



January 2, 2025

Town of Castle Rock
100 N. Wilcox St.
Castle Rock, CO 80104

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM
DATE OF DEVELOPMENT SERVICES APPROVAL

Approved by:  **DEVELOPMENT SERVICES
APPROVED**
By jkirkpatrick
on 04/23/2025
APPROVED-CD22-0026 Drn
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Development Services

Date

RE: SDP20-0004; CD22-0026
Lot 1, Block 1, Outlets at Castle Rock Filing No. 1
Outlets at Castle Rock – Pads B & C
Drainage Conformance Letter (Phase III Report)

General

This letter is provided to demonstrate the subject site's conformance to previous design documents used to develop existing infrastructure serving the site and surrounding properties. The subject site is a part of Lot 1, Block 1, Outlets at Castle Rock Filing No. 1; generally located at 5050 Factory Shops Boulevard, otherwise a part of the Outlets at Castle Rock owned by Craig Realty Group (see attachments; Vicinity Map). Portions of this lot are intended to be developed by the owner as a pad lot, generally within the existing parking field west of the overall outlet development. Final development of the pad sites, including building construction, is to be accomplished by future tenants (see attachments; Site Maps/Calculations/Figures & Tables).

More particularly, the subject site is situated in the north half of Section 27, Township 7 South, Range 67 West of the 6th Principal Meridian, Town of Castle Rock, County of Douglas, State of Colorado. Factory Shops Boulevard lies generally west of the site; the Outlet Access road intersecting with Factory Shops Boulevard lies generally north of the site; the Outlets at Castle Rock retail development lies generally east of the site; and parking for the Outlets at Castle Rock retail development lies generally south of the site. Land use on all sides of the subject site is existing or assumed future commercial development (see attachments; Vicinity Map).

The portions of the subject site to be developed as leased pad sites will be approximately 1.8 acres. Improvements to the existing parking field within which the pad sites lie; including parking island reconfiguration, re-grading, and re-paving will occur over a larger area (i.e. the pad lot). The subject site mainly consists of existing pavement and landscaping typical of commercial development. The Natural Resources Conservation Service (NRCS) Web Soil Survey indicates site soils are mainly (Bo) Blakeland-Orsa association, 1 to 4 percent slopes, rated as Hydrologic Soil Group A; and (BrB) Bresser sandy loam, cool, 1 to 3 percent slopes, rated as Hydrologic Soil Group B (see attachments; NRCS SOIL MAP). The Federal Emergency Management Agency (FEMA) Flood Map Service Center documents the site on Flood Insurance Rate Map (FIRM), Map No. 08035C0167G, Map revised March 16, 2016,

and Map No. 08035C0186G, Map revised March 16, 2016; and indicates the site is within Flood Zone X (Unshaded), “Areas determined to be outside the 0.2% annual chance floodplain...” (see attachments; FEMA FIRM).

For the purposes of this letter, the reports and documents referenced herein are considered the most recent and most pertinent. Phase III report(s) (other than any referenced herein) specific to the subject site have not been found or made available from typical sources such as the Town of Castle Rock, online resources, or the property owner(s).

Existing Drainage Analysis – General

Runoff from the subject site is currently captured by three on site inlets (a.k.a. IN-1, IN-2, and IN-3) and conveyed in associated underground storm sewer systems to an offsite detention and water quality pond (a.k.a. Lowe’s South Detention Pond; see attachments, *Castle Rock Utilities Maps* a.k.a. ToCR Map 1 and ToCR Map 2). The Lowe’s South Detention Pond is the final pond in a succession of ponds (Pond 220, Detention Pond B, Temporary Detention Pond C, Lowe’s South Detention Pond respectively) designed to serve the subject site and surrounding areas.

Existing Drainage Analysis – Detailed

Table 1 (below) summarizes the chronology and relevance of the existing reports referenced herein.

The most current, existing drainage document obtained from the Town of Castle Rock pertaining to the subject site is the *Phase III Drainage Report, Castle Pines Commercial Filing 10A, Part 2 – Lowe’s Detention Ponds (East Plum Creek Tributaries B2 & C Ponds)*, prepared by Civil Design Group, Inc., dated August 20, 2007 (a.k.a. LOWE’S REPORT; see attachments). This report indicates that it “...presents the final design of stormwater detention for the under construction Lowe’s home improvement store...” and that the “...South Detention Pond is designed to detain for [the] south half of the Lowe’s development, the existing tributary Factory Outlet Shops, and the future development of the currently vacant portions of Filing No. 10A...” The LOWE’S REPORT goes on to say that the *Castle Pines Commercial Filing 10A – Part 1 (Lowe’s Interim Pond) Phase III Drainage Report*, prepared by TST Inc. of Denver, Consulting Engineers, dated August 9, 2006 (a.k.a. INTERIM REPORT; see attachments) “...presented a detailed and comprehensive analysis of the off-site and on-site flows which drain to the area proposed for Lowe’s South Detention Pond...” including contributions from “...the 70 acres Factory Shops basin...” and that the “...Part 1 [INTERIM] report specified the required water quality volume for the South Detention Pond...”

The INTERIM REPORT describes revisions to the downstream portion of the drainage facilities within Factory Shops Boulevard and New Memphis Court serving the subject site and surrounding areas, including the construction of Temporary Detention Pond C (a.k.a. Lowe’s South Detention Pond; see above). The INTERIM REPORT states that the “...detention requirements for all basins have been included in the temporary detention pond proposed with water quality...” and that “...volume was calculated accounting for developed flows of the basins reported in this [INTERIM] report in addition to all upstream basins. The assumed imperviousness for all of the basins was based on previously approved drainage reports and field verification, with primarily commercial usage.” Previous reports referenced in the INTERIM REPORT include the *Castle Pines Commercial P.D., Castle Rock, Colorado, Master Drainage Report*, prepared by TST Inc. of Denver, Consulting Engineers, dated February 10, 1995 (a.k.a. MASTER

REPORT; see attachments); and the *Phase III Drainage Report, Castle Pines Commercial P.D. Parcel 5*, prepared by TST Inc. of Denver, Consulting Engineers, dated April 14, 1997 (unavailable). The INTERIM REPORT includes the subject site within its Basin 111 with an area of 70 acres and an imperviousness of 80% which correlates with the report's inclusion of "...an off-site contribution to the improvements from...the Factory Shops to the east..." and suggests it simulates "...the general drainage concept of regional detention for the existing Detention Pond B by relocating this pond further south and adding a defined water quality volume to this pond [a.k.a. Temporary Detention Pond C]."

The MASTER REPORT states that the site considered within its analysis is comprised of the "...Castle Pines Commercial P.D. ... a parcel of approximately 450 acres...generally bounded by Interstate 25 to the east, U.S. Highway 85 to the west, Meadows Parkway to the south, and the Castle Pines development to the north." The MASTER REPORT also indicates that described within it "...are the results of an investigation of the proposed hydrologic conditions for the site..." and that the "...background information and assumptions...have been taken from the *Master Drainage Study for Castle Rock Business Park* ("Study"), TST Inc., October 1991 [see below] and further discussed and refined in the *Preliminary Drainage Report for Castle Pines Commercial P.D.*, TST Inc. of Denver, July 7, 1994 [unavailable]." The MASTER REPORT includes a description of existing drainage improvements consisting of "...the parking lot and building drainage, storm inlets and piping ...[and] detention pond...that is associated with the development of the Factory Shops."

Although a copy of the *Master Drainage Study for Castle Rock Business Park* ("Study"), prepared by TST Inc., dated October 1991 (see above), tying the MASTER REPORT (and subsequent INTERIM REPORT and LOWE'S REPORT) more specifically to the "Factory Shops" and their associated drainage facilities within Factory Shops Boulevard and New Memphis Court serving the subject site and surrounding areas noted above does not appear to be available; a copy of the *Master Drainage Study for Castle Pines Commercial Amended*, prepared by TST Inc., Consulting Engineers, dated October 1991, and revised December 1991 (a.k.a. MASTER STUDY; see attachments), is available and does appear to be a report that fills this role in the succession of existing documents.

The MASTER STUDY is a revision to the *Master Drainage Study for the Castle Pines Commercial, Metropolitan District No.'s 1 through 5*, prepared by Taranto, Stanton & Tagge, Consulting Engineers, dated January 1987 (a.k.a. 1987 REPORT), "...necessitated by a change in the master plan to allow primarily for the inclusion of a factory outlet mall." The MASTER STUDY indicates that at the time of its preparation, "...Castle Pines Holdings, Inc., [had] become the owner of a portion of the original development, that portion being generally the southern two-thirds of the development..." and that "...This revised report addresses primarily this property, although the additional property to the north has been included for completeness." The MASTER STUDY also indicates that it presents "...the results of an investigation into...the...hydrologic conditions for the Castle Pines Holdings site..." and that it "...is intended to evaluate the site in connection with the most intense probable development." The MASTER STUDY's considered scope of work includes "...Evaluation of detention pond locations and sizing..." and reports such in its Section III.C, Table V for a Pond 221 modeled by node 220.

Shortly after the preparation of the MASTER STUDY to account for "...the inclusion of a factory outlet mall..." the *Final Drainage Report for Castle Rock Factory Shops*, prepared by Rocky Mountain Consultants, Inc., dated February 1992, and revised March 1992 (a.k.a. FACTORY SHOPS REPORT; see attachments), was prepared to address "...A drainage system design for the Castle Rock Factory Shops

retail center...” and “...A design of the offsite detention pond facilities.” The FACTORY SHOPS REPORT indicates it was based on both the 1987 REPORT and an October 1991 version of the MASTER STUDY resulting in “...proposed drainage facilities [that would] intercept the on-site and off-site runoff for 100-year storm frequency, and convey it to a detention pond 220...” and more specifically that “...Discharge from the site’s west and north parking areas [would be] collected at inlets and routed to a... branch of storm sewer in Factory Shops Boulevard... [outfalling] to a detention pond [(Pond 220)] just west of Factory Shops Boulevard.”

ToCR MAP 1 and ToCR MAP 2 indicate the existence of this drainage system and detention pond serving the subject site. Review of as-built plans provided by the Town of Castle Rock within the *Castle Rock Factory Shops Construction Plans – As-Built*, prepared by Rocky Mountain Consultants, Inc., dated December 6, 1993 (a.k.a. SOUTH ASBUILT; see attachments), corroborates the construction of the majority of this system including Pond 220 located at the west end of New Memphis Court even though the ultimate alignment of Factory Shops Boulevard and other upstream improvements appear to have been installed after preparation of the as-built plan.

Table 1

DOCUMENT	YEAR	RELEVANT CONTENT
LOWE’S REPORT	2007	Design of Lowe’s South Detention Pond; dependent on INTERIM REPORT analysis
INTERIM REPORT	2006	Design of Temporary Detention Pond C, a revision to Detention Pond B; dependent on MASTER REPORT assumptions
MASTER REPORT	1995	Analysis of hydrologic conditions including the Factory Shops development; dependent on assumptions in previous studies similar to MASTER STUDY
MASTER STUDY	1991	Evaluation and preliminary design of detention ponds necessary due to changes in 1987 REPORT including Pond 221 (a.k.a. Pond 220 in succeeding documents)
1987 REPORT	1987	
FACTORY SHOPS REPORT	1992	Detailed design of Factory Shops drainage system and Pond 220
SOUTH ASBUILT	1993	Asbuilt of Factory Shops drainage system and Pond 220

Conformance

Conformance to these existing conditions and the designs described within the aforementioned documents can be shown by a comparison of impervious area. Without a specific breakdown in the INTERIM REPORT of impervious and pervious areas within Basin 111, a direct comparison to the subject site is not possible. However, a comparison of imperviousness between the existing and proposed conditions for basins impacted by the proposed pad lot limit (existing Basins IN-1, IN-2, IN-3, Remainder North, Remainder South and X3; proposed Basins P1 through P10, Remainder North, Remainder South and X3) in conjunction with tributary basins not impacted by the proposed pad lot limit (Basins O1, IN-D, A1 through A4, B1, C1 through C5, and X1, X2 and X4 through X6) does

indicate an equivalent imperviousness (76%) when combined with pad site development which is less than or equal to 84% imperviousness (see table below and attachments; Site Maps/Calculations/Figures & Tables, and ToCR Map 2). Basins X1 through X6 are equivalent to Basins B1 through B6 described in the *Lot 3, Block 1, Castle Rock Factory Shops, Amendment 1 – Qdoba-Starbucks Development Drainage Conformance Letter*, prepared by Sterling Design Associates, llc, dated December 3, 2014 (a.k.a. PAD A LETTER; see attachments). Such an imperviousness for the pad lot also represents compliance with the imperviousness for Basin 111 (80%) and therefore conformance as described herein.

In addition, rational method, runoff calculations have been performed based on the areas and imperviousness values described herein to analyze existing system capacity through relative comparison (see table below and attachments; Site Maps/Calculations/Figures & Tables, and ToCR Map 2). It is important to note that review of the FACTORY SHOPS REPORT suggests while the existing onsite storm sewer system was generally designed with the "...minor storm...based upon a two-year storm frequency, and the major storm...based upon a one hundred-year storm frequency..."; the "...drainage system will provide carrying capacity to keep the 2-year and 100-year storm flows below 6 inches at the crown or flowline of the median curb..." and more specifically that "...The inlets and storm sewers in the east parking lot were designed to accommodate the runoff from the 100-year storm event...[with]...an emergency route for storm water in the event of a blockage of the inlets, storm sewer or a greater than 100-year event...designed between the buildings..." This description, along with additional hydraulic analysis and review of the FACTORY SHOPS REPORT calculations suggests the existing storm sewer serving the subject site (generally the west parking lot) was not designed to convey 100-year runoff. Rather, the combination of the existing storm sewer system and the Factory Shops Boulevard street section were intended to convey the major storm event runoff.

The calculations included herein indicate that runoff at Design Points 1 through 5 is unchanged by the proposed development. At Design Point 6.7 and its equivalent existing Design Point 6, proposed runoff is slightly less than existing, indicating Basins P2 through P7 contribute less runoff than Basins IN-1 and IN-2. At Design Point 7, the addition of Basin P1 (upstream at Design Point 4.1) increases the proposed runoff above the existing amount ($Q_{100} = 66.64$ cfs proposed compared to $Q_{100} = 60.38$ cfs existing), reflecting a proposed shift of the basin line between Basins IN-2 and IN-3, to the south and subsequent increase in tributary area to Design Point 7. However, the existing system as described in the FACTORY SHOPS REPORT is already conveying excess 100-year runoff in the Factory Shops Boulevard street section at this point, (FACTORY SHOPS REPORT Design Point 14; Q_{100} pipe flow = 55 cfs, Q_{100} street flow = 34.4 cfs) and has an assumed Q_{100} total flow = 89.4 cfs which is greater than the Design Q_{100} total flow = 66.64 cfs. This comparison suggests the existing combined pipe and street drainage system should have capacity for the increased flow at Design Point 7.

Calculations indicate runoff at Design Point 8 is unchanged by the proposed development. Proposed runoff at Design Points 9 and 10 is less than existing, reflecting the same basin line shift described above. This subsequently offsets the Design Point 7 increase, at Design Point 11 ($Q_{100} = 87.98$ cfs proposed compared to $Q_{100} = 87.97$ cfs existing).

Runoff at Design Points 12 and 13, as for Basin Remainder North (RN), are calculated with minor differences between existing and proposed and should therefore pose no significant impact to the existing drainage system.

Conformance Summary

Table 2

DESIGN PT. ¹ (EXISTING) (PROPOSED)	AREA (ac.)	CA	Q ₅ (cfs)	Q ₁₀₀ (cfs)
1	2.161	1.83	8.04	16.14
1	2.161	1.83	8.04	16.14
2	2.324	1.97	7.83	15.73
2	2.324	1.97	7.87	15.73
3	3.133	2.54	10.95	22.36
3	3.133	2.54	10.95	22.36
4	5.457	4.51	17.47	35.60
4	5.457	4.51	16.91	35.60
5	1.618	1.31	5.90	11.56
5	1.618	1.31	5.90	11.56
6	6.934	5.08	15.42	31.99
6.7	5.991	4.55	14.73	31.66
7	12.391	9.58	29.38	60.38
7	12.531	9.87	31.24	66.64
8	3.284	2.59	11.06	22.77
8	3.284	2.59	11.06	22.77
9	5.959	4.62	16.13	33.27
9	5.568	4.34	15.81	32.96
10	7.598	5.33	14.77	31.43
10	7.168	5.04	14.02	29.73
11	19.989	14.91	41.91	87.97
11	19.699	14.91	42.62	87.98
12	3.039	2.59	8.66	18.21
12	3.230	2.65	9.10	18.60
13	23.028	17.50	55.14	101.51
13	22.929	17.56	48.28	101.83
RN	2.226	1.47	2.96	8.67
RN	2.325	1.53	3.00	9.01
Total ¹	25.254		58.10	110.18
Total ¹	25.254		51.28	110.84

¹Total = D.P. 13 + RN

Table 3

BASIN	IMPERVIOUSNESS (%)	TRIBUTARY TO POND	STORMWATER QUALITY PROVISION
Exist. Site ²	76	Lowe's South Detention Pond	WQCV
Prop. Site ^{1,2}	76	Lowe's South Detention Pond	WQCV
Basin 111	80	Lowe's South Detention Pond	WQCV

¹Pad Site Imperviousness must not exceed 84%.

²"Site" includes basins both impacted and not impacted by pad lot development; all tributary during varying storm events and/or emergency situations to existing drainage system serving the "Site." (i.e. Total tributary area from Table 2 + Basins A3, C4 and C5).

Stormwater Quality

The Town of Castle Rock, *Storm Drainage Design and Technical Criteria Manual* (a.k.a. SDDTCM), Section 14.1 – Stormwater Quality Design Process, describes a four-step process regarding stormwater quality. In addition, Section 4.4.2.V.C – Water Quality Enhancement Control Measures, lists attributes of stormwater quality facilities to consider. The pad lot's proposed design as described in this letter addresses the four steps and subsequent attributes in the following manner:

The pad lot design attempts to reduce runoff volume to the maximum extent practicable (Step 1) by including the installation of additional landscape areas. Water Quality Capture Volume and flood control detention (Step 2) for the pad lot and pad sites are provided by off site facilities. Previous reports discuss specific attributes associated with these facilities. The previous design, approval, and construction of these facilities and their outfalls, as well as for any applicable open channel conveyance facilities, would be the appropriate time and place to address stream channel stabilization (Step 3). As neither the pad lot nor the pad sites discharge directly to any open channels or streams, but rather to existing underground storm sewer systems ultimately the responsibility of the Town of Castle Rock; stream channel stabilization techniques do not appear applicable to the design described in this letter. In addition, structural and/or non-structural source controls to reduce the potential for illicit discharges (as defined in the SDDTCM) (Step 4) such as covering chemical, oil, fertilizer, and other pollutant storage and handling areas; addressing spill containment and control; provision of proper waste receptacles; good housekeeping practices (as described in the SDDTCM or its referenced documents); preventative maintenance; and employee education and training should be employed by the owner/operator as applicable and as required by the Town of Castle Rock or other jurisdictional entities with authority. Snow storage within areas not exceeding 15% of the required parking spaces should be anticipated as a part of these practices. Such snow storage is tributary to the onsite drainage system described herein and therefore to the downstream, offsite stormwater quality pond also described herein. Additional practices that could be employed by the owner/operator include storing snow in landscape areas to facilitate treatment and runoff reduction through infiltration, dilution, and biodegradation; and clearing and proper disposal of debris from snow storage areas shortly after melting and prior to conveyance by rainfall runoff.

Proposed Drainage System

The drainage system proposed to be constructed with the development of the subject site is intended to be in accordance with applicable portions of the SDDTCM and any applicable portions of the Mile High Flood District's (MHFD) *Urban Storm Drainage Criterial Manual* (MANUAL) by reference. In addition, the proposed drainage system is intended to conform to the assumptions of the aforementioned previous drainage studies. The Rational Method has been used as the basis for hydrology calculations including 5-year and 100-year storm recurrence interval characteristics; and 5-year and 100-year rainfall from Figure 6-1 of the SDDTCM for Times of Concentration calculated using standard methods and equations from the MANUAL. Detention calculations are unnecessary as both flood storage and stormwater quality are accounted for downstream as discussed herein. Hydraulic calculations for inlets and storm sewer systems have been based on standard methods described in the SDDTCM and the MANUAL. Headloss coefficients included in the storm sewer calculations are based on the MHFD's Technical Paper, "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc., dated October 6, 2009 (a.k.a. AMEC TECHNICAL PAPER). One of this paper's stated purposes is to provide "...an engineering guideline for StormCAD so that [it] can be depended upon to produce similar and more conservative results than UD-Sewer." The results of the paper indicate that "...StormCAD's Standard Method for calculating headloss most closely resembled UD-Sewer's headloss results..." and that "... The user defined K value for the standard method also provides the engineer with the option of entering the conversion coefficients thus giving StormCAD similar results to UD-Sewer." The AMEC TECHNICAL PAPER goes on to describe its approach for deriving K coefficients for use in StormCAD that will "...produce the same or greater headloss achieved with UD-Sewer..." and provides such coefficients in its Table 2 – StormCAD Standard Method Conversions which "...can be used in StormCAD to replicate UD-Sewer results." In addition, the geotechnical investigation prepared specifically for the subject site states that, "Groundwater was not encountered during drilling operations. Due to the anticipated grading planned for the development, groundwater should not be a constraint to the proposed development. However, depending on the depth of buried utility lines, groundwater may be encountered during buried utility line installation."

Developed runoff will generally follow existing drainage paths and patterns, being conveyed from east to west across the subject site's paved parking areas and associated landscape islands until captured by existing or proposed curb and gutter. This curb and gutter will convey runoff to onsite inlets (proposed inlets IN-P1 through IN-P10) and proposed and existing underground storm sewer which will discharge to the existing surrounding underground storm sewer system, street drainage system, and downstream detention and stormwater quality pond described herein. Runoff from the subject site's perimeter landscape and paved area, portions of which are north and west of the parking field and pad lot development (Basins REMAINDER NORTH and REMAINDER SOUTH) will be conveyed as surface flow to the adjacent streets (the Outlet Access Road and Factory Shops Boulevard) and their existing drainage systems as in its historic condition. As noted above, any changes in the amount of runoff for these basins appears minor and should therefore pose no significant impact to the existing drainage system. A portion of the subjects site's perimeter landscape and paved area south of the parking field and pad lot development will be conveyed to existing Basin X3 (equivalent to the PAD A LETTER's Basin B3) increasing this basin's runoff from a reported $Q_{100} = 6.42$ cfs to a design $Q_{100} = 6.79$ cfs. This change in the amount of runoff for this basin appears minor as well, and should therefore pose no significant impact to the existing drainage system.

Proposed inlets IN-P1 through IN-P7 generally replace existing inlets IN-1 and IN-2 and serve their respective tributary areas. Proposed inlets IN-P8 through IN-P10 generally replace existing inlet IN-3 and serve its respective tributary area. More specifically, the Pad Sites have been accounted for in the respective inlet designs assuming future tenant construction will adhere to the assumptions of this report.

As discussed above, the existing onsite storm sewer system does not appear to have been designed to convey runoff from the 100-year storm event; rather, allowing this runoff to exceed the system's capacity and presumably over-top adjacent curbs, run down the existing landscaped slope as surface flow directly to Factory Shops Boulevard, and be conveyed in the combined storm sewer and street section downstream.

In an effort to protect the proposed pad sites and associated pad lot retaining wall from 100-year runoff which cannot be routed around these improvements, the proposed storm sewer system has been designed to capture and convey runoff from the 100-year storm event downstream of these improvements. Once past these improvements and without a variance from the Town of Castle Rock, the proposed downstream storm sewer sections must not tie into the original system's smaller pipes which historically convey runoff to the storm sewer system in Factory Shops Boulevard. Rather, the upsized onsite system must be conveyed in pipes of the same or greater size until it ties to similarly sized existing pipes. Therefore, several existing storm sewer pipes within the public R.O.W. and which cross the Factory Shops Boulevard traveled way, must be removed and replaced as shown on the accompanying drainage plan. While the modeling within this report indicates that this approach will convey 100-yr runoff around the onsite improvements, it does not mitigate the original design intent; that of conveying the same runoff in the combined storm sewer and Factory Shops Boulevard street section. Subsequently, hydraulic calculations within this report confirm that the existing system's capacity, particularly within the Factory Shops Boulevard R.O.W. (e.g. from manholes FS-2 through FS-5 and upstream, and including the existing inlet to the east of manhole FS-2 proposed to be replaced as inlet IN-X) is exceeded in the proposed model similar to as in the existing model.

In the event of inlet or system failure, calculations have been performed to determine the capacity of various drive aisle sections through which runoff would pass downstream. As the combination and routing of these emergency flows does not mirror that for the intended capture of 100-year runoff within the proposed drainage system, separate calculations have been performed for various alternatives. Generally, the alternatives start by modeling the failure of immediate onsite inlets and progress to modeling the failure of additional upstream onsite inlets; then to modeling the contribution of upstream offsite basins generally associated with the west side of the Outlets at Castle Rock and ultimately the contribution of offsite upstream basins associated with the east side of the Outlets at Castle Rock as described in the FACTORY SHOPS REPORT. In all cases, the calculations indicate that the analyzed sections have capacity to pass the assumed runoff downstream prior to exceeding the temporary asphalt curb(s) or assumed future vertical curb construction associated with the pad sites.

In addition, the emergency flow calculations have been used to analyze conditions at the various points at which such runoff would pass from the proposed pad lot development downstream to Factory Shops Boulevard (at IN-P1, IN-P7, IN-P10, and the existing inlet serving Basin X3). Emergency flow at IN-P1 would overtop the adjacent curb and be conveyed as surface sheet flow across the downstream landscape area(s) to the Outlet Access Drive and Factory Shops Boulevard. Emergency flow at IN-P7

would also overtop the adjacent curb. To protect the adjacent downstream retaining wall, a concrete apron is to be constructed from the top-back-of-curb to the top-back-of-wall. The toe of the wall is to be protected from overtopping runoff by the installation of armoring. The dissipated runoff would then be conveyed as surface sheet flow across the remaining landscaped slope to Factory Shops Boulevard. Until the pad site(s) associated with Basin P10 are further developed, emergency flow at IN-P10 is calculated at 0.50 cfs. In the event of IN-P10 failure, 100-year event rainfall volume for the associated pad site(s) has been calculated as 901 cf. A berm, to be constructed at the downstream end of Basin P10 above the adjacent retaining wall, in association with pad site overlot grading and temporary conveyance swales, is intended to provide temporary ponding for 1,033 cf until the failure is rectified. Development of the associated pad site(s) will need to confirm protection of the adjacent retaining wall or propose additional improvements to do so. Emergency flow at the existing inlet serving Basin X3 would also overtop the adjacent curb and be conveyed as surface sheet flow across the downstream landscape area(s) to Factory Shops Boulevard as is the existing condition, albeit with additional runoff contributed from the proposed development.

The majority of the proposed improvements occur on Lot 1, Block 1, Outlets at Castle Rock Filing No. 1, all of which is private property owned by Craig Realty Group. Therefore, maintenance of the storm sewer system will be the property owner's responsibility. Additional drainage easements are proposed to cover what will be the first structure upstream of the existing public system on adjacent property or the R.O.W. Water quality enhancement control measures serving the site are regional. Maintenance and operation of these measures are outside the scope of this report. Maintenance of the storm sewer system described within this report could include annual inspections and inspections after major storm events of the inlets, manholes, and pipes comprising the system. Routine maintenance may include removal of debris which could diminish the system's capacity. Non-routine maintenance may include structural repair of the same.

Supporting calculations, tables, figures, and exhibits are included in the attachments to this letter.

Conclusions

The proposed improvements are not anticipated to impact on-site nor off-site major drainage basin characteristics. Neither are the proposed improvements anticipated to significantly impact existing drainage patterns or paths. Three existing on-site inlets (existing IN-1, IN-2, and IN-3) are to be relocated or replaced (proposed IN-P1 through IN-P10) to accommodate changes to the pad lot. All are intended to capture and convey runoff to the storm sewer system in Factory Shops Boulevard which should function in its historic manner. Subsequently, associated existing storm sewer systems are not anticipated to require capacity in addition to what they currently convey. The town has requested the submittal of a Technical Criteria Variance Application regarding the SDDTCM Section 9.8.3 – Hydraulic Evaluation of Storm Sewers in the Major Storm Event, to address the existing (and therefore requisite proposed) hydraulic grade line condition of the existing public storm sewer system being less than a minimum of 1-foot below the final grade in Factory Shops Boulevard. Storage facilities and permanent, post construction, structural stormwater quality enhancement control measures are provided downstream in the Lowe's South Detention Pond described above. Final development of the pad sites, including improvements such as additional inlets and storm sewer systems associated with the building construction as necessary, are to be designed and constructed by future tenants. Therefore, the

proposed improvements associated with the development of the subject site as described herein are intended to effectively manage, and to properly convey, store, and treat stormwater.

If you have any questions; please contact me by email or phone at jay@sterlingdesignassociates.com or (303) 794-4727 ext. 203.

Craig Realty Group hereby certifies that the drainage facilities for the Outlets at Castle Rock – Pads B & C shall be constructed according to the design presented in this letter. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed and/or certified by my engineer and that the Town of Castle Rock reviews drainage plans pursuant to the Municipal Code; but cannot, on behalf of the Outlets at Castle Rock – Pads B & C, guarantee that final drainage design review will absolve Craig Realty Group and/or their successors and/or assigns of future liability for improper design.

Craig Realty Group

Name of Developer

Patrick Wentland

Authorized Signature

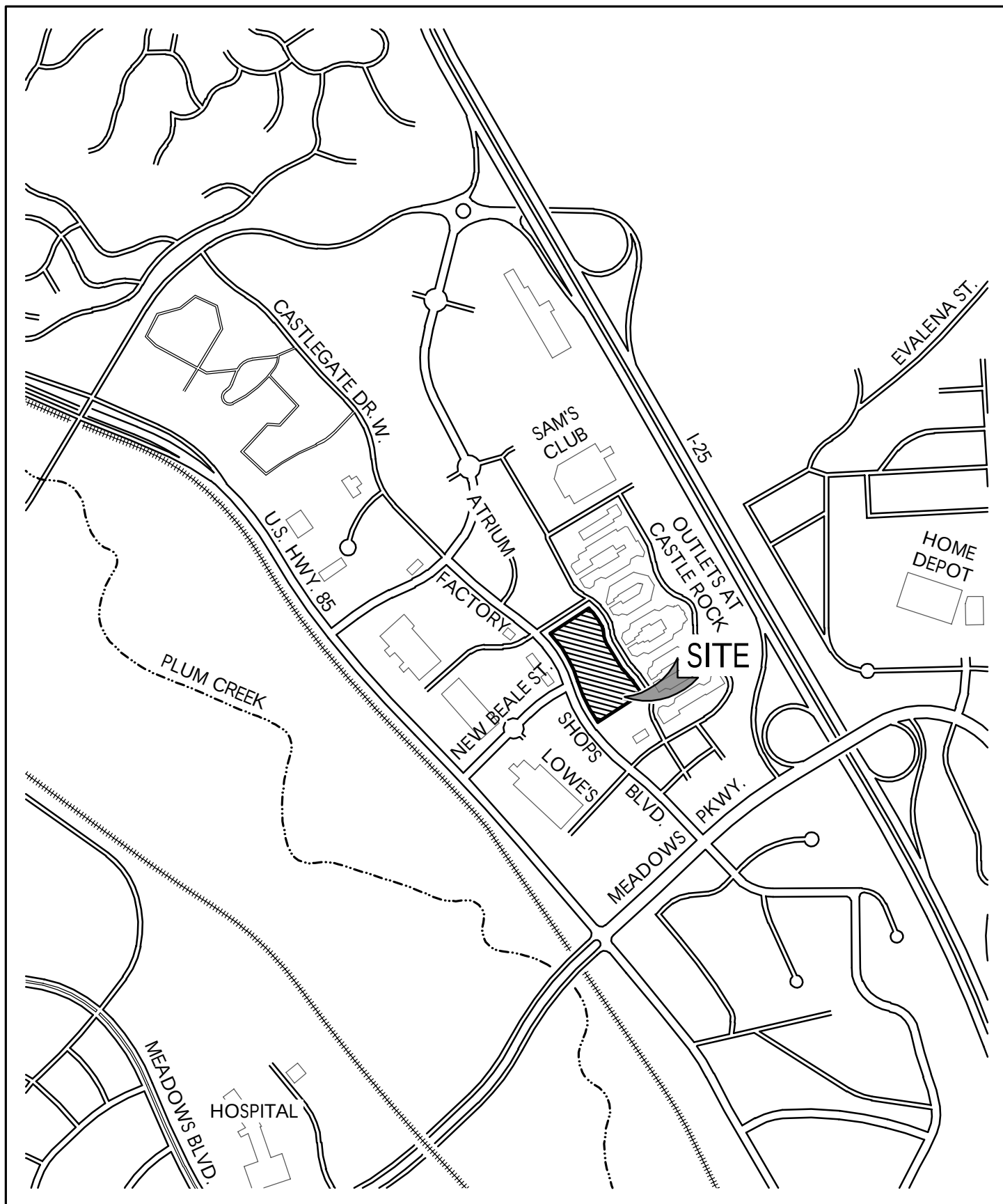
I affirm that this report and plan for the Phase III drainage design of the Outlets at Castle Rock – Pads B & C was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria as described herein for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.



1 / 2 / 25

Registered Professional Engineer
State of Colorado No. 35219

ATTACHMENTS



VICINITY MAP
LOT 1, BLOCK 1, OUTLETS AT CASTLE ROCK FIL. NO. 1



SCALE: 1" = 1,000'
DATE: 9/17/2021

NRCS SOIL MAP

Hydrologic Soil Group—Castle Rock Area, Colorado



Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	7.1	77.3%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	B	2.1	22.7%
Totals for Area of Interest			9.1	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.

FEMA FIRM

National Flood Hazard Layer FIRMette



39°25'11.58"N

104°52'53.49"W



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

1:6,000

Feet

2,000

1,500

1,000

500

0

Legend

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

Without Base Flood Elevation (BFE)
Zone A, V, A99

With BFE or Depth
Zone AE, AO, AH, VE, AR

Regulatory Floodway

SPECIAL FLOOD HAZARD AREAS

0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
Zone X

Future Conditions 1% Annual Chance Flood Hazard
Zone X

Area with Reduced Flood Risk due to Levee, See Notes, Zone X

Area with Flood Risk due to Levee
Zone D

OTHER AREAS OF FLOOD HAZARD

NO SCREEN

Effective LOMRs

Area of Minimal Flood Hazard
Zone X

Area of Undetermined Flood Hazard
Zone D

OTHER AREAS

GENERAL STRUCTURES

Channel, Culvert, or Storm Sewer

Levee, Dike, or Floodwall

Cross Sections with 1% Annual Chance

Water Surface Elevation

Coastal Transect

Base Flood Elevation Line (BFE)

Limit of Study

Jurisdiction Boundary

Coastal Transect Baseline

Profile Baseline

Hydrographic Feature

OTHER FEATURES

Digital Data Available

No Digital Data Available

Unmapped

MAP PANELS

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/7/2019 at 5:29:27 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

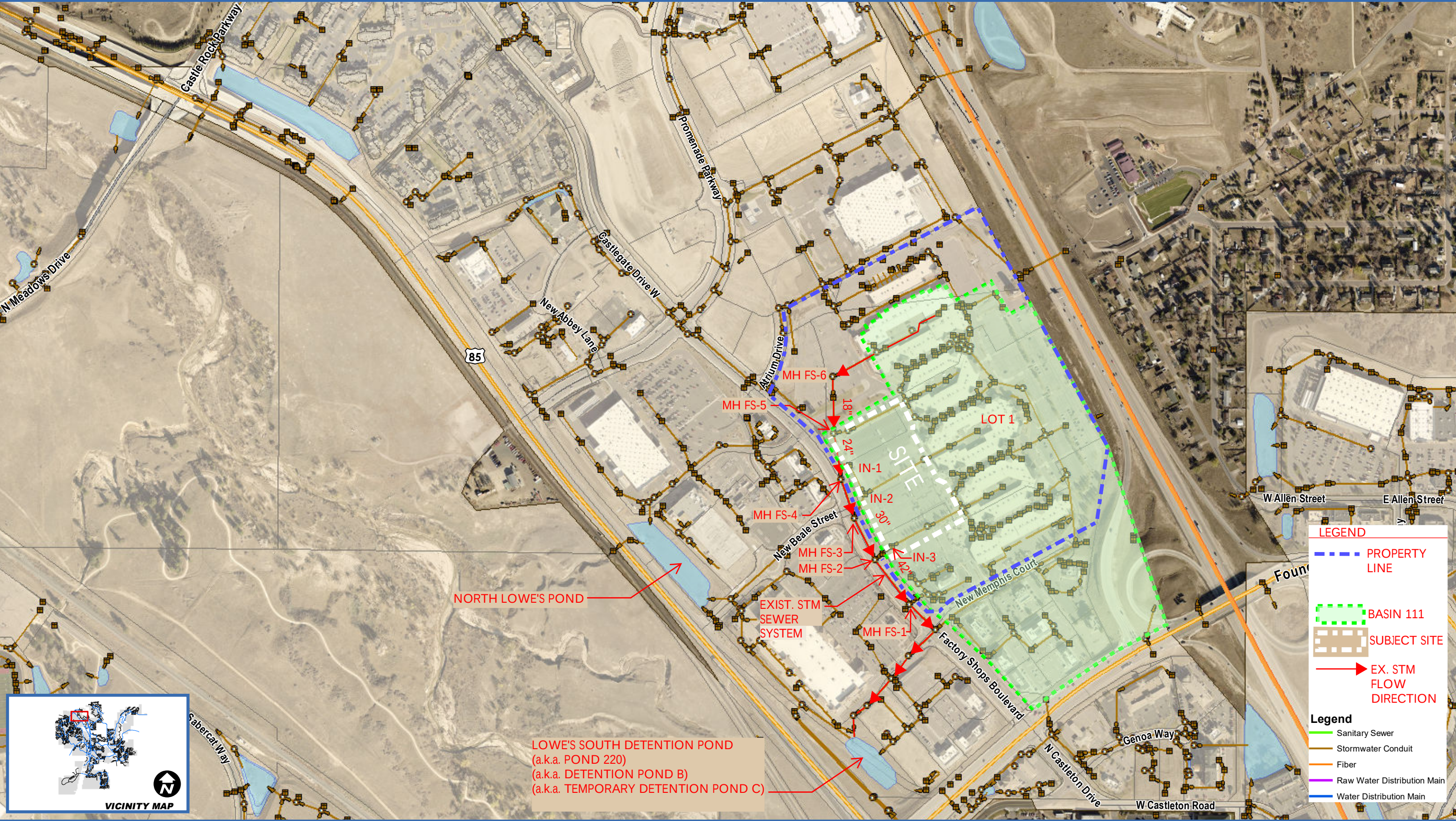
104°52'16.04"W

39°24'43.78"N

TOWN OF CASTLE ROCK UTILITY MAP 1
November 15, 2019

(a.k.a. ToCR MAP 1)

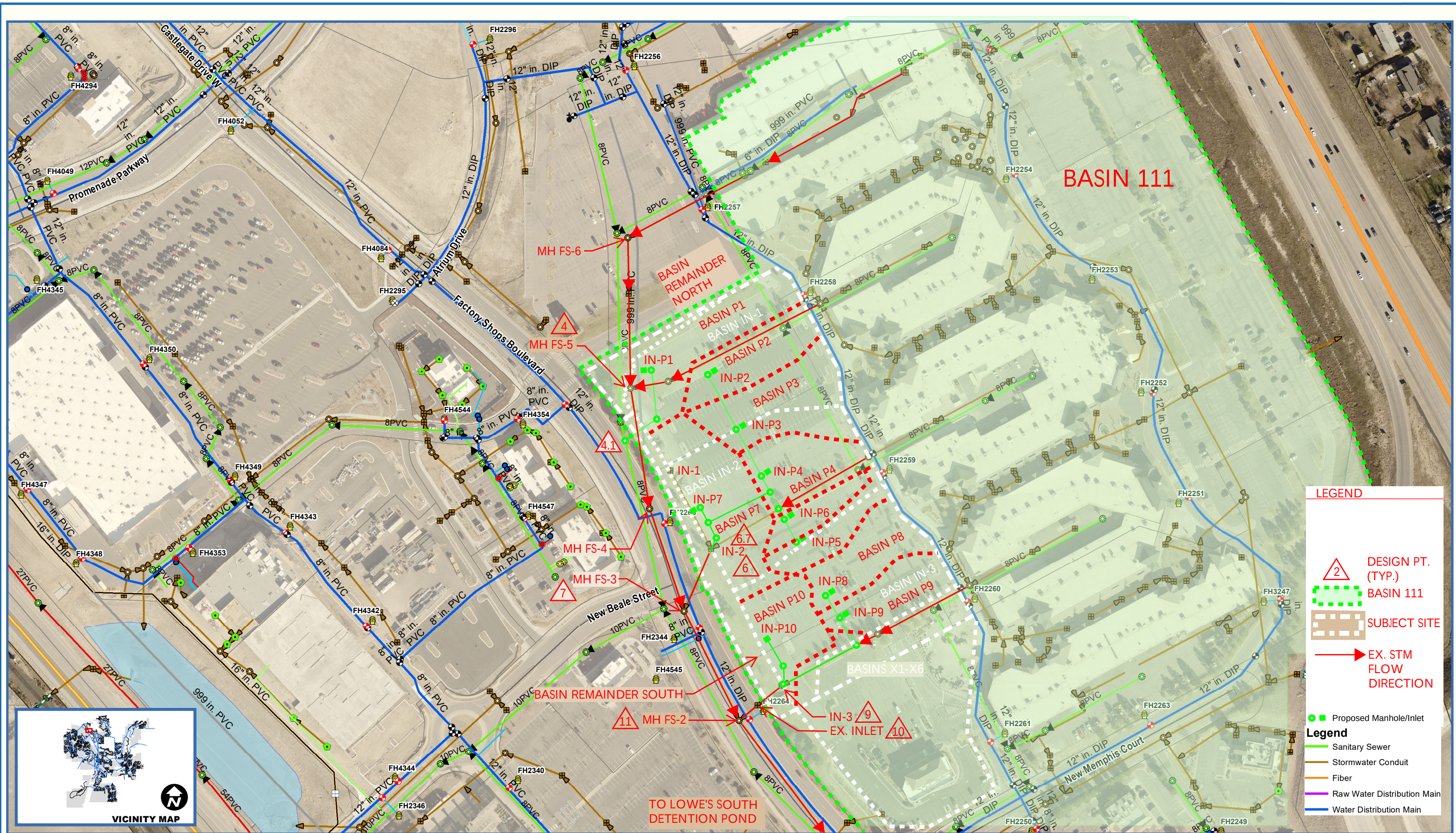
Town of Castle Rock - Map 1



TOWN OF CASTLE ROCK UTILITY MAP 2
September 6, 2019

(a.k.a. ToCR MAP 2)

Town of Castle Rock - Map 2



PHASE III DRAINAGE REPORT, CASTLE PINES COMMERCIAL FILING 10A, PART 2 –
LOWE'S DETENTION PONDS (EAST PLUM CREEK TRIBUTARIES B2 & C PONDS)
August 20, 2007

(a.k.a. LOWE'S REPORT)

PHASE III DRAINAGE REPORT

**Castle Pines Commercial Filing 10A
Part 2 - Lowe's Detention Ponds
(East Plum Creek Tributaries B2 & C Ponds)**

Prepared for:

**Dev-Vic, LLC
858 Happy Canyon Road, Suite 200
Castle Rock, Colorado 80108
(303) 688-6300
(303) 688-6985 Fax**

Prepared by:

**Civil Design Group, Inc.
2300 15th St., Suite 400
Denver, Colorado 80202
(303) 431-0505**

August 20, 2007

IA.

GENERAL LOCATION

- 1) Castle Pines Commerical, Filing No. 10A contains 27.6 acres.
- 2) The project is located in Section 27, Township 7 South, Range 67 West of the 6th p.m., Town of Castle Rock, Douglas County Colorado (See Vicinity Map in the Appendix A).
- 3) The project is located at the northeast corner of Meadows Parkway and U.S. Highway 85.
- 4) The Castle Rock Factory Outlet Shops are located east of the site, while undeveloped parcels within the Castle Pines Commercial development lie to the north. Existing commercial and industrial development is located southeast of Meadows Parkway. The land west of U.S. Highway 85 is currently undeveloped.

IB.

DESCRIPTION OF PROPERTY

- 1) Ground cover consists of native grasses. The Lowe's building, utilities, and parking lot are currently under construction.
- 2) FEMA FIRM Panels 08035C0186F and 08035C0167F delineates a floodplain on the site for Tributary C to East Plum Creek. This floodplain is an approximate Zone A floodplain without base flood elevations and encompasses the previous Factory Outlet Shops' detention pond. There are no irrigation facilities on the property.
- 3) This report presents the final design of stormwater detention for the under construction Lowe's home improvement store. The South Detention Pond is designed to detain for south half of the Lowe's development, the existing tributary Factory Outlet Shops, and the future development of the currently vacant portions of Filing No. 10A bound by Lowe's, Factory Shops Boulevard, Meadows Parkway, and U.S. Highway 85 (approximately 17 acres). The North detention Pond is designed to detain for the north half of the Lowe's development, as well as, the development of the currently vacant portions of Filings No. 10A and 10C bound by Lowe's, Factory Shops Boulevard, Atrium Circle and Drive, and U.S. Highway 85.

II.

DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

- 1) The site is located between Tributaries B2 and C of the East Plum Creek major drainage basin. FEMA FIRM Panels 08035C0186F and 08035C0167F delineates a floodplain on the site for Tributary C. This floodplain is an approximate Zone A floodplain without base flood elevations and encompasses the previous Factory Outlet Shops' detention pond. Following the construction of the South Detention Pond, a LOMR application will be submitted to FEMA to update the Zone A

floodplain (South Detention Pond's 100-year water surface limits). There are no irrigation facilities on the property.

- 2) Tributary's C's drainage basin has experienced a large amount of development during the past two decades. TST, Inc. of Denver prepared Phase III Drainage Report - Castle Pines Commercial Filing No. 10A – Part 1 (August 9, 2006) which designed Lowe's Interim (Temporary) South Detention Pond. This report presented a detailed and comprehensive analysis of the off-site and on-site flows which drain to the area proposed for Lowe's South Detention Pond (Tributary C). The off-site flows originate from a 200 acre basin east of U.S. Interstate 25 (I-25 Basin), the 70 acres Factory Shops basin, and a 200 acre basin southeast of Meadows Parkway. A storm sewer collects the flows from the I-25 and Factory Shops basins and discharges to the South Detention Pond. The aforementioned Part 1 report prepared a SWMM drainage analysis for the flows along this storm sewer. The hydrograph from the Part 1 report was input into the updated SWMM analysis for the final design of the South Detention Pond as presented in this Part 2 report. Excerpts from the Part 1 report are presented in Appendix A of this Part 2 report. Additionally, the Part 1 report approximated the 100-year flows from the 200 acre Meadows Parkway Basin to be 400 cfs. These flows are conveyed to the site by 3 – 48" RCP culverts under Meadows Parkway. The 400 cfs flow was based upon culvert capacity analysis which limited the headwater on the three culverts to one foot below the finish floor elevation of the existing buildings in the southeast corner of Meadows Parkway and U.S. 85 (per Town of Castle Rock direction). The project proposes to divert the Meadows Parkway basin's flows around the South Detention Pond by extending the three existing 48" culverts under Meadows Parkway to the existing U.S. 85, 10' x 6' box culvert located immediately west of Lowe's.
- 3) TST's aforementioned Part 1, Phase III Drainage report for the Interim South Detention Pond identified the area soils to be primarily hydrologic soil group designation C (See Appendix A).

B. Sub-Basin Description

- 1) Three sub-basins (B1, B2, and B3) have been designated for the design of Lowe's North Detention Pond. The North Detention Pond is currently designed to detain for Lowe's basin B1 and the future development of the undeveloped basin B2 (34 acres), but has additional volume to detain for basin B3 if it regraded to drain to the pond. This would require a future modification to the outlet structure. A composite imperviousness of 80% was projected for the two basins. As basins B2 and B3 are developed, the North Detention Pond's tributary area and imperviousness needs to be reevaluated. The South Detention Pond is designed to detain for the future development of the vacant portions of Filing No. 10A (Basin 113), as well as, the Lowe's and the existing Factory Outlet Shops. This 17.2 acre basin includes the South Detention Pond, and therefore, only 10.5 acres can be developed in the future with an estimated imperviousness of 90%. This results in a composite basin imperviousness of 55%.

- 2) As previously mentioned, the site is impacted by large quantities of off-site flows. The off-site flows originate from a 200 acre basin east of U.S. Interstate 25 (I-25 Basin), the 70 acres Factory Shops basin, and a 200 acre basin southeast of Meadows Parkway.

III. DRAINAGE DESIGN CRITERIA:

A. Regulations

The Town of Castle Rock Storm Drainage Design and Technical Criteria Manual (SDD&TC) is used as the basis for the drainage facility design for this project. The UD & FCD Manual was used to supplement the town's regulations. Applicable charts and figures from these manuals are enclosed in this report.

B. Development Criteria Reference and Constraints

- 1) TST, Inc. of Denver prepared Phase III Drainage Report - Castle Pines Commercial Filing No. 10A – Part 1 (August 9, 2006) which designed Lowe's Interim (Temporary) South Detention Pond. This report presented a detailed and comprehensive analysis of the off-site and on-site flows which drain to the area proposed for Lowe's South Detention Pond as discussed previously in the "Major Basin Description" section of this report. The off-site flows originate from a 200 acre basin east of U.S. Interstate 25 (I-25 Basin), the 70 acres Factory Shops basin, and a 200 acre basin southeast of Meadows Parkway. The I-25 and factory shops basins are conveyed to the South Detention Pond by an existing storm sewer, while the project proposes to divert the Meadows Parkway basin's flows around the South Detention Pond by extending the three existing 48" culverts under Meadows Parkway to the existing U.S. 85, 10' x 6' box culvert. Additionally, the **Part 1 report specified the required water quality volume for the South Detention Pond** to be 4.5 acre-feet.
- 2) The previous drainage studies for the adjacent developments do not negatively affect the drainage design presented in this report.
- 3) Besides the large quantity of off-site stormwater flows, site constraints do not have a large influence upon the drainage design for the site.

C. Hydrological Criteria:

- 1) The design rainfall was developed from Chapter 4 of the SDD&TC.
- 2) Runoff flow rates are based upon a SWMM computer analysis.
- 3) The South Detention Pond was designed using a SWMM analysis with an assumption that the pond's water quality volume is full at the start of the storm. TST's aforementioned Part 1 report, identified the existing 10 and 100-year flows from the I-25 Basin to be 73 cfs and 284 cfs, respectively. The Part 1 analysis did consider the upstream detention at Home Depot and Conoco. The tributary basin from the Factory Shops and Filing No.



LEGEND

SUBBASIN BOUNDARY
--- EXISTING CONDITION
--- DESIGN CONDITION

100
74.4
ac

SUBBASIN ID
SUBBASIN AREA

16
CONVEYANCE ELEMENT ID

10
SWMM NODE ID

420
DETENTION POND

EXISTING AND DESIGN
SUBBASIN CHANGES
AC2 DC-DEV
TB-TC (4.4 ac.)

AC - NON-CONTRIBUTING AREA
AC - ADDITIONAL CONTRIBUTING AREA
DEV - CHANGE DUE TO DEVELOPMENT
DC - CHANGE DUE TO INCREASED DETAIL IN TOPO
DC - DESIGN CONDITION
T - TRIBUTARY (SHOWN: TO - TRIBUTARY ID
AREA IN PARENTNESS)

AERIAL PHOTO: NAIP 2005 Imagery
NOTE: TRIBUTARIES DIGITIZED FROM AERIAL PHOTO

CASTLE PINES COMMERCIAL FILING 10A – PART I (LOWE'S INTERIM POND)
PHASE III DRAINAGE REPORT
August 9, 2006

(a.k.a. INTERIM REPORT)

Castle Pines Commercial Filing 10A – Part 1
(Lowe's Interim Pond)

PHASE III DRAINAGE REPORT

PREPARED FOR

Dev-Vic LLC

August 9, 2006

BY:

TST INC. OF DENVER, CONSULTING ENGINEERS
9222 TEDDY LANE
LONE TREE, CO 80124

PROJECT NO. 771-039



TST

INTRODUCTION

This document is Part 1 of the Phase III Drainage Report for Castle Pines Commercial Filing 10A in the Town of Castle Rock, Douglas County, Colorado. The purpose of this report is to estimate anticipated storm water runoff quantities, recommend specific solutions for onsite and off-site drainage resulting from development, and identify necessary improvements to safely route storm water runoff to adequate outfall facilities to allow for early grading and earthwork associated with the construction of Lowe's on Lot 1.

LOCATION

Castle Pines Commercial Filing 10A is approximately 27.59 acres located in Section 27, Township 7 South, Range 67 West of the 6th Principal Meridian, Castle Rock, Douglas County, Colorado. The area of study includes Filing 10A and upstream basins in addition to public roads adjacent to the filings totaling 61.8 acres. It is bounded by Castlegate Drive West to the north, Prime Outlet Factory Shops to the east, Meadows Parkway to the south, and Highway 85 to the west (see Vicinity Map, in Appendix A). Castle Pines Commercial Filing 10A is composed of six commercial lots.

EXISTING BASIN DESCRIPTION

The site generally drains from east to west across the parcel. There is an off-site contribution to the improvements from Meadows Parkway and from the Factory Shops to the east. There are known 100-year floodplains within the project limits per the published maps and the *Castle Rock Factor Shops LOMR-Tributary B* produced by Anderson Consulting Engineers from the Federal Emergency Management Agency (FEMA). The Castle Rock Factory Shops LOMR removes the 100-year floodplain from all improvements within Atrium Drive.

The existing drainage improvements on the site include those associated with the existing factory shops and the expansion of the factory shops: a 72" RCP storm sewer, an outfall energy dissipation structure, Detention Pond B, and an outlet structure, and 10' x 6' RCB under Highway 85.

The soils vary from quartz and granite cobble, cobbly sandy loam to Fondis and Kutch clay loam, have medium to rapid runoff, and have slight to moderate erosion hazard. Soils included on site are Bresser Sandy Loam (BrB), Blakeland-Orsa association (Bo), Newlin gravelly sandy loam (NeE), Sampson loam (Sa), and Sandy alluvial land (Sd). From the SCS Soils Classification Map, it is indicated that this area is primarily hydrological soil group designation C.

PROPOSED DEVELOPMENT

The proposed development will include simulating the general drainage concept of regional detention for the existing Detention Pond B by relocating this pond further south and adding a defined water quality volume to this pond. This is required before any improvements can be made on Castle Pines Commercial Filing 10A.

1. Overlot grading and storm sewer conveyance of all flows, on and off-site.
2. Drainage swales with capacities to route the 5-year and 100-year events as required.

DISCUSSION

The following portion of this report addresses the results of the study and overall drainage plan. Please refer to the calculation sheets and exhibits for actual sizes and flows. The calculations shown in Appendix B are summary in nature, using spreadsheets that use accepted engineering equations to calculate the result of a given set of the above-mentioned parameters.

Drainage System

The proposed drainage system provides conveyance for the 100-year (major) storm event for all of the developed on-site contributions (see Exhibit in Appendix F). The majority of flows will be directed to proposed and existing inlets and routed to existing detention ponds via proposed and existing storm pipe and existing storm swales.

Basins

Design Point 1 collects developed flows from upstream basins in an existing 72" RCP storm sewer. At Design Point 1 a 10-foot by 15-foot junction box is proposed. From this point downstream, the existing 72" storm sewer will be removed and a 6-foot by 10-foot reinforced box culvert shall be installed, following the same alignment. This will require the removal of the existing energy dissipater in the existing detention pond.

Design Point 2 collects on-site flows from parking lots within Castle Pines Commercial Filing 10A. Preliminary calculations for these flows have been used for this analysis and shall be confirmed with the on-site Phase III Drainage Report for each lot to be developed. Flows from Design Point 2 enter the 6-foot by 10-foot RBC and continue downstream to the temporary detention pond at Design Point 5.

Design Point 3 collects on-site flows from parking lots within Castle Pines Commercial Filing 10A. Preliminary calculations for these flows have been used for this analysis and

shall be confirmed with the on-site Phase III Drainage Report for each lot to be developed. Flows from Design Point 3 enter the 6-foot by 10-foot RBC and continue downstream to the temporary detention pond at Design Point 5.

Design Point 4 collects on-site flows from parking lots within Castle Pines Commercial Filing 10A. Preliminary calculations for these flows have been used for this analysis and shall be confirmed with the on-site Phase III Drainage Report for each lot to be developed. Flows from Design Point 4 enter the 6-foot by 10-foot RBC and continue downstream to the temporary detention pond at Design Point 5.

Design Point 5 is outfall to the temporary detention pond and includes flows from Design Point 1 through Design Point 4. Rip rap will be placed at this Design Point 5 to mitigate any erosion from occurring.

Design Point 6 is the water quality outlet structure for the temporary pond and is designed to the ultimate configuration. Flows enter the structure at defined rates set by the Urban Drainage Flood Control District into a proposed 24" RCP storm sewer and enter an improved open channel which conveys flows to an existing 6-foot by 10-foot reinforced box culvert at Design Point 9.

Design Point 7 is the 10-year and 100-year weir release for the temporary detention pond. Design of this weir system will release events at the defined rates into the improved open channel.

Design Point 8 collects flows from upstream basins considered to be Tributary C1. Calculations for these flows can be found in Appendix C. Flows are conveyed downstream via an improved trapezoidal open channel with a 5' bottom width and 3:1 maximum side slopes to an existing 6-foot by 10-foot reinforced box culvert at Design Point 9.

Design Point 9 collects flows from all of the upstream design points noted in an existing 6-foot by 10-foot reinforced box culvert. Capacity calculations for the box culvert can be found in Appendix C.

Detention

The detention requirements for all basins have been included in the temporary detention pond proposed with water quality. From the existing approved report, there is no clear delineation of volumes attributed to each basin, only to overall performance of the regional system as defined from the Drainage Report. The proposed total design volume available at the temporary pond is V_{100} of 10.6 acre-feet. This includes 4.5 acre-feet of water quality volume. This volume was calculated accounting for developed flows of the basins reported in this report in addition to all upstream basins. The assumed imperviousness for all of the basins

was based on previously approved drainage reports and field verification, with primarily commercial usage. The release rates will be maintained with the additional developed flows. Calculations for the sizing and volumes of the outlet grate and orifices can be found in Appendix D. An overflow weir is proposed on the western side of the detention pond adjacent to Highway 85. The design and size of the overflow weir is based on the calculated historic release rates for Tributary C for the 10-year and 100-year events.

The temporary detention pond C discharges into an improved open channel running parallel to Highway 85. The flows are then discharged into an existing 6-foot by 10-foot reinforced box culvert under Highway 85 and railroad tracks and enter an unimproved arroyo channel that discharges directly into East Plum Creek. With the proposed improvements, the detention pond volume will be relocated as well as a new outlet structure and 36" outlet pipe that will convey water quality flows to the improved open channel. In the larger events (10-year and 100-year), a weir structure will release flows to historic rates.

The existing detention pond B located within Lot 1 of Castle Pines Commercial Filing 10A is proposed to be removed including the existing outfall structure, trickle channel, and outlet structure. The volume of detention storage lost with the removal of this pond will be allocated to the temporary Pond C. Flows that were discharged into Pond B will now be conveyed south to Pond C. The existing detention Pond B had a design volume of 10.6 acre-feet and a release rate of 319 cfs during the 100-year event.

Erosion Control

The erosion control required for this site will include structural erosion control measures. These following measures, as a minimum, will be in place prior to any construction activity to properly control the sediment:

- 1) The entire lower perimeter of the site shall have silt fence installed before grading of the site occurs. Periodic maintenance will be necessary to remove sediment build-up along this perimeter. This fence must remain in place for the duration of all construction activities.
- 2) Dust control during the construction shall include the use of water, snow fences, and other barriers to help minimize any movement of dust. These measures will be monitored by the contractors and Town's field representative.
- 3) All areas that have been graded but are not scheduled for immediate development have been re-seeded using the Town-approved specifications. Any areas not taking hold will need to be re-seeded again per Town standards.

APPENDIX B

HYDROLOGY

**CASTLE PINES COMMERCIAL FILING 10A – PART 1,
PHASE III DRAINAGE REPORT:
LOWES SITE - HYDROLOGY**

Submitted To:

***Town of Castle Rock
Utilities Department
175 Kellogg Court
Castle Rock, CO 80109***

Prepared For:

***TST Inc. of Denver
9222 Teddy Lane
Lone Tree, CO 80124***

Prepared By:

***Anderson Consulting Engineers, Inc.
772 Whalers Way, Suite 200
Fort Collins, CO 80525
(ACE Project No. COTST74)***



August 8, 2006

Table 1. Hydrologic Modeling Subbasin Parameters.

Subbasin No.	Basin Width (ft)	Basin Area (acres)	Percent Impervious	Average Basin Slope (ft/ft)	Manning's Roughness		Depression Storage (inches)		Infiltration Rates (in/hr)		Horton's Decay Rate
					Impervious	Pervious	Impervious	Pervious	Initial	Final	
HISTORIC CONDITION											
101	17,840	204.8	2.0	0.290	0.020	0.400	0.1	0.35	3.0	0.5	0.0018
103	6,930	79.5	2.0	0.036	0.020	0.200	0.1	0.35	4.2	0.6	0.0018
EXISTING CONDITION											
110	11,890	136.5	5.0	0.290	0.020	0.400	0.1	0.35	3.0	0.5	0.0018
111	30,510	70.0	80.0	0.040	0.020	0.200	0.1	0.35	4.0	0.6	0.0018
112	1,230	14.1	14.0	0.045	0.020	0.200	0.1	0.35	4.5	0.6	0.0018
113	1,590	18.3	24.0	0.040	0.020	0.200	0.1	0.35	4.5	0.6	0.0018
120	6,740	46.4	27.0	0.040	0.020	0.200	0.1	0.35	3.0	0.5	0.0018
121	7,380	17.0	2.0	0.107	0.020	0.400	0.1	0.35	3.0	0.5	0.0018
122	2,240	2.6	80.0	0.045	0.020	0.200	0.1	0.35	3.0	0.5	0.0018
123	2,850	3.3	80.0	0.045	0.020	0.200	0.1	0.35	3.0	0.5	0.0018
124	2,460	5.7	10.0	0.090	0.020	0.200	0.1	0.35	3.0	0.5	0.0018
125	2,070	4.7	50.0	0.050	0.020	0.200	0.1	0.35	3.0	0.5	0.0018
DESIGN CONDITION											
113	1,500	17.2	24.0	0.040	0.020	0.200	0.1	0.35	4.5	0.6	0.0018
116	6,990	8.0	90.0	0.025	0.020	0.200	0.1	0.35	4.5	0.6	0.0018

APPENDIX D

DETENTION

DETENTION POND VOLUMES
CASTLE PINES COMMERCIAL TEMPORARY DETENTION POND C

Elevation	Area (sf)	Volume (cf)	Total Volume (cf)	Total Volume (ac-ft)
6057.75	-	603	603	0.0
6058	4,823	38,378	38,981	0.9
6060	33,555	97,870	136,851	3.1
6062	64,315	164,502	301,353	6.9
6064	100,187	237,502	538,855	12.4
6066	137,315	142,240	681,095	15.6
6067	147,164	149,975	831,070	19.1
6068	152,786			

	CF	AC-FT
Vol Req (WQ)=	196020	4.5
Vol Req (100-YR)=	461736	10.6
Vol Required (TOTAL)=	657756	15.1
100-Year WSE	=	6067.70
Provided 100-Year Volume	=	780,160 CF
		17.9 AC-FT
WQ WSE	=	6062.72
WQ Volume	=	196,020 CF
		4.5 AC-FT

Note: The provided 100-year detention volume is greater than the required volume due to the necessity to create a headwater condition to diverge flows into the open channel which has a large tailwater condition.

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 1 of 3

Designer: Taylor C. Goertz, P.E.
 Company: TST Inc. of Denver
 Date: August 1, 2006
 Project: Castle Pines Commercial Filing 10A-Part 1
 Location: Castle Rock, CO

<p>1. Basin Storage Volume</p> <p>A) Tributary Area's Imperviousness Ratio ($I = I_a / 100$)</p> <p>B) Contributing Watershed Area (Area)</p> <p>C) Water Quality Capture Volume (WQCV) $(WQCV = 1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I))$</p> <p>D) Design Volume: $Vol = (WQCV / 12) * Area * 1.2$</p>	<p>$I_a = \underline{95.00} \%$ $i = \underline{0.95}$</p> <p>Area = <u>100.60</u> acres</p> <p>WQCV = <u>0.45</u> watershed inches</p> <p>Vol = <u>4.4992</u> acre-feet</p>
<p>2. Outlet Works</p> <p>A) Outlet Type (Check One)</p> <p>B) Depth at Outlet Above Lowest Perforation (H)</p> <p>C) Recommended Maximum Outlet Area per Row, (A_o)</p> <p>D) Perforation Dimensions: i) Circular Perforation Diameter or ii) 2" Height Rectangular Perforation Width</p> <p>E) Number of Columns (nc, See Table 6a-1 For Maximum)</p> <p>F) Actual Design Outlet Area per Row (A_o)</p> <p>G) Number of Rows (nr)</p> <p>H) Total Outlet Area (A_{ot})</p>	<p>☒ Orifice Plate ☐ Perforated Riser Pipe ☐ Other: _____</p> <hr/> <p>H = <u>2.75</u> feet</p> <p>$A_o = \underline{6.2}$ square inches</p> <p>D = <u>2.000</u> inches W = _____ inches</p> <p>$nc = \underline{2}$ number</p> <p>$A_o = \underline{6.3}$ square inches</p> <p>$nr = \underline{8}$ number</p> <p>$A_{ot} = \underline{51.8}$ square inches</p>
<p>3. Trash Rack</p> <p>A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$</p> <p>B) Type of Outlet Opening (Check One)</p> <p>C) For 2", or Smaller, <u>Round Opening</u> (Ref.: Figure 6a):</p> <p>i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1</p> <p>ii) Height of Trash Rack Screen (H_{TR})</p>	<p>$A_t = \underline{1.557}$ square inches</p> <p>☒ <u>< 2" Diameter Round</u> ☐ <u>2" High Rectangular</u> ☐ Other: _____</p> <hr/> <p>$W_{conc} = \underline{48}$ inches</p> <p>$H_{TR} = \underline{63}$ inches</p>

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 2 of 3

Designer:	Taylor C. Goertz, P.E.
Company:	TST Inc. of Denver
Date:	August 1, 2006
Project:	Castle Pines Commercial Filing 10A-Part 1
Location:	Castle Rock, CO

<p>iii) Type of Screen (Based on Depth H), Describe if "Other"</p> <p>iv) Screen Opening Slot Dimension, Describe if "Other"</p> <p>v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)</p> <p>vi) Type and Size of Holding Frame (Ref.: Table 6a-2)</p> <p>D) For 2" High Rectangular Opening (Refer to Figure 6b):</p> <p>i) Width of Rectangular Opening (W)</p> <p>ii) Width of Perforated Plate Opening ($W_{conc} = W + 12"$)</p> <p>iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1</p> <p>iv) Height of Trash Rack Screen (H_{TR})</p> <p>v) Type of Screen (based on depth H) (Describe if "Other")</p> <p>vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"</p> <p>vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6b-2) (Based on depth of WQCV surcharge)</p>	<p>S.S. #93 VEE Wire (US Filter) Other: _____</p> <p>0.139" (US Filter) Other: _____</p> <p>_____ inches</p> <p>_____ inches</p> <p>W = _____ inches</p> <p>$W_{conc} =$ _____ inches</p> <p>$W_{opening} =$ _____ inches</p> <p>$H_{TR} =$ _____ inches</p> <p>Klemp™ KPP Series Aluminum Other: _____</p> <p>_____ inches Other: _____</p> <p>_____ inches</p>
<p>4. Detention Basin length to width ratio</p>	<p>_____ 0.75 (L/W)</p>
<p>5 Pre-sedimentation Forebay Basin - Enter design values</p> <p>A) Volume (no less than 5% of Design Volume from 1D)</p> <p>B) Surface Area</p> <p>C) Connector Pipe Diameter (Size to drain this volume in 5-minutes under inlet control)</p> <p>D) Paved/Hard Bottom and Sides</p>	<p>_____ acre-feet</p> <p>_____ acres</p> <p>_____ inches</p> <p>_____ yes/no</p>

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 3 of 3

Designer: Taylor C. Goertz, P.E.

Company: TST Inc. of Denver

Date: August 1, 2006

Project: Castle Pines Commercial Filing 10A-Part 1

Location: Castle Rock, CO

6. Two-Stage Design - See Figure EDB-1

A) Top Stage (Depth $D_{WQ} = 2'$ Minimum)

$D_{WQ} =$ _____ feet
Storage = _____ acre-feet

B) Bottom Stage Depth ($D_{BS} = 1.0'$ Minimum, $2.0'$ Maximum)

Bottom Stage Storage (no less than 3% of Design Volume (0.13497590025 acre-feet.))

$D_{BS} =$ _____ feet
Storage = _____ acre-feet
Surf. Area = _____ acres

C) Micro Pool (Minimum Depth = the Larger of
0.5 * Top Stage Depth or 2.5 Feet)

Depth = _____ feet
Storage = _____ acre-feet
Surf. Area = _____ acres

D) Total Volume: $Vol_{tot} =$ Storage from 5A + 6A + 6B
(Must be > Design Volume in 1D, or 4.499196675 acre-feet.)

$Vol_{tot} =$ _____ acre-feet

7. Basin Side Slopes (Z, horizontal distance per unit vertical)
Minimum Z = 4, Flatter Preferred

Z = _____ (horizontal/vertical)

8. Dam Embankment Side Slopes (Z, horizontal distance)
per unit vertical) Minimum Z = 3, Flatter Preferred

Z = _____ (horizontal/vertical)

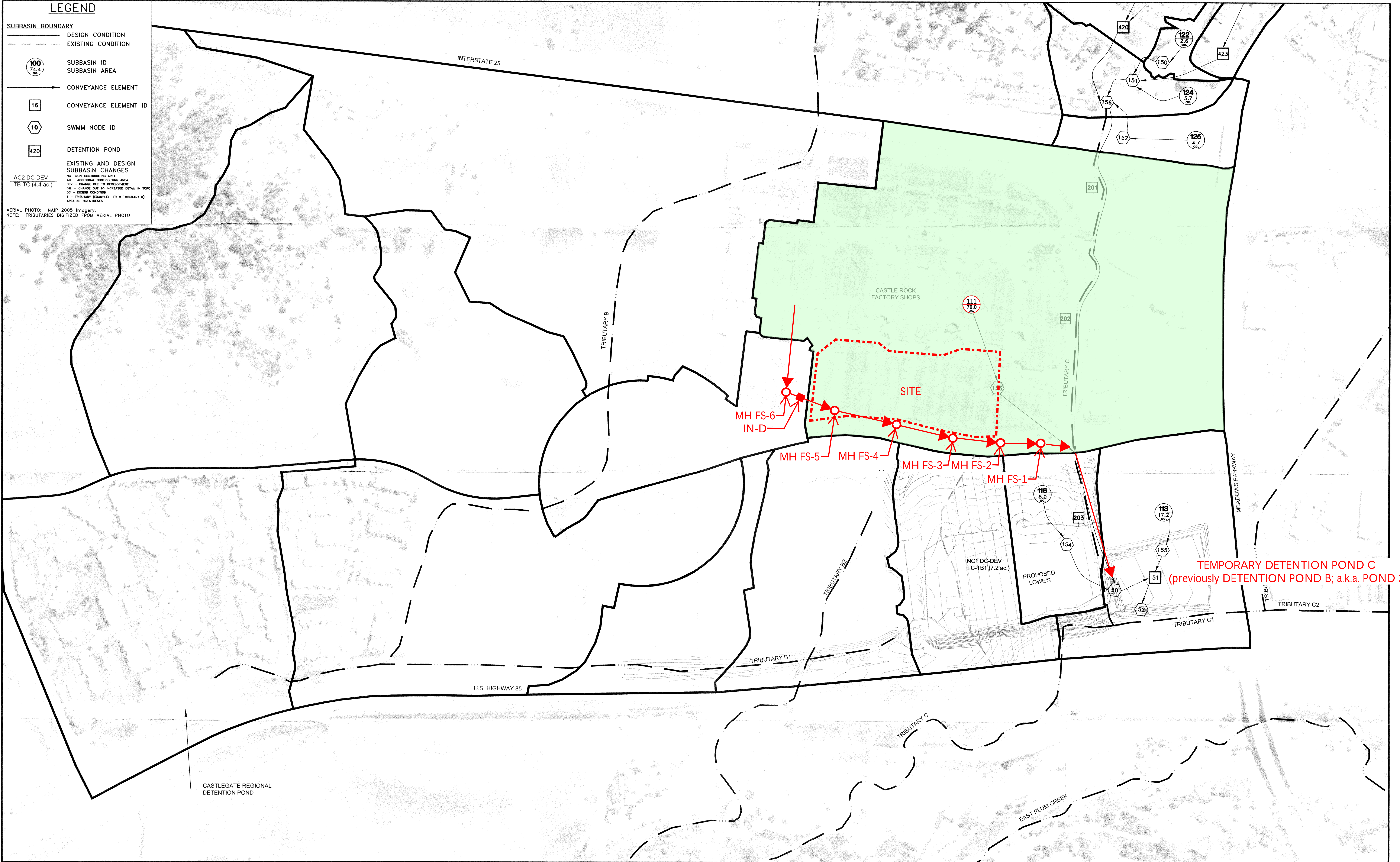
9. Vegetation (Check the method or describe "Other")

_____ Native Grass
_____ Irrigated Turf Grass
_____ Other: _____

Notes:

APPENDIX F

PHASE III DRAINAGE EXHIBIT



LEGEND

SUBBASIN BOUNDARY
--- DESIGN CONDITION
--- EXISTING CONDITION

100
74.4 ac.
SUBBASIN ID
SUBBASIN AREA

16
CONVEYANCE ELEMENT ID

10
SWMM NODE ID

420
DETENTION POND

EXISTING AND DESIGN SUBBASIN CHANGES
AC2 DC-DEV
TB-TC (4.4 ac.)
NC1 DC-DEV
TC-TB1 (7.2 ac.)
DEV - CHANGE DUE TO DEVELOPMENT
DTL - CHANGE DUE TO INCREASED DETAIL IN TOPO
DC - DESIGN CONDITION
T - TRIBUTARY (EXAMPLE: TB = TRIBUTARY B)
AREA IN PARENTHESES

AERIAL PHOTO: NAIP 2005 Imagery.
NOTE: TRIBUTARIES DIGITIZED FROM AERIAL PHOTO

REVISIONS:
REV1
REV2
REV3
REV4
REV5
REV6

CONTOUR INTERVAL
2 FEET

ORIGINAL SCALE: 1"=200'

0 100 200 400

PROJECT NUMBER: COTST74	DRAWN BY: DSL
ACAD FILE: HISTORIC CONDITION MAP	DESIGNED BY: BLV
DATE: 08/08/2006	CHECKED BY: BLV / CJP

 **Anderson Consulting Engineers, Inc.**
Civil • Water Resources • Environmental
772 Whalers Way, Suite 100, Fort Collins, CO 80526
Phone: (970) 226-0120 / Fax: (970) 226-0121

CASTLE PINES COMMERCIAL FILING 10A - PART 1
PHASE III DRAINAGE REPORT - HYDROLOGY

DESIGN CONDITION
SUBBASIN AND CONVEYANCE ELEMENT MAP

CASTLE PINES COMMERCIAL P.D., CASTLE ROCK, COLORADO, MASTER
DRAINAGE REPORT
February 10, 1995

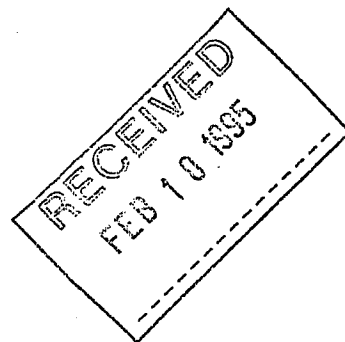
(a.k.a. MASTER REPORT)

1234

1
2
3
4

CASTLE PINES COMMERCIAL P.D.
CASTLE ROCK, COLORADO

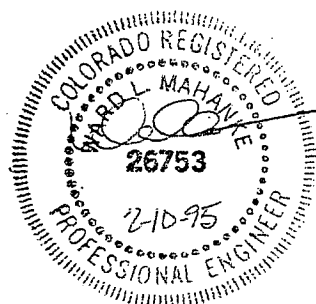
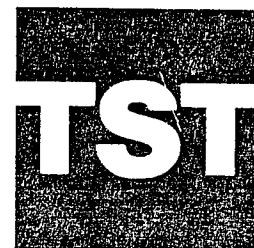
**MASTER DRAINAGE
REPORT**



PREPARED FOR
DEV-VIC LTD. LIABILITY CO.
FEBRUARY 10, 1995

BY:
TST INC. OF DENVER, CONSULTING ENGINEERS
102 INVERNESS TERRACE EAST, SUITE 105
ENGLEWOOD, CO 80112
(303) 792-0557

PROJECT NO. 40-771-001



INTRODUCTION

The Castle Pines Commercial P.D. ("PD") is a parcel of approximately 450 acres located within the northern limits of the Town of Castle Rock, Colorado ("Town"). It is generally bounded by Interstate 25 to the east, U.S. Highway 85 to the west, Meadows Parkway to the south, and the Castle Pines development to the north. It is a planned development which is currently zoned for commercial and office use. A revised PD has been submitted to the Town to change the parcel layout and to include a residential area in the northern portion of the parcel. Currently, the only improvements on the parcel are those associated with the Castle Rock Factory Shops. The general location of the project is shown on Figure 1.

The development has a divided ownership, with the Dev-Vic Ltd. Liability Co. owning the southern two-thirds of the property and CCRT & Co. owning the remainder. This report was authorized by and prepared for Dev-Vic Ltd. Liability Co.

Described in this report are the results of an investigation of the proposed hydrologic conditions for the site. The background information and assumptions, including all of the modeling parameters, have been taken from the *Master Drainage Study for Castle Rock Business Park ("Study")*, TST Inc., October 1991 and further discussed and refined in the *Preliminary Drainage Report for Castle Pines Commercial P.D.*, TST Inc. of Denver, July 7, 1994. This master study is culmination of the review of the above-mentioned documents and comments from the Town of Castle Rock.

EXISTING SITE DESCRIPTION

The PD site generally drains from east to west across the site. There is a substantial off-site contributing area upstream of the site. This flow is deposited onto the site in several eastern locations in the form of culverts that cross under Interstate 25. Well-defined channels are evident downstream of these culverts. The flows that come from off-site and on-site locations are then conveyed under Highway 85 by one of five culverts. These culverts have comparable crossings under the adjacent railroad, and after a relatively short side-channel, flows reach East Plum Creek. The known 100-year floodplains within the property were defined by the Federal Emergency Management Agency (FEMA) and subsequently revised by a Letter of Map Revision (LOMR) prepared by Rocky Mountain Consultants, Inc.

The drainage improvements on the site consist of the parking lot and building drainage, storm inlets and piping, an outfall energy dissipation structure, detention pond, and outlet control structure that is associated with the development of the Factory Shops.

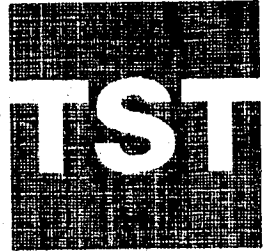
MASTER DRAINAGE STUDY FOR CASTLE PINES COMMERCIAL AMENDED
December 1991

(a.k.a. MASTER STUDY)

656

MASTER DRAINAGE STUDY

For



**CASTLE PINES
COMMERCIAL AMENDED**

**Prepared For
CASTLE PINES HOLDINGS, INC.**

**OCTOBER 1991
REVISED
DECEMBER 1991**

**TST, Inc.
CONSULTING
ENGINEERS**

SECTION I. INTRODUCTION

A. Background

The Castle Pines Commercial Amended development project is located at the northern edge of the Town of Castle Rock limits (see Vicinity Map, Figure 1). The area will be accessed via Highway 85 along the project's southwestern boundaries, and from I-25 at the Silver Heights interchange off Meadows Parkway

A Master Drainage Study for the Castle Pines Commercial site was prepared in January 1987 by TST, Consulting Engineers. This revised report was necessitated by a change in the master plan to allow primarily for the inclusion of a factory outlet mall. Road alignments and usage information changed as a result of the mall inclusion. Castle Pines Holdings, Inc. has become the owner of a portion of the original development, that portion being generally the southern two-thirds of the development lying on the south side of Interstate 25. This revised report addresses primarily this property, although the additional property to the north has been included for completeness.

The proposed "integrated business" development area encompasses approximately 400 acres. The area presently receives off-site drainage flows from the east side of I-25, at a number of culvert crossings as shown on the Historic Drainage Basin Map (Figure 2).

This report will present the results of an investigation into both the existing and proposed hydrologic conditions for the Castle Pines Holdings site. The drainage analysis for the maximum probable development conditions has been based upon the land use projections used in the Felsburg, Holt and Ullevig traffic study. The property on the east side of I-25 which was included in the 1987 study has not been included as there is no known change in the use. For information on that property, refer to the 1987 study. A comparison of the developed-condition results with the pre-development (historic) system response is provided for the 100-year event, for critical locations throughout the development area.

The majority of the site will drain toward Highway 85, from a ridge line along I-25. Runoff from the site will then pass through culverts beneath Highway 85 and contribute to flows in East Plum Creek.

This report is intended to evaluate the site in connection with the most intense probable development. Actual design and sizing of drainage facilities will be accomplished in conjunction with development of parcels and roads at the time they are developed.

B. Scope of Work

The areas of emphasis investigated as part of this study are:

1. A hydrologic analysis, including the computations of storm hydrographs at locations throughout the development area.

2. Evaluation of detention pond locations and sizing.
3. Calculation of existing culvert capacity under Highway 85 at the points of discharge.

SECTION III. DRAINAGE DESIGN

A. Scope of Design

The drainage design specified for the Castle Pines Commercial Amended area includes preliminary estimate of storm system dimensions and detention pond volumes and release rates. Each of these design items are covered in detail in this chapter.

A map illustration of the proposed storm system is presented as Figure 3.

B. Storm Sewer Sizing and Location

At each location within the proposed development area shown on the project Master Plan where concentrated runoff flows will intersect a major roadway, an assumed culvert crossing has been sized to accommodate the 100-year flow release rates based upon fully developed conditions.

The estimate of cross culvert sizing has been performed using the Manning's equation for pipe flow, under presumed slope conditions. Final storm sewer sizing will be performed when the road design is undertaken. Results of this sizing along with estimated open channel sizes are included in Table VI.

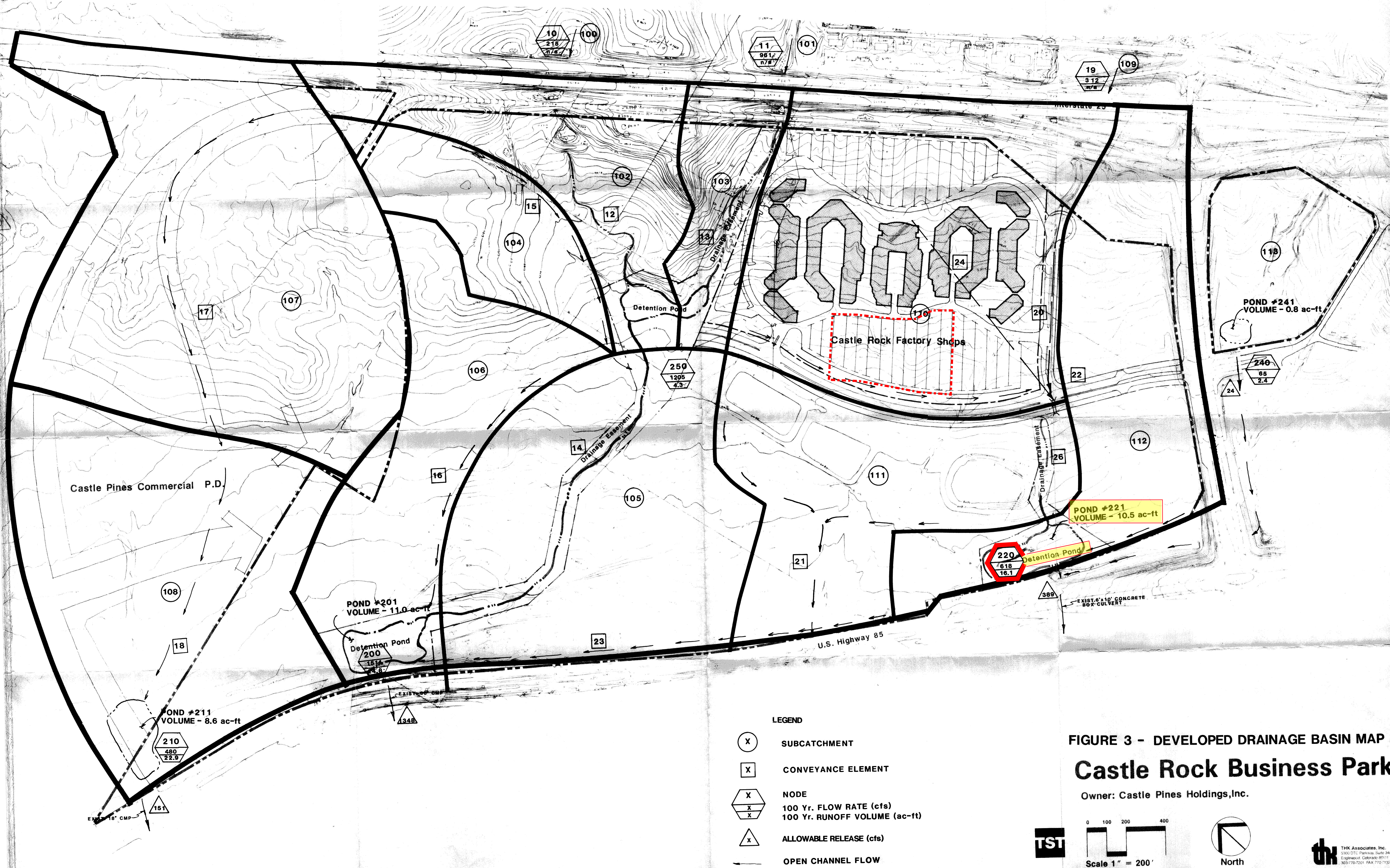
For the purposes of this report, it has been assumed that no storm sewer other than conveyance element numbers 20 and 24 will be installed. It is recognized that future development areas may want to put some of these flows into conduits, however the extent and location of those is not currently known. This document therefore recommends that as the parcels are developed the Phase III report identify the method of drainage and propose methods to keep it within the flow and routing assumptions of this study. This may necessitate some additional detention within development sites.

C. Detention Pond Design

Three major detention pond facilities are anticipated within the project area, for the purposes of reducing major storm peak flow rates. One additional minor detention pond will be provided within the parcel south of Meadows Parkway.

The preliminary sizing of these detention areas has been accomplished by measurement of the required storage volume indicated at an assumed release rate, as illustrated in Figures 5 and 6. Inflow and outflow hydrograph peaks for each of the six ponds are reproduced in Table V.

TABLE V Detention Pond Inflow and Release Rates			
Pond	Peak Inflow (cfs)	Peak Release (cfs)	Detention Volume (ac-ft)
201	1514	1348	11.0
211	480	151	8.6
221	618	389	10.5
241	65	24	0.8



LEGEND

- X SUBCATCHMENT
- X CONVEYANCE ELEMENT
- X
X
X NODE
100 Yr. FLOW RATE (cfs)
100 Yr. RUNOFF VOLUME (ac-ft)
- X ALLOWABLE RELEASE (cfs)
- OPEN CHANNEL FLOW

FIGURE 3 - DEVELOPED DRAINAGE BASIN MAP
Castle Rock Business Park
 Owner: Castle Pines Holdings, Inc.

TST

Scale 1" = 200'

0 100 200 400

North

THK Associates, Inc.
 5300 DTC Parkway, Suite 340
 Englewood, Colorado 80111
 303-770-7201 FAX 770-7132

FINAL DRAINAGE REPORT FOR CASTLE ROCK FACTORY SHOPS
March 1992

(a.k.a. FACTORY SHOPS REPORT)

#654

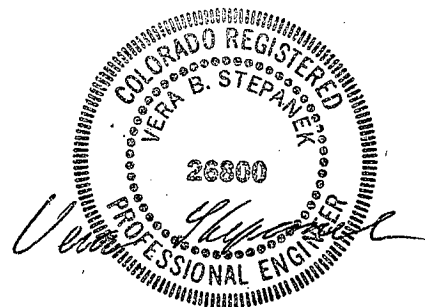
Final Drainage Report
for
CASTLE ROCK FACTORY SHOPS

Prepared for:

CASTLE PINES HOLDINGS, INC.
c/o Colorado National Bank
950 17th Street, Suite 2240
Denver, Colorado 80202

Prepared by:

ROCKY MOUNTAIN CONSULTANTS, INC.
8301 East Prentice Avenue
Englewood, Colorado 80111



RMC Job No. 1811.001.02
February 1992
Revised March 1992

Approved:
Daniel W. Bane II
4-1-92

The Master Drainage Study identified the subject site as basin 110. The offsite flows entering the site originate in area designated as a basin 109. Conveyances 20 and 26 modeled an existing drainageway "C", described further. Detention Pond was labeled No. 220.

The site's historic basin lies between two right bank tributaries to East Plum Creek as outlined on the Flood Insurance Rate Map (FIRM - Reference 5). One of these tributaries, drainageway "A", follows the site's northerly boundary and flows east to west. The drainageway lies entirely off-site and its designated preliminary floodplain does not encroach within the site boundary. The second of these tributaries, drainageway "C", enters the site at its southeast corner and crosses the site in a westerly direction. Both of the drainageways cross Highway 85 through culverts and join East Plum Creek approximately 1/2 mile west of Highway 85.

2. Scope of Study and Design Criteria

This study addresses three aspects of the development:

1) A drainage system design for the Castle Rock Factory Shops retail center.

2) Conveyance of the historic drainageway "C" peak flows through the developed area.

3) A design of the offsite detention pond facilities.

3. Design Criteria

This report was prepared pursuant to the Town of Castle Rock drainage design criteria (Reference 3) and the Urban Storm Drainage Criteria Manual (Reference 4).

The Rational Method was used for determining on-site developed runoff rates and subsequent sizing of inlets and storm sewers. The minor storm was based upon a two-year storm frequency, and the major storm was based upon a one hundred-year storm frequency.

The drainageway "C" peak flows, detention volumes and release rates, were determined in the Master Drainage Study (Reference 2), using computer modeling of the area hydrology. In order to incorporate the project site in the computer model, the Colorado Urban Hydrograph Procedure (CUHP) and Storm Water Management Model (SWMM) were used. This allowed the development of on-site hydrographs which would confirm the flows' routing through the proposed facilities such as storm sewers and a pond.

The drainage system will provide carrying capacity to keep the 2-year and 100-year storm flows below 6 inches at the crown or flowline of the median curb. Wherever the hydraulic grade line for 2-year storm exceeded the top of a pipe, R-4 sealant joints were used in the sewer design.

The storm sewer hydraulic grade lines were calculated using the Hydroflow computer program. Hydroflow uses the energy equation, with friction loss computation based on Manning's Formula.

C. DRAINAGE FACILITY DESIGN

1. On-Site Drainage System

The proposed storm drain facilities will intercept the on-site and off-site runoff for 100-year storm frequency, and convey it to a detention pond 220 (Reference 3) to be constructed on the east side of Highway 85.

Discharge from the site's east parking area is collected at the low points and is conveyed by a storm sewer to the main storm sewer in New Memphis Court. Discharge from the site's west and north parking areas is collected at inlets and routed to a second branch of storm sewer in Factory Shops Boulevard. Both storm sewer lines will outfall to a detention pond just west of Factory Shops Boulevard.

2. Relocation of Drainageway "C"

The peak flows for the natural drainageway "C" relocation were based on a 100-year storm frequency. A proposed 60" diameter storm sewer will replace the natural drainage channel along the south boundary of the site. At the southeast corner of the site, a concrete inlet structure,

6. Emergency Provisions

The inlets and storm sewers in the east parking lot were designed to accommodate the runoff from the 100-year storm event. An emergency route for storm water in the event of a blockage of the inlets, storm sewer or a greater than 100-year event was designed between the buildings. Should any of these conditions occur the storm water would overtop the high point and flow on the landscaped passageway and safely pass to Factory Shops Boulevard without inundating any finished floors.

7. Development Phasing

The site's development is planned to progress in three construction phases. Phase I includes the development of 20.2 acres of Lot 1, access roads and private drives and all utilities serving Lot 1.

The project's drainage system is designed for the ultimate development and will also serve the partially undeveloped site. The erosion control plan that will be prepared for Phase I construction, will provide protection for areas prone to erosion due to the phased nature of the development. Temporary seeding of areas exposed by rough grading of the site and a sedimentation pond will control erosion prior to site's ultimate development.

D. CONCLUSION

The revised routing of the natural drainageway "C" channel flow will not adversely affect the adjacent properties. The alteration to the drainageway floodplain, discussed in this report will be supported in a Letter of Map Revision (LOMR) submitted to the Town of Castle Rock. The proposed storm sewer system has adequate capacity to convey the 100-year frequency storm flows. Additionally, the storm sewer outfall into the detention pond has been designed to reduce scour and downstream erosion.

The net effect of the storm drainage system for the proposed Castle Rock Factory Shops will be to maintain developed storm water release rates from the proposed detention facility to historic levels.

The facilities proposed in this report are in compliance with the Town of Castle Rock criteria and the Master Drainage Report.

APPENDIX

DISCHARGE SUMMARY

Design Point	Sub-basin Designation	Contributing Area (Acres)	Minor Storm Discharge	Major Storm Discharge	Note
1	A1	4.8	10.8	33.8	Inlet No. 1
2	01, A2	4.5	8.8	28.3	Inlet No. 2
3	A3	4.3	9.6	30.3	Inlet No. 3
4	01, A1+A3	13.6	27.7	87.1	
5	02	211.2	N/A	312.0	TST Hydrograph 19
6	A4	2.0	4.5	14.1	Inlet No. 4
7	03, A5	3.4	7.4	19.4	Inlet No. 5
8	03, A4+A6	8.5	13.6	37.2	Inlet No. 13
Basin A, Off-site		22.1	N/A	(124.3)	RMC Hydrograph 201
9	B1	5.7	11.6	35.7	Inlet No. 6
10	B2	2.0	5.0	15.7	Inlet No. 7
11	B1, B2	7.7	15.1	46.9	
12	B3	2.7	6.8	21.1	Inlet No. 8
13	B4	4.7	9.9	31.9	Inlet No. 9
14	B1+B4	15.1	28.5	89.4	
15	B5	2.1	5.3	16.5	Inlet No. 10
16	B6	4.1	8.6	26.8	Inlet No. 11
17	B1+B6	21.3	38.8	120.5	
18	B7	2.1	4.4	6.5	Inlet No. 12
19(a)	B8	4.1	8.1	24.2	Inlet No. 13
19	B1+B8	27.7	50.4	156.6	
Basin B		27.7	50.4 N/A	(156.6) 112.0	RMC Hydrograph 202
20	C1, C2, 04	4.1	5.9	18.5	
21	06	14.2	7.7	23.8	
Basin C		18.3	13.4	41.5	Inlet No. 14
Basin A+B+C Offsites 01,03,04,05,06		68.1			

CLIENT: Factory Shops JOB NO.: _____ SHEET _____ OF _____

DESCRIPTION: Hydraulic Grade Line DESIGNED BY: _____ DATE: _____

Outfall - Factory Shops Road CHECKED BY: _____ DATE: _____
- main trunk

Line No.	Q_2 (cfs)	Q_{100} (cfs)	Dia	Street Flow		PA
				$Q_2^{(1)}$	$Q_{100}^{(2)}$	
1	312 *	612	72"	0	0	21
2	55	156	48"	0	0	19
3	39	63	42"	0	57.5	17
4	29	55	30"	0	34.4	14
5	15	28	24"	0	31.9	-
6	15	15	24"	0	31.9	11
7	12	12	18"	0	24.1	-
8	12	12	18"	0	24.1	-
9	12	12	18"	0	24.1	9

* Q_2 estimated as 51% of Q_{100}

1) See Discharge Summary for Q_2

2) $Q_{STREET} = Q_{100} - Q_{PIPE}$

See Drainage Map for Line Nos.

HYDRAULIC GRADE LINE

100yr

JOB DESCR: FACTORY SHOP
 RUN DATE :01-21-1991

See Drainage Map for Line Nos.

STORM SEWER - HYDRAULIC ANALYSIS - FILE: factr2.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
 RETURN PERIOD = 100 YRS

LINE 1 / DFG = 612.0 / HT = 72 / WID = 72 / N = .013 / L = 560 / JLC = .2

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	6068.37	70.48	6062.50	21.76	6075.72	20.70	70.48	28.13
UPSTRM	6079.52	72.00	6070.50	21.65	6086.79	0.00	70.48	28.27

DA = 0 C = 0 Tc = 6.5 INL TM = 0 INT = 9.19 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.429 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFG = 156.0 / HT = 48 / WID = 48 / N = .013 / L = 193.07 / JLC = .5

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	6080.97	48.00	6071.00	12.42	6083.37	0.00	43.92	12.56
UPSTRM	6083.25	48.00	6072.50	12.41	6085.64	0.00	43.92	12.57

DA = 0 C = 0 Tc = 5.3 INL TM = 0 INT = 9.59 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.777 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFG = 63.0 / HT = 42 / WID = 42 / N = .013 / L = 315 / JLC = .3

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	6084.45	42.00	6073.02	6.55	6085.11	0.00	30.21	9.62
UPSTRM	6085.68	42.00	6076.67	6.55	6086.35	0.00	30.21	9.62

DA = 0 C = 0 Tc = 4.2 INL TM = 0 INT = 9.97 TOT CA = 0

JOB DESCR: FACTORY SHOP
RUN DATE :01-21-1991

2yr

STORM SEWER - HYDRAULIC ANALYSIS - FILE: factr2.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = ~~100~~² YRS

LINE 1 / DFQ = 312.0 / HT = 72 / WID = 72 / N = .013 / L = 560 / JLC = .2

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	6068.37	70.49	6062.50	11.08	6070.28	18.97	58.61	28.16
UPSTRM	6075.40	58.75	6070.50	12.63	6077.87	55.79	58.61	24.70

DA = 0 C = 0 Tc = 6.5 INL TM = 0 INT = 9.19 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.429 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 55.0 / HT = 48 / WID = 48 / N = .013 / L = 193.07 / JLC = .5

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	6075.89	48.00	6071.00	4.38	6076.19	0.00	27.09	12.56
UPSTRM	6076.12	43.44	6072.50	4.60	6076.45	28.15	27.09	11.96

DA = 0 C = 0 Tc = 5.3 INL TM = 0 INT = 9.59 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.777 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 39.0 / HT = 42 / WID = 42 / N = .013 / L = 315 / JLC = .3

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	6076.28	39.17	6073.02	4.17	6076.55	20.74	23.71	9.35
UPSTRM	6078.65	23.81	6076.67	6.93	6079.40	41.62	23.71	5.63

DA = 0 C = 0 Tc = 4.2 INL TM = 0 INT = 9.97 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

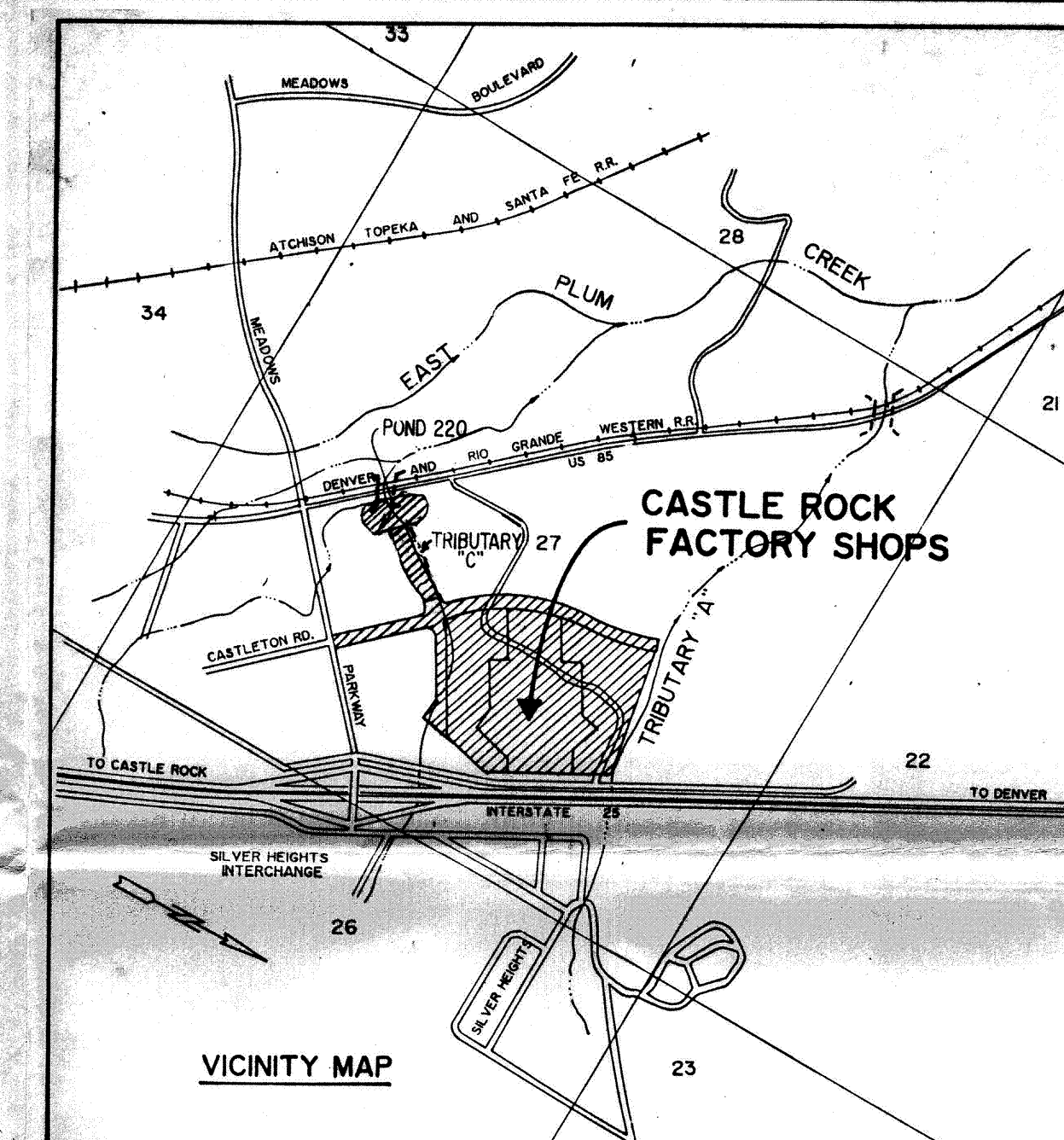
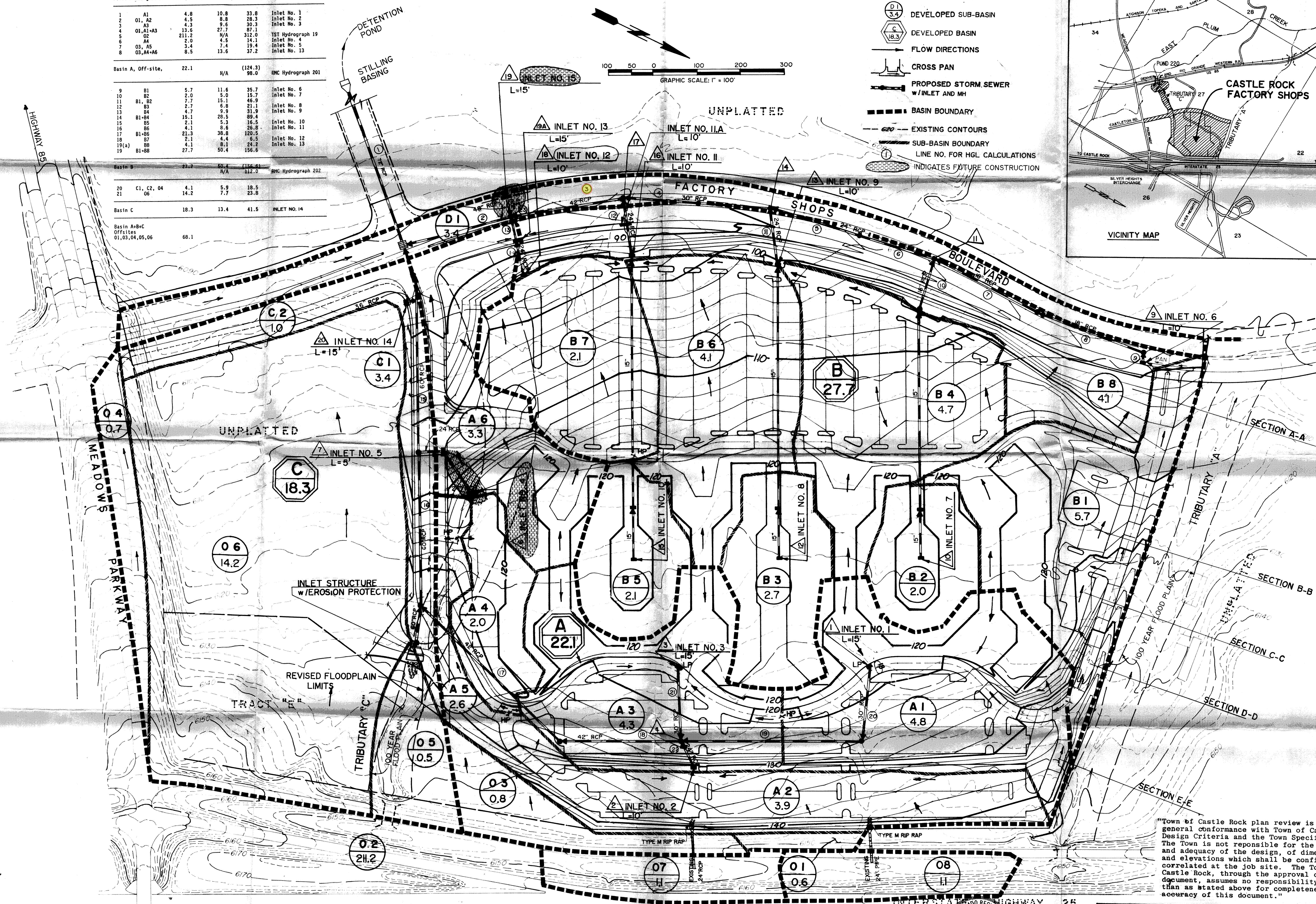
SLOPE OF INVERT = 1.159 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

DISCHARGE SUMMARY

Design Point	Sub-basin Designation	Contributing Area (Acres)	Minor Storm Discharge	Major Storm Discharge	Note
1	A1	4.8	10.8	33.8	Inlet No. 1
2	A1, A2	4.5	8.8	28.3	Inlet No. 2
3	A3	4.3	9.6	30.3	Inlet No. 3
4	O1, A1-A3	13.6	27.7	87.1	TST Hydrograph 19
5	O2	211.2	N/A	312.0	Inlet No. 4
6	A4	2.0	4.5	14.1	Inlet No. 5
7	O3, A5	3.4	7.4	19.4	Inlet No. 6
8	O3, A4-A6	8.5	13.6	37.2	Inlet No. 13
Basin A, Off-site,		22.1	N/A	(124.3)	RMC Hydrograph 201
9	B1	5.7	11.6	35.7	Inlet No. 6
10	B1, B2	5.0	5.0	15.7	Inlet No. 7
11	B2	7.7	15.1	46.9	Inlet No. 8
12	B3	2.7	6.0	21.1	Inlet No. 9
13	B4	4.7	9.9	31.3	Inlet No. 10
14	B1-B4	15.1	28.5	89.4	Inlet No. 11
15	B5	2.1	5.3	16.5	Inlet No. 12
16	B6	4.1	8.6	26.2	Inlet No. 13
17	B1-B6	21.3	38.8	120.5	Inlet No. 14
18	B7	2.1	4.4	6.5	Inlet No. 15
19	B8	4.1	8.1	24.1	Inlet No. 16
19(a)	B1-B8	27.7	50.4	156.6	
Basin B		27.7	50.4	(156.6)	RMC Hydrograph 202
20	C1, C2, O4	4.1	5.9	18.5	
21	O6	14.2	7.7	23.3	
Basin C		18.3	13.4	41.5	Inlet No. 14
Basin A+B+C Offsites		68.1			
01, 03, 04, 05, 06					

LEGEND

- △ DESIGN POINT
- ① DEVELOPED SUB-BASIN
- ② DEVELOPED BASIN
- FLOW DIRECTIONS
- CROSS PAN
- PROPOSED STORM SEWER w/ INLET AND MH
- BASIN BOUNDARY
- EXISTING CONTOURS
- SUB-BASIN BOUNDARY
- LINE NO. FOR HGL CALCULATIONS
- INDICATES FUTURE CONSTRUCTION



"Town of Castle Rock plan review is only for general conformance with Town of Castle Rock Design Criteria and the Town Specifications. The Town is not responsible for the accuracy and adequacy of the design, of dimensions, and elevations which shall be confirmed and correlated at the job site. The Town of Castle Rock, through the approval of this document, assumes no responsibility other than as stated above for completeness and/or accuracy of this document."

PREPARED UNDER THE DIRECT SUPERVISION OF



APPROVED FOR ONE YEAR FROM THIS DATE
 Daniel W. Bax II
 Town Engineer
 Date 4-1-92

ROCKY MOUNTAIN CONSULTANTS
 8301 EAST PRENTICE AVENUE, SUITE 101
 ENGLEWOOD, COLORADO 80111
 (303) 741-6000

RMC

NO.	REVISIONS	DESCRIPTION	DATE BY
1			

CASTLE ROCK FACTORY SHOPS
 FINAL DRAINAGE PLAN

DATE: OCT. 1991
 DESIGNED BY: V.S.
 DRAWN BY: H.H.
 CHECKED BY: L.W.
 JOB NO. 1811-001-01
 SHEET 1 OF 1

CASTLE ROCK FACTORY SHOPS CONSTRUCTION PLANS – AS-BUILT
December 6, 1993

(a.k.a. SOUTH ASBUILT)

CASTLE ROCK FACTORY SHOPS CONSTRUCTION PLANS

PREPARED FOR

THE PRIME GROUP, INC.
36 SOUTH CHARLES STREET, SUITE 2401
BALTIMORE, MARYLAND 21201
PHONE: (301) 234-0782

SHEET INDEX

AS BUILT

DUWAYNE M. PHILLIPS L.S. NO. 9329
FOR AND ON BEHALF OF
ROCKY MOUNTAIN CONSULTANTS, INC.
DATE 12/6/93 FIELD BOOK

CALL UTILITY NOTIFICATION
CENTER OF COLORADO
1-800-922-1987
IN METRO DENVER
534-6700
CALL 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE, OR EXCAVATE
FOR THE MARKING OF UNDERGROUND
MEMBER UTILITIES.

ORIGIN BENCHMARK

U.S.C. AND G.S. BENCHMARK A 355
ELEVATION = 6,047.50

3 1/2" BRASS CAP AT NORTH END OF A CONCRETE HEADWALL, EAST SIDE OF DENVER AND RIO GRANDE WESTERN RAILROAD TRACKS, APPROXIMATELY 3.1 MILES NORTH OF CASTLE ROCK STATION (SEE VICINITY MAP FOR APPROXIMATE LOCATION).

PROJECT BENCHMARK

RMC TBM #95026
ELEVATION = 6,090.55 (U.S.C. AND G.S.)
SOUTHEAST BONNET BOLT ON FIRE HYDRANT AT THE SOUTH SIDE OF MEADOWS PARKWAY AT STATION 340+50, 700 FEET EAST OF CENTERLINE INTERSECTION OF HIGHWAY 85 AND MEADOWS PARKWAY.

THE PLANS ARE REVIEWED FOR CONCEPT ONLY AND THE REVIEW DOES NOT IMPLY RESPONSIBILITY BY THE REVIEWING DEPARTMENT, THE TOWN ENGINEER OR THE TOWN OF CASTLE ROCK FOR ACCURACY AND CORRECTNESS OF CALCULATION. THE REVIEW DOES NOT IMPLY THAT QUANTITIES OF ITEMS INDICATED ON THE PLANS ARE THE FINAL QUANTITIES REQUIRED. THE REVIEW SHALL NOT BE CONSTRUED FOR ANY REASON AS ACCEPTANCE OF FINANCIAL RESPONSIBILITY BY THE TOWN OR REVIEWING DEPARTMENTS FOR ADDITIONAL ITEMS AND ADDITIONAL QUANTITIES OF ITEMS SHOWN THAT MAY BE REQUIRED DURING THE CONSTRUCTION PHASE.

ALL WORK SHALL BE CONSTRUCTED TO THE MOST RECENT TOWN OF CASTLE ROCK STANDARD CONSTRUCTION SPECIFICATIONS.

APPROVED FOR ONE YEAR FROM THIS DATE

Town Engineer

Date

Director of Public Works

Date

Fire Department

Date

DATE MAR. 27 1992

DESIGNED BY

DRAWN BY

CHECKED BY

JOB NO.

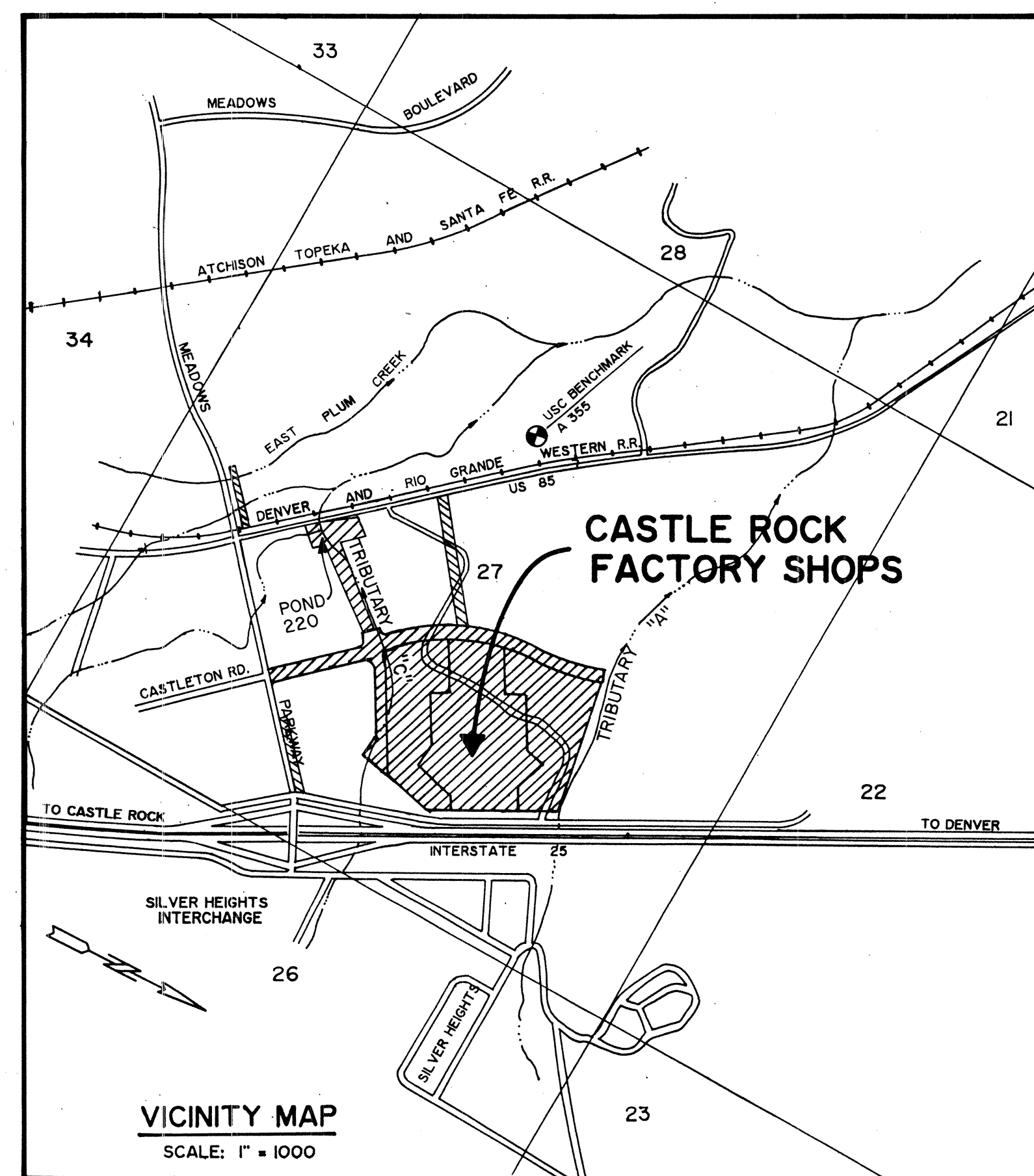
1811-001-02

SHEET

1 OF 46

- REISSUED 6/18/92 WHK

PHAS MA031002
Castle Rock Factory Shops
Phase I - Streets, Utility, Grading
RMC
12/6/93



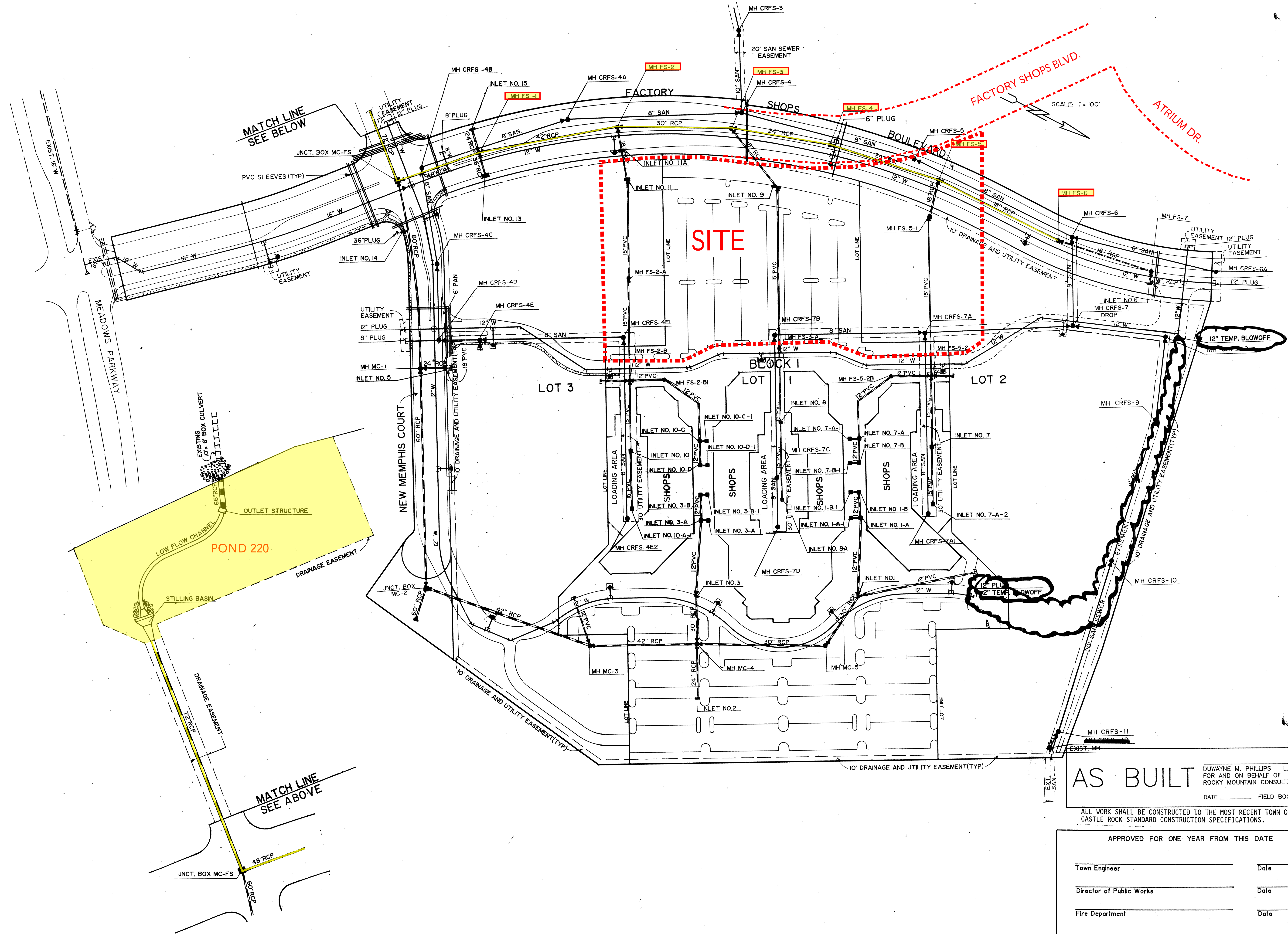
- 1 OF 46 COVER SHEET
- 2 OF 46 GENERAL NOTES
- 3 OF 46 FINAL PLAT
- 4 OF 46 FINAL PLAT
- 5 OF 46 MEADOWS PARKWAY PLAN AND PROFILE
- 6 OF 46 MEADOWS PARKWAY PLAN AND PROFILE
- 7 OF 46 FACTORY SHOPS BOULEVARD PLAN AND PROFILE
- 8 OF 46 FACTORY SHOPS BOULEVARD PLAN AND PROFILE
- 9 OF 46 NEW MEMPHIS COURT PLAN AND PROFILE STREET
- 10 OF 46 STREET DETAILS AND TYPICAL SECTIONS
- 10A OF 46 PAVEMENT PLAN
- 10B OF 46 PARKING PLAN
- 11 OF 46 SIGNING AND STRIPING PLAN
- 12 OF 46 OVERALL UTILITY PLAN
- 13 OF 46 DETENTION POND AND STORM SEWER
- 14 OF 46 STORM SEWER NEW MEMPHIS COURT
- 15 OF 46 STORM SEWER
- 16 OF 46 STORM SEWER FACTORY SHOPS BOULEVARD
- 17 OF 46 STORM SEWER FACTORY SHOPS BOULEVARD
- 18 OF 46 STORM SEWER DETAILS
- 19 OF 46 STORM SEWER DETAILS
- 20 OF 46 STORM SEWER DETAILS
- 21 OF 46 STORM SEWER DETAILS
- 22 OF 46 STORM SEWER DETAILS
- 23 OF 46 SANITARY SEWER OUTFALL LINE
- 24 OF 46 SANITARY SEWER FACTORY SHOPS BOULEVARD

- 25 OF 46 SANITARY SEWER ON-SITE
- 26 OF 46 SANITARY SEWER ON-SITE
- 27 OF 46 SANITARY SEWER ON-SITE
- 28 OF 46 SANITARY SEWER FACTORY SHOPS BOULEVARD
- 29 OF 46 SANITARY SEWER NEW MEMPHIS COURT
- 30 OF 46 SANITARY SEWER ON-SITE
- 31 OF 46 SANITARY SEWER DETAILS
- 31A OF 46 SANITARY SEWER FLOW METER DETAIL
- 32 OF 46 16" WATERLINE MEADOWS PKWY AT PLUM CREEK
- 33 OF 46 16" WATERLINE DETAILS
- 34 OF 46 WATERLINE FACTORY SHOPS BOULEVARD
- 35 OF 46 WATERLINE FACTORY SHOPS BOULEVARD
- 36 OF 46 WATERLINE NEW MEMPHIS COURT
- 37 OF 46 WATERLINE ON-SITE
- 38 OF 46 WATERLINE ON-SITE
- 39 OF 46 WATERLINE DETAILS
- 40 OF 46 DETAIL SHEET AND CURVE DATA TABLE
- 41 OF 46 GRADING PLAN AND HORIZONTAL CONTROL
- 42 OF 46 GRADING PLAN AND HORIZONTAL CONTROL
- 43 OF 46 GRADING PLAN AND HORIZONTAL CONTROL
- 44 OF 46 GRADING PLAN AND HORIZONTAL CONTROL
- 45 OF 46 GRADING PLAN AND HORIZONTAL CONTROL
- 46 OF 46 GRADING PLAN AND HORIZONTAL CONTROL
- 46A OF 46 ROUGH GRADING PLAN (50 SCALE)
- 46B OF 46 ROUGH GRADING PLAN (50 SCALE)
- 46C OF 46 EROSION CONTROL PLAN
- 46D OF 46 EROSION CONTROL PLAN AND DETAIL
- 46E OF 46 DEMOLITION PLAN

PREPARED UNDER THE SUPERVISION

ROCKY MOUNTAIN CONSULTANTS
8301 EAST PRENTICE AVENUE, SUITE 101
ENGLEWOOD, COLORADO 80111
(303) 741-6000

CASTLE ROCK FACTORY SHOPS
CONSTRUCTION PLANS



AS BUILT

DUWAYNE M. PHILLIPS L.S. NO. 9329
 FOR AND ON BEHALF OF
 ROCKY MOUNTAIN CONSULTANTS, INC.
 DATE _____ FIELD BOOK _____

ALL WORK SHALL BE CONSTRUCTED TO THE MOST RECENT TOWN OF CASTLE ROCK STANDARD CONSTRUCTION SPECIFICATIONS.

APPROVED FOR ONE YEAR FROM THIS DATE	
Town Engineer _____	Date _____
Director of Public Works _____	Date _____
Fire Department _____	Date _____

ROCKY MOUNTAIN CONSULTANTS
 8301 EAST PRENTICE AVENUE, SUITE 101
 ENGLEWOOD, COLORADO 80111
 (303) 741-6000

CASTLE ROCK FACTORY SHOPS
OVERALL UTILITY PLAN

NO.	REVISIONS	DESCRIPTION	DATE BY
1	REVISED WATERLINE	6/18/92 MJK	
2	REVISED SANITARY	6/18/92 MJK	

DATE: MAY 21, 1992
 DESIGNED BY: _____
 DRAWN BY: HRH
 CHECKED BY: A.K.

JOB NO.
 1811-001-02
 SHEET
 12 OF 46

LOT 3, BLOCK 1, CASTLE ROCK FACTORY SHOPS,
AMENDMENT 1 - QDOBA-STABUCKS DEVELOPMENT DRAINAGE
CONFORMANCE LETTER

December 3, 2014

(a.k.a. PAD A LETTER)



Sterling Design Associates, LLC

CIVIL ENGINEERS - LANDSCAPE ARCHITECTS

December 3, 2014

Town of Castle Rock
100 North Wilcox Street
Castle Rock, CO 80104

RE: RE: Lot 3, Block 1, Castle Rock Factory Shops, Amendment I- Qdoba-Starbucks Development; Project # CD14-0016 ; Drainage Conformance Letter

Dear Ms. Vargish:

The proposed Qdoba-Starbucks development includes an approximately 5,200 square foot restaurant on a portion of Lot 3, Block I, Castle Rock Factory Shops, Amendment I in Castle Rock, Colorado. Lot 3 is situated in the northeast quarter of Section 27, Township 7 South, Range 67 West of the 6th P.M. in the Town of Castle Rock, State of Colorado. The proposed development will impact approximately 2.1 acres of Lot 3. The site is currently developed with a parking lot that services the existing outlet mall. Drainage systems serving this area have been installed as a part of the surrounding, overall development. Design of these systems is described within the "Final Drainage Report for Castle Rock Factory Shops" prepared by Rocky Mountain Consultants, Inc., dated March 1992 (Factory Shops Report).

The site lies within Subbasins A6 and B7, tributary to Design Point 19A, as described in the Factory Shops Report. The Factory Shops Report indicates that the proposed drainage facilities will, "...intercept the on-site and off-site runoff for 100-year storm frequency, and convey it to a detention pond 220.....to be constructed on the east side of Highway 85." The Final Drainage Plan from the Factory Shops Report, showing the drainage subbasins, has been included with this letter.

Review of the Flood Insurance Rate Maps published by the Federal Emergency Management Agency for Douglas County, Colorado, and Incorporated Areas, Map Number 08035C0186F, dated September 30, 2005; indicates that the subject property lies in Zone "X" (unshaded), "Areas determined to be outside the 0.2% annual chance floodplain." A copy of the FIRM has been included with this letter.

The development will result in an increase of impervious area of 3,796-sf. There are six drainage basins on the site. Site runoff will generally be conveyed as surface flow across building roof, paved drive, and landscape areas to proposed curb and gutter and/or proposed concrete pan. These improvements will convey runoff to proposed on-site inlets throughout the parking lot. After being captured by the inlets, runoff will be conveyed in an underground storm sewer pipe to an existing storm sewer system within Factory Shops Blvd at Design Point 19A.

Capacities for the various storm sewer pipes were determined using Manning's Equation calculations assuming uniform flow. The UDFCD spreadsheet for Street and Inlet Hydraulics was used to analyze the proposed inlet capacity. Storm sewer pipes are designed to convey 100-yr flows assuming free outfall and without surcharging; therefore, hydraulic grade line calculations were not performed.

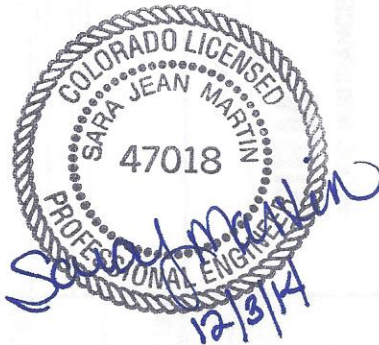
Jay M. Newell, PE
Wayne T. Sterling, RLA, LEED AP

2009 W. Littleton Blvd. #300
Littleton, CO 80120

303.794.4727
www.SterlingDesignAssociates.com

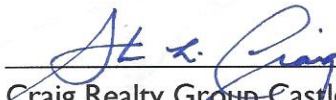
Calculations included with this letter include the existing and developed 100-yr and 2-yr storm event flows for the site development area. The design peak 100-yr flow rate at Design Point 19A is 20.7-cfs, per the Factory Shops Report. In the developed condition, the peak 100-yr flow rate tributary to Design Point 19A is 18.21-cfs. The developed peak 100-yr flow rate at Design Point 19A is less than the design flow rate; therefore the development will have minimal impact on the existing storm drain system.

Sincerely,

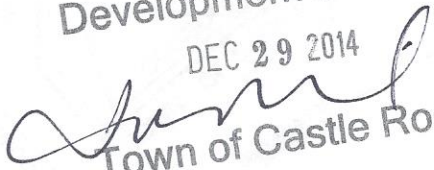


Sara J. Martin, PE
On behalf of
Sterling Design Associates, LLC

This drainage conformance letter is on file at the Town of castle rock and appears to fulfill the applicable Town of castle rock storm drainage criteria, as amended. The requirements of this letter are the obligation of the permittees until such time as the project is properly completed, modified or voided.


Craig Realty Group Castle Rock LLC

12-5-14
Date

Approved
Development Services
DEC 29 2014

Town of Castle Rock

Jay M. Newell, PE
Wayne T. Sterling, RLA, LEED AP

2009 W. Littleton Blvd. #300
Littleton, CO 80120

303.794.4727
www.SterlingDesignAssociates.com

Weighted Runoff Coefficients

Date: 10/20/2014 9:54

Project: Outlets at Castle Rock

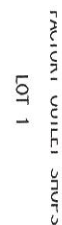
By: SJM

	Frequency				%
	2	5	10	100	Impervious ¹
Roof	0.80	0.85	0.90	0.90	90
Landscape	0.00	0.10	0.20	0.50	0
Pavement	0.87	0.88	0.90	0.93	100

Basin	Roof	Landscape	Pavement	Total	Weighted Runoff Coefficient ²			% Impervious	
					C2	C5	C10	C100	Impervious
B1	0.000	0.079	0.600	0.679	0.70	0.72	0.75	0.82	88%
B2	0.000	0.091	0.700	0.791	0.70	0.73	0.75	0.82	88%
B3	0.000	0.070	0.980	1.050	0.78	0.79	0.82	0.87	93%
B4	0.000	0.003	0.180	0.183	0.86	0.87	0.89	0.93	98%
B5	0.120	0.003	0.138	0.261	0.79	0.81	0.83	0.88	94%
B6	0.000	0.000	0.075	0.075	0.89	0.90	0.92	0.96	100%
Total	0.120	0.246	2.673	3.039					

¹Imperviousness from UDFCD - DCM, Vol. I, Table RO-3

²Weighted Runoff Coefficient from UDFCD - DCM, Vol. I, Table RO-4, Soil Type C



**PROPOSED DRAINAGE BASINS
OUTLETS AT CASTLE ROCK - PAD A
CASTLE ROCK, CO
SCALE: 1"= 100'-0"
DATE: 10/23/14**



CONVEYANCE SYSTEM ANALYSIS AND SIZING TABLE USING THE RATIONAL METHOD

Location		Sub	Area	C	C*A	Sum	Tc	I(R)	Q(R)	Pipe	Typ.	Slope	Q(F)	V	V	L	Tt	% d/D
From	To	Basin Number	(ac)			C*A	(min.)		(c.f.s.)	(in.)	n	(ft.ft.)	(pipe full)	(pipe full)	(at Q(R))	(ft.)	(min.)	
Inlet 1	MH 1	B1	0.68	0.82	0.56	0.56	10.0	7.03	3.91	12	0.014	3.0%	5.75	7.32	7.88	6	0.01	60.50%
MH 1	MH 2		0.00	0.00	0.00	0.56	10.0	7.03	3.91	12	0.014	3.0%	5.75	7.32	7.88	105	0.22	60.50%
Inlet 2	MH 2	B2	0.79	0.82	0.65	0.65	10.0	7.03	4.56	12	0.014	3.0%	5.75	7.32	8.22	6	0.01	66.50%
MH 2	MH 3		0.00	0.00	0.00	1.21	10.2	7.03	8.47	18	0.014	3.3%	17.69	10.01	9.71	84	0.14	49.50%
Inlet 3	MH 4	B3	1.05	0.87	0.91	0.91	10.0	7.03	6.42	18	0.014	3.0%	16.94	9.59	8.84	7	0.01	43.00%
MH 4	MH 3		0.00	0.00	0.00	2.12	10.3	7.03	14.90	18	0.014	3.0%	16.94	9.59	10.86	60	0.09	72.50%
MH 3	MH 6		0.00	0.00	0.00	2.12	10.4	7.03	14.90	18	0.014	3.0%	16.94	9.59	10.86	80	0.12	72.50%
Inlet 4	MH 5	B4	0.18	0.93	0.17	0.17	10.0	7.03	1.20	12	0.014	1.0%	3.32	4.23	3.82	178	0.78	42.00%
Inlet 5	MH 5	B5	0.26	0.88	0.23	0.23	10.0	7.03	1.61	12	0.014	4.0%	6.63	8.44	7.00	32	0.08	33.50%
Inlet 6	MH 5	B6	0.08	0.96	0.07	0.07	10.0	7.03	0.51	12	0.014	2.9%	5.65	7.19	4.53	44	0.16	20.00%
MH 5	MH 6		0.00	0.00	0.00	0.47	11.0	7.03	3.32	12	0.014	10.0%	10.49	13.36	11.50	62	0.09	39.50%
MH 6	EX Inlet		0.00	0.00	0.00	2.59	11.2	7.03	18.21	18	0.014	3.3%	17.77	10.06	10.31	63	0.10	99.90%
<div> <div>Project: Outlets at Castle Rock-Pad A</div> <div>Location: Castle Rock, CO</div> </div> <div> <div>R= 100 yr</div> <div>2.60</div> </div> <div> <div>Calcs by: SJM</div> <div>Date: 10/22/14</div> </div> <div> <div>Job No: CD 14-0016</div> <div>Page 1</div> </div>																		

SITE MAPS / CALCULATIONS / FIGURES & TABLES

PHASE III DRAINAGE PLAN
A PORTION OF LOT 1, BLOCK 1, OUTLETS AT CASTLE ROCK FILING NO. 1
LOCATED IN THE N $\frac{1}{2}$ OF SECTION 27, T7S, R67W, OF THE 6TH P.M.
TOWN OF CASTLE ROCK, COUNTY OF DOUGLAS, STATE OF COLORADO
TOWN OF CASTLE ROCK PROJECT NO. CD22-0026

SUMMARY
RUNOFF TABLE

DESIGN PT.	BASIN	Q _s (CFS)	Q ₁₀₀ (CFS)
1	O1	8.04	16.14
	IN-D	0.49	1.05
2	A1	7.83	15.73
	A2	4.64	9.31
	A4	2.57	5.31
		3.74	7.73
3		10.95	22.36
4		17.47	35.60
5	B1	5.90	11.56
	IN-1	5.83	12.83
	IN-2	5.60	11.61
6		15.42	31.99
7		29.38	60.38
	C1	2.64	5.38
	C2	4.92	9.64
	C3	3.50	7.74
8		11.06	22.77
	IN-3	7.20	14.64
9		16.13	33.27
	RS	1.47	4.17
10		14.77	31.43
11		41.91	87.97
12	X1 THROUGH X6	8.66	18.21
13		55.14	101.51
	RN	2.96	8.67



ISSUES & REVISIONS		
NO. 1	DATE:	BY:
NO. 2	DATE:	BY:
NO. 3	DATE:	BY:
NO. 4	DATE:	BY:
NO. 5	DATE:	BY:
NO. 6	DATE:	BY:

DATE:	SCALE:
05/01/2022	1" = 50'
PROJECT MANAGER:	PROJECT NO.:
JS	
DRAWN BY:	DRAWING FILE:
JN	
PROJECT:	

OUTLETS AT CASTLE ROCK
PADS B & C
5050 FACTORY SHOPS BLVD.
CASTLE ROCK, CO 80108

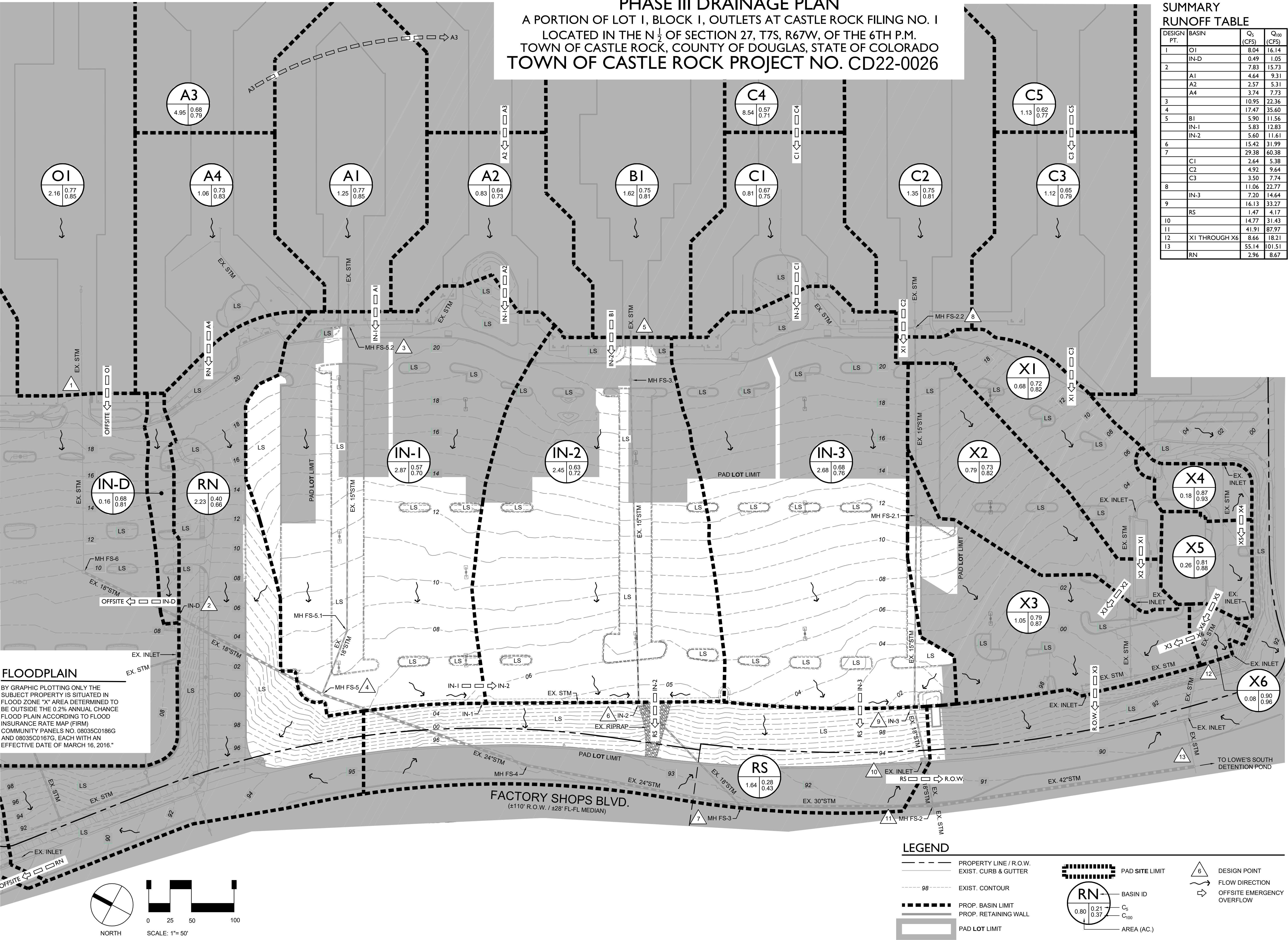
CLIENT:
CRAIG REALTY GROUP
4100 MACARTHUR BLVD., SUITE 100
NEWPORT BEACH, CA 92660

TEL: (714) 299-7578

SHEET TITLE:
EXISTING DRAINAGE PLAN

SHEET NUMBER:

1



PHASE III DRAINAGE PLAN
A PORTION OF LOT 1, BLOCK 1, OUTLETS AT CASTLE ROCK FILING NO. 1
LOCATED IN THE N¹/₂ OF SECTION 27, T7S, R67W, OF THE 6TH P.M.
TOWN OF CASTLE ROCK, COUNTY OF DOUGLAS, STATE OF COLORADO
TOWN OF CASTLE ROCK PROJECT NO. CD22-0026

SUMMARY
RUNOFF TABLE

DESIGN PT.	Basin	Q _s (CFS)	Q ₁₀₀ (CFS)
1	O1	8.04	16.14
2	IN-D	0.49	1.05
	A1	4.64	9.31
	A2	2.57	5.31
	A4	3.74	7.73
3		10.95	22.36
4		16.91	35.60
4.1	P1	2.67	5.76
5	B1	17.42	36.69
	P2	5.90	11.56
	P3	1.48	3.25
6.1		3.62	7.38
	P4	4.57	9.93
6.2		2.14	4.29
	P5	6.13	13.34
	P6	1.53	3.07
6.3		0.40	0.96
6.4		1.78	3.72
6.5		6.81	13.70
	P7	12.20	26.14
6.6		3.86	7.69
6.7		14.94	32.11
7		14.73	31.66
		31.24	66.64
8		2.64	5.38
	C1	4.92	9.64
	C2	3.50	7.74
	C3	11.06	22.77
8.1	P8	3.15	6.28
8.2	P9	1.88	3.81
		4.83	9.86
	P10	14.41	30.18
9		1.98	4.05
	RS	15.81	32.96
10		1.49	4.15
		14.02	29.73
11		42.62	87.98
	X3	3.00	6.79
12	X1 THROUGH X6	9.10	18.60
13		48.28	101.83
	RN	3.00	9.01



ISSUES & REVISIONS		
NO. 1	DATE:	BY:
DESCRIPTION:		
NO. 2	DATE:	BY:
DESCRIPTION:		
NO. 3	DATE:	BY:
DESCRIPTION:		
NO. 4	DATE:	BY:
DESCRIPTION:		
NO. 5	DATE:	BY:
DESCRIPTION:		
NO. 6	DATE:	BY:
DESCRIPTION:		

DATE:	SCALE:
08/25/2022	1" = 50'
PROJECT MANAGER:	PROJECT NO.:
JS	
DRAWN BY:	DRAWING FILE:
JN	
PROJECT:	

OUTLETS AT CASTLE ROCK
PADS B & C
5050 FACTORY SHOPS BLVD.
CASTLE ROCK, CO 80108

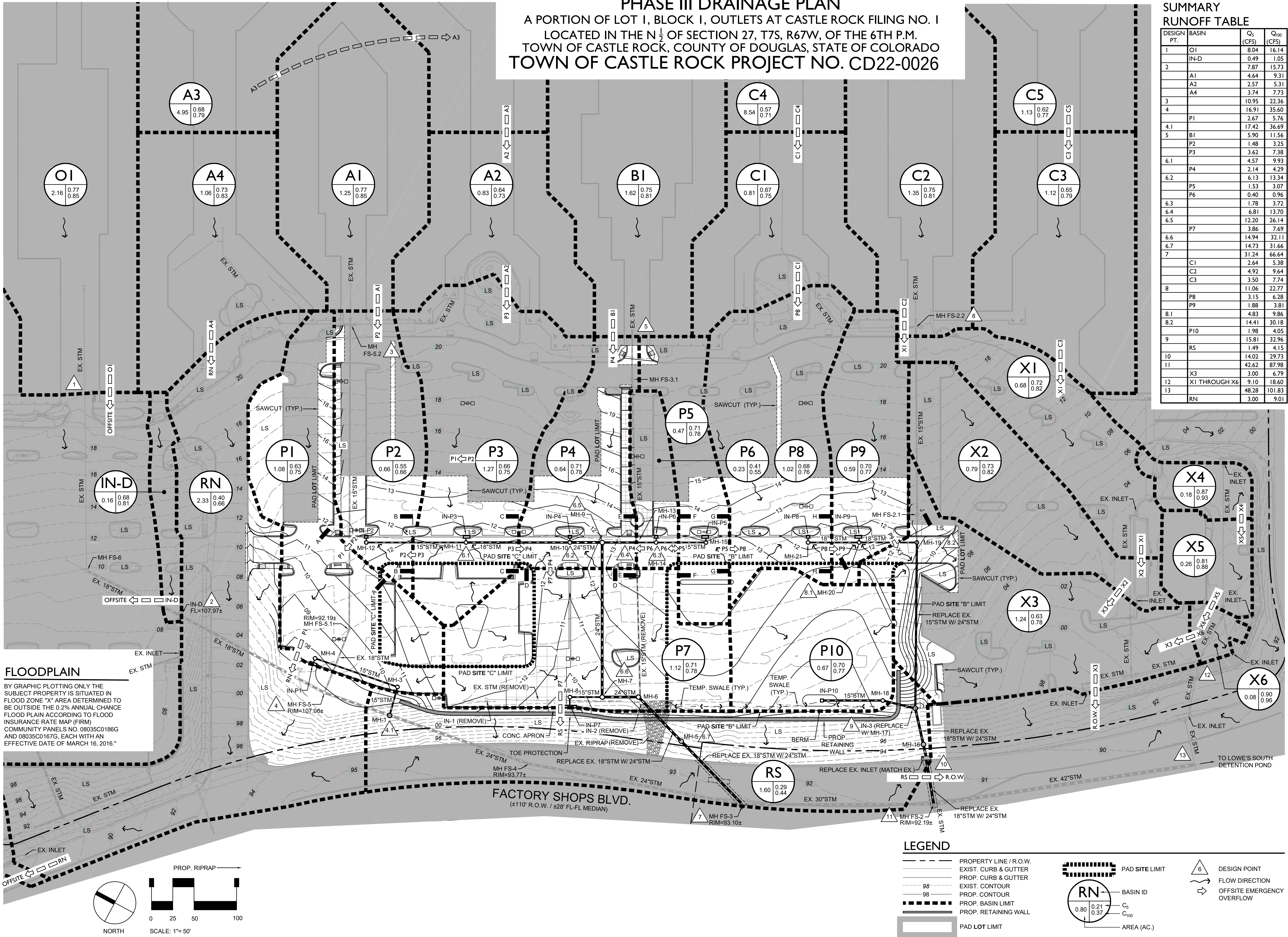
CLIENT:
CRAIG REALTY GROUP
4100 MACARTHUR BLVD., SUITE 100
NEWPORT BEACH, CA 92660

TEL: (714) 299-7578

SHEET TITLE:
PROPOSED DRAINAGE PLAN

SHEET NUMBER:

2





Weighted Imperviousness

Job Name: CROM Pad - Castle Rock, Colorado

Date: 5/3/22

By: JMN

	¹ I (%)
Roof	90
Lawn	2
Drives & Walks	90

¹% Impervious from MHFD, *USDCM Vol. 1*, Table 6-3

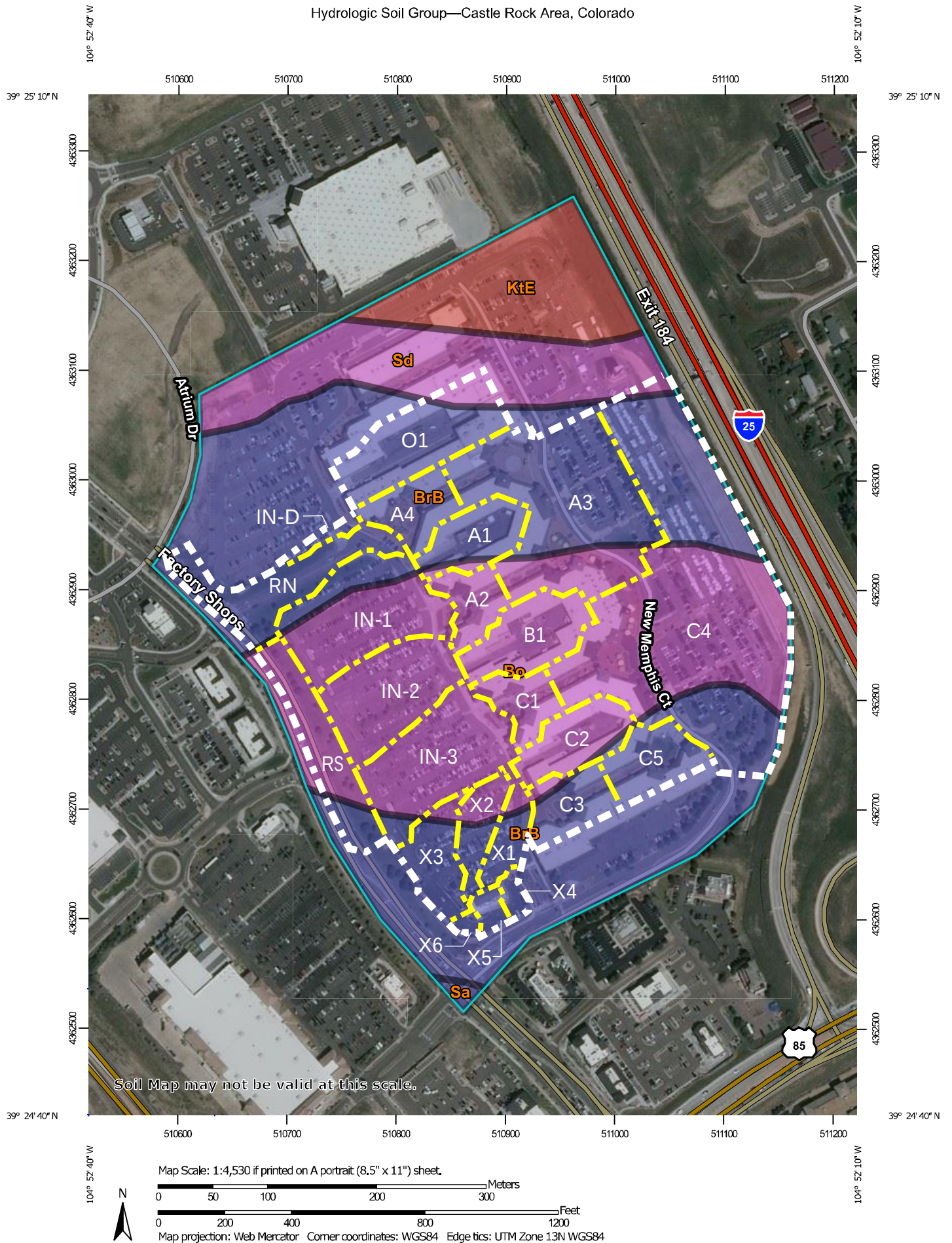
EXISTING

Basin	³ Hydrologic Soil Classification	Drives & Walks (ac.)	Lawn (ac.)	Roof (ac.)	Total (ac.)	I (%)	C ₅	² Weighted Runoff Coeff.				
								C ₁₀	C ₂₅	C ₅₀	C ₁₀₀	
O1	B	0.768	0.000	1.393	2.161	90	0.77	0.79	0.82	0.83	0.85	
IN-D	(PAD D LETTER)	0.147	0.017	0.000	0.163	81	0.68	0.71	0.76	0.78	0.81	
A1	B	0.488	0.000	0.759	1.247	90	0.77	0.79	0.82	0.83	0.85	
A2	A	0.072	0.098	0.656	0.826	80	0.64	0.66	0.68	0.70	0.73	
A4	B	0.249	0.052	0.759	1.060	86	0.73	0.75	0.79	0.81	0.83	
B1	A	0.632	0.000	0.986	1.618	90	0.75	0.76	0.78	0.79	0.81	
IN-1	67% A + 33% B	2.180	0.601	0.087	2.868	72	0.57	0.60	0.64	0.66	0.70	
IN-2	A	2.058	0.333	0.057	2.449	78	0.63	0.64	0.67	0.69	0.72	
C1	A	0.120	0.072	0.622	0.814	82	0.67	0.68	0.71	0.72	0.75	
C2	A	0.479	0.003	0.870	1.352	90	0.75	0.76	0.78	0.79	0.81	
C3	B	0.137	0.167	0.813	1.118	77	0.65	0.68	0.73	0.76	0.79	
IN-3	A	2.374	0.202	0.098	2.675	83	0.68	0.70	0.72	0.73	0.76	
RS	A	0.730	0.910	0.000	1.639	41	0.28	0.29	0.32	0.37	0.43	
RN	B	1.181	1.017	0.028	2.226	50	0.40	0.46	0.56	0.61	0.66	
A3	25% A + 75% B	2.713	0.503	1.730	4.946	81	0.68	0.70	0.74	0.76	0.79	
C4	50% A + 50% B	5.661	1.896	0.978	8.536	70	0.57	0.60	0.64	0.67	0.71	
C5	B	0.211	0.205	0.716	1.132	74	0.62	0.66	0.72	0.74	0.77	
X1	(PAD A LETTER)	0.600	0.079	0.000	0.679	88	0.72	0.75			0.82	
X2	(PAD A LETTER)	0.700	0.091	0.000	0.791	88	0.73	0.75			0.82	
X3	(PAD A LETTER)	0.980	0.070	0.000	1.050	93	0.79	0.82			0.87	
X4	(PAD A LETTER)	0.180	0.003	0.000	0.183	98	0.87	0.89			0.93	
X5	(PAD A LETTER)	0.138	0.003	0.120	0.261	94	0.81	0.83			0.88	
X6	(PAD A LETTER)	0.075	0.000	0.000	0.075	100	0.90	0.92			0.96	
Total		22.871	6.323	10.674	39.868	76						

²Rational Coefficient from MHFD, *USDCM Vol. 1*, Table 6-4

³Hydrologic Soil Group from NRCS Web Soil Survey

Hydrologic Soil Group—Castle Rock Area, Colorado



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

3/15/2022
Page 1 of 4

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	21.2	33.0%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	B	32.3	50.2%
KtE	Kutch sandy loam, 5 to 20 percent slopes	D	4.6	7.1%
Sa	Sampson loam	B	0.2	0.3%
Sd	Sandy alluvial land	A	6.0	9.4%
Totals for Area of Interest			64.4	100.0%



Weighted Imperviousness

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

By: JMN

	¹ I (%)
Roof	90
Lawn	2
Drives & Walks	90

¹% Impervious from MHFD, *USDCM Vol. 1*, Table 6-3

PROPOSED

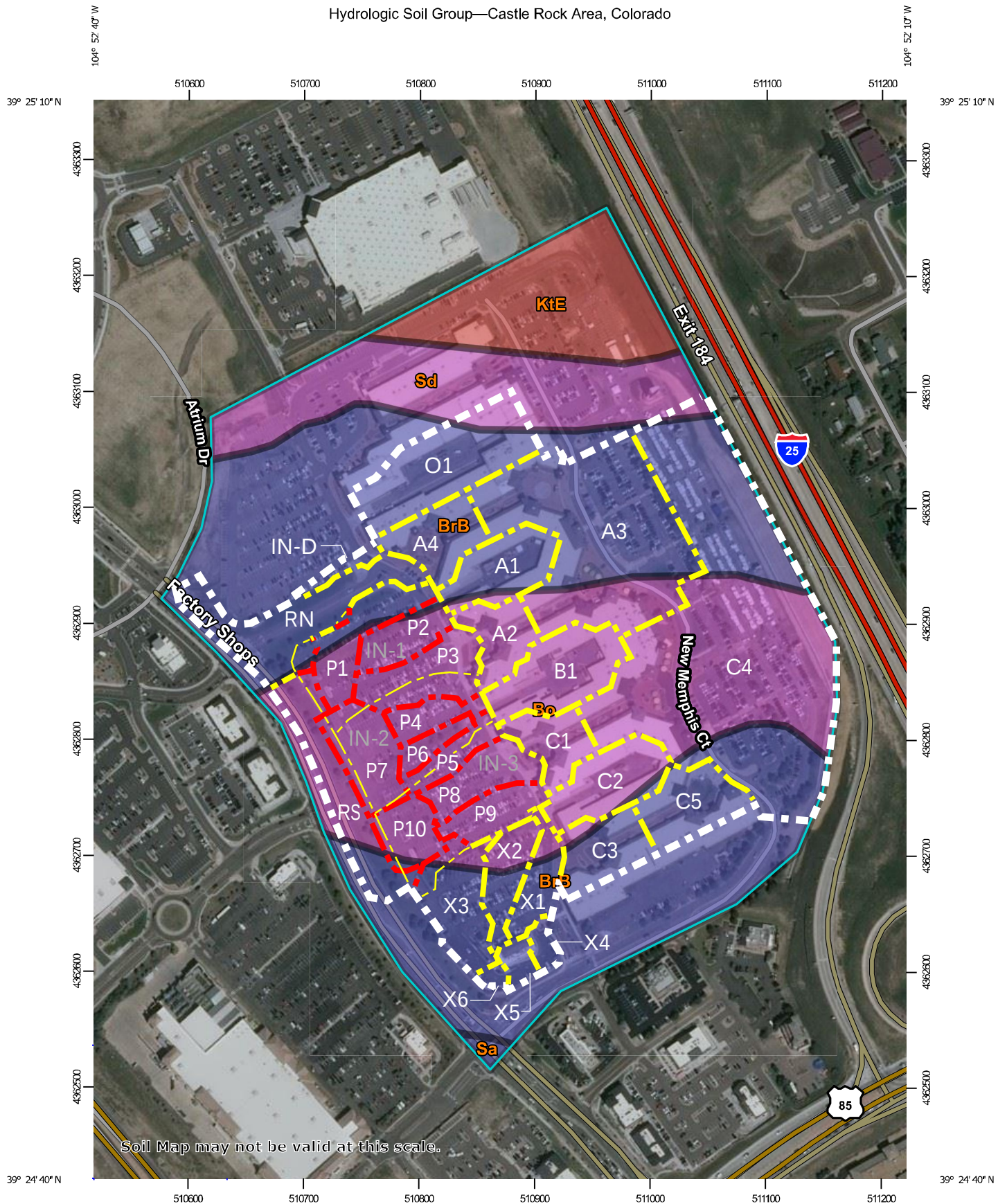
Basin	³ Hydrologic Soil Classification	Drives & Walks (ac.)	Pad	Lawn (ac.)	Roof (ac.)	Total (ac.)	I (%)	C _s	² Weighted Runoff Coeff.				
									C ₁₀	C ₂₅	C ₅₀	C ₁₀₀	
O1	B	0.768		0.000	1.393	2.161	90	0.77	0.79	0.82	0.83	0.85	
IN-D	(PAD D LETTER)	0.147		0.017	0.000	0.163	81	0.68	0.71	0.76	0.78	0.81	
A1	B	0.488		0.000	0.759	1.247	90	0.77	0.79	0.82	0.83	0.85	
A2	A	0.072		0.098	0.656	0.826	80	0.64	0.66	0.68	0.70	0.73	
A4	B	0.249		0.052	0.759	1.060	86	0.73	0.75	0.79	0.81	0.83	
P1	50% A + 50% B	0.815	0.099	0.154	0.015	1.083	77	0.63	0.66	0.69	0.72	0.75	
B1	A	0.632		0.000	0.986	1.618	90	0.75	0.76	0.78	0.79	0.81	
P2	A	0.478	0.012	0.147	0.022	0.658	70	0.55	0.56	0.59	0.62	0.66	
P3	A	0.980	0.092	0.114	0.080	1.266	82	0.66	0.68	0.70	0.72	0.75	
P4	A	0.598	0.002	0.026	0.012	0.637	86	0.71	0.73	0.75	0.76	0.78	
P5	A	0.318	0.097	0.017	0.034	0.467	86	0.71	0.72	0.74	0.75	0.78	
P6	A	0.141	0.001	0.088	0.000	0.230	56	0.41	0.43	0.46	0.50	0.55	
P7	A	0.725	0.367	0.023	0.000	1.115	86	0.71	0.73	0.75	0.76	0.78	
C1	A	0.120		0.072	0.622	0.814	82	0.67	0.68	0.71	0.72	0.75	
C2	A	0.479		0.003	0.870	1.352	90	0.75	0.76	0.78	0.79	0.81	
C3	B	0.137		0.167	0.813	1.118	77	0.65	0.68	0.73	0.76	0.79	
P8	A	0.852	0.047	0.072	0.053	1.024	84	0.68	0.70	0.72	0.74	0.76	
P9	A	0.509	0.018	0.034	0.027	0.588	85	0.70	0.71	0.73	0.74	0.77	
P10	A	0.000	0.672	0.000	0.000	0.672	84	0.69	0.71	0.73	0.74	0.77	
RS	A	0.731		0.869	0.000	1.600	42	0.29	0.30	0.33	0.38	0.44	
RN	B	1.217		1.079	0.028	2.325	49	0.40	0.46	0.56	0.60	0.66	
A3	25% A + 75% B	2.713		0.503	1.730	4.946	81	0.68	0.70	0.74	0.76	0.79	
C4	50% A + 50% B	5.661		1.896	0.978	8.536	70	0.57	0.60	0.64	0.67	0.71	
C5	B	0.211		0.205	0.716	1.132	74	0.62	0.66	0.72	0.74	0.77	
X1	(PAD A LETTER)	0.600		0.079	0.000	0.679	88	0.72	0.75			0.82	
X2	(PAD A LETTER)	0.700		0.091	0.000	0.791	88	0.73	0.75			0.82	
(Exist. X3)	(PAD A LETTER) (	0.980		0.070	0.000	1.050	(	93	0.79	0.82		0.87	)
(Δ to Exist. X3)	(	-0.020		0.020	0.000	0.000	)						
(Add to Exist. X3)	(	0.047		0.121	0.000	0.191	)						
Prop. X3	B	1.007	0.023	0.210	0.000	1.241	75	0.63	0.66	0.72	0.75	0.78	
X4	(PAD A LETTER)	0.180		0.003	0.000	0.183	98	0.87	0.89			0.93	
X5	(PAD A LETTER)	0.138		0.003	0.120	0.261	94	0.81	0.83			0.88	
X6	(PAD A LETTER)	0.075		0.000	0.000	0.075	100	0.90	0.92			0.96	
Total		21.739	1.429	6.026	10.674	39.868	76						

²Rational Coefficient from MHFD, *USDCM Vol. 1*, Table 6-4

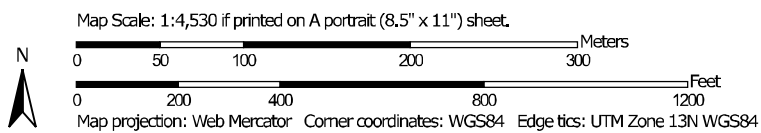
³Hydrologic Soil Group from NRCS Web Soil Survey

⁴Pad Site Imperviousness must not exceed 84 % for overall compliance to existing condition

Hydrologic Soil Group—Castle Rock Area, Colorado



Soil Map may not be valid at this scale.



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

3/15/2022
Page 1 of 4

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	21.2	33.0%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	B	32.3	50.2%
KtE	Kutch sandy loam, 5 to 20 percent slopes	D	4.6	7.1%
Sa	Sampson loam	B	0.2	0.3%
Sd	Sandy alluvial land	A	6.0	9.4%
Totals for Area of Interest			64.4	100.0%



Time of Concentration

Job Name: CROM Pad - Castle Rock, Colorado

Date: 5/3/22

Calculated by: JMN

EXISTING OVERLAND FLOW (100-yr Analysis)

Sub-Basin Data			¹ Initial/Overland Time (T _i)			² Travel Time T _t			³ T _c Check Urbanized Basin				Final T _c	Remarks
Desig	C _s	Area Ac	Length _i Ft	Slope _o Ft/Ft	T _i Min	Length _t Ft	Slope _o Ft/Ft	T _t Min	Length _t Ft	i	S _t Ft/Ft	T _c Min	Min	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
IN-D	0.68	0.16	280	0.057	7.10				280	81	0.057	13.21	7.10	
IN-1	0.57	2.87	300	0.045	10.04	178	0.022	1.00						
						168	0.009	1.48	646	72	0.029	17.14	12.51	
IN-2	0.63	2.45	300	0.043	9.15	152	0.035	0.68						
						144	0.006	1.55	596	78	0.032	15.53	11.38	
IN-3	0.68	2.67	300	0.046	7.91	153	0.036	0.67						
						153	0.016	1.01	606	83	0.036	14.41	9.59	
RS	0.28	1.64	48	0.020	8.19	648	0.006	6.97	696	41	0.007	28.42	15.16	
RN	0.40	2.23	142	0.020	11.93	434	0.061	1.46						
						276	0.029	1.35	852	50	0.044	21.78	14.75	

EXISTING OVERLAND FLOW (Emergency Analysis)

IN-1	0.57	2.87				180	0.009	1.58					1.58	
A2	0.64	0.83	150	0.020	8.05								8.05	
C1	0.67	0.81	200	0.020	8.73								8.73	
C3	0.65	1.12	270	0.020	10.73								10.73	

¹T_i calculated from MHFD, *USDCM*, Vol. I, Equation 6-3

²T_t calculated from MHFD, *USDCM*, Vol. I, Equation 6-4 & Table 6-2

³T_c calculated from MHFD, *USDCM*, Vol. I, Equation 6-5



Time of Concentration

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

Calculated by: JMN

PROPOSED OVERLAND FLOW (100-yr Analysis)

Sub-Basin Data			¹ Initial/Overland Time (T _i)			² Travel Time T _t			³ T _c Check Urbanized Basin				Final T _c	Remarks
Desig (1)	C ₅ (2)	Area Ac (3)	Length _i Ft (4)	Slope _o Ft/Ft (5)	T _i Min (6)	Length _t Ft (7)	Slope _o Ft/Ft (8)	T _t Min (9)	Length _t Ft (10)	i (11)	S _t Ft/Ft (12)	T _c Min (13)	Min (14)	
IN-D	0.68	0.16	280	0.057	7.10				280	81	0.057	13.21	7.10	
P1	0.63	1.08	300	0.045	8.92	100	0.020	0.59						
						28	0.010	0.23	428	77	0.037	14.80	9.75	
P2	0.55	0.66	195	0.053	8.05	70	0.023	0.38						
						43	0.010	0.36	308	70	0.040	15.42	8.79	
P3	0.66	1.27	228	0.044	7.31	40	0.031	0.19						
						45	0.010	0.38	313	82	0.037	13.44	7.87	
P4	0.71	0.64	164	0.048	5.33	98	0.045	0.38						
						15	0.010	0.13	277	86	0.045	12.35	5.84	
P5	0.71	0.47	168	0.046	5.57	71	0.028	0.35						
						15	0.014	0.11	254	86	0.039	12.47	6.03	
P6	0.41	0.23	128	0.048	8.37	42	0.022	0.24						
						13	0.010	0.11	183	56	0.039	17.32	8.71	

¹T_i calculated from MHFD, USDCM, Vol. I, Equation 6-3

²T_t calculated from MHFD, USDCM, Vol. I, Equation 6-4 & Table 6-2

³T_c calculated from MHFD, USDCM, Vol. I, Equation 6-5

Sub-Basin Data			¹ Initial/Overland Time (T _i)			² Travel Time T _t			³ T _c Check Urbanized Basin				Final T _c	Remarks
Desig	C _s	Area Ac	Length _i Ft	Slope _o Ft/Ft	T _i Min	Length _t Ft	Slope _o Ft/Ft	T _t Min	Length _t Ft	i	S _t Ft/Ft	T _c Min	Min	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
P7	0.71	1.11	43	0.025	3.39	103	0.010	0.86						
						47	0.020	0.28	193	86	0.016	12.54	4.52	(Use 5.00 minimum)
P8	0.68	1.02	204	0.046	6.47	74	0.035	0.33						
						20	0.019	0.12	298	84	0.042	12.97	6.92	
P9	0.70	0.59	194	0.052	5.90	70	0.026	0.36						
						15	0.010	0.13	279	85	0.043	12.67	6.39	
P10	0.69	0.67	136	0.015	7.50	39	0.020	0.23						
						0	0.020	0.00	175	84	0.016	12.75	7.73	(Developed Conditions)

PROPOSED OVERLAND FLOW (Emergency Analysis)

P2	0.55	0.66				150	0.020	0.88						
						28	0.010	0.23						
						(Total)		1.12					1.12	
P10	0.01	0.76	190	0.027	19.62								19.62	(Undeveloped Conditions)

¹T_i calculated from MHFD, USDCM, Vol. I, Equation 6-3

²T_t calculated from MHFD, USDCM, Vol. I, Equation 6-4 & Table 6-2

³T_c calculated from MHFD, USDCM, Vol. I, Equation 6-5



Stormwater Runoff

Job Name: CROM Pad - Castle Rock, Colorado

Date: 5/3/22

Calculated by: JMN

Design Storm: 5-yr

EXISTING

Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
	Area Desig	Area (Ac)	Runoff Coeff	² Tc (min)	CA	¹ I (in/hr)	Q (cfs)	Tc (min)	Total CA	¹ I (in/hr)	Q (cfs)	Slope %	Street Flow	Design Flow	Slope %	Pipe Size (in)	Length (ft)	Vel (f/s)	Tt (min)	
1	O1	2.16	0.77	³ 5.00	1.66	4.85	8.04							8.04		15	186	6.55	0.47	to MH FS-6
(MH FS-6)														8.04		18	123	4.55	0.45	to DP 2
	IN-D	0.16	0.68	7.10	0.11	4.43	0.49													to DP 2
2								7.10	1.77	4.43	7.83			7.83		18	192	4.44	0.72	to DP 4
	A1	1.25	0.77	³ 5.00	0.96	4.85	4.64													to DP 3
	A2	0.83	0.64	³ 5.00	0.53	4.85	2.57													to DP 3
	A4	1.06	0.73	³ 5.00	0.77	4.85	3.74													to DP 3
3								³ 5.00	2.26	4.85	10.95			10.95		15	358	8.92	0.67	to MH FS-5.1
(MH FS-5.1)														10.95		18	80	6.20	0.22	to DP 4
4								7.82	4.03	4.34	17.47			17.47		24	510	5.56	1.53	to DP 7
5	B1	1.62	0.75	³ 5.00	1.22	4.85	5.90							5.90		15	380	4.81	1.32	to DP 6
	IN-1	2.87	0.57	12.51	1.64	3.55	5.83							5.83		15	180	4.75	0.63	to DP 6
	IN-2	2.45	0.63	11.38	1.53	3.65	5.60													to DP 6
6								13.14	4.39	3.51	15.42			15.42		18	167	8.73	0.32	to DP 7
7								13.46	8.42	3.49	29.38			29.38		30	225	5.99	0.63	to DP 11
	C1	0.81	0.67	³ 5.00	0.55	4.85	2.64													to DP 8
	C2	1.35	0.75	³ 5.00	1.01	4.85	4.92													to DP 8
	C3	1.12	0.65	³ 5.00	0.72	4.85	3.50													to DP 8
8								³ 5.00	2.28	4.85	11.06			11.06		15	445	9.02	0.82	to DP 9
	IN-3	2.67	0.68	9.59	1.82	3.95	7.20													to DP 9
9								9.59	4.10	3.93	16.13			16.13		18	61	9.13	0.11	to DP 10
	RS	1.64	0.28	15.16	0.45	3.24	1.47													to DP 10
10								15.16	4.56	3.24	14.77			14.77		18	55	8.36	0.11	to DP 11
11								15.27	12.98	3.23	41.91			41.91		42	300	4.36	1.15	to DP 13
12	X1 through X6			⁴ 11.20	⁴ 2.34	3.70	8.66													to DP 13
13								16.42	15.32	3.60	55.14									to MS4 & Pond
	RN	2.23	0.40	14.75	0.90	3.30	2.96													to Ex. Inlet

¹Intensity from Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual*, Figure 6-1

²See Time of Concentration calculations for Tc

³Assumed minimum Tc

⁴(Pad A Letter)



Stormwater Runoff

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

Calculated by: JMN

Design Storm: 5-yr

PROPOSED

Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time		Tt (min)	Remarks
	Area Desig	Area (Ac)	Runoff Coeff	² Tc (min)	CA	¹ I (in/hr)	Q (cfs)	Tc (min)	Total CA	¹ I (in/hr)	Q (cfs)	Slope %	Street Flow	Design Flow	Slope %	Pipe Size (in)	Length (ft)	Vel (f/s)		
1	O1	2.16	0.77	³ 5.00	1.66	4.85	8.04							8.04		15	186	6.55	0.47	to MH FS-6
(MH FS-6)														8.04		18	123	4.55	0.45	to DP 2
	IN-D	0.16	0.68	7.10	0.11	4.40	0.49													to DP 2
2								7.10	1.77	4.45	7.87			7.87		18	192	4.46	0.72	to DP 4
	A1	1.25	0.77	³ 5.00	0.96	4.85	4.64													to DP 3
	A2	0.83	0.64	³ 5.00	0.53	4.85	2.57													to DP 3
	A4	1.06	0.73	³ 5.00	0.77	4.85	3.74													to DP 3
3								³ 5.00	2.26	4.85	10.95			10.95		15	358	8.92	0.67	to MH FS-5.1
(MH FS-5.1)														10.95		18	80	6.20	0.22	to DP 4
4								7.82	4.03	4.20	16.91			16.91		24	81	5.38	0.25	to DP 4.1
	P1	1.08	0.63	9.75	0.68	3.90	2.67							2.67		15	144	2.17	1.10	to DP 4.1
4.1								10.85	4.71	3.70	17.42			17.42		24	429	5.55	1.29	to DP 7
5	B1	1.62	0.75	³ 5.00	1.22	4.85	5.90							5.90		15	192	4.81	0.67	to DP 6.4
	P2	0.66	0.55	8.79	0.36	4.10	1.48							1.48		15	124	1.21	1.71	to DP 6.1
	P3	1.27	0.66	7.87	0.84	4.30	3.62													to DP 6.1
6.1								10.50	1.20	3.80	4.57			4.57		15	122	3.72	0.55	to DP 6.2
	P4	0.64	0.71	5.84	0.45	4.70	2.14													to DP 6.2
6.2								11.05	1.66	3.70	6.13			6.13		18	38	3.47	0.18	to DP 6.5
	P5	0.47	0.71	6.03	0.33	4.65	1.53							1.53		15	65	1.25	0.87	to DP 6.3
	P6	0.23	0.41	8.71	0.10	4.20	0.40													to DP 6.3
6.3								8.71	0.42	4.20	1.78			1.78		15	23	1.45	0.26	tp DP 6.4
6.4								8.97	1.64	4.15	6.81			6.81		15	40	5.55	0.12	to DP 6.5
6.5								11.23	3.30	3.70	12.20			12.20		24	180	3.89	0.77	to DP 6.6
	P7	1.11	0.71	³ 5.00	0.79	4.85	3.86							3.86		15	51	3.14	0.27	to DP 6.6
6.6								12.00	4.09	3.65	14.94			14.94		24	115	4.76	0.40	to DP 6.7
6.7								12.40	4.09	3.60	14.73			14.73		24	104	4.69	0.37	to DP 7
7								12.14	8.80	3.55	31.24			31.24		30	225	6.37	0.59	to DP 11
	C1	0.81	0.67	³ 5.00	0.55	4.85	2.64													to DP 8
	C2	1.35	0.75	³ 5.00	1.01	4.85	4.92													to DP 8
	C3	1.12	0.65	³ 5.00	0.72	4.85	3.50													to DP 8
8								³ 5.00	2.28	4.85	11.06			11.06		15	253	9.02	0.47	to DP 8.2
	P8	1.02	0.68	6.92	0.70	4.50	3.15							3.15		18	67	1.78	0.63	to DP 8.1
	P9	0.59	0.70	6.39	0.41	4.60	1.88													to DP 8.1
8.1								7.55	1.11	4.35	4.83			4.83		18	68	2.73	0.41	to DP 8.2
8.2								7.97	3.39	4.25	14.41			14.41		24	195	4.59	0.71	to DP 9
	P10	0.67	0.69	7.73	0.47	4.25	1.98							1.98		15	111	1.61	1.15	to DP 9
9								8.87	3.86	4.10	15.81			15.81		24	61	5.03	0.20	to DP 10
	RS	1.60	0.29	15.16	0.46	3.25	1.49													to DP 10
10								15.16	4.31	3.25	14.02			14.02		24	55	4.46	0.21	to DP 11
11								15.37	13.11	3.25	42.62			42.62		42	300	4.43	1.13	to DP 13
	Prop. X3	1.24	0.63	⁴ 10.00	0.78	⁴ 3.85	3.00													
12	X1 through X6							⁴ 11.20	2.46	3.70	9.10									to DP 13
13								16.49	15.57	3.10	48.28									to MS4 & Pond
	RN	2.33	0.40	14.75	0.92	3.25	3.00													to Ex. Inlet

¹Intensity from Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual* , Figure 6-1

²See Time of Concentration calculations for Tc

³Assumed minimum Tc

⁴(Pad A Letter)



Stormwater Runoff

Job Name: CROM Pad - Castle Rock, Colorado

Date: 5/3/22

Calculated by: JMN

Design Storm: 100-yr

EXISTING

Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
	Area Desig	Area (Ac)	Runoff Coeff	² Tc (min)	CA	¹ I (in/hr)	Q (cfs)	Tc (min)	Total CA	¹ I (in/hr)	Q (cfs)	Slope %	Street Flow	Design Flow	Slope %	Pipe Size (in)	Length (ft)	Vel (f/s)	Tt (min)	
1	O1	2.16	0.85	³ 5.00	1.83	8.80	16.14							16.14		15	186	13.16	0.24	to MH FS-6
(MH FS-6)														16.14		18	123	9.14	0.22	to DP 2
	IN-D	0.16	0.81	7.10	0.13	8.00	1.05													to DP 2
2								7.10	1.97	8.00	15.73			15.73		18	192	8.91	0.36	to DP 4
	A1	1.25	0.85	³ 5.00	1.06	8.80	9.31													to DP 3
	A2	0.83	0.73	³ 5.00	0.60	8.80	5.31													to DP 3
	A4	1.06	0.83	³ 5.00	0.88	8.80	7.73													to DP 3
3								³ 5.00	2.54	8.80	22.36			22.36		15	358	18.23	0.33	to MH FS-5.1
(MH FS-5.1)														22.36		18	80	12.66	0.11	to DP 4
4								7.46	4.51	7.90	35.60			35.60		24	510	11.34	0.75	to DP 7
5	B1	1.62	0.81	³ 5.00	1.31	8.80	11.56							11.56		15	380	9.42	0.67	to DP 6
	IN-1	2.87	0.70	12.51	2.00	6.40	12.83							12.83		15	180	10.46	0.29	to DP 6
	IN-2	2.45	0.72	11.38	1.76	6.60	11.61													to DP 6
6								12.80	5.08	6.30	31.99			31.99		18	167	18.11	0.15	to DP 7
7								12.95	9.58	6.30	60.38			60.38		30	225	12.31	0.30	to DP 11
	C1	0.81	0.75	³ 5.00	0.61	8.80	5.38													to DP 8
	C2	1.35	0.81	³ 5.00	1.10	8.80	9.64													to DP 8
	C3	1.12	0.79	³ 5.00	0.88	8.80	7.74													to DP 8
8								³ 5.00	2.59	8.80	22.77			22.77		15	445	18.56	0.40	to DP 9
	IN-3	2.67	0.76	9.59	2.03	7.20	14.64													to DP 9
9								9.59	4.62	7.20	33.27			33.27		18	61	18.83	0.05	to DP 10
	RS	1.64	0.43	15.16	0.71	5.90	4.17													to DP 10
10								15.16	5.33	5.90	31.43			31.43		18	55	17.79	0.05	to DP 11
11								15.21	14.91	5.90	87.97			87.97		42	300	9.15	0.55	to DP 13
12	X1 through X6			⁴ 11.20	⁴ 2.59	⁴ 7.03	⁴ 18.21													to DP 13
13								15.76	17.50	5.80	101.51									to MS4 & Pond
	RN	2.23	0.66	14.75	1.47	5.90	8.67													to Ex. Inlet

¹Intensity from Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual*, Figure 6-1

²See Time of Concentration calculations for Tc

³Assumed minimum Tc

⁴(Pad A Letter)



Stormwater Runoff

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

Calculated by: JMN

Design Storm: 100-yr

PROPOSED

Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time		Tt (min)	Remarks
	Area Desig	Area (Ac)	Runoff Coeff	² Tc (min)	CA	¹ I (in/hr)	Q (cfs)	Tc (min)	Total CA	¹ I (in/hr)	Q (cfs)	Slope %	Street Flow	Design Flow	Slope %	Pipe Size (in)	Length (ft)	Vel (f/s)		
1	O1	2.16	0.85	³ 5.00	1.83	8.80	16.14							16.14		15	186	13.16	0.24	to MH FS-6
(MH FS-6)														16.14		18	123	9.14	0.22	to DP 2
	IN-D	0.16	0.81	7.10	0.13	8.00	1.05													to DP 2
2								7.10	1.97	8.00	15.73			15.73		18	192	8.91	0.36	to DP 4
	A1	1.25	0.85	³ 5.00	1.06	8.80	9.31													to DP 3
	A2	0.83	0.73	³ 5.00	0.60	8.80	5.31													to DP 3
	A4	1.06	0.83	³ 5.00	0.88	8.80	7.73													to DP 3
3								³ 5.00	2.54	8.80	22.36			22.36		15	358	18.23	0.33	to MH FS-5.1
(MH FS-5.1)														22.36		18	80	12.66	0.11	to DP 4
4								7.46	4.51	7.90	35.60			35.60		24	81	11.34	0.12	to DP 4.1
	P1	1.08	0.75	9.75	0.81	7.10	5.76							5.76		15	144	4.70	0.51	to DP 4.1
4.1								10.26	5.32	6.90	36.69			36.69		24	429	11.69	0.61	to DP 7
5	B1	1.62	0.81	³ 5.00	1.31	8.80	11.56							11.56		15	192	9.42	0.34	to DP 6.4
	P2	0.66	0.66	8.79	0.43	7.50	3.25							3.25		15	124	2.65	0.78	to DP 6.1
	P3	1.27	0.75	7.87	0.95	7.80	7.38													to DP 6.1
6.1								9.57	1.38	7.20	9.93			9.93		15	122	8.10	0.25	to DP 6.2
	P4	0.64	0.78	5.84	0.50	8.60	4.29													to DP 6.2
6.2								9.82	1.88	7.10	13.34			13.34		18	38	7.55	0.08	to DP 6.5
	P5	0.47	0.78	6.03	0.36	8.45	3.07							3.07		15	65	2.50	0.43	to DP 6.3
	P6	0.23	0.55	8.71	0.13	7.60	0.96													to DP 6.3
6.3								8.71	0.49	7.60	3.72			3.72		15	23	3.03	0.13	tp DP 6.4
6.4								8.84	1.80	7.60	13.70			13.70		15	40	11.17	0.06	to DP 6.5
6.5								9.90	3.68	7.10	26.14			26.14		24	180	8.32	0.36	to DP 6.6
	P7	1.11	0.78	³ 5.00	0.87	8.80	7.69							7.69		15	51	6.27	0.14	to DP 6.6
6.6								10.26	4.55	7.05	32.11			32.11		24	115	10.23	0.19	to DP 6.7
6.7								10.45	4.55	6.95	31.66			31.66		24	104	10.08	0.17	to DP 7
7								10.87	9.87	6.75	66.64			66.64		30	225	13.58	0.28	to DP 11
	C1	0.81	0.75	³ 5.00	0.61	8.80	5.38													to DP 8
	C2	1.35	0.81	³ 5.00	1.10	8.80	9.64													to DP 8
	C3	1.12	0.79	³ 5.00	0.88	8.80	7.74													to DP 8
8								³ 5.00	2.59	8.80	22.77			22.77		15	253	18.56	0.23	to DP 8.2
	P8	1.02	0.76	6.92	0.78	8.05	6.28							6.28		18	67	3.55	0.31	to DP 8.1
	P9	0.59	0.77	6.39	0.45	8.40	3.81													to DP 8.1
8.1								7.24	1.23	8.00	9.86			9.86		18	68	5.59	0.20	to DP 8.2
8.2								7.44	3.82	7.90	30.18			30.18		24	195	9.61	0.34	to DP 9
	P10	0.67	0.77	7.73	0.52	7.85	4.05							4.05		15	111	3.30	0.56	to DP 9
9								8.29	4.34	7.60	32.96			32.96		24	61	10.50	0.10	to DP 10
	RS	1.60	0.44	15.16	0.70	5.90	4.15													to DP 10
10								15.16	5.04	5.90	29.73			29.73		18	55	16.83	0.05	to DP 11
11								15.21	14.91	5.90	87.98			87.98		42	300	9.15	0.55	to DP 13
	Prop. X3	1.24	0.78	⁴ 10.00	0.97	⁴ 7.03	6.79													
12	X1 through X6							⁴ 11.20	2.65	7.03	18.60									to DP 13
13								15.76	17.56	5.80	101.83									to MS4 & Pond
	RN	2.33	0.66	14.75	1.53	5.90	9.01													to Ex. Inlet

¹Intensity from Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual* , Figure 6-1

²See Time of Concentration calculations for Tc

³Assumed minimum Tc

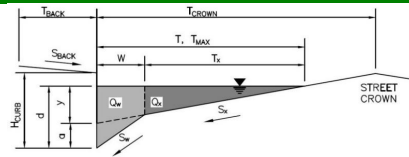
⁴(Pad A Letter)

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P1

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 30.0$ ft
 $W = 2.00$ ft
 $S_x = 0.040$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	30.0	30.0	ft
$d_{MAX} =$	6.0	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

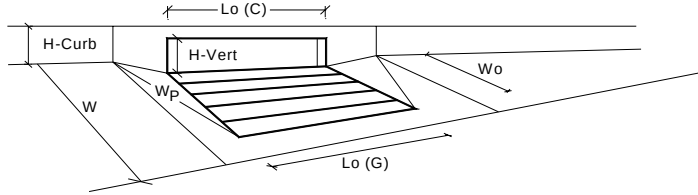
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



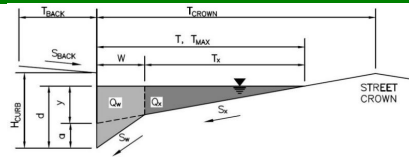
Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)					
		MINOR		MAJOR	
Type =	Denver No. 16 Combination				
a _{local} =	2.00	2.00		inches	
No =	2	2			
Ponding Depth =	6.0	6.0		inches	
		MINOR		MAJOR	
L _o (G) =	3.00	3.00		feet	
W _o =	1.73	1.73		feet	
A _{ratio} =	0.31	0.31			
C _r (G) =	0.50	0.50			
C _w (G) =	3.60	3.60			
C _o (G) =	0.60	0.60			
		MINOR		MAJOR	
L _o (C) =	3.00	3.00		feet	
H _{vert} =	6.50	6.50		inches	
H _{throat} =	5.25	5.25		inches	
Theta =	0.00	0.00		degrees	
W _p =	2.00	2.00		feet	
C _r (C) =	0.10	0.10			
C _w (C) =	3.70	3.70			
C _o (C) =	0.66	0.66			
		MINOR		MAJOR	
d _{Grate} =	0.523	0.523		ft	
d _{Curb} =	0.33	0.33		ft	
RF _{combination} =	0.71	0.71			
RF _{Curb} =	1.00	1.00			
RF _{Grate} =	0.71	0.71			
		MINOR		MAJOR	
Q _s =	6.2	6.2		cfs	
Q _{PEAK REQUIRED} =	2.7	5.8		cfs	

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P2

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_x = 0.020$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	5.6	5.6	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

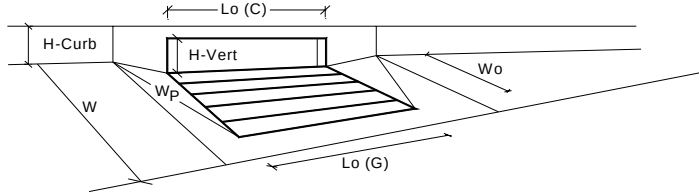
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



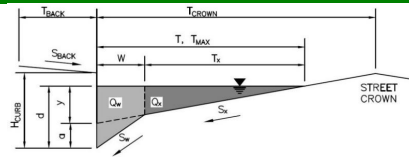
Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)					
		MINOR		MAJOR	
Type =	Denver No. 16 Combination				
a _{local} =	2.00	2.00		inches	
No =	1	1			
Ponding Depth =	5.6	5.6		inches	
		MINOR		MAJOR	
L _o (G) =	3.00	3.00		feet	
W _o =	1.73	1.73		feet	
A _{ratio} =	0.31	0.31			
C _r (G) =	0.50	0.50			
C _w (G) =	3.60	3.60			
C _o (G) =	0.60	0.60			
		MINOR		MAJOR	
L _o (C) =	3.00	3.00		feet	
H _{vert} =	6.50	6.50		inches	
H _{throat} =	5.25	5.25		inches	
Theta =	0.00	0.00		degrees	
W _p =	2.00	2.00		feet	
C _r (C) =	0.10	0.10			
C _w (C) =	3.70	3.70			
C _o (C) =	0.66	0.66			
		MINOR		MAJOR	
d _{Grate} =	0.493	0.493		ft	
d _{Curb} =	0.30	0.30		ft	
RF _{combination} =	0.88	0.88			
RF _{Curb} =	1.00	1.00			
RF _{Grate} =	0.88	0.88			
		MINOR		MAJOR	
Q _s =	3.4	3.4		cfs	
Q _{PEAK REQUIRED} =	1.5	3.3		cfs	

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P3

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_x = 0.041$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	6.4	6.4	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

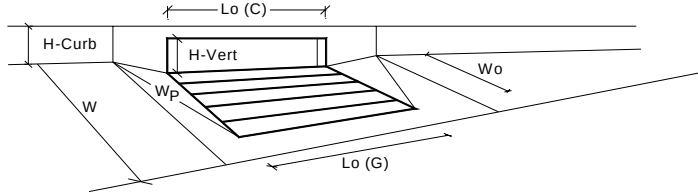
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



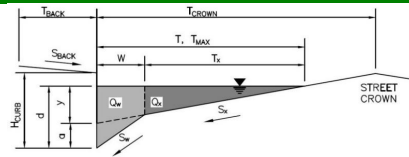
Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)					
		MINOR		MAJOR	
Type =	Denver No. 16 Combination				
a _{local} =	2.00	2.00		inches	
No =	2	2			
Ponding Depth =	6.4	6.4		inches	
		MINOR		MAJOR	
L _o (G) =	3.00	3.00		feet	
W _o =	1.73	1.73		feet	
A _{ratio} =	0.31	0.31			
C _r (G) =	0.50	0.50			
C _w (G) =	3.60	3.60			
C _o (G) =	0.60	0.60			
		MINOR		MAJOR	
L _o (C) =	3.00	3.00		feet	
H _{vert} =	6.50	6.50		inches	
H _{throat} =	5.25	5.25		inches	
Theta =	0.00	0.00		degrees	
W _p =	2.00	2.00		feet	
C _r (C) =	0.10	0.10			
C _w (C) =	3.70	3.70			
C _o (C) =	0.66	0.66			
		MINOR		MAJOR	
d _{Grate} =	0.556	0.556		ft	
d _{Curb} =	0.37	0.37		ft	
RF _{combination} =	0.75	0.75			
RF _{Curb} =	1.00	1.00			
RF _{Grate} =	0.75	0.75			
		MINOR		MAJOR	
Q _s =	7.4	7.4		cfs	
Q _{PEAK REQUIRED} =	3.6	7.4		cfs	

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P4

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_x = 0.025$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	6.4	6.4	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

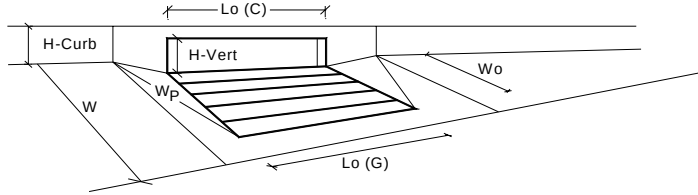
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



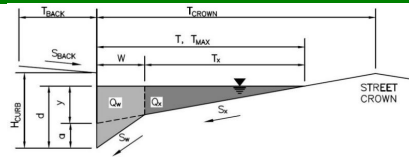
Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)					
		MINOR		MAJOR	
Type =	Denver No. 16 Combination				
a _{local} =	2.00	2.00		inches	
No =	1	1			
Ponding Depth =	6.4	6.4		inches	
		MINOR		MAJOR	
L _o (G) =	3.00	3.00		feet	
W _o =	1.73	1.73		feet	
A _{ratio} =	0.31	0.31			
C _r (G) =	0.50	0.50			
C _w (G) =	3.60	3.60			
C _o (G) =	0.60	0.60			
		MINOR		MAJOR	
L _o (C) =	3.00	3.00		feet	
H _{vert} =	6.50	6.50		inches	
H _{throat} =	5.25	5.25		inches	
Theta =	0.00	0.00		degrees	
W _p =	2.00	2.00		feet	
C _r (C) =	0.10	0.10			
C _w (C) =	3.70	3.70			
C _o (C) =	0.66	0.66			
		MINOR		MAJOR	
d _{Grate} =	0.556	0.556		ft	
d _{Curb} =	0.37	0.37		ft	
RF _{combination} =	1.00	1.00			
RF _{Curb} =	1.00	1.00			
RF _{Grate} =	1.00	1.00			
		MINOR		MAJOR	
Q _s =	4.4	4.4		cfs	
Q _{PEAK REQUIRED} =	2.1	4.3		cfs	

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P5

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_x = 0.035$ ft/ft
 $S_y = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	4.7	4.7	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

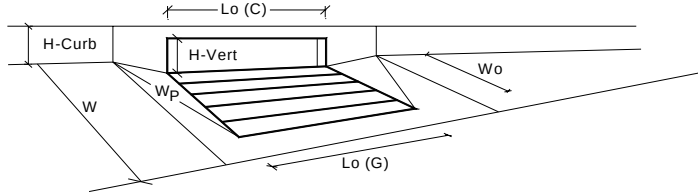
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
WARNING: Inlet Capacity less than Q Peak for Major Storm					

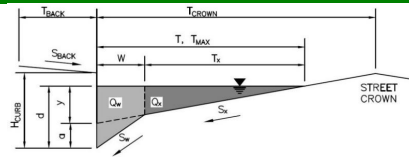
	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
a _{local} =	2.00	2.00	inches
No =	2	2	
Ponding Depth =	4.7	4.7	inches
	MINOR	MAJOR	Override Depths
L _o (G) =	3.00	3.00	feet
W _o =	1.73	1.73	feet
A _{ratio} =	0.31	0.31	
C _r (G) =	0.50	0.50	
C _w (G) =	3.60	3.60	
C _o (G) =	0.60	0.60	
	MINOR	MAJOR	
L _o (C) =	3.00	3.00	feet
H _{vert} =	6.50	6.50	inches
H _{throat} =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
W _p =	2.00	2.00	feet
C _r (C) =	0.10	0.10	
C _w (C) =	3.70	3.70	
C _o (C) =	0.66	0.66	
	MINOR	MAJOR	
d _{Grate} =	0.413	0.413	ft
d _{Curb} =	0.22	0.22	ft
RF _{combination} =	0.55	0.55	
RF _{Curb} =	1.00	1.00	
RF _{Grate} =	0.55	0.55	
	MINOR	MAJOR	
Q _s =	3.1	3.1	cfs
Q _{PEAK REQUIRED} =	1.6	3.5	cfs

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P6

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_x = 0.024$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	2.0	2.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

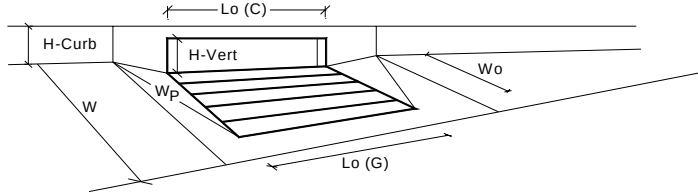
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storm					

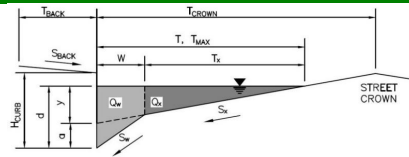
	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
a _{local} =	2.00	2.00	inches
No =	1	1	
Ponding Depth =	2.0	2.0	inches
	MINOR	MAJOR	Override Depths
L _o (G) =	3.00	3.00	feet
W _o =	1.73	1.73	feet
A _{ratio} =	0.31	0.31	
C _r (G) =	0.50	0.50	
C _w (G) =	3.60	3.60	
C _o (G) =	0.60	0.60	
	MINOR	MAJOR	
L _o (C) =	3.00	3.00	feet
H _{vert} =	6.50	6.50	inches
H _{throat} =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
W _p =	2.00	2.00	feet
C _r (C) =	0.10	0.10	
C _w (C) =	3.70	3.70	
C _o (C) =	0.66	0.66	
	MINOR	MAJOR	
d _{Grate} =	0.189	0.189	ft
d _{Curb} =	0.02	0.02	ft
RF _{combination} =	0.31	0.31	
RF _{Curb} =	0.97	0.97	
RF _{Grate} =	0.31	0.31	
	MINOR	MAJOR	
Q _s =	0.2	0.2	cfs
Q _{PEAK REQUIRED} =	0.4	1.0	cfs

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P7

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 48.0$ ft
 $W = 2.00$ ft
 $S_x = 0.020$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	48.0	48.0	ft
$d_{MAX} =$	6.0	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

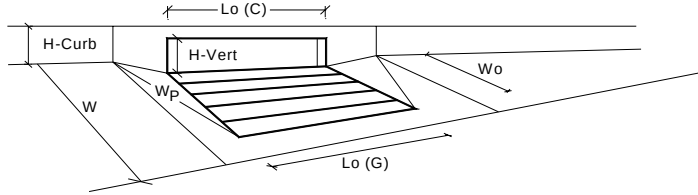
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)					

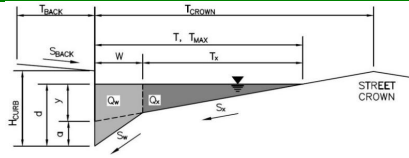
	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
a _{local} =	2.00	2.00	inches
No =	4	4	
Ponding Depth =	6.0	6.0	inches
	MINOR	MAJOR	Override Depths
L _o (G) =	3.00	3.00	feet
W _o =	1.73	1.73	feet
A _{ratio} =	0.31	0.31	
C _r (G) =	0.50	0.50	
C _w (G) =	3.60	3.60	
C _o (G) =	0.60	0.60	
	MINOR	MAJOR	
L _o (C) =	3.00	3.00	feet
H _{vert} =	6.50	6.50	inches
H _{throat} =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
W _p =	2.00	2.00	feet
C _r (C) =	0.10	0.10	
C _w (C) =	3.70	3.70	
C _o (C) =	0.66	0.66	
	MINOR	MAJOR	
d _{Grate} =	0.523	0.523	ft
d _{Curb} =	0.33	0.33	ft
RF _{combination} =	0.57	0.57	
RF _{Curb} =	0.87	0.87	
RF _{Grate} =	0.57	0.57	
	MINOR	MAJOR	
Q _a =	10.1	10.1	cfs
Q _{PEAK REQUIRED} =	4.0	8.1	cfs

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P8

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_c = 0.037$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	3.4	3.4	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

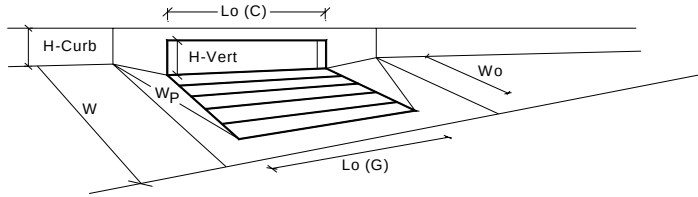
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storm					

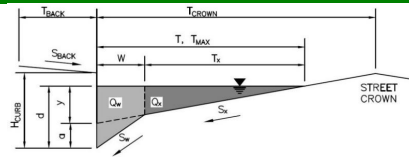
	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
a _{local} =	2.00	2.00	inches
No =	1	1	
Ponding Depth =	3.4	3.4	inches
	MINOR	MAJOR	Override Depths
L _o (G) =	3.00	3.00	feet
W _o =	1.73	1.73	feet
A _{ratio} =	0.31	0.31	
C _r (G) =	0.50	0.50	
C _w (G) =	3.60	3.60	
C _o (G) =	0.60	0.60	
	MINOR	MAJOR	
L _o (C) =	3.00	3.00	feet
H _{vert} =	6.50	6.50	inches
H _{throat} =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
W _p =	2.00	2.00	feet
C _r (C) =	0.10	0.10	
C _w (C) =	3.70	3.70	
C _o (C) =	0.66	0.66	
	MINOR	MAJOR	
d _{Grate} =	0.303	0.303	ft
d _{Curb} =	0.11	0.11	ft
RF _{combination} =	0.53	0.53	
RF _{Curb} =	1.00	1.00	
RF _{Grate} =	0.53	0.53	
	MINOR	MAJOR	
Q _s =	0.9	0.9	cfs
Q _{PEAK REQUIRED} =	3.2	6.7	cfs

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

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

Project: Outlets at Castle Rock - Pads B & C

Inlet ID: P9

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 0.0$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 32.0$ ft
 $W = 2.00$ ft
 $S_x = 0.039$ ft/ft
 $S_y = 0.083$ ft/ft
 $S_0 = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	32.0	32.0	ft
$d_{MAX} =$	7.1	7.1	inches

☐ ☐

MINOR STORM Allowable Capacity is based on Depth Criterion

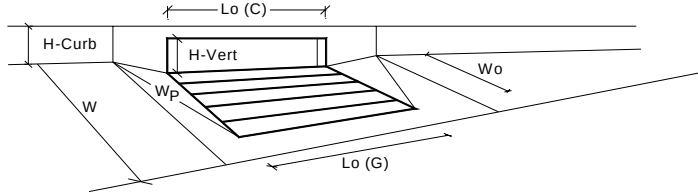
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

	Minor Storm	Major Storm	
	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	Denver No. 16 Combination				
Local Depression (additional to continuous gutter depression 'a' from above)					
Number of Unit Inlets (Grate or Curb Opening)					
Water Depth at Flowline (outside of local depression)					
Grate Information					
Length of a Unit Grate					
Width of a Unit Grate					
Area Opening Ratio for a Grate (typical values 0.15-0.90)					
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)					
Grate Weir Coefficient (typical value 2.15 - 3.60)					
Grate Orifice Coefficient (typical value 0.60 - 0.80)					
Curb Opening Information					
Length of a Unit Curb Opening					
Height of Vertical Curb Opening in Inches					
Height of Curb Orifice Throat in Inches					
Angle of Throat (see USDCM Figure ST-5)					
Side Width for Depression Pan (typically the gutter width of 2 feet)					
Clogging Factor for a Single Curb Opening (typical value 0.10)					
Curb Opening Weir Coefficient (typical value 2.3-3.7)					
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)					
Low Head Performance Reduction (Calculated)					
Depth for Grate Midwidth					
Depth for Curb Opening Weir Equation					
Combination Inlet Performance Reduction Factor for Long Inlets					
Curb Opening Performance Reduction Factor for Long Inlets					
Grated Inlet Performance Reduction Factor for Long Inlets					
Total Inlet Interception Capacity (assumes clogged condition)					
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)					
		MINOR		MAJOR	
		Type =		Denver No. 16 Combination	
		a _{local} =		2.00 inches	
		No =		2	
		Ponding Depth =		7.1 inches	
		L _o (G) =		3.00 feet	
		W _o =		1.73 feet	
		A _{ratio} =		0.31	
		C _r (G) =		0.50	
		C _w (G) =		3.60	
		C _o (G) =		0.60	
		L _o (C) =		3.00 feet	
		H _{vert} =		6.50 inches	
		H _{throat} =		5.25 inches	
		Theta =		0.00 degrees	
		W _p =		2.00 feet	
		C _r (C) =		0.10	
		C _w (C) =		3.70	
		C _o (C) =		0.66	
		d _{Grate} =		0.614 ft	
		d _{Curb} =		0.43 ft	
		RF _{combination} =		0.84	
		RF _{Curb} =		1.00	
		RF _{Grate} =		0.84	
		Q _a =		9.8 cfs	
		Q _{PEAK REQUIRED} =		4.2 cfs	



Inlet Calculations (IN-P10)

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

By: JMN

DEVELOPED CONDITION

$$Q_i = C_w L_w d^{1.5}$$
$$Q_i = C_o A_o (2gd)^{0.5}$$

MHFD, USDCM Vol. 1, Eq. 7-37
MHFD, USDCM Vol. 1, Eq. 7-38

$$C_w = 3.00$$
$$C_o = 0.67$$

MHFD, USDCM Vol. 1, Table 7-8; Grate Inlet
MHFD, USDCM Vol. 1, Table 7-8; Grate Inlet

$$L_w = 12.00 \quad (\text{ft})$$
$$A_o = 7.30 \quad (\text{sf})$$
$$d = 1.00 \quad (\text{ft})$$

(CDOT Type C Close Mesh Grate)
(CDOT Type C Close Mesh Grate)

$$Q_w = 36.00 \quad (\text{cfs})$$
$$Q_o = 39.25 \quad (\text{cfs})$$

$$Q_{\text{design}} = 9.00 \quad (\text{cfs})$$

(with 75% reduction factor for clogging)

$$Q_s = 1.98 \quad (\text{cfs})$$
$$Q_{10} = 4.05 \quad (\text{cfs})$$

(Design Runoff - Developed)
(Design Runoff - Developed)

¹Calculations performed using MHFD, USDCM Vol. 1, Chapter 7, Section 3.2.7 standard equations.

UNDEVELOPED CONDITION (determine volume required for 100-yr event runoff in case of inlet failure)

$$V_{100} = C P_1 A$$

$$P_1 = 2.60 \quad (\text{in})$$
$$C = 0.13 \quad (\%)$$
$$\text{Area} = 0.76 \quad (\text{ac})$$
$$33,105 \quad (\text{sf})$$

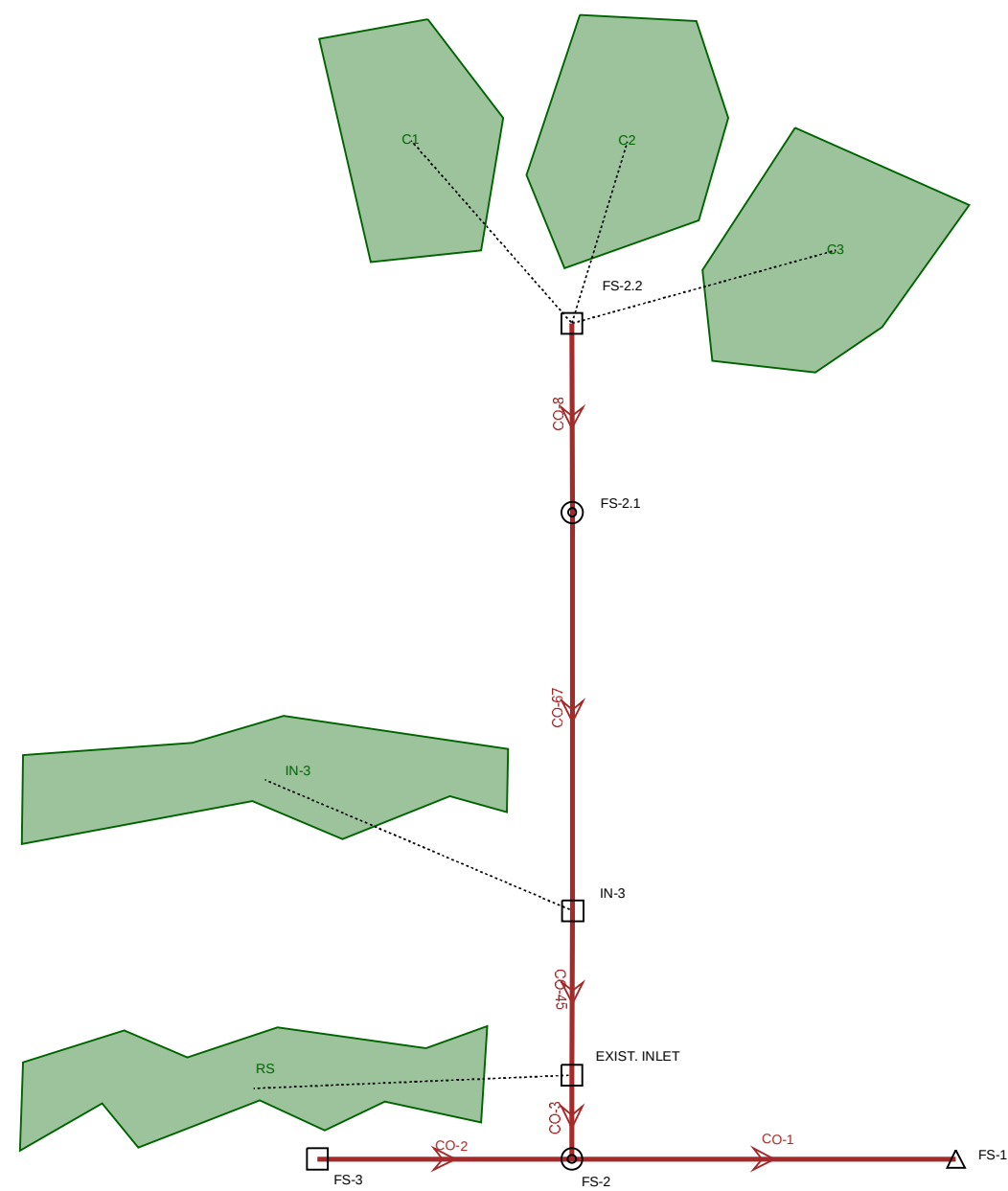
Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual*, Table 6-1
(Assumed overlot native seed = 2% imp.; MHFD Table 6-5 Hydrologic Soil A, C=0.13)
(Area = Basin P10 + Pad Site contributions in Basins P8, P9, and X3)

$$V_{100} = 901 \quad (\text{cf})$$

$$V_{\text{provided}} = \sum ((A_1 A_2)^{0.5} + A_1 + A_2) (h/3)$$

Elev.	Area (sf)	Vol. (cf)	ΣVol. (cf)
109.0	0	167	167
110.0	500	866	1033
110.6	2674		

Scenario: Base



Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-1	75.99	FS-2	79.14	1.770	42.0	315.0	0.013	0.010	42.29	10.00	81.52	81.23	330,968.9	12.984	15.209	3.231
CO-2	FS-2	79.76	FS-3	82.21	0.000	30.0	224.6	0.013	0.011	29.17	9.39	84.05	82.53	0.0	8.420	13.440	3.437
CO-3	FS-2	79.89	EXIST. INLET	85.76	0.050	18.0	55.0	0.013	0.107	14.89	18.73	87.16	82.53	330,968.9	4.564	15.160	3.236
CO-8	FS-2.1	108.69	FS-2.2	115.20	0.000	15.0	220.4	0.013	0.030	11.18	10.31	116.41	109.72	143,051.0	2.286	5.000	4.850
CO-45	EXIST. INLET	86.21	IN-3	92.25	0.050	18.0	61.4	0.013	0.098	16.27	18.59	93.68	87.00	259,574.0	4.105	9.590	3.931
CO-67	IN-3	92.90	FS-2.1	108.59	0.050	15.0	225.7	0.013	0.070	11.01	14.76	109.79	93.63	143,051.0	2.286	5.356	4.779

¹Downstream HGL interpolated from FACTORY SHOPS REPORT, Appendix - Hydraulic Grade Line:

The FACTORY SHOPS REPORT includes 2-yr and 100-yr HGL calculations only. Line 3 is equivalent to the existing 42"RCP downstream of manhole FS-2 with an invert = 6072.50. FACTORY SHOPS REPORT Line 3 Q₂ = 39 cfs and Q₁₀₀ = 120.5 cfs. Design imperviousness for the tributary area is 76% (see above). MHFD 2-yr, 5-yr, and 100-yr Rational Coefficients for Soil Types A and B are 0.61, 0.64, 0.78 and 0.59, 0.61, 0.70 respectively. Interpolating between the FACTORY SHOPS REPORT Q₂ and Q₁₀₀ using the relationship of the MHFD Rational Coefficients for a tributary area imperviousness of 76% results in a FACTORY SHOPS REPORT Q₅ = 53.4 and 53.8 cfs for the respective soil types. Using the reported Q₂ and Q₁₀₀, and interpolated Q₅ (= 53.6 cfs average) with the FACTORY SHOPS REPORT reported 2-yr and 100-yr HGL elevation differences to the downstream manhole invert (3.78' and 11.95' respectively) results in a 5-yr HGL 5.24' above the manhole invert. Applied to the equivalent Surveyed/Design manhole invert of 6075.99 = HGL 6081.23.

²Upstream runoff contribution modeled at FS-3 by Design Point 7 External CA = 8.42 ac. at 0.224 hr. (see above)

³H_L coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-1	75.99	FS-2	79.14	1.770	42.0	315.0	0.013	0.010	88.14	9.16	90.36	87.94	330,968.9	14.907	15.211	5.866
CO-2	FS-2	79.76	FS-3	82.21	0.000	30.0	224.6	0.013	0.011	61.33	12.49	97.21	92.19	0.0	9.580	12.950	6.351
CO-3	FS-2	79.89	EXIST. INLET	85.76	0.050	18.0	55.0	0.013	0.107	31.54	17.85	97.15	92.19	330,968.9	5.327	15.160	5.874
CO-8	FS-2.1	108.69	FS-2.2	115.20	0.000	15.0	220.4	0.013	0.030	22.96	18.71	140.44	112.59	143,051.0	2.589	5.000	8.800
CO-45	EXIST. INLET	86.21	IN-3	92.25	0.050	18.0	61.4	0.013	0.098	33.29	18.84	95.88	89.71	259,574.0	4.622	9.590	7.146
CO-67	IN-3	92.90	FS-2.1	108.59	0.050	15.0	225.7	0.013	0.070	22.78	18.56	124.22	96.15	143,051.0	2.589	5.196	8.729

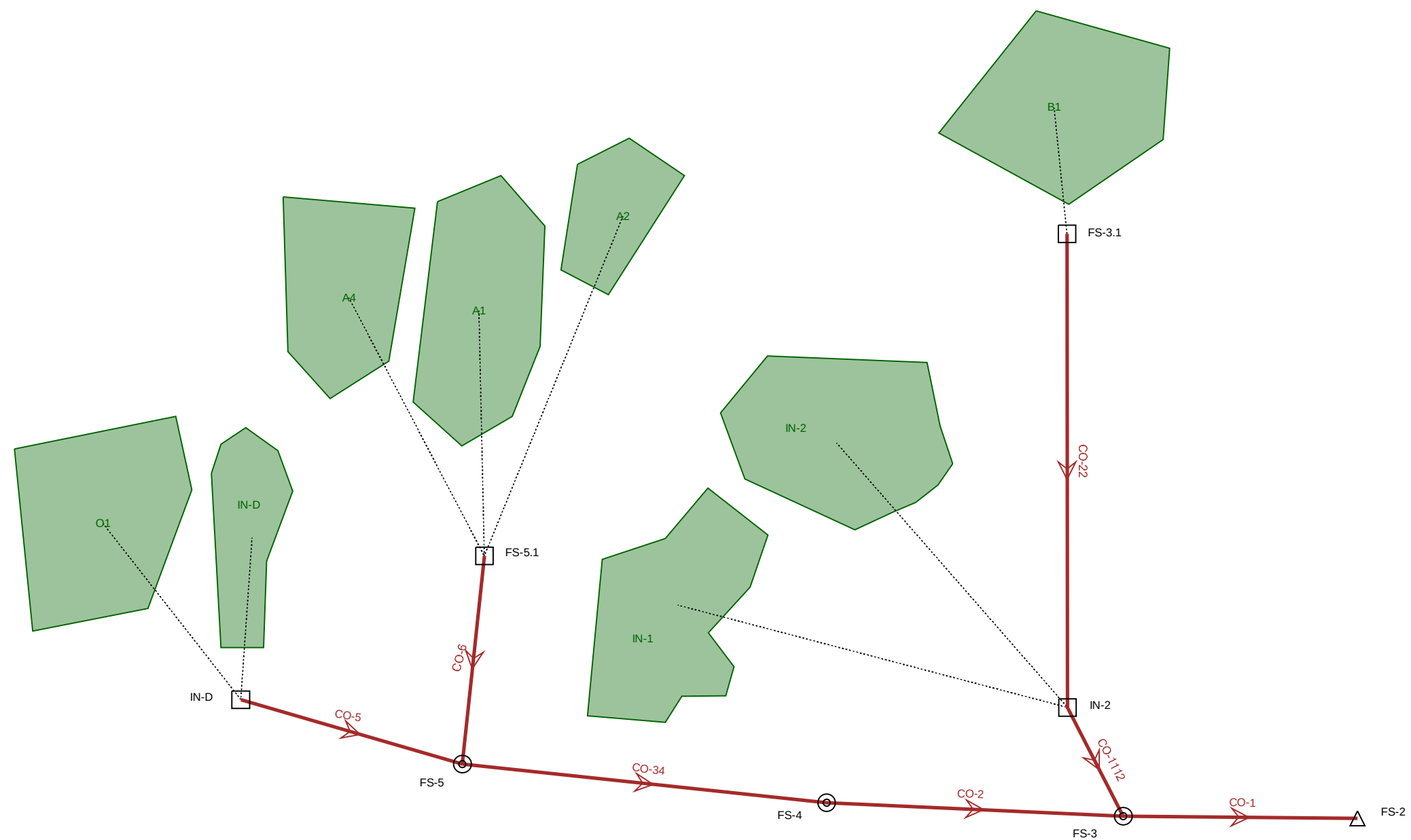
¹Downstream HGL from FACTORY SHOPS REPORT, Appendix - Hydraulic Grade Line:

FACTORY SHOPS REPORT Line 3 is equivalent to existing 42"RCP downstream of manhole FS-2. FACTORY SHOPS REPORT Downstream 100-yr HGL = 6084.45 (11.95' above a reported manhole invert = 6072.50).
11.95' applied to equivalent Surveyed/Design manhole invert of 6075.99 = HGL 6087.94

²Upstream runoff contribution modeled at FS-3 by Design Point 7 External CA = 9.58 ac. at 0.216 hr. (see above)

³H_L coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Scenario: Base



Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-2	79.76	FS-3	82.21	1.770	30.0	224.6	0.013	0.011	29.68	9.42	84.07	81.29	539,795.5	8.429	12.972	3.493
CO-2	FS-3	82.71	FS-4	85.47	0.050	24.0	256.0	0.013	0.011	17.23	8.17	86.97	85.65	237,706.9	4.037	8.079	4.234
CO-5	FS-5	89.10	IN-D	91.22	0.000	18.0	191.8	0.013	0.011	7.92	6.80	92.31	91.43	101,233.4	1.775	7.100	4.430
CO-6	FS-5	89.10	FS-5.1	95.85	0.000	18.0	79.9	0.013	0.084	10.91	15.83	97.12	91.43	136,473.5	2.263	5.330	4.784
CO-1112	FS-3	83.21	IN-2	94.90	0.100	18.0	167.3	0.013	0.070	15.55	16.16	96.32	85.65	302,088.6	4.391	12.800	3.514
CO-22	IN-2	95.20	FS-3.1	115.76	0.000	15.0	379.9	0.013	0.054	5.93	11.52	116.75	96.44	70,480.1	1.214	5.000	4.850
CO-34	FS-4	85.77	FS-5	88.60	1.770	24.0	254.0	0.013	0.011	17.64	8.32	90.11	87.05	237,706.9	4.037	7.570	4.336

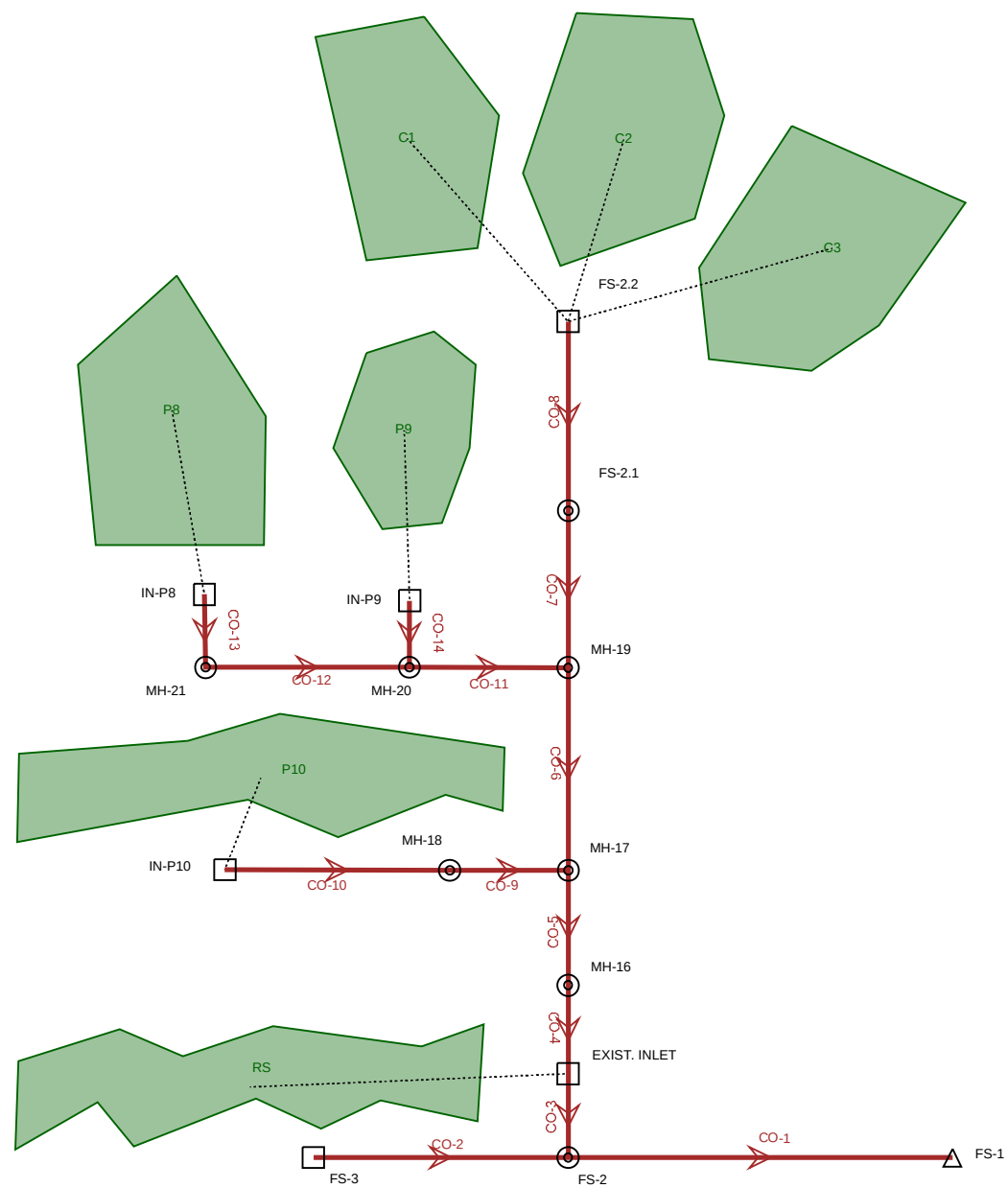
¹H_L coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-2	79.76	FS-3	82.21	1.770	30.0	224.6	0.013	0.011	61.41	12.51	97.23	92.19	539,795.5	9.593	12.951	6.351
CO-2	FS-3	82.71	FS-4	85.47	0.050	24.0	256.0	0.013	0.011	35.39	11.27	99.87	93.60	237,706.9	4.512	7.823	7.783
CO-5	FS-5	89.10	IN-D	91.22	0.000	18.0	191.8	0.013	0.011	15.96	9.03	108.25	103.81	101,233.4	1.969	7.100	8.043
CO-6	FS-5	89.10	FS-5.1	95.85	0.000	18.0	79.9	0.013	0.084	22.25	12.59	107.40	103.81	136,473.5	2.543	5.330	8.681
CO-1112	FS-3	83.21	IN-2	94.90	0.100	18.0	167.3	0.013	0.070	32.70	18.50	109.82	93.60	302,088.6	5.081	12.800	6.384
CO-22	IN-2	95.20	FS-3.1	115.76	0.000	15.0	379.9	0.013	0.054	11.63	13.52	116.97	104.50	70,480.1	1.311	5.000	8.800
CO-34	FS-4	85.77	FS-5	88.60	1.770	24.0	254.0	0.013	0.011	36.00	11.46	100.20	93.77	237,706.9	4.512	7.454	7.916

¹H_i coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Scenario: Base



Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-1	75.99	FS-2	79.14	1.770	42.0	315.0	0.013	0.010	42.68	10.03	81.53	81.23	312,238.1	13.108	15.223	3.230
CO-2	FS-2	79.76	FS-3	82.21	0.000	30.0	224.6	0.013	0.011	31.63	9.55	84.13	82.55	0.0	8.780	12.300	3.574
CO-3	FS-2	79.89	EXIST. INLET	83.12	0.050	24.0	55.0	0.013	0.059	14.12	14.62	84.47	82.55	312,238.1	4.328	15.160	3.236
CO-4	EXIST. INLET	86.01	MH-16	87.60	0.050	24.0	16.2	0.013	0.098	16.52	18.40	89.07	86.87	242,542.1	3.864	8.043	4.241
CO-5	MH-16	89.81	MH-17	92.09	1.770	24.0	43.6	0.013	0.052	16.56	14.65	93.56	90.67	242,542.1	3.864	7.994	4.251
CO-6	MH-17	92.29	MH-19	102.51	1.770	24.0	194.9	0.013	0.052	15.06	14.29	103.91	94.79	213,269.8	3.394	7.236	4.402
CO-7	MH-19	106.32	FS-2.1	108.59	0.050	15.0	32.5	0.013	0.070	11.01	14.78	109.79	107.13	143,051.0	2.286	5.356	4.779
CO-8	FS-2.1	108.69	FS-2.2	115.20	0.000	15.0	220.4	0.013	0.030	11.18	10.31	116.41	109.72	143,051.0	2.286	5.000	4.850
CO-9	MH-17	96.54	MH-18	99.68	0.100	15.0	39.3	0.013	0.080	2.02	9.80	100.25	96.82	29,272.3	0.470	7.927	4.264
CO-10	MH-18	102.32	IN-P10	103.75	0.000	15.0	71.5	0.013	0.020	2.04	5.99	104.32	102.72	29,272.3	0.470	7.728	4.304
CO-11	MH-19	103.01	MH-20	104.37	1.770	18.0	67.9	0.013	0.020	4.95	7.57	105.23	105.04	70,218.7	1.108	7.087	4.432
CO-12	MH-20	104.57	MH-21	105.77	1.320	18.0	60.0	0.013	0.020	3.13	6.66	106.44	105.85	44,605.4	0.696	6.937	4.462
CO-13	MH-21	105.97	IN-P8	106.11	0.000	18.0	6.8	0.013	0.021	3.13	6.75	106.78	106.78	44,605.4	0.696	6.920	4.466
CO-14	MH-20	105.93	IN-P9	106.07	0.000	15.0	6.8	0.013	0.021	1.90	5.95	106.62	106.36	25,613.3	0.412	6.390	4.572

¹Downstream HGL interpolated from FACTORY SHOPS REPORT, Appendix - Hydraulic Grade Line:

The FACTORY SHOPS REPORT includes 2-yr and 100-yr HGL calculations only. Line 3 is equivalent to the existing 42"RCP downstream of manhole FS-2 with an invert = 6072.50. FACTORY SHOPS REPORT Line 3 Q₂ = 39 cfs and Q₁₀₀ = 120.5 cfs. Design imperviousness for the tributary area is 76% (see above). MHFD 2-yr, 5-yr, and 100-yr Rational Coefficients for Soil Types A and B are 0.61, 0.64, 0.78 and 0.59, 0.61, 0.70 respectively. Interpolating between the FACTORY SHOPS REPORT Q₂ and Q₁₀₀ using the relationship of the MHFD Rational Coefficients for a tributary area imperviousness of 76% results in a FACTORY SHOPS REPORT Q₅ = 53.4 and 53.8 cfs for the respective soil types. Using the reported Q₂ and Q₁₀₀, and interpolated Q₅ (= 53.6 cfs average) with the FACTORY SHOPS REPORT reported 2-yr and 100-yr HGL elevation differences to the downstream manhole invert (3.78' and 11.95' respectively) results in a 5-yr HGL 5.24' above the manhole invert. Applied to the equivalent Surveyed/Design manhole invert of 6075.99 = HGL 6081.23.

²Upstream runoff contribution modeled at FS-3 by Design Point 7 External CA = 8.78 ac. at 0.205 hr. (see above)

³H_L coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-1	75.99	FS-2	79.14	1.770	42.0	315.0	0.013	0.010	88.00	9.15	90.35	87.94	312,238.1	14.901	15.256	5.859
CO-2	FS-2	79.76	FS-3	82.21	0.000	30.0	224.6	0.013	0.011	67.31	13.71	98.24	92.19	0.0	9.860	11.030	6.773
CO-3	FS-2	79.89	EXIST. INLET	83.12	0.050	24.0	55.0	0.013	0.059	29.85	9.50	93.15	92.19	312,238.1	5.041	15.160	5.874
CO-4	EXIST. INLET	86.01	MH-16	87.60	0.050	24.0	16.2	0.013	0.098	33.77	10.75	90.07	89.71	242,542.1	4.337	7.989	7.723
CO-5	MH-16	89.81	MH-17	92.09	1.770	24.0	43.6	0.013	0.052	33.83	17.56	94.00	91.16	242,542.1	4.337	7.947	7.738
CO-6	MH-17	92.29	MH-19	102.51	1.770	24.0	194.9	0.013	0.052	30.51	17.16	104.38	97.29	213,269.8	3.820	7.431	7.924
CO-7	MH-19	106.32	FS-2.1	108.59	0.050	15.0	32.5	0.013	0.070	22.78	18.56	111.61	107.57	143,051.0	2.589	5.196	8.729
CO-8	FS-2.1	108.69	FS-2.2	115.20	0.000	15.0	220.4	0.013	0.030	22.96	18.71	139.73	111.88	143,051.0	2.589	5.000	8.800
CO-9	MH-17	96.54	MH-18	99.68	0.100	15.0	39.3	0.013	0.080	4.05	11.96	100.49	96.95	29,272.3	0.517	7.893	7.758
CO-10	MH-18	102.32	IN-P10	103.75	0.000	15.0	71.5	0.013	0.020	4.08	7.23	104.57	102.91	29,272.3	0.517	7.728	7.817
CO-11	MH-19	103.01	MH-20	104.37	1.770	18.0	67.9	0.013	0.020	9.92	5.62	107.73	107.12	70,218.7	1.231	7.229	7.997
CO-12	MH-20	104.57	MH-21	105.77	1.320	18.0	60.0	0.013	0.020	6.35	3.59	108.82	108.60	44,605.4	0.778	6.951	8.097
CO-13	MH-21	105.97	IN-P8	106.11	0.000	18.0	6.8	0.013	0.021	6.36	3.60	109.11	109.08	44,605.4	0.778	6.920	8.108
CO-14	MH-20	105.93	IN-P9	106.07	0.000	15.0	6.8	0.013	0.021	3.79	3.09	108.62	108.60	25,613.3	0.453	6.390	8.299

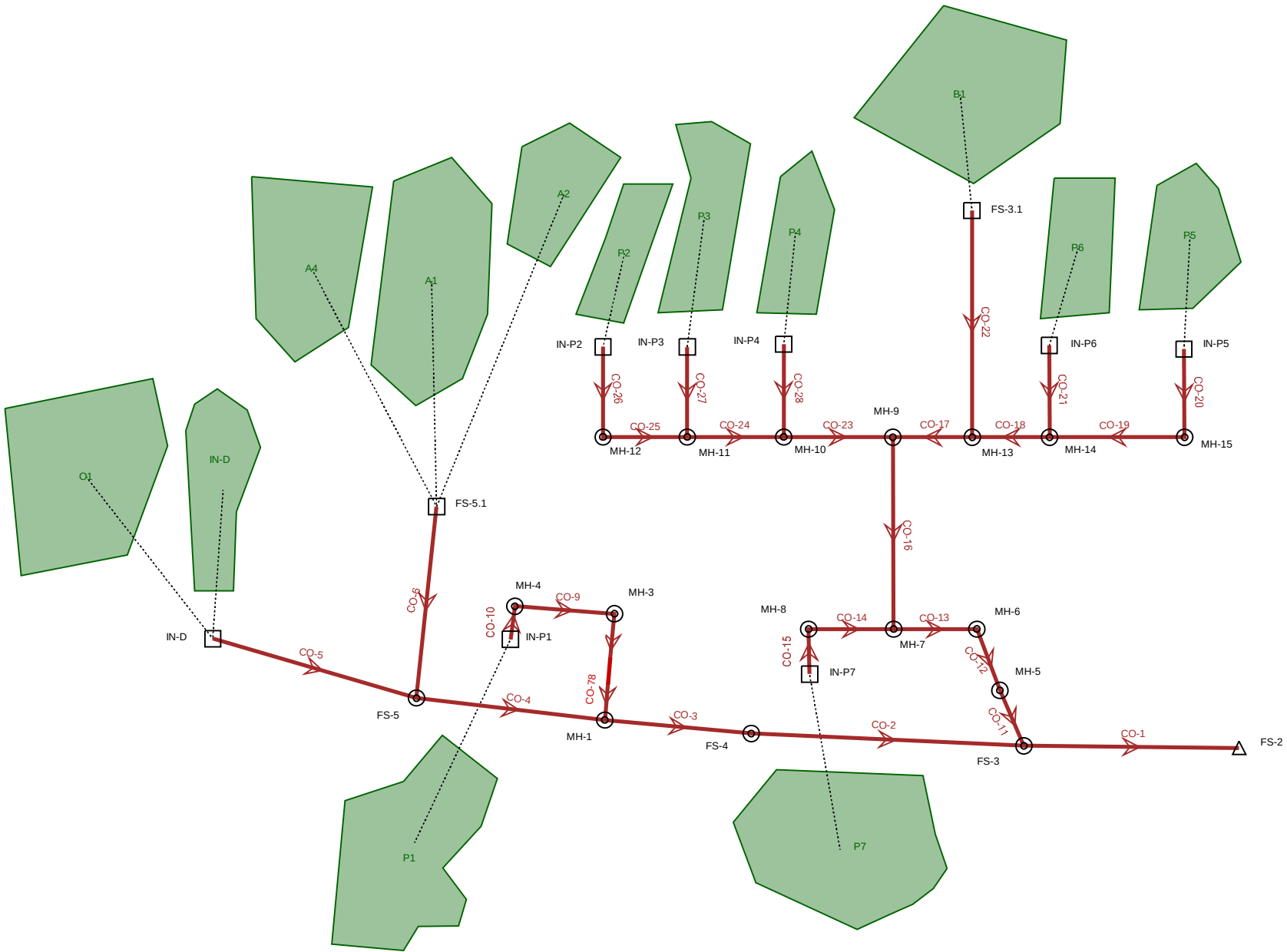
¹Downstream HGL from FACTORY SHOPS REPORT, Appendix - Hydraulic Grade Line:

FACTORY SHOPS REPORT Line 3 is equivalent to existing 42"RCP downstream of manhole FS-2. FACTORY SHOPS REPORT Downstream 100-yr HGL = 6084.45 (11.95' above a reported manhole invert = 6072.50).
11.95' applied to equivalent Surveyed/Design manhole invert of 6075.99 = HGL 6087.94

²Upstream runoff contribution modeled at FS-3 by Design Point 7 External CA = 9.86 ac. at 0.184 hr. (see above)

³H_L coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Scenario: Base



Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-2	79.76	FS-3	82.21	1.770	30.0	224.6	0.013	0.011	32.91	9.62	84.16	81.40	545,850.4	8.800	11.167	3.710
CO-2	FS-3	82.71	FS-4	85.47	0.050	24.0	256.0	0.013	0.011	18.07	5.75	87.56	85.92	284,882.4	4.720	10.425	3.799
CO-3	FS-4	85.77	MH-1	87.70	1.770	24.0	172.8	0.013	0.011	18.27	8.38	89.24	87.58	284,882.4	4.720	10.081	3.840
CO-4	MH-1	87.70	FS-5	88.60	1.770	24.0	81.2	0.013	0.011	17.45	5.55	91.09	90.60	237,706.9	4.037	7.813	4.287
CO-5	FS-5	89.10	IN-D	91.22	0.000	18.0	191.8	0.013	0.011	7.92	4.48	93.03	91.93	101,233.4	1.775	7.100	4.430
CO-6	FS-5	89.10	FS-5.1	95.85	0.000	18.0	79.9	0.013	0.084	10.91	15.83	97.12	91.93	136,473.5	2.263	5.330	4.784
CO-9	MH-3	99.72	MH-4	101.77	1.320	15.0	102.4	0.013	0.020	2.68	6.47	102.43	100.51	47,175.5	0.682	9.767	3.896
CO-10	MH-4	101.97	IN-P1	102.11	0.000	15.0	6.8	0.013	0.021	2.68	6.53	102.77	102.77	47,175.5	0.682	9.750	3.899
CO-11	FS-3	83.21	MH-5	90.46	0.050	24.0	103.8	0.013	0.070	15.87	16.09	91.90	85.92	260,968.0	4.081	9.961	3.857
CO-12	MH-5	90.66	MH-6	92.57	1.320	24.0	72.1	0.013	0.027	15.95	11.30	94.01	91.62	260,968.0	4.081	9.854	3.878
CO-13	MH-6	92.77	MH-7	93.91	1.770	24.0	42.7	0.013	0.027	16.00	11.34	95.35	94.90	260,968.0	4.081	9.791	3.891
CO-14	MH-7	102.70	MH-8	103.46	1.320	15.0	38.0	0.013	0.020	3.87	7.13	104.26	103.28	48,569.4	0.792	5.026	4.845
CO-15	MH-8	103.66	IN-P7	103.89	0.000	15.0	11.3	0.013	0.020	3.87	7.19	104.69	104.71	48,569.4	0.792	5.000	4.850
CO-16	MH-7	94.11	MH-9	99.22	1.770	24.0	181.7	0.013	0.028	13.08	10.96	100.52	96.55	212,398.6	3.289	9.515	3.946
CO-17	MH-9	99.72	MH-13	103.25	1.770	18.0	40.1	0.013	0.088	6.76	14.10	104.26	101.53	100,841.4	1.639	8.782	4.093
CO-18	MH-13	103.70	MH-14	105.77	1.770	15.0	23.4	0.013	0.089	1.76	9.76	106.30	105.05	30,361.3	0.426	8.742	4.101
CO-19	MH-14	105.97	MH-15	107.14	1.320	15.0	58.4	0.013	0.020	1.55	5.56	107.63	106.65	20,342.5	0.332	6.040	4.642
CO-20	MH-15	107.34	IN-P5	107.48	0.000	15.0	6.8	0.013	0.021	1.55	5.62	107.97	107.88	20,342.5	0.332	6.020	4.646
CO-21	MH-14	107.66	IN-P6	107.80	0.000	15.0	6.8	0.013	0.021	0.39	3.74	108.04	107.84	10,018.8	0.094	8.712	4.107
CO-22	MH-13	105.37	FS-3.1	115.76	0.000	15.0	192.1	0.013	0.054	5.93	11.52	116.75	105.92	70,480.1	1.214	5.000	4.850
CO-23	MH-9	99.42	MH-10	100.18	1.770	24.0	38.0	0.013	0.020	6.59	8.02	101.49	101.53	111,557.2	1.650	9.436	3.962
CO-24	MH-10	100.68	MH-11	103.13	1.770	18.0	122.1	0.013	0.020	4.85	7.53	103.98	101.74	83,809.4	1.197	9.166	4.016
CO-25	MH-11	103.38	MH-12	105.73	1.320	15.0	117.2	0.013	0.020	1.49	5.49	106.21	104.59	28,662.5	0.362	8.810	4.087
CO-26	MH-12	105.93	IN-P2	106.07	0.000	15.0	6.8	0.013	0.021	1.49	5.56	106.55	106.45	28,662.5	0.362	8.790	4.091
CO-27	MH-11	105.85	IN-P3	105.99	0.000	15.0	6.8	0.013	0.021	3.60	7.10	106.76	106.47	55,147.0	0.836	7.872	4.275
CO-28	MH-10	105.41	IN-P4	105.55	0.000	15.0	6.8	0.013	0.021	2.13	6.16	106.13	105.87	27,747.7	0.452	5.840	4.682
CO-78	MH-1	96.05	MH-3	99.52	1.320	15.0	34.6	0.013	0.100	2.64	11.48	100.17	96.36	47,175.5	0.682	10.031	3.846

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Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Upstream Structure Headloss Coefficient	Diameter (in)	Length (User Defined) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	System Drainage Area (ft²)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)
CO-1	FS-2	79.76	FS-3	82.21	1.770	30.0	224.6	0.013	0.011	67.78	13.81	98.32	92.19	545,850.4	9.876	10.865	6.809
CO-2	FS-3	82.71	FS-4	85.47	0.050	24.0	256.0	0.013	0.011	36.97	11.77	100.44	93.60	284,882.4	5.324	10.502	6.889
CO-3	FS-4	85.77	MH-1	87.70	1.770	24.0	172.8	0.013	0.011	37.25	11.86	98.46	93.77	284,882.4	5.324	10.260	6.942
CO-4	MH-1	87.70	FS-5	88.60	1.770	24.0	81.2	0.013	0.011	36.00	11.46	104.38	102.33	237,706.9	4.512	7.454	7.916
CO-5	FS-5	89.10	IN-D	91.22	0.000	18.0	191.8	0.013	0.011	15.96	9.03	111.49	107.06	101,233.4	1.969	7.100	8.043
CO-6	FS-5	89.10	FS-5.1	95.85	0.000	18.0	79.9	0.013	0.084	22.25	12.59	110.65	107.06	136,473.5	2.543	5.330	8.681
CO-9	MH-3	99.72	MH-4	101.77	1.320	15.0	102.4	0.013	0.020	5.80	4.72	103.86	103.04	47,175.5	0.812	9.774	7.080
CO-10	MH-4	101.97	IN-P1	102.11	0.000	15.0	6.8	0.013	0.021	5.80	4.73	104.38	104.32	47,175.5	0.812	9.750	7.089
CO-11	FS-3	83.21	MH-5	90.46	0.050	24.0	103.8	0.013	0.070	31.47	10.02	95.61	93.60	260,968.0	4.552	10.637	6.859
CO-12	MH-5	90.66	MH-6	92.57	1.320	24.0	72.1	0.013	0.027	31.59	10.06	97.09	95.69	260,968.0	4.552	10.518	6.885
CO-13	MH-6	92.77	MH-7	93.91	1.770	24.0	42.7	0.013	0.027	31.66	10.08	100.00	99.17	260,968.0	4.552	10.447	6.901
CO-14	MH-7	102.70	MH-8	103.46	1.320	15.0	38.0	0.013	0.020	7.71	8.35	104.56	103.60	48,569.4	0.870	5.030	8.789
CO-15	MH-8	103.66	IN-P7	103.89	0.000	15.0	11.3	0.013	0.020	7.71	6.29	105.65	105.49	48,569.4	0.870	5.000	8.800
CO-16	MH-7	94.11	MH-9	99.22	1.770	24.0	181.7	0.013	0.028	25.91	8.25	105.18	102.80	212,398.6	3.682	10.080	6.982
CO-17	MH-9	99.72	MH-13	103.25	1.770	18.0	40.1	0.013	0.088	13.37	7.57	107.70	107.05	100,841.4	1.801	8.988	7.363
CO-18	MH-13	103.70	MH-14	105.77	1.770	15.0	23.4	0.013	0.089	3.67	2.99	109.35	109.27	30,361.3	0.491	8.857	7.410
CO-19	MH-14	105.97	MH-15	107.14	1.320	15.0	58.4	0.013	0.020	3.09	2.52	109.73	109.59	20,342.5	0.364	6.065	8.416
CO-20	MH-15	107.34	IN-P5	107.48	0.000	15.0	6.8	0.013	0.021	3.10	2.52	109.87	109.86	20,342.5	0.364	6.020	8.432
CO-21	MH-14	107.66	IN-P6	107.80	0.000	15.0	6.8	0.013	0.021	0.95	0.78	109.60	109.59	10,018.8	0.126	8.712	7.463
CO-22	MH-13	105.37	FS-3.1	115.76	0.000	15.0	192.1	0.013	0.054	11.63	13.51	116.97	109.27	70,480.1	1.311	5.000	8.800
CO-23	MH-9	99.42	MH-10	100.18	1.770	24.0	38.0	0.013	0.020	13.31	4.24	107.18	107.05	111,557.2	1.881	9.931	7.024
CO-24	MH-10	100.68	MH-11	103.13	1.770	18.0	122.1	0.013	0.020	9.98	5.65	108.78	107.68	83,809.4	1.384	9.570	7.153
CO-25	MH-11	103.38	MH-12	105.73	1.320	15.0	117.2	0.013	0.020	3.25	2.65	109.95	109.66	28,662.5	0.434	8.832	7.419
CO-26	MH-12	105.93	IN-P2	106.07	0.000	15.0	6.8	0.013	0.021	3.25	2.65	110.11	110.10	28,662.5	0.434	8.790	7.434
CO-27	MH-11	105.85	IN-P3	105.99	0.000	15.0	6.8	0.013	0.021	7.43	6.06	109.74	109.66	55,147.0	0.950	7.872	7.765
CO-28	MH-10	105.41	IN-P4	105.55	0.000	15.0	6.8	0.013	0.021	4.26	3.47	107.71	107.68	27,747.7	0.497	5.840	8.497
CO-30	MH-1	96.05	MH-3	99.52	1.320	15.0	34.6	0.013	0.100	5.71	4.65	102.60	102.33	47,175.5	0.812	10.135	6.969

¹H_i coefficient in accordance with MHFD, Technical Paper; "Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods," prepared by AMEC Earth & Environmental, Inc.; dated October 6, 2009; prepared for Urban Drainage and Flood Control District; Table 2 - StormCAD Standard Method Conversions.

Job Name: CROM Pad - Castle Rock, Colorado

Date: 5/9/22

Calculated by: JMN

Design Storm: 100-yr

EXISTING

[illegible]

	C4	8.54	0.71	³ 10.00	6.05	7.00	42.32												to C1
	C1	0.81	0.75	8.73	0.61	7.50	4.59												to DP 9
								18.73	6.66	5.30	35.29					606		9.59	to DP 9
	IN-3	2.67	0.76	9.59	2.03	7.20	14.64												to DP 9
9 (Alt C)								28.32	8.69	4.20	36.50								to RS
(Alt A)	X3	1.05	0.87				6.42												to R.O.W.
	X4	0.18	0.93				1.20												to X5
	X5	0.26	0.88				1.61												to X6
	X6	0.08	0.96				0.51												to X3
	X1	0.68	0.82				3.91												to X2
	X2	0.79	0.82				4.56												to X3
	X3	1.05	0.87				6.42												to R.O.W.
(Alt B)								11.20	2.59	7.03	18.21								to R.O.W.
	C2	1.35	0.81	³ 5.00	1.10	8.80	9.64												to X1
	C3	1.12	0.79	10.73	0.88	6.75	7.74												to X1
								10.73	1.98	6.75	13.33							11.20	to R.O.W.
	X4	0.18	0.93				1.20												to X5
	X5	0.26	0.88				1.61												to X6
	X6	0.08	0.96				0.51												to X3
	X1	0.68	0.82				3.91												to X2
	X2	0.79	0.82				4.56												to X3
	X3	1.05	0.87				6.42												to R.O.W.
(Alt C)								21.93	4.57	4.85	22.14								to R.O.W.
	C5	1.13	0.77	³ 5.00	0.88	8.80	7.71												to C3
	C2	1.35	0.81	³ 5.00	1.10	8.80	9.64												to X1
	C3	1.12	0.79	10.73	0.88	6.75	7.74												to X1
								15.73	2.85	5.75	16.40							11.20	to R.O.W.
	X4	0.18	0.93				1.20												to X5
	X5	0.26	0.88				1.61												to X6
	X6	0.08	0.96				0.51												to X3
	X1	0.68	0.82				3.91												to X2
	X2	0.79	0.82				4.56												to X3
	X3	1.05	0.87				6.42												to R.O.W.
(Alt D)								26.93	5.44	4.35	23.67								to R.O.W.

¹Intensity from Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual*, Figure 6-1

²See Time of Concentration calculations for Tc

³Assumed minimum Tc

⁴(Pad A Letter)

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

Calculated by: JMN

Design Storm: 100-yr

PROPOSED

[illegible]

[illegible]

	C1	0.81	0.75	8.73	0.61	7.50	4.59											6.92	to P8
	P5	0.23	0.78	6.03	0.18	8.45	1.53												to P8
	P6	0.11	0.55	8.71	0.06	7.60	0.48												to P8
	P8	1.02	0.76	6.92	0.78	8.05	6.28												to P8
								17.45	1.64	5.60	9.16								to P9
	P9	0.59	0.77	6.39	0.45	8.40	3.81												to P9
								17.45	2.09	5.60	11.70							10.00	to X3
	C2	1.35	0.81	³ 5.00	1.10	8.80	9.64												to X1
	C3	1.12	0.79	10.73	0.88	6.75	7.74												
								10.73	1.98	6.75	13.33							11.20	to R.O.W.
	X4	0.18	0.93				1.20												
	X5	0.26	0.88				1.61												
	X6	0.08	0.96				0.51												
	X1	0.68	0.82				3.91												
	X2	0.79	0.82				4.56												
	X3	1.05	0.87				6.42												
(Alt D)								27.45	6.71	4.35	29.19								to R.O.W.
	C4	8.54	0.71	³ 10.00	6.05	7.00	42.32											8.73	to P9
	C1	0.81	0.75	8.73	0.61	7.50	4.59												
	P5	0.23	0.78	6.03	0.18	8.45	1.53												
	P6	0.11	0.55	8.71	0.06	7.60	0.48												
	P8	1.02	0.76	6.92	0.78	8.05	6.28												
								27.45	7.68	4.35	33.42								to P9
	P9	0.59	0.77	6.39	0.45	8.40	3.81												to P9
								27.45	8.14	4.35	35.39							10.00	to X3
	C5	1.13	0.77	³ 5.00	0.88	8.80	7.71											10.73	
	C2	1.35	0.81	³ 5.00	1.10	8.80	9.64												
	C3	1.12	0.79	10.73	0.88	6.75	7.74												
								15.73	2.85	5.75	16.40							11.20	
	X4	0.18	0.93				1.20												
	X5	0.26	0.88				1.61												
	X6	0.08	0.96				0.51												
	X1	0.68	0.82				3.91												
	X2	0.79	0.82				4.56												
	X3	1.05	0.87				6.42												
(Alt E)								37.45	13.63	3.33	45.40								to R.O.W.
(Alt A)	P10	0.67	0.77	7.73	0.52	7.85	4.05											(Developed)	to R.O.W.
(Alt B)	P10	0.76	0.13	19.62	0.10	5.20	0.50											(Undeveloped)	to R.O.W.

¹Intensity from Town of Castle Rock, *Storm Drainage Design & Technical Criteria Manual* , Figure 6-1

²See Time of Concentration calculations for Tc

³Assumed minimum Tc

⁴(Pad A Letter)



Emergency Weir

Job Name: CROM Pad - Castle Rock, Colorado

Date: 8/31/22

By: JMN

$$Q_a = C_{bcw} L H^{1.5}$$

$$Q_b = (2/5) C_{bcw} Z H^{2.5}$$

$$C_{bcw} = 3.00$$

MHFD, USDCM Vol. 2, Eq. 12-8

MHFD, USDCM Vol. 2, Eq. 12-9

MHFD, USDCM Vol. 2, Sec. 5.14.2

Section	Elevation	H (ft)	Sloping Section	Rectangular Section	Q _{cap} (cfs)	Q ₁₀₀ (cfs)	Q _{em} (cfs)
			Z	L (ft)			
AA	11.84	0.050	12.00		0.0080		
		0.050	204.50		0.1372		
	12.00	0.160		1.00	0.1920		
		0.160		10.22	1.9622		
	12.26	0.160	204.50		2.5129		
		0.260		1.00	0.3977		
		0.260		42.94	17.0782		
		0.260	63.60		2.6307		
(Total)					24.9190	6.80	18.79
BB (future)	11.95	0.080	12.00		0.0261		
	12.37	0.420		1.00	0.8166		
		0.420	50.00		6.8592		
		0.080	12.00		0.0261		
		0.100		1.00	0.0949		
	12.55	0.100	49.50		0.1878		
		0.180		1.00	0.2291		
		0.180		21.00	4.8112		
		0.180	50.00		0.8248		
	12.69	0.180	35.17		0.5801		
		0.140		1.00	0.1571		
		0.140		30.00	4.7145		
		0.140		6.33	0.9948		
		0.140	35.14		0.3092		
		0.140	50.00		0.4400		
		0.320		5.95	3.2312		
		0.320	49.56		3.4450		

	12.93	0.240 0.240 0.240	50.00 49.56	71.06	25.0647 1.6931 1.6782		
(Total)					56.1837	3.69	12.15
BB (temp)	11.95 12.37	0.080 0.420 0.420 0.080 0.100 0.100 12.55 0.180 0.180 0.180 0.180 0.180 0.180 13.00 0.450 0.140 0.310 0.450 0.450 0.080 0.370	12.00 50.00 12.00 49.50 21.00 50.00 35.17 49.56 35.14 4.92 14.87 49.56 12.00	1.00 1.00 1.00 21.00 5.95 37.33 4.92 14.87 1.00	0.0261 0.8166 6.8592 0.0261 0.0949 0.1878 0.2291 4.8112 0.8248 0.5801 1.3632 0.8175 33.8063 0.3092 2.5476 13.4664 8.0787 0.0261 0.6752		
(Total)					75.5460	3.69	12.15
CC	11.94 12.36 12.55 12.63 12.72	0.080 0.420 0.420 0.190 0.190 0.190 0.190 0.080 0.080 0.080 0.090 0.090 0.080 0.420 0.420	12.00 49.19 49.16 31.26 31.25 12.00 31.22 12.00 36.26	1.00 1.00 20.66 36.94 40.44 1.00	0.0261 0.8166 6.7481 0.2485 5.1331 0.9283 0.5903 2.5076 0.0679 0.0261 3.2756 0.0910 0.0261 0.8166 4.9743		
(Total)					26.2760	3.69	12.15

DD	12.25	0.500		1.14	1.2092		
		0.500		1.14	1.2092		
		0.470		1.47	1.4210		
		0.430		1.47	1.2435		
		0.030	49.00		0.0092		
	12.27	0.070	21.00		0.0327		
		0.470	48.98		8.9011		
		0.430	21.28		3.0962		
		0.020		66.17	0.5615		
		0.020	48.98		0.0033		
	12.77	0.020	21.27		0.0014		
		0.500		67.57	71.6688		
		0.500	21.28		4.5142		
(Total)					93.8711	9.25	15.94
EE	13.26	0.080	12.00		0.0261		
	13.68	0.420		1.00	0.8166		
		0.420	50.00		6.8592		
	13.86	0.180		22.00	5.0403		
		0.180	50.00		0.8248		
		0.120	100.00		0.5986		
		0.060		12.00	0.5291		
		0.060	8.07		0.0085		
	13.94	0.080		43.48	2.9515		
		0.080	12.00		0.0261		
		0.080	8.07		0.0175		
	14.44	0.500		45.13	47.8676		
		0.500	8.07		1.7119		
(Total)					67.2777	1.86	9.82
FF	13.26	0.080	12.00	x 2	0.0521		
	13.46	0.200		2.00	0.5367		
		0.200	44.20		0.9488		
		0.200	50.00		1.0733		
	13.86	0.400		20.84	15.8164		
		0.400	45.63		5.5409		
		0.400	50.00		6.0716		
	14.14	0.280		59.10	26.2691		
		0.280	50.00		2.4891		
		0.280	45.64		2.2721		
(Total)					61.0702	1.53	13.09

GG (future)	13.20	0.080	12.00	x 2	0.0521		
	13.86	0.660		2.00	3.2171		
		0.660	45.45		19.3008		
		0.660	42.70		18.1330		
	14.24	0.380		60.18	42.2911		
		0.380	50.00		5.3408		
		0.380	42.68		4.5589		
(Total)					92.8939	1.86	9.82
GG (temp)	13.20	0.080	12.00	x 2	0.0521		
	13.86	0.660		2.00	3.2171		
		0.660	45.45		19.3008		
		0.660	42.70		18.1330		
	14.44	0.580		60.18	79.7472		
		0.580	42.69		13.1243		
		0.080	12.00		0.0261		
		0.500		1.00	1.0607		
(Total)					134.6613	1.86	9.82
HH (future)	11.72	0.080	12.00	x 2	0.0521		
	12.56	0.840		2.00	4.6192		
		0.840	35.71		27.7121		
		0.840	36.89		28.6278		
	12.94	0.380		62.99	44.2658		
		0.380	36.89		3.9405		
		0.380	50.00		5.3408		
(Total)					114.5584	6.28	33.42
HH (temp)	11.72	0.080	12.00	x 2	0.0521		
	12.56	0.840		2.00	4.6192		
		0.840	35.71		27.7121		
		0.840	36.89		28.6278		
	13.14	0.580		62.99	83.4709		
		0.580	36.90		11.3443		
		0.080	12.00		0.0261		
		0.500		1.00	1.0607		
(Total)					156.9131	6.28	33.42

J (temp)	11.93	0.080	12.00		0.0261		
	12.35	0.420		1.00	0.8166		
		0.420	97.21		13.3357		
	12.56	0.210		41.83	12.0764		
		0.210	26.05		0.6317		
		0.210	97.19		2.3570		
	12.81	0.250		67.71	25.3913		
		0.250	26.04		0.9765		
		0.080	12.00		0.0261		
		0.170		1.00	0.2103		
(Total)					55.8475	3.81	35.39

Design Point	Elevation	H (ft)	Sloping Section	Rectangular Section	Q _{capy} (cfs)	Q ₁₀₀ (cfs)	Q _{em} (cfs)
			Z	L (ft)			
IN-P1	108.14	0.280	100.00		4.9782		
		0.280	40.00		1.9913		
	108.31	0.170		39.36	8.2766		
		0.170	20.57		0.2941		
		0.170	40.00		0.5720		
	108.63	0.320		49.66	26.9683		
		0.320	46.08		3.2031		
		0.320	40.00		2.7805		
(Total)					49.0640	5.76	21.89
IN-P7	110.25	0.610	33.33		11.6247		
		0.610	33.33		11.6247		
(Total)					23.2493	7.69	18.38

Ex. Inlet @ X3	98.79	0.030	23.31		0.0044		
	98.80	0.040	275.00		0.1056		
	98.80	0.010		2.70	0.0081		
	98.80	0.010	100.00		0.0012		
	98.93	0.130		14.69	2.0657		
	98.93	0.130	19.92		0.1457		
	98.93	0.130	100.00		0.7312		
	98.94	0.010		30.20	0.0906		
	98.94	0.010	19.92		0.0002		
	98.94	0.010	75.19		0.0009		
	99.33	0.390		31.15	22.7602		
	99.33	0.390	75.19		8.5704		
	99.33	0.390	30.67		3.4959		
	99.50	0.170		72.42	15.2284		
	99.50	0.170	30.67		0.4385		
	99.50	0.170	24.83		0.3550		
(Total)					54.0020	6.79	45.40

Basin P7 & P10 Temp. Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	0.50	ft ³ /s

Results

Normal Depth	0.33	ft
Flow Area	0.33	ft ²
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.16	ft
Top Width	1.98	ft
Critical Depth	0.28	ft
Critical Slope	0.01204	ft/ft
Velocity	1.53	ft/s
Velocity Head	0.04	ft
Specific Energy	0.37	ft
Froude Number	0.66	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.28	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01204	ft/ft

Basin P7 & P10 Temp. Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	0.50	ft³/s

Results

Normal Depth	0.29	ft
Flow Area	0.25	ft²
Wetted Perimeter	1.83	ft
Hydraulic Radius	0.14	ft
Top Width	1.74	ft
Critical Depth	0.28	ft
Critical Slope	0.01204	ft/ft
Velocity	1.98	ft/s
Velocity Head	0.06	ft
Specific Energy	0.35	ft
Froude Number	0.92	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.28	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01204	ft/ft

Basin P7 & P10 Temp. Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	0.50	ft ³ /s

Results

Normal Depth	0.25	ft
Flow Area	0.19	ft ²
Wetted Perimeter	1.61	ft
Hydraulic Radius	0.12	ft
Top Width	1.53	ft
Critical Depth	0.28	ft
Critical Slope	0.01204	ft/ft
Velocity	2.57	ft/s
Velocity Head	0.10	ft
Specific Energy	0.36	ft
Froude Number	1.27	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.28	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01204	ft/ft

Table 6-2. NRCS Conveyance factors, K

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

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only):	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A =$ $0.84i^{1.302}$	$C_A =$ $0.86i^{1.276}$	$C_A =$ $0.87i^{1.232}$	$C_A =$ $0.88i^{1.124}$	$C_A =$ $0.85i+0.025$	$C_A =$ $0.78i+0.110$	$C_A =$ $0.65i+0.254$
B	$C_B =$ $0.84i^{1.169}$	$C_B =$ $0.86i^{1.088}$	$C_B =$ $0.81i+0.057$	$C_B =$ $0.63i+0.249$	$C_B =$ $0.56i+0.328$	$C_B =$ $0.47i+0.426$	$C_B =$ $0.37i+0.536$
C/D	$C_{C/D} =$ $0.83i^{1.122}$	$C_{C/D} =$ $0.82i+0.035$	$C_{C/D} =$ $0.74i+0.132$	$C_{C/D} =$ $0.56i+0.319$	$C_{C/D} =$ $0.49i+0.393$	$C_{C/D} =$ $0.41i+0.484$	$C_{C/D} =$ $0.32i+0.588$

Where:

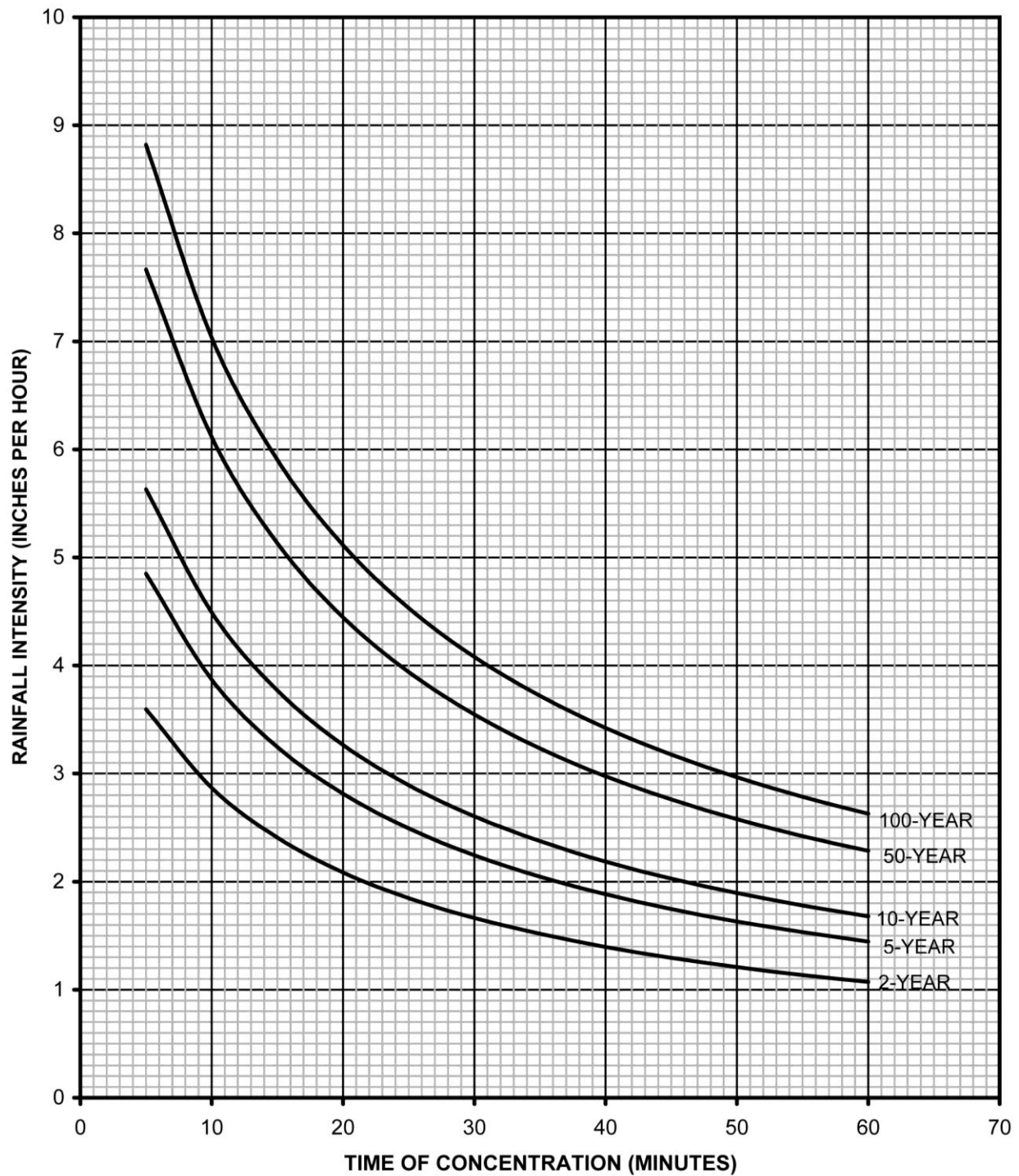
i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

FIGURE 6-1
RAINFALL INTENSITY-DURATION CURVE
TOWN OF CASTLE ROCK





Summary of Water Quality Conformance to MS4 Permit

The purpose of this worksheet is to document conformance with the Town of Castle Rock's MS4 permit with regard to permanent water quality on land disturbance projects.

Project Name Outlets Pads B & C Infrastructure; SDP20-0004

Project Owner Craig Realty Group

Project Location 5050 Factory Shops Boulevard

ToCR Project Number CD22-0026

Total Site Area 9.0 acres

Total Size of Common Plan of Development 55.8 acres

Check all that apply:

☒ **Project within Plum Creek Basin**

☐ **Project within Cherry Creek Basin**

Estimated construction completion date Fall 2023

1. The water quality control measure(s) for applicable development sites shall meet one of the following base design standards as per the SDDTCM Section 14.4. Please select all design standards that were applied to meet conformance with the MS4 on this site.

- ☐ WQCV standard
- ☐ Pollutant removal standard
- ☐ Runoff reduction standard
- ☒ Applicable site draining to regional WQVC control measure (accepts drainage prior to discharging to WOTS)
- ☐ Applicable site draining to regional WQVC control facility (with receiving pervious area control measure upstream of WOTS)
- ☐ Constrained redevelopment sites standard
 - Imperviousness of existing site _____/_____ (Imp. Ac/Site Ac) = ____%
 - Variance required TCV No. _____
- ☐ Existing control measure with WQCV per previous criteria standards
 - Reference Construction Permit No. _____
- ☐ Cherry Creek Basin only, choose one: ☐ Tier 1 ☐ Tier 2 ☐ Tier 3
- ☐ No control measures provided (See Permanent WQ Worksheet for applicability)

Summary of Water Quality Conformance to MS4 Permit

2. Was an exclusion to water quality applied as per SDDTCM Section 13.1.5? ☐ Yes ☒ No

i. If yes, please select all that apply, provide total excluded impervious area(s) and submit variance, as applicable: TCV No. _____

☐ Pavement management site

Excluded impervious area: _____ acres

☐ Excluded roadway redevelopment

Excluded impervious area: _____ acres

☐ Excluded existing roadway areas

Excluded impervious area: _____ acres

☐ Above ground and below ground utilities

☐ Large lot single family home

☐ Non-residential and non-commercial infiltration

Excluded impervious area: _____ acres

☐ Land disturbance for land to remain undeveloped

Excluded impervious area: _____ acres

☐ Stream Stabilization Sites

Excluded impervious area: _____ acres

☐ Trails

Excluded impervious area: _____ acres

☐ Oil and Gas Exploration

3. For Development and Redevelopment sites, following any exclusions claimed above, was any portion of the site excluded up to 20% of the site and not to exceed one acre? ☐ Yes ☒ No

If yes, complete the following:

Excluded area: _____ acres

Total Site area: _____ acres, _____ % site excluded

4. For Constrained sites, was any portion of the site excluded up to 50% of the site and not to exceed 50% of the impervious area? ☐ Yes ☐ No

If yes, complete the following:

Excluded area: _____ acres

Excluded impervious area: _____ acres

Total Site area: _____ acres, _____ % site excluded

Total Impervious area: _____ acres, _____ % impervious excluded

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

Project:	Outlets at Castle Rock - Pads B & C	Project#	CD22-0026	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 Yes	☐ ☒	Proceed to section 1.2. 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 Yes	☐ ☐	Proceed to section 1.3. Proceed to section 2.
1.3	Is the project within the Cherry Creek Watershed?	Yes No	☐ ☐	Permanent water quality control measures may be required. Refer to Water Quality Control Regulation 72.7 for details and allowable exclusions. 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 Yes	☐ ☒	Project is an applicable Development Site. Proceed to section 3. Proceed to 2.2.
2.2	Does the project have greater than 75% impervious area on the existing site?	No Yes	☐ ☒	Project is an applicable Redevelopment Site. Proceed to section 3. Project is an applicable Constrained 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	☒ ☐	No further action required. Proceed to 2.4.
2.4	Do any other water quality exclusions apply to the site?	No Yes	☐ ☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for variance for <u>Constrained Redevelopment Sites</u> . Proceed to section 3. Following approval of other exclusions, design remaining site in accordance with Constrained Redevelopment standards and apply for variance for <u>Constrained Redevelopment Sites</u> .
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 No	☐ ☐	Proceed to next line. Proceed to 3.1.2.
	Is the trail for a roadway?	Yes No	☐ ☐	Proceed to 3.1.2. Project is excluded. Submit variance for <u>Trails Excluded from Permanent Water Quality Requirements</u> .
3.1.2	Is the project primarily used for parking or access to parking?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Pavement Management Sites Excluded from Permanent Water Quality Requirements</u> . 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 Yes	☐ ☐	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No Yes	☐ ☐	Existing areas of site are excluded only. Submit variance for <u>Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements</u> . 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 No	☐ ☐	Project is excluded. Submit variance for <u>Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes No	☐ ☐	Project is excluded. Submit variance for <u>Stream Stabilization Sites Excluded from Permanent Water Quality Requirements</u> . 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 No	☐ ☐	Project is excluded. Submit variance for <u>Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements</u> . 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 No	☐ ☐	Project is excluded. Submit variance for <u>Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . 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 Yes	☐ ☐	Project is excluded. Submit study along with variance for <u>Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements</u> . 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 No	☐ ☐	Proceed to next line. Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Is the project site greater than 20% impervious?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No Yes	☐ ☐	Project is excluded. Submit study along with variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> . 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 No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes No	☐ ☐	This portion of the project is excluded. Submit variance for <u>Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . Proceed to next line. Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No Yes	☐ ☐	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. This exclusion does not apply. Permanent water quality is required.