Soleana Subdivision

Phase II Drainage Report

Grading Only CD25-0043

IMEG #20002764.00

Prepared for:

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ENGINEERS CERTIFICATION

I affirm that this report and plan for the Phase II drainage design of Soleana Subdivision was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.

Rick Rome P.E.
Registered Professional Engineer State
Of Colorado No. 35103
(Affix Seal)

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GENERAL LOCATION AND DESCRIPTION

A. Site Location

The project is located in the north half of Section 26 T7S R67W 6th PM and is currently unplatted land. The property is bounded on the east by the Diamond Ridge subdivision, on the south by the Cooper Hook subdivision with the Martinez property immediately south of that, and on the west by the Silver Heights subdivision. The property ownership is divided into two parcels submitted as a single project with the north half owned by Tierra Investors LLC and the southern portion owned by 455 Alexander LLC. The owners are the developers for the property. IMEG is the consulting engineer providing civil engineering services.

The proposed Soleana Subdivision is in the north half of Section 26, Township 7 South, Range 67 west of the 6th Principal Meridian in Douglas County, Colorado. The property is centrally located and includes portions of the NE ¼ and the NW ¼ of Section 26. The overall project boundary encompasses approximately 77.96 acres.

B. Description of Property and Land Use

The property encompasses approximately 77.96 acres that is generally sloped from east to west at grades ranging from 2% to 20% in the buildable areas, and some areas of significant slope along Diamond Ridge. The proposed development plan calls for a low density, low impact neighborhood with approximate ½ acre single family residential lots proposed.

Ground cover for the property includes scrub oaks, native grasses, and rock outcroppings. Site development will include over lot grading activities to optimize the use of available space and views from the subdivision. Open space areas will remain undisturbed to preserve the natural character of the community.

Soils on site are a combination of Kutch Sandy Loams (49.1%) and Stony steep land (50.9%). These soils are generally consistent with hydrologic soil group D.

The project area is historically tributary to East Plum Creek through two tributaries located at the north and south sides of the site. The north tributary drains through the Silver Heights neighborhood in an established drainage system including a combination of open channels and storm sewer to the confluence with East Plum Creek located approximately 1.5 miles west of the development. The south outfall drains through the Cooper Hook development through a 72” storm sewer that is part of the Tributary C to Plum Creek as modeled in the Flood Hazard Area Delineation and Master plan prepared for the Town of Castle Rock.

The site is in zone X as noted on FIRM Panel 08035C0186G Revised March 16, 2016. There are no irrigation ditches or canals adjacent to or impacted by this project. There is a designated FEMA floodplain that begins approximately 2500 feet west of the project boundary. The FHAD for Tributary C identifies flood limits along the southern boundary of the Cooper Hook property.

Proposed improvements specific to this report include a grading only application in anticipation of the approved site plan approved with process SDP24-0010. Proposed improvements include constructing the storm outfall path to Plum Creek Tributary B and Tributary C together with local sediment control. The grading condition is proposed in conformance with the Drainage and grading concepts presented with the approved SDP.

Future development will be reviewed and approved under a separate process. For the purpose of this grading package, we have assumed development consistent with the Site Development Plan that includes 55 single-family detached lots ranging from half-acre to one acre in size. Additionally, there are 22 duplex units proposed to be built in the southwest corner of the site with access to Via Soleana Lane (AKA Brewer Court). For this analysis, we have assumed impervious coverage with the development based on relative use.

DRAINAGE BASIN AND SUB-BASINS

A. Major Drainage Basins

The project area spans two basins in the Plum Creek watershed. The northern region is associated with Tributary B to Plum Creek as identified in the Masterplan by CH2M Hill. The Soleana development is located in portions of Basin 22 and 23 of the Tributary B watershed. The tributary areas from Soleana in Basin 23 includes a small portion of the Diamond Ridge rear lot drainage and the northern region of Soleana which is currently tributary to the Silver Heights subdivision by way of sheet flow to the adjacent neighbors and concentrated flow beginning at the corner of the Douglas County Park property. This area has a documented history of creating localized flooding in the Silver Heights subdivision. As part of this project, the Soleana Subdivision grading plan will direct an additional 11.5 acres south to the Tributary C outfall in Basin 106 which will serve to mitigate potential impacts to the existing Silver Heights development.

The project area is described in the Tributary C and D Watershed Masterplan prepared by Respec Dated October 2014. The property itself is a part of sub-Basin 106. Basin 106 was estimated with approximately 97.5 acres at an approximate historic impervious coverage of 6.0%. This total includes approximately 47.9 acres of the proposed Soleana subdivision. Basin 106 also includes approximately 16 acres of lands expected to be developed with a higher density residential density, and existing facility for assisted living, and open space under ownership by the Town of Castle Rock.

Sub Basin 106 receives stormwater runoff from Sub basin 107. Sub Basin 107 represents the upper reach of the tributary area and is defined by a local ridgeline along the eastern and southern limits of the watershed. Ownership in the basin incudes a combination of the following:

- 21.2 and 7.5 acres open space owned by the Town of Castle Rock
- approximately 15 acres of unincorporated lands under private ownership
- 7.9 acres of the Soleana development which is proposed as dedicated open space.
- 2.1 acres of existing large lot development from Diamond Ridge

The combined area for Basin 107 is 53.7 acres with a 2.7% impervious coverage. There are no changes proposed in this watershed resulting from the Soleana development.

The historic drainage basin was also reviewed using the USGS Streamstats application. This was done for comparison purposes to evaluate relative runoff flow rates establishing a range of major event flow rates to accommodate the naturalized condition of the offsite tributary areas.

The combined tributary area to the proposed combined pond at Design Point 28 as planned in the masterplan report is 162.7 acres including the intercepted flows from the northern portion of the development.

The watershed considered in this report includes the project area and surrounding regions that extends from the Silver Heights neighborhood on the west to the ridgeline with Diamond Ridge Estates to the east. The southern boundary of the site is generally located along Alexander Place, off East Allen Street. The southern limit of the watershed is the existing ridgeline located between 800 and 1300 feet south of the property. The north boundary is the approximate project property line. The watershed generally discharges along two flow paths going either north or south.
In addition, areas immediately adjacent to the property, this analysis considers properties to the south and east of the development that constitute the balance of the regional basin that is the upper reaches of the Tributary C to Plum Creek (Respec Basin 106). These properties include the Cooperhook property that is immediately adjacent to the Soleana subdivision to the south, the unplatted 8.4 acres immediately south of Cooperhook referred to in this report as the Martinez property in reference to the ownership (Martinez Real Estate Company LLC). The Thornton Property is located south and east of the property which is unincorporated and unplatted lands. In addition, the Town of Castle Rock owns Tract D of Metzler Ranch which includes 49.8 acres of open space trails in the uppermost limits of the watershed.

Basins A generally drains along its historic flow path to the north draining through the existing channel system that is part of the Silver Heights subdivision. This basin historically includes tributary areas to the east and proposed rear lot drainage along the western project boundary. Tributary runoff from this basin will be attenuated and treated for water quality and discharged

directly into the existing drainage channel directly north of the project in its historic flow path. The pond discharges near design point 3

Basins B, C, D, E and F generally drain south through the storm sewer constructed with the Cooper Hook development also identified as Tributary C. Historically a portion of the flow from Basin B would cross the western boundary as a sheet flow or surface concentrated flow over the adjacent lots in Silver Heights. This condition represented a drainage challenge for the downstream area as documented in the Silver Heights Drainage Study alternative solutions to Local Drainage Problems (Reference 4). The improvements associated with this development will concentrate the tributary flow areas identified with Reference 4 and direct them through a controlled flow path to a proposed pond and ultimately back into Plum Creek. This approach will significantly alleviate the impacts of stormwater to the downstream community. These basins discharge near design point 28 in a combined pond that attenuates historic tributary areas in addition to the redirected flow from historic Basin A.

There are no surface irrigation features that are impacted by the local drainage patterns described in this analysis. Stormwater runoff from this area drains west to Tributary “C” to Plum Creek located approximately 1 mile west of the project area.

The design of the major drainage features is based on assumptions related to specific detention requirements for the tributary areas. Volume requirements for basin A is established in Pond 1, Volume requirements for Basins B, C, D and E are identified in the proposed Pond 2. These basins are located within Sub Basin 106 as described in the Town FHAD and Master Plan Studies for Tributary C. Basin E is a historic hill side that will not be modified with this development and is part of sub-Basin 107 in the Tributary C FHAD and Masterplan. In addition, offsite flows from the Diamond Ridge subdivision are treated as pass through flows.

The final design of the watershed impervious coverage will be refined with the Phase 3 reports prepared through the Town of Castle Rock entitlement process. This will include but not be limited to updated impervious values based on the current MHFD published impervious chart 6-2. This report specifically addresses overlot grading design and discharge only assuming a 5% impervious coverage for all on site tributary basins consistent with the Mile High Flood District recommendations.

Silver Heights Mitigation

The existing outfall path for this area includes a combination of retention and overflow through the Silver Heights subdivision. The historic Basin A includes a total of 11.1 acres of tributary area including rear lot drainage from Diamond Ridge, and undeveloped areas. Additional flows tributary to the Silver Heights subdivision includes direct flow from the historic Basin B area including a total of 12.5 acres that is tributary to the rear lots along the eastern boundary of the Silver Heights development.

The grading only proposed improvements are designed to manage stormwater runoff from a graded and stabilized site. The primary goal of these improvements is to manage direct stormwater runoff to controlled locations for sediment control and release to the planned outfall locations. This is accomplished by re-directing the historic Basin B area to the south intercepting flows that are historically tributary to Silver Heights in the Via Soleana Lane extension and directing those flows to the south through a defined storm sewer system. This takes existing drainage pressure from the central area of the Silver Heights subdivision. In addition, the historic area tributary from combined Basin A and B is reduced from 19.72 acres to 8.25 acres.

This grading represents a net reduction in tributary area and a controlled release to the defined drainage outfall creating a reduction in stormwater impact to the downstream areas. Future improvements will include a detention and water quality facility that addressed development in the basins as part of a separate approval process.

The outfall path for historic waters from Basin A through Silver Heights includes a combination of retention, overflow direct flow and local conveyance. The pond discharge from the Soleana development will discharge into the existing retention area on the Douglas County Park property as described above. The historic drainage pattern includes an emergency overflow and local drainage path that drains along the rear lot lines of the residential lots between Evalena Road and Buckey Street. The combined basin drains to the existing detention facility located near Harvey Street and Interstate 25. The combination of the detention facility in Basin A and the diversion of Basin B dramatically improves the existing drainage condition of historic flows entering the Silver Heights subdivision.

The Phase III drainage report will include a review of the impact of this development to the existing outfall system. It is noteworthy that the outfall system specific Tributary B to Plum Creek includes a combination of jurisdictional limits for both Douglas County and the Town of Castle Rock. The Town of Castle Rock jurisdictional areas include tributary runoff from Maher Ranch Filing 2 and amendments in the northern and eastern portion of the watershed, portions of the Soleana subdivision and area on the west side of Interstate 25 including the Outlets at Castle Rock. Douglas County jurisdictional boundaries include the Silver Heights subdivision and surrounding large lot parcels in those areas east of Interstate 25. The Phase III analysis will include a review of the pre-existing outfall path as compared to the impact of the flow reductions presented with the development of the Soleana subdivision.

B. Minor Drainage Basins

The Minor drainage basins are developed using the design parameters from the SDP24-0010 project with applied impervious coverage based on undeveloped lands. References to streets and tracts are based on the approved SDP and will be dedicated with a future plat process..

<u>Basin A</u>

The Basin A watershed represents the north region of the study area. Basin A is divided into three sub basins with Basin A1 representing the offsite tributary area and Basin A2 representing the onsite undeveloped area tributary to design point 2. Basin A3 represents rear lot drainage along the Via Soleana extension tributary to design point 3. The basin historically drains directly to the existing channel in the Silver Heights subdivision. Developed areas will be intercepted and directed to Pond 1. Basin A includes a total of approximately 8.25 acres with 0.97 acres being tributary from offsite areas.

The rear lot drainage from Basin A3 will be intercepted in a proposed concrete channel that drains parallel to the existing shared property line with the Silver Heights subdivision. This preserves the historic flow path with a dramatically reduced tributary area resulting from the diversion of flow to Basin 106. A localized graded channel will be installed to direct concentrated runoff to Pond 1 where water quality treatment and peak flow attenuation will occur. This interceptor channel will restrict stormwater runoff from crossing the existing properties to the west thereby mitigating potential flood impacts on the existing downstream properties. The proposed configuration will concentrate and direct flow from the rear lot drainage of 5 proposed lots directed to Pond 1. We understand that this approach is discouraged in the Town criteria, however we believe that this solution provides maximum protection for the existing properties to the west while limiting impact to the adjacent properties to the north by providing a clear conveyance path for stormwater runoff to Pond 1.

Basin A is the sole tributary area to Pond 1. The pond will serve as a sediment control basin until such time as final construction documents are proposed for the development. The improvements associated with the Pond 1 outfall are developed in anticipation of providing a clear outfall in the near term that satisfies this Grading Only application and meets the needs for future detained release serving Basin A
The emergency spillway rundown is sized to accommodate 100 year developed flow as overflow condition under future development conditions. That anticipated flow rate is approximately 22 cfs based on the rational method tributary 100 year flow. This design capacity and final design conditions will be revisited with the pond design anticipated with the final construction documents.

A comparison of historic to proposed flow parameters is presented in the table below:

Q 100 Historic	Q 100 Interim	Q 100 Developed	V 100 Historic	V100 Interim Runoff	V 100 Developed
29.5 cfs	20.9 cfs	10.7 cfs	1.553 ac-ft	1.126 ac-ft	1.196 ac-ft

The results demonstrate a reduction in both peak rate and total volume to the outfall system through the Silver Heights subdivision as a result of the basin diversion from Tributary D to Tributary C. Basin A area is subject to review through Douglas County as the agency responsible for conveyance of public stormwater to Plum Creek.

The Phase III report will include a presentation of the impact of the Soleana development on the receiving outfall through the Silver Heights subdivision. It should be noted that the pre-existing conditions have been evaluated in prior reports that included implementation of infrastructure that addressed documented drainage constraints in the outfall area. These are noted in references 4, 5 and 6. The Phase II report will demonstrate compliance with these improvements and associated point source improvements that demonstrate improvements to the infrastructure along the historic flow path.

Basin B

The Basin B watershed represents the north central area of the study limits. This Basin includes 24.63 acres that is bounded by Basin A on the north and Basin C on the south. The eastern boundary of the basin is Diamond Ridge Estates. Basin B includes approximately 0.97 acres being tributary from offsite areas. Sub Basins B1, B2 and B3 are directed south (DP 5 and 6) as additional areas tributary as an extension of Sub Basin 106 and represent approximately 11.47 acres of additional area tributary to proposed Pond 2. As previously mentioned, these areas are a basin diversion from Tributary B to Tributary C directing stormwaters away from the Silver Heights surface flow path to a more clearly defined outfall where flow rates can more easily be attenuated before releasing downstream. Runoff from Basin B is attenuated in proposed Pond 2.

Mitigation for the additional tributary area to Tributary C is accounted for by comparing predevelopment peak flow from the Masterplan to the proposed outfall configuration. Existing design flows from the masterplan are 181 cfs for Basin 106 and 98 cfs for Basin 107 for a combined flow of 279 cfs as a predevelopment baseline flow. The configuration of pond 2 will be determined using the MHFD Detention worksheet and maintaining a maximum release from the regional pond not to exceed the existing historic release as documented with the Masterplan study for the original tributary area. The final configuration will be documented with the Phase 3 drainage report and associated construction documents.

Sub-basins B1, B2 and B3 includes approximately are part of historic Basin A, that historically would sheet flow to the Silver Heights Subdivision. The improvements proposed with this development include a diversion of these flows to the south using the street and storm sewer along Via Soleana to Pond 2. This proposal will alleviate the shallow flooding condition that Silver Heights currently experiences along the Tributary B outfall path.

The proposed Basin B area is collected in the graded future Right of way that is proposed in the extension of Via Soleana that discharges to Pond 2. These flows discharge to a proposed sediment basin at the northwest corner of the pond which is proposed as a temporary sediment control constructed in the upper reaches of Tributary C to Plum Creek. Basins B4 thru B7 represented areas that are historically included in Regional Basin 106 and drain through tributary C to Plum Creek. Basin B enters the pond at DP 10 and exits the pond at DP 28.

Basin C

The Basin C watershed is in the central region of the study area and includes approximately 42.9 acres. The proposed Basin C area is collected in the future ROW for Luminara Court and Brisa Way that discharges to Pond 2 at DP 27. The watershed is bound by the ridgeline with Diamond Ridge Estates to the northeast. Basin B forms the northern boundary of Basin C. The southern boundary roughly follows Basin D to the South and the extension of Flamecrest Trail to the west. Basin C includes approximately 13.03 acres being tributary from offsite areas. Runoff from Basin C is attenuated in proposed Pond 2. The proposed alignment for Basin C includes two alternatives for access to the Pond. The first option as presented includes an extension of Luminara Street to Alexander Place through the Cooperhook property. This alignment represents the most efficient use of resources by streamlining and combining the flow path to a proposed forebay serving Basins C, D and E. This alternative is currently in negotiations with the adjacent property owners and will be finalized as a condition of approval. The alternative solution is to direct Basin C flows to the Pond in a storm sewer through Tract J and position the forebay structure in the northeast corner of the pond. Design points in Basin C are defined at key locations for inlet calculations

Basin D

The Basin D watershed is in the south-central region of the study area and includes approximately 17.8 acres. The watershed is bounded by the ridgeline with Diamond Ridge Estates to the northeast. Basin C forms the northern boundary of Basin D. The southern boundary roughly follows the property line with 382 Alexander Place. The southeastern boundary is Basin E. Basin D includes approximately 2.14 acres being tributary from offsite areas both upstream and downstream of the project development limit. Runoff from Basin D is attenuated in proposed Pond 2. Basin D drains sequentially between design points 24 and 27 to Pond 2.

Basin E

The Basin E watershed is in the southeastern region of the study area and includes approximately 7.94 acres. Basin E is located within the Masterplan Basin 107 and is tributary to

Basin 106. The watershed is bounded by the ridgeline with Diamond Ridge Estates to the northeast. Basin D forms the northern boundary of Basin E. The southern boundary roughly follows the property line with 382 Alexander Place. Basin E includes approximately 4.07 acres being tributary from offsite areas. Runoff from Basin E is attenuated in proposed Pond 2. Basin E discharges to tributary C near design point 30

It is noteworthy that there is no development activity proposed in Basin E

Basin F

The Basin F watershed is in the southwestern region of the study area and includes approximately 0.97 acres. The watershed includes the approximate limits of lot 9. This basin is located at the top of the existing hill in the southwest corner of the development. Runoff from this basin will sheet flow from design point 31 along its historic flow path to the south and be intercepted in an existing drainage swale at the top of the commercial retaining wall. This swale drains west toward Via Soleana Lane and is collected in an existing inlet at the top of the wall that is connected to the existing Tributary C drainage outfall system.

Tributary C Detention

Stormwater Runoff in the upper reaches of tributary C is captured in the existing channel and drains to the proposed location for Pond 2. This pond is located in regional basins 106 and serves both basins 106 and 107 and includes a total of 162.7 acres at a composite impervious coverage of 11.9%. The pond design assumes that developed tributary flows are provided from the Soleana property, the Cooperhook property, and the Martinez Property. The remainder of the watershed is treated as undeveloped. This pond is proposed as an extended detention basin serving the upper reaches of Tributary C to Plum Creek. The outfall will connect to an existing 72” RCP draining to the west through the existing commercial development.

Pond 2 Summary Detention Table (Future Conditions)

EVENT	VOLUME	RELEASE	DEPTH
WQCV	1.051 ac-ft	40 hour	2.99 ft
EURV	1.633 ac-ft	42 hour	3.86 ft
V 100	6.715 ac-ft	219.8 cfs	9.56 ft

Under Interim conditions, the pond volume is expanded to accommodate the tributary areas, but only sediment control is proposed with Pond 2 until such time as the final development takes place in the tributary area.

DRAINAGE DESIGN CRITERIA

A. Regulations

This analysis is prepared in accordance with the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual and The Town of Castle Rock Temporary Erosion and Sediment Control Manual. Supplemental data is developed using the Mile High Flood District Criteria Manuals Volumes 1 2 and 3 together with published worksheets for stormwater detention and inlet capacity sizing.

B. Drainage Studies, Master Plans, Site Constraints

Design for this site also takes into consideration the Regional Basin Tributary C and D Masterplan and the Tributary C & D Flood Hazard area delineation reports addressing the regional flows crossing the Cooperhook subdivision. Immediately south of the Cooperhook subdivision is the Martinez property that includes approximately 6 acres of unplatted land. This analysis builds on the Phase 1 Drainage report for the Alexander Way subdivision. Previous reports in the area include the Design Report for Home Street/Evalena Road Interim Drainage improvements in the Silver Heights subdivision, the Silver Heights Drainage Study alternative solution to local Drainage problems by Kirkham Michael from 1993, and the Phase III Drainage report for Silver Heights Collings Street, Harvey Street and Evalena Road by HKS dated September 2011.

C. Hydrology

Hydrology for the site is evaluated using several methods to establish a reliable comparison of runoff and impact on the drainage system accounting for different types of terrain, offsite basin impacts and routing design flow through the development. For the future development area, the rational method is used with an undeveloped impervious percentage Given the relative size of the overall basin, the validity of the rational method was compared to a CUHP evaluation for the full watershed. The CUHP analysis demonstrated a peak flow of 146 cfs at a time to peak of 40 minutes. A similar watershed includes basins B and C that routs for a 45 minute time of concentration and generates a composite 100 year flow of 130.0 cfs. These total values are comparable and considered sufficient to justify the modeling methodology.

D. Hydraulics

Hydraulics for the storm sewer system was evaluated for the 5 year and 100 year rainfall events using the Bently StormCAD software. Inlet Capacity was evaluated using the MHFD inlet worksheet. Stormwater routing for the major event basin was accomplished by taking the incremental increase in watershed size with the incremental increase in travel time to approximate total runoff in the system. Inlet capacity from upstream basins was subtracted for the composite flow in order to determine an appropriate street flow at each design point.

E. Water Quality Enhancement

Water quality mitigation for volume is managed through recommendations for impervious coverage that minimize directly connected impervious areas, suggest alternatives for impervious paving, and support drought tolerant green spaces that optimize water usage for the site. In addition to source control, water quality enhancements can occur as part of the area detention proposed for the site and adjoining developments. This approach has the benefit of mitigating various particulate as sedimentation at fore bay structures and at the micro pool for the pond outlet.

The slope areas receiving stormwater runoff from the Diamond Ridge development may include isolated improvements for channelized areas where runoff is currently conveyed. This may include grass buffers, rock check structures, or formal channelization in localized areas for runoff management that control offsite tributary runoff prior to conveyance across the site using surface and piped conveyance solutions.

Water quality mitigation can be addressed through a series of techniques that may include minimizing directly connected impervious areas, identifying areas where grass buffers and infiltration can be encouraged, and source controls including community education for strategies as presented in the Water Efficiency Plan. This plan does not propose structural elements for source control.

STORMWATER MANAGEMENT FACILITY DESIGN

A. Regulations:

This project is proposed in conformance with the Town of Castle Rock's Storm Drainage Design and Technical Criteria Manual and Stormwater Quality Regulations and supporting information from the Mile High Flood District Drainage Criteria Manuals Volumes 1, 2 and 3.

B. Stormwater Conveyance Facilities

Stormwater conveyance is accommodated through a surface conveyance system that uses the rough cut street and locally constructed diversion berms to direct stormwater to a series of sediment control ponds that will be developed for each phase of construction and ultimately directed to the two pond outfall locations.

The proposed ponds 1 and 2 are presented as sediment control basins with the grading only phase of construction. Future improvements will include modifying these facilities to function as Extended Detention Basins to include staged detention and release of water quality capture volume for a 40 hour detention time frame, EURV addressing an approximate 70 hour attenuation process, and 100 year stormwater detention for peak flow attenuation.

Pond 1 discharges to the Plum Creek Tributary B outfall through the Silver Heights subdivision. Stormwater exiting the pond is discharged to the existing channel through a proposed flared end section that will include rip rap outlet protection designed in accordance with the Mile High Flood District requirements. Emergency overflow is provided in the immediate vicinity of the outfall structure and is directly tributary to the existing outfall flow path for Tributary B.

Pond 2 discharges to the existing 72" RCP that was designed and installed in conjunction with the commercial development. This location serves as the regional connection for the upper limits of Basin 106 and is combined with developed flows from the commercial area. Emergency overflow is provided in the immediate vicinity of the outfall structure and is directly tributary to the existing outfall flow path for Tributary C. The flow path includes overflow through the parking lot area for the commercial development with intermittent areas collecting and redirecting overflows to the storm sewer outfall through a combination of inlets and storm sewers.

C. Stormwater Storage Facilities

Stormwater detention is planned for design and construction with the Phase III drainage report in support of the full construction documents. The Phase 2 evaluation was prepared in conjunction with the Site Development Plan and serves as the basis of design for the Final design with inclusion of current Mile High Flood District criteria revision anticipated for inclusion with the future final design.

D. Water Quality Enhancement Best Management Practices

This analysis includes six primary watersheds as part of the analysis identified as Basins A, B, C, D, E and F.

Basin A drains through Pond 1 and is attenuated for sediment control with the Grading Only phase. An emergency spillway rundown is provided that will mitigate major event flow during construction. The historic flow path for Basin A is to the north through the Silver Heights subdivision.

Basins B, C, D, E and F drain through proposed Pond 2 and are attenuated for sediment control with the Grading Only Plan. The historic flow path for Basins B through F is a combination of the southerly outfall path as formalized with the development and an easterly sheet flow through the Silver Heights subdivision that is being corrected with the development of this project.
To mitigate flow through these systems, we are proposing that these flows be directed south to combine with release flow from proposed Pond 2. The future pond design includes the

additional tributary area from the north end of the watershed, and design release will be restricted to maintain predevelopment release from consistent with the original tributary areas. This approach is intended to minimize impact to the existing open channel system. Ultimate design release may be adjusted to minimize the peak condition tributary to the Cooper Hook storm sewer system.

The water quality facilities for the development are sized in accordance with Town of Castle Rock Criteria. In as much as possible, the improvements associated with this project and future design, will adhere to the four-step process for water quality mitigation described below. It is noteworthy that the scope of the improvements for this project are specific to the conveyance and attenuation infrastructure proposed with the public improvements. The finished lots will be sold as custom lots with site specific development improvements will be more clearly defined and are beyond the scope of this analysis.

Step 1 Reduce Runoff Volume.
Where possible, home builders are encouraged to employ strategies to limit the amount of directly connected impervious flow paths. Some solutions that have been successful for this goal include
This includes directing runoff from roof drainage to naturalized flow paths to encourage infiltration prior to discharge to the street and storm sewer system. Additional strategies may include

- Discharge roof drains and downspouts to a graded section on the lot. This may include turf, mulch or softscape material to encourage infiltration prior to discharge of runoff to the streets.
- Employ the use of previous or partially pervious surfaces for hardscape on the lot such as patios or driveways. This solution will likely require underdrain or foundation protection in accordance with the geotechnical requirements identified for the site.
- Homeowners may consider rain gardens or low impact development strategies that are incorporated into the landscape package at the time of permitting and design of the individual lots.

Step 2 Provide Water quality Capture Volume and Flood control via full spectrum detention.
Both ponds proposed on this site employ a strategy of WQCV, EURV and 100 year peak flow attenuation. The ponds incorporate a weir plate and overflow structure intended to provide adequate pond staging time for dissolution of suspended solids as well as time to release flows at a reduced rate to approximate an equivalent urban runoff volume. These criteria are proposed in conformance with the Mike High Flood District recommendations.

Step 3: Utilize Stream channel stabilization techniques.
This project includes discharge to the North outfall (tributary B) through an existing channelized system. This outfall in significant areas drains along rear lot property lines

across drainage easements through an established path. As such, there is little opportunity to provide physical improvements on the private lots, however part of the strategy is to reduce the volume of runoff by diverting options of the developed basin to the south as described in this report.

The south outfall for Tributary C is connected directly to the existing 72" piped outfall that conveys locally generated runoff from the developed basin across Interstate 25 before discharging to a surface channel as a tributary to Plum Creek.
Stormwater runoff in the upper reaches of Basin 106 will be collected and conveyed to Pond 2 being a shared facility.

Step 4 Source Control
As a residential development, pollutants and sources of illicit discharge will be consistent with residential waste. This will include sources such as vehicles, fertilizers and pesticides for yard maintenance.

During the construction phase, the project will employ strategies consistent with the Town of Castle Rock Temporary Erosion and Sediment Control program being prepared under a separate cover.

There are no wetlands associated with the Soleana Development.

Public storm sewer facilities are proposed in public right of way. As such, maintenance and inspection access is provided through the public road system proposed in accordance with Town of Castle Rock criteria. Pond maintenance access is provided along the combination to Tracts A, B and C for Pond 1 providing a corridor for piped access. Pond 2 maintenance access is provided from the Right of way for Alexader Place and Via Soleana Lane with a graded access tract that will be designed with the Phase III construction plans and associated report.

D. Floodplain Modification

Development along the Cooper Hook improvements is beyond the scope of this analysis; however a proposal is in development with this report to aggregate the stormwater improvements from the Master Planned basins 106 and 107 for a combined detention at the upper end of the existing 72" outfall pipe. This solution will include a detention and stormwater quality facility. This plan does not propose modifications to Tributary C to Plum Creek.

The final configuration will be evaluated with the Phase III report in conjunction with a hydrology and hydraulic evaluation for the pond area. The area is designated as a floodway in conjunction with the Tributary C FHAD and Masterplan which will likely require a floodplain permit for construction of the shared facility.

E. Additional Permitting Requirements

The project is not located on or adjacent to a FEMA designated Floodplain. The project does not impact designated wetlands or waters of the US. Therefore, there are no State or Federal permitting requirements related to storm water that are required for this project. The site will be subject to Stormwater discharge permits for construction activities together with compliance with the Town of Castle Rock requirements for sediment control and stormwater discharge. The project will also be subject to review through Douglas County for the unincorporated properties to the north and west of the development.
A copy of the Critical Habitat for Preble's Meadow Jumping Mouse for Unit 9 West Plum Creek is provided in appendix D for reference demonstrating that designated Riparian Conservation zones are not impacted with any portion of the development.

CONCLUSIONS

A. Compliance with Standards

This analysis was developed in compliance with the Town of Castle Rock Stormwater criteria and includes site-specific revisions proposed for the improvement of offsite drainage conditions. The approach for stormwater detention is to regionalize the improvements to optimize the use of space in the overall watershed and to make the expenditure of resources as efficient as possible.

B. Variances

This report includes a recommendation that we redirect 11.5 acres from Basin B to the south through the Cooper Hook storm sewer system. This recommendation alleviates some pressure from the existing Silver Heights Drainage system, however, poses as a deviation from the study completed by RESPEC. A degree of over detention may be necessary to mitigate this proposed diversion that will be addressed with the Phase III Drainage report associated with the construction documents.

In addition, as part of the subsequent analysis for this site and the proposals for development on the adjacent areas, we may negotiate a combined drainage facility serving the local developments along Alexander Place. This determination will be complete with the presentation of the Phase 3 drainage study subsequent to this report. Pond Criteria and design flows in this report reflect the shared uses approach.

A third variance is requested addressing the exemption for Basin F1 representing lot 9 with the proposed development. This area as a final lot will be 1 acre or less in tributary area and that is located in an isolated portion of the watershed that is accessed from a flag configuration. The historic drainage includes a 20' natural fall across the lot to a

localized low point on the property line of the existing lot. The proposal for discharge from this basin preserves the historic drainage patterns while minimizing areas of disturbance and untreated discharge.

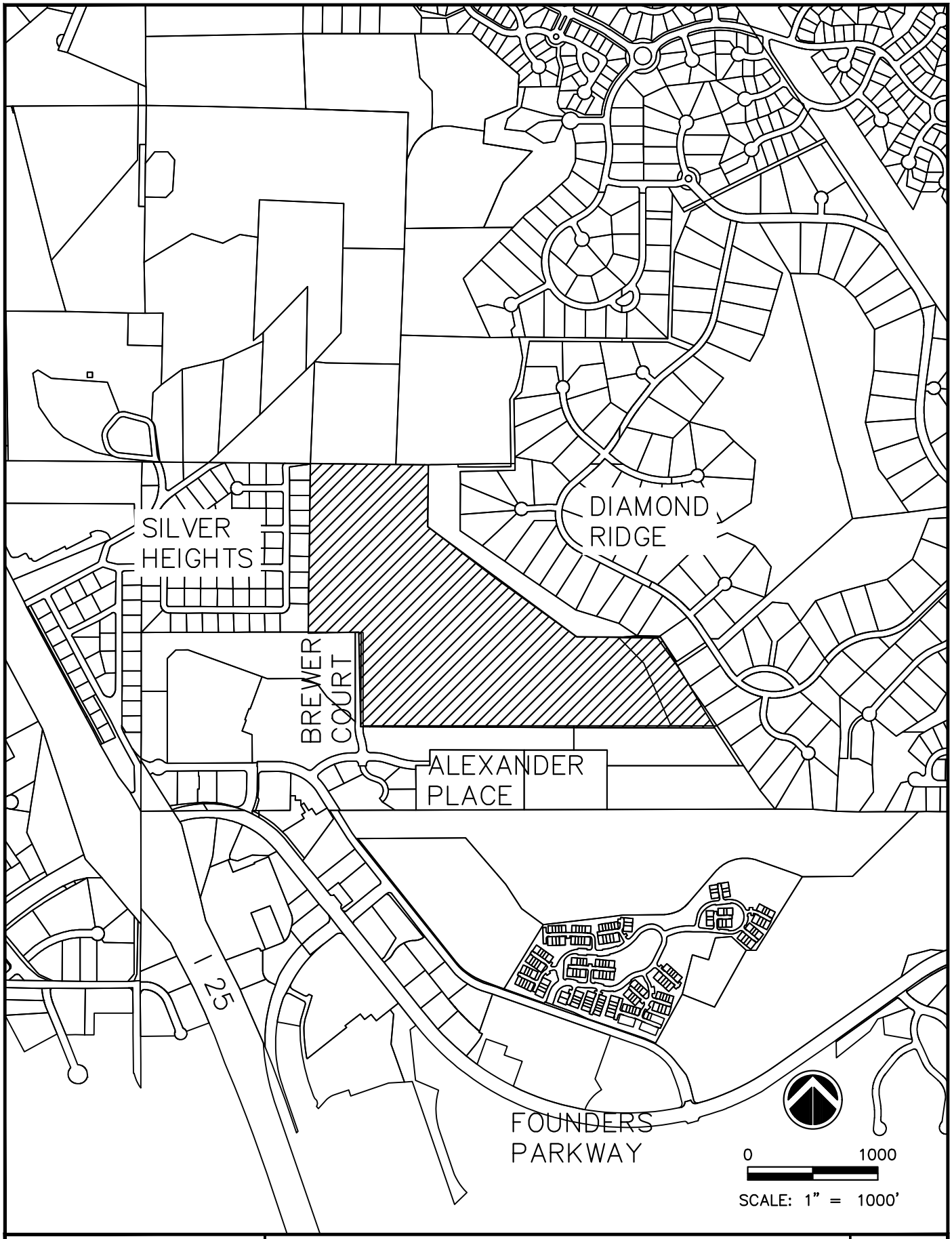
REFERENCES

1. Storm Drainage Design and Technical Criteria Manual, Town of Castle Rock, June 2019
2. Mile High Flood District Urban Storm Drainage Criteria Manual Volumes 1, 2 and 3
3. Phase III Drainage Report for Cooper Hook/Main Place Filing No. 1, Galloway Romero & Associates, August 2001
4. Silver Heights Drainage Study Alternative Solutions to Local Drainage Problems. Kirkham Michael and Associates, January 1994
5. Phase III Drainage Report for Silver Heights – Collins Street, Harvey Street and Evalena Road Drainage Improvements, Harris Kocher Smith September 8, 2011
6. Design Report for Home Street/Evalena Road Interim Drainage Improvements, Muller Engineering Company, July 2015
7. FIRM Panel number 08035C0186G Douglas County Colorado Dated March 16, 2016.
8. Flood Hazard Area Delineation Tributary C and D Watersheds – Respec, October 2014

Appendix A

Related Graphs Figures and Tables

- Vicinity Map
- FIRM Pannel
- FHAD Excerpts
- SCS soil survey



IMEG
323 N. LEROUX STREET
SUITE 201
FLAGSTAFF, AZ 86001
PH: 928.255.0410
www.imegcorp.com

ALEXANDER WAY

CASTLE ROCK, CO

VICINITY MAP

EXHIBIT

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 shown on 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 Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

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 Floodway Data table shown on this FIRM.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM 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. 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, Maryland 20910-3282
(301) 713-3242

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 by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

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 **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

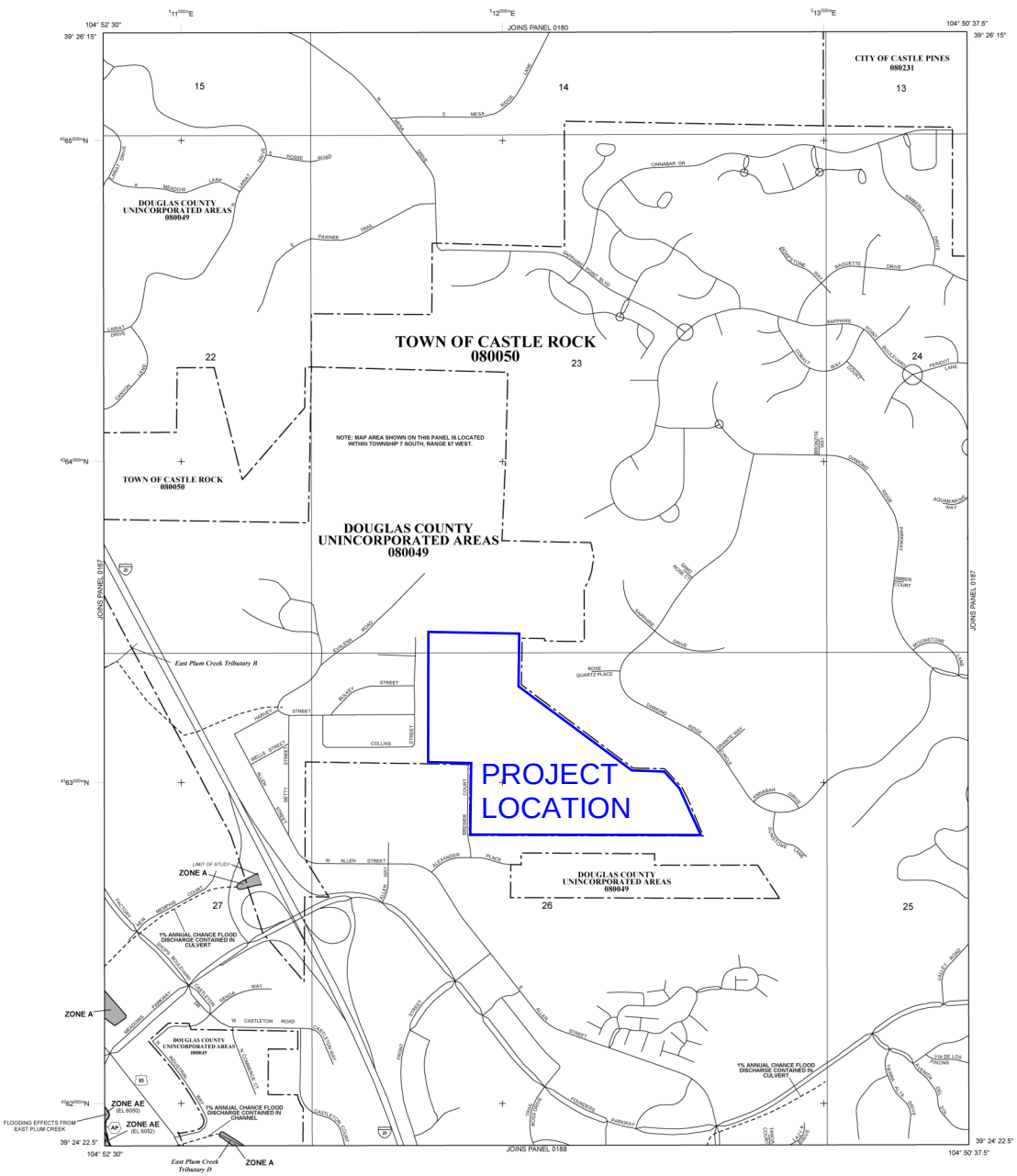
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

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.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

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



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 Areas 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.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and 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

A23 Cross section line

A23 Transect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4989000 N 1000-meter Universal Transverse Mercator grid values, zone 13

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

SEPTEMBER 30, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, 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

PANEL 0186G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 186 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

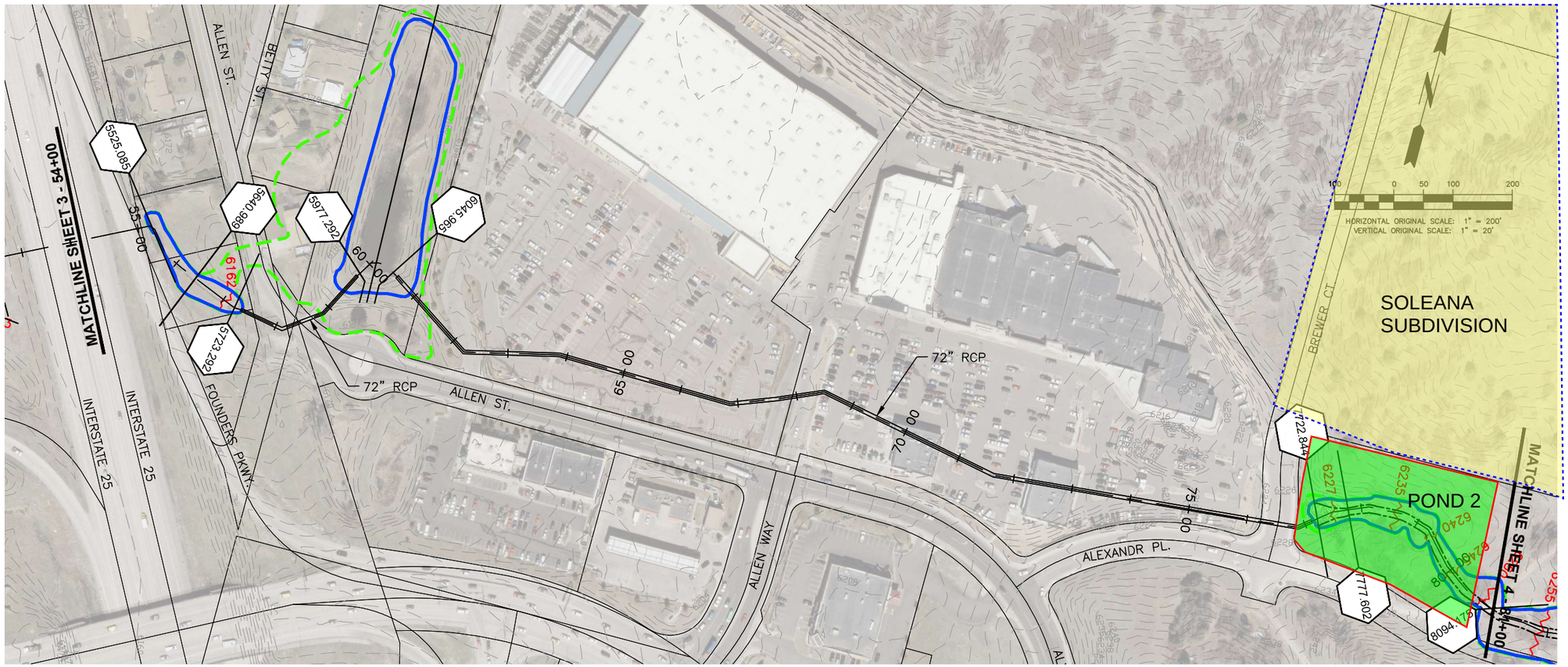
COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	0186	G
DOUGLAS COUNTY	080049	0186	G
CASTLE PINES, CITY OF	080231	0186	G

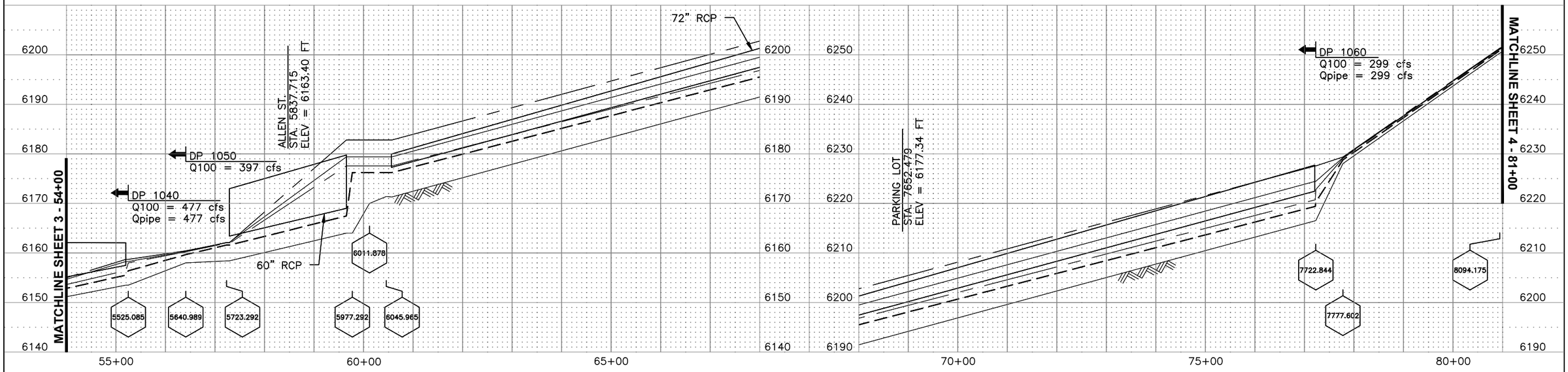
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0186G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM





NO.	DATE	DESCRIPTION	BY

DESIGNED WPF DATE 7/8/13
DRAWN ACT DATE 7/8/13
CHECKED RCO DATE 7/8/13

RESPEC WATER & NATURAL RESOURCES
720 S. COLORADO BLVD. SUITE 410S
DENVER, CO 80246
PH: (303) 757-3655

PROJECT NO. _____

TOWN OF CASTLE ROCK COLORADO

TOWN OF CASTLE ROCK

TRIBUTARY C
FLOOD HAZARD AREA
DELINEATION

PLAN AND PROFILE
54+00 TO 81+00

FIGURE 3 OF 4

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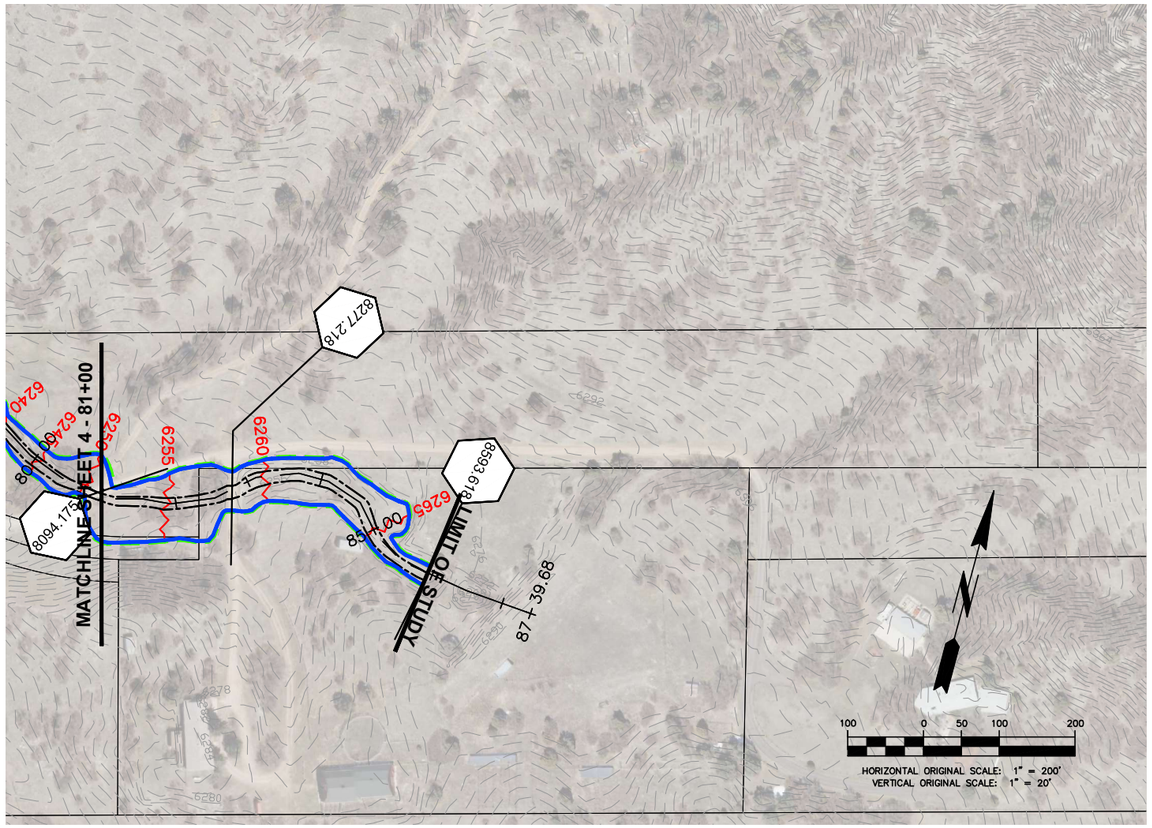
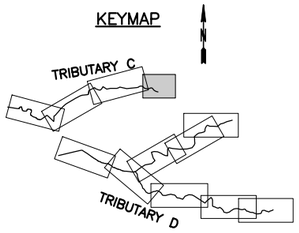
PLOT DATE: Jul 25, 2014 9:26am



KEYMAP

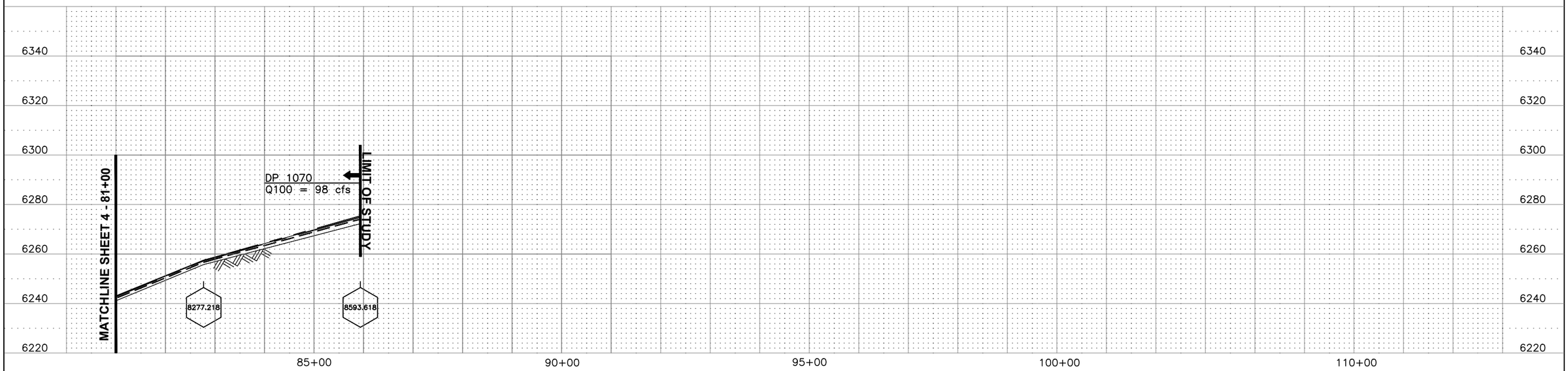


PLAN LEGEND

- XXXX — CROSS SECTION
- 100–YEAR FLOODPLAIN
- 500–YEAR FLOODPLAIN
- FLOODWAY
- BFE
- EXISTING CONTOURS

PROFILE LEGEND

- XXXX — CROSS SECTION
- 500–YEAR FLOODPLAIN
- 100–YEAR FLOODPLAIN
- 50–YEAR FLOODPLAIN
- 10–YEAR FLOODPLAIN
- EXISTING GROUND



NO.	DATE	DESCRIPTION	BY

DESIGNED WPF DATE 7/8/13
DRAWN ACT DATE 7/8/13
CHECKED RCO DATE 7/8/13

RESPEC WATER & NATURAL RESOURCES
720 S. COLORADO BLVD. SUITE 410S
DENVER, CO 80246
PH: (303) 757–3655

PROJECT NO. _____

TOWN OF CASTLE ROCK COLORADO

TOWN OF CASTLE ROCK

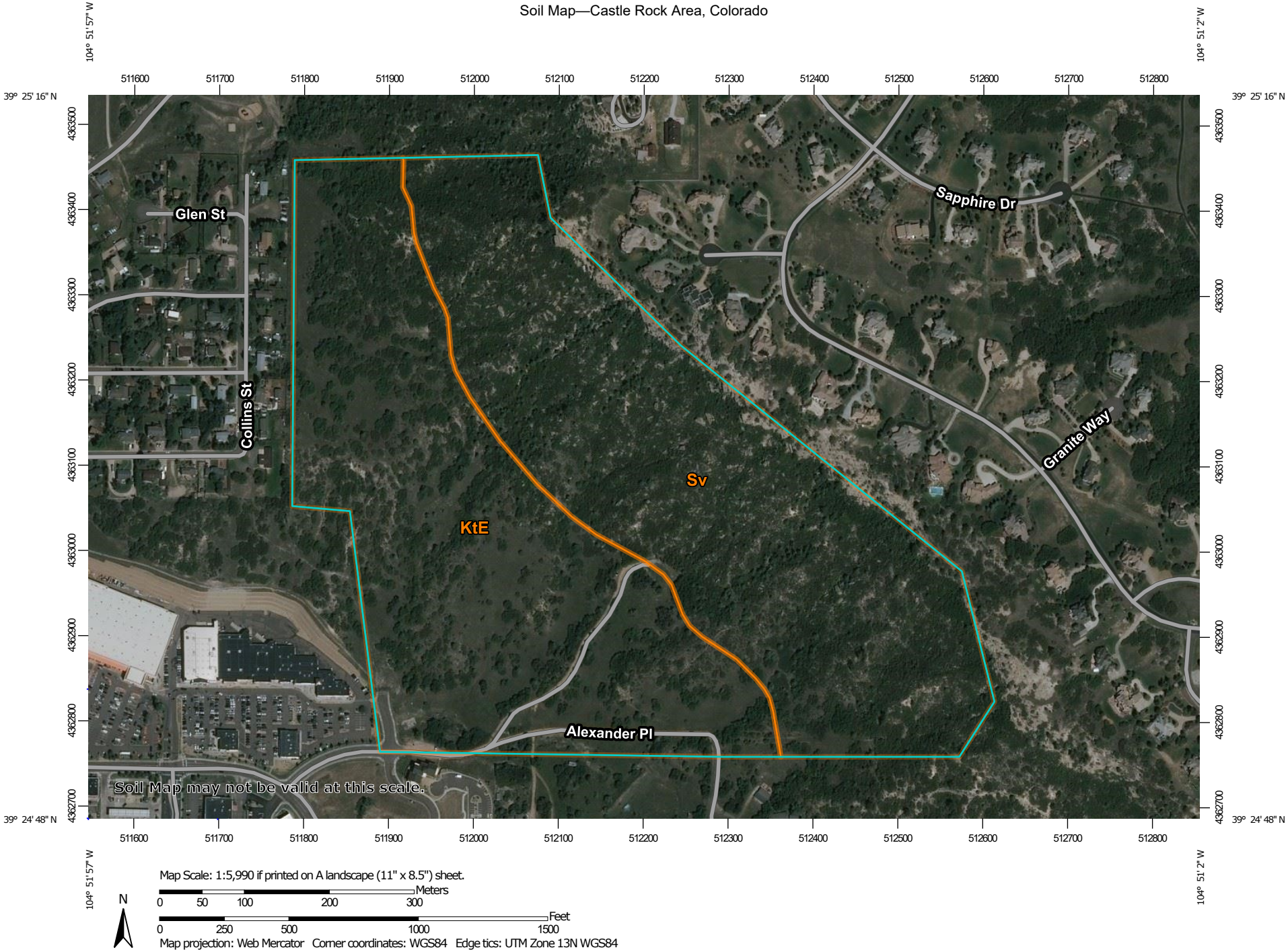
TRIBUTARY C FLOOD HAZARD AREA DELINEATION

PLAN AND PROFILE 81+00 TO 85+93.62

FIGURE 4 OF 4

NAME: Z:\Castle Rock\TCR Planning Studies\CAD\Dwg-Fhad\Tributary C FHAD P & P.dwg
PLOT DATE: Jul 25, 2014 9:27am

Soil Map—Castle Rock Area, Colorado



Map Scale: 1:5,990 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

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 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 13, Jun 5, 2020

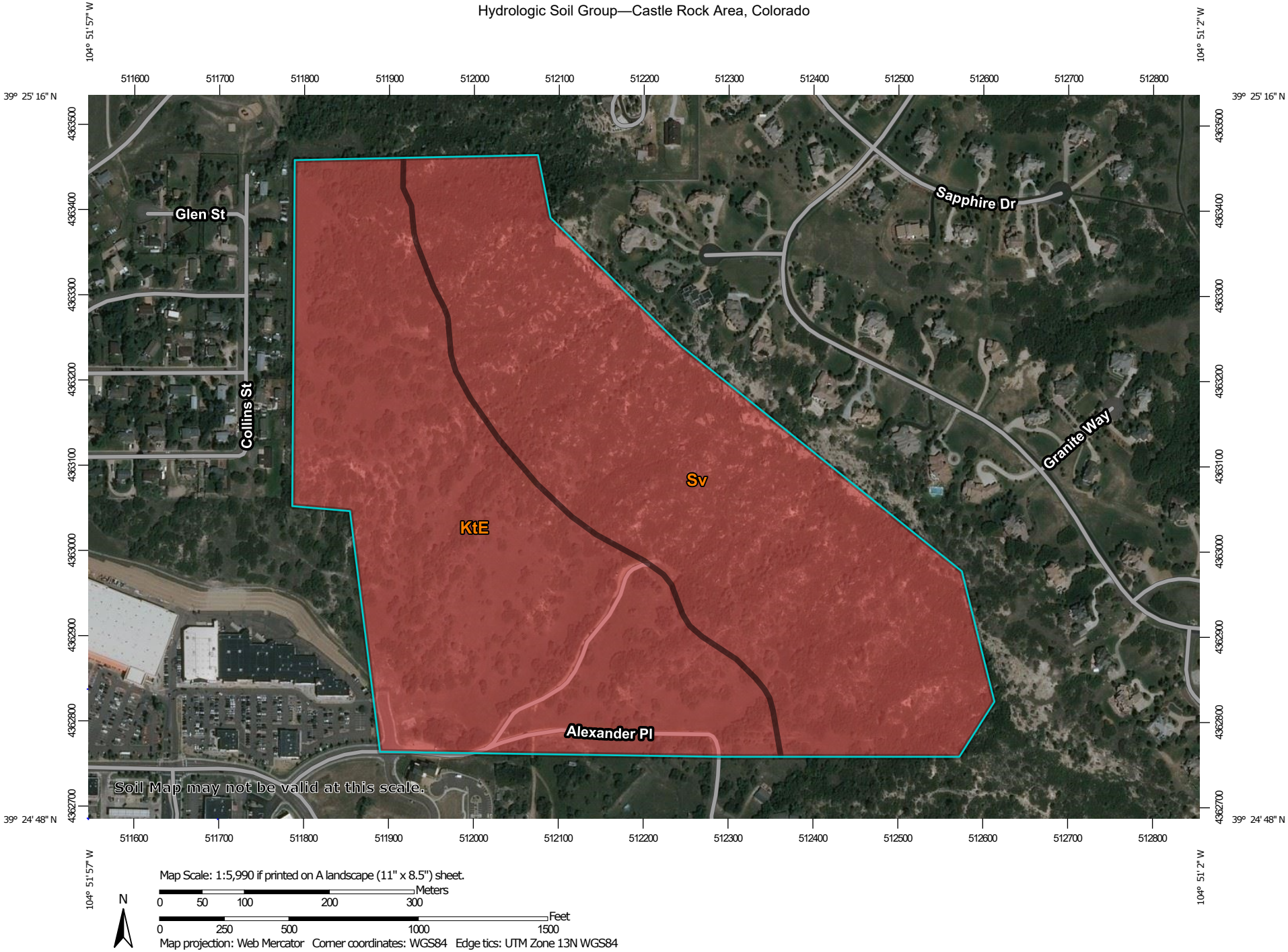
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 24, 2018—Nov 19, 2018

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
KtE	Kutch sandy loam, 5 to 20 percent slopes	47.8	49.1%
Sv	Stony steep land	49.5	50.9%
Totals for Area of Interest		**97.3**	**100.0%**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104° 51' 2" W
39° 25' 16" N
39° 24' 48" N
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511700
511800
511900
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512300
512400
512500
512600
512700
512800
4363500
4363400
4363300
4363200
4363100
4363000
4362900
4362800
4362700
Glen St
Collins St
Sapphire Dr
Granite Way
Alexander Pl
Sv
KtE
Soil Map may not be valid at this scale.
N
Map Scale: 1:5,990 if printed on A landscape (11" x 8.5") sheet.
Meters
0 50 100 200 300
Feet
0 250 500 1000 1500
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 Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Jul 24, 2018—Nov 19, 2018

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KtE	Kutch sandy loam, 5 to 20 percent slopes	D	47.8	49.1%
Sv	Stony steep land	D	49.5	50.9%
Totals for Area of Interest			**97.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Appendix B

Hydrologic Calculations

- Historic Basins
- Phase 2 Rational Calculations
- Masterplan Excerpts

Soleana CD25-0043
Phase II Drainage Report Grading Only
Historic Basins A and B

STANDARD FORM SF-2

REFERENCE MHFD TABLE 6-2

Runoff Calculations

Time of Concentration

Watercourse Coefficient

Heavy Meadow	2.5	Short Grass Pasture & Lawns	7.0	Grassed Waterway	15.0
Tillage/field	5.0	Nearly Bare Ground	10.0	Paved Area & Shallow Gutter	20.0

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA ac.	% I	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	EQ 6-5	min.
1	HA	11.06	5.0%	0.08	70	2.0	12.5	240	10.0	2.5	0.8	5.1	17.6	310	25.3	17.6
2	HB	12.42	5.0%	0.08	200	10.0	12.3	400	10.0	2.5	0.8	8.4	20.7	600	25.5	20.7
3	DA	8.15	15.2%	0.16	70	2.0	11.4	240	10.0	2.5	0.8	5.1	16.5	310	23.6	16.5

STANDARD FORM SF-3

REFERENCE: MHFD Volume 1

Runoff Calculations

Rainfall Depth-Duration-Frequency (1-hr) = 1.43

(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATON				DIRECT RUNOFF				TOTAL RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	SUM C x A	I in/hr	Q cfs	REMARKS
1	HA	11.06	0.08	17.6	0.84	3.01	2.5					
2	HB	12.42	0.08	20.7	0.94	2.76	2.6	20.7	1.78	2.76	4.9	HA HB
3	DA	8.15	0.16	16.5	1.30	3.10	4.0					

Soleana CD25-0043
Phase II Drainage Report Grading Only
Historic Basins A and B

STANDARD FORM SF-3

REFERENCE: MHFD Volume 1

Runoff Calculations

Rainfall Depth-Duration-Frequency (1-hr) = 2.60

(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATON				DIRECT RUNOFF				TOTAL RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	SUM C x A	I in/hr	Q cfs	REMARKS
1	HA	11.06	0.50	17.6	5.58	5.47	30.5					
2	HB	12.42	0.50	20.7	6.27	5.02	31.4	20.7	11.84	5.02	59.4	HA HB
3	DA	8.15	0.55	16.5	4.45	5.65	25.1					

STANDARD FORM SF-2

REFERENCE MHFD TABLE 6-2

Runoff Calculations

Time of Concentration

Watercourse Coefficient

Heavy Meadow	2.5	Short Grass Pasture & Lawns	7.0	Grassed Waterway	15.0
Tillage/field	5.0	Nearly Bare Ground	10.0	Paved Area & Shallow Gutter	20.0

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA ac.	% I	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	EQ 6-5	min.
1	A1	0.97	5.0%	0.08	70	2.0	12.5	240	10.0	2.5	0.8	5.1	17.6	310	25.3	17.6
2	A2	2.22	5.0%	0.08	200	10.0	12.3	400	10.0	2.5	0.8	8.4	20.7	600	25.5	20.7
3	A3	5.06	5.0%	0.08	70	2.0	12.5	250	10.0	7.0	2.2	1.9	14.4	320	25.3	14.4
4	B1	0.97	5.0%	0.08	200	10.0	12.3	400	10.0	10.0	3.2	2.1	14.4	600	25.5	14.4
5	B2	8.07	5.0%	0.08	300	10.0	15.1	800	1.0	10.0	1.0	13.3	28.4	1100	27.0	27.0
6	B3	4.10	5.0%	0.08	250	5.0	17.3	400	5.0	10.0	2.2	3.0	20.3	650	25.6	20.3
7	B4	0.83	5.0%	0.08	100	2.0	14.9	550	5.0	10.0	2.2	4.1	19.0	650	25.7	19.0
8	B5	4.01	5.0%	0.08	200	10.0	12.3	800	8.0	10.0	2.8	4.7	17.0	1000	25.8	17.0
9	B6	1.24	5.0%	0.08	50	2.0	10.5	600	5.0	10.0	2.2	4.5	15.0	650	25.7	15.0
10	B7	2.04	5.0%	0.08	50	2.0	10.5	650	8.0	10.0	2.8	3.8	14.3	700	25.6	14.3
11	B8	2.59	5.0%	0.08	50	2.0	10.5	650	8.0	10.0	2.8	3.8	14.3	700	25.6	14.3
12	B9	1.09	5.0%	0.08	200	10.0	12.3	800	8.0	10.0	2.8	4.7	17.0	1000	25.8	17.0
13	C1.1	5.79	5.0%	0.08	200	5.0	15.5	700	6.0	7.0	1.7	6.8	22.3	900	25.8	22.3
14	C1.2	7.40	5.0%	0.08	100	10.0	8.7	900	6.0	7.0	1.7	8.7	17.4	1000	25.9	17.4
15	C2.1	3.72	5.0%	0.08	250	5.0	17.3	250	8.0	7.0	2.0	2.1	19.4	500	25.5	19.4
16	C2.2	4.99	5.0%	0.08	150	5.0	13.4	400	5.0	7.0	1.6	4.3	17.7	550	25.6	17.7

REFERENCE MHFD TABLE 6-2

Runoff Calculations

Time of Concentration

Watercourse Coefficient

Heavy Meadow	2.5	Short Grass Pasture & Lawns	7.0	Grassed Waterway	15.0
Tillage/field	5.0	Nearly Bare Ground	10.0	Paved Area & Shallow Gutter	20.0

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA ac.	% I	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	EQ 6-5	min.
17	C2.3	3.67	5.0%	0.08	250	5.0	17.3	150	8.0	7.0	2.0	1.3	18.6	400	25.4	18.6
18	C2.4	6.72	5.0%	0.08	250	10.0	13.8	550	5.0	7.0	1.6	5.9	19.7	800	25.8	19.7
19	C3	1.98	5.0%	0.08	200	10.0	12.3	550	5.0	10.0	2.2	4.1	16.4	750	25.7	16.4
20	C4	2.15	5.0%	0.08	200	10.0	12.3	550	5.0	10.0	2.2	4.1	16.4	750	25.7	16.4
21	C5	4.72	5.0%	0.08	200	10.0	12.3	550	5.0	10.0	2.2	4.1	16.4	750	25.7	16.4
22	C6	0.58	5.0%	0.08	100	2.0	14.9	1550	8.0	10.0	2.8	9.1	24.0	1650	26.1	24.0
23	C7	1.18	5.0%	0.08	30	2.0	8.2	150	8.0	10.0	2.8	0.9	9.1	180	25.3	9.1
24	D1	2.14	5.0%	0.08	200	2.0	21.0	200	10.0	10.0	3.2	1.1	22.1	400	25.4	22.1
25	D2	6.28	5.0%	0.08	200	10.0	12.3	700	2.0	10.0	1.4	8.2	20.5	900	26.2	20.5
26	D3	1.74	5.0%	0.08	50	2.0	10.5	700	2.0	10.0	1.4	8.2	18.7	750	26.1	18.7
27	D4	3.81	5.0%	0.08	30	2.0	8.2	500	4.0	10.0	2.0	4.2	12.4	530	25.6	12.4
28	D5	3.83	5.0%	0.08	150	10.0	10.7	350	10.0	10.0	3.2	1.8	12.5	500	25.4	12.5
29	E1	3.35	5.0%	0.08	150	10.0	10.7	650	10.0	10.0	3.2	3.4	14.1	800	25.6	14.1
30	E2	4.59	5.0%	0.08	150	10.0	10.7	450	10.0	10.0	3.2	2.4	13.1	600	25.5	13.1
31	F1	0.97	5.0%	0.08	150	10.0	10.7	450	10.0	10.0	3.2	2.4	13.1	600	25.5	13.1

STANDARD FORM SF-3

REFERENCE: MHFD Volume 1

Runoff Calculations

Rainfall Depth-Duration-Frequency (1-hr) = 1.43

(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATON				DIRECT RUNOFF				TOTAL RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	SUM C x A	I in/hr	Q cfs	REMARKS
1	A1	0.97	0.08	17.6	0.07	3.01	0.2					
2	A2	2.22	0.08	20.7	0.17	2.76	0.5	20.7	0.24	2.76	0.7	A1, A2
3	A3	5.06	0.08	14.4	0.38	3.31	1.3	20.7	0.63	2.76	1.7	A1 thru A3
4	B1	0.97	0.08	14.4	0.07	3.31	0.2					
5	B2	8.07	0.08	27.0	0.61	2.39	1.5	27.0	0.69	2.39	1.6	B1, B2
6	B3	4.10	0.08	20.3	0.31	2.79	0.9	27.0	1.00	2.39	2.4	B1 thru B3
7	B4	0.83	0.08	19.0	0.06	2.89	0.2	27.0	1.06	2.39	2.5	B1 thru B4
8	B5	4.01	0.08	17.0	0.30	3.05	0.9	27.0	1.37	2.39	3.3	B1 thru B5
9	B6	1.24	0.08	15.0	0.09	3.25	0.3	27.0	1.46	2.39	3.5	B1 thru B6
10	B7	2.04	0.08	14.3	0.16	3.32	0.5	27.0	1.62	2.39	3.9	B1 thru B7
11	B8	2.59	0.08	14.3	0.20	3.32	0.7					
12	B9	1.09	0.08	17.0	0.08	3.05	0.3	17.0	0.28	3.05	0.9	B8, B9
								27.0	1.90	2.39	4.5	B1 thru B9
13	C1.1	5.79	0.08	22.3	0.44	2.65	1.2					
14	C1.2	7.40	0.08	17.4	0.56	3.02	1.7	22.3	1.00	2.65	2.7	C1.1, C1.2
15	C2.1	3.72	0.08	19.4	0.28	2.86	0.8					
16	C2.2	4.99	0.08	17.7	0.38	3.00	1.1	19.4	0.66	2.86	1.9	C2.1,2.2

REFERENCE: MHFD Volume 1

Runoff Calculations

Rainfall Depth-Duration-Frequency (1-hr) = 1.43

(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATON				DIRECT RUNOFF				TOTAL RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	SUM C x A	I in/hr	Q cfs	REMARKS
17	C2.3	3.67	0.08	18.6	0.28	2.92	0.8					
18	C2.4	6.72	0.08	19.7	0.51	2.84	1.4	19.7	1.45	2.84	4.1	C2
								22.3	2.45	2.65	6.5	C1 thru C2
19	C3	1.98	0.08	16.4	0.15	3.11	0.5	19.7	2.60	2.84	7.4	C1 thru C3
20	C4	2.15	0.08	16.4	0.16	3.11	0.5	19.7	2.77	2.84	7.9	C1 thru C4
21	C5	4.72	0.08	16.4	0.36	3.11	1.1	19.7	3.13	2.84	8.9	C1 thru C5
22	C6	0.58	0.08	24.0	0.04	2.55	0.1	24.0	3.17	2.55	8.1	C1 thru C6
23	C7	1.18	0.08	9.1	0.09	4.01	0.4	24.0	3.3	2.55	8.3	C1 thru C7
24	D1	2.14	0.08	22.1	0.16	2.67	0.4					
25	D2	6.28	0.08	20.5	0.48	2.77	1.3	22.1	0.64	2.67	1.7	D1,D2
26	D3	1.74	0.08	18.7	0.13	2.91	0.4	22.1	0.77	2.67	2.1	D1 thru D3
27	D4	3.81	0.08	12.4	0.29	3.54	1.0	22.1	1.06	2.67	2.8	D1 thru D4
28	D5	3.83	0.08	12.5	0.29	3.52	1.0	22.1	1.35	2.67	3.6	D1 thru D6
29	E1	3.35	0.08	14.1	0.25	3.34	0.9					
30	E2	4.59	0.08	13.1	0.35	3.46	1.2	14.1	0.60	3.34	2.0	E1,E2
31	F1	0.97	0.08	13.1	0.07	3.46	0.3					
		67.8						27.0	5.16	2.39	12.3	Sum B & C

STANDARD FORM SF-3

REFERENCE: MHFD Volume 1

Runoff Calculations

Rainfall Depth-Duration-Frequency (1-hr) = 2.60

(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATON				DIRECT RUNOFF				TOTAL RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	SUM C x A	I in/hr	Q cfs	REMARKS
1	A1	0.97	0.50	17.6	0.49	5.47	2.7					
2	A2	2.22	0.50	20.7	1.12	5.02	5.6	20.7	1.61	5.02	8.1	A1, A2
3	A3	5.06	0.50	14.4	2.55	6.02	15.4	20.7	4.16	5.02	20.9	A1 thru A3
4	B1	0.97	0.50	14.4	2.07	6.01	12.4					
5	B2	8.07	0.50	27.0	4.07	4.34	17.7	27.0	6.14	4.34	26.6	B1, B2
6	B3	4.10	0.50	20.3	2.07	5.08	10.5	27.0	8.21	4.34	35.6	B1 thru B3
7	B4	0.83	0.50	19.0	0.42	5.25	2.2	27.0	8.63	4.34	37.4	B1 thru B4
8	B5	4.01	0.50	17.0	2.02	5.55	11.2	27.0	10.65	4.34	46.2	B1 thru B5
9	B6	1.24	0.50	15.0	0.63	5.91	3.7	27.0	11.28	4.34	48.9	B1 thru B6
10	B7	2.04	0.50	14.3	1.03	6.03	6.2	27.0	12.31	4.34	53.4	B1 thru B7
11	B8	2.59	0.50	14.3	1.31	6.03	7.9					
12	B9	1.09	0.50	17.0	0.55	5.55	3.1	17.0	1.86	5.55	10.3	B8, B9
								27.0	14.16	4.34	61.4	B1 thru B9
13	C1.1	5.79	0.50	22.3	2.92	4.83	14.1					
14	C1.2	7.40	0.50	17.4	3.73	5.48	20.5	22.3	6.65	4.83	32.1	C1.1, C1.2
15	C2.1	3.72	0.50	19.4	1.88	5.20	9.8					
16	C2.2	4.99	0.50	17.7	2.52	5.45	13.7	19.4	4.39	5.20	22.8	C2.1,2.2

REFERENCE: MHFD Volume 1

Runoff Calculations

Rainfall Depth-Duration-Frequency (1-hr) = 2.60

(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATON				DIRECT RUNOFF				TOTAL RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	SUM C x A	I in/hr	Q cfs	REMARKS
17	C2.3	3.67	0.50	18.6	1.85	5.32	9.8					
18	C2.4	6.72	0.50	19.7	3.39	5.16	17.5	19.7	9.64	5.16	49.7	C2
								22.3	16.29	4.83	78.6	C1 thru C2
19	C3	1.98	0.50	16.4	1.00	5.66	5.6	19.7	17.29	5.16	89.2	C1 thru C3
20	C4	2.15	0.50	16.4	1.08	5.66	6.1	19.7	18.37	5.16	94.8	C1 thru C4
21	C5	4.72	0.50	16.4	2.38	5.66	13.5	19.7	20.76	5.16	107.1	C1 thru C5
22	C6	0.58	0.50	24.0	0.29	4.63	1.4	24.0	21.05	4.63	97.5	C1 thru C6
23	C7	1.18	0.50	9.1	0.60	7.30	4.3	24.0	21.6	4.63	100.2	C1 thru C7
24	D1	2.14	0.50	22.1	1.08	4.86	5.2					
25	D2	6.28	0.50	20.5	3.17	5.04	16.0	22.1	4.25	4.86	20.6	D1,D2
26	D3	1.74	0.50	18.7	0.88	5.29	4.6	22.1	5.13	4.86	24.9	D1 thru D3
27	D4	3.81	0.50	12.4	1.92	6.44	12.4	22.1	7.05	4.86	34.2	D1 thru D4
28	D5	3.83	0.50	12.5	1.93	6.40	12.4	22.1	8.98	4.86	43.6	D1 thru D6
29	E1	3.35	0.50	14.1	1.69	6.07	10.3					
30	E2	4.59	0.50	13.1	2.32	6.29	14.6	14.1	4.01	6.07	24.3	E1,E2
31	F1	0.97	0.50	13.1	0.49	6.29	3.1					
								27.0	35.80	4.34	155.3	Sum B & C

Table B-4 - Land Use by Subwatershed - Tributary C

Future

Subwatershed ID	Subwatershed Area (Acres)	Subwatershed Imperviousness (%)	Subwatershed Land Use Breakdown (Acres)						
			Open Space / Agricultural / Vacant (2%)	Single Family Large Lot (20%)	Multi-Family Residential (60%)	General Commercial (70%)	General / Restricted Commercial (85%)	General Commercial (95%)	Roads (100%)
101	25.5	39.8	15.5	0.0	0.0	0.0	1.2	0.0	8.8
102	24.0	63.3	7.9	0.0	0.0	0.0	5.0	5.7	5.4
103	72.0	89.3	4.5	0.0	0.0	0.0	9.5	37.4	20.6
104	37.7	51.7	3.2	18.1	0.0	0.0	3.9	0.0	12.5
105	48.1	61.3	13.1	1.3	0.4	0.0	30.5	0.0	2.9
106	97.5	14.9	73.5	11.5	0.5	0.0	10.4	0.0	1.6
107	53.7	2.9	51.5	2.1	0.0	0.0	0.1	0.0	0.0
108	76.3	88.7	0.9	0.0	0.0	0.0	51.8	0.0	23.6
109	37.0	84.0	3.1	0.0	0.0	0.0	19.0	0.0	14.9
110	37.2	64.3	4.4	0.0	17.9	0.0	11.9	0.0	3.0
111	12.4	74.2	2.1	0.0	0.0	0.0	7.7	0.0	2.7
112	28.4	78.7	1.2	0.0	0.0	14.8	0.0	9.3	3.1
113	13.7	70.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0
114	11.5	70.0	0.0	0.0	0.0	13.7	0.0	0.0	0.0
115	19.5	95.5	0.0	0.0	0.0	0.0	0.2	16.9	2.3
Total	**594.6**	**58.1**	**181.0**	**33.0**	**18.7**	**40.0**	**151.3**	**69.3**	**101.2**

Existing

Subwatershed ID	Subwatershed Area (Acres)	Subwatershed Imperviousness (%)	Subwatershed Land Use Breakdown (Acres)					
			Open Space / Agricultural / Vacant (2%)	Single Family Large Lot (20%)	Multi-Family Residential (60%)	General / Restricted Commercial (85%)	General Commercial (95%)	Roads (100%)
101	25.5	35.7	16.7	0.0	0.0	0.0	0.0	8.8
102	24.0	46.0	13.0	0.0	0.0	0.0	5.7	5.4
103	72.0	84.8	8.4	0.0	0.0	5.6	37.4	20.6
104	37.7	51.7	3.2	18.1	0.0	3.9	0.0	12.5
105	48.1	57.4	15.4	1.3	0.4	28.2	0.0	2.9
106	97.5	6.0	83.9	11.5	0.5	0.0	0.0	1.6
107	53.7	2.7	51.6	2.1	0.0	0.0	0.0	0.0
108	76.3	82.6	6.5	0.0	0.0	46.2	0.0	23.6
109	37.0	84.0	3.1	0.0	0.0	19.0	0.0	14.9
110	37.2	64.3	4.4	0.0	17.9	11.9	0.0	3.0
111	12.4	29.6	8.8	0.0	0.0	1.0	0.0	2.7
112	28.4	43.3	16.0	0.0	0.0	0.0	9.3	3.1
113	13.7	20.9	11.0	0.0	0.0	0.0	0.0	2.6
114	11.5	7.8	10.9	0.0	0.0	0.0	0.0	0.7
115	19.5	94.6	0.2	0.0	0.0	0.0	16.9	2.3
Total	**594.6**	**49.1**	**253.2**	**33.0**	**18.7**	**115.8**	**69.3**	**104.5**

Tributary C
Watershed Boundary

Douglas County
Town of
Castle Rock

I-25

Douglas County
Town of
Castle Rock

Soleana Subdivision

Tributary D
Watershed Boundary

Santa Fe Dr

Founders Pkwy

East Plum Creek

Meadows Pkwy

0 187.5 375 750 1,125 1,500
Feet

N

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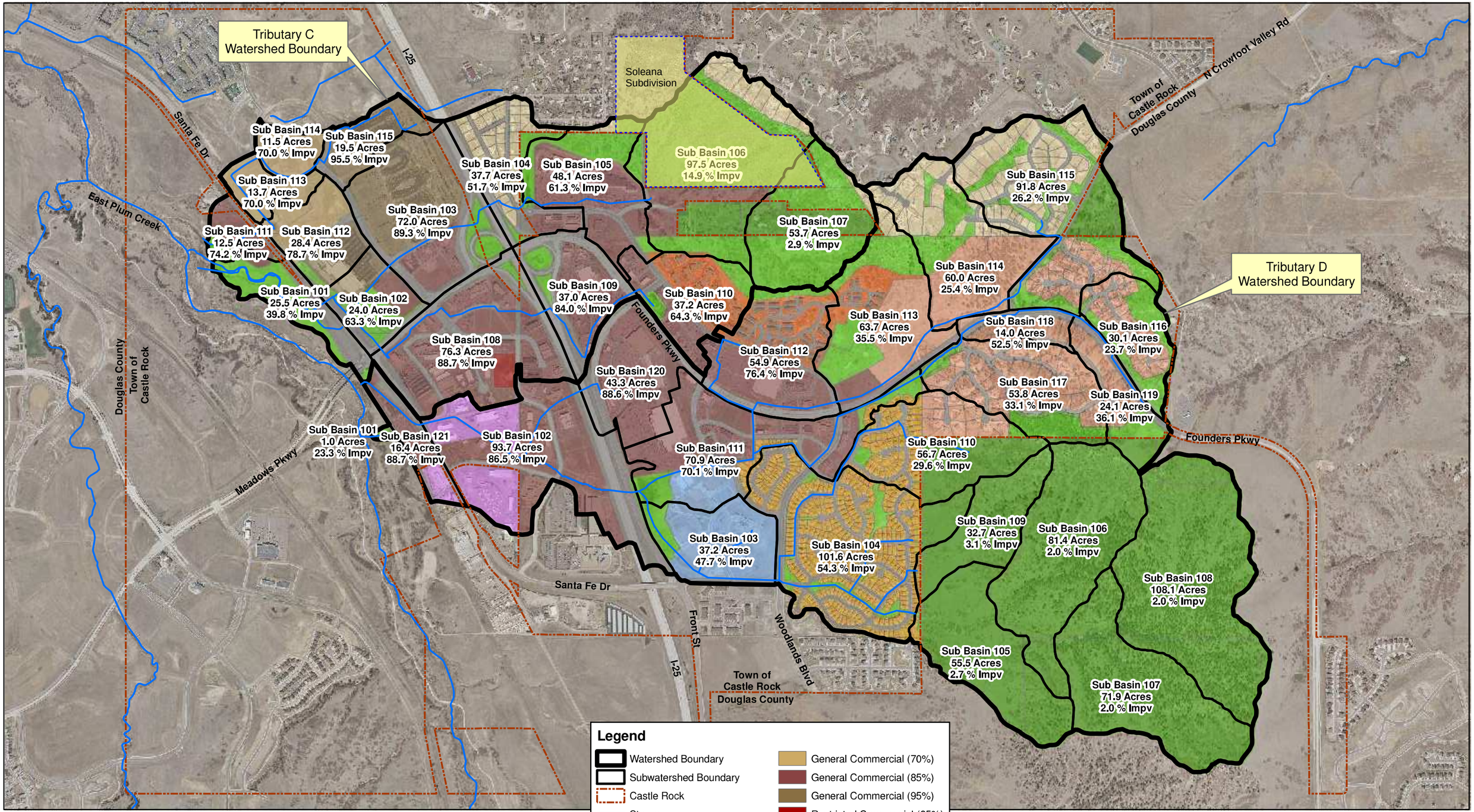
Legend

- Watershed Boundary
- Subwatershed Boundary
- Castle Rock
- Streams
- Conveyance Link
- Basin ID
- Design Point
- Detention
- Conveyance
- Diversion

Tributary C - EPA SWMM Connectivity
Figure A-7
Tributary C and Tributary D
Tributary Watersheds Master Plan



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Future Land Use
Figure A-5
Tributary C and Tributary D
Tributary Watersheds Master Plan

Table B-9 CUHP Subwatershed Peak Flows - Tributary C

Catchment Name/ID	2-Yr				5-Yr				10-Yr				25-Yr				50-Yr				100-Yr				500-Yr			
	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)	Exist. (cfs)	Vol (cf)	Fut. (cfs)	Vol (cf)
101	9	36,095	11	40,225	16	64,901	19	69,475	20	85,091	24	89,784	124,095	32	128,599	37	38	145,900	43	150,502	47	182,948	53	187,414	60	235,271	67	240,145
102	14	40,382	23	56,422	24	67,123	35	85,686	30	85,066	42	104,793	122,609	46	141,299	59	53	142,938	68	161,874	65	177,192	82	195,280	83	226,575	101	245,057
103	124	219,476	131	231,416	172	309,631	180	324,592	202	367,912	210	383,921	469,416	261	484,663	267	295	530,288	300	545,730	348	624,651	353	639,052	425	768,957	429	783,824
104	36	71,360	36	71,350	60	114,488	60	114,476	75	143,315	75	143,302	200,682	107	200,670	107	124	232,413	124	232,402	151	285,150	151	285,140	190	362,454	190	362,445
105	56	105,639	60	111,341	91	164,355	95	170,706	110	203,165	114	209,704	272,757	151	278,923	155	173	313,576	177	319,832	209	379,139	213	384,989	259	475,910	264	481,952
106	16	41,532	25	68,541	49	136,050	62	169,804	68	207,733	82	244,047	359,687	118	394,958	137	142	439,992	163	476,405	181	587,036	206	621,642	237	781,352	267	818,072
107	7	17,892	7	18,140	25	68,372	25	68,704	35	107,288	35	107,652	191,324	63	191,675	63	76	235,292	76	235,658	98	316,798	98	317,141	128	423,429	128	423,796
108	127	238,972	139	257,089	181	342,905	194	363,725	214	409,079	227	431,006	521,305	278	542,547	290	314	589,090	326	610,700	366	693,031	378	713,844	447	853,655	460	874,770
109	48	121,389	48	121,389	68	173,763	68	173,763	79	207,003	79	207,003	262,250	104	262,250	104	117	295,983	117	295,983	138	347,356	138	347,356	169	426,840	169	426,840
110	49	90,132	49	90,132	75	136,540	75	136,540	89	166,857	89	166,857	220,170	121	220,170	121	137	251,812	137	251,812	165	301,893	165	301,893	203	376,801	203	376,801
111	5	15,129	18	34,937	10	29,197	27	51,265	12	39,108	31	61,770	58,219	19	79,712	41	23	68,841	46	90,517	28	87,067	55	107,284	36	112,535	68	132,799
112	16	42,813	42	82,520	26	67,751	59	117,686	34	86,324	71	140,715	129,840	53	182,394	94	63	152,775	106	206,912	78	193,609	126	245,643	100	249,428	155	303,918
113	2	9,061	14	35,637	4	21,687	21	52,781	6	30,409	25	63,794	52,747	11	84,481	34	13	63,792	39	96,298	17	83,807	47	115,184	22	110,896	58	143,630
114	1	2,139	16	30,263	3	8,548	24	44,019	4	14,059	28	53,184	32,757	10	70,737	38	12	41,424	43	80,773	16	58,719	53	97,059	22	80,534	66	121,036
115	35	69,947	35	70,718	47	97,377	48	98,301	55	114,599	55	115,588	142,979	69	143,934	70	78	160,452	78	161,427	90	186,672	91	187,609	110	227,863	110	228,818

Table B-11 Peak Flow Summary Table - Tributary C

Station	Design Point	Location	Drainage Area		100-Year Runoff Volume	2-Year		5-Year		10-Year		25-Year		50-Year		100-Year		500-Year	
			(acres)	(sq.mi.)	FuLU (ac-ft)	Existing (cfs)	Future (cfs)	Existing (cfs)	Future (cfs)	Existing (cfs)	Future (cfs)	Existing (cfs)	Future (cfs)	Existing (cfs)	Future (cfs)	Existing (cfs)	Future (cfs)	Existing (cfs)	Future (cfs)
	113		14	0.021	2.6	2	14	4	21	6	25	11	34	13	39	17	47	22	58
	114		12	0.018	2.2	1	16	3	24	4	28	10	38	12	43	16	53	22	66
	115		19	0.030	4.3	35	35	47	48	55	55	69	70	78	78	90	91	110	110
	104		38	0.059	6.5	36	36	60	60	75	75	107	107	124	124	151	151	190	190
	105		48	0.075	8.8	56	60	91	95	110	114	151	155	173	177	209	213	259	264
	112		28	0.044	5.6	16	42	26	59	34	71	53	94	63	106	78	126	100	155
	102		24	0.038	4.5	14	23	24	35	30	42	46	59	53	68	65	82	83	101
	111		12	0.019	2.5	5	18	10	27	12	31	19	41	23	46	28	55	36	68
	101		26	0.040	4.3	9	11	16	19	20	24	32	37	38	43	47	53	60	67
	110		37	0.058	6.9	49	49	75	75	89	89	121	121	137	137	165	165	203	203
	103		72	0.113	14.7	124	131	172	180	202	210	261	267	295	300	348	353	425	429
	107		54	0.084	7.3	7	7	25	25	35	35	63	63	76	76	98	98	128	128
	106		97	0.152	14.3	16	25	49	62	68	82	118	137	142	163	181	206	237	267
	109		37	0.058	8.0	48	48	68	68	79	79	104	104	117	117	138	138	169	169
	108		76	0.119	16.4	127	139	181	194	214	227	278	290	314	326	366	378	447	460
	1130		45	0.070	9.2	34	61	51	87	60	102	84	136	96	154	116	183	144	225
	1140		31	0.048	6.5	34	49	48	68	57	80	76	104	86	117	102	139	126	170
	1150		19	0.030	4.3	35	35	47	48	55	55	69	70	78	78	90	91	110	110
	1110	North Outfall to East Plum Creek D/S Study Limits	86	0.134	15.5	9	22	14	31	17	36	29	59	40	78	72	115	113	239
	1010	South Outfall to East Plum Creek D/S Study Limits	509	0.795	82.0	173	189	250	269	293	310	426	467	563	614	793	860	1,135	1,209
	1100		37	0.058	5.5	4	4	7	7	9	9	20	20	27	27	32	32	35	35
	1060	Brewer Court and Alexander Place	151	0.236	21.5	22	30	73	84	101	114	180	196	216	235	278	299	364	390
	1086		74	0.116	13.3	48	48	68	68	79	79	104	104	117	117	139	139	182	182
	1030	Factory Shops Blvd	309	0.483	49.1	156	164	227	235	272	279	390	410	469	505	628	662	866	934
	1070		54	0.084	7.3	7	7	25	25	35	35	63	63	76	76	98	98	128	128
	1020		333	0.520	51.3	68	74	96	100	139	157	311	343	410	453	577	641	835	892
	1012		484	0.756	77.7	171	185	240	256	281	298	402	439	534	582	753	817	1,084	1,154
	1026		333	0.520	53.6	168	185	248	268	298	319	434	467	515	562	689	738	938	1,019
	1084		74	0.116	10.2	2	2	15	15	22	22	26	26	28	28	30	30	32	32
	1082	Castleton Road	74	0.116	10.2	2	2	15	15	22	22	26	26	28	28	30	30	32	32
	1092		37	0.058	5.4	4	4	7	7	9	9	20	20	27	27	32	32	35	35
	1052		199	0.311	30.3	63	76	141	156	183	201	296	317	351	374	442	470	570	603
	1036		237	0.370	34.7	35	36	106	123	141	147	270	292	337	361	435	498	654	701
	1102		37	0.058	6.9	49	49	75	75	89	89	121	121	137	137	165	165	203	203
	1042		199	0.311	28.0	13	22	86	99	104	116	222	240	276	289	359	395	528	567
	1124		-	0.000	2.3	8	9	12	12	12	12	12	12	12	12	12	12	12	12
	1112		73	0.114	13.1	7	9	9	22	12	30	27	53	35	70	62	102	95	216
	1122		73	0.114	17.1	50	99	78	141	96	167	143	225	165	256	202	306	253	377
	1014	U/S of US 85 (South)	484	0.756	77.7	171	185	240	256	281	298	402	439	534	582	753	817	1,084	1,154
	1022	Lot 3 Detention	333	0.520	22.0	76	83	108	112	112	112	112	112	112	112	112	112	112	143
	1024		333	0.520	53.6	76	83	108	112	151	169	323	355	422	463	582	644	843	904
	1120	U/S of US 85 (North)	73	0.114	13.1	7	9	9	22	12	30	27	53	35	70	62	102	95	207
	1080	Meadows Pkwy and US 85	151	0.235	26.5	128	140	182	195	215	228	280	292	315	327	367	380	449	462
	1040	I-25	237	0.370	34.5	36	36	106	123	141	147	270	292	337	361	435	477	655	701
	1090		74	0.116	13.4	48	48	68	68	79	79	104	104	117	117	139	139	174	174
	1050	U/S of US 85	199	0.311	28.0	13	22	86	99	104	116	222	240	276	289	360	397	529	567
	1034		237	0.370	34.4	35	36	106	123	141	147	270	292	337	361	435	498	654	701
	1032		237	0.370	34.4	35	36	106	123	141	147	270	292	337	361	435	496	654	701
	1028	South Lowe's Pond	333	0.520	53.6	168	185	248	268	298	319	434	467	515	562	689	738	938	1,019
	1108	Pond H	37	0.058	6.9	49	49	75	75	89	89	121	121	137	137	165	165	203	203
	1058	Home Depot Pond	199	0.311	30.3	63	76	141	156	183	201	296	317	351	374	442	470	570	603
	1088	Douglas County Justice Center Filing No. 3 Pond	74	0.116	13.3	48	48	68	68	79	79	104	104	117	117	139	139	182	182
	1128	North Lowe's Pond	73	0.114	17.1	50	99	78	141	96	167	143	225	165	256	202	306	253	377

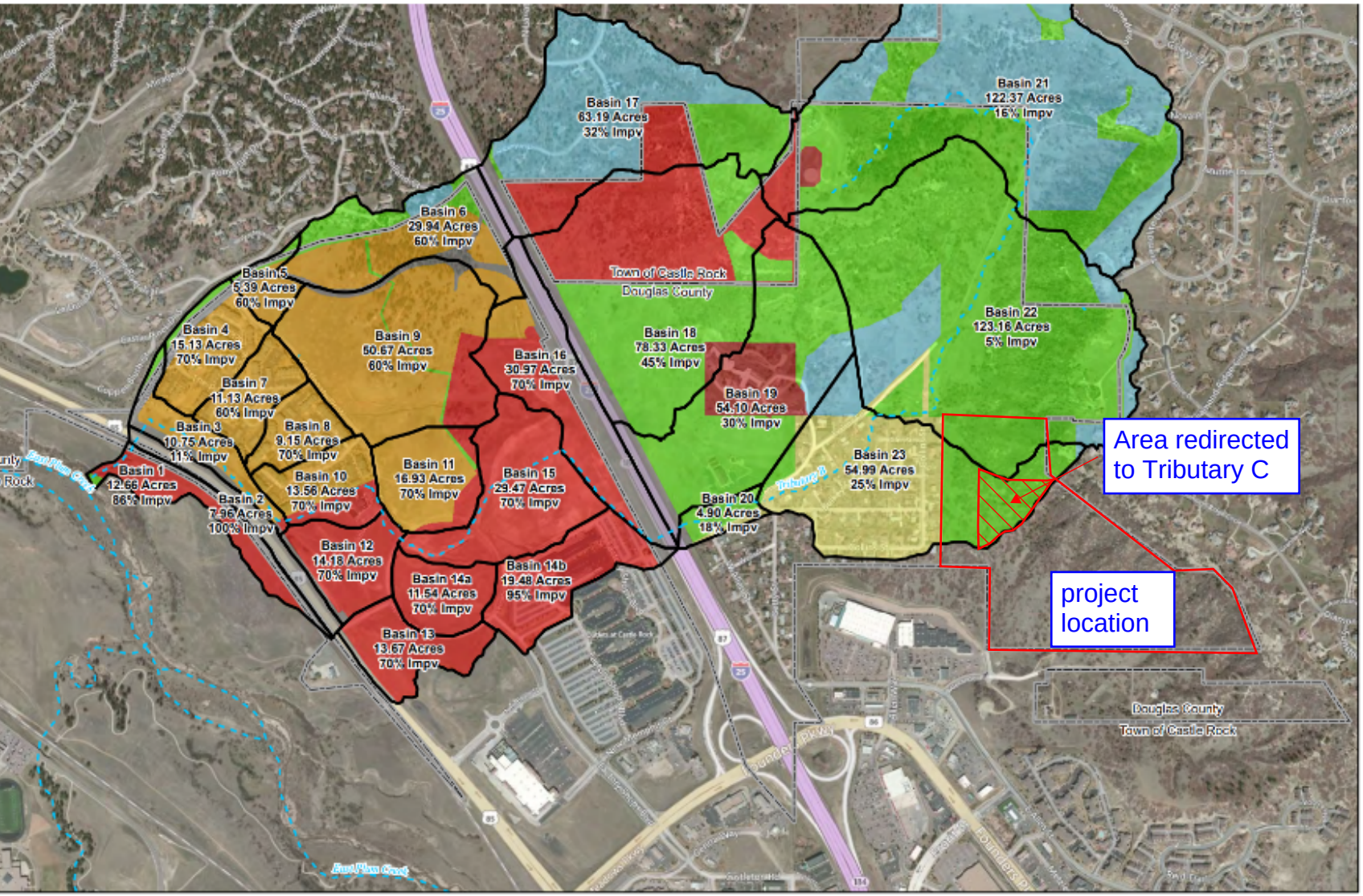


FIGURE A-4
Future Land Use
Tributary B Watershed Master Plan
Castle Rock, Colorado

CH2MHILL

Appendix C

Hydraulic Calculations

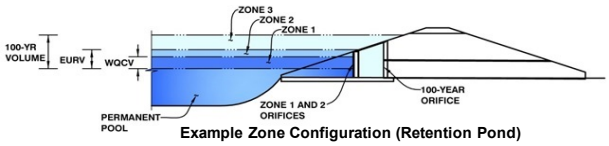
- Pond 1 Calculations
- Pond 2 Calculations
- Hydraulic Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Soleana Subdivision Grading Only**

Basin ID: **Basin A Pond 1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	8.25	acres
Watershed Length =	1,100	ft
Watershed Length to Centroid =	550	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	5.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	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) =	0.025	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.032	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.075	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.255	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	0.393	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.69 in.) =	0.467	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	0.842	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	1.126	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.500	acre-feet		inches
Approximate 2-yr Detention Volume =	0.023	acre-feet		
Approximate 5-yr Detention Volume =	0.081	acre-feet		
Approximate 10-yr Detention Volume =	0.120	acre-feet		
Approximate 25-yr Detention Volume =	0.126	acre-feet		
Approximate 50-yr Detention Volume =	0.151	acre-feet		
Approximate 100-yr Detention Volume =	0.230	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.025	acre-feet
Zone 2 Volume (100-year - Zone 1) =	0.205	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.230	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	

Depth Increment = 0.50 ft

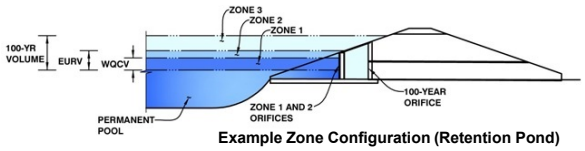
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	50	0.001		
	--	0.33	--	--	--	50	0.001	17	0.000
6262	--	1.00	--	--	--	1,386	0.032	498	0.011
6263	--	2.00	--	--	--	3,020	0.069	2,701	0.062
6264	--	3.00	--	--	--	5,183	0.119	6,802	0.156
6265	--	4.00	--	--	--	8,119	0.186	13,453	0.309
6266	--	5.00	--	--	--	11,049	0.254	23,037	0.529
6267	--	6.00	--	--	--	13,445	0.309	35,284	0.810
6268	--	7.00	--	--	--	15,950	0.366	49,982	1.147
6269	--	8.00	--	--	--	18,427	0.423	67,170	1.542

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Soleana Subdivision Grading Only**

Basin ID: **Basin A Pond 1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.35	0.025	Orifice Plate
Zone 2 (100-year)	3.54	0.205	
Zone 3			
Total (all zones)		0.230	

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

Underdrain Orifice Invert Depth =	0.00	ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		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 =	1.389E-03	ft^2
Depth at top of Zone using Orifice Plate =	3.00	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	14.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.20	sq. inches (diameter = 1/2 inch)	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	1.20	2.40					
Orifice Area (sq. inches)	0.20	0.20	0.20					

	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 =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			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))

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		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).

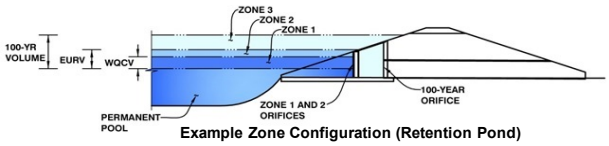
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.69	2.26	2.60	3.14
CUHP Runoff Volume (acre-ft) =	0.025	0.032	0.075	0.255	0.393	0.467	0.842	1.126	1.500
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.075	0.255	0.393	0.467	0.842	1.126	1.500
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.9	3.2	4.4	5.6	9.7	12.4	16.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.38	0.54	0.67	1.17	1.51	1.98
Peak Inflow Q (cfs) =	N/A	N/A	1.0	3.3	4.6	5.8	9.9	12.6	16.5
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	50	84	>120	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**44**	52	87	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	1.36	1.50	2.14	3.66	4.39	4.72	6.07	6.91	7.87
Area at Maximum Ponding Depth (acres) =	0.05	0.05	0.08	0.16	0.21	0.23	0.31	0.36	0.42
Maximum Volume Stored (acre-ft) =	0.025	0.032	0.071	0.249	0.385	0.458	0.832	1.115	1.487

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Soleana Subdivision Grading Only**

Basin ID: **Pond 2 Sub Basins 106 and 107 Masterplan Grading Only**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	162.70	acres
Watershed Length =	3,270	ft
Watershed Length to Centroid =	1,490	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	5.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	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) =	0.490	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.640	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	1.480	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	5.062	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	7.792	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	9.262	acre-feet	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	16.677	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	22.313	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	29.738	acre-feet	inches
Approximate 2-yr Detention Volume =	0.444	acre-feet	
Approximate 5-yr Detention Volume =	1.589	acre-feet	
Approximate 10-yr Detention Volume =	2.366	acre-feet	
Approximate 25-yr Detention Volume =	2.487	acre-feet	
Approximate 50-yr Detention Volume =	2.979	acre-feet	
Approximate 100-yr Detention Volume =	4.538	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.490	acre-feet
Zone 2 Volume (100-year - Zone 1) =	4.048	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	4.538	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	

Depth Increment = 1.00 ft

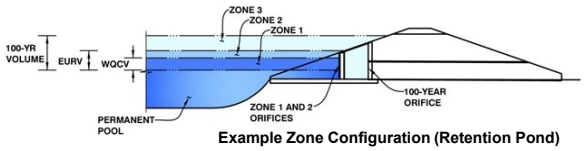
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
6219	--	1.00	--	--	--	11,928	0.274	6,014	0.138
6220	--	2.00	--	--	--	20,074	0.461	22,015	0.505
6221	--	3.00	--	--	--	28,140	0.646	46,122	1.059
6222	--	4.00	--	--	--	30,847	0.708	75,615	1.736
6223	--	5.00	--	--	--	33,657	0.773	107,867	2.476
6224	--	6.00	--	--	--	36,570	0.840	142,981	3.282
6225	--	7.00	--	--	--	39,587	0.909	181,059	4.157
6226	--	8.00	--	--	--	42,707	0.980	222,206	5.101
6227	--	9.00	--	--	--	45,929	1.054	266,524	6.119
6228	--	10.00	--	--	--	49,254	1.131	314,116	7.211
6229	--	11.00	--	--	--	52,681	1.209	365,083	8.381
6230	--	12.00	--	--	--	56,211	1.290	419,529	9.631

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Soleana Subdivision Grading Only

Basin ID: Pond 2 Sub Basins 106 and 107 Masterplan Grading Only



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.97	0.490	Orifice Plate
Zone 2 (100-year)	7.42	4.048	
Zone 3			
Total (all zones)		4.538	

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

Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		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 =	1.736E-02	ft^2
Depth at top of Zone using Orifice Plate =	2.00	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.50	sq. inches (diameter = 1-3/4 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	0.70	1.40					
Orifice Area (sq. inches)	2.50	2.50	2.50					

	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 =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			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))

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

Routed Hydrograph Results

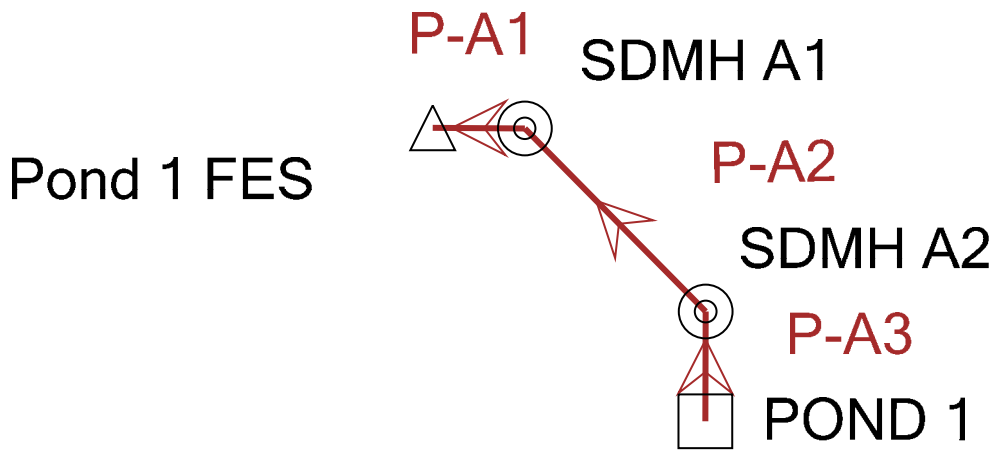
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

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	1.06	1.43	1.66	1.69	2.26	2.60	3.14
CUHP Runoff Volume (acre-ft) =	0.490	0.640	1.480	5.062	7.792	9.262	16.677	22.313	29.738
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.480	5.062	7.792	9.262	16.677	22.313	29.738
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	22.2	80.6	113.5	139.3	243.6	311.5	409.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.50	0.70	0.86	1.50	1.91	2.52
Peak Inflow Q (cfs) =	N/A	N/A	26.6	85.7	118.4	144.4	248.5	316.5	414.2
Peak Outflow Q (cfs) =	0.3	0.3	0.4	0.7	0.8	0.8	0.8	0.8	0.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	46	68	>120	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**43**	49	75	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	1.97	2.28	3.55	7.85	10.39	11.61	12.00	12.00	12.00
Area at Maximum Ponding Depth (acres) =	0.46	0.51	0.68	0.97	1.16	1.26	1.29	1.29	1.29
Maximum Volume Stored (acre-ft) =	0.492	0.642	1.424	4.955	7.646	9.134	9.631	9.631	9.631

Soleana Phase II Grading Only Drainage Report

Scenario: 100 Years

Active Scenario: 100 Years



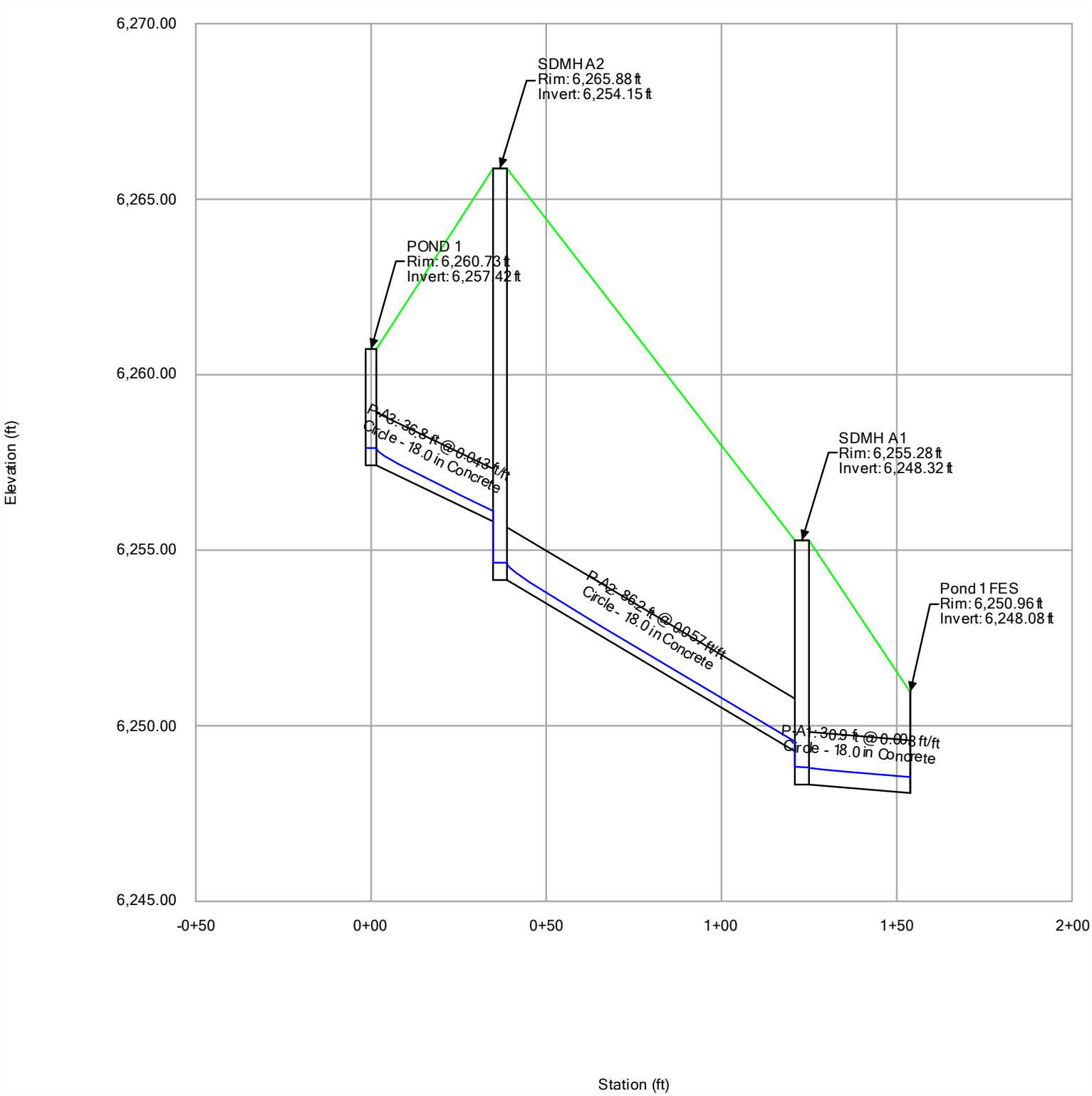
Soleana Phase II Grading Only Drainage Report

Conduit FlexTable: Table - 1

Active Scenario: 5 Years

Label	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-A1	18.0	1.70	3.71	0.014	6,248.32	6,248.08	6,248.81	6,248.54
P-A2	18.0	1.70	7.51	0.014	6,254.15	6,249.27	6,254.64	6,249.55
P-A3	18.0	1.70	6.84	0.014	6,257.42	6,255.82	6,257.91	6,256.12

Soleana Phase II Grading Only Drainage Report
Profile Report
Engineering Profile - Pond 1 Outfall (StormCAD Model_Grading Only.stsw)
Active Scenario: 5 Years



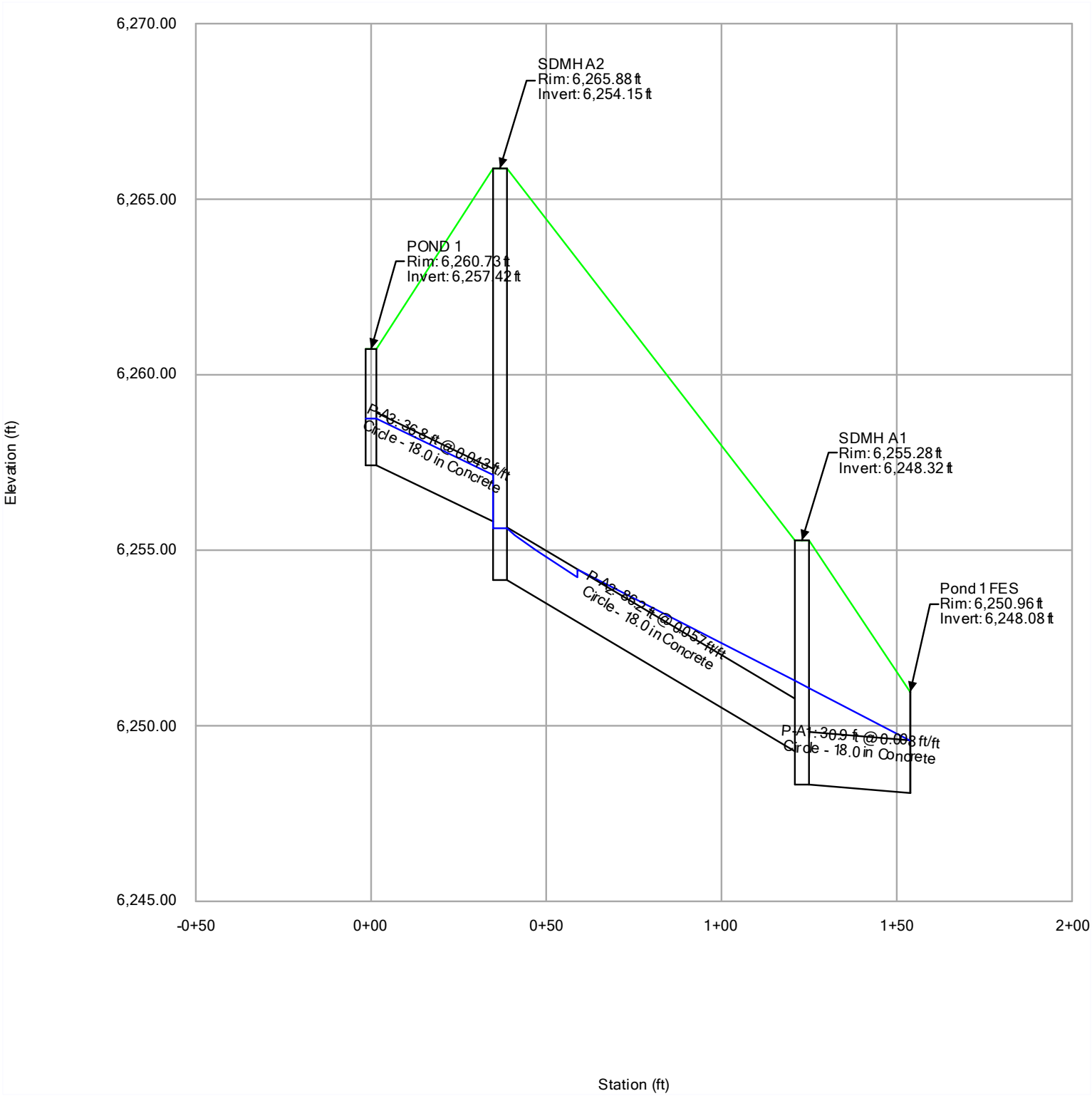
Soleana Phase II Grading Only Drainage Report

Conduit FlexTable: Table - 1

Active Scenario: 100 Years

Label	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-A1	18.0	20.90	11.83	0.014	6,248.32	6,248.08	6,251.07	6,249.55
P-A2	18.0	20.90	14.50	0.014	6,254.15	6,249.27	6,255.62	6,251.29
P-A3	18.0	20.90	12.64	0.014	6,257.42	6,255.82	6,258.75	6,257.15

Soleana Phase II Grading Only Drainage Report
Profile Report
Engineering Profile - Pond 1 Outfall (StormCAD Model_Grading Only.stsw)
Active Scenario: 100 Years



Worksheet for West Channel 5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.010	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	5.00	ft
Discharge	1.30	cfs

Results		
Normal Depth	2.0	in
Flow Area	0.9	ft²
Wetted Perimeter	6.4	ft
Hydraulic Radius	1.8	in
Top Width	6.33	ft
Critical Depth	1.5	in
Critical Slope	0.027	ft/ft
Velocity	1.38	ft/s
Velocity Head	0.03	ft
Specific Energy	0.20	ft
Froude Number	0.633	
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	2.0	in
Critical Depth	1.5	in
Channel Slope	0.010	ft/ft
Critical Slope	0.027	ft/ft

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Worksheet for West Channel 100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.010	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	5.00	ft
Discharge	15.40	cfs

Results		
Normal Depth	7.9	in
Flow Area	5.1	ft²
Wetted Perimeter	10.4	ft
Hydraulic Radius	5.8	in
Top Width	10.29	ft
Critical Depth	6.8	in
Critical Slope	0.018	ft/ft
Velocity	3.05	ft/s
Velocity Head	0.14	ft
Specific Energy	0.81	ft
Froude Number	0.767	
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	7.9	in
Critical Depth	6.8	in
Channel Slope	0.010	ft/ft
Critical Slope	0.018	ft/ft

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Worksheet for North Channel 5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.100	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	5.00	ft
Discharge	0.70	cfs

Results		
Normal Depth	0.7	in
Flow Area	0.3	ft²
Wetted Perimeter	5.5	ft
Hydraulic Radius	0.7	in
Top Width	5.47	ft
Critical Depth	1.0	in
Critical Slope	0.031	ft/ft
Velocity	2.29	ft/s
Velocity Head	0.08	ft
Specific Energy	0.14	ft
Froude Number	1.703	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.7	in
Critical Depth	1.0	in
Channel Slope	0.100	ft/ft
Critical Slope	0.031	ft/ft

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Worksheet for North Channel 100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.100	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	5.00	ft
Discharge	8.10	cfs

Results		
Normal Depth	2.9	in
Flow Area	1.5	ft²
Wetted Perimeter	7.0	ft
Hydraulic Radius	2.5	in
Top Width	6.96	ft
Critical Depth	4.7	in
Critical Slope	0.020	ft/ft
Velocity	5.51	ft/s
Velocity Head	0.47	ft
Specific Energy	0.72	ft
Froude Number	2.116	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.9	in
Critical Depth	4.7	in
Channel Slope	0.100	ft/ft
Critical Slope	0.020	ft/ft

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Worksheet for South Channel 5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.080	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	12.00	ft
Discharge	8.30	cfs

Results		
Normal Depth	2.0	in
Flow Area	2.1	ft²
Wetted Perimeter	13.3	ft
Hydraulic Radius	1.9	in
Top Width	13.30	ft
Critical Depth	2.9	in
Critical Slope	0.022	ft/ft
Velocity	4.03	ft/s
Velocity Head	0.25	ft
Specific Energy	0.42	ft
Froude Number	1.806	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.0	in
Critical Depth	2.9	in
Channel Slope	0.080	ft/ft
Critical Slope	0.022	ft/ft

Worksheet for South Channel 100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.080	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	12.00	ft
Discharge	100.20	cfs

Results		
Normal Depth	8.3	in
Flow Area	10.3	ft²
Wetted Perimeter	17.7	ft
Hydraulic Radius	7.0	in
Top Width	17.57	ft
Critical Depth	13.6	in
Critical Slope	0.014	ft/ft
Velocity	9.74	ft/s
Velocity Head	1.48	ft
Specific Energy	2.17	ft
Froude Number	2.245	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.3	in
Critical Depth	13.6	in
Channel Slope	0.080	ft/ft
Critical Slope	0.014	ft/ft

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Appendix D

Exhibits

- USGS Stream Stats Comparison
- TCR Checklist
- Critical Habitat Exhibit
- Phase II Drainage Map
- Historic Basin Map

USGS
science for a changing world

Study Area Storm Event Runoff Summary for 6 Hour 100 Year Precipitation (Rational Method)

General Disclaimers

Drainage area is greater than recommended maximum threshold of 200 acres.

Parameters

Precipitation Intensity (inches/hour):	**0.597**
Drainage Area (square miles):	**0.36**
Soil Runoff Coefficient (dimensionless):	**0.33**

Summary

Peak runoff (cubic feet per second):	**45.3**

Citations

Kuichling, E., 1889, The relation between the rainfall and the discharge of sewers in populous districts: Transactions, American Society of Civil Engineers v. 20, 60 p.

Dhakal N., 2012, Development of Guidance for Runoff Coefficient Selection and Modified Rational Unit Hydrograph Method for Hydrologic Design, 176 p., accessed October 5, 2016 (https://www.researchgate.net/publication/265233885Development_of_Guidance_for_Runoff

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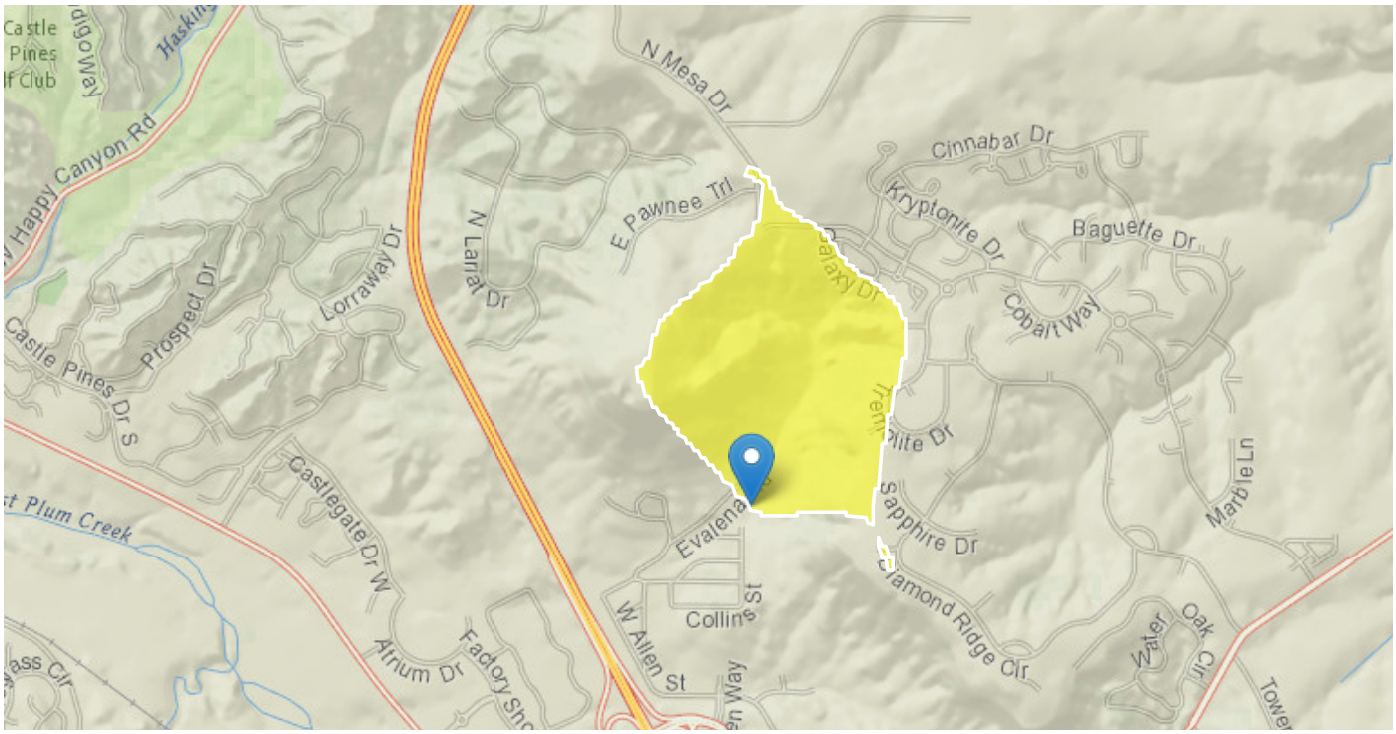
Application Version: 4.19.4

StreamStats Report

Region ID: CO
Workspace ID: CO20240214163257188000
Clicked Point (Latitude, Longitude): 39.42103, -104.86336
Time: 2024-02-14 09:33:20 -0700



Application Version: 4.19.4
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Castle Rock Water
175 Kellogg Court, Castle Rock CO 80109
720-733-6000

Phase II Drainage Report Checklist

The Phase II Drainage Report must be in conformance with the latest Town of Castle Rock Storm Drainage Design and Technical Criteria Manual available on the Town's website.

The Phase II Drainage Report must be signed and sealed by a Professional Engineer licensed in the State of Colorado. The purpose of the Phase II Drainage Report is to identify and refine conceptual stormwater management solutions to the challenges that may be present or occur on-site and off-site.

The preparer should contact and work with the Town Stormwater Engineering Staff regarding any design, master planning and existing system questions (720-733-6000). The following outline sets forth the **required minimum** content to be provided in the Phase II Drainage Report that shall be submitted with the Planned Development Plan or Straight Zoning documents. A copy of this checklist must be submitted with the Phase II Drainage Report.

Please see Chapter 4 of the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual for additional details and information. Please check off the following items to assure your report is complete. Appropriate notations shall be provided with the checklist. For example, if a specific item is not addressed or not applicable, an explanation needs to be provided.

Included	N/A	
X		**I. COVER SHEET**
X		A. Name of Project, including legal name of development
X		B. Address
X		C. Owner
	X	D. Developer
X		E. Engineer
X		F. Submittal date and revision dates as applicable
		II. GENERAL LOCATION AND DESCRIPTION
X		A. Site Location
X		B. Description of Property and Land Use
		III. DRAINAGE BASIN AND SUB-BASINS
X		A. Major Drainage Basins
X		B. Minor Drainage Basins
		IV. DRAINAGE DESIGN CRITERIA
X		A. Regulations
X		B. Drainage Studies, Master Plans, Site Constraints
X		C. Hydrology
X		D. Hydraulics
X		E. Water Quality Enhancement

Phase II Drainage Report Checklist

Included	N/A	
		V. STORMWATER MANAGEMENT FACILITY DESIGN
X		A. Stormwater Conveyance Facilities
X		B. Stormwater Storage Facilities
X		C. Water Quality Enhancement Best Management Practices
X		D. Floodplain Modification
X		E. Additional Permitting Requirements
X		F. General
		VI. CONCLUSIONS
X		A. Compliance with Standards
X		B. Variances
X		C. Drainage Concept
		VII. REFERENCES
		VIII. APPENDICES
X		A. Hydrologic Computations
X		B. Hydraulic Computations (If known at this time—not required)
X		C. Water Quality Enhancement Best Management Practices
X		D. Referenced Information
X		**OVERALL DRAINAGE PLAN (IN POCKET)**
	X	**DETAILED DRAINAGE PLANS (IN POCKET)**

Notes/Comments:

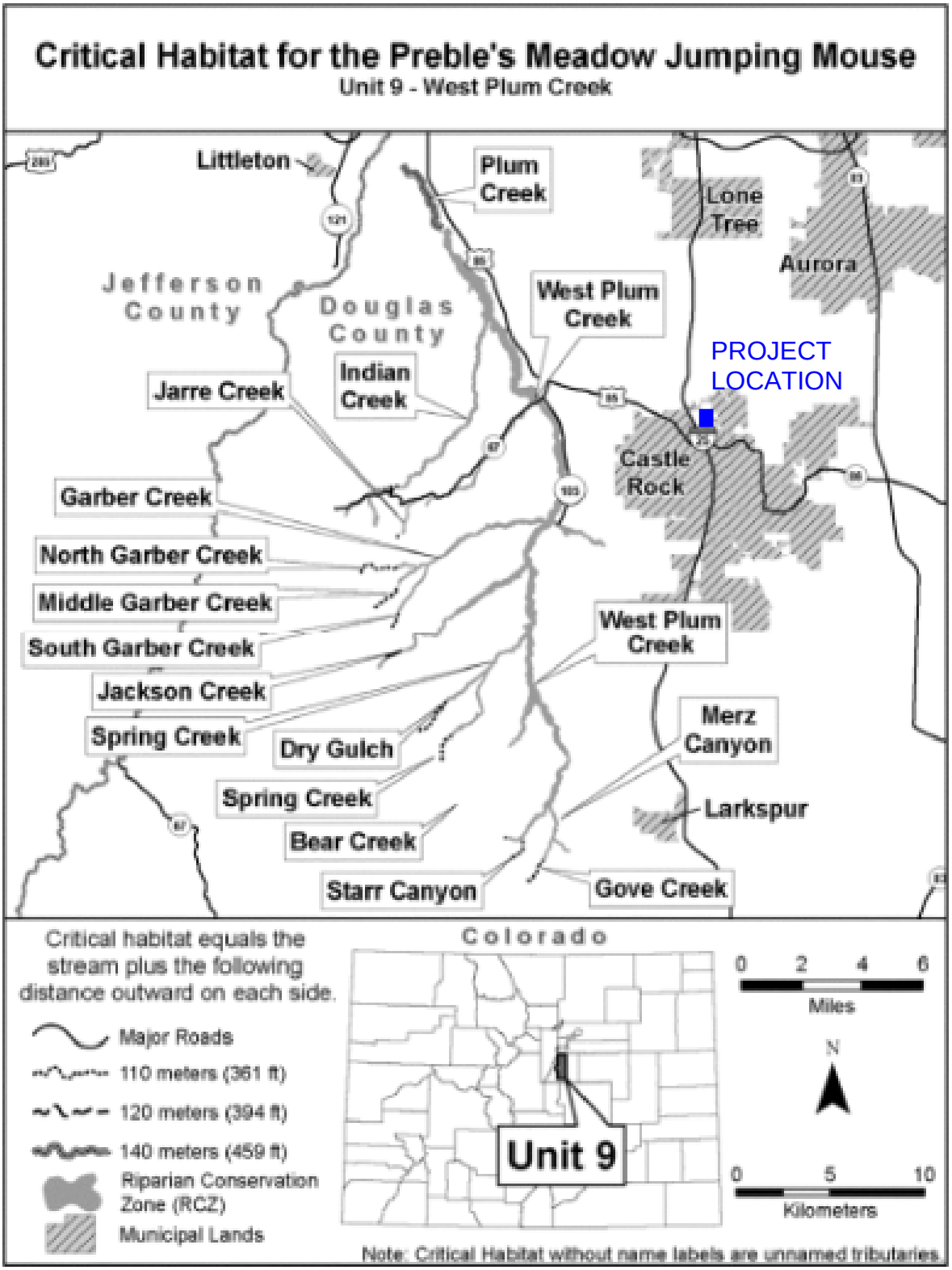
Drainage plans pending final coordination with metropolitan district inclusion areas.

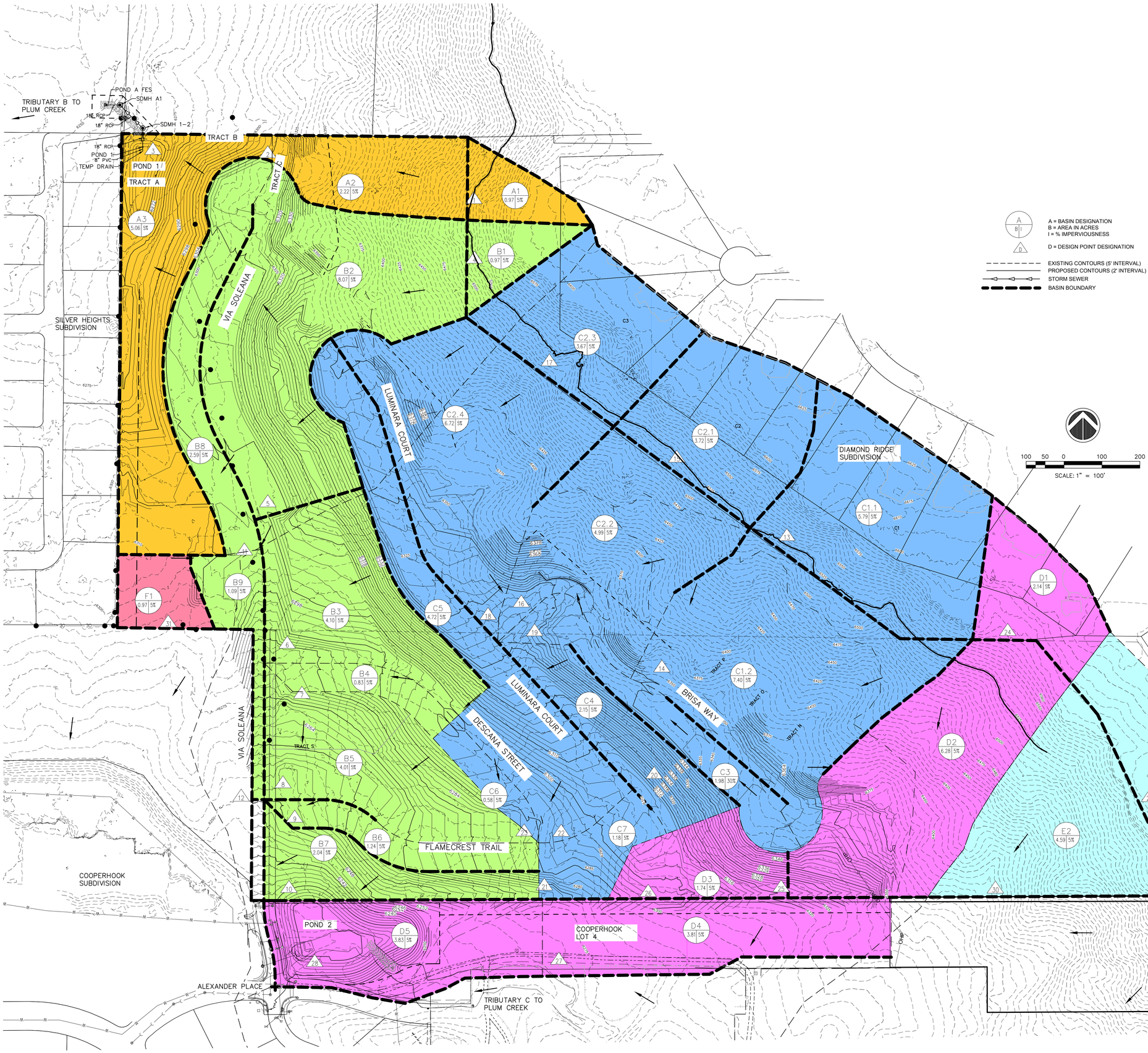
Permanent Water Quality Determination Worksheet (Taken from 2019 SDDTCM Sections 13.1.4 and 13.1.5)

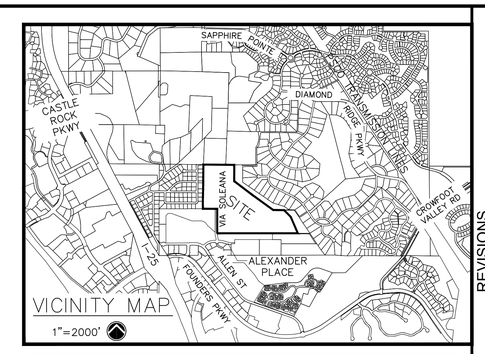
Project:		**Project#**		**Applicant:**
Section	**Questions**	**Response**	**Check those that apply**	**Instructions**
1	**Non-applicable Sites**			
1.1	Will the project result in a temporary disturbance of greater than one acre?	No	☐	Proceed to section 1.2.
		Yes	☒	Proceed to section 2.
1.2	Is the project part of a larger common plan of development or sale where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related and are within 1/4 mile of each other? (A common plan of development will generally be documented on a site development plan, master plan, or equivalent, for the property/project)	No	☐	Proceed to section 1.3.
		Yes	☐	Proceed to section 2.
1.3	Is the project within the Cherry Creek Watershed?	Yes	☐	Permanent water quality control measures may be required. Refer to Water Qualtiy Control Regulation 72.7 for details and allowable exclusions.
		No	☐	Permanent water quality control measures are not required.
2	**Applicable Site Types and Exclusions by Variance**			
2.1	Does the project have more than 35% impervious area on the existing site?	No	☒	Project is an applicable Development Site. Proceed to section 3.
		Yes	☐	Proceed to 2.2.
2.2	Does the project have greater than 75% impervious area on the existing site?	No	☐	Project is an applicable Redevelopment Site. Proceed to section 3.
		Yes	☐	Project is an applicable Constrainted Redevelopment Site. Proceed to 2.3.
2.3	Will 100% of the runoff from the existing and proposed site be captured and treated using one or more of the allowable design standards for permanent water quality?	Yes	☐	No further action required.
		No	☐	Proceed to 2.4.
2.4	Do any other water quality exclusions apply to the site?	No	☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
		Yes	☐	Proceed to section 3. Following approval of other exclusions, design remaining site in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
3	**Applicable Sites with Other Exclusions by Variance**			
3.1	**Category 1: Roadways, bridges and trails only**			
3.1.1	Is the project a bike or pedestrian trail?	Yes	☐	Proceed to next line.
		No	☒	Proceed to 3.1.2.
	Is the trail for a roadway?	Yes	☐	Proceed to 3.1.2.
		No	☐	Project is excluded. Submit **variance** for Trails Excluded from Permanent Water Quality Requirements.
3.1.2	Is the project primarily used for parking or access to parking?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☒	Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	No	☐	Project is excluded. Submit **variance** for Pavement Management Sites Excluded from Permanent Water Quality Requirements.
		Yes	☒	Proceed to 3.1.4.

Section	Questions	Response	Check those that apply	Instructions
3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☒	Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☒	Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No	☐	Existing areas of site are excluded only. Submit **variance** for Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements.
		Yes	☒	This exclusion does not apply. Permanent water quality is required.
3.2	**Category 2: Non-residential and non-commercial projects only**			
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	Yes	☐	Project is excluded. Submit **variance** for Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes	☐	Project is excluded. Submit **variance** for Stream Stabilization Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of aboveground or underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	Yes	☐	Project is excluded. Submit **variance** for Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	Yes	☐	Project is excluded. Submit **variance** for Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.3	**Category 3: Residential, Agricultural and Commercial projects**			
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	Yes	☐	Proceed to next line.
		No	☒	Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No	☐	Project is excluded. Submit **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Is the project site greater than 20% impervious?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

Section	Questions	Response	Check those that apply	Instructions
3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☒	Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes	☐	This portion of the project is excluded. Submit **variance** for Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements. Proceed to next line.
		No	☒	Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☒	Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☒	Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No	☒	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the **drainage report**. No further action is needed.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.


Critical Habitat for the Preble's Meadow Jumping Mouse
Unit 9 - West Plum Creek
Littleton
Plum Creek
Lone Tree
Aurora
Jefferson County
Douglas County
West Plum Creek
PROJECT LOCATION
Jarre Creek
Indian Creek
Castle Rock
Garber Creek
North Garber Creek
Middle Garber Creek
South Garber Creek
West Plum Creek
Jackson Creek
Merz Canyon
Spring Creek
Dry Gulch
Spring Creek
Larkspur
Bear Creek
Starr Canyon
Gove Creek
Critical habitat equals the stream plus the following distance outward on each side.
Major Roads
110 meters (361 ft)
120 meters (394 ft)
140 meters (459 ft)
Riparian Conservation Zone (RCZ)
Municipal Lands
Colorado
Unit 9
0 2 4 6
Miles
N
0 5 10
Kilometers
Note: Critical Habitat without name labels are unnamed tributaries.





RUNOFF SUMMARY TABLE							
DESIGN POINT	BASIN	AREA	Q5 BASIN	Q5 CUMULATIVE	Q 100 BASIN	Q 100 CUMULATIVE	REMARKS
1	A1	0.97	0.2		2.7		
2	A2	2.22	0.5	0.7	5.6	8.1	A1, A2
3	A3	5.06	1.3	1.7	15.4	20.9	A1 thru A3
4	B1	0.97	0.2		12.4		
5	B2	8.07	1.5	1.6	17.7	26.6	B1, B2
6	B3	4.1	0.9	2.4	10.5	35.6	B1 thru B3
7	B4	0.83	0.2	2.5	2.2	37.4	B1 thru B4
8	B5	4.01	0.9	3.3	11.2	46.2	B1 thru B5
9	B6	1.24	0.3	3.5	3.7	48.9	B1 thru B6
10	B7	2.04	0.5	3.9	6.2	53.4	B1 thru B7
11	B8	2.59	0.7		7.9		
12	B9	1.09	0.3	0.9	3.1	10.3	B8, B9
13	C1.1	5.79	1.2		14.1		
14	C1.2	7.4	1.7	2.7	20.5	32.1	C1.1, C1.2
15	C2.1	3.72	0.8		9.8		
16	C2.2	4.99	1.1	1.9	13.7	22.8	C2.1,2.2
17	C2.3	3.67	0.8		9.8		
18	C2.4	6.72	1.4	4.1	17.5	49.7	C2
19	C3	1.98	0.5	7.4	5.6	89.2	
20	C4	2.15	0.5	7.9	6.1	94.8	C1 thru C4
21	C5	4.72	1.1	8.9	13.5	107.1	C1 thru C5
22	C6	0.58	0.1	8.1	1.4	97.5	C1 thru C6
23	C7	1.18	0.4	8.3	4.3	100.2	C1 thru C7
24	D1	2.14	0.4		5.2		
25	D2	6.28	1.3	1.7	16.0	20.6	D1,D2
26	D3	1.74	0.4	2.1	4.6	24.9	D1 thru D3
27	D4	3.81	1.0	2.8	12.4	34.2	D1 thru D4
28	D5	3.83	1.0	3.6	12.4	43.6	D1 thru D6
29	E1	3.35	0.9		10.3		
30	E2	4.59	1.2	2.0	14.6	24.3	E1,E2
31	F1	0.97	0.3		3.1		

NOTE:
STORM SEWER DESIGN IS PRESENTED FOR THE GRADING PACKAGE ONLY. FUTURE STORM SEWER DESIGN WILL BE REVIEWED WITH THE FINAL CONSTRUCTION DOCUMENT SUBMITTAL.
ACCESS FOR DETENTION POND MAINTENANCE WILL BE PROVIDED PER SECTION 13.6.1 OF THE STORM WATER CRITERIA MANUAL.
A STABLE WORKING BENCH MUST BE PROVIDED TO THE TOP OF THE OUTLET STRUCTURE AND SPILLWAY; A WORKING BENCH, NOT EXCEEDING 10%, SHOULD ALSO BE PROVIDED TO THE BOTTOM OF THE OUTLET STRUCTURE AND FOREBAY(S).

REVISIONS
DESCRIPTION
DATE
No.

IMEG
PH: 303.796.8500
www.imegcorp.com
7600 E Orchard Rd
Suite 250-S
Greenwood Village, CO 80111

SOLEANA
CASTLE ROCK, CO
PHASE II DRAINAGE MAP

IMEG Project No: 2002764.00
File Name: 20002764.00 Phase II TESC

Field Book No:
Drawn By: RAR
Checked By: TCG
Date: 8/12/2022

1

Sheet 1 of 1

Wednesday, October 22, 2025 5:14:12 PM
G:\2020\2002764.00\DESIGN\CIVIL\CSD\EXHIBIT\CONCEPT\2002764.00 PHASE II TESC DRAINAGE EXHIBIT.DWG

HISTORIC LIMITS OF
TRIBUTARY B OUTFALL

TRIBUTARY B

LOCALIZED SUMP
AREA ON COUNTY
PROPERTY

C3
22
1032

EXISTING
DETENTION AREA

SILVER HEIGHTS
SUBDIVISION

HISTORIC FLOW
PATH ACROSS
SILVER HEIGHTS
SUBDIVISION

2.3
55.0
7

AREA REDIRECTED
TO BASIN 106

HISTORIC FLOW
PATH ACROSS
I 25

DIAMOND RIDGE
SUBDIVISION

VIA SOLEANA

97.5

COOPERHOOK
SUBDIVISION

OVERFLOW PATH THROUGH
PARKING LOT PER COOPERHOOK
SUBDIVISION DESIGN

TRIBUTARY C

ALEXANDER PLACE

COOPERHOOK
LOT 4

CASTLE ROCK

MARTINEZ REAL
ESTATE

THORNTON

107
67.1

THORNTON

HISTORIC FLOW
PATH ACROSS
I 25

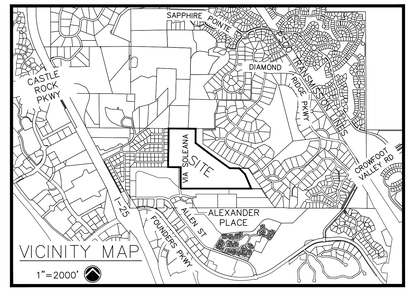
CASTLE ROCK
TRACT D

TRIBUTARY D

A = BASIN DESIGNATION
B = AREA IN ACRES
I = % IMPERVIOUSNESS

D = DESIGN POINT DESIGNATION

EXISTING CONTOURS (5' INTERVAL)
PROPOSED CONTOURS (2' INTERVAL)
STORM SEWER
BASIN BOUNDARY



VICINITY MAP
1"=2000'

200 100 0 200 400
SCALE: 1" = 200'

NOTE:
STORM SEWER DESIGN WILL BE REVIEWED WITH THE SDP SUBMITTAL
ACCESS FOR DETENTION POND MAINTENANCE WILL BE PROVIDED
PER SECTION 13.6.1 OF THE STORM WATER CRITERIA MANUAL
A STABLE WORKING BENCH MUST BE PROVIDED TO THE TOP OF
THE OUTLET STRUCTURE AND SPILLWAY; A WORKING BENCH, NOT
EXCEEDING 10%, SHOULD ALSO BE PROVIDED TO THE BOTTOM OF
THE OUTLET STRUCTURE AND FOREBAY(S).

REVISIONS

NO.	DESCRIPTION	DATE

IMEG
321 N. LEROUX STREET
SUITE 201
FLAGSTAFF, AZ 86001
PH: 928.233.0430
www.imegcorp.com

SOLEANA

REGIONAL DRAINAGE EXHIBIT

IMEG Project No:

File Name:
20002764.00 Phase II Historic

Field Book No:

Drawn By: ***

Checked By: ***

Date: 1/29/25

1

Sheet 1 of 1

Wednesday, March 5, 2025 7:54:11 PM
G:\2020\20002764.00\DESIGN\CIVIL\C3D\EXHIBIT\CONCEPT\20002764.00 PHASE II HISTORIC DRAINAGE EXHIBIT.DWG