FINAL DRAINAGE REPORT

FOR

CROSSROADS MIXED USE FILING NO. 1
EL PASO COUNTY, COLORADO

APRIL 2022

Prepared for:

Crossroads Metropolitan District No. 1
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Project #18-003A
PCD Filing No.: SF 21-029

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DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc

COLORADO REGISTERED
VIRGIL A. SANCHEZ
37160
04/21/22
PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT

I, the developer have read and will comply with all the requirements specified in this drainage report and plan.

BY:_____
Danny Mientka –Owner

DATE: 4-22-2022

ADDRESS: Colorado Springs Equities LLC
90 South Cascade Avenue, Suite 1500
Colorado Springs, CO 80903

EL PASO COUNTY'S STATEMENT

Filed in accordance with the requirements of El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Manual, as amended.

BY:_____ DATE:_____
Jennifer Irvine, P.E.
County Engineer / ECM Administrator

CONDITIONS:

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Purpose

This Final Drainage Report for Crossroads Mixed Use Filing No. 1 is in support of the Final Plat, Preliminary Plan, and Construction Drawings of the subject site. This report functions to identify the existing and proposed runoff patterns and recommend proposed drainage improvements which are intended to safely convey runoff through the proposed development, while minimizing impacts to downstream facilities and adjacent properties.

The Final Plat and Construction Drawings for this site will be submitted concurrently with this report. Individual drainage letters and/or reports shall be required with the development of each lot not otherwise clearly analyzed by this report for Crossroads Mixed Use Filing No. 1. This report is subject to changes dependent upon future lot development. In such case, an updated report and accompanying drawings shall be submitted.

Project Location and Description

The subject site is located at 0 Meadowbrook Parkway in the southwestern quarter of Section 8, Township 14 South, Range 65 West of the 6th P.M. in El Paso County, Colorado. The 29.049 Acre site is currently undeveloped. The site is bound to the west by undeveloped Softball West Subdivision Filing No. 2, to the north by Meadowbrook Crossing Subdivision, south by Highway 24, and to the east by Newt Drive.

The proposed site is will be developed into ten (10) commercial lots, one (1) multifamily residential lot, and three (3) tracts for detention and roadway use. The development will extend Meadowbrook Parkway to the west and will include a single lane roundabout to be constructed at the intersection of the Meadowbrook Parkway and Newt Drive. The property is within the commercial aviation district overlay. A rezone application has been approved to rezone 12.703 acres from CR to the RM-30 Zone.

The majority of the existing site is covered with native grasses with fair to good cover, the exception being portions of the future Meadowbrook Parkway corridor where exposed soils are present. Known earthwork operations for “borrow material” have occurred over a small area of the eastern portion of the site in early to mid 2019, but have since stabilized. A few dirt paths/trails are present along the far west end of the site, likely from recreational vehicles. Generally, the site slopes from east to west slightly greater than 1% with some localized depressions and general terrain undulations near the west boundary that have slopes ranging from 1- 20%. Some of these may be the results of previous earthwork activities. The site lies within the Sand Creek Drainage

Basin. No existing drainage facilities or improvements are onsite. No known irrigation systems or wells are present.

Soils

Soils in the project area have been determined to be Blakeland Loamy Sand (8) and Blendon Sandy Loam (10), which are characterized to be part of Hydrologic Soil Types "A" & "B" as determined from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) "Web Soils Survey". A soils map illustrating the site location and soil types is provided in the appendix of this report.

Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Nos. 08041C0754 G & 08041C0752 G, effective date December 7th, 2018, none of the site lies within a designated floodplain. A copy of these annotated maps can be found in the appendix. The Sand Creek East Fork Channel is located to the northwest of the adjacent Meadowbrook Crossing subdivision.

Previous Studies

The area which encompasses Crossroads Mixed Use Filing No. 1 has been previously studied. Below is a short outline of the assumptions regarding the lands of the subject site and those based upon the previously assembled and approved drainage reports and how the assumptions within them impact the subject site.

"Sand Creek Drainage Basin Planning Study, Preliminary Design Report", prepared by Kiowa Engineering Corporation, dated January 1993, revised March 1996.

- Establishes that the subject site falls within the East Fork Sand Creek Drainage Basin, a portion of the larger Sand Creek Watershed
- Establishes that there are no requirements for major infrastructure improvements and subsequently no drainage-improvement related reimbursements with the development of this parcel
- Drainage fees shall be required to plat the subdivision

"Claremont Business Park Filing No.2 prepared by Matrix Design Group, revised November 2006

- Establishes the drainage patterns of offsite Basins 0S-4 and E2 which are to be conveyed within the Meadowbrook Rights of Way
- Established up-gradient offsite drainage to be directed under Meadowbrook north to offsite East Fork Sand Creek Channel, and away from the subject site

"Final Drainage Report, Lot 1 24/94 Business Park Filing No.1 prepared by Core Engineering Group, dated July 14, 2016

- The development of the 24/94 Business Park FDR shows future curb inlets along the future Meadowbrook Parkway extension on the south and west corners of the intersection to capture runoff from up-gradient watersheds in addition to a proposed inlet which was to be located above the intersection at the northwest corner of the subject site.
- Establishes that flows from the parcel upstream of the convenience store (29/94 FDR Basin OS4) EX-B now to be collected by the extension of a 36" RCP along the south side of Meadowbrook Parkway. Runoff within the right of way/roadway separated out as Basin EX-A2.
- Continues assumption that flows from Newt Drive be conveyed north to East Fork Sand Creek.
- Evaluated pre-development drainage patterns for subject site including direct discharge flow rates to the CDOT rights of way of 1.9 and 14.5 cfs for the 5 and 100 year events, respectively. (Basin EX-E).

"Preliminary and Final Drainage Report Meadowbrook Crossing Filing No. 1 and Filing 2, El Paso County, Colorado prepared by Kiowa Engineering Corporation, dated July 25, 2017

- Proposed the installation of a future 10' Type R inlet at the southeast corner of Newt Drive and Meadowbrook Parkway with the extension of Meadowbrook Parkway to the west (along the northern boundary of the subject site). The inlet was to function to collect offsite runoff from a portion of the south half of Meadowbrook Parkway and Newt Drive north of Hwy 24. Intercepted runoff would be conveyed via a proposed 24" storm sewer to the existing storm sewer system within the Meadowbrook Crossings development.
- Proposed the installation of a 10' Type R inlet at the west end of future Meadowbrook Parkway. The inlet was to collect runoff from the north half of the future roadway. An 18" storm drain was proposed to convey collected runoff to the existing water quality pond located within the Meadowbrook Crossings Development. The report indicates a separate forebay or the modification of an existing forebay would be required.
- Shifted the location of the existing 10' Type R curb inlet to be installed upstream of the intersection of Newt Drive (as shown with the 24/94 Business Park FDR), flows in excess of the inlet capacity are to continue within the future Meadowbrook.

"Final Drainage Report for Meadowbrook Dirt Borrow Site, El Paso County Colorado, prepared by M&S Civil Consultants, November 2018.

- Evaluated onsite drainage patterns
- Excluded offsite runoff impacts from areas to the east of site.
- Allowed site to be utilized as a "borrow site" for offsite earthwork activities.

Hydrologic Calculations

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual and where applicable the Urban Storm Drainage Criteria

Manual. The Rational Method was used to estimate stormwater runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

Hydraulic Calculations

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. Grassed swale cross sections were analyzed using an open channel flow calculator with parameters such as a surface roughness coefficient of 0.025 (good condition w/ little to no stones or weeds). Topographical information was used to define swale geometry, and design point flows were used to obtain channel flow depths and velocities at their maximum design capacity for flood and erosion control considerations. Storm drains were designed using parameters and criteria summarized in Chapter 8 of El Paso County's Drainage Criteria Manual Vol. 1 and the City of Colorado Springs Drainage Criteria Manuals. Parameters such as Manning's values of 0.13 were used for concrete pipe flow, and design considerations for minimum freeboard and maximum velocities were applied. The relevant data sheets are included in the appendix of this report. Hydraulic grade line calculations for the storm system in the ultimate (future) condition are provided in the Appendix of this Final Drainage report.

Drainage Criteria

This drainage analysis has been prepared in accordance with current El Paso County Drainage Criteria Manual and, where applicable, City of Colorado Springs and Mile High Flood District Criteria Manuals. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 100 acres. See Appendix for supporting calculations.

Historic (Pre-Grading) Drainage Characteristics

The historic drainage patterns discussed within this report reflect the site conditions prior to the approval of the 2018 Meadowbrook Dirt Borrow Site Grading and Erosion Control Plan. This 'historic condition' generally coincides with the existing condition analysis and mapping that accompanied that project's hydrologic analysis.

The following excerpt is from the existing Drainage Characteristics section of the Final Drainage Report for Meadowbrook Dirt Borrow Site, El Paso County, Colorado, by M&S Civil Consultants and adequately describes the general site characteristics prior to grading.

"Site vegetation is sparse, consisting primarily of native grasses and weeds. The parcel possesses a ridgeline that bisects the parcel, directing runoff to the south and west boundaries, with slopes varying from 1% to 20%. A few small depressions are located on site, near the west boundary. For the purposes of hydrologic analysis, the small depressions are not considered to detain runoff."

Given the increase in breadth and scope of this study, significant consideration of the impacts of offsite drainage from the adjacent developments will be evaluated. This includes drainage from a small portion of Hwy 24 which combines with flows within existing from portions of Newt Drive. Runoff from this offsite area combines with by-pass flows from two inlets located within existing Meadowbrook Drive, prior to entering the site at its northeast corner. Runoff from these locations ultimately combines with onsite flows within the proposed Meadowbrook Parkway corridor, prior to discharging to downstream properties.

The detailed description of the historic (pre-grading) condition is as follows. Please refer to the historic conditions drainage map which is provided within the appendix of this report.

Historic Conditions - Detailed Drainage Discussion

Design Point 1

Basins E2 and EX-A2 geometry were derived from their respective reports. Flow velocity equations, conveyance coefficients, and time of concentration equations have been modified since these reports were approved, therefore, these parameters were remodeled with El Paso's hydrologic criteria current to this report's date. Excerpts of reported calculations for these basins are provided in the Appendix for comparison. **Basin E2 (Claremont Business Park Filing No.2)** consists of a reported 3.86 developed acres of development located along the southeastern half of existing Meadowbrook Parkway, some 1200' northeast of the subject site. Runoff produced by the offsite development (CBPF2 Lot 46) is conveyed to Meadowbrook Parkway at flow rates of Q5=15.1 and Q100=28.6 cfs in the 5 and 100-year storm events respectively. The collected flows combine with runoff from **Basin EX-A2 (Lot 1 24/94 Business Park Filing No.1)** (Q5=2.5, Q100=4.5 cfs) which consists of 0.59 acres of the southeastern half of Meadowbrook Parkway, and is located immediately east of existing Newt Drive. The collected flows from the two basins culminate at **Design Point 1** at peak rates of Q5=14.2 and Q100=26.5 cfs. An existing 10' CDOT Type R at-grade inlet (**Inlet 1**) intercepts flows of Q5=8.4 and Q100=11.1 cfs, with subsequent by-pass flows of 5.8 and 15.4 cfs in the 5 and 100 year events. Surface flows continue west within the south half of existing Meadowbrook Parkway.

Design Point 2

Basin OS-A (Meadowbrook Crossing Filing 1 and 2) consists of 1.29 acres of the northern half of existing Meadowbrook Parkway located immediately east of Newt Drive. Runoff produced within this basin totals Q5=3.1 and Q100=6.0 cfs. These calculated flows differ 0.1 cfs from reported flows due to the significant digits used for the basin acreage in the flow calculation, yet can be viewed as conservative values since they are higher. An existing 10' CDOT Type R at grade inlet (**Inlet 2**) collects runoff of Q5=3.1 and Q100=5.3 cfs, with subsequent by-pass flows in only the 100 year event of 0.7 cfs. Runoff leaving the design point continuing west within the north half of existing Meadowbrook Parkway.

Design Point 3

Basin OS-1 consists of approximately 1.28 developed acres of existing Newt Drive located along the eastern boundary of the site. Runoff produced within the basin (Q5=5.8 cfs, Q100=10.5 cfs)

combine with flow-by from **DP1** in the intersection at peak flow rates of 9.8 cfs, and 22.5 cfs in the 5 and 100-year storm events.

Surface runoff and by-pass flows from both **DP2** and **DP3** enter **Basin A** in the undeveloped rights of way of future Meadowbrook Parkway, at the northeast corner of the site.

Design Point 4

Basin A consists of 12.88 undeveloped acres located along the northern boundary that drains from east to west across the subject site. Runoff produced by this basin (Q5=1.9 cfs, Q100=14.2 cfs) combine with flowby from **DP2** and flows from **DP3.** The cumulative runoff at **DP4** of Q5=7.4 cfs and Q100=27.7 cfs discharges onto the adjacent property (Lot 1, Softball West Subdivision 2) along the western boundary of the site, approximately 250' to south of the northern property line.

Design Point 5

Basin B consists of 13.63 undeveloped acres located along the western side of the subject site. Runoff produced by the basin generally flows from northeast to southwest, discharging onto the adjacent property (Lot 2, Softball West Subdivision 2) approximately 200' north of the southern property line. Runoff reaching the boundary at **DP5** are calculated at 2.5 cfs and 18.2 cfs in the 5 year and 100 year events, respectively.

Design Point 6

Basin C currently consists of 5.89 undeveloped acres located along the southern boundary of the site. Runoff produced within the basin travels east to west as sheet flow before eventually discharging into the existing barrow ditch which travels along the US HWY 24 CDOT right of way**.** Peak runoff rates reaching the subdivision boundary at **DP6** are calculated at 1.2 cfs and 8.5 cfs in the 5 year and 100 year events respectively.

Design Point 7

Basin OS-2 consists of 4.98 acres of a portion of the northern half of the US HWY 24 roadway and the adjoining, native, grass-lined barrow ditch. Runoff produced within the basin (Q5=8.7, Q100=19.6 cfs) combines with flows from **DP6** at cumulative peak runoff rates of 10.4 and 31.9 cfs in the 5 and 100 year storm events at **DP7**. A modeled hydraulic cross section of the ditch section at **DP7** calculates flow depths of 0.59 feet traveling at a velocity of approximately 4.02 feet per second. Input parameters for this analysis can be found in the Hydraulics section of the Appendix. The roadside ditch at this design point was selected as the suitable downstream outfall, therefore, intermediate events have been routed through the site to compare predevelopment to post development flows at this point. Calculations are provided in the Roadside Ditch Intermediate Events Routing Summary in the appendix.

Runoff from **Design Points 4 and 5** ultimately combine with the flows from **DP7** within the barrow ditch of US Hwy 24 several hundred feet downstream of the subject site. An existing 36" RCP culvert located at the interchange of HWY 24 and Peterson Road aids in conveying a portion of the runoff from the subject site and adjacent offsite areas under the roadway. Flows in excess of the culverts carrying capacity, overtop the roadway before rejoining within a subsequent drainage swale

that parallels the west bound HWY 24 on-ramp. Ultimately flows discharge into the East Fork of the Sand Creek via an existing riprap rundown. Site visits conducted by M&S Civil at the time of the writing of this report, found no significant signs of erosion or deposition along the aforementioned corridor.

A Drainageway Exhibit in the appendix of this report provides an aerial illustration of the aforementioned conveyance route to the channel, which will also serve to function as the emergency overflow path for the proposed site development.

Existing Drainage Characteristics

The subject site has been utilized as a "borrow site" to provide surplus earthwork to offsite developments in the area. This recent grading effort occurred during the spring and summer of 2019. At the request of El Paso County, an existing conditions drainage analysis has been provided to show the changes to the topography and drainage patterns as a result of this effort. As the only changes between the two conditions are onsite, the offsite drainage patterns calculations and assumptions determined within the historical analysis will remain the same. Specifically, basins **E2**, **EX-A2**, and **OS-2** remained the same. This correlates to **DP1**, **DP2**, and **DP3** remaining the same. It should be noted that the subject site was not disturbed to the full extent of the approved plan, with limited excavation primarily occurring within the eastern side of the site.

In the existing condition, vegetation remains sparse, consisting primarily of native grasses and weeds with good to fair cover. Areas disturbed by grading activities were reseeded and have since stabilized. With regards to historic versus existing drainage basin delineation, the bisecting parcel ridgeline has been relocated further to the south, which results in redirecting more of the runoff to the southwestern part of the site and less to the CDOT rights of way. The few small depressions remain on site, near the west boundary. For the purposes of hydrologic analysis, these small depressions will continue to not be evaluated for their ability to detain runoff. Ultimately, all runoff from the parcel is conveyed to the west towards existing drainage facilities located under Peterson Road and ultimately the East Fork of Sand Creek as in the historic condition.

This section only discusses the changes in basin geometry and drainage pattern and provides a direct comparison of the historic versus existing conditions, utilizing the same outfall (design) points, which have remained undisturbed.

<u>Design Point 4</u>
Basin A (Q5=1.5, Q100=11.1 cfs) currently consists of 11.02 acres which continues to drain from east to west eventually discharging along the western boundary of the site, approximately 250' south of the northern property line. Peak runoff, post-grading, has decreased to 7.1 and 25.5 cfs as compared to the historic condition flow rates of 7.4 and 27.7 cfs in the 5-year and 100-year events respectively.

<u>Design Point 5</u>
Basin B (Q5=2.0, Q100=14.5 cfs) consists of 17.31 acres that drains from northeast to southwest, eventually discharging along the western boundary of the site, approximately 200' north of the

southern property line. Peak runoff rates at this location are also than lower than the historic conditions with post grading flows of 2.0 cfs and 14.5 cfs, as compared to 2.5 cfs and 18.2cfs in the 5-year and 100-year events respectively. Despite the basin currently being larger in area than in the historic condition, a decrease in the peak flow rates occurs as a result of a longer flow path to the given design point.

Design Point 6

Basin C consists of 3.99 undeveloped acres that drains from east to west into the US HWY 24 Right of Way at the southern boundary of the site. The peak runoff at this location is less than the historic condition at an estimated 0.9 and 6.3 cfs, as compared to 1.2 and 8.5 cfs in the 5-year and 100-year events, respectively.

Design Point 7

Basin OS-2 (Q5=8.7, Q100=19.6 cfs) consists of 4.98 acres of the northern half of the US HWY 24 roadway and adjoining native grass lined barrow ditch. Runoff produced within the basin combines with runoff from the subject site at lower cumulative peak runoff rates of 9.9 and 28.0 cfs in the 5 and 100-year storm events at **DP7** as compared to 10.4 and 31.9 cfs in the historic condition. A cross section of the ditch at this location was analyzed in the 100 yr event for comparison purposes and is provided in the appendix.

Four Step Process

Step 1 Employ Runoff Reduction Practices – Approx. 2.54 acres of the proposed development is being set aside for a Full Spectrum Detention (FSD) Pond. Whenever possible, runoff produced within developable area containing impervious surfaces will be routed through landscaped areas or earthen swales (grass-lined where slope exceeds 2%) to minimize direct connection of impervious surfaces. In the interim, runoff will be reduced through the use of (4) temporary sediments ponds until the ground has been stabilized with vegetation or permanently developed.

Step 2 Stabilize Drainageways – The development of this site is not anticipated to have negative effects on downstream drainage ways since flows released will be below historic rates. In the interim, the site proposes four temporary sedimentation ponds, before discharging at the southwest property corner of the site and onto an adjacent undeveloped property via riprap-lined spillways. This ensures that in this stage of the development negative effects on the downstream drainage ways will be avoided.

In the proposed and future conditions, the flow is discharged to the same location offsite through an RCP pipe outfall lined with rip rap. From here it continues southwest in CDOT's man-made roadside ditch until it reaches Peterson Road. It is then conveyed to the other side of the road, into a similar earthen channel, via a 36" CMP culvert. The drainage continues southwest in the right of way, until it reaches the East Fork Sand Creek Channel. Existing rip rap barriers are lined throughout this portion of the pathway approximately every 90-100 feet within the ditch to the channel bank. The Drainageway Exhibit provided in the Drainage Maps section of the Appendix provides a visual representation of this information. Roadside ditch calculations for various storm events are provided

for the selected suitable downstream outfall (project site's discharge location) to ensure the facility can adequately contain and convey the flows.

Step 3 Provide Water Quality Capture Volume (WQCV)– The site will use a Full Spectrum Detention (FSD) Pond to control developed runoff that is discharging into an existing CDOT ROW roadside ditch and ultimately into Sand Creek. The FSD pond's outlet structure will be designed to drain the water quality event storm in 40 hours, while reducing the 100 year peak discharge to approximately 90% of the predevelopment conditions.

Step 4 Consider Need For Selecting Industrial And Commercial BMP's – The proposed development will implement a Stormwater Management Plan including property housekeeping practices, spill containment procedures, and coverage of storage/handling areas. Specialized BMP's are not required since the vertical development of the commercial areas are unknown at this time.

Future Drainage Characteristics

The future site will be developed into ten (10) commercial lots, one (1) multifamily residential lot, and three (3) tracts for detention and roadway use. The proposed development will extend Meadowbrook Parkway to the west and will include a single lane roundabout to be constructed at the intersection of the Meadowbrook Parkway and Newt Drive to aid in traffic control. A proposed private looped roadway, consisting of Southern Rail Point and Pacific Rail Point will extend into the site to provide access and a utility corridor to both the commercial and residential developments. At this time, it is anticipated that the development and design of Lot 11 (by others) is planned to occur concurrently with the construction of the proposed utilities and infrastructure provided by this plan. A separate drainage letter or report will be required for that portion of the development.

The following summary generalizes the proposed drainage patterns and drainage improvements required to safely route developed runoff to downstream facilities.

A storm sewer pipe and inlet will be constructed at the southwest corner of the newly constructed roundabout to aid in collecting runoff reaching the site from offsite watersheds. These facilities will connect to the existing system located inside the existing Meadowbrook Subdivision. Bypassed flows and developed flows within the newly constructed Meadowbrook Parkway will be collected by a pair of sump inlets located at the west end of the roadway. The drainage facilities located with the rights of way will be public and all remaining onsite storm sewer and drainage improvements shall be private. A future, private, looped roadway will provide access and utility corridors for development. Private storm sewer mains, stubs, and inlets will be extended along these corridors to serve the development. The extension of these facilities beyond what is shown by this plan is likely with future development. Runoff collected by the infrastructure will be conveyed to a single full spectrum detention pond located in the southwest corner of the subdivision. The proposed outfall from the pond is planned to discharge into the existing barrow ditch located with the north half of the existing CDOT Right of Way. A drainage easement will be required from CDOT for the outfall and slope protection facilities that fall within the corridor. It

should be noted that the storm outfall will be shaped into the existing hillside and any soil riprap protection will be buried. Runoff leaving the site and entering the CDOT corridor will discharge at greater-than-historic rates in certain events, but the anticipated effects of this increase to downstream infrastructure has been concluded to be negligible. A detailed discussion of the comparative analysis associated with this conclusion is provided with **Design Point 16** below. The previous discharge points along the west boundary of the subject site, which also previously contributed to the barrow ditch will be virtually eliminated, further reducing the peak flow rates to downstream facilities.

Future Detailed Drainage Discussion

Design Point 1

Basin E2 (Claremont Business Park Filing No.2) consists of a reported 3.86 developed acres of development located along the southeastern half of existing Meadowbrook Parkway some 1200' northeast of the subject site. Runoff produced by the offsite development (CBPF2 Lot 46) is conveyed to Meadowbrook Parkway at flow rates of Q5=15.1 and Q100=28.6 cfs in the 5 and 100-year storm events respectively. The collected flows combine with runoff from **Basin EX-A2 (Lot 1 24/94 Business Park Filing No.1)** (Q5=2.5, Q100=4.5 cfs) which consists of 0.59 acres of the southeastern half of Meadowbrook Parkway located immediately east of existing Newt Drive. The collected flows from the two basins culminate at **Design Point 1** at peak rates of Q5=14.2 and Q100=26.5 cfs. An existing 10' CDOT Type R at-grade inlet (**Inlet 1**) intercepts flows of Q5=8.4 and Q100=11.1 cfs, with subsequent by-pass flows of 5.8 and 15.4 cfs in the 5 and 100 year events. Surface flows continue west within the south half of existing Meadowbrook Parkway.

Design Point 2

Basin OS-A (Meadowbrook Crossing Filing 1 and 2) consists of 1.29 acres of the northern half of existing Meadowbrook Parkway located immediately east of Newt Drive. Runoff produced within this basin totals Q5=3.1 and Q100=6.0 cfs. An existing 10' CDOT Type R at grade inlet (**Inlet 2**) collects runoff of Q5=3.1 and Q100=5.3 cfs, with subsequent by-pass flows in only the 100 year event of 0.7 cfs. Runoff leaving the design point continuing west within the north half of existing Meadowbrook Parkway.

Design Point 3

In accordance with the assumptions outlined within the Meadowbrook Subdivision Final Drainage Report, an offsite public storm sewer pipe and inlet will be constructed at the southwest corner of the proposed roundabout to aid in collecting runoff from a portion of the offsite watershed located to the east of the site. A new manhole is not anticipated to be required to connect the outfall to the existing pipe located inside the existing Meadowbrook Subdivision. As this area is already paved, increases to the imperviousness of this area are not anticipated.

Basin OS-1 consists of approximately 1.40 acres of existing Newt Drive that will be retrofitted with new raised median as part of an intersection conversion to a roundabout. Runoff produced within the basin (Q5=6.4 and Q100=11.5 cfs) will combine with flow-by from **DP1** at peak rates of Q5=10.2 and Q100=23.3 cfs at a proposed public 10' at-grade inlet (**Inlet 3**: Q5=6.7, Q100=9.8 cfs

intercepted; Q5=3.5, Q100=13.5 cfs flowby) located at **DP3**. A proposed public 24" storm sewer (**PR1**) will convey water across the intersection to the existing 42" storm sewer with Meadowbrook Crossings in accordance with that subdivision's drainage report. The existing manhole connection has been determined to be sufficient following construction of this proposed inlet and storm sewer. It is important to note that this connection also remains feasible as the roundabout is not anticipated to significantly increase the overall imperviousness of the area above that of the existing condition. Runoff in excess of the inlet capacity will continue westward via the curb and gutter of Proposed Meadowbrook Parkway.

Design Point 4

Basin A consists of 1.67 acres of the north half of proposed Meadowbrook. Runoff within this basin (Q5=6.5 and Q100=11.6 cfs) combines with flow by from **DP2** for total flows of 6.5 and 12.4 cfs in the 5 year and 100 year events, respectively. A proposed 15' at-grade inlet (**Inlet 4:** Q5=6.5, Q100=10.6 cfs intercepted; Q5=0.0, Q100=1.8 cfs flowby) is located at the west end of the roadway just before the proposed temporary cul-de-sac. This inlet conveys intercepted flows to **PR1.5**, a proposed 24" RCP public storm sewer. Flowby from the 100 year event continues west to downstream infrastructure.

Design Point 4.5

1.8 cfs of flowby in the 100 year event continues west from **DP4** towards **Inlet 4.5**, a **NEENAH R-2501 Type C Grate** lid and frame at the low point of the cul-de-sac. Supporting calculations for this non-standard inlet are provided in the Appendix. This inlet is anticipated to reach a maximum depth of 0.5' in order to convey this flow underneath the roadway via a proposed public 24" storm sewer (**PR2**). The NEENAH inlet is to be removed and replaced with a standard CDOT 5' Type R inlet when the roadway cul de sac is removed and the roadway is extended to the west with future development. In the case of inlet clogging, overflow will collect at **DP5**, which has an additional 13.3 cfs capacity.

Design Point 5

Basin B consists of 1.48 acres of the south half of proposed Meadowbrook Parkway. Runoff produced within this basin (Q5=5.8 and Q100=10.3 cfs) combines with flow-by leaving **DP3** at peak flowrates of Q5=9.8, Q100=25.8 cfs. A proposed public 15' sump inlet (**Inlet 5:** Q5=9.8, Q100=25.8 cfs intercepted; no flowby) located at west end of the roadway will prevent developed flows from leaving exiting the roadway corridor. The intercepted runoff will combine with **PR2** flows in a 36" private storm sewer system (**PR3, by others**). Combined flows within the proposed system are calculated to reach peak rates of 16.2 and 37.9 cfs. The storm sewer system is to be planned by others through the multi-family site (Lot 11) but ultimately will tie back into the system at **DP15**. In case of inlet clogging, overflows will overtop the curb on the southern side onto the apartment site and be conveyed to the swale on the west side of the site.

Design Point 6

Basin C (Q5=18.7, Q100=34.5 cfs) consists of 4.61 acres of commercial lots (1-5 and portions of lot 6) located along the east side of the site. Earthen swales are proposed to convey flows along the basin edge to the proposed depression. Rip rap (Type H, D50=1.5 ft, 3' thickness) is proposed at the terminus and will protect the slopes of the depression. A future private 30" storm sewer (**PR4-PR7**)

is provided to collect and convey flows of Q5=18.7 and Q100=34.5 cfs in the 5 and 100-year storm event, respectively. **PR4.5** is a 30" private stub provided to assist in intercepting flows from future development of the commercial lots, and therefore does not receive any flows in this condition. Intercepted flows are conveyed west underground within the roadway tract. Rip rap sizing was determined with the use of the Steep Slope Rip Rap Design charts from the Surface Mining Water Diversion Manual and is provided in the appendix. Flow to the depression considered the 2:1 longitudinal slope into the depression, 2:1 side slopes in the depression, and was assumed to spread and encompass a 6' base width at the entry point of the depression from the swale. The rip rap sizing at this design point was conservatively used at other depressions around the site due to having the largest flow accumulation.

Design Point 7

Basin D consists of 2.22 acres of commercial lots located between Meadowbrook Parkway and the looped roadway. **Basin D**, which includes portions of Lots 9 and 10, will require a private 24" storm drain (**PR8**) to collect peak flows of Q5=9.3 and Q100=17.0 cfs from this basin in the 5 and 100 year storm events, respectively. Earthen swales are proposed to convey flows along the basin edge to the proposed depression. Rip rap (Type H, D50=1.5 ft, 3' thickness) is proposed at the terminus of the swale and will protect the slopes of the depression. Rip rap was conservatively sized using **DP6's** analysis.

Design Point 8

Basin E (Q5=4.1, Q100=7.4 cfs) consists of 1.04 acres of commercial lots and roadway located in the central portion of the site. A private 10' CDOT Type R at-grade inlet (**Inlet 6:** Q5=4.0, Q100=6.0 cfs intercepted; Q5=0.1, Q100=1.4 cfs flowby) is located on the north side of the roadway to intercept flows. Runoff bypassing this inlet continues to downstream infrastructure. Flows collected from the inlet combined with **PR8** and are conveyed to a box base manhole in the middle of the planned roadway via a private 30" (**PR9**) storm drain.

Design Point 9

Basin E1 (Q5=6.4, Q100=11.7 cfs) consists of 1.67 acres of commercial lots and roadway located in the central portion of the site. A private 10' CDOT Type R at-grade inlet (**Inlet 7:** Q5=5.5, Q100=7.7 cfs intercepted; Q5=0.9, Q100=4.0 cfs flowby) is located on the south side of the roadway to intercept flows. Runoff bypassing this inlet continues to downstream infrastructure. Flows collected from the inlet are conveyed to a box base manhole in the middle of the planned roadway via a private 18" (**PR10**) storm drain. **PR7** and **PR9** also collect at this junction. A proposed 36" private storm sewer (**PR11**) will then convey flows west underground at peak flow rates of 35.0 and 60.5 cfs in the 5 and 100-year events. **PR12**, a 42" private storm sewer, then directs the system south from another manhole. Pipe flows from the proposed apartment site (**PR11.5**, private 24" RCP) combine with **PR12** in **PR12.5**, a proposed private 48" storm drain.

Design Point 10

Basin G (Q5=2.1, Q100=3.8 cfs) consists of 0.46 acres of multi-family lots and roadway located in the central portion of the site. A private 10' CDOT Type R sump inlet (**Inlet 8**: Q5=2.1, Q100=3.8 cfs; no flowby) located on the west side of the street functions to collect the runoff from **Basin G. PR13**, a proposed 18" private storm sewer, will direct runoff east to a box base manhole at peak

flow rates of 2.1 cfs and 3.8 cfs in the minor and major storm events, respectively. In the case of inlet clogging, overflow is directed to the swale at **DP13**.

Design Point 11

Basin G1 (Q5=2.8, Q100=5.0 cfs) consists of 0.60 acres of commercial lots and roadway located in the central portion of the site. A private 15' CDOT Type R sump inlet (**Inlet 9:** Q5=3.7, Q100=15.3 cfs intercepted; no flowby), located on the east side of the street functions to collect the runoff from **Basin G1** as well as bypass flows from **DP8 and DP9**, totaling Q5=3.7 and Q100=15.3 cfs. **PR14**, a proposed 30" private storm sewer, will direct runoff west to an underground box base manhole at peak flow rates of 3.7 cfs and 15.3 cfs in the minor and major storm events, respectively. From the junction, flows from **PR12.5**, **PR13**, and **PR14** combine at **PR15** (Q5=48.0, Q100=93.7 cfs), a 48" private storm sewer, and are directed south. In the case of inlet clogging, overflows will overtop the curb and collect in the rip rap protected depression at **DP12**.

Design Point 12

Basin F consists of 2.57 acres of commercial lots (Lot 8 and portions of Lot 7) located along the southern boundary of the site. An earthen swale is proposed to convey flows to the depression. Rip rap (Type M, D50=1.5 ft, 3' thickness) is proposed at the terminus of the swale and will protect the slopes of the depression. Rip rap was conservatively sized using **DP6's** analysis. A private 24" storm drain (**PR16**) is provided to collect the basin flows of Q5=10.8 and Q100=19.6 cfs at **DP12** in the 5 and 100 year events, respectively. Intercepted flows are conveyed west underground to the main line where they combine with flows from **PR15** at a manhole junction. **PR17,** a private 48" RCP storm sewer directs the collected runoff to a manhole which joins with **PR21** (private 48" RCP) at peak flow rates of Q5=57.9 and Q100=112.1 cfs. The collected flows are conveyed southwest in **PR18** (Private 48" RCP) until discharging into the proposed forebay at **DP15**.

Design Point 13

DP13 consists of a 2' bottom earthen swale that is designed to convey overflow runoff from the proposed apartment site (**Basin A-5 Overflow**: Q5=0.9, Q100=7.8 cfs, **Basin Z-1**: Q5=0.47, Q100=1.27 cfs, and **Basin D-1 Overflow**: Q5=0.0, Q100=1.5 cfs) to the northwest corner of the pond. This swale joins another on the west end of the property (**DP14**) that ultimately conveys flows into the pond. Overflows from the apartment site were obtained by using flowby from the "Final Drainage Report for Aura at Crossroads" MHFD inlet sheets, which are provided in the appendix. The maximum runoff expected at **DP13** is 1.3 and 10.9 cfs in the 5 and 100 year events, respectively. Calculations for this swale (Section C-C') are included in the appendix of this report.

Design Point 14

DP14 represents the on-site portion of a proposed, v-shaped, earthen swale that collects flows not anticipated to be collected by the apartment site's storm sewer (**Basin Z-2**: Q5=0.57, Q100=1.43 cfs), and combines with flows from **Design Point 13**. Runoff collected within this swale (maximum Q5=2.0 cfs, Q100=9.7 cfs) is conveyed from north to south to the proposed FSD pond at **DP15**. Calculations for this swale before (Section B-B') and after (Section D-D') the junction are provided in the appendix of this report. Anticipated flows for **Basin Z-2** from "Final Drainage Report for Aura at Crossroads" were used to determine swale cross section prior to the junction location, and combined flows with **DP13** were used for after. North American Green SC-250

erosion control blanketing or approved equal shall be used as swale protection and was selected based on flow velocity.

Design Point 15

Basin J consists of 3.21 acres of the proposed Tract for the full spectrum detention pond. Runoff produced within this basin reaches peak runoff rates (Q5=2.3 and Q100=10.0 cfs) combines with flows from **DP14** and **PR18** (proposed 48" private RCP) in the pond. **PR19** (proposed 48" private RCP) represents the tie in point for the apartment site storm sewer, and conveys collected flows into the proposed forebay. The cumulative flows at **FSD Pond 1** are Q5=116.7 and Q100=235.0 cfs. Flow exiting the pond will be routed to the existing 5' bottom earthen swale (Proposed Section A-A' Analyses) in CDOT's Right of Way at **DP16** via 18" private **PR20** (Q5=1.2 and Q100=11.4 cfs). A rip rap pad (Type L, D50=9") is provided as outlet protection. Refer to the Appendix for rip rap sizing calculations.

Design Point 16

Basin OS-2 consists of 4.98 acres. Approximately half of this basin is comprised of the paved surface of U.S. Highway 24, while the other half is comprised of the 5 foot bottom earthen swale in CDOT's Right of Way. Runoff produced within this basin (Q5=8.7 and Q100=19.6 cfs) flows from northeast to southwest, combining with outfall flows from **DP15**. This combination of runoff collects in the existing swale in the right of way. The pond releases flows at Q5=1.2, Q100=11.4 cfs. The cumulative flows at **DP16** are Q5=9.9 and Q100=31.0 cfs, which are lower than historic. See below discussion for predevelopment, historic, and future condition comparison for the intermediate events at this location. Flows from this design point continue to downstream infrastructure.

Roadside Ditch Intermediate Events: Drainage Summary

The MHFD Pond Routing worksheet shows that future discharge rates are greater than allowable predevelopment rates. This is largely a result of the small separation between intermediate events (~0.3') due to pond geometry and configuration limitations, as well as drainage pattern assumptions involved in the CUHP procedure. The pond has been designed for maximum, non-jurisdictional depth to allow for the most separation possible between the events and have the most flow control through the outlet structure. Since the three historic site discharge points have been condensed to a single point-discharge location in the future condition and predevelopment discharge peaks were shown to be greater using the MHFD approximation, a comparative rational analysis has been provided to more accurately describe and compare release rates at **Design Point 16**.

Design Point 7 in the historic condition has been compared to **Design Point 16** in the future condition. Rational calculations for the 5, 10, 25, 50, and 100 year events for the swale are provided and compared with historic patterns in the "Roadside Ditch Intermediate Events: Routing Summary" in the Appendix. To accomplish a rational comparison, pond peak discharge flows from the MHFD worksheet were converted into "CA" values using rainfall intensities derived from **Basin OS-2** time of concentration, creating the conservative assumption that peak discharge rates from the pond occur at this point in time. Following the analysis, all except the 25 and 50 year events are lower than the historic condition. Historic flows for the 25 and 50 year events are reported as 21.1 and 26.2 cfs, respectively. Future flow conditions at the discharge point for these

two events are 23.2 and 27.7 cfs, respectively. This is approximately a 9% and 6% increase relative to the historic flows. Open channel cross section analyses were constructed to model the effects of the discharge increase in these two events. These cross sections have also been provided in the Appendix. An increase of ~.1 ft/sec from 3.6 and 3.8 ft/sec in the historic condition was observed for both events. Due to this relative increase, resulting velocities are less than 5 ft/sec, and the potential for a 5% error introduced in these successive calculations, flow and velocity increase impacts have been determined to be negligible in terms of erosion effects in the ditch and downstream infrastructure.

Proposed Drainage Characteristics

In the proposed condition Lot 11, (apartment site), Tract C, and Meadowbrook Parkway infrastructure will be constructed and Tract D (future 10 commercial lots) will remain undeveloped. Since the future (full-buildout) condition was used to size this infrastructure and has been shown to adequately convey site drainage to the downstream facilities, the undeveloped characteristics of Tract D cause lower contributions to overall flows that are conveyed to downstream facilities. Calculations have been provided in the appendix notating these characteristics. Parks and cemeteries runoff coefficients were used to analyze the undeveloped area drainage. Surface flows at **DP's 1-5**, **DP10**, **DP11**, **DP13**, and **DP14** remain the same as the future condition. Pipe flow analysis was simplified to a comparison of the affected upstream storm sewer (**PR11**) to the manhole junction at **PR17** for this condition since it has been shown that the entire system sufficiently serves the future condition. A detailed drainage discussion for the undeveloped portion of the site (Tract D) in the proposed condition is provided below that highlights and summarizes the results of this analysis.

Design Point 7

Basin P1 consists of 8.97 undeveloped acres. Runoff produced within this basin (Q5=3.8 and Q100=20.7 cfs) flows from northeast to southwest and collects in a proposed swale parallel to Tract C that discharges into a temporary sediment basin (**SB2**). Flows from the sediment basin discharge into a proposed swale to the south to continue to downstream infrastructure. In the case of clogging, overflow will be directed to the swale to the south. Since no flows at this location enter the storm system, **PR11** and **PR12** convey no flow in the proposed condition. **PR11.5** conveys flows from the apartment site into the trunk main at **PR12.5** (Q5=6.9, Q100=13.8 cfs). Inlets 8 and 9 function as they do in the future condition and combine with **PR12.5** at cumulative flow rates of Q5=10.8 and Q100=27.0 cfs at **PR15** in the proposed condition. See below for continued discussion of the pipe conveyance to and from **DP12**.

Design Point 12

Basin P2 consists of 3.04 undeveloped acres. Runoff produced within this basin (Q5=1.3 and Q100=7.2 cfs) flows from northeast to southwest, combining with outfall flows from **DP7**. Detention effects from the sediment basin was not considered, therefore, inflow was considered equal to outflow as a conservative analysis. This combination of runoff collects in a proposed swale parallel to Tract C that discharges into a proposed sediment basin (**SB3**). The sediment basin outfall discharges onto a rip rap protected depression at the design point. In the case of overflow, flows will be directed to this same location. Runoff then enters the storm drain system at

proposed 24" private RCP **PR16** (Q5=5.1, Q100=27.9 cfs). A manhole junction joins flows from **PR15** and **PR16** in **PR17** (Q5=15.9, Q100=54.7 cfs). The storm system at this location is considerably less than the future condition (Q5=57.0, Q100=110.1 cfs). Flows continue through the storm drain system until discharging in the eastern forebay of the FSD pond. Backwater effects in the storm system are considered negligible and were not analyzed due to the reduction in flows at the aforementioned entry points and sheer volumetric reduction in flow. An assumption was also made that the system (**PR11-PR18**) in this condition will not be pressurized from the results of this analysis.

Water Quality Provisions and Maintenance

The proposed full spectrum detention (FSD) pond functions to provide detention and water quality for the proposed development. This full spectrum detention pond will function to treat approximately 32.20 acres of 78.67% impervious, tributary area by providing 0.863 acre-feet of storage for the water quality event, 3.295 acre feet of storage at the EURV storm event, and 4.668 acre-feet of storage in the 100-year event. The 33' wide emergency spillway is designed with a foot of freeboard in the 100-year event. This spillway safely conveys flows to CDOT's Right of Way in the event of outlet clogging or failure, and will be armored with permanent erosion control fabric and Type M (D50=12") soil rip rap. Rip Rap sizing calculations for the embankment protection are provided in the appendix. The results show that the FSD pond remains functional in the 100-year event and the outlet structure is able to safely discharge flows to an existing swale and ultimately to Sand Creek. Discharge and velocity increases for the 25 and 50 year events in the swale have been determined to be negligible following a comparative, rational analysis that was developed to more accurately describe intermediate events at the site discharge location. The calculations for this analysis can be viewed in the Roadside Ditch Intermediate Events Drainage and Routing Summaries calculations in the appendix. Cross sections of the swale in these conditions can also be found there. The sizing for the full spectrum detention facility has been determined using the guidelines set forth in the Urban Drainage and Flood Control District Criteria Manual. Refer to the UDFCD MHFD-Detention, Version 4.03, Excel Workbook located within the appendix of this report for calculations.

The proposed FSD pond will be privately owned and maintained by Crossroads Metropolitan District No. 1. Access to the pond shall be granted to the owner/district and El Paso County for access and maintenance of the private facility. A private maintenance agreement document shall accompany this report submittal.

Erosion Control

It is the policy of the El Paso County that M&S Civil Consultants submit a grading and erosion control plan with the drainage report. The plan includes proposed silt fence, vehicle tracking control, (4) temporary sediment basins, and straw bale barriers as proposed erosion control measures. The plan also includes provisions for stockpiling, staging, and concrete washout areas. A stormwater management plan is provided to accompany the plans.

2022 Drainage & Bridge Fees:

Drainage Fees:	17.033	x	78.67%	x	$21,814.00	=	$ 292304.57
Bridge Fees:	17.033	x	78.67%	x	$8,923.00	=	$ 119,566.96
						Total	**$ 411,871.53**

Drainage fees shall be paid at the time of platting. Tract D drainage fees are not included and will be paid at the time of platting. Future development of these lots shall require individual drainage reports.

Construction Cost Estimate (Non-Reimbursable)

Item	Amount	Unit	Unit Cost	Total Cost
10' CDOT Type R Inlet	4	EA	$ 9,890.00	$ 39,560.00
15' CDOT Type R Inlet	3	EA	$ 13,002.00	$ 39,006.00
Custom Grate Inlet	1	EA	$ 5,000.00	$ 5,000.00
Type I MH	8	EA	$ 9,800.00	$ 78,400.00
Type II MH	1	EA	$ 6,000.00	$ 6,000.00
Rip Rap Aprons	84.5	CY	$ 65.00	$ 5,492.50
18" SD	113	LF	$ 45.00	$ 5,085.00
24" SD	232	LF	$ 81.00	$ 18,792.00
30" SD	432	LF	$ 100.00	$ 35,800.00
36" SD	16	LF	$ 124.00	$ 1,984.00
42" SD	396	LF	$ 166.00	$ 65,736.00
48" SD	395	LF	$ 202.00	$ 79,790.00
Concrete Channel	2,416	SF	$ 5.00	$ 12,080.00
Outlet Structure	1	EA	$ 15,000.00	$ 15,000.00
Forebay	2	EA	$ 8,000.00	$ 16,000.00
Gravel (Access)	629	CY	$ 52.00	$ 32,708.00
Spillway	1	EA	$ 20,000.00	$ 20,000.00
TOTAL COST:	**$**			**476,433.50**

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost and drainage basin fee amounts in 2022.

Summary:

The construction of this site is for the purposes of creating a commercial tract, detention tract, and an apartment site in the proposed condition. In the future condition, the commercial tract is proposed to be platted into ten lots. This condition was analyzed to appropriately size the infrastructure for full buildout of the site. The site will be graded and all disturbed areas will be seeded. Post construction runoff will be discharged to downstream property at rates that are below historic discharge rates for the 5 and 100 year design events. Intermediate events within this swale were rationally analyzed since peak discharge rates were shown to be greater than predevelopment

peaks, largely due to pond geometry and configuration limitations. In the historic condition, the total flows leaving the site that reach the East Fork Sand Creek Channel are 10.4, 14.8, 21.1, 26.2, and 31.9 cfs in the 5, 10, 25, 50, and 100 year storm events, respectively. Flows leaving the site in the future condition for these respective events are 9.9, 13.7, 23.2, 27.7, and 31.0 cfs. Negligible erosion impacts have been concluded from the minor flow and velocity increase in flows in the 25 and 50 year events following this analysis. The ditch is also being adequately protected with rip rap and a concrete toe wall to prevent erosion and scouring at this location. Erosion control measures will be implemented throughout the site to prevent sediment migration. The construction of Crossroads Mixed Use Filing No. 1 shall not adversely affect adjacent or downstream property. Subsequent drainage reports will be required when the site is developed behind the uses defined within this report.

References

1.) "El Paso County and City of Colorado Springs Drainage Criteria Manual".

2.) "Urban Storm Drainage Criteria Manual"

3.) SCS Soils Map for El Paso County.

4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Revised date December 7th, 2018.

5.) "Final Drainage Report for Claremont Business Park Filing No. 2", dated November 2006, by Matrix Design Group, Inc.

6.) "Preliminary and Final Drainage Report Meadowbrook Crossing Filing 1 and Filing 2", dated July 25, 2017, by Kiowa Engineering Corporation.

7.) "Final Drainage Report Lot 1 24/94 Business Park Filing No. 1 on Platte Avenue and Meadowbrook Parkway", dated April 28, 2016 and revised July 14, 2016, by Core Engineering Group, LLC.

8.) "Final Drainage Report for Meadowbrook Dirt Borrow Site ", dated November 2018, by M&S Civil Consultants, Inc.

9.) "Sand Creek Drainage Basin Planning Study", revised March 1996, by Kiowa Engineering Corporation.

10.) “Final Drainage Report for Aura at Crossroads”, dated April 4th, 2022, by Harris Kocher Smith.

APPENDIX

VICINITY MAP

VICINITY MAP

N.T.S.

SOILS MAP

Map Scale: 1:4,120 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

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 1:24,000.

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: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

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

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

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
8	Blakeland loamy sand, 1 to 9 percent slopes	35.2	95.4%
10	Blendon sandy loam, 0 to 3 percent slopes	1.7	4.6%
Totals for Area of Interest		**36.9**	**100.0%**

FIRM PANELS

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map

This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 65 WEST, AND TOWNSHIP 14 SOUTH, RANGE 65 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
^{4275000m}N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0752G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 752 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	G
EL PASO COUNTY	080059	0752	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0752G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

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El Paso County Vertical Datum Offset Table

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NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 14 SOUTH, RANGE 65 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

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150 0 150 300 METERS

NFIP

PANEL 0754G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 754 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0754	G
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MAP NUMBER
08041C0754G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

HYDROLOGIC CALCULATIONS

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Historic Area Runoff Coefficient Summary)

			STREETS / DEVELOPED			*OVERLAND / DEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
C	256383.3	5.89	0.00	0.90	0.96	5.89	0.08	0.35	***0.08***	***0.35***
A	561176.6	12.88	0.00	0.90	0.96	12.88	0.08	0.35	***0.08***	***0.35***
B	593693.4	13.63	0.00	0.90	0.96	13.63	0.08	0.35	***0.08***	***0.35***
OS-1	55560.16	1.28	1.28	0.90	0.96	0.00	0.08	0.35	***0.90***	***0.96***
OS-2	216993.7	4.98	2.49	0.90	0.96	2.49	0.08	0.35	***0.49***	***0.66***
EX-A2*		0.59	0.59	0.90	0.96	0.00	0.08	0.35	***0.90***	***0.96***
OS-A**		1.29	1.29	0.62	0.72	0.00	0.08	0.35	***0.62***	***0.72***
E2*		3.86	3.86	0.80	0.90	0.00	0.08	0.35	***0.80***	***0.90***

*FROM FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2

**FROM FDR FOR MEADOWBROOK CROSSING FILING 1 AND FILING 2

***FROM FDR FOR LOT 1 24/94 BUSINESS PARK FILING NO. 1 ON PLATTE AVENUE AND MEADOWBROOK PARKWAY

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Historic Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY ^*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
C	5.89	0.08	0.35	0.08	300	9	22.2	500	2.0%	1.0	8.4	30.6	14.4	2.5	4.1	***1.2***	***8.5***
A	12.88	0.08	0.35	0.08	300	13	19.7	1350	1.6%	0.9	25.2	44.8	19.2	1.9	3.2	***1.9***	***14.2***
B	13.63	0.08	0.35	0.08	300	11	20.8	750	1.7%	0.9	13.7	34.5	15.8	2.3	3.8	***2.5***	***18.2***
OS-1	1.28	0.90	0.96	0.90	100	3	2.5	490	2.2%	3.0	2.8	5.3	13.3	5.1	8.5	***5.8***	***10.5***
OS-2	4.98	0.49	0.66	0.49	85	8	4.8	1165	1.8%	2.0	9.6	14.5	16.9	3.6	6.0	***8.7***	***19.6***
EX-A2***	0.59	0.90	0.96	0.90	10	0.2	0.9	916	1.9%	2.7	5.6	6.5	15.1	4.8	8.0	***2.5***	***4.5***
OS-A*	1.29	0.62	0.72	0.62	40	0.8	4.4	1310	1.9%	2.8	7.9	12.3	17.5	3.8	6.4	***3.1***	***6.0***
***E2**	3.86	0.80	0.90	0.80	50	1	3.0	400	1.3%	2.3	2.9	6.0	12.5	4.9	8.2	***15.1***	***28.6***

^ Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

*VALUES DERIVED USING DATA FROM FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2
**VALUES DERIVED USING DATA FROM FDR FOR MEADOWBROOK CROSSING FILING 1 AND FILING 2 PAGE 31
***VALUES DERIVED USING DATA FROM FDR FOR LOT 1 24/94 BUSINESS PARK FILING NO. 1 ON PLATTE AVENUE AND MEADOWBROOK PARKWAY

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Historic Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**E2**	3.09	3.47				6.0	916	1.9%	2.7	5.6	11.6	3.9	6.6	***14.2***	***26.5***	
	EX-A2	0.53	0.57														
		3.62	4.04	Tc for E2 Used													EXISTING 10' CDOT TYPE R AT GRADE INLET
2	**OS-A**	0.80	0.93									12.3	3.8	6.4	***3.1***	***6.0***	
				See Area Drainage Sheet for Input													EXISTING 10' CDOT TYPE R AT GRADE INLET
3	**OS-1**	1.15	1.22				11.6	150	1.0%	2.0	1.3	12.8	3.8	6.3	***9.8***	***22.5***	
	FB-DP1	1.47	2.35														
		2.62	3.57	Tc for DP1 Used													END OF PAVEMENT
4	**A**	1.03	4.51				12.8	1470	1.6%	0.9	28.0	40.8	2.0	3.4	***7.4***	***27.7***	
	FB-DP2	0.00	0.10														
	DP3	2.62	3.57														
		3.65	8.19	Tc for DP3 Used													ADJACENT PARCEL (LOT 1)
5	**B**	1.09	4.77									34.5	2.3	3.8	***2.5***	***18.2***	
				See Area Drainage Sheet for Input													ADJACENT PARCEL (LOT 2)
6	**C**	0.47	2.06									30.6	2.5	4.1	***1.2***	***8.5***	
				See Area Drainage Sheet for Input													DISCHARGE TO CDOT ROW
7	**OS2**	2.44	3.26									14.5	3.6	6.0	***10.4***	***31.9***	
	DP6	0.47	2.06														BARROW DITCH
		2.91	5.32	Tc for OS2 Used													SW CORNER OF SITE/CDOT ROW

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Existing Area Runoff Coefficient Summary)

			STREETS / DEVELOPED			*OVERLAND / DEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
C	173960	3.99	0.00	0.90	0.96	5.89	0.08	0.35	***0.08***	***0.35***
A	480166.8	11.02	0.00	0.90	0.96	11.02	0.08	0.35	***0.08***	***0.35***
B	754121.6	17.31	0.00	0.90	0.96	17.31	0.08	0.35	***0.08***	***0.35***
OS-1	55560.16	1.28	1.28	0.90	0.96	0.00	0.08	0.35	***0.90***	***0.96***
OS-2	216993.7	4.98	2.49	0.90	0.96	2.49	0.08	0.35	***0.49***	***0.66***
EX-A2*		0.59	0.59	0.90	0.96	0.00	0.08	0.35	***0.90***	***0.96***
OS-A**		1.29	1.29	0.62	0.72	0.00	0.08	0.35	***0.62***	***0.72***
E2*		3.86	3.86	0.80	0.90	0.00	0.08	0.35	***0.80***	***0.90***

*FROM FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2

**FROM TO FDR MEADOWBROOK CROSSING FILING 1 AND FILING 2

***FROM FDR LOT 1 24/94 BUSINESS PARK FILING NO. 1 ON PLATTE AVENUE AND MEADOWBROOK PARKWAY

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Existing Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY ^*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
C	3.99	0.08	0.35	0.08	120	2.8	15.3	555	1.5%	0.9	10.6	25.9	13.8	2.7	4.5	***0.9***	***6.3***
A	11.02	0.08	0.35	0.08	165	8	13.8	1730	1.3%	0.8	36.3	50.1	20.5	1.7	2.9	***1.5***	***11.1***
B	17.31	0.08	0.35	0.08	300	3	30.9	1390	1.2%	0.8	29.7	60.6	19.4	1.4	2.4	***2.0***	***14.5***
OS-1	1.28	0.90	0.96	0.90	100	3	2.5	490	2.2%	3.0	2.8	5.3	13.3	5.1	8.5	***5.8***	***10.5***
OS-2	4.98	0.49	0.66	0.49	85	8	4.8	1165	1.8%	2.0	9.6	14.5	16.9	3.6	6.0	***8.7***	***19.6***
EX-A2***	0.59	0.90	0.96	0.90	10	0.2	0.9	916	1.9%	2.7	5.6	6.5	15.1	4.8	8.0	***2.5***	***4.5***
OS-A*	1.29	0.62	0.72	0.62	40	0.8	4.4	1310	1.9%	2.8	7.9	12.3	17.5	3.8	6.4	***3.1***	***6.0***
***E2**	3.86	0.80	0.90	0.80	50	1	3.0	400	1.3%	2.3	2.9	6.0	12.5	4.9	8.2	***15.1***	***28.6***

^ Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

*VALUES DERIVED USING DATA FROM FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2
**VALUES DERIVED USING DATA FROM FDR FOR MEADOWBROOK CROSSING FILING 1 AND FILING 2 PAGE 31
***VALUES DERIVED USING DATA FROM FDR FOR LOT 1 24/94 BUSINESS PARK FILING NO. 1 ON PLATTE AVENUE AND MEADOWBROOK PARKWAY

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Existing Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**E2**	3.09	3.47				6.0	916	1.9%	2.7	5.6	11.6	3.9	6.6	***14.2***	***26.5***	
	EX-A2	0.53	0.57														
		3.62	4.04	Tc for E2 Used													EXISTING 10' CDOT TYPE R AT GRADE INLET
2	**OS-A**	0.80	0.93									12.3	3.8	6.4	***3.1***	***6.0***	
				See Area Drainage Sheet for Input													EXISTING 10' CDOT TYPE R AT GRADE INLET
3	**OS-1**	1.15	1.22				11.6	150	1.0%	2.0	1.3	12.8	3.8	6.3	***9.8***	***22.5***	
	FB-DP1	1.47	2.35														
		2.62	3.57	Tc for DP1 Used													END OF PAVEMENT
4	**A**	0.88	3.86				12.8	1470	1.6%	0.9	28.0	40.8	2.0	3.4	***7.1***	***25.5***	
	FB-DP2	0.00	0.10														
	DP3	2.62	3.57														
		3.50	7.54	Tc for DP3 Used													ADJACENT PARCEL (LOT 1)
5	**B**	1.38	6.06									60.6	1.4	2.4	***2.0***	***14.5***	
				See Area Drainage Sheet for Input													ADJACENT PARCEL (LOT 2)
6	**C**	0.32	1.40									25.9	2.7	4.5	***0.9***	***6.3***	
				See Area Drainage Sheet for Input													DISCHARGE TO CDOT ROW
7	**OS2**	2.44	3.26									14.5	3.6	6.0	***9.9***	***28.0***	
	DP6	0.32	1.40														BARROW DITCH
		2.76	4.66	Tc for OS2 Used													SW CORNER OF SITE/CDOT ROW

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE CALCULATIONS
(Future Area Runoff Coefficient Summary)

			STREETS / COMMERC.			*MULTI-FAMILY/PARKLAND*			*OVERLAND / UNDEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(Sq Ft)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
						FUTURE BASINS							
OS-A*		1.29	1.29	0.62	0.72	0.00	0.49	0.62	0.00	0.08	0.35	***0.62***	***0.72***
E2*		3.86	3.86	0.80	0.90	0.00	0.49	0.62	0.00	0.08	0.35	***0.80***	***0.90***
EX-A2**		0.59	0.59	0.90	0.96	0.00	0.49	0.62	0.00	0.08	0.35	***0.90***	***0.96***
OS-1	***60793.3017***	1.40	1.40	0.90	0.96	0.00	0.49	0.62	0.00	0.08	0.35	***0.90***	***0.96***
OS-2	***216993.7096***	4.98	2.49	0.90	0.96	0.00	0.49	0.62	2.49	0.08	0.35	***0.49***	***0.66***
A	***72787.0873***	1.67	1.67	0.90	0.96	0.00	0.49	0.62	0.00	0.08	0.35	***0.90***	***0.96***
B	***64490.3787***	1.48	1.48	0.90	0.96	0.00	0.49	0.62	0.00	0.08	0.35	***0.90***	***0.96***
C	***200631.5748***	4.61	4.46	0.81	0.88	0.00	0.49	0.62	0.15	0.08	0.35	***0.79***	***0.86***
D	***96773.7602***	2.22	2.22	0.81	0.88	0.00	0.49	0.62	0.00	0.08	0.35	***0.81***	***0.88***
E	***45497.7355***	1.04	0.24	0.90	0.96	0.80	0.81	0.88	0.00	0.08	0.35	***0.83***	***0.90***
E1	***72636.2925***	1.67	0.24	0.90	0.96	1.43	0.81	0.88	0.00	0.08	0.35	***0.82***	***0.89***
F	***112036.6061***	2.57	2.57	0.81	0.88	0.00	0.49	0.62	0.00	0.08	0.35	***0.81***	***0.88***
G	***20057.4496***	0.46	0.46	0.90	0.96	0.00	0.49	0.62	0.00	0.08	0.35	***0.90***	***0.96***
J	***139924.2472***	3.21	0.00	0.90	0.96	3.21	0.16	0.41	0.00	0.08	0.35	***0.16***	***0.41***
A-5**	***159865.2***	3.67	0.00	0.90	0.96	3.67	0.68	0.79	0.00	0.08	0.35	***0.68***	***0.79***
Z-1**	***16117.2***	0.37	0.00	0.90	0.96	0.37	0.33	0.52	0.00	0.08	0.35	***0.33***	***0.52***
D-1**	***33976.8***	0.78	0.00	0.90	0.96	0.78	0.62	0.75	0.00	0.08	0.35	***0.62***	***0.75***
Z-2**	***16552.8***	0.38	0.00	0.90	0.96	0.38	0.38	0.56	0.00	0.08	0.35	***0.38***	***0.56***
G1	***25962.0179***	0.60	0.60	0.90	0.96	0.00	0.16	0.41	0.00	0.08	0.35	***0.90***	***0.96***

*FROM FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2
**FROM FDR FOR MEADOWBROOK CROSSING FILING 1 AND FILING 2
***FROM FDR FOR LOT 1 24/94 BUSINESS PARK FILING NO. 1 ON PLATTE AVENUE AND MEADOWBROOK PARKWAY
****FROM FDR FOR AURA AT CROSSROADS, DATED APRIL 4TH, 2022

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE REPORT
(Future Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T_t)		INTENSITY #		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C_5	C_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	CHECK (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
		From DCM Table 5-1															
Future Area Drainage Summary																	
OS-A**	1.29	0.62	0.72	0.62	40	0.8	4.4	1310	1.9%	2.8	7.9	12.3	17.5	3.8	6.4	3.1	6.0
E2*	3.86	0.80	0.90	0.80	50	1	3.0	400	1.3%	2.3	2.9	6.0	12.5	4.9	8.2	15.1	28.6
EX-A2***	0.59	0.90	0.96	0.90	10	0.2	0.9	916	1.9%	2.7	5.6	6.5	15.1	4.8	8.0	2.5	4.5
OS-1	1.40	0.90	0.96	0.90	100	3	2.5	490	2.2%	3.0	2.7	5.2	13.3	5.1	8.6	6.4	11.5
OS-2	4.98	0.49	0.66	0.49	85	8	4.8	1165	1.8%	2.0	9.6	14.5	16.9	3.6	6.0	8.7	19.6
A	1.67	0.90	0.96	0.90	30	0.6	1.6	1325	0.7%	1.7	7.3	8.9	17.5	4.3	7.2	6.5	11.6
B	1.48	0.90	0.96	0.90	25	0.5	1.4	1335	0.7%	1.7	7.3	8.8	17.6	4.3	7.3	5.8	10.3
C	4.61	0.79	0.86	0.79	50	1	3.2	260	1.5%	2.4	1.4	5.0	11.7	5.2	8.7	18.7	34.5
D	2.22	0.81	0.88	0.81	50	1	2.9	200	1.5%	2.4	1.1	5.0	11.4	5.2	8.7	9.3	17.0
E	1.04	0.83	0.90	0.83	60	1.2	3.0	700	1.0%	2.0	3.8	6.8	14.2	4.7	7.9	4.1	7.4
E1	1.67	0.82	0.89	0.82	60	1.2	3.0	700	1.0%	2.0	3.8	6.8	14.2	4.7	7.9	6.4	11.7
F	2.57	0.81	0.88	0.81	50	0.8	3.2	300	1.3%	2.3	1.6	5.0	11.9	5.2	8.7	10.8	19.6
G	0.46	0.90	0.96	0.90	50	1	2.0	466	1.1%	2.1	2.6	5.0	12.9	5.2	8.7	2.1	3.8
J	3.21	0.16	0.41	0.16	50	2	7.6	0	0.0%	0.0	0.0	7.6	10.3	4.5	7.6	2.3	10.0
A-5****	3.67	0.68	0.79	0.68	REFER TO "FDR FOR AURA AT CROSSROADS" FOR DETAILS											8.72	17.06
Z-1****	0.37	0.33	0.52	0.33	REFER TO "FDR FOR AURA AT CROSSROADS" FOR DETAILS											0.47	1.27
D-1****	0.78	0.62	0.75	0.62	REFER TO "FDR FOR AURA AT CROSSROADS" FOR DETAILS											2.08	4.20
Z-2****	0.38	0.38	0.56	0.38	REFER TO "FDR FOR AURA AT CROSSROADS" FOR DETAILS											0.57	1.43
G1	0.60	0.90	0.96	0.90	50	1	2.0	466	1.1%	2.1	2.6	5.0	12.9	5.2	8.7	2.8	5.0

Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

*VALUES DERIVED USING DATA FROM FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2

**VALUES DERIVED USING DATA FROM FDR MEADOWBROOK CROSSING FILING 1 AND FILING 2 PAGE 31

***VALUES DERIVED USING DATA FROM FDR LOT 1 24/94 BUSINESS PARK FILING NO. 1 ON PLATTE AVENUE AND MEADOWBROOK PARKWAY

****FROM FDR FOR AURA AT CROSSROADS, DATED APRIL 4TH, 2022

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE REPORT
(Future Basin Routing Summary)

From Area Runoff Coefficient Summary				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY *		TOTAL FLOWS		
DESIGN POINT	CONTRIBUTING BASINS	CA_5	CA_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	COMMENTS
FUTURE DRAINAGE BASIN ROUTING SUMMARY																	
1	E2, EX-A2	3.62	4.04				6.0	916	1.9%	2.7	5.6	11.6	3.9	6.6	14.2	26.5	Existing 10' CDOT Type R At-Grade Inlet (Public)
				Tc for E2 Used													
2	OS-A	0.80	0.93									12.3	3.8	6.4	3.1	6.0	Existing 10' CDOT Type R At-Grade Inlet (Public)
				See Area Drainage Sheet for Input													
3	OS-1, FB-DP1	2.73	3.69				11.6	150	1.0%	2.0	1.3	12.8	3.8	6.3	10.2	23.3	Proposed 10' CDOT Type R At-Grade Inlet (Public)
				Tc for DP1 Used													
4	A, FB-DP2	1.50	1.71									8.9	4.3	7.2	6.5	12.4	Proposed 15' CDOT Type R At-Grade Inlet (Public)
				Tc for Basin A used													
4.5	FB-DP4	0.00	0.25									8.9	4.3	7.2	0.0	1.8	Proposed NEENAH R-2501 MH Lid and Frame (Public)
				Tc for DP4 used													
5	B, FB-DP3	2.28	3.56									8.8	4.3	7.3	9.8	25.8	Proposed 15' CDOT Type R Sump Inlet (Public)
				Tc for Basin B Used													
6	C	3.62	3.98									5.0	5.2	8.7	18.7	34.5	Future 30" RCP or PP Storm Sewer, Rip Rap Pad (Private)
				See Area Drainage Sheet for Input													
7	D	1.80	1.96									5.0	5.2	8.7	9.3	17.0	Future 24" RCP or PP Storm Sewer, Rip Rap Pad (Private)
				See Area Drainage Sheet for Input													
8	E	0.87	0.94									6.8	4.7	7.9	4.1	7.4	Future 10' CDOT Type R At-Grate Inlet (Private)
				See Area Drainage Sheet for Input													
9	E1	1.37	1.49									6.8	4.7	7.9	6.4	11.7	Future 10' CDOT Type R At-Grade Inlet (Private)
				See Area Drainage Sheet for Input													
10	G	0.41	0.44									5.0	5.2	8.7	2.1	3.8	Proposed 10' CDOT Type R Sump Inlet (Private)
				Tc for Basin G Used													
11	G1 FB-DP8 FB-DP9	0.51 0.02 0.20 **0.73**	1.32 0.18 0.51 **1.83**	Weighted Tc Used								5.6	5.0	8.4	3.7	15.3	Proposed 15' CDOT Type R Sump Inlet (Private)
12	F	2.08	2.26									5.0	5.2	8.7	10.8	19.6	Proposed 24" RCP or PP Storm Sewer (Private)
				See Area Drainage Sheet for Input													
13	Basin A-5 (Overflow) Basin Z-1 Basin D-1 (Overflow)	0.23 0.12 0.00 **0.36**	1.32 0.20 0.21 **1.72**	Weighted Tc Used								12.8	3.8	6.3	1.3	10.9	Proposed 2' Bottom Earthen Swale, Rip Rap Rundown
14	Basin Z-2 DP 13	0.14 0.36 **0.50**	0.03 1.43 **1.46**	Tc for Basin Z-2 Used								11.1	4.0	6.7	2.0	9.7	Proposed Triangular Earthen Swale (Private)
15	J, DP14, PR19, PR18	24.15	28.95	Weighted Tc Used								6.3	4.8	8.1	116.7	235.0	Full Spectrum Extended Detention Basin (Private)
16	POND OUTFALL OS-2	2.77	5.16	Tc for Basin OS-2 Used								14.5	3.6	6.0	9.9	31.0	HISTORIC FLOW IN CDOT BARROW DITCH Q5= 10.4 CFS, Q100 = 31.9 CFS PER HISTORIC DRAINAGE ANALYSIS

* Intensity equations assume a minimum travel time of 5 minutes.

Overflow- obtain flows from inlet sheets provided in Background Information Section of Appendix

CVW
Date: 1/31/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE CALCULATIONS
(Future Storm Sewer Routing Summary)

PIPE RUN	Contributing Pipes/Design Points	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity* I_5	Intensity* I_{100}	Flow Q_5	Flow Q_{100}	PIPE SIZE
1	DP3 (INLET 3)	1.78	1.55	12.8	3.8	6.3	6.7	9.8	24" SD
1.5	DP4 (INLET 4)	1.50	1.46	8.9	4.3	7.2	6.5	10.6	24" SD
2	PR1.5, DP4.5 (INLET 4.5)	1.50	1.71	9.0	4.3	7.2	6.4	12.3	24" SD
3	PR2, DP5 (INLET 5)	3.78	5.27	9.0	4.3	7.2	16.2	37.9	36" SD
4	DP6	3.62	3.98	5.0	5.2	8.7	18.7	34.5	30" SD
4.5	Future Commercial Lot	0.00	0.00	0.0	0.0	0.0	0.0	0.0	30" SD
5	PR4, PR4.5	3.62	3.98	5.0	5.2	8.7	18.7	34.5	30" SD
6	PR5	3.62	3.98	5.0	5.2	8.7	18.7	34.5	30" SD
7	PR6	3.62	3.98	5.0	5.2	8.7	18.7	34.5	30" SD
8	DP7	1.80	1.96	5.0	5.2	8.7	9.3	17.0	24" SD
9	PR8, DP8 (Inlet 6)	2.65	2.72	6.8	4.7	7.9	12.5	21.4	30" SD
10	DP9 (Inlet 7)	1.17	0.98	6.8	4.7	7.9	5.5	7.7	18" SD
11	PR7, PR9, PR10	7.45	7.67	6.8	4.7	7.9	35.0	60.5	36" SD
11.5*	SEE FDR FOR AURA AT CROSSROADS	1.93	2.30	14.6	3.6	6.0	6.9	13.8	30" SD
12	PR11	7.45	7.67	7.0	4.7	7.8	34.7	60.0	42" SD
12.5	PR12, PR11.5	9.38	9.97	7.2	4.6	7.8	43.3	77.4	48" SD
13	DP10 (Inlet 8)	0.41	0.44	5.0	5.2	8.7	2.1	3.8	18" SD
14	DP11 (Inlet 9)	0.73	1.83	5.6	5.0	8.4	3.7	15.3	30" SD
15	PR12.5, PR13, PR14	10.52	12.24	7.5	4.6	7.7	48.0	93.7	48" SD
16	DP12	2.08	2.26	5.0	5.2	8.7	10.8	19.6	24" SD
17	PR15, PR16	12.61	14.50	7.7	4.5	7.6	57.0	110.1	48" SD
18	PR17, PR21	13.09	15.08	8.2	4.4	7.4	57.9	112.1	48" SD
19*	SEE FDR FOR AURA AT CROSSROADS	10.05	11.09	15.0	3.5	5.9	35.4	65.5	48" SD
20	POND OUTFALL	PER	MHFD	WKSHT			1.2	11.4	18" SD
21*	SEE FDR FOR AURA AT CROSSROADS	0.48	0.58	8.8	4.3	7.3	2.1	4.2	30" SD

*REFER TO FDR FOR AURA AT CROSSROADS FOR CONTRIBUTING PIPE FLOW DETAILS

DP - Design Point
EX - Existing Design Point

FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE CALCULATIONS
(Proposed Area Runoff Coefficient Summary)

			STREETS / COMMERC.			*MULTI-FAMILY/PARKLAND*			*DISTURBED & UNDEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(Sq Ft)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
TRACT D PROPOSED BASINS													
P1	***390703.7678***	8.97	0.00	0.90	0.96	0.00	0.38	0.56	8.97	0.12	0.39	***0.12***	***0.39***
P2	***132430.7607***	3.04	0.00	0.90	0.96	0.00	0.16	0.41	3.04	0.12	0.39	***0.12***	***0.39***

Calculated by: CVW
Date: 2/7/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE REPORT
(Proposed Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY #*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	**CHECK** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		From DCM Table 5-1															
Proposed Area Drainage Summary																	
P1	8.97	0.12	0.39	0.12	173	2	22.2	728	1.1%	1.6	7.7	29.9	15.0	3.5	5.9	***3.8***	***20.7***
P2	3.04	0.12	0.39	0.12	175	2	22.4	525	1.5%	1.9	4.7	27.1	13.9	3.6	6.1	***1.3***	***7.2***

Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW
Date: 2/7/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE REPORT
(Proposed Basin Routing Summary)

From Area Runoff Coefficient Summary				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY *		TOTAL FLOWS		
DESIGN POINT	CONTRIBUTING BASINS	CA_5	CA_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	COMMENTS
PROPOSED DRAINAGE BASIN ROUTING SUMMARY																	
7	P1	1.08	3.50				15.0					15.0	3.5	5.9	3.8	20.7	Proposed Sediment Basin (SB2)
				Tc for P1 Used													
12	P2, DP7	1.44	4.68				14.7					14.7	3.6	6.0	5.1	27.9	Proposed Sediment Basin (SB3)
				Weighted Tc Used													

* Intensity equations assume a minimum travel time of 5 minutes.

CVW
Date: 2/7/2022
Checked by: DLM

CROSSROADS MIXED USE FILING NO. 1
FINAL DRAINAGE CALCULATIONS
(Proposed Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*		PIPE SIZE
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
11	**N/A**	0.00	0.00	0.0	0.0	0.0	***0.0***	***0.0***	36" SD
*11.5**	**SEE FDR FOR AURA AT CROSSROADS**	1.93	2.30	14.6	3.6	6.0	***6.9***	***13.8***	30" SD
12	**PR11**	0.00	0.00	0.0	0.0	0.0	***0.0***	***0.0***	42" SD
12.5	**PR12, PR11.5**	1.93	2.30	14.6	3.6	6.0	***6.9***	***13.8***	48" SD
13	**Inlet 8 (See Future Drainage)**	0.41	0.44	5.0	5.2	8.7	***2.1***	***3.8***	18" SD
14	**Inlet 9 (See Future Drainage)**	0.73	1.83	5.6	5.0	8.4	***3.7***	***15.3***	30" SD
15	**PR12.5 PR13, PR14**	3.07	4.57	15.0	3.5	5.9	***10.8***	***27.0***	48" SD
16	**DP12**	1.44	4.68	14.7	3.6	6.0	***5.1***	***27.9***	24" SD
17	**PR15, PR16**	4.51	9.25	15.0	3.5	5.9	***15.9***	***54.7***	48" SD

*REFER TO FDR FOR AURA AT CROSSROADS FOR CONTRIBUTING PIPE FLOW DETAILS

DP - Design Point
EX - Existing Design Point

FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: CVW
Date: 2/7/2022
Checked by: DLM

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Roadside Ditch Intermediate Events Drainage Summary)

From Area Runoff Coefficient Summary							*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY ^*					*TOTAL FLOWS*				
BASIN	**AREA TOTAL**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{10}**	**I_{25}**	**I_{50}**	**I_{100}**	**Q_5**	**Q_{10}**	**Q_{25}**	**Q_{50}**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*						*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(in/hr)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*	*(c.f.s.)*	*(c.f.s.)*	*(c.f.s.)*
C	5.89	0.08	0.15	0.25	0.30	0.35	0.1	300	9.0	22.2	300	2%	1.0	8.4	30.6	14.4	2.9	3.6	4.2	4.8	5.4	***1.3***	***3.2***	***6.2***	***8.4***	***11.1***
OS-2	4.98	0.49	0.54	0.60	0.63	0.66	0.5	85	8.0	4.8	1165	1.8%	2.0	9.6	14.5	16.9	3.6	4.2	4.8	5.4	6.0	***8.7***	***11.1***	***14.1***	***16.7***	***19.6***

^ Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

Crossroads Mixed Use Filing No. 1
FINAL DRAINAGE REPORT
(Roadside Ditch Intermediate Events: Routing Summary)

From Area Runoff Coefficient Summary							*OVERLAND*				*PIPE / CHANNEL FLOW*				T_t	*INTENSITY **					*TOTAL FLOWS*				
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA10**	**CA25**	**CA50**	**CA_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**I_5**	**I_{10}**	**I_{25}**	**I_{50}**	**I_{100}**	**Q_5**	**Q10**	**Q25**	**Q50**	**Q_{100}**
(CONDITION)								*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(in/hr)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*	*(c.f.s.)*	*(c.f.s.)*	*(c.f.s.)*
7	**OS2**	2.44	2.67	2.96	3.11	3.26				14.5					14.5	3.6	4.2	4.8	5.4	6.0	***10.4***	***14.8***	***21.1***	***26.2***	***31.9***
(Historic)	**DP6 (Basin C)**	0.47	0.88	1.47	1.77	2.06																			
		2.91	3.55	4.44	4.88	5.32	Tc for OS2 Used																		
Peak Discharge		**COLORADO URBAN HYDROGRAPH PROCEDURE USED TO DEVELOP PEAK FLOWS**																			***1.2***	***2.6***	***9.1***	***11.0***	***11.4***
(From MHFD Worksheet)																									
16	**OS2**	2.44	2.67	2.96	3.11	3.26				14.5					14.5	3.6	4.2	4.8	5.4	6.0	***9.9***	***13.7***	***23.2***	***27.7***	***31.0***
(Future)	**POND OUTFALL (MHFD)**	0.34	0.62	1.91	2.05	1.90																			
		2.78	3.29	4.87	5.17	5.16	Tc for OS2 Used																		

Calculated by: CVW
Date: 1/31/2022
Checked by: DLM

HYDRAULIC CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **CROSSROADS MIXED USE**

Basin ID: **POND 1**

Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	32.20	acres
Watershed Length =	1,725	ft
Watershed Length to Centroid =	1,000	ft
Watershed Slope =	0.006	ft/ft
Watershed Imperviousness =	78.67%	percent
Percentage Hydrologic Soil Group A =	95.4%	percent
Percentage Hydrologic Soil Group B =	4.6%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.859	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.293	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.407	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.122	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.696	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.394	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.058	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.833	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	7.551	acre-feet		inches
Approximate 2-yr Detention Volume =	2.178	acre-feet		
Approximate 5-yr Detention Volume =	2.835	acre-feet		
Approximate 10-yr Detention Volume =	3.393	acre-feet		
Approximate 25-yr Detention Volume =	4.014	acre-feet		
Approximate 50-yr Detention Volume =	4.379	acre-feet		
Approximate 100-yr Detention Volume =	4.723	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.859	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.433	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.430	acre-feet
Total Detention Basin Volume =	4.723	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
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_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	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

Depth Increment = 2.00 ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6287.68	**Top of Micropool**	--	0.00	--	--	--	125	0.003		
	88	--	0.40	--	--	--	240	0.006	73	0.002
	90	--	2.40	--	--	--	17,342	0.398	16,784	0.385
	92	--	4.40	--	--	--	39,263	0.901	72,518	1.665
	94	--	6.40	--	--	--	47,710	1.095	159,490	3.661
	96	--	8.40	--	--	--	60,034	1.378	267,234	6.135

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **CROSSROADS MIXED USE**

Basin ID: **POND 1**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.35	0.859	Orifice Plate
Zone 2 (EURV)	6.06	2.433	Orifice Plate
Zone 3 (100-year)	7.32	1.430	Weir&Pipe (Restrict)
Total (all zones)		4.723	

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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	6.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	2.03	4.05					
Orifice Area (sq. inches)	3.77	6.25	12.60					

	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)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.09	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.09	N/A	feet
Overflow Weir Front Edge Length =	5.70	N/A	feet	Overflow Weir Slope Length =	2.91	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	13.14	N/A	
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	11.61	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	5.81	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.88	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.43	N/A	feet
Restrictor Plate Height Above Pipe Invert =	9.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.85	feet
Spillway Crest Length =	33.00	feet	Stage at Top of Freeboard =	9.15	feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	1.38	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	6.13	acre-ft

Calculated Parameters for Spillway

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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.859	3.293	2.407	3.122	3.696	4.394	5.058	5.833	7.551
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.407	3.122	3.696	4.394	5.058	5.833	7.551
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.3	0.5	5.1	9.2	14.8	26.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.01	0.16	0.29	0.46	0.82
Peak Inflow Q (cfs) =	N/A	N/A	33.3	42.7	49.7	61.8	71.7	83.5	108.3
Peak Outflow Q (cfs) =	0.5	1.3	1.1	1.2	2.6	9.1	11.0	11.4	40.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.7	5.6	1.8	1.2	0.8	1.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.7	0.8	0.8	0.9
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) =	38	67	61	66	69	68	67	66	62
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	65	72	76	75	75	75	74
Maximum Ponding Depth (ft) =	3.35	6.06	5.02	5.70	6.19	6.44	6.75	7.28	7.72
Area at Maximum Ponding Depth (acres) =	0.63	1.06	0.96	1.03	1.07	1.10	1.14	1.22	1.28
Maximum Volume Stored (acre-ft) =	0.863	3.295	2.242	2.918	3.434	3.705	4.042	4.668	5.230

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use Existing Inlets**

Inlet ID: **INLET 1**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.8**	**32.7**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR STORM'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.4**	**11.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**5.8**	**15.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**59**	**42**	**%**

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use Existing Inlets**

Inlet ID: **INLET 2**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.8**	**32.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.1**	**5.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**88**	**%**

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 3**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	27.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.005	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	22.8	27.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.8**	**24.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.7**	**9.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**3.5**	**13.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**65**	**42**	**%**

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 4 - AT-GRADE**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.8	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.8**	**32.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.5**	**10.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

NEEHAH R-2501 TYPE C GRATE (100 YR)

width	N/A	area (sf)	1.1	open area x 50%	0.55
length	N/A	area blockage	0.5		
perimeter (lf)	4.9	perimeter blockage	3	avail perm. (lf)	1.9

		Orifice (cfs)	Weir (cfs)
58	0	0.00	0.00
58.125	0.125	0.94	0.26
58.25	0.25	1.32	0.74
58.375	0.375	1.62	1.35
58.5	0.5	1.87	2.08
58.625	0.625	2.09	2.91
58.75	0.75	2.29	3.83
58.875	0.875	2.48	4.82
59	1	2.65	5.89
59.125	1.125	2.81	7.03
59.25	1.25	2.96	8.23
59.375	1.375	3.11	9.50
59.5	1.5	3.24	10.82
59.625	1.625	3.38	12.20
59.75	1.75	3.50	13.64
59.875	1.875	3.63	15.12
60	2	3.75	16.66
60.125	2.125	3.86	18.25
60.25	2.25	3.97	19.88
60.375	2.375	4.08	21.56
60.5	2.5	4.19	23.28
60.625	2.625	4.29	25.05
60.75	2.75	4.39	26.86
60.875	2.875	4.49	28.71
61	3	4.59	30.61
61.125	3.125	4.68	32.54
61.25	3.25	4.77	34.51

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 5**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.8	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.4	51.0	cfs
Interception with Clogging	Q_{wa} =	9.9	48.8	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	29.4	40.9	cfs
Interception with Clogging	Q_{oa} =	28.1	39.1	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	16.2	42.5	cfs
Interception with Clogging	Q_{ma} =	15.5	40.6	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.9**	**39.1**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	18.9	43.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	4.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.34	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.9**	**39.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.8	25.8	cfs

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 6**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	8.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.36	3.36	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.87	4.87	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	12.0	12.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.425	0.425	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	5.5	5.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.1	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**9.6**	**9.6**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	6.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.6	2.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.8	30.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.8	28.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.498	0.191	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.2	54.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.2	42.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.2	12.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	3.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.4	58.7	cfs
Average Flow Velocity Within the Gutter Section	V =	5.7	9.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.1	7.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.4**	**49.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.35	8.26	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.39	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.4**	**49.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.0**	**6.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**1.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**81**	**%**

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 7**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	8.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.36	3.36	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.87	4.87	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	12.0	12.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.425	0.425	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	5.5	5.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.1	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**9.6**	**9.6**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	6.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.6	2.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	12.0	30.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	10.0	28.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.490	0.191	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.4	54.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.4	42.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.3	12.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	3.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.7	58.7	cfs
Average Flow Velocity Within the Gutter Section	V =	5.8	9.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.1	7.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.7**	**49.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.40	8.26	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.39	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.7**	**49.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.5**	**7.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.9**	**4.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**86**	**66**	**%**

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 8**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018

Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	8.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.20	0.50	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.75	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.82	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.3**	**16.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.1	3.8	cfs

Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Crossroads Mixed Use**

Inlet ID: **Inlet 9**

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018

Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	8.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.20	0.50	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.75	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.89	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**20.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.7	15.3	cfs

HISTORIC DRAINAGE MAP: A-A' 100 YR ANALYSIS

Select Channel Type: Trapezoid

Depth from Q

Select unit system: Feet(ft)

Channel slope: .018 ft/ft	Water depth(y): 0.59 ft	Bottom width(b) 5 ft
Flow velocity 4.02 ft/s	LeftSlope (Z1): 19 to 1 (H:V)	RightSlope (Z2): 9.9 to 1 (H:V)
Flow discharge 31.9 ft^3/s	Input n value .025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 22.04 ft	Flow area 7.94 ft^2	Top width(T) 21.99 ft
Specific energy 0.84 ft	Froude number 1.18	Flow status Supercritical flow
Critical depth 0.64 ft	Critical slope 0.0125 ft/ft	Velocity head 0.25 ft

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EXISTING DRAINAGE MAP: A-A' 100 YR ANALYSIS

Select Channel Type: Trapezoid

Depth from Q

Select unit system: Feet(ft)

Channel slope: .018 ft/ft	Water depth(y): 0.55 ft	Bottom width(b) 5 ft
Flow velocity 3.89 ft/s	LeftSlope (Z1): 19 to 1 (H:V)	RightSlope (Z2): 9.9 to 1 (H:V)
Flow discharge 28 ft^3/s	Input n value .025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 21.04 ft	Flow area 7.2 ft^2	Top width(T) 21 ft
Specific energy 0.79 ft	Froude number 1.17	Flow status Supercritical flow
Critical depth 0.6 ft	Critical slope 0.0123 ft/ft	Velocity head 0.23 ft

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FUTURE DRAINAGE MAP: A-A' 100 YR ANALYSIS

Select Channel Type: Trapezoid

Depth from Q

Select unit system: Feet(ft)

Channel slope: .018 ft/ft	Water depth(y): 0.58 ft	Bottom width(b) 5 ft
Flow velocity 3.96 ft/s	LeftSlope (Z1): 19 to 1 (H:V)	RightSlope (Z2): 9.9 to 1 (H:V)
Flow discharge 31 ft^3/s	Input n value .025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 21.9 ft	Flow area 7.83 ft^2	Top width(T) 21.85 ft
Specific energy 0.83 ft	Froude number 1.17	Flow status Supercritical flow
Critical depth 0.63 ft	Critical slope 0.0122 ft/ft	Velocity head 0.24 ft

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FUTURE DRAINAGE MAP: B-B' 100 YR ANALYSIS

Select Channel Type: Trapezoid

Depth from Q

Select unit system: Feet(ft)

Channel slope: .015 ft/ft	Water depth(y): 0.44 ft	Bottom width(b) 0 ft
Flow velocity 2.506355 ft/s	LeftSlope (Z1): 3 to 1 (H:V)	RightSlope (Z2): 3 to 1 (H:V)
Flow discharge 1.43 ft^3/s	Input n value .025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 2.76 ft	Flow area 0.57 ft^2	Top width(T) 2.62 ft
Specific energy 0.53 ft	Froude number 0.95	Flow status Subcritical flow
Critical depth 0.43 ft	Critical slope 0.0154 ft/ft	Velocity head 0.1 ft

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FUTURE DRAINAGE MAP: C-C' 100 YR ANALYSIS

Select Channel Type: Trapezoid

Depth from Q

Select unit system: Feet(ft)

Channel slope: .010 ft/ft	Water depth(y): 0.66 ft	Bottom width(b) 0 ft
Flow velocity 2.809 ft/s	LeftSlope (Z1): 14 to 1 (H:V)	RightSlope (Z2): 4 to 1 (H:V)
Flow discharge 10.9 ft^3/s	Input n value .025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 11.92 ft	Flow area 3.88 ft^2	Top width(T) 11.82 ft
Specific energy 0.78 ft	Froude number 0.86	Flow status Subcritical flow
Critical depth 0.62 ft	Critical slope 0.0133 ft/ft	Velocity head 0.12 ft

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FUTURE DRAINAGE MAP: D-D' 100 YR ANALYSIS

Select Channel Type: Trapezoid

Depth from Q

Select unit system: Feet(ft)

Channel slope: .015 ft/ft	Water depth(y): 0.89 ft	Bottom width(b) 0 ft
Flow velocity 4.066 ft/s	LeftSlope (Z1): 3 to 1 (H:V)	RightSlope (Z2): 3 to 1 (H:V)
Flow discharge 9.7 ft^3/s	Input n value .025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 5.64 ft	Flow area 2.39 ft^2	Top width(T) 5.35 ft
Specific energy 1.15 ft	Froude number 1.07	Flow status Supercritical flow
Critical depth 0.92 ft	Critical slope 0.0124 ft/ft	Velocity head 0.26 ft

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CROSSROADS MIXED USE FILING NO. 1
EMERGENCY SPILLWAY CALCULATIONS PRIVATE FSD POND (POND 1)

Horizontal Broad-Crested Weir (Eqn 12-20 UDFCD)						
Variable				*Solve For*		
C	3.00			L (ft)	H (ft)	Q (cfs)
L	33.00	ft		0.0	0.0	79.0
H	0.86	ft				
Q		cfs				

Total Q	83.89

Equation 12-20

$$Q = C_{BCW} L H^{1.5}$$

Sloping Broad-Crested Weir (Eqn 12-21 UDFCD)						
Variable				*Solve For*		
C	3.00			Z (ft)	H (ft)	Q (cfs)
Z	3.00	ft		0.0	0.0	2.5
H	0.86	ft				
Q		cfs				

Equation 12-21

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

Figure 12-20. Sloping broad-crest weir

DESIGN POINT 6 RIP RAP SIZING CHART

Figure 5.4. Steep slope riprap design, trapezoidal channels; 2:1 sideslopes, 6 ft base width.

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212 N. Wahsatch Ave., Ste. 305
Colorado Springs, CO
719.955.5485

Project: CROSSROADS MIXED USE FIL. NO. 1: POND STRUCTURES

Date: 2/8/2022

Minimum Forebay Volume

- 3% of WQCV $= (0.03)(0.863\ ac \cdot ft)\left(43560\ \frac{ft^2}{ac}\right) = \frac{1127.77\ ft^3}{2\ \text{forebays}}$

$\approx$ **564 ft^3 / forebay (design)**

$(301\ ft^2)(2\ ft\ depth) = 602\ ft^3$ (Actual) $> 564\ ft^3$ (Design) ∴ ✓

Forebay Release and Configuration

- Release 2% of 100-yr Peak Discharge

$(0.02)(82.7\ cfs) = 1.65\ cfs$ (design) $< 2.13\ cfs$ (actual)* ∴ ✓

* See attached "Rectangular Contracted Weir Sheet" for actual flow determination

Micropool Sizing

- 32.2 acres @ 78.7% imperviousness

Tributary Impervious Area $= (32.2\ acres)(78.7\%) = 25.3\ acres$

From Fig. 1 - Micropool Surface Area (SA) determination chart provided by City of Colorado Springs,

[Design SA $= 108\ ft^2$] < [Actual SA $= 126\ ft^2$ SA] ∴ ✓

See Attached

1.) See attached "Open Channel Flow Calculator" sheet for low-flow channel capacity

Irrigation in the Pacific Northwest

- Home
- Mobile
- Irrigation Calculators
  - Popular
  - Irrigation Management Calculators
  - Drip
  - Sprinkler
  - Center Pivot
  - Residential
  - General Design Calculators
  - Water Measurement Calculators
    - Cipolletti (Trapezoidal) Weir
    - 90° Triangular Notch Weir
    - Parshall Flume
    - Rectangular Contracted Weir
    - Rectangular Submerged Orifices
    - Trapezoidal Flume
    - Vertical Pipes
  - Chemigation
- FAQs & Tutorials
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Rectangular Contracted Weir

This calculates the water flow rate over a rectangular contracted weir. This weir has a rectangular opening where the sides are straight up and down. A contracted weir means that the ditch or canal leading up to the weir is wider than the weir opening itself. The water before the weir should be held in a relatively calm and smooth pool. There should be air (not trapped) underneath the water leaving the weir. The Length is the bottom width of the weir. The height is measured from the bottom of the weir opening to the top of the water level ponded behind the weir (not the water level right as it leaves the weir). Learn more about the units used on this page.

Length:

3 in

Height:

2 ft

Calculate

Flow Rate:

2.13 cfs

* Note: 1 point = 1/100 ft.

The Equation

The Equation used to determine the flow rate (Q) of a Rectangular Contracted Weir is:

$$Q = 3.247 \cdot L \cdot H^{1.48} - \frac{0.566L^{1.9}}{1 + 2 \cdot L^{1.87}} \cdot H^{1.9}$$

Where:

Q = Flow Rate in cfs.

L = Bottom width of the weir in feet.

H = Height of the upstream water above the weir crest in feet.

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Figure 1 – Micropool Surface Area (SA) Determination Chart

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$

POND 1
78.7%x32.1AC= 25.3 AC

TIA = Tributary impervious area (acres)
I = Imperviousness (fraction)
A = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

ISV = Initial surcharge volume (cf)
SA = Surface area (from Figure 1, sf)

TRICKLE CHANNEL CAPACITY

Select Channel Type: Trapezoid

Velocity(V)&Discharge(Q)

Select unit system: Feet(ft)

Channel slope: .005 ft/ft	Water depth(y): .5 ft	Bottom width(b) 4 ft
Flow velocity 4.388 ft/s	LeftSlope (Z1): 0 to 1 (H:V)	RightSlope (Z2): 0 to 1 (H:V)
Flow discharge 8.776 ft^3/s	Input n value .013 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 5 ft	Flow area 2 ft^2	Top width(T) 4 ft
Specific energy 0.8 ft	Froude number 1.09	Flow status Supercritical flow
Critical depth 0.53 ft	Critical slope 0.0041 ft/ft	Velocity head 0.3 ft

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Project: CROSSROADS MIXED USE FIL. NO. 1: RIP RAP SIZING

Date: 2/8/2022

Pond 1 Outfall: Rip Rap Sizing

* Based on outfall pipe condition, flow is subcritical ($F_r = 0.89$)

1. $\frac{Q}{D_c^{2.5}} = \frac{11.4\,cfs}{(1.5ft)^{2.5}} = 4.14 \leq 6.0$ ∴ Use Figure 9-38 (see attached) for rip rap sizing

2. $\frac{Y_t}{D_c} = \frac{0.58'}{1.5'} = 0.39$

$\boxed{\text{From Figure 9-38, Type L Rip Rap Shall Be Used}}$

Pond 1 Spillway: Rip Rap Sizing

1. Unit Discharge (cfs/ft) $= \frac{82.7\,cfs}{33\,ft} = \underline{2.51\,cfs/ft}$

2. Longitudinal Slope $= \frac{1'}{5.5'} = 18.1\%$ ← Used steepest portion of slope

$\boxed{\text{From Figure 12-21, Type M Rip Rap Shall Be Used}}$

(SEE ATTACHED FIGURE)

POND 1 OUTFALL: RIP RAP SIZING

Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

EMERGENCY SPILLWAY PROFILE

EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

SOIL RIPRAP NOTES:

1. ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2–INCHES GREATER THAN THE THICKNESS SHOWN.

2. WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE–MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65PERCENT RIPRAP AND 35 PERCENT SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND SHALL HAVE A MINIMUM FINES CONTENT OF 15 PERCENT. THE SOIL RIPRAP SHALL BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERIAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.

3. WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.

4. ALL SOIL RIPRAP THAT IS BURIED WITH TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.

GRADATION FOR GRANULAR BEDDING		
U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT	
	TYPE I CDOT SECT. 703.01	TYPE II CDOT SECT. 703.09 CLASS A
3 INCHES	–	90 – 100
1½ INCHES	–	–
¾ INCHES	–	20 – 90
⅜ INCHES	100	–
#4	95 – 100	0 – 20
#16	45 – 80	–
#50	10 – 30	–
#100	2 – 10	–
#200	0 – 2	0 – 3

RIPRAP BEDDING

Figure 8-34. Riprap and soil riprap placement and gradation (part 2 of 3)

THICKNESS REQUIREMENTS FOR GRANULAR BEDDING			
RIPRAP DESIGNATION	MINIMUM BEDDING THICKNESS (INCHES)		
	FINE–GRAINED SOILS [1]		COARSE–GRAINED SOILS [2]
	TYPE I (LOWER LAYER)	TYPE II (UPPER LAYER)	TYPE II
VL (D_{50} = 6 IN)	4	4	6
L (D_{50} = 9 IN)	4	4	6
M (D_{50} = 12 IN)	4	4	6
H (D_{50} = 18 IN)	4	6	8
VH (D_{50} = 24 IN)	4	6	8

NOTES:
1. MAY SUBSTITUTE ONE 12–INCH LAYER OF TYPE II BEDDING. THE SUBSTITUTION OF ONE LAYER OF TYPE II BEDDING SHALL NOT BE PERMITTED AT DROP STRUCTURES. THE USE OF A COMBINATION OF FILTER FABRIC AND TYPE II BEDDING AT DROP STRUCTURES IS ACCEPTABLE.
2. FIFTY PERCENT OR MORE BY WEIGHT RETAINED ON THE #40 SIEVE.

Figure 8-34. Riprap and soil riprap placement and gradation (part 3 of 3)

STORM MAIN NETWORK LAYOUT

STORM MAIN: 100 YR FLEXTABLE

FlexTable: Conduit Table

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR18	32	MH-8	112.10	108.1	95.9	8.92	0.786	(N/A)	3.20	6,296.78	6,296.20	6,295.54	6,294.96	0.58
PR17	36	MH-7	110.10	76.3	199.1	8.76	1.474	2.62	3.17	6,299.02	6,297.85	6,297.83	6,296.66	1.17
PR15	38	MH-6	93.70	84.0	26.5	7.46	1.093	2.81	2.93	6,299.88	6,299.76	6,299.01	6,298.90	0.11
LAT-2.1	46	INLET 9	15.30	16.7	25.7	3.12	3.469	0.69	1.32	6,300.51	6,300.48	6,300.36	6,300.33	0.04
PR11	68	MH-4	60.50	45.3	58.4	8.56	3.102	1.42	2.51	6,305.00	6,304.51	6,303.86	6,303.38	0.48
LAT-2.2	73	INLET 8	3.80	16.2	15.7	2.15	3.181	0.41	0.75	6,300.42	6,300.40	6,300.35	6,300.33	0.02
LAT-3.3	84	INLET 7	7.70	15.6	2.5	4.36	6.691	0.40	1.08	6,305.90	6,305.88	6,305.60	6,305.59	0.01
LAT-3.2	86	INLET 6	21.40	41.0	27.8	4.36	1.932	1.11	1.57	6,305.96	6,305.88	6,305.66	6,305.59	0.08
PR7	88	MH-3	34.50	63.8	175.7	7.03	1.880	1.45	2.00	6,307.60	6,306.35	6,306.83	6,305.59	1.24
PR6	90	MH-2	34.50	75.3	60.1	10.25	1.522	1.62	2.00	6,308.29	6,307.69	6,307.25	6,306.91	0.34
PR5	92	MH-1	34.50	78.2	125.3	9.95	1.446	1.66	2.00	6,310.04	6,308.74	6,309.00	6,307.22	1.77
PR4	94	HW-MAIN	34.50	47.7	22.5	14.56	2.635	1.22	2.00	6,311.04	6,310.76	6,310.00	6,308.80	1.20
LAT-3.1	104	HW-3	17.00	20.2	15.1	5.41	5.583	0.61	1.49	6,306.50	6,306.42	6,306.05	6,305.96	0.09
LAT-1	118	HW-1	19.60	40.1	38.4	6.24	3.161	0.88	1.59	6,299.79	6,299.51	6,299.19	6,298.90	0.29
PR21	129	INLET D1 (BY OTHERS)	4.20	5.4	87.6	8.49	2.873	0.39	0.67	6,296.68	6,296.67	6,296.60	6,296.66	-0.05
PR12	135	MH-5	60.00	52.2	165.6	6.24	1.786	1.80	2.43	6,303.18	6,302.59	6,302.58	6,301.99	0.59
PR12.5	136	MH-5.5	77.40	69.5	213.2	6.16	1.171	2.46	2.66	6,301.54	6,300.92	6,300.95	6,300.33	0.62
PR11.5	138	MH-B4 (BY OTHERS)	13.80	47.7	110.3	2.81	1.055	1.22	1.25	6,302.24	6,302.11	6,302.11	6,301.99	0.13

Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
6,296.66	8.76	0.900	1.11	6,295.00	6,301.41	6,290.10	6,290.60	Circle - 48.0 in
6,298.90	6.24	0.900	1.07	6,301.41	6,304.40	6,290.90	6,292.91	Circle - 48.0 in
6,300.33	2.15	1.520	1.31	6,304.40	6,302.57	6,293.21	6,293.37	Circle - 48.0 in
6,300.59	3.12	1.500	0.23	6,302.57	6,302.59	6,294.87	6,296.15	Circle - 30.0 in
6,305.59	4.36	1.520	1.73	6,306.99	6,308.27	6,298.11	6,300.45	Circle - 36.0 in
6,300.46	2.15	1.500	0.11	6,302.57	6,302.59	6,295.87	6,296.65	Circle - 18.0 in
6,306.04	4.36	1.500	0.44	6,308.27	6,307.05	6,301.95	6,302.50	Circle - 18.0 in
6,305.96	5.41	1.020	0.30	6,308.27	6,307.77	6,300.95	6,301.40	Circle - 30.0 in
6,306.91	7.11	0.100	0.08	6,308.27	6,310.70	6,300.95	6,304.00	Circle - 30.0 in
6,307.35	9.89	0.100	0.10	6,310.70	6,312.53	6,304.50	6,305.25	Circle - 30.0 in
6,309.10	11.25	0.100	0.10	6,312.53	6,313.79	6,305.55	6,307.00	Circle - 30.0 in
6,311.06	8.21	1.020	1.07	6,313.79	6,311.00	6,307.30	6,308.00	Circle - 30.0 in
6,306.46	5.41	1.020	0.46	6,307.77	6,306.00	6,301.90	6,304.00	Circle - 24.0 in
6,299.62	6.24	1.020	0.62	6,304.40	6,299.00	6,295.21	6,297.00	Circle - 24.0 in
6,296.72	2.28	1.500	0.12	6,301.41	6,301.20	6,292.40	6,295.60	Circle - 30.0 in
6,303.38	8.56	1.320	0.80	6,306.99	6,304.52	6,297.61	6,295.45	Circle - 42.0 in
6,301.99	2.81	1.770	1.04	6,304.52	6,302.57	6,294.95	6,293.67	Circle - 48.0 in
6,302.18	2.81	0.500	0.06	6,304.52	6,303.80	6,296.45	6,297.00	Circle - 24.0 in

STORM MAIN - 100 YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: MH-1
Type: Manhole
ID: 91
Label: MH-2
Type: Manhole
ID: 89
Label: MH-3
Type: Manhole
ID: 87
Label: MH-4
Type: Manhole
ID: 97
Label: MH-5
Type: Manhole
ID: 47
Label: MH-5.5
Type: Manhole
ID: 134
Label: MH-6
Type: Manhole
ID: 37
Label: MH-7
Type: Manhole
ID: 35
Label: MH-8
Type: Manhole
ID: 31
Label: HW-MAIN
Type: Catch Basin
ID: 119
Label: PR4
Type: Conduit
ID: 94
Label: PR5
Type: Conduit
ID: 92
Label: PR6
Type: Conduit
ID: 90
Label: PR7
Type: Conduit
ID: 88
Label: PR11
Type: Conduit
ID: 68
Label: PR12
Type: Conduit
ID: 135
Label: PR12.5
Type: Conduit
ID: 136
Label: PR15
Type: Conduit
ID: 38
Label: PR17
Type: Conduit
ID: 36
Label: PR18
Type: Conduit
ID: 32
Label: EAST FOREBAY
Type: Outfall
ID: 60

LAT 1 - 100 YR
EGL
HGL
Label: MH-7
Type: Manhole
ID: 35
Label: HW-1
Type: Catch Basin
ID: 116
Label: LAT-1
Type: Conduit
ID: 118
Elevation (ft)
Station (ft)

LAT-2 - 100 YR
Elevation (ft)
Station (ft)
EGL
HGL
Label: INLET 8
Type: Catch Basin
ID: 74
Label: MH-6
Type: Manhole
ID: 37
Label: INLET 9
Type: Catch Basin
ID: 45
Label: LAT-2.2
Type: Conduit
ID: 73
Label: LAT-2.1
Type: Conduit
ID: 46

LAT-3 - 100 YR
EGL
HGL
Elevation (ft)
Station (ft)
Label: HW-3
Type: Catch Basin
ID: 120
Label: LAT-3.1
Type: Conduit
ID: 104
Label: INLET 6
Type: Catch Basin
ID: 107
Label: LAT-3.2
Type: Conduit
ID: 86
Label: MH-4
Type: Manhole
ID: 97
Label: LAT-3.3
Type: Conduit
ID: 84
Label: INLET 7
Type: Catch Basin
ID: 108

STORM 4.1 - 100 YR
EGL
HGL
Label: MH-8
Type: Manhole
ID: 31
Label: INLET D1 (BY OTHERS)
Type: Catch Basin
ID: 139
Label: PR21
Type: Conduit
ID: 129
Elevation (ft)
6,301.50
6,301.00
6,300.50
6,300.00
6,299.50
6,299.00
6,298.50
6,298.00
6,297.50
6,297.00
6,296.50
6,296.00
6,295.50
6,295.00
6,294.50
6,294.00
6,293.50
6,293.00
6,292.50
6,292.00
6,291.50
6,291.00
6,290.50
-4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0 82.0 84.0 86.0 88.0 90.0
Station (ft)

STORM 1 LAYOUT

STORM 1 - FLEXTABLE

FlexTable: Conduit Table

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR-20	40	OUTLET STRUCTURE	11.40	102.0	112.2	7.20	1.059	1.26	1.29	6,289.33	6,288.06	6,288.56	6,287.26	1.30

Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
6,289.72	7.06	1.500	1.16	6,287.50	6,293.77	6,286.00	6,287.27	Circle - 18.0 in

STORM 1 - 100YR - Base
Elevation (ft)
Station (ft)
EGL
HGL
Label: POND OUTFALL
Type: Outfall
ID: 38
Label: PR-20
Type: Conduit
ID: 40
Label: OUTLET STRUCTURE
Type: Catch Basin
ID: 39

STORM 2 NETWORK LAYOUT

STORM 2: 100 YR FLEXTABLE

FlexTable: Conduit Table

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR-2	36	INLET 4.5	12.30	54.3	51.0	7.35	1.417	1.05	1.26	6,302.41	6,302.26	6,302.16	6,302.02	0.14
PR-1.5	37	INLET 4	10.60	34.2	92.8	8.93	2.025	0.81	1.17	6,303.97	6,302.78	6,303.49	6,302.60	0.89
(A-0) BY OTHERS	43	MH A0 (BY OTHERS)	38.65	67.1	64.3	8.74	1.256	1.80	2.02	6,301.24	6,300.95	6,300.33	6,300.38	0.05
PR-3	44	INLET 5	37.90	56.1	15.6	9.83	1.526	1.61	2.00	6,302.02	6,301.98	6,301.54	6,301.52	0.02

Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
6,302.60	3.37	1.770	0.44	6,306.22	6,306.00	6,299.77	6,300.28	Circle - 24.0 in
6,304.21	5.57	1.500	0.72	6,306.00	6,306.77	6,300.58	6,302.32	Circle - 24.0 in
6,301.52	5.41	1.320	1.19	6,304.95	6,305.72	6,297.83	6,298.31	Circle - 36.0 in
6,302.02	3.92	1.000	0.48	6,305.72	6,306.22	6,298.61	6,298.77	Circle - 36.0 in

STORM 2-100YR - Base
EGL
HGL
Elevation (ft)
Station (ft)
Label: MH A1 (BY OTHERS)
Type: Outfall
ID: 41
Label: MH A0 (BY OTHERS)
Type: Manhole
ID: 42
Label: INLET 5
Type: Catch Basin
ID: 32
Label: INLET 4.5
Type: Catch Basin
ID: 33
Label: INLET 4
Type: Catch Basin
ID: 34
Label: PR-1.5
Type: Conduit
ID: 37
Label: PR-2
Type: Conduit
ID: 36
Label: PR-3
Type: Conduit
ID: 44
Label: (A-0) BY OTHERS
Type: Conduit
ID: 43

STORM 3 NETWORK LAYOUT

STORM 3: 100 YR FLEXTABLE

FlexTable: Conduit Table

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR-1	35	INLET 3	9.80	43.9	88.3	3.12	1.434	0.93	1.12	6,315.92	6,315.75	6,315.77	6,315.60	0.17

Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
6,315.99	3.12	1.500	0.23	6,317.99	6,317.80	6,313.16	6,312.30	Circle - 24.0 in

STORM 3 - 100YR - Base
EGL
HGL
Label: INLET 3
Type: Catch Basin
ID: 31
Label: EX STORM MH 1
Type: Outfall
ID: 33
Label: PR-1
Type: Conduit
ID: 35
Elevation (ft)
6,318.00
6,317.50
6,317.00
6,316.50
6,316.00
6,315.50
6,315.00
6,314.50
6,314.00
6,313.50
6,313.00
6,312.50
6,312.00
6,311.50
6,311.00
6,310.50
Station (ft)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0 82.0 84.0 86.0 88.0 90.0 92.0 94.0

STORM 5 NETWORK LAYOUT

STORM 5: 100 YR FLEXTABLE

FlexTable: Conduit Table

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)
PR19	130	IN-A9 (BY OTHERS)	65.50	63.1	99.7	5.21	1.117	2.31	2.44	6,295.59	6,295.38	6,295.17	6,294.96	0.21

Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
6,295.80	5.21	1.500	0.63	6,294.50	6,297.05	6,290.00	6,290.52	Circle - 48.0 in

STORM 5 - 100 YR
Elevation (ft)
6,297.00
6,296.50
6,296.00
6,295.50
6,295.00
6,294.50
6,294.00
6,293.50
6,293.00
6,292.50
6,292.00
6,291.50
6,291.00
6,290.50
6,290.00
Station (ft)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
Label: WEST FOREBAY
Type: Outfall
ID: 60
Label: IN-A9 (BY OTHERS)
Type: Catch Basin
ID: 128
Label: PR19
Type: Conduit
ID: 130
EGL
HGL

BACKGROUND

NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH.

STRUCTURE TABLE	
STRUCTURE ID	DESCRIPTION
A0	TYPE I MANHOLE
A1	TYPE I MANHOLE
A2	TYPE I MANHOLE
A3	INLET TYPE R 10'
A4	INLET TYPE R 5'
A5	TYPE I MANHOLE
A6	TYPE I MANHOLE
A7	TYPE I MANHOLE
A8	INLET TYPE R 15' MOD
A9	INLET TYPE R 10'
B1	INLET TYPE C

STRUCTURE TABLE	
STRUCTURE ID	DESCRIPTION
B2	INLET TYPE R 5'
B3	TYPE II MANHOLE
B4	INLET TYPE R 10'
B5	TYPE I MANHOLE
C1	TYPE I MANHOLE
C2	TYPE I MANHOLE
C3	INLET TYPE R 10'
C4	INLET TYPE R 15'
D1	INLET TYPE R 10'

PIPE TABLE						
NAME	UPSTREAM STRUCTURE	DOWNSTREAM STRUCTURE	SIZE	LENGTH	SLOPE	MATERIAL
A-0	A0	A1	36"	64.26'	0.50%	RCP
A-1	A1	A2	36"	182.49'	0.50%	RCP
A-2	A3	A2	18"	36.82'	4.50%	RCP
A-3	A2	A5	36"	331.29'	0.50%	RCP
A-4	A4	A5	15"	102.94'	1.50%	RCP
A-5	A5	A6	36"	64.06'	2.03%	RCP
A-6	A6	A7	36"	286.28'	0.58%	RCP
A-7	A7	A8	36"	130.14'	0.50%	RCP
A-8	A9	A8	24"	125.80'	1.00%	RCP
A-9	A8		48"	10.05'	0.50%	RCP
B-1	B1		15"	35.69'	0.50%	RCP
B-2	B2	B3	18"	109.40'	0.50%	RCP
B-3	B3	B4	18"	107.86'	0.50%	RCP
B-4	B4	B5	24"	110.33'	0.50%	RCP
C-1		C1	36"	60.28'	2.00%	RCP
C-2	C1	B5	42"	165.64'	1.30%	RCP
C-3	B5	C2	48"	213.24'	0.60%	RCP
C-4	C3	C2	18"	15.67'	5.00%	RCP
C-5	C4	C2	30"	25.67'	5.00%	RCP
C-6	C2		48"	16.52'	0.60%	RCP

DESIGN POINT SUMMARY		
DESIGN POINT	Q5 (CFS)	Q100 (CFS)
0	16.48	38.58
1	4.61	9.36
2	19.17	43.45
3	0.88	1.90
4	19.60	44.42
5	19.55	45.20
6	2.76	5.24
7	30.16	65.43
8	1.38	3.17
9	2.06	4.57
10	6.85	13.80
11	35.00	60.50
12	41.65	73.75
13	44.47	79.25
14	2.08	4.20
15	0.47	1.27
16	0.57	1.43

DIRECT RUNOFF SUMMARY			
SUBBASIN	AREA (AC)	Q5 (CFS)	Q100 (CFS)
X-1	0.42	0.58	1.50
X-2	0.01	0.05	0.10
X-3	0.08	0.26	0.50
A-1	2.07	4.61	9.36
A-2	0.43	0.88	1.90
A-3	0.42	0.13	0.94
A-4	0.76	2.76	5.24
A-5	3.67	8.72	17.06
B-1	0.75	1.38	3.17
B-2	0.28	0.74	1.45
B-3	1.91	4.89	9.52
C-1	0.77	1.86	3.84
C-2	0.44	1.39	2.64
D-1	0.78	2.08	4.20
Z-1	0.37	0.47	1.27
Z-2	0.38	0.57	1.43

811 Know what's below. Call before you dig.

40 0 40 80
SCALE: 1" = 40'

DESIGNED BY: EEM
CHECKED BY: JDO
DRAWN BY: EEM

ISSUE DATE: 08-06-2021

DATE	REVISION COMMENTS
10-29-2021	PER COUNTY COMMENTS
01-13-2022	PER COUNTY COMMENTS

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

TRINSIC ACQUISITION COMPANY, LLC

AURA AT CROSSROADS
DRAINAGE PLAN

PROJECT #: 200823
SHEET NUMBER
1
1 OF 1

FILEPATH: K:\200823\ENGINEERING\DRAINAGE\DRAINAGE PLAN.DWG LAYOUT: LAYOUT1 (2)
5 XREFs: e-sesgp, p-base, e-base-xyz, p-legal, p-util-hydt
PLOTTED: TUE 04/05/22 5:38:38P BY: ETHAN MARKS

Basin A-5 Overflow

MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Crossroads
Inlet ID: A8

Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.150		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.010		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**21.5**	**21.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.1**	**12.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.9**	**7.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**90**	**61**	**%**

Basin D-1 Overflow

MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Crossroads
Inlet ID: D1

Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.060		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.010		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**21.5**	**21.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**5.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**78**	**%**

Aura at Crossroads

Network Schematic

Aura at Crossroads

FlexTable: Conduit Table

Active Scenario: 5 YR

Label	Start Node	Stop Node	Length (Unified) (ft)	Rise (Unified) (ft)	Notes	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	System Known Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)
A-0	A0	A1	64.3	3.00	36" RCP	6,298.31	6,297.99	0.005	22.65	47.06	6.59	6,299.84	6,299.46	6,305.84	6,305.38
A-1	A1	A2	182.5	3.00	36" RCP	6,297.79	6,296.88	0.005	22.65	47.10	6.60	6,299.32	6,298.35	6,305.38	6,304.10
A-2	A3	A2	38.3	1.50	18" RCP	6,299.84	6,298.18	0.043	4.61	21.88	9.81	6,300.66	6,298.67	6,302.56	6,304.10
A-3	A2	A5	331.3	3.00	36" RCP	6,296.68	6,295.04	0.005	24.63	46.92	6.72	6,298.28	6,296.58	6,304.10	6,300.87
A-4	A4	A5	102.9	1.25	15" RCP	6,298.13	6,296.59	0.015	0.88	7.90	4.25	6,298.50	6,296.87	6,302.89	6,300.87
A-5	A5	A6	64.1	3.00	36" RCP	6,294.84	6,293.54	0.020	24.95	94.98	11.32	6,296.45	6,294.66	6,300.87	6,300.83
A-6	A6	A7	286.3	3.00	36" RCP	6,293.34	6,291.67	0.006	24.86	50.94	7.16	6,294.95	6,293.72	6,300.83	6,297.03
A-7	A7	A9	130.1	3.00	36" RCP	6,291.47	6,290.82	0.005	24.86	47.14	6.76	6,293.69	6,293.61	6,297.03	6,297.91
A-8	A8	A9	125.8	2.00	24" RCP	6,293.78	6,292.52	0.010	2.76	22.64	4.88	6,294.36	6,293.51	6,299.57	6,297.91
A-9	A9	O-2	104.4	4.00	48" RCP	6,290.50	6,290.00	0.005	35.44	99.40	7.25	6,293.46	6,293.44	6,297.91	6,294.00
B-1	B1	B2	35.7	1.25	15" RCP	6,299.37	6,299.19	0.005	1.38	4.59	3.27	6,299.84	6,299.65	6,302.34	6,303.02
B-2	B2	B3	109.4	1.50	18" RCP	6,298.99	6,298.44	0.005	2.06	7.45	3.60	6,299.53	6,298.98	6,303.02	6,304.77
B-3	B3	B4	107.9	1.50	18" RCP	6,298.24	6,297.70	0.005	2.06	7.43	3.60	6,298.84	6,298.82	6,304.77	6,303.81
B-4	B4	B5	110.3	2.00	24" RCP	6,297.50	6,296.95	0.005	6.85	15.97	4.89	6,298.43	6,297.87	6,303.81	6,304.53
C-1	FUT-1	C1	60.3	3.00	36" RCP	6,300.45	6,298.11	0.039	35.00	131.40	15.73	6,302.37	6,299.29	6,308.24	6,307.03
C-2	C1	B5	165.7	3.50	42" RCP	6,297.61	6,295.45	0.013	35.00	114.88	10.48	6,299.44	6,296.78	6,307.03	6,304.53
C-3	B5	C2	213.2	4.00	48" RCP	6,294.95	6,293.67	0.006	41.65	111.28	8.22	6,296.88	6,295.37	6,304.53	6,302.67
C-4	C3	C2	15.7	1.50	18" RCP	6,296.65	6,295.87	0.050	1.86	23.41	7.92	6,297.16	6,296.18	6,299.96	6,302.67
C-5	C4	C2	25.7	2.50	30" RCP	6,296.15	6,294.87	0.050	3.60	91.53	9.05	6,296.77	6,295.23	6,300.16	6,302.67
C-6	C2	EX2	26.5	4.00	48" RCP	6,293.37	6,293.21	0.006	46.67	111.56	8.48	6,295.42	6,295.32	6,302.67	6,304.40
D-1	D1	EX1	87.7	2.50	30" RCP	6,295.49	6,292.40	0.035	2.08	77.00	6.80	6,295.96	6,293.49	6,301.22	6,298.00
EX-1	EX2	EX1	204.3	4.00	48" RCP	6,292.91	6,290.90	0.010	57.47	142.47	10.73	6,295.19	6,293.46	6,304.40	6,298.00
EX-2	EX1	O-1	99.4	4.00	48" RCP	6,290.60	6,290.00	0.006	59.55	111.59	9.03	6,293.44	6,293.44	6,298.00	6,295.00

Aura at Crossroads

FlexTable: Conduit Table

Active Scenario: 100 YR

Label	Start Node	Stop Node	Length (Unified) (ft)	Rise (Unified) (ft)	Notes	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	System Known Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)
A-0	A0	A1	64.3	3.00	36" RCP	6,298.31	6,297.99	0.005	38.65	47.06	7.43	6,300.38	6,300.15	6,305.84	6,305.38
A-1	A1	A2	182.5	3.00	36" RCP	6,297.79	6,296.88	0.005	38.65	47.10	7.44	6,300.08	6,299.69	6,305.38	6,304.10
A-2	A3	A2	38.3	1.50	18" RCP	6,299.84	6,298.18	0.043	9.36	21.88	11.89	6,301.02	6,299.75	6,302.56	6,304.10
A-3	A2	A5	331.3	3.00	36" RCP	6,296.68	6,295.04	0.005	43.51	46.92	6.16	6,299.68	6,298.27	6,304.10	6,300.87
A-4	A4	A5	102.9	1.25	15" RCP	6,298.13	6,296.59	0.015	1.90	7.90	5.29	6,298.68	6,298.22	6,302.89	6,300.87
A-5	A5	A6	64.1	3.00	36" RCP	6,294.84	6,293.54	0.020	44.48	94.98	6.29	6,298.19	6,297.90	6,300.87	6,300.83
A-6	A6	A7	286.3	3.00	36" RCP	6,293.34	6,291.67	0.006	45.26	50.94	6.40	6,297.71	6,296.39	6,300.83	6,297.03
A-7	A7	A9	130.1	3.00	36" RCP	6,291.47	6,290.82	0.005	45.26	47.14	6.40	6,296.16	6,295.56	6,297.03	6,297.91
A-8	A8	A9	125.8	2.00	24" RCP	6,293.78	6,292.52	0.010	5.24	22.64	5.86	6,295.38	6,295.33	6,299.57	6,297.91
A-9	A9	O-2	104.4	4.00	48" RCP	6,290.50	6,290.00	0.005	65.49	99.40	5.21	6,295.18	6,294.96	6,297.91	6,294.00
B-1	B1	B2	35.7	1.25	15" RCP	6,299.37	6,299.19	0.005	3.17	4.59	4.03	6,300.16	6,300.07	6,302.34	6,303.02
B-2	B2	B3	109.4	1.50	18" RCP	6,298.99	6,298.44	0.005	4.57	7.45	4.43	6,299.96	6,299.83	6,303.02	6,304.77
B-3	B3	B4	107.9	1.50	18" RCP	6,298.24	6,297.70	0.005	4.57	7.43	2.59	6,299.81	6,299.61	6,304.77	6,303.81
B-4	B4	B5	110.3	2.00	24" RCP	6,297.50	6,296.95	0.005	13.80	15.97	5.72	6,298.93	6,298.29	6,303.81	6,304.53
C-1	FUT-1	C1	60.3	3.00	36" RCP	6,300.45	6,298.11	0.039	60.50	131.40	18.20	6,302.96	6,299.76	6,308.24	6,307.03
C-2	C1	B5	165.7	3.50	42" RCP	6,297.61	6,295.45	0.013	60.50	114.88	12.10	6,300.05	6,297.29	6,307.03	6,304.53
C-3	B5	C2	213.2	4.00	48" RCP	6,294.95	6,293.67	0.006	73.75	111.28	9.47	6,297.55	6,297.34	6,304.53	6,302.67
C-4	C3	C2	15.7	1.50	18" RCP	6,296.65	6,295.87	0.050	3.84	23.41	9.78	6,297.40	6,297.41	6,299.96	6,302.67
C-5	C4	C2	25.7	2.50	30" RCP	6,296.15	6,294.87	0.050	17.30	91.53	14.33	6,297.56	6,297.41	6,300.16	6,302.67
C-6	C2	EX2	26.5	4.00	48" RCP	6,293.37	6,293.21	0.006	93.89	111.56	9.95	6,297.32	6,297.21	6,302.67	6,304.40
D-1	D1	EX1	87.7	2.50	30" RCP	6,295.49	6,292.40	0.035	4.20	77.00	8.39	6,296.16	6,295.89	6,301.22	6,298.00
EX-1	EX2	EX1	204.3	4.00	48" RCP	6,292.91	6,290.90	0.010	113.49	142.47	9.03	6,296.98	6,295.71	6,304.40	6,298.00
EX-2	EX1	O-1	99.4	4.00	48" RCP	6,290.60	6,290.00	0.006	117.96	111.59	9.39	6,295.63	6,294.96	6,298.00	6,295.00

IMPERVIOUSNESS AND RUNOFF COEFFICIENTS CALCULATIONS, POST DEVELOPMENT

CALC'D BY: EEM
DATE: 10/29/21
NRCS Hydrologic Soil Group: A/B

PROJECT: Aura at Crossroads
PROJ. NO: 200823

LAND USE TYPES (per Table 6-6 of Volume 1 Update of El Paso County DCM) :

Land Use or Surface Characteristics	Imperviousness	Runoff Coefficients, C											
		2-year		5-year		10-year		25-yr		50-yr		100-yr	
		A/B	C/D	A/B	C/D	A/B	C/D	A/B	C/D	A/B	C/D	A/B	C/D
Paved Streets, Drives, Parking, Walks	100%	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Building Roofs	90%	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns, Landscape Areas	2%	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

		ACRES					COMPOSITE RUNOFF COEFFICIENTS (Eq. 6-6)					
Subbasin	Areas	Paved Streets, Drives, Parking, Walks	Building Roofs	Lawns, Landscape Areas	Imperviousness	Imperv. Acres	C_2=	C_5=	C_{10}=	C_{25}=	C_{50}=	C_{100}=
X-1	0.42	0.00	0.18	0.24	39.42%	0.16	0.31	0.36	0.41	0.48	0.51	0.55
X-2	0.01	0.01	0.00	0.00	77.91%	0.01	0.69	0.72	0.75	0.78	0.80	0.82
X-3	0.08	0.07	0.00	0.01	83.16%	0.07	0.74	0.76	0.79	0.82	0.84	0.86
A-1	2.07	0.87	0.59	0.61	68.37%	1.42	0.58	0.61	0.65	0.69	0.72	0.74
A-2	0.43	0.13	0.12	0.18	57.23%	0.25	0.48	0.52	0.56	0.61	0.64	0.67
A-3	0.42	0.00	0.00	0.42	2.00%	0.01	0.02	0.08	0.15	0.25	0.30	0.35
A-4	0.76	0.46	0.19	0.11	83.16%	0.63	0.72	0.74	0.76	0.80	0.82	0.83
A-5	3.67	1.92	0.94	0.81	75.80%	2.78	0.65	0.68	0.71	0.75	0.77	0.79
B-1	0.75	0.27	0.09	0.39	48.53%	0.37	0.42	0.46	0.50	0.57	0.60	0.63
B-2	0.28	0.12	0.10	0.06	74.95%	0.21	0.63	0.66	0.69	0.73	0.75	0.77
B-3	1.91	1.17	0.31	0.43	76.49%	1.46	0.67	0.69	0.72	0.76	0.78	0.80
D-1	0.78	0.39	0.15	0.23	68.64%	0.53	0.59	0.62	0.66	0.70	0.73	0.75
C-1	0.77	0.34	0.17	0.26	64.66%	0.50	0.56	0.59	0.62	0.67	0.70	0.72
C-2	0.44	0.36	0.00	0.08	81.51%	0.36	0.73	0.75	0.77	0.81	0.83	0.84
Z-1	0.37	0.00	0.14	0.23	35.36%	0.13	0.28	0.33	0.38	0.45	0.49	0.52
Z-2	0.38	0.01	0.17	0.21	42.47%	0.16	0.34	0.38	0.43	0.50	0.53	0.56
Total/Composite	13.55	6.13	3.15	4.27	66.79%	9.05	0.57	0.60	0.64	0.69	0.71	0.73

When multiple sub-basins are delineated, the composite C value calculation is:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \ldots C_iA_i) / A_t \qquad \text{(Eq. 6-6)}$$

Where:

C_c = composite runoff coefficient for total area

C_i = runoff coefficient for subarea corresponding to surface type or land use

A_i = area of surface type corresponding to C_i (units must be the same as those used for total area)

A_t = total area of all subareas for which composite runoff coefficient applies

i = number of surface types in the drainage area

CALCULATED BY: EEM
CHECKED BY: MW
DATE: 10/29/2021

Standard Form SF-1 (Modified)
Time of Concentration, Post-Development

JOB NO: 200823
PROJECT: Aura at Crossroads
REVISED: 10/29/2021

SUB-BASIN DATA			INITIAL/OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					T_c CHECK (URBANIZED BASINS)				FINAL T_c	REMARKS
BASIN	AREA (AC)	C_5	LENGTH (FT)	SLOPE %	T_i (MIN)	LENGTH (FT)	SLOPE %	C_v	VELOCITY (FPS)	T_t (MIN)	COMPOS. $T_c = T_i + T_t$ (MIN)	L_t, TOTAL LENGTH	AVG SLOPE	$T_c = (L/180) + 10$ (MIN)	(MIN)	
X-1	0.42	0.36	243.0	1.26	19.7	16.0	1.00	15	1.50	0.2	19.8	259	1.25	11.4	11.4	to proposed area/landscape drains
X-2	0.01	0.72	28.9	5.29	2.2	285.0	1.30	20	2.28	2.1	5.0	313.9	1.67	11.7	5.0	to existing off-site inlet
X-3	0.08	0.76	87.5	1.41	5.2	613.6	1.10	20	2.10	4.9	10.1	701.1	1.14	13.9	10.1	to existing off-site inlet
A-1	2.07	0.61	362.0	1.13	16.4	318.0	1.18	20	2.17	2.4	18.8	680	1.15	13.8	13.8	to proposed curb inlet
A-2	0.43	0.52	203.0	1.10	14.7	67.4	1.96	20	2.80	0.4	15.1	270.4	1.32	11.5	11.5	to proposed curb inlet
A-3	0.42	0.08	70.2	3.59	10.2	378.0	2.00	15	2.12	3.0	13.2	448.16	2.25	12.5	12.5	to proposed area inlet
A-4	0.76	0.74	52.4	2.18	3.7	282.0	1.10	20	2.10	2.2	6.0	334.4	1.27	11.9	6.0	to proposed modified curb inlet
A-5	3.67	0.68	198.0	1.06	10.7	701.0	1.03	20	2.03	5.8	16.5	899	1.04	15.0	15.0	to proposed curb inlet
B-1	0.75	0.46	180.0	2.11	12.3	5.0	1.00	10	1.00	0.1	12.4	185	2.08	11.0	11.0	to proposed area inlet
B-2	0.28	0.66	182.5	1.28	10.1	76.0	1.70	20	2.61	0.5	10.5	258.5	1.40	11.4	10.5	to proposed curb inlet
B-3	1.91	0.69	210.3	1.54	9.5	451.0	1.00	20	2.00	3.8	13.2	661.3	1.17	13.7	13.2	to proposed curb inlet
D-1	0.78	0.62	125.0	1.48	8.6	40.0	2.60	20	3.22	0.2	8.8	165	1.75	10.9	8.8	to proposed curb inlet
C-1	0.77	0.59	50.0	2.14	5.2	706.0	1.46	20	2.42	4.9	10.0	756	1.51	14.2	10.0	to proposed curb inlet
C-2	0.44	0.75	13.0	0.15	4.4	754.0	1.48	20	2.43	5.2	9.5	767	1.45	14.3	9.5	to proposed curb inlet
Z-1	0.37	0.33	90.0	0.24	21.5	277.4	1.06	20	2.06	2.2	23.8	367.4	0.86	12.0	12.0	to proposed area/landscape drains
Z-2	0.38	0.38	126.0	2.25	11.3	67.0	1.22	7	0.77	1.4	12.7	193	1.89	11.1	11.1	to landsacpe drains/grass swale to detention pond

Estimating Time of Concentration (T_c):

$$t_c = t_i + t_t \qquad \text{(RO-2)}$$

in which:

t_c = time of concentration (minutes)

t_i = initial or overland flow time (minutes)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (minutes)

2.4.1 Initial Flow Time

The initial or overland flow time, t_i, may be calculated using equation RO-3:

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(RO-3)}$$

in which:

t_i = initial or overland flow time (minutes)

C_5 = runoff coefficient for 5-year frequency (from Table RO-5)

L = length of overland flow (500 ft maximum for non-urban land uses, 300 ft maximum for urban land uses)

S = average basin slope (ft/ft)

Estimating Overland Travel Time (T_t):

$$V = C_v S_w^{0.5} \qquad \text{(RO-4)}$$

in which:

V = velocity (ft/sec)

C_v = conveyance coefficient (from Table RO-2)

S_w = watercourse slope (ft/ft)

Table RO-2—Conveyance Coefficient, C_v

Type of Land Surface	Conveyance Coefficient, C_v
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

The time of concentration, t_c, is then the sum of the initial flow time, t_i, and the travel time, t_t, as per Equation RO-2.

CALCULATED BY:	EEM	**Standard Form SF-2 (Modified)**	JOB NO:	200823
DATE:	3/24/2022	**Storm Drainage System Design**	PROJECT:	Aura at Crossroads
CHECKED BY:	MW	**(Rational Method Procedure)** **Post Development**	DESIGN STORM:	5 YR
PROJECT MANAGER:	JDO			

SUBBASIN(s)	DESIGN POINT (DP)	DIRECT RUNOFF AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	Q (CFS)	TOTAL RUNOFF T_c (MIN)	Σ(C x A) (AC)	I (IN/HR)	Q (CFS)	INLET INTERCEPTION (CFS)	BYPASS (CFS)	PIPE DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	REMARKS
Offsite Basin A		1.68	0.96	8.9	1.50	4.30	6.46														data per FDR for Crossroads Mixed Use (M&S Civil, August 2021)
Offsite Basin B		1.49	0.96	8.8	2.28	4.32	9.85														data per FDR for Crossroads Mixed Use (M&S Civil, August 2021)
								8.9	3.78	4.30	16.27										
X-1		0.42	0.36	11.4	0.15	3.93	0.58														Flows offsite to Meadowbrook Curb Inlet
X-2		0.01	0.72	5.0	0.01	5.17	0.05														Flows offsite to Meadowbrook Curb Inlet
X-3		0.08	0.76	10.1	0.06	4.12	0.26														Flows offsite to Meadowbrook Curb Inlet
Offsite + X-1 + X-2 + X-3	0							10.1	4.00	4.12	16.48			16.48	0.75	30	32.23	246.75	6.6	0.63	
A-1	1	2.07	0.61	13.8	1.26	3.65	4.61					4.40	0.21	4.61	2.00	18	13.48	38.51	7.6	0.08	
DP0+DP1	2							13.9	5.27	3.64	19.17			19.17	0.93	36	58.35	331.00	8.3	0.67	
A-2	3	0.43	0.52	11.5	0.22	3.92	0.88							0.88	1.50	15	7.18	103.00	5.8	0.29	
DP2+DP3	4							14.5	5.49	3.57	19.60			19.60	2.00	36	85.57	65.00	12.1	0.09	
A-3		0.42	0.08	12.5	0.03	3.80	0.13														Landscape Area Drain to DP-5
DP4+DP5	5							14.8	5.53	3.54	19.55			19.55	0.55	36	44.87	406.00	6.3	1.07	
A-4	6	0.76	0.74	6.0	0.56	4.91	2.76							0.00	2.00	24	29.02	132.06	9.2	0.24	
A-5		3.67	0.68	15.0	2.48	3.52	8.72														
A-5+DP6	7						8.93	15.0	8.56	3.52	30.16	6.80	2.13	30.16	0.50	48	4.14	131.29	3.4	0.65	
B-1	8	0.75	0.46	11.0	0.35	3.98	1.38							1.38	0.50	15	4.14	35.33	3.4	0.17	
B-2		0.28	0.66	10.5	0.18	4.05	0.74							0.74	0.50	24	14.51	215.10	4.6	0.78	
B-2+DP8	9							11.7	0.53	3.90	2.06										
B-3		1.91	0.69	13.2	1.32	3.71	4.89														
B-3+DP8	10							13.2	1.85	3.71	6.85	4.60	0.29	6.85	0.50	30	26.31	110.00	5.4	0.34	
Offsite Basin E		1.36	0.89	6.9	1.21	4.69	5.65														
	11							14.2			35.00			35.00	1.10	36	63.46	226.00	9.0	0.42	
DP10 + DP11	12							14.2	1.85	3.60	41.65			41.65	0.60	48	100.94	213.00	8.0	0.44	1/2 of Basin E in Crossroads Mixed Use PDR
C-1		0.77	0.59	10.0	0.45	4.12	1.86							1.86	2.00	18	13.48	16.16	7.6	0.04	Flow and Time of Travel is from Crossroads PDR
							1.86														
C-2		0.44	0.75	9.5	0.33	4.20	1.39							1.39	2.00	30	52.62	16.16	10.7	0.03	
OS-1+OS-2+DP12	13							14.2	0.78	3.60	44.47			44.47	1.00	48	130.31	30.49	10.4	0.05	
D-1	14	0.78	0.62	8.8	0.48	4.32	2.08														
							2.08							0.00	3.50	30		87.00			
Z-1	15	0.37	0.33	12.0	0.12	3.85	0.47														Landscape drains and overflow into detention pond
Z-2	16	0.38	0.38	11.1	0.14	3.98	0.57														Swale that flows existing detention pond

CALCULATED BY:	EEM	**Standard Form SF-2 (Modified)**	JOB NO:	200823
DATE:	3/24/2022	**Storm Drainage System Design**	PROJECT:	Aura at Crossroads
CHECKED BY:	MW	**(Rational Method Procedure)** **Post Development**	DESIGN STORM:	**100** YR
PROJECT MANAGER:	JDO			

		DIRECT RUNOFF						TOTAL RUNOFF				INLET		PIPE							
SUBBASIN(s)	DESIGN POINT (DP)	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	Q (CFS)	T_c (MIN)	Σ(C x A) (AC)	I (IN/HR)	Q (CFS)	INLET INTERCEPTION (CFS)	BYPASS (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	REMARKS
Offsite Basin A		1.67	0.96	8.9	1.71	7.23	12.36														data per FDR for Crossroads Mixed Use (M&S Civil, August 2021)
Offsite Basin B		1.48	0.96	8.8	3.56	7.25	25.83														data per FDR for Crossroads Mixed Use (M&S Civil, August 2021)
								8.9	5.27	7.23	38.08										
X-1		0.42	0.55	11.4	0.23	6.59	1.50														Flows offsite to Meadowbrook Curb Inlet
X-2		0.01	0.82	5.0	0.01	8.68	0.10														Flows offsite to Meadowbrook Curb Inlet
X-3		0.08	0.86	10.1	0.07	6.91	0.50														Flows offsite to Meadowbrook Curb Inlet
Offsite + X-1 + X-2 + X-3	0							10.1	5.58	6.91	38.58			38.58	0.75	30	35.52	246.75	7.2	0.57	
A-1	1	2.07	0.74	13.8	1.53	6.12	9.36					6.80	2.56	9.36	2.00	18	14.86	38.51	8.4	0.08	
DP0+DP1	2							13.9	7.11	6.11	43.45			43.45	0.93	36	64.32	331.00	9.1	0.61	
A-2	3	0.43	0.67	11.5	0.29	6.58	1.90					1.70	0.20	1.90	1.50	15	7.91	103.00	6.4	0.27	
DP2+DP3	4							14.5	7.40	6.00	44.42			44.42	2.00	36	94.33	65.00	13.3	0.08	
A-3		0.42	0.35	12.5	0.15	6.37	0.94														
DP4+DP5	5							14.5	7.55	5.99	45.20			45.20	0.55	36	49.46	406.00	7.0	0.97	
A-4	6	0.76	0.83	6.0	0.64	8.24	5.24					4.80	0.44								
														4.80	2.00	24	31.99	132.06	10.2	0.22	
A-5		3.67	0.79	15.0	2.89	5.91	17.06														
A-5+DP6	7						20.26	15.0	11.07	5.91	65.43	11.60	8.66	65.43	0.50	48	101.57	131.29	8.1	0.27	
B-1	8	0.75	0.63	11.0	0.47	6.69	3.17							3.17	0.50	15	4.57	35.33	3.7	0.16	
B-2		0.28	0.77	10.5	0.21	6.80	1.45							1.45	0.50	24	16.00	215.10	5.1	0.70	
B-2+DP8	9							11.2	0.69	6.65	4.57										
B-3		1.91	0.80	13.2	1.53	6.23	9.52					6.90	2.62								
B-3+DP8	10							13.2	2.22	6.23	13.80			13.80	0.50	30	29.00	110.00	5.9	0.31	
Offsite Basin E		1.36	0.89	6.9	1.21	7.87	9.49														
	11							14.2			60.50			60.50	1.10	36	69.95	226.00	9.9	0.38	
DP10 + DP11	12							14.6	2.22	5.98	73.75			73.75	0.50	48	101.57	213.00	8.1	0.44	
C-1		0.77	0.72	10.0	0.56	6.92	3.84							3.84	2.00	18	14.86	16.16	8.4	0.03	1/2 of Basin E in Crossroads Mixed Use PDR
							4.79					4.00	0.79								Flow and Time of Travel is from Crossroads PDR
C-2		0.44	0.84	9.5	0.37	7.05	2.64					1.70	0.94	2.64	2.00	30	58.01	16.16	11.8	0.02	
OS-1+OS-2+DP12	13							15.0	0.93	5.91	79.25			79.25	1.00	48	143.64	30.49	11.4	0.04	
D-1	14	0.78	0.75	8.8	0.58	7.25	4.20					4.60	2.23								
							6.83							0.00	3.50	30	76.74	87.00	15.6	0.09	
Z-1	15	0.37	0.52	12.0	0.20	6.46	1.27														Landscape drains and overflow into detention pond
Z-2	16	0.38	0.56	11.1	0.21	6.68	1.43														Swale that flows existing detention pond

DRAINAGE PLAN
CLAREMONT BUSINESS PARK FILING NO. 2

LOCATION MAP
NTS

MEADOWBROOK PARKWAY TYPICAL SECTION
NOT TO SCALE

EAST FORK SAND CREEK
SECTION B-B
N.T.S.
FOR INFORMATION ONLY

EAST FORK SAND CREEK
SECTION A-A
N.T.S.
FOR INFORMATION ONLY

NOTE:
CONSTRUCTION OF THE EAST FORK SAND CREEK CHANNEL IMPROVEMENTS WILL BE REQUIRED TO REMOVE A PORTION OF CLAREMONT BUSINESS PARK FILING No. 1 FROM THE EXISTING 100-YEAR FLOODPLAIN (PER FEMA FLOOD INSURANCE RATE MAPS 752F AND 756F)

OWNER = ADVANCED RV & SELF STORAGE LLP
(69.8 AC.)
LAND USE = VACANT LAND
ZONING = PUD/PID

EX. PUB. RIP-RAP
EX. PUB. RIP-RAP
EX. PUB. 48" FES w/ 16'x16'x1.5' RIPRAP PAD
EX. PUB. RIP-RAP
EX. PUB. 24" FES w/ 8'x8'x1.5' RIPRAP PAD
EX. PUB. RIP-RAP
PROPOSED CHANNEL
EXISTING 100-YR FEMA FLOODWAY
EX. PUB. RIP-RAP
FUT. PVT. 18" FES
FUT. PVT. TYPE R INLET
10' DRAINAGE EASEMENT
PROP. PVT. 10' TYPE R INLET
10' DRAINAGE EASEMENT
LOT 43
LOT 44
PROP. PVT. 5' TYPE R INLET
EX. PUB. 48" RCP
FUT. PVT. 36" FES
EX. PUB. 10' TYPE R INLET
PROP. PVT. GRATED INLETS
FUT. PVT. 36" RCP
FUT. PVT. 42" RCP
EX. PUB. 10' TYPE R INLET
FUT. PVT. 30" FES
EX. PUB. 10' TYPE R INLET
TRACT C
MARKSHEFFEL ROAD
OWNER = VENTIMIGLIA JOHN M (54.29 AC.)
LAND USE = SINGLE FAMILY RES.
ZONING = RR-3

A1 3.35 AC.
B1 7.35 AC.
B2 6.07 AC.
B3 4.68 AC.
B4 1.51 AC.
B5 4.00 AC.
B6 0.79 AC.
C1 3.17 AC.
D1 4.02 AC.
OS1 1.15 AC.

DESIGN POINT SUMMARY			
D.P.	SUB-BASINS	Q(5)	Q(100)
1	B1, B2	31.5	63.6
2	1, B3, OS1(flow by)	42.6	86.6
3	2(sewer), B4(flow by)	43.1	88.2
4	3, B6	44.1	90.1
4A	4, B5	52.8	107.5
5	D1(flow by), D3	13.5	25.9
6	5, D4	24.1	48.9
7	6, D5	40.8	82.5
8	7, D6, B4(flow by)	53.1	107.6
9	8, D7	61.6	124.5
10	D1(flow by), D2, E1, E2	19.4	40.6
11	10, E4	27.7	57.1
12	11, E5	36.3	74.3
13	12, E6	41.8	85.3

LEGEND

- 6520 — PROPOSED CONTOUR
- 6520 — EXISTING CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- DRAINAGE CHANNEL
- PROPOSED TYPE 'R' INLET
- PROPOSED TYPE I OR II MANHOLE
- FLOW ARROW
- BASIN DESIGNATION
- "C" COEFFICIENT (100 YR)
- BASIN AREA (ACRES)
- FILING 1 LIMITS
- DRAINAGE BASIN BOUNDARY
- FILING NO. 2

GRAPHIC SCALE
100 0 50 100 200
(IN FEET)
1 inch = 100 ft.

REFERENCE DRAWINGS
-BASE-04.052.001
-HIR
-TOPO
-ROAD
-BASE
-TOPO 09-01-05-bas

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

S:\05.151.006(FILING2)\300 Water Resources\302-FDR\DR01-02.dwg
PLOT DATE: Nov 27, 2006 2:55pm

BENCHMARK DATA(ELEV.)
(DATUM)
(DESCRIPTION/LOCATION)

SUBDIVIDER
HAMMERS CONSTRUCTION INC.
3460 CAPITAL DRIVE
COLORADO SPRINGS, CO 80915-9710

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.

Matrix Design Group, Inc.
Integrated Design Solutions 2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

CLAREMONT BUSINESS PARK
FINAL DRAINAGE PLAN
MASTER DEVELOPMENT DRAINAGE PLAN
FINAL DRAINAGE PLAN
FILING NO. 2

DESIGNED BY: RGC	SCALE	DATE ISSUED: SEPTEMBER 2006	DR01
DRAWN BY: GES	HORIZ: 1"= 100'		
CHECKED BY: JPL	VERT: N/A	SHEET NO. 1 OF 2 SHEETS	

DRAINAGE PLAN
CLAREMONT BUSINESS PARK FILING NO. 2

DESIGN POINT SUMMARY			
D.P.	SUB-BASINS	Q(5)	Q(100)
1	B1, B2	31.9	63.8
2	1, B3, OS1(flow by)	42.6	88.6
3	2(sewer), B4(flow by)	43.1	88.2
4	3, B6	44.1	90.1
4A	4, B5	52.8	107.5
5	D1(flow by), D3	13.5	25.9
6	5, D4	24.1	48.9
7	6, D5	40.8	82.5
8	7, D6, B4(flow by)	53.1	107.6
9	8, D7	61.6	124.5
10	D1(flow by), D2, E1, E2	19.4	40.6
11	10, E4	27.7	57.1
12	11, E5	36.3	74.3
13	12, E6	41.8	85.3
OS4	OS4	13.4	33.5

REFERENCE DRAWINGS

X-BASE 04.052.001
x-util
X-TOPO
X-ROAD
X-BASE
X-TOPO-09 01-05 .bas

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

S:\05.151.006(FILINGS)\300 Water Resources\302-FDR\DN01 02.dwg
PLOT DATE: Nov 27, 2006 2:34pm

BENCHMARK DATA(ELEV.) _____
(DATUM) _____
(DESCRIPTION/LOCATION) _____

SUBDIVIDER

HAMMERS CONSTRUCTION INC.
3460 CAPITAL DRIVE
COLORADO SPRINGS, CO 80915-9710

FOR AND ON BEHALF OF
MATRIX DESIGN GROUP, INC.

Matrix Design Group, Inc.
Integrated Design Solutions 2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

CLAREMONT BUSINESS PAR

FINAL DRAINAGE PLAN

MASTER DEVELOPMENT DRAINAGE PLA
FINAL DRAINAGE PLAN
FILING NO. 2

DESIGNED BY:	RCC	SCALE	DATE ISSUED: SEPTEMBER 2006
DRAWN BY:	GES	HORIZ: 1"= 100'	
CHECKED BY:	JPL	VERT: N/A	SHEET NO. 2 OF 2 SHEETS

DR

Claremont Business Park Filing No. 2
Rational Method
Fully Developed Conditions
Final Drainage Report

Sub-Basin Designation	Design Point	Sewer or Road	Sub-Basins	Comments	Total Area (ac.)	Weighted Coefficients C(5)	Weighted Coefficients C(100)	CA CA(5)	CA CA(100)	Overland Time Overland Length (ft)	Overland Time Overland Slope (%)	Overland Time T(initial) (min.)	Travel Time Travel Length (ft)	Travel Time Weighted Slope (%)	Travel Time Velocity (fps)	Travel Time T(travel) (min.)	Travel Time Final T(c)	T(c) check =d/180+10	Final T(c)	Intensity I(5) (in/hr)	Intensity I(100) (in/hr)	Peak Runoff Q(5) (cfs)	Peak Runoff Q(100) (cfs)
A1					3.35	0.80	0.90	2.68	3.02	60	2.0%	9.8	475	2.0%	2.6	3.0	12.8	13.0	12.8	3.71	6.60	9.9	19.9
B1					7.35	0.80	0.90	5.88	6.62	50	2.0%	8.9	1225	1.1%	2.3	8.9	17.8	17.1	17.1	3.26	5.80	19.2	38.4
B2					6.07	0.66	0.76	4.03	4.64	55	2.0%	9.4	900	1.4%	2.5	6.0	15.4	15.3	15.3	3.43	6.11	13.8	28.3
B3					4.68	0.71	0.81	3.33	3.80	40	2.0%	8.0	700	1.0%	2.0	5.8	13.8	14.1	13.8	3.59	6.39	12.0	24.3
B4					1.51	0.80	0.90	1.21	1.36	25	2.0%	6.3	1650	1.3%	2.3	12.0	18.3	19.3	18.3	3.15	5.61	3.8	7.6
B5					4.00	0.80	0.90	3.20	3.60	60	2.0%	9.8	500	3.0%	3.2	2.6	12.4	13.1	12.4	3.76	6.70	12.0	24.1
B6					0.79	0.80	0.90	0.63	0.71	50	2.0%	8.9	175	2.0%	2.6	1.1	10.1	11.3	10.1	4.09	7.28	2.6	5.2
	1	Sewer	B1, B2		13.42			9.91	11.25			17.1	275		5.0	0.9	18.0			3.18	5.65	31.5	63.6
	2	Sewer	1, B3, OS1(flowby)		18.10			13.48	15.39			18.0	50		5.0	0.2	18.2			3.16	5.63	42.6	86.6
	2	Road	B3, OS1(flowby)		18.10			3.57	4.13			13.8	50		5.0	0.2	14.0			3.57	6.36	12.8	26.3
	3	Sewer	2(sewer), B4(flow by)		19.61			13.73	15.78			18.3	50		5.0	0.2	18.4			3.14	5.59	43.1	88.2
	4	Sewer	3, B6		20.40			14.37	16.49			18.4	250		5.0	0.8	19.3			3.07	5.47	44.1	90.1
	4A	Sewer	4, B5		24.40			17.57	20.09			19.3	250		5.0	0.8	20.1			3.01	5.35	52.8	107.5
C1					3.17	0.80	0.90	2.54	2.85	50	2.0%	8.9	850	1.9%	2.6	5.4	14.4	15.0	14.4	3.53	6.28	8.9	17.9
C2					3.28	0.80	0.90	2.62	2.95	50	2.0%	8.9	350	3.0%	3.2	1.8	10.8	12.2	10.8	3.99	7.10	10.5	20.9
D1					4.02	0.64	0.74	2.57	2.97	50	2.0%	8.9	740	1.2%	2.3	5.4	14.3	14.4	14.3	3.54	6.30	9.1	18.7
D2					2.07	0.74	0.84	1.52	1.73	50	2.0%	8.9	1500	1.4%	2.4	10.4	19.4	18.6	18.6	3.12	5.56	4.8	9.6
D3					2.02	0.73	0.83	1.48	1.69	50	2.0%	8.9	540	1.1%	2.0	4.5	13.4	13.3	13.3	3.66	6.51	5.4	11.0
D4					2.06	0.73	0.83	1.51	1.72	50	2.0%	8.9	675	1.0%	2.1	5.4	14.3	14.0	14.0	3.57	6.35	5.4	10.9
D5					7.69	0.80	0.90	6.15	6.92	40	2.0%	8.0	1550	1.0%	2.1	12.3	20.3	18.8	18.8	3.11	5.53	19.1	38.3
D6					5.77	0.80	0.90	4.62	5.19	40	2.0%	8.0	1200	1.2%	2.3	8.7	16.7	16.9	16.7	3.29	5.86	15.2	30.4
D7					4.99	0.80	0.90	3.99	4.49	75	2.0%	11.0	1075	1.4%	2.4	7.5	18.4	16.4	16.4	3.32	5.91	13.3	26.6
	5	Sewer	D1 (flow by), D3		6.04			3.84	4.14			14.3	50		5.0	0.2	14.5			3.52	6.26	13.5	25.9
	6	Sewer	5, D4,OS2		8.10			8.83	10.08			23.1	350		5.0	1.2	24.2			2.73	4.85	24.1	48.9
	7	Sewer	6, D5		15.79			14.98	17.00			24.2	10		5.0	0.0	24.3			2.73	4.85	40.8	82.5
	8	Sewer	7, D6, B4(flow by)		23.07			19.85	22.59			24.3	250		5.0	0.8	25.1			2.68	4.76	53.1	107.6
	9	Sewer	8, D7		28.06			23.84	27.08			25.1	500		5.0	1.7	26.8			2.58	4.60	61.6	124.5
E1					5.83	0.77	0.87	4.49	5.08	55	2.0%	9.4	800	1.9%	2.6	5.1	14.5	14.8	14.5	3.52	6.26	15.8	31.8
E2					3.86	0.80	0.90	3.09	3.47	50	2.0%	8.9	400	1.3%	2.3	2.9	11.8	12.5	11.8	3.84	6.83	11.8	23.7
E4					3.87	0.80	0.90	3.10	3.48	55	2.0%	9.4	750	1.6%	2.5	5.0	14.4	14.5	14.4	3.53	6.28	10.9	21.9
E5					4.00	0.80	0.90	3.20	3.60	55	2.0%	9.4	800	1.6%	2.5	5.3	14.7	14.8	14.7	3.49	6.22	11.2	22.4
E6					2.74	0.80	0.90	2.19	2.47	55	2.0%	9.4	800	1.6%	2.5	5.3	14.7	14.8	14.7	3.49	6.22	7.7	15.3
	10	Sewer	D1(flow by), D2, E1		7.90			6.23	7.33			18.6	50		5.0	0.2	18.8			3.11	5.54	19.4	40.6
	10	Road	D1(flow by), D2		7.90			1.74	2.26			18.6	10		5.0	0.0	18.6				5.56	5.4	12.5
	11	Sewer	10, E4		11.77			9.33	10.82			18.8	550		5.0	1.8	20.6				5.28	27.7	57.1
	12	Sewer	11, E5		15.77			12.53	14.42			20.6	300		5.0	1.0	21.6				5.16	36.3	74.3
	13	Sewer	12, E6		18.51			14.72	16.88			21.6	250		5.0	0.8	22.4				5.06	41.8	85.3
F1					7.72	0.80	0.90	6.18	6.95	50	2.0%	8.9	900	1.9%	2.6	5.8	14.7	15.3	14.7	3.49	6.22	21.6	43.2
OS1				Marksheffel	1.15	0.84	0.89	0.97	1.02	15	2.0%	4.9	630	1.7%	2.4	4.4	9.3	13.6	9.3	4.22	7.51	4.1	7.7
OS2				Hwy 24	7.52	0.46	0.56	3.48	4.23	50	2.0%	8.9	2300	2.0%	2.6	14.7	23.7	23.1	23.1	2.80	4.98	9.7	21.1
OS3				Hwy 24	0.79	0.50	0.60	0.40	0.47	25	2.0%	6.3	300	3.0%	3.2	1.6	7.9	11.8	7.9	4.47	7.95	1.8	3.8
OS4 (Hist)				Meadowbrook	15.61	0.25	0.35	3.90	5.46	50	2.0%	8.9	1500	3.8%	4.0	6.3	15.2	18.6	15.2	3.44	6.13	13.4	33.5
OS4 (Future)				Meadowbrook	15.61	0.90	0.90	14.05	14.05	50	2.0%	8.9	1500	3.8%	6.0	4.2	13.1	18.6	13.1	3.68	6.54	51.6	91.9

UPDATED CALCULATIONS

STREET CAPACITIES FOR MEADOWBROOK PARKWAY

5-year flow (1/2 Street)
6.00% = 34.0cfs (max)
2.00% = 28.3cfs
1.20% = 21.9cfs
0.80% = 17.9cfs

100-year flow (1/2 Street)
6.00% = 235.2cfs
2.00% = 166.3cfs
1.20% = 128.8cfs
0.80% = 105.2cfs

LEGEND

	DRAINAGE BASIN BOUNDARY
X	DRAINAGE BASIN DESIGN POINT
BASIN / XX AC / X.X | X.X	BASIN I.D. / ACREAGE / 5 YR/100 YR CFS
	DIRECTION OF FLOW
6600	EXISTING CONTOUR
HP	HIGH POINT
LP	LOW POINT
GB	GRADE BREAK
TC	TOP BACK OF CURB
FL	FLOWLINE
	TIME OF CONCENTRATION

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
Circle K Stores, Inc.
1199 South Beltline Road, Suite 160
COPPELL, TX 75019
(940) 453-0015
CONTACT: Tim Peters

PROJECT:
24/94 BUSINESS PARK
Meadowbrook Parkway, & Platte Avenue
COLORADO SPRINGS, COLORADO

DRAWN: LAB 8/9/16
DESIGNED: LAB 8/9/16
CHECKED: RLS 8/15/16

EXISTING CONDITIONS DRAINAGE PLAN
24/94 BUSINESS PARK
EL PASO COUNTY, CO

DATE:
APRIL, 2016

PROJECT NO.
319.001

SHEET NUMBER
1

TOTAL SHEETS: 1

STREET CAPACITIES FOR MEADOWBROOK PARKWAY

5-year flow (1/2 Street)
6.00% = 34.0cfs (max)
2.00% = 28.3cfs
1.20% = 21.9cfs
0.80% = 17.9cfs

100-year flow (1/2 Street)
6.00% = 235.2cfs
2.00% = 166.3cfs
1.20% = 128.8cfs
0.80% = 105.2cfs

DESIGN POINT SUMMARY TABLE

DESIGN POINT	RUNOFF 5 YR (cfs)	RUNOFF 100 YR (cfs)	COMMENTS
INLET #2	40.1	71.9	FLOW IN PIPE
INLET #1	44.4	83.2	FLOW IN PIPE
INLET #3	7.1	12.9	ON-SITE INLET, 24" RCP TO WQ VAULT
STMH #6	7.5	15.1	FROM BASIN EX-OS2

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: rlsch@cegr.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
Circle K Stores, Inc.
1199 South Beltline Road, Suite 160
COPPELL, TX 75019
(940) 453-7019
CONTACT: Tim Peters

PROJECT:
24/94 BUSINESS PARK
Meadowbrook Parkway & Platte Avenue
COLORADO SPRINGS, COLORADO

DRAWN: LAB, 9/9/15
DESIGNED: LAB, 9/9/15
CHECKED: RLS, 9/10/15

PROPOSED STORM SEWER PLAN
LOT 1 OF 24/94 BUSINESS PARK
Meadowbrook Pkwy, EL PASO COUNTY, CO

DATE:
JULY 2016

PROJECT NO.
319.001

SHEET NUMBER
2

TOTAL SHEETS: 2

DESIGN POINT SUMMARY TABLE

DESIGN POINT	RUNOFF 5 YR (cfs)	RUNOFF 100 YR (cfs)	COMMENTS
DP-1	40.1	71.9	FLOW IN PIPE
DP-2	44.4	83.2	FLOW IN PIPE
INLET #3	7.1	12.9	ON-SITE INLET, 24" RCP TO WQ VAULT
STMH #6	7.5	15.1	FROM BASIN EX-OS2

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PROJECT: 24/94 BUSINESS PARK
Meadowbrook Parkway & Platte Avenue
COLORADO SPRINGS, COLORADO

PREPARED FOR:
Circle K Stores, Inc.
1199 South Beltline Road, Suite 160
COPPELL, TEXAS 75019
(940) 453-0015
CONTACT: Tim Peters

DRAWN: LAB, 9/9/15
DESIGNED: LAB, 9/9/15
CHECKED: RLS, 9/10/15

PROPOSED CONDITIONS DRAINAGE PLAN
LOT 1 OF 24/94 BUSINESS PARK
Meadowbrook Pkwy., EL PASO COUNTY, CO

DATE: JULY, 2016

PROJECT NO. 319.001

SHEET NUMBER 1

TOTAL SHEETS: 2

STORM SEWER PLAN/PROFILE (PUBLIC)

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
LOVE IN ACTION
270 N. WAHSATCH AVE, STE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
24/94 BUSINESS PARK
MEADOWBROOK PARKWAY/HWY 24
COLORADO SPRINGS, COLORADO

DRAWN:
DESIGNED:
CHECKED:

24/94 BUSINESS PARK
STORM SEWER PLAN AND PROFILE
STA 0+18 TO 10+92

DATE: 11/21/2016

PROJECT NO. 319.001

SHEET NUMBER 3

TOTAL SHEETS: 8

CORE ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: 24/94 Business Park
PROJECT NUMBER: 319 001
ENGINEER: LAB
DATE: September 4, 2015

Preliminary Drainage Plan
EXISTING CONDITIONS TRAVEL TIME CALCULATIONS

BASIN	"P" or "K" (TR-55)	"n" "Cs"	"WP" or "Pipe Dia"	HIGH ELEV.	LOW ELEV.	LENGTH	HEIGHT	SLOPE	"V"	"TT" (min)	COMMENTS
EX-A1		0.90		6340.7	6340.5	10	0.2	2.00%		0.92	Overland Flow
				6340.0	6317.0	1250	23.0	1.84%	4.00	5.21	Street Flow
						1260				6.1	
EX-A2		0.90		6335.8	6335.6	10	0.2	2.00%		0.92	Overland Flow
				6335.1	6318.1	916	17.0	1.86%	4.02	3.80	Street Flow
						926				4.7	
EX-B		0.08		6380.0	6345.0	300	35.0	11.67%		14.28	Overland Flow
				6345.0	6316.5	574	28.5	4.97%	6.57	1.46	
						874				15.7	
EX-C1		0.90		6332.1	6331.9	10	0.2	2.00%		0.92	Overland Flow
				6331.9	6317.7	574	14.2	2.47%	4.64	2.06	Street Flow
						584				3.0	
EX-C2		0.90		6329.2	6329.0	10	0.2	2.00%		0.92	Overland Flow
				6329.0	6317.0	530	12.0	2.26%	4.44	1.99	Street Flow
						540				2.9	
EX-D		0.08		6325.0	6314.0	230	11.0	4.78%		16.83	Overland Flow
				6314.0	6294.7	1585	19.3	1.22%	2.13	12.41	Swale Flow
						1815				29.2	
EX-E		0.08		6321.5	6316.0	282	5.5	1.95%		25.13	Overland Flow
				6316.0	6285.0	1364	31.0	2.27%	2.62	8.69	Swale Flow
						1646				33.8	
EX-F		0.08		6318.0	6307.0	300	11.0	3.67%		21.00	Overland Flow
				6307.0	6293.0	805	14.0	1.74%	2.09	6.42	Swale Flow
						1105				27.4	
EX-OS1		0.08		6316.0	6313.0	150	3.0	2.00%		18.18	Overland Flow
				6313.0	6301.0	680	12.0	1.76%	2.02	5.61	Swale Flow
						830				23.8	
EX-OS2		0.57		6373.0	6371.0	35	2.0	5.71%		3.22	Overland Flow
				6371.0	6329.4	1643	41.6	2.53%	2.85	9.62	Swale Flow
						1678				12.8	
DP-1 (EX-B & EX-OS2)		0.57		6373.0	6371.0	35	2.0	5.71%		3.22	Overland Flow
				6371.0	6329.4	1643	41.6	2.53%	2.85	9.62	Swale Flow
		0.024	1.5	6325.5	6319.1	117	6.4	5.43%	7.50	0.26	18" Dia CMP
				6319.1	6316.5	400	2.6	0.65%	1.22	5.47	Swale Flow
						517				18.6	

UPDATED CALCULATIONS

VICINITY MAP
SCALE: NTS

LEGEND

A / 1.84 AC	PROPOSED BASIN DESIGNATION / DRAINAGE BASIN ACRES
C5 RUNOFF COEF 0.76 / 0.83 C100	RUNOFF COEFFICIENT
	DIRECTIONAL FLOW ARROW
	DRAINAGE BASIN BOUNDARY
10	HYDRAULIC STRUCTURE IDENTIFIER
S10	STORM SEWER IDENTIFIER
1	DESIGN POINT
	STORMWATER EMERGENCY OVERFLOW PATH
	R.O.W. / PROPERTY LINE
	EXISTING EASEMENT
EX STM	EXISTING STORM SEWER
(6020)	EXISTING CONTOURS
6020	PROPOSED CONTOURS
(2.3%)	EXISTING FLOW DIRECTION AND SLOPE
2.3%	PROPOSED FLOW DIRECTION AND SLOPE
	PROPOSED CURB AND GUTTER
100	EXISTING 100 YEAR FLOODPLAIN
100	PROPOSED 100 YEAR FLOODPLAIN
	PROPOSED 100 YEAR BASE FLOOD ELEVATION LINE
	PROPOSED STORM SEWER PIPE AND MANHOLE
	PROPOSED STORM CURB INLET
	PROPOSED OUTLET STRUCTURE

WATER QUALITY BASIN

	WATER SURFACE ELEV. (FT)	REQUIRED STORAGE VOLUME	RELEASE RATE	PROVIDED STORAGE VOLUME
WQCV	6303.62	0.36 AC-FT		
SPILLWAY CREST ELEVATION: 6305.00				
TOP OF EMBANKMENT MINIMUM ELEVATION: 6306.50				

NOTES:
1. AS-BUILT SURVEY AND VOLUME CERTIFICATION REQUIRED BY A LICENSED PROFESSIONAL LAND SURVEYOR, SEE GRADING NOTES.

SUB-BASIN AND DESIGN POINT DISCHARGES

BASIN & CONTRIBUTING BASINS	DESIGN POINT	5-YR FLOW	100-YR FLOW
OS-A		3.0 cfs	5.9 cfs
OS-B		3.5 cfs	6.9 cfs
OS-C		3.8 cfs	6.7 cfs
OS-D		1.8 cfs	3.4 cfs
OS-E		2.4 cfs	5.0 cfs
A		3.4 cfs	8.6 cfs
B		2.1 cfs	5.3 cfs
C		1.8 cfs	4.4 cfs
D		3.1 cfs	7.9 cfs
E		2.2 cfs	5.4 cfs
F		2.9 cfs	7.3 cfs
G		3.1 cfs	7.7 cfs
H		3.7 cfs	9.3 cfs
I		0.8 cfs	3.1 cfs
J		4.1 cfs	23.4 cfs
F,G	DP 1	5.9 cfs	15.0 cfs
E,H	DP 2	5.8 cfs	14.6 cfs
A-H	DP 3	19.2 cfs	48.4 cfs
A-I	DP 4	19.6 cfs	50.2 cfs
A-I, OSB	DP 4A	22.1 cfs	55.1 cfs
A-J, OSB	DP 5	26.3 cfs	77.7 cfs
OSC, OSD	DP 10	5.5 cfs	10.1 cfs

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 1300
Lakewood, Colorado 80235
(303) 692-0369

MEADOWBROOK SUBDIVISION
PRELIMINARY/FINAL DRAINAGE REPORT
DRAINAGE PLAN - PROPOSED CONDITION
EL PASO COUNTY, COLORADO

Project No.:	16039
Date:	July 25, 2017
Design:	ELS
Drawn:	ELS
Check:	MWE
Revisions:	

EXHIBIT
B

DRAINAGE MAPS

CROSSROADS MIXED USE FILING NO. 1

HISTORIC CONDITIONS DRAINAGE MAP

*NOTES:

1.) NOT SHOWN IS BASIN "E2". THIS BASIN LIES TO THE EAST OF BASIN "EX-A2". DELINEATION AND HYDROLOGIC DETAILS OF THIS BASIN CAN BE FOUND IN THE "FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2" ON PAGES 39 AND 41, RESPECTIVELY.

VICINITY MAP
N.T.S.

LEGEND

BASIN DESIGNATION: Z; 25 (ACRES); .25 / .35; C5 / C100

1	SURFACE DESIGN POINT
	BASIN BOUNDARY
(7070)	EXIST MAJ CONT
(7072)	EXIST MIN CONT
	EXISTING FLOW DIRECTION ARROW
H.P.	HIGH POINT
L.P.	LOW POINT
	PROPOSED SWALE
	EXISTING SWALE
	CONSTRUCTION/DISTURBANCE LIMITS
	SITE BOUNDARY
	R.O.W./EASEMENT
	LOT LINE
ST	EX. STORM SEWER LINE
UE	EX. UNDERGROUND ELECTRIC LINE
SS	EX. SANITARY SEWER LINE
WL	EX. WATER LINE
ST	EX. STORM SEWER LINE
9	LOT NUMBER
ICV	EX. IRRIGATION VALVE
ST	EX. STORM INLET
G	EX. GAS TEST NODE
T	EX. TELEPHONE PEDESTAL
EVL	EX. ELECTRIC VAULT
SS	EX. SANITARY MANHOLE
	EX. WATER VALVE

BASIN I.D.	AREA (ACRES)	Q5 (CFS)	Q100 (CFS)
C	5.89	1.2	8.5
A	12.88	1.9	14.2
B	13.63	2.5	18.2
OS-1	1.28	5.8	10.5
OS-2	4.98	8.7	19.6
EX-A2***	0.59	2.5	4.5
OS-A**	1.29	3.1	6.0
E2*	3.86	15.1	28.6

DESIGN POINT	Q5	Q100	BASIN(S)/FLOWBYS	OUTFALL
1	14.2	26.5	E2, EX-A2	EXIST 10' CDOT TYPE R AT GRADE INLET
2	3.1	6.0	OS-A	EXIST 10' CDOT TYPE R AT GRADE INLET
3	9.8	22.5	OS-1, FBDP1	END OF PAVEMENT
4	7.4	27.7	A, FB-DP2, DP3	DISCHARGE TO ADJACENT PARCEL (LOT 1)
5	2.5	18.2	B	DISCHARGE TO ADJACENT PARCEL (LOT2)
6	1.2	8.5	C	DISCHARGE TO CDOT ROW
7	10.4	31.9	OS2, DP6	CDOT BARROW DITCH

HISTORIC DRAINAGE MAP
CROSSROADS MIXED USE
JOB NO. 18-003
DATE PREPARED: JANUARY 31, 2022
DATE REVISED:

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

PCD FILING NO: SF 21-029

CROSSROADS MIXED USE FILING NO. 1
EXISTING CONDITIONS DRAINAGE MAP

*NOTES:

1.) NOT SHOWN IS BASIN "E2". THIS BASIN LIES TO THE EAST OF BASIN "EX-A2". DELINEATION AND HYDROLOGIC DETAILS OF THIS BASIN CAN BE FOUND IN THE "FDR FOR CLAREMONT BUSINESS PARK FILING NO. 2" ON PAGES 39 AND 41, RESPECTIVELY.

VICINITY MAP
N.T.S.

LEGEND

BASIN DESIGNATION: Z; 25 (ACRES); .25 (C5); .35 (C100)

- SURFACE DESIGN POINT
- BASIN BOUNDARY
- (7070) EXIST MAJ CONT
- (7072) EXIST MIN CONT
- EXISTING FLOW DIRECTION ARROW
- H.P. HIGH POINT
- L.P. LOW POINT
- PROPOSED SWALE
- EXISTING SWALE
- CONSTRUCTION/DISTURBANCE LIMITS
- SITE BOUNDARY
- R.O.W./EASEMENT
- LOT LINE
- ST EX. STORM SEWER LINE
- UE EX. UNDERGROUND ELECTRIC LINE
- SS EX. SANITARY SEWER LINE
- WL EX. WATER LINE
- ST EX. STORM SEWER LINE
- 9 LOT NUMBER
- ICV EX. IRRIGATION VALVE
- ST EX. STORM INLET
- G EX. GAS TEST NODE
- T EX. TELEPHONE PEDESTAL
- EVL EX. ELECTRIC VAULT
- SS EX. SANITARY MANHOLE
- EX. WATER VALVE

BASIN I.D.	AREA (ACRES)	Q5 (CFS)	Q100 (CFS)
C	3.99	0.9	6.3
A	11.02	1.5	11.1
B	17.31	2.0	14.5
OS-1	1.28	5.8	10.5
OS-2	4.98	8.7	19.6
EX-A2***	0.59	2.5	4.5
OS-A**	1.29	3.1	6.0
E2*	3.86	15.1	28.6

DESIGN POINT	Q5	Q100	BASIN(S)/FLOWBYS	OUTFALL
1	14.2	26.5	E2, EX-A2	EXIST 10' CDOT TYPE R AT GRADE INLET
2	3.1	6.0	OS-A	EXIST 10' CDOT TYPE R AT GRADE INLET
3	9.8	22.5	OS-1, FB-DP1	END OF PAVEMENT
4	7.1	25.5	A, FB-DP2, DP3	DISCHARGE TO ADJACENT PARCEL (LOT 1)
5	2.0	14.5	B	DISCHARGE TO ADJACENT PARCEL (LOT 2)
6	0.9	6.3	C	DISCHARGE TO CDOT ROW
7	9.9	28.0	OS2, DP6	CDOT BARROW DITCH

A-A' CROSS SECTION

EXISTING DRAINAGE MAP
CROSSROADS MIXED USE
JOB NO. 18-003
DATE PREPARED: JANUARY 31, 2022
DATE REVISED:

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

PCD FILING NO: SF 21-029

CROSSROADS MIXED USE FILING NO. 1
PROPOSED CONDITIONS DRAINAGE MAP

VICINITY MAP
N.T.S.

1" = 100'

0 50 100 200
Scale in Feet

SEDIMENT BASIN TABLE

SEDIMENT BASIN NO.	UPSTREAM DRAINAGE AREA AC.	BASIN WIDTH FT.	BASIN LENGTH FT.	ANTIC. MAX WATER HT FT.	REQ'D VOLUME C.F.	SPILLWAY LENGTH FT.	HOLE DIA. IN.	ROWS OF HOLES IN STANDPIPE
SB2	9	55	110	3	36,168	13	7/8	1
SB3	4	33.5	67	3	16,818	6	9/16	1

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
P1	8.97	3.8	20.7
P2	3.04	1.3	7.2

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
7	3.8	20.7	P1	PROPOSED SEDIMENT BASIN (SB2)
12	5.1	27.9	P2, DP7	PROPOSED SEDIMENT BASIN (SB3)

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
11	0.0	0.0	36" SD	N/A
11.5*	6.9	13.8	24" SD	SEE FDR FOR AURA AT CROSSROADS
12	0.0	0.0	42" SD	PR11
12.5	6.9	13.8	48" SD	PR12, PR11.5
13	2.1	3.8	18" SD	DP10 (INLET 8)
14	3.7	15.3	30" SD	DP11 (INLET 9)
15	48.0	93.7	48" SD	PR12.5, PR13, PR14
16	10.8	19.6	24" SD	DP12
17	57.0	110.1	48" SD	PR15, PR16

SD = STORM DRAIN
* REFER TO "FDR FOR AURA AT CROSSROADS FOR CONTRIBUTING PIPE FLOW DETAILS

LEGEND

BASIN DESIGNATION — Z; 25; .25; .35; C5; C100; ACRES

- SURFACE DESIGN POINT
- BASIN BOUNDARY
- PROP MAJ CONT
- PROP MIN CONT
- EXIST MAJ CONT
- EXIST MIN CONT
- PROPOSED STORM SEWER PIPE
- STORM SEWER PIPE BY OTHERS
- FUTURE STORM SEWER PIPE
- EXISTING FLOW DIRECTION ARROW
- H.P. HIGH POINT
- L.P. LOW POINT
- PROPOSED SWALE
- EXISTING SWALE
- SITE BOUNDARY
- UTILITY EASEMENT
- DRAINAGE EASEMENT
- LANDSCAPE EASEMENT
- LOT LINE
- ST STORM SEWER LINE
- UE EX. UNDERGROUND ELECTRIC LINE
- SS EX. SANITARY SEWER LINE
- WL EX. WATER LINE
- ST EX. STORM SEWER LINE
- 9 LOT NUMBER
- ICV EX. IRRIGATION VALVE
- ST EX. STORM INLET
- G EX. GAS TEST NODE
- T EX. TELEPHONE PEDESTAL
- EVL EX. ELECTRIC VAULT
- SS EX. SANITARY MANHOLE
- EX. WATER VALVE
- PROPOSED RIPRAP
- EMERGENCY OVERFLOW DIRECTION
- SB TEMPORARY SEDIMENT BASIN–INITIAL

NOTES:

1.) REFER TO CROSSROADS MIXED USE FILING NO. 1 FUTURE CONDITIONS MAP FOR SURROUNDING BASIN DELINEATION AND DRAINAGE DETAILS

PROPOSED DRAINAGE MAP
CROSSROADS MIXED USE
JOB NO. 18–003
DATE PREPARED: FEBRUARY 7TH 2022
DATE REVISED:

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

PCD FILING NO: SF–21–029

CROSSROADS MIXED USE FILING NO. 1

FUTURE CONDITIONS DRAINAGE MAP

VICINITY MAP
N.T.S.

1" = 100'

0 50 100 200
Scale in Feet

LEGEND

BASIN DESIGNATION: Z; 25 (ACRES); .25 / .35; C5 / C100

- SURFACE DESIGN POINT
- PROPOSED BASIN BOUNDARY
- PIPE RUN LABEL
- PROP MAJ CONT
- PROP MIN CONT
- EXIST MAJ CONT
- EXIST MIN CONT
- PROPOSED STORM SEWER PIPE
- PROPOSED STORM SEWER PIPE (OTHERS)
- FUTURE STORM SEWER PIPE
- EXISTING FLOW DIRECTION ARROW
- HIGH POINT
- EXISTING SWALE
- SITE BOUNDARY
- PROPOSED UTILITY EASEMENT
- PROPOSED DRAINAGE EASEMENT
- PROPOSED LANDSCAPE EASEMENT
- LOT LINE
- STORM SEWER LINE
- EX. UNDERGROUND ELECTRIC LINE
- EX. SANITARY SEWER LINE
- EX. WATER LINE
- EX. STORM SEWER LINE
- LOT NUMBER
- EX. IRRIGATION VALVE
- EX. STORM INLET
- EX. GAS TEST NODE
- EX. TELEPHONE PEDESTAL
- EX. ELECTRIC VAULT
- EX. SANITARY MANHOLE
- EX. WATER VALVE
- PROPOSED RIPRAP
- EMERGENCY OVERFLOW DIRECTION
- LOW POINT
- PROPOSED SWALE

D–D' CROSS SECTION
N.T.S.

B–B' CROSS SECTION
N.T.S.

C–C' CROSS SECTION
N.T.S.

A–A' CROSS SECTION
N.T.S.

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
OS–A	1.29	3.1	6.0
E2	3.86	15.1	28.6
EXA2	0.59	2.5	4.5
OS–1	1.40	6.4	11.5
A	1.67	6.5	11.6
B	1.48	5.8	10.3
C	4.61	18.7	34.5
D	2.22	9.3	17.0
E	1.04	4.1	7.4
E1	1.67	6.4	11.7
F	2.57	10.8	19.6
G	0.46	2.1	3.8
G1	0.60	2.8	5.0
J	3.21	2.3	10.0
OS–2	4.98	8.7	19.6
A–5*	3.67	8.72	17.06
Z–1*	0.37	0.47	1.27
Z–1*	0.78	2.08	4.20
Z–2*	0.38	0.57	1.43

*REFER TO FDR FOR AURA AT CROSSROADS, DATED APRIL 4TH 2022, FOR CONTRIBUTING BASIN DETAILS

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	14.2	26.5	E2, EX–A2	EX 10' AT–GRADE INLET
2	3.1	6.0	OS–A	EX 10' AT–GRADE INLET
3	10.2	23.3	OS–1, FB–DP1	PROP. 10' AT–GRADE INLET
4	6.5	12.4	A, FB–DP2	PROP. 15' AT–GRADE INLET
4.5	0.0	1.8	FB–DP4	PROP. NEENAH R–2501 MANHOLE LID AND FRAME
5	9.8	25.8	B, FB–DP3	PROP. 15' SUMP INLET
6	18.7	34.5	C	FUT. PRIVATE 30" RCP OR PP STORM SEWER
7	9.3	17.0	D	FUT. 24" RCP OR PP STORM SEWER
8	4.1	7.4	E	FUT. 10' AT–GRADE INLET
9	6.4	11.7	E1	FUT. 10' AT–GRADE INLET
10	2.1	3.8	G	PROP. 10' SUMP INLET
11	3.7	15.3	G1, FB–DP8, FB–DP9	PROP. 15' SUMP INLET
12	10.8	19.6	F	PROP. 24" RCP OR PP STORM SEWER
13	1.3	10.9	A–5 OVERFLOW*, Z–1*, D–1 OVERFLOW*	PROP. 2' BTM EARTHEN SWALE, RIP RAP RUNDOWN
14	2.0	9.7	Z–2*, DP13	PROP. TRIANGULAR EARTHEN SWALE
15	116.7	235.0	J, DP14, PR19, PR18	FULL SPECTRUM DET POND
16	9.9	31.0	POND OUTFALL, OS2	EXISTING CDOT ROADSIDE DITCH

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
1	6.7	9.8	24" SD	DP3 (INLET 3)
1.5	6.5	10.6	24" SD	DP4 (INLET 4)
2	6.4	12.3	24" SD	PR1.5, DP4.5 (INLET 4.5)
3	16.2	37.9	36" SD	PR2, DP5 (INLET 5)
4	18.7	34.5	30" SD	DP6
4.5	0.0	0.0	30" SD	FUTURE COMMERCIAL LOT
5	18.7	34.5	30" SD	PR4, PR4.5
6	18.7	34.5	30" SD	PR5
7	18.7	34.5	30" SD	PR6
8	9.3	17.0	24" SD	DP7
9	12.5	21.4	30" SD	PR8, DP8 (INLET 6)
10	5.5	7.7	18" SD	DP9 (INLET 7)
11	35.0	60.5	36" SD	PR7, PR9, PR10
11.5*	6.9	13.8	24" SD	SEE FDR FOR AURA AT CROSSROADS
12	34.7	60.0	42" SD	PR11
12.5	43.3	77.4	48" SD	PR12, PR11.5
13	2.1	3.8	18" SD	DP10 (INLET 8)
14	3.7	15.3	30" SD	DP11 (INLET 9)
15	48.0	93.7	48" SD	PR12.5, PR13, PR14
16	10.8	19.6	24" SD	DP12
17	57.0	110.1	48" SD	PR15, PR16
18	57.9	112.1	48" SD	PR17, PR21
19*	35.4	65.5	48" SD	SEE FDR FOR AURA AT CROSSROADS
20	1.2	11.4	18" SD	POND OUTFALL
21*	2.1	4.2	30" SD	SEE FDR FOR AURA AT CROSSROADS

SD = STORM DRAIN
* REFER TO "FDR FOR AURA AT CROSSROADS" FOR CONTRIBUTING PIPE FLOW DETAILS

FULL SPECTRUM DETENTION POND POND 1 (PRIVATE)

WQ VOLUME	0.863 AC–FT
EURV VOLUME	3.295 AC–FT
100 YR STORAGE VOLUME	4.668 AC–FT
100 YR WATER SURFACE EL	6294.96
SPILLWAY CREST EL	6294.98
TOP OF EMBANKMENT EL	6297.00
SPILLWAY DESIGN FLOW DEPTH	0.86 FT

FUTURE DRAINAGE MAP
CROSSROADS MIXED USE
JOB NO. 18–003
DATE PREPARED: FEBRUARY 1ST, 2022
DATE REVISED:

CIVIL CONSULTANTS, INC.
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PHONE: 719.955.5485

PCD FILING NO: SF–21–029

CROSSROADS MIXED USE

DRAINAGEWAY EXHIBIT
FEBRUARY 2021

1" = N.T.S.

0 N.T.S.
Scale in Feet

LEGEND

1	SURFACE DESIGN POINT		EXISTING FLOW ARROW
	SITE BOUNDARY	1.3%	EXISTING DITCH SLOPE
	EXISTING RIP RAP BARRIERS		EXISTING STORM SEWER AND FES
			PROPOSED STORM SEWER
			R.O.W./EASEMENT
			PROPOSED SWALE
6280	PROPOSED CONTOUR		PROPOSED SANITARY SEWER MANHOLE
6290	EXISTING CONTOUR		PROPOSED SEWER LINE
			PROPOSED WATER LINE
	PROPOSED WATER FITTING		PROPOSED EMERGENCY OVERFLOW DIRECTION

HISTORIC DESIGN POINT SUMMARY

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
4	7.4	27.7
5	8.3	18.2
6	1.2	8.5
7	10.4	31.9

FUTURE DESIGN POINT SUMMARY

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
16	9.9	31.0

NOTES:

1.) REFER TO DRAINAGE MAPS IN FINAL DRAINAGE REPORT FOR CROSSROADS MIXED USE FOR DETAILED ON SITE FLOWS AS WELL AS HYDROLOGIC AND HYDRAULIC ANALYSES CORRESPONDING TO CHANGES FROM HISTORIC AND EXISTING CONDITIONS

A-A' CROSS SECTION
N.T.S.

PCD FILING NO: SP-20-011

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
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