged by adding a detention facility in the courtyard area to capture the additional required stormwater detention volume for Detention Pond 1. To meet the required volumes, almost the entire lawn area would need to be replaced with a stormwater detention facility being 5'-6' in depth. This removes an essential lawn area for all of the users on-site and creates an un-safe condition for mental health and at-risk individuals. Please refer to Exhibit 3.

We have prepared a stormwater management plan for the Aurora Mental Health Center project with multiple facilities on-site in an attempt to minimize the need and size of an underground detention facility. At the same time, we feel we have maintained the vision and integrity of a project which emphasizes in mental health, and at-risk individuals.

Please feel free to contact us at your earliest convenience with any questions or concerns.

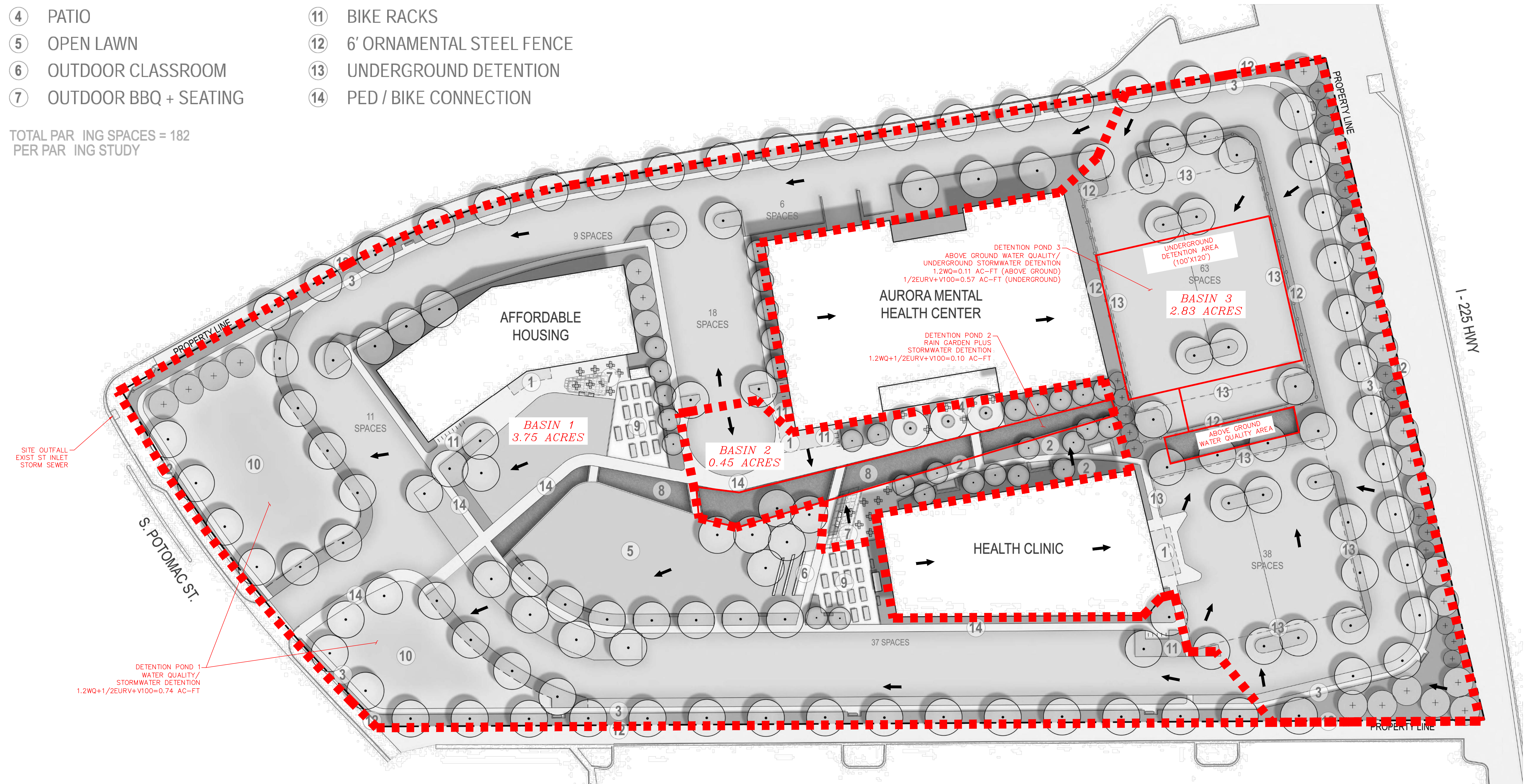
Joe Coco
CKE Engineering Inc

KEY :

EXHIBIT 1 PROPOSED DEVELOPMENT

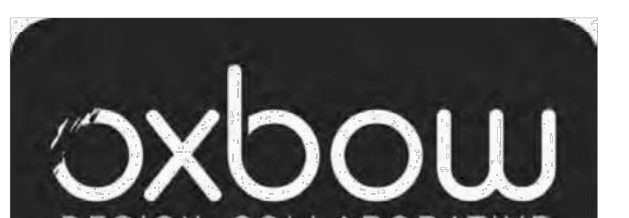
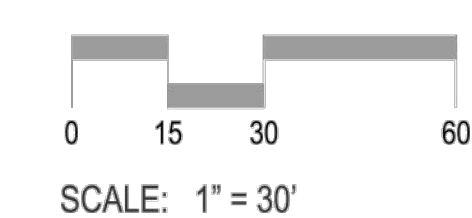
- | | |
|---------------------------|-----------------------------|
| ① ENTRY PLAZA / FORECOURT | ⑧ RAIN GARDEN |
| ② THERAPEUTIC GARDEN | ⑨ COMMUNITY GARDEN |
| ③ CAMPUS LOOP | ⑩ DETENTION POND |
| ④ PATIO | ⑪ BIKE RACKS |
| ⑤ OPEN LAWN | ⑫ 6' ORNAMENTAL STEEL FENCE |
| ⑥ OUTDOOR CLASSROOM | ⑬ UNDERGROUND DETENTION |
| ⑦ OUTDOOR BBQ + SEATING | ⑭ PED / BIKE CONNECTION |

TOTAL PARING SPACES = 182
PER PARING STUDY



AURORA MENTAL HEALTH CENTER / LANDSCAPE MASTER PLAN

Aurora, Colorado



KEY :

- 1

ENTRY PLAZA / FORECOURT
- 2

THERAPEUTIC GARDEN
- 3

CAMPUS LOOP
- 4

PATIO
- 5

OPEN LAWN
- 6

OUTDOOR CLASSROOM
- 7

OUTDOOR BBQ + SEATING
- 8

RAIN GARDEN
- 9

COMMUNITY GARDEN
- 10

DETENTION POND
- 11

BIKE RACKS
- 12

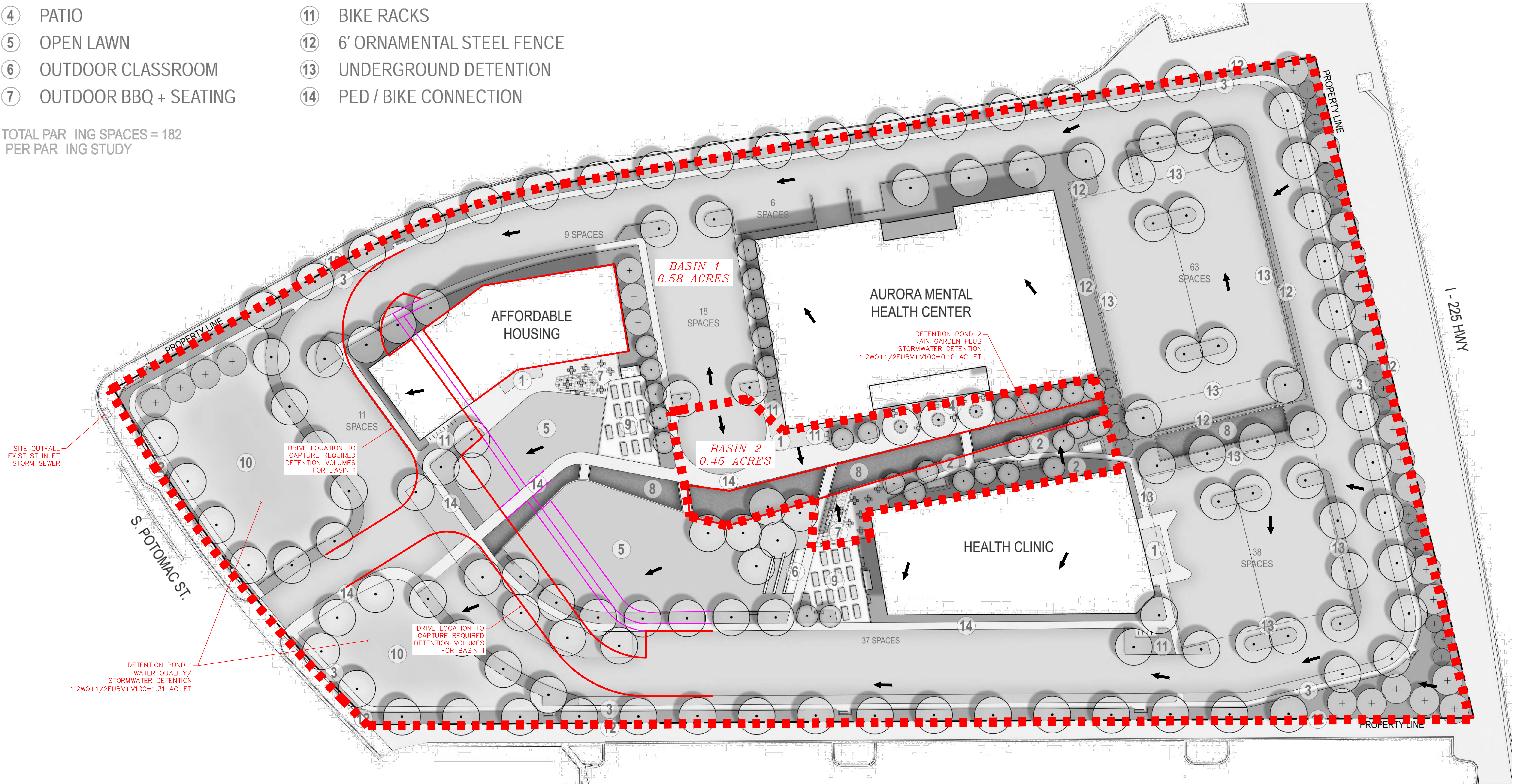
6' ORNAMENTAL STEEL FENCE
- 13

UNDERGROUND DETENTION
- 14

PED / BIKE CONNECTION

TOTAL PARKING SPACES = 182
PER PARKING STUDY

EXHIBIT 2 ENLARGED POND 1
RELOCATED DRIVE



- 1 ENTRY PLAZA / FORECOURT
- 2 THERAPEUTIC GARDEN
- 3 CAMPUS LOOP
- 4 PATIO
- 5 OPEN LAWN
- 6 OUTDOOR CLASSROOM
- 7 OUTDOOR BBQ + SEATING

① ENTRY PLAZA/ FORECOURT	⑧ RAIN GARDEN
② THERAPEUTIC GARDEN	⑨ COMMUNITY GARDEN
③ CAMPUS LOOP	⑩ DETENTION POND
④ PATIO	⑪ BIKE RACKS
⑤ OPEN LAWN	⑫ 6' ORNAMENTAL STEEL FENCE
⑥ OUTDOOR CLASSROOM	⑬ UNDERGROUND DETENTION
⑦ OUTDOOR BBQ + SEATING	⑭ PED / BIKE CONNECTION

① ENTRY PLAZA/ FORECOURT	⑧ RAIN GARDEN
② THERAPEUTIC GARDEN	⑨ COMMUNITY GARDEN
③ CAMPUS LOOP	⑩ DETENTION POND
④ PATIO	⑪ BIKE RACKS
⑤ OPEN LAWN	⑫ 6' ORNAMENTAL STEEL FENCE
⑥ OUTDOOR CLASSROOM	⑬ UNDERGROUND DETENTION
⑦ OUTDOOR BBQ + SEATING	⑭ PED / BIKE CONNECTION



Aurora, Colorado



APPENDIX E

COPIES OF PERTINENT INFORMATION FROM PREVIOUS DRAINAGE REPORTS

FINAL DRAINAGE STUDY

FOR

CAREUNIT OF AURORA
AURORA, COLORADO

February 25, 1987
Revised April 1, 1987

Prepared for:

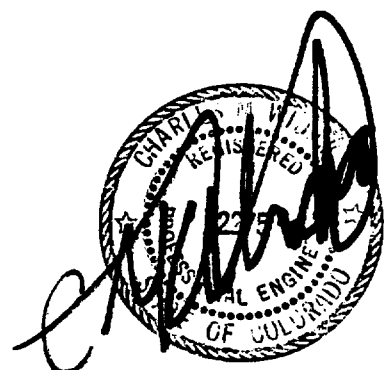
COMPCARE
COMPREHENSIVE CARE CORPORATION
18551 VON KARMAN AVENUE
IRVINE, CALIFORNIA 92715

Prepared by:

GREENHORNE & O'MARA, INC.
3131 SOUTH VAUGHN WAY
SUITE 228
AURORA, COLORADO 80014
(303) 755-9000
Job No. 4049-000-411
Contact: Nancy J. Hild

IIF

870091



Approved for One Year From this Date

5-20-87

6-11-87
H.C. LaBonde
Director of Public Works
5-12-87
D. Brundell
Director of Utilities

5/11/87
Date
5/12/87
Date

The initial (2-year) and major (100-year) storm events were calculated using the Intensity-Duration-Frequency Curves developed for the area south of East Alameda Avenue in the City of Aurora. The runoff coefficients "C" were taken out of the City of Aurora Storm Drainage Criteria and a composite 'C' value was calculated for each basin. Time of Concentration (T_c) was calculated based on UD&FCD equations (3-3) and (3-4) and the UD&FCD Velocity Chart. The 2-year and 100-year frequency runoff rates for historic and developed conditions are summarized in Figure 2.

The existing drainage studies used for reference in this report include: Final Drainage Report for Potomac Square (COA-C6-2-754) which is located northwest of the proposed site; Final Drainage Study for the East by Southeast Subdivision-Filing No. 1 (COA-C8-2-981) which is located south of the proposed site; and the Final Drainage Study for Chaddsford Village - Filing No. 1 (COA-C8-2-370) which is located to the west of the proposed site and details the sizing of a 48" storm sewer in East Louisiana Avenue which eventually intercepts the flows from this upstream basin. Per the City Master Plan and Floodplain Studies, this site is not located within a floodplain zone.

DRAINAGE SYSTEM DESIGN

The 7.04 acre parcel has been divided into 6 developed drainage areas which are shown on the drainage map. Basin 1 drains directly off-site with a 100-year flow of 0.50 cfs which will have no adverse effect on the downstream parcel. Each of the on-site basins develops overland runoff to a single collection point. A composite 'C' value has been calculated for each of these basins because of the vast differences in the surfaces. Basins 2 and 3 are mainly open space with a portion of roof drainage. Basins 4 and 5 consist mainly of parking area, roof, and sidewalks, and therefore have a much larger runoff coefficient than Basins 2 and 3. In order to carry the flows away from and around the building on the south side (Basin 3) a 2' concrete pan will be constructed at 0.5% starting near the southeast corner of the building and draining into the parking lot. This flow and the flow from Basin 4 will collect at a low point located in the southwest corner of the site and will be routed to the detention pond located in the northwest corner via a drop inlet and an 18" storm sewer. Basin 2 drains to a low point located near the north corner of the conversation area, where it is

SUMMARY OF DISCHARGES

(SEE FIGURE 3 FOR BASIN DELINEATIONS)

DESIGN POINT	CONTRIBUTING AREA (ACRES)	RUNOFF 2-YEAR (CFS)	PEAK 100-YEAR (CFS)
<u>ON-SITE</u>			
<u>HISTORIC FLOWS</u>			
Basin H-1	2.90		2.3
Basin H-2	1.25		1.0
Basin H-3	2.89		<u>2.3</u>
			5.6
<u>DEVELOPED FLOWS</u>			
1	0.36	0.0	0.5
2	2.22	0.7	3.6
3	1.61	1.5	2.9
4	0.85	2.4	7.3
5	1.93	5.2	15.9
6	0.10	0.3	1.0

Figure 2

intercepted by a flared end section and 15" pipe and then discharged into the parking lot. In case the flared end section to the pipe is clogged, this low point will act as a detention area with the emergency overflow draining onto the site to the north. Because this basin is mostly landscaping with only a small portion of roof and patio drainage, the flow generated is similar to the historic flow. At the outlet of the 15" pipe, the flow will drain towards the detention pond along the north curb line and through open curb cuts in the medians. Basins 2, 3, 4, and 5 will be detained in the detention pond located at the northwest corner of the site with an allowed release rate of 4.1 cfs. Basin 6 which consists of the entrance into the center will drain directly off site, run along the curb line and be intercepted by the 10' Type 'R' inlet. The 100-year flow generated from this area is 1.0 cfs. Therefore, the total historic release rate of 5.6 cfs will be maintained. An emergency overflow weir will be located at the northwest corner of the detention pond. The elevation of this weir is 80.4 which is equal to the elevation of the 100-year detained storm. A detailed drawing of this weir is located in the Appendix. The 2-year storm event will not overtop the curb as shown in the calculations also in the Appendix. The site has been graded to ensure adequate drainage away from the building and sidewalk areas for safety and maintenance purposes. Along the Potomac Street frontage, landscaped berms will be graded as a buffer to the rehabilitation center and the detention ponds.

The historic flow of 4.1 cfs released from the detention pond will tie into the existing 10' Type 'R' inlet located just north of the site on the east side of Potomac Street. In the Potomac Square Study (COA-C6-2-754), this inlet and pipe have been designed to carry the "developed with detention" flow of 40.0 cfs for 100-year flows and 39.0 cfs for 2-year flows. Careunit of Aurora is within these parameters by releasing only at its historic rate. The existing pipe under Potomac is a 29" x 45" elliptical R.C.P. at a grade of 1.0% (Capacity = 67 cfs). This flow is then routed through a 36" R.C.P. at 0.40% (Capacity = 42 cfs) where it is discharged into a drainage ditch on the south side of Louisiana Avenue. This ditch has been designed to carry the 100-year developed flow and will eventually be piped when the area to the south of the ditch is developed.

CONCLUSIONS

This report has been prepared in accordance with the City of Aurora Standards for Final Drainage Studies. It has outlined the routing of the 2-year and 100-year storm events through the project drainage system. It has been designed with the use of on-site detention to release flows off of the site at the historic rate. These proposed improvements provide adequate protection to this site without adverse impacts on adjoining upstream and downstream properties.

SUBDIVISION AROUND OF AURORA
 LOCATION POTOMAC + LOUISIANA
 DESIGN STORM 2 YR RECURRENCE INTERVAL
 COMPUTATIONS BY NJH DATE 11/6/86
 SUBMITTED BY _____ DATE _____
 (Engineering Firm)

CITY OF AURORA, COLORADO
 STORM DRAINAGE SPECIFICATIONS

RUNOFF COMPUTATIONS
 (Rational Method)

PAGE 7 OF _____

Design Point	Area Designation	A (Acres)	c	c _f	$\bar{c} = (c+c_f)/2$	A · \bar{c}	$\Sigma A \cdot \bar{c}$	t _c (min)	i (in/hr)	Q = ($\Sigma A \cdot \bar{c}$) · i cfs	Slope (S)	Length L (feet)	VEL* V fps	t (min)	Remarks
<u>1</u>		0.36	.00	-	.00	0.0		12.7	2.6	0.0					
<u>2</u>		2.22	.20	-	.20	.44		27.9	1.6	0.7					
<u>3</u>		1.61	.49	-	.49	.79		21.7	1.9	1.5					
<u>4</u>		0.85	.71	-	.71	.60		5.0	4.0	2.4					
<u>5</u>		1.93	.67	-	.67	1.29		5.4	4.0	5.2					
<u>6</u>		0.10	.87	-	.87	0.09		5.0	4.0	0.3					RELEASED DIRECTLY OFF SITE

* These values must be substantiated with additional computations or use of appropriate charts, etc.

August, 1969

Form SD 1-3

SUBDIVISION CAREUNIT OF AURORA
 LOCATION PITOMAC + LOUISIANA
 DESIGN STORM 100 YR RECURRENCE INTERVAL
 COMPUTATIONS BY NJH DATE 11/6/86
 SUBMITTED BY _____ DATE _____
 (Engineering Firm)

CITY OF AURORA, COLORADO
 STORM DRAINAGE SPECIFICATIONS

RUNOFF COMPUTATIONS
 (Rational Method)

PAGE 8 OF _____

Design Point	Area Designation	A (Acres)	c	c _f	$\bar{c} = (c+c_f)/2$	A · \bar{c}	$\Sigma A \cdot \bar{c}$	t _c (min)	i (in/hr)	Q = ($\Sigma A \cdot \bar{c}$) · i cfs	Slope (S)	Length L (feet)	VEL ^a V fps	t (min)	Remarks
<u>1</u>		.36	.20	-	.20	.07		12.7	7.0	0.5					
<u>2</u>		2.22	.37	-	.37	.82		27.9	4.4	3.6					
<u>3</u>		1.61	.35	-	.35	.56		21.7	5.1	2.9					
<u>4</u>		0.85	.79	-	.79	.67		5.0	10.82	7.3					
							1.23	21.7	5.1	6.3					BASINS 3+4 CONSIDERED AS ONE
<u>5</u>		1.93	.76	-	.76	1.47		5.4	10.82	15.9					
							2.29	27.9	4.4	10.1					BASINS 2+5 CONSIDERED AS ONE
<u>6</u>		0.10	.89	/	.89	0.09		5.0	10.82	1.0					RELEASED DIRECTLY OFF-SITE

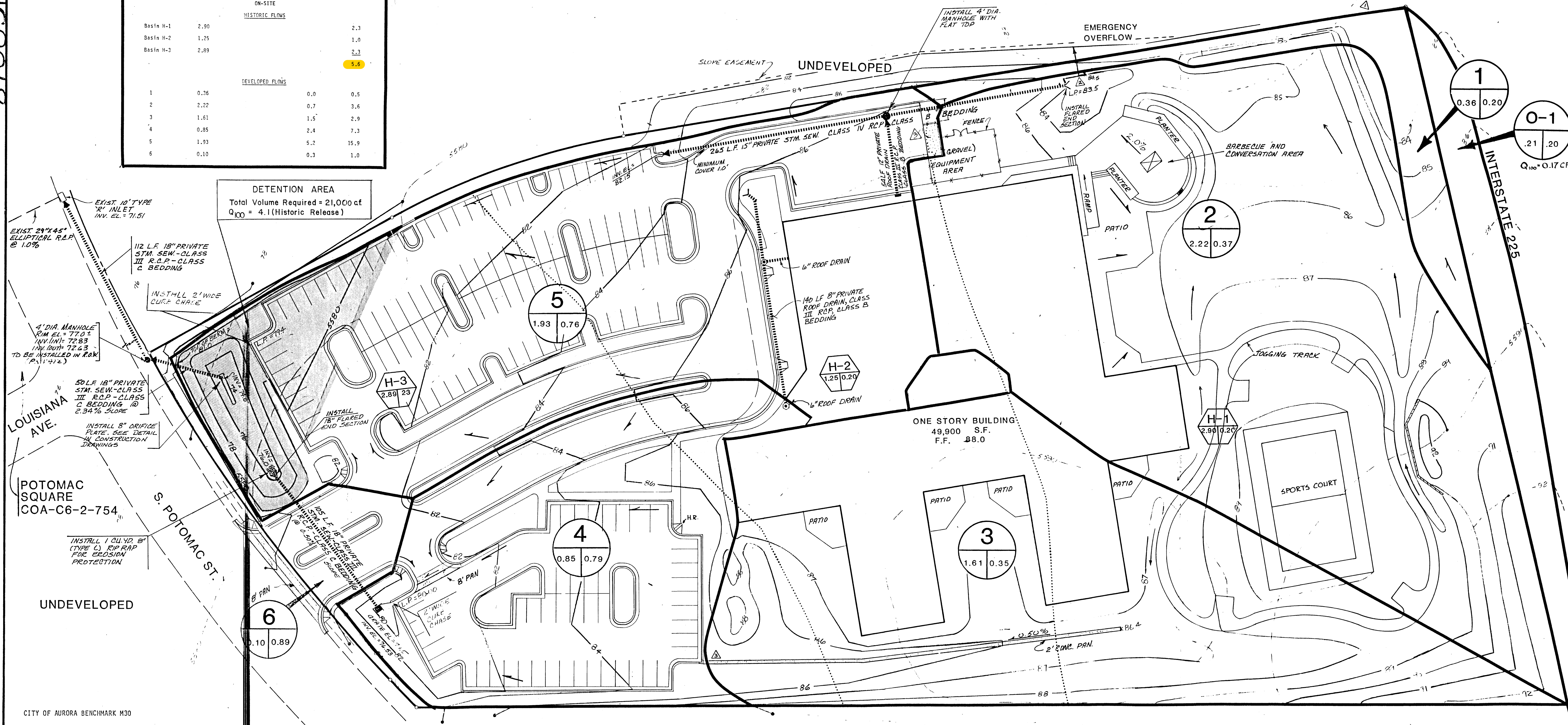
^a These values must be substantiated with additional computations or use of appropriate charts, etc.

August, 1969

Form SD 1-3

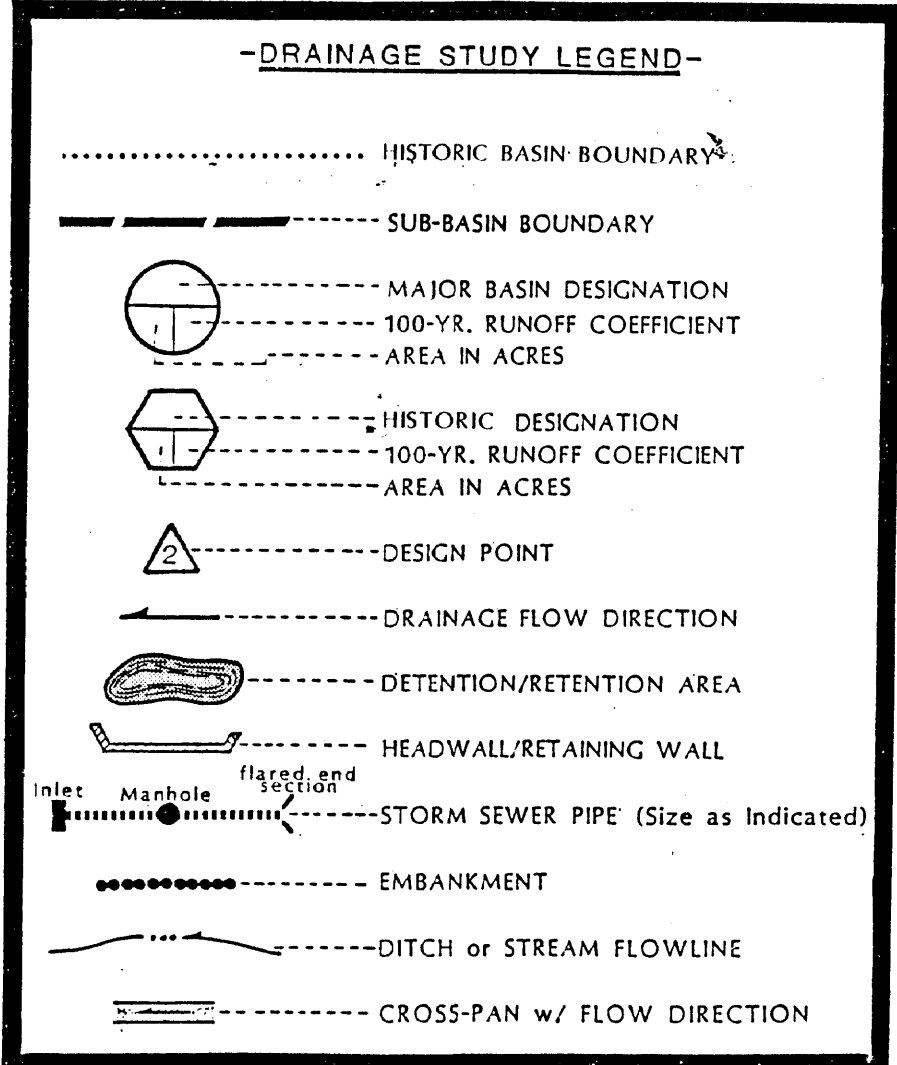
370091

SUMMARY OF DISCHARGES			
DESIGN POINT	CONTRIBUTING AREA (ACRES)	RUNOFF 2-YEAR (CFS)	PEAK 100-YEAR (CFS)
ON-SITE HISTORIC FLOWS			
Basin H-1	2.90		2.3
Basin H-2	1.25		1.0
Basin H-3	2.89		2.3
			5.6
DEVELOPED FLOWS			
1	0.36	0.0	0.5
2	2.22	0.7	3.6
3	1.61	1.5	2.9
4	0.85	2.4	7.3
5	1.93	5.2	15.9
6	0.10	0.3	1.0

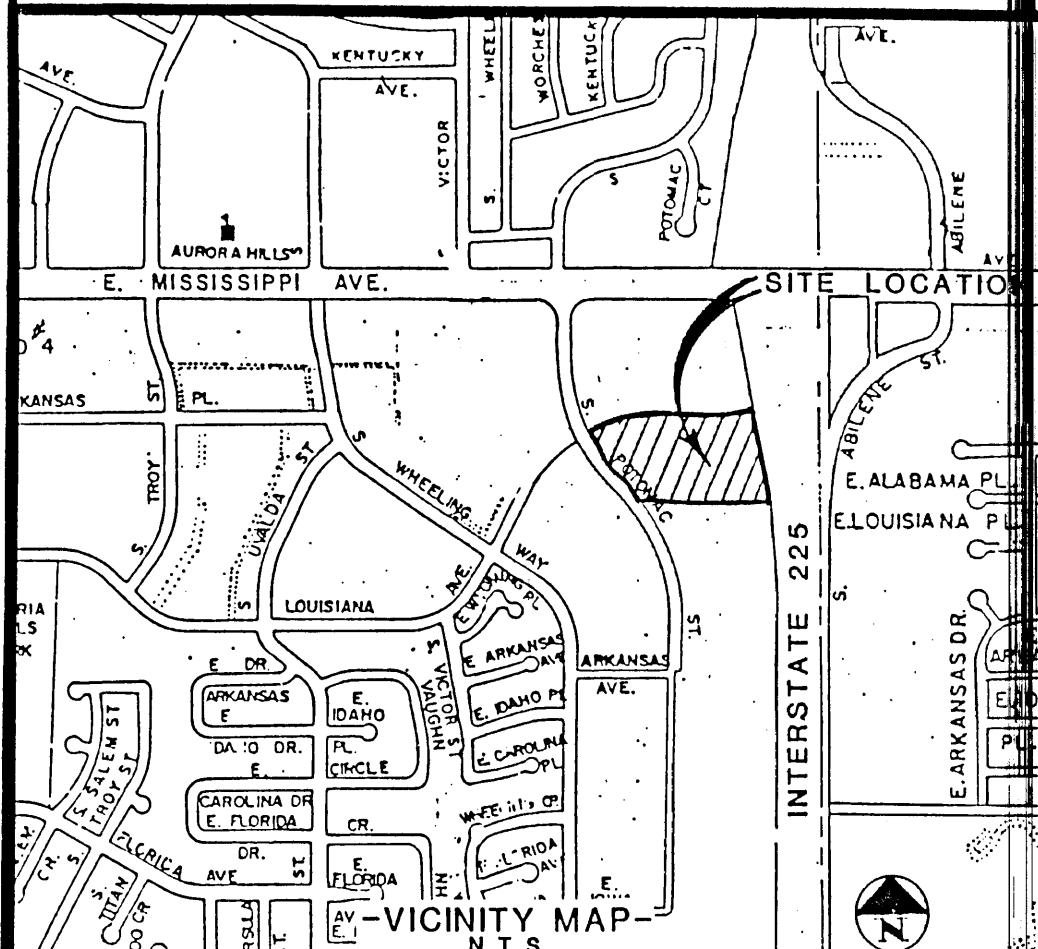


DETENTION AREA
Total Volume Required = 21,000 cf
Q₁₀₀ = 4.1 (Historic Release)

EAST BY SOUTHEAST SUBDIVISION
FILING NO. 1
COA-C8-2-981



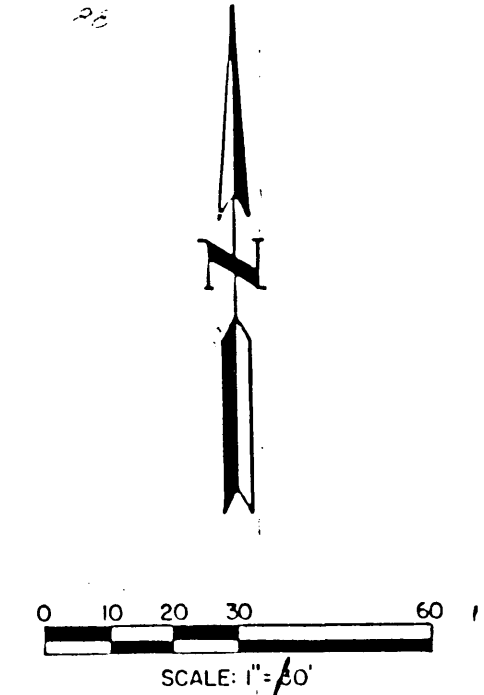
- NOTES:
- CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS AND ELEVATION WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOBSITE. THE CITY OF AURORA THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO OTHER RESPONSIBILITY OTHER THAN AS STATED ABOVE FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.
 - DEPTH OF PONDING SHALL NOT EXCEED 1.0 FEET IN ANY PARKING SPACE OR 1.5 FEET IN ANY DRIVING LANE.
 - THE CITY OF AURORA SHALL NOT BE LIABLE FOR THE MAINTENANCE OF IMPROVEMENTS LABELED AS "PRIVATE".



LANDSCAPE ARCHITECT / PLANNER:
A. GENGARO & ASSOCIATES
155 SOUTH MADISON ST.
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DENVER, COLORADO 80209
(303) 333-1464
CONTACT: ANTHONY GENGARO

Approved for One Year From this Date
5-20-87

Director of Public Works	Date
Director of Utilities	Date



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(303) 333-1464

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CAREUNIT OF AURORA
FIGURE 3
FINAL DRAINAGE PLAN
1986-3066 870091

Designed by: N.J.H.
Checked by: PK.W.
Date: FEB. 1987

Job No: 4049-FIN-411
Scale: 1" = 30'