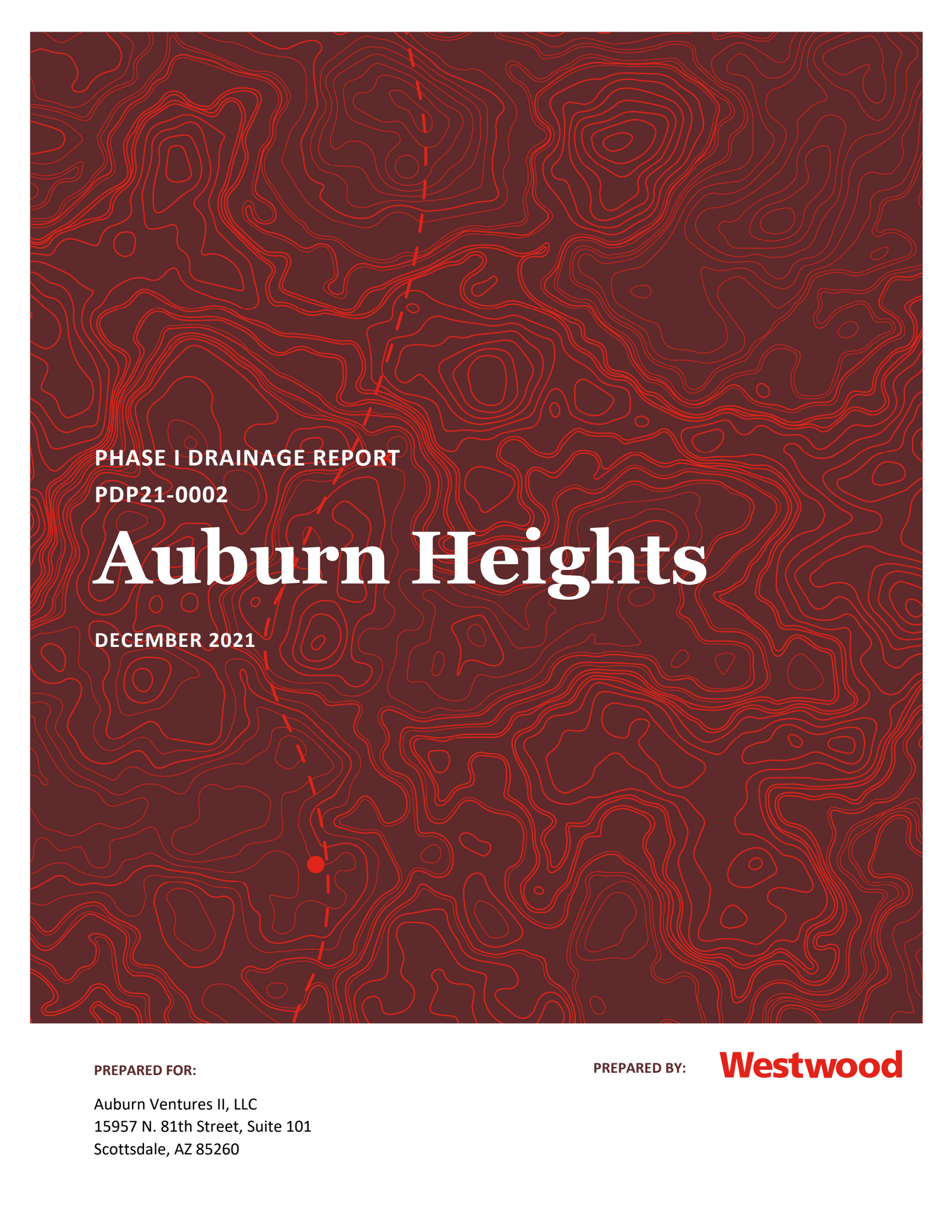




PHASE I DRAINAGE REPORT

PDP21-0002

Auburn Heights

DECEMBER 2021

PREPARED FOR:

Auburn Ventures II, LLC
15957 N. 81th Street, Suite 101
Scottsdale, AZ 85260

PREPARED BY:

Westwood

Phase I Drainage Report

Auburn Heights, PDP21-0002

Town of Castle Rock, Douglas County, Colorado

Prepared For:

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Preparation Date: July 9, 2021
Revised: September 17, 2021
Revised: December 1, 2021

CERTIFICATION PAGE

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

Melinda E. Lundquist

Registered Professional Engineer

State of Colorado No. 38413

"Auburn Ventures II, LP hereby certifies that the drainage facilities for Auburn Heights shall be constructed according to the design presented in this report. I understand that the Town of Castle Rock does not and will not assume liability for the 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 Auburn Heights, guarantee that final drainage design review will absolve Auburn Ventures II, LP and/or their successors and/or assigns of future liability for improper design."

Name of Developer

Authorized Signature

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1.0 General Location and Description

A. Site Location

The Auburn Heights development is located in a portion of the south half of section 3, Township 8 South, Range 67 West of the 6th principal meridian in the Town of Castle Rock, Douglas County, Colorado. The site is bounded by Omni Gulch to the northwest, Auburn Ridge Apartments to the northeast, Auburn Drive to the southeast, and Castle Highlands Filing No. 2 to the southwest. Five multifamily residential buildings, a clubhouse, and free-standing garages are planned for this site.

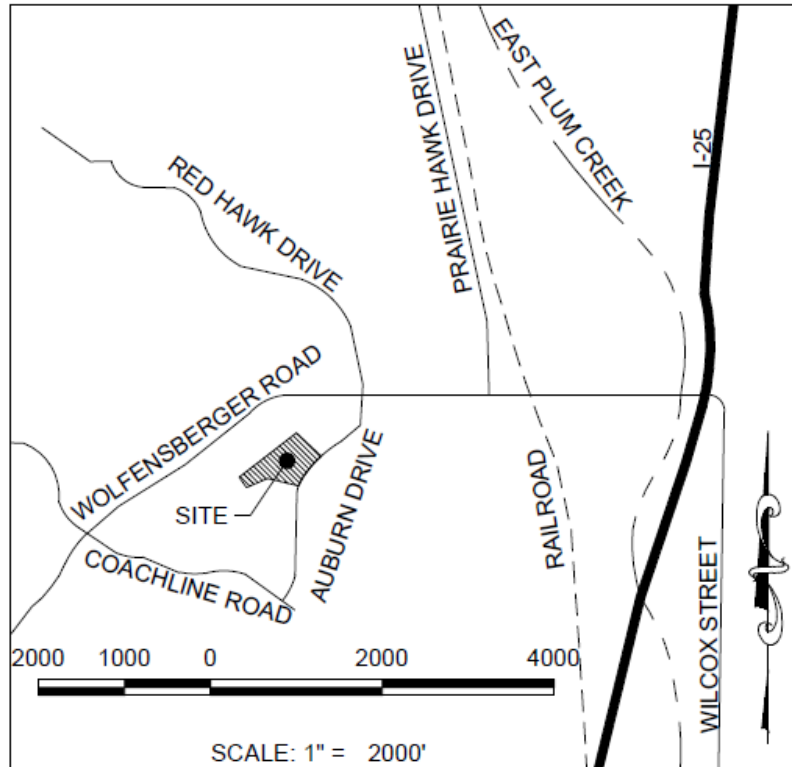


Figure 1. Vicinity Map

B. Description of Property

Auburn Heights is a multifamily development and is approximately 6.1 acres. The existing ground generally slopes to the north and northeast where majority of the site's existing drainage pattern sheet-flows to Omni Gulch. The site contains slopes ranging from 2% to 25%. The Auburn Heights site contains an existing water quality pond developed during the Auburn Villas project.

The site lies within Zone X outside the 100-year floodplain per FEMA Flood Insurance Rate Map number 08035C0169G, dated March 16, 2016.

The onsite soils consist of Bresser-Truckton sandy loams with 5 to 25 percent slopes and Newlin gravelly sandy loam with 8 to 30 percent slopes. These soils are both classified as group B soils, meaning the soils have a high infiltration rate when thoroughly wet. Please refer to the Appendix for a copy of the NRCS soils map.

2.0 Drainage Basins and Sub-Basins

A. Major Drainage Basins

Majority of the site currently drains to the northwest toward Omni Gulch, an open channel. Within the limits of this project boundary, an existing water quality pond is located in the northwest corner that had been designed and constructed in association with Auburn Ridge Phase I. Approximately 1.5 acres of the project site sheet flows into the water quality pond in the existing state.

B. Minor Drainage Basins

The existing topography associated with this project site is divided into seven on-site drainage basins and two off-site drainage basins. Please refer to the Appendix for the Historic Drainage map for basin locations.

Historic Basin E1 is 0.02 acres that includes a small portion of the southwest corner of the site. E1 has a 5-year runoff coefficient of 0.01 and a 100-year runoff coefficient of 0.44. Stormwater flows from east to west, to design point 1e.

Historic Basin E2 is 0.06 acres that includes a small portion of the southwest corner of the site which sheet flows toward Millbrook Court. E2 has a 5-year runoff coefficient of 0.01 and a 100-year runoff coefficient of 0.44. Stormwater flows from north to south, to design point 2e.

Historic Basin E3 is 2.38 acres that contains a large portion of the western side of the site which sheet flows to Omni Gulch. E3 has a 5-year runoff coefficient of 0.01 and a 100-year runoff coefficient of 0.44. Stormwater flows from southwest to northeast, to design point 3e.

Historic Basin E4 is 0.29 acres that contains a small portion of the site located at the center of the south boundary and sheet flows toward Millbrook Court. E4 has a 5-year runoff coefficient of 0.01 and a 100-year runoff coefficient of 0.44. Stormwater flows from north to south, to design point 4e.

Historic Basin E5 is 0.67 acres that contains the eastern portion of the site which sheet flows to Auburn Drive. E5 has a 5-year runoff coefficient of 0.01 and a 100-year runoff coefficient of 0.44. Stormwater flows from southwest to northeast, to design point 5e.

Historic Basin E6 is 1.19 acres that covers the central portion of the site and sheet flows to the northeast toward Auburn Ridge. E6 has a 5-year runoff coefficient of 0.01 and a 100-year runoff coefficient of 0.44. Stormwater flows from southwest to northeast, to design point 6e.

Historic Basin E7 is 1.49 acres that covers the central portion of the site and drains to the existing water quality pond in the northwest portion of the site. E7 has a 5-year runoff coefficient of 0.01 and

a 100-year runoff coefficient of 0.44. Stormwater flows from southwest to northeast, to design point 7e.

Historic Basin OS-1, as delineated by Manhard Consulting in association with the original Auburn Villas project, is 0.19 acres that consists of an existing building located north of the project site. OS-1 has a 5-year runoff coefficient of 0.71 and a 100-year runoff coefficient of 0.81.

Historic Basin OS-2, as delineated by Manhard Consulting in association with the original Auburn Villas project, is 0.67 acres that consists of an existing building, paved areas and landscaping, located north of the project site. OS-2 has a 5-year runoff coefficient of 0.76 and a 100-year runoff coefficient of 0.81.

The developed site consists of ten on-site drainage basins as well as the same two offsite basins.

Developed Basin D1 contains a small portion of the southwest corner of the site that sheet flows off-site towards the open space (Tract D) of Castle Highlands Filing No. 2. Basin D1 has a 5-year runoff coefficient of 0.03 and a 100-year runoff coefficient of 0.45. This basin consists of the landscaping located adjacent to the proposed 8-unit building and is included as part of the area described in the water quality conformance summary attached in the Appendix.

Developed Basin D2 contains the portion of the site that fronts the Omni Gulch Channel which includes landscaping located adjacent to the 8-unit and 52-unit buildings. Basin D2 has a 5-year runoff coefficient of 0.03 and a 100-year runoff coefficient of 0.45. This basin sheet flows off-site, to Omni Gulch and is included as part of the area described in the water quality conformance summary attached in the Appendix.

Developed Basin D3 contains the southeast portion of the site that drains to a Type C inlet (SDIN2) located at a low point in the drive aisle. Basin D3 has a 5-year runoff coefficient of 0.59 and a 100-year runoff coefficient of 0.75. Stormwater is conveyed by a 2' concrete pan located in the middle of the drive aisle to the Type C inlet SDIN2, design point 3d. If the inlet becomes clogged, flow will bypass to Basins D4 and D6 where it will be collected by an inlet at design point 4d and will overland flow offsite to design point 6d.

Developed Basin D4 contains the central, southern portion of the site which includes landscaping, covered parking, and paved areas. Basin D4 has a 5-year runoff coefficient of 0.50 and a 100-year runoff coefficient of 0.70. Stormwater is conveyed by a 2' concrete pan located in the middle of the drive aisle to the Type C inlet SDIN3, design point 3d. If the inlet becomes clogged, flow will bypass to Basins D3 and D8 where it will be collected by Type C inlets at design points 8d and 3d.

Developed Basin D5 contains the southeast portion of the site which includes covered parking, two buildings, paved areas and landscaping. Basin D5 has a 5-year runoff coefficient of 0.58 and a 100-year runoff coefficient of 0.74. Stormwater is conveyed by a 2' concrete pan located in the middle of the drive aisle to the Type C inlet SDIN 5, design point 5d. If the inlet becomes clogged, flow will bypass to Basin D8 where it will be collected by the Type C inlet SDIN4 at design point 8d.

Developed Basin D6 is located along the eastern boundary of the project and includes the landscaping adjacent to the clubhouse. Basin D 6 has a 5-year runoff coefficient of 0.03 and a 100-year runoff coefficient of 0.45. This basin drains off-site toward Auburn Drive and is included as part of the area described in the water quality conformance summary attached in the Appendix.

Developed Basin D7 is the north corner of the site and contains the existing water quality pond. The pond will be landscaped and maintained regularly.

Developed Basin D8 contains the central portion of the site which includes covered parking, landscaping, portions of the pool and volleyball area, and the 52-unit building. Basin D8 has a 5-year runoff coefficient of 0.70 and a 100-year runoff coefficient of 0.81. Stormwater is conveyed by a 2' concrete pan located in the middle of the drive aisle to the Type C inlet SDIN 4, design point 8d. If this inlet becomes clogged, flow will bypass to Basin D9 where it will be collected by the Type C inlet SDIN 1, design point 9d.

Developed Basin D9 contains the northwest portion of the site which includes landscaping, one building, covered parking, portions of the pool and volleyball area, and paved areas. Basin 9D has a 5-year runoff coefficient of 0.71 and a 100-year runoff coefficient of 0.81. Stormwater is conveyed by a 2' concrete pan located in the middle of the drive aisle to the Type C inlet SDIN 1, design point 9d. If this inlet becomes clogged, flow will bypass to Basin D7 where it will be collected in the water quality pond.

Developed Basin D10 is located in the northeast corner of the site that contains paved areas and landscaping. Basin D10 has a 5-year runoff coefficient of 0.53 and a 100-year runoff coefficient of 0.71. This basin drains off-site toward Auburn Ridge Apartments and is included as part of the area described in the water quality conformance summary attached in the Appendix.

Basin OS-1 will remain the same as its historic state and continue to flow toward the existing water quality pond.

Basin OS-2 becomes slightly larger as a result of this project and remains tributary to the existing water quality pond.

3.0 Drainage Design Criteria

A. Regulations

This drainage study is prepared in conformance with the Town of Castle Rock *Storm Drainage and Technical Criteria Manual* as revised June 2019, and per the Mile High Flood District Manuals 1-3, latest editions.

Town criteria requires that full-spectrum detention be provided for the site. However, due to stormwater detention provided immediately upstream of the site, only water quality treatment is required for the proposed development. This detention pond is referred to as Pond A in the

Castle Highlands Filing No. 2 Phase III Drainage Study. Both the narrative and calculations pertaining to the design of Pond A from this study by JR Engineering are included in Appendix D.

B. Drainage Studies, Master Plans, Site Constraints

The previous drainage studies impacting the site are the following:

- Castle Highlands Filing No. 2 Phase III Drainage Study by JR Engineering dated August 21, 2001.
- The Floodplain Modification Study for Omni Tributary Channel Stabilization Project by Wright Waters Engineers dated May 2018.
- The Auburn Villas Lot 2, Auburn Ridge Phase III Drainage Report by Manhard Consulting LTD dated May 2016.
- Auburn Ridge Drainage Details As-builts dated March 10, 2013.

There is an existing water quality pond in the northeast corner of the site that was constructed with the Auburn Ridge project engineered by Vermilion Peak Engineering. This water quality pond collects water from the central portion of the site, provides water quality treatment, then releases into Omni Gulch. Per the Castle Highlands Filing No. 2 Phase III Drainage Study, "Pond A" upstream of the site provides the required detention for this lot and only water quality treatment is required prior to release into Omni Gulch.

Castle Highlands Filing No. 2 Phase III Drainage report by JR Engineering dated August 21, 2001, accounts for the required detention for Basin KK, located within this project site, which was determined to have a 100-year flow of 31.5 cfs (refer to the Appendix for referenced drainage basin and SF-form). Although this current site plan has an increased percent impervious than what was anticipated in the master study, the 100-year flow discharging from this current project site is 29.7 cfs (refer to MHFD UD spreadsheet in the Appendix where this calculated flow is highlighted on the outlet structure sheet) which is less than what JR Engineering accounted for within the detention volume of Pond A. This difference in 100-year flows are due to the higher 100-year rainfall intensity JR Engineering used when developing this drainage study and the higher 100-year runoff coefficient of 0.80 versus 0.74 used in the attached calculations. JR Engineering used a 100-year rainfall intensity of 8.5 in/hr while the current rainfall intensity *Town of Castle Rock Storm Drainage Design and Technical Criteria Manual* lists the 100-yr rainfall intensity as 2.6 in/hr in Table 6-1, which was the value used in our drainage calculations.

As the volume of the existing water quality pond and the design of the existing outlet structure was designed per assumptions of developed flows for this project site, the outlet structure has been redesigned to drain the water quality capture volume within forty (40) hours.

C. Storage and Water Quality Enhancement

The existing water quality pond has been designed to drain the Water Quality Capture Volume in 40 hours. The existing outlet structure will be modified for this new development to ensure the drain time remains 40 hours given the existing pond size.

4.0 Stormwater Management Facility Design

A. Stormwater Conveyance Facilities

This project site contains five multifamily residential buildings, a clubhouse, and free-standing garages. The drive aisles will include concrete pans in an inverted-crown street cross section to capture and direct stormwater to the water quality pond in the northeast corner of the site.

Inlets and storm pipe will also capture and direct water to the water quality pond.

B. Stormwater Storage Facilities

There is an existing water quality pond in the northeast corner of the site constructed during Auburn Ridge. This water quality pond collects water from the majority of the existing site, provides water quality treatment, then releases into Omni Gulch. Per the Castle Highlands Filing No. 2 Phase III Drainage Study, "Pond A" upstream of the site provides the required 100-year detention for this lot and only water quality treatment is required prior to release in Omni Gulch.

The existing outlet structure of the water quality pond will be redesigned to adequately drain the Water Quality Capture Volume in 40 hours for the proposed development. The water from the pond will be released into Omni Gulch which ultimately flows to East Plum Creek approximately one mile north of the site.

C. Water Quality Enhancement Control Measures

Employ Runoff Reduction Practices:

Reducing the runoff peak volumes is an important best management practice (BMP) to not overwhelm existing infrastructure or receiving bodies of water with developed stormwater flows. The existing water quality pond is designed to drain the Water Quality Capture Volume in forty (40) hours to reduce the release rate of major storm events.

Implement BMPs that Provide a Water Quality Capture Volume (WQCV) with Slow Release:

The water quality pond is designed to drain the WQCV in forty (40) hours to promote time of suspended solids to settle before discharging into Omni Gulch. Water draining from paved areas to the provided landscaping helps reduce runoff volume as it can infiltrate into the ground.

Stabilize Drainageways:

The adjacent channel, Omni Gulch located northwest of the project site, is being modified and stabilized through the Floodplain Modification Study completed by Wright Water Engineers in conjunction with the previous project, Auburn Villas. Approximately 360 feet of the existing channel will be stabilized with four cutoff wall grade control structures and drop structures.

Implement Site Specific and Other Source Control BMPs:

An existing overflow weir has been provided with the construction of the existing water quality pond. The overflow weir was taken into account with the redesign of the outlet structure to ensure a foot of freeboard is provided for flood control. The existing outlet structure will also be modified to drain the WQCV in forty (40) hours given the proposed improvements related to this project.

D. Floodplain Modification

A floodplain modification study was completed in conjunction with the Auburn Villas proposed site by Wright Water Engineers in May 2018. This floodplain modification study analyzed the stabilization of 360 feet of existing channel. The channel experiences erosion occurring intermittently along its length. There is a 100-year floodplain in the subject reach of the Omni Channel delineated in the Omni Industrial and Westfield Watersheds Flood Hazard Delineation (FHAD) report, dated April 2013. However, the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Map Number 09035C0169G, Effective March 16, 2016 (FEMA, 2016), shows the channel in the Project site being designated as Zone X floodplain (i.e., approximate floodplain with no Base Flood Elevation determined). See Appendix for FEMA map.

E. Additional Permitting Requirements

No additional permitting requirements are anticipated with this project.

F. General

The general runoff of the site directs runoff to the concrete pans located in the middle of the drive aisles. The concrete pans convey the stormwater to Type C inlets that ultimately convey the stormwater to the water quality pond in the northwest corner of the site.

The existing water quality pond was analyzed and re-designed by using the Mile High Flood District Detention spreadsheet. When inputting the as-built elevations and volumes in the stage storage, and putting in the existing outlet structure plate criteria, the WQCV was not being captured within the forty hours and was overtopping the weir. To mediate this issue, the outlet structure plate will need to be modified by raising the grate elevation and using a flat top instead of slope of 4:1. By doing so, this allows the WQCV water surface elevation to be below the grate, meaning it will go through the orifice holes and into the outlet pipe.

The orifice plate will now have three orifice holes, each having a diameter of 13/16 inch, to drain the WQCV in forty hours. A 50% debris clogging factor was used within the design calculations, however if the grate is completely clean, the two-year storm will go through the plate rather than the spillway.

The five proposed inlets were sized using the UD Inlet spreadsheet which analyzed the five-year and 100-year storms to ensure that no ponding occurred outside of the drive aisle. The storm drains were sized using SewerGEMS. The combined basin flowrates were inputted from the SF-forms for the 5-year and 100-year storms and the respective hydraulic grade lines (HGL) were

profiled to ensure the 5-year HGL was within the pipe and the 100-year HGL was beneath the surface elevation.

5.0 Conclusions

G. Compliance with Standards

This drainage study complies with the Mile High Flood District standards and the Town of Castle Rock Standards for drainage facilities.

H. Variances

As Basins D1, D2, D6 and D10 do not receive water quality before flowing offsite, a water quality exclusion is required and the water quality compliance summary is included in the Appendix.

I. Drainage Concept

The proposed development is a total of 6.1 acres that will consist of five multi-unit buildings, a club house, covered parking, a pool, volleyball court, landscaping and paved areas which will ultimately increase the overall imperviousness of the project site, therefore, increasing stormwater runoff from its pre-construction characteristics. To mitigate this outcome, the existing water quality basin in the northwest corner of the site has been evaluated to capture the project site, as well as two offsite basins from Auburn Ridge, and drain the Water Quality Capture Volume (WQCV) in forty hours. Upstream of this project is a full spectrum extended detention basin (EDB) that has been sized for the 100-year stormwater runoff for this project site, therefore the pond was only sized for WQCV before discharging into the adjacent channel, Omni Gulch.

6.0 References

1. Town of Castle Rock Standards and Specifications
2. Urban Storm Drainage Criteria Manual, Vol 1, 2, & 3
3. Web Soil Survey
4. FIRM, Flood Insurance Rate Map

APPENDIX A

Maps: Soils Map, FIRM, &
Historic/Developed Drainage Basins

Hydrologic Soil Group—Castle Rock Area, Colorado
(Auburn Heights)



Hydrologic Soil Group—Castle Rock Area, Colorado (Auburn Heights)

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	4.9	79.2%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	1.3	20.8%
Totals for Area of Interest			6.2	100.0%

Description

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

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

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

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

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

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

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

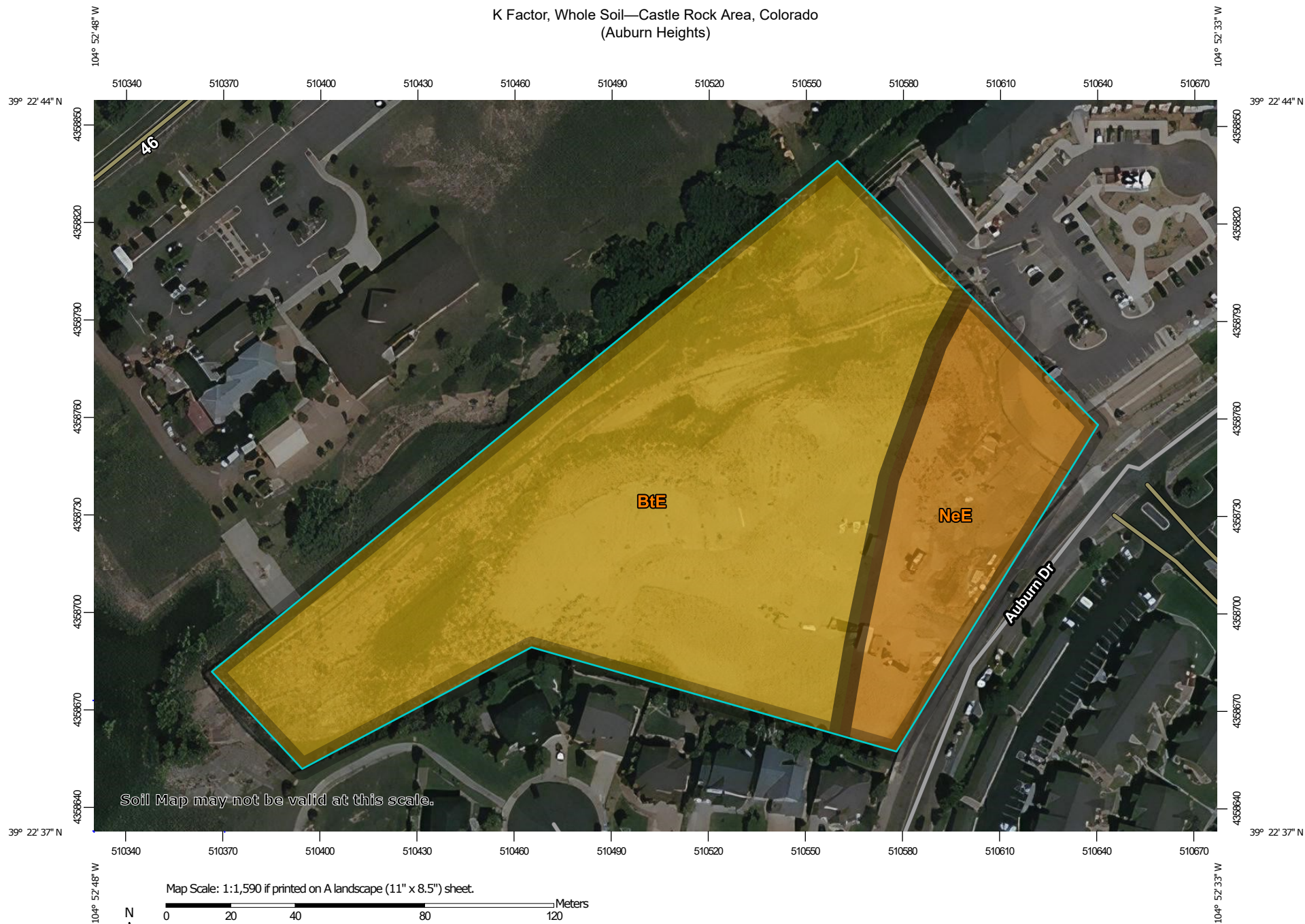
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

K Factor, Whole Soil—Castle Rock Area, Colorado
(Auburn Heights)



K Factor, Whole Soil—Castle Rock Area, Colorado
(Auburn Heights)

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

	.02
	.05
	.10
	.15
	.17
	.20
	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Soil Rating Lines

	.02
	.05
	.10
	.15
	.17
	.20

	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Soil Rating Points

	.02
	.05
	.10
	.15
	.17
	.20
	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Water Features

	Streams and Canals
	Rails
	Interstate Highways
	US Routes
	Major Roads
	Local Roads
	Background
	Aerial Photography

MAP INFORMATION

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

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

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

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Survey Area Data: Version 13, Jun 5, 2020

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

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

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

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	.15	4.9	79.2%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	.10	1.3	20.8%
Totals for Area of Interest			6.2	100.0%

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Factor K does not apply to organic horizons and is not reported for those layers.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

NOTES TO USERS

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

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

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

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

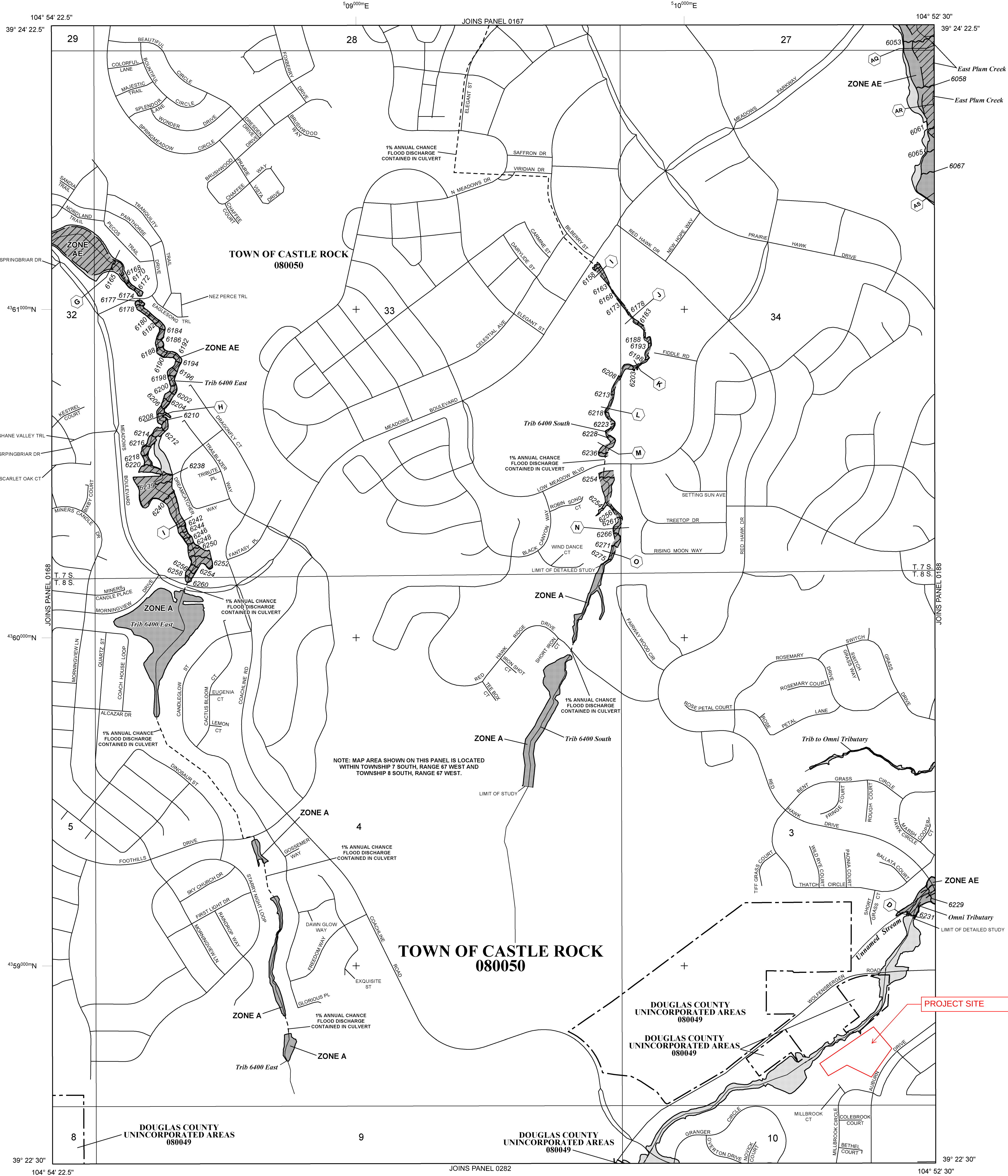
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the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

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

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

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

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



LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
- The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently deteriorated. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**
- The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE X** Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPAs)**
- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- Cross section line**
- Transect line**
- 45° 02' 08" 93° 02' 12"
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 13
- DX5510 X
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5
- River Mile

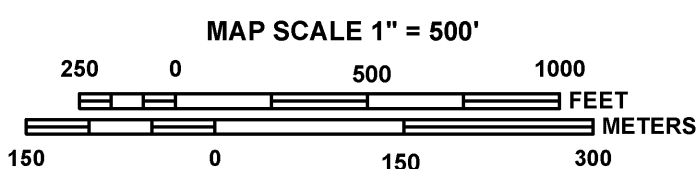
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
SEPTEMBER 30, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision.

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

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



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0169G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 169 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

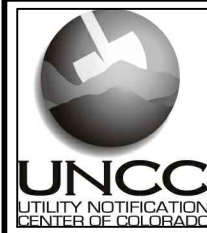
COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	0169	G
DOUGLAS COUNTY	080049	0169	G

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

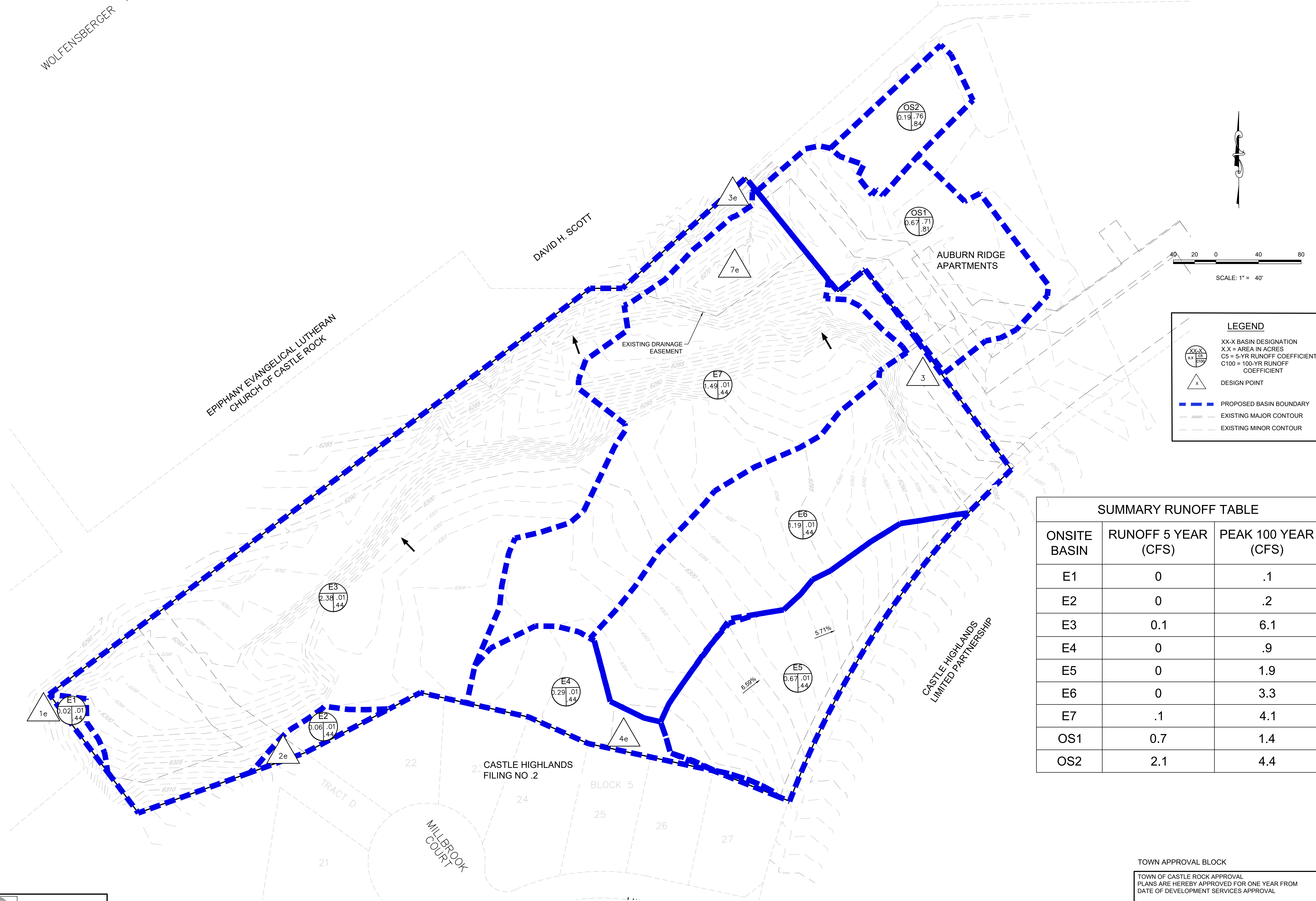
MAP NUMBER
08035C0169G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

N:\PROJECTS\31207 AUBURN HTS\DRAINAGE\02_DRAINAGE MAP\HISTORIC DRAINAGE MAP.DWG, LAGRADY, 11/20/21



CALL 811
TWO WORKING DAYS
BEFORE YOU DIG
1-800-922-1987



TOWN APPROVAL BLOCK

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

Approved By: _____
Date: _____

DEVELOPMENT SERVICES _____ Date _____

10333 E. Dry Creek Rd. Suite 240
Englewood, CO 80112
Tel: 720.482.952
www.cvlinc.net
westwoodps.com

a Westwood team

AUBURN VENTURES II, LP
ATTN: JOHN GICHON
15957 N 81TH STREET
SUITE 101
SCOTTSDALE, ARIZONA 85260

AUBURN HEIGHTS
DRAINAGE MAP
HISTORIC

DRAWN BY: KMG
CHECKED BY: MEL
DATE: December 2021

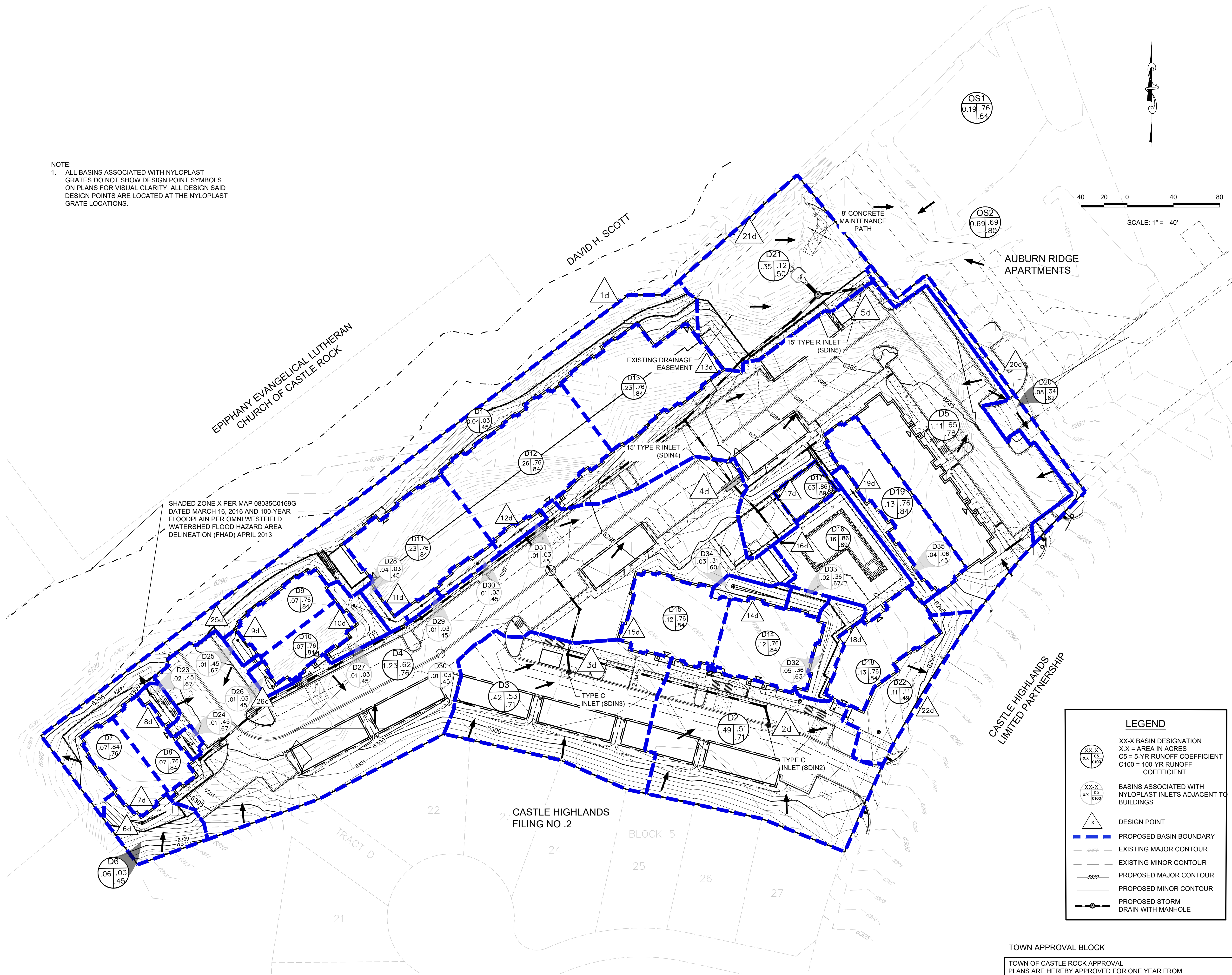
SCALE: AS SHOWN
FILE NO: R0031207.00

SHEET NUMBER
DR-1

Revisions
No. Date Init. Appr. Date

BASIN ID	RUNOFF 5-YR (CFS)	RUNOFF 100-YR (CFS)
D1	0.04	1.17
D2	1.02	2.62
D3	0.91	2.28
D4	2.88	6.59
D5	2.85	6.36
D6	0.01	0.19
D7	0.25	0.52
D8	0.25	0.52
D9	0.25	0.52
D10	0.25	0.52
D11	0.83	1.70
D12	0.83	1.70
D13	0.83	1.70
D14	0.43	0.89
D15	0.43	0.89
D16	0.65	1.26
D17	0.12	0.24
D18	0.39	0.81
D19	0.47	0.96
D20	0.13	0.43
D21	0.16	1.19
D22	0.04	0.37
D23	0.04	0.12
D24	0.02	0.06
D25	0.00	0.04
D26	0.01	0.15
D27	0.00	0.08
D28	0.00	0.04
D29	0.00	0.08
D30	0.00	0.04
D31	0.09	0.27
D32	0.04	0.12
D33	0.04	0.16
D34	0.01	0.15
D35	0.70	1.41

NOTE:
1. ALL BASINS ASSOCIATED WITH NYLOPLAST GRATES DO NOT SHOW DESIGN POINT SYMBOLS ON PLANS FOR VISUAL CLARITY. ALL DESIGN SAID DESIGN POINTS ARE LOCATED AT THE NYLOPLAST GRATE LOCATIONS.



LEGEND

- XX-X BASIN DESIGNATION
X.X = AREA IN ACRES
C5 = 5-YR RUNOFF COEFFICIENT
C100 = 100-YR RUNOFF COEFFICIENT
- XX-X BASINS ASSOCIATED WITH NYLOPLAST INLETS ADJACENT TO BUILDINGS
- DESIGN POINT
- PROPOSED BASIN BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED STORM DRAIN WITH MANHOLE

TOWN APPROVAL BLOCK

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

Approved By: _____

DEVELOPMENT SERVICES _____ Date _____

SHEET NUMBER	DRAWN BY: KING	CHECKED BY: MEL	DATE: December 2021	SCALE: AS SHOWN	FILE NO: R0031207.00	AUBURN HEIGHTS DRAINAGE MAP DEVELOPED	AUBURN VENTURES II, LP ATTN: JOHN GICHON 15957 N 81TH STREET SUITE 101 SCOTTSDALE, ARIZONA 85260	CML a Westwood team	10333 E. Dry Creek Rd. Suite 240 Englewood, CO 80112 Tel: 720.482.9522 www.cvlinc.net westwoodps.com	Revisions	Date	Appr.	Date	
										No.				
DR-2														

PROJECTS1207 AUBURN HTS DRAINAGE02_DRAINAGE MAPS DEVELOPED DRAINAGE MAP DWG. LACORADY. 11/29/21

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UTILITY NOTIFICATION
CENTER OF COLORADO

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APPENDIX E

Summary of Water Quality
Conformance to MS4 Permit



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 Auburn Heights

Project Owner Auburn Ventures II, LP

Project Location South half of section 3, Township 8 South, Range 67 West of the 6th P.M.

ToCR Project Number SDP21-0037

Total Site Area 6.14 acres

Total Size of Common Plan of Development 6.14 acres

Check all that apply:

☒ **Project within Plum Creek Basin**

☐ **Project within Cherry Creek Basin**

Estimated construction completion date MAY 2022

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. 1

- ☐ 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: 0.53 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: 0.53 acres
Total Site area: 6.13 acres, 8.6 % 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

APPENDIX F

Referenced Information

*From
Reference
4*

**CASTLE HIGHLANDS FILING NO. 2
PHASE III DRAINAGE STUDY**

Prepared for:

CASTLE ROCK EQUITIES, L.L.C.
6950 East Belleview Avenue, Suite 301
Englewood Colorado, 80111
Contact: Sam N. Perry

Prepared by:

JR ENGINEERING
6020 Greenwood Plaza Boulevard
Englewood, Colorado 80111
303.740.9393
Contact: Mr. James Fitzmorris

Project Number 2316.05

August 23, 1999
Revised: December 10, 1999

Project Number 14695.00

Revised: August 21, 2001

X:\1460000.all\1469500\Reports\drainage.doc

Project: Castle Highlands Filing No. 2
Date: August 21, 2001

ENGINEER'S STATEMENT:

The enclosed drainage report, and exhibits, were prepared by me, or under my direct supervision, and are correct to the best of my knowledge and belief. Said drainage report has been prepared in accordance with applicable Town of Castle Rock criteria and is in conformance with the master plan of drainage for the effected area. I accept responsibility for any liability causes by negligent acts, errors or omissions on my part in preparing this report.

*No signatures on
Town copy*

James P. Fitzmorris, P.E.
Colorado Registered Professional Engineer No. 28211
For and On Behalf of JR Engineering, Ltd.

OWNER/ DEVELOPER'S STATEMENT:

As Owner/Developer of land(s) identified within this report; I agree to proceed, implement and comply with all recommendations and requirements outlined herein.

Owner Name and Signature

TOWN OF CASTLE ROCK APPROVALS:

ENGINEERING DIVISION

DATE

PUBLIC WORKS DIRECTOR

DATE

General Location and Description

Location

Castle Highlands Filing No. 2 consists of 75.0 acres and is located in portions of Section 3 and 10, Township 8 South, Range 67 West of the Sixth Principal Meridian, Town of Castle Rock, Douglas County, Colorado (Figure 1). The site is bounded on the north and northwest by Wolfensberger Road, by Cedar Hill Cemetery on the east and by undeveloped land on the remaining sides.

Description of Property

Soils on the site consist of Bresser-Truckton sandy loam and Newlin gravelly sandy loam (Figure 2). Vegetation consists of native grasses, cacti, and stands of scrub oak. The site slopes northeasterly in direction at grades varying from one to thirty percent.

The site is undeveloped and is currently pastureland for livestock. The proposed development will include 31.9 acres of single family development, 8.5 acres of multi-family development, and 4.5 acres of commercial development. 8.8 acres will be dedicated as public right-of-way and 21.3 acres will remain as open space. The entire site will be overlot graded and temporary and permanent seeding will be used to minimize erosion.

Drainage Basins and Sub-Basins

Major Basin Description

Castle Highlands Filing No. 2 is within the East Plum Creek drainage basin. Plum Creek is located approximately one mile downstream of this site. The site is not within a 100-year flood plain as shown on FIRM maps 080049-0285c and 080049-0170c dated September 30, 1987. The Soil Conservation Service (figure 2) classifies the on-site soils as Hydrologic Group B.

Sub-Basin Description

The site slopes northeasterly in direction at grades varying from one to thirty percent. Approximately two-thirds of the site historically drains into an existing channel that outfalls into an existing on-stream detention pond. The pond outlets to the northeast into the continuation of said channel. A portion of the site drains into the channel downstream of the detention pond. The channel conveys flows under Wolfensberger Road via an existing 42" CMP and an existing 48" CMP which discharges in an existing channel on the north side of the road. The channel continues northeasterly in direction for approximately one mile where it outfalls into East Plum Creek.

The remaining one-quarter of the site also drains northeasterly. This area is routed to an existing channel along the south side of Wolfensberger Road. The channel along the south side of Wolfensberger Road continues easterly in direction for approximately thirteen hundred feet where it ties into a tributary of East Plum Creek.

This site accepts off-site flows from an undeveloped area to the southwest. A majority of this basin will remain as open space. Any developed portions will provide detention ponds that will not release at rates higher than historic. This site will release detained flows at historic rates as required by the Town of Castle Rock.

Drainage Design Criteria

Regulations

This report was prepared to meet the regulatory requirements of the Town of Castle Rock, Colorado. This report was prepared following guidelines and regulations within the "Town of Castle Rock Public Works Regulations" (TCRPWR, October 1, 1998) the Douglas County Storm Drainage Design and Technical Criteria (DCSDDTC) and the "Urban Storm Drainage Criteria Manual", (USDCM, 1992).

Development Criteria

This site was addressed in an approved preliminary drainage report by JR Engineering titled "Castle Highlands Preliminary Drainage Study" (September 1, 1994). This study identified historic flows for this site and upstream of this site. It defined required detention volumes and release rates. This site encompasses a majority of the area addressed in this study. The only area excluded from this filing is the multi-family site east of Auburn Drive. This study is in compliance with the preliminary study.

Hydrologic Criteria

This report analyzes the 5-year and 100-year storms for storm water conveyance systems and 10-year and 100-year storms for the detention requirements. All on-site runoff calculations utilized the Rational Method to determine runoff quantities. Runoff from the major offsite basin and its continuation through this project was evaluated using the Colorado Urban Hydrograph Procedure (CUHP). Detention and release values were calculated using the CUHP runs from the Preliminary Study and the Empirical Formula, $V = KA$, where $K_{100} = (1.78I - 0.002I^2 - 3.56) / 1000$ and $K_{10} = (0.95I - 1.90) / 1000$. In this formula, "V" represents the required volume for the 100-year or 10-year storm (acre-feet), "I" represents the developed basin imperviousness (%), and "A" represents the tributary area (acres).

Hydraulic Criteria

Open channel flow calculations utilized Manning's equation. Storm sewer capacities, hydraulic grades and energy grades were also calculated using Manning's equation. Pond release rates were calculated using standard weir and orifice equations.

Drainage Facility Design

General Concept

Conveyance of flood peaks within the Castle Highlands Subdivision will be handled through the use of storm sewers, streets and channelization. Both of the single-family areas drain into the

proposed detention pond (the modified existing pond, shown as "Pond A" on map). This detention pond has been sized to retain the increased runoff from the site and pass through historic off-site flows.

The future multi-family site (Lot 2, Block 7) will drain undetained into the existing channel downstream of "Pond A". The release rate from "Pond A" has been reduced to account for these undetained releases. On-site water quality facilities are recommended for the future multi-family site when it is developed. The Commercial site will be required to construct a detention/water quality pond to account for increased runoff. This pond will be designed and incorporated into the layout of the commercial site with the land development process for this parcel.

The off-site runoff through this site from Basin OS1 was obtained from the Castle Highlands Preliminary Drainage Study (Reference 6). The CUHP run shows the 100-year flow to be 485 cfs. This flow will be conveyed under Coachline Road with two 72-inch RCP pipes into a junction box. This box also receives the on-site flows from basins A-J, OS1A, OS1B, OS2, and OS3 through a 48-inch storm sewer located in Coachline Road. The flow from this box will be conveyed by a 72-inch RCP to an outlet point 950 feet downstream to the existing natural channel. The outlet of this pipe will be protected from erosion by riprap. Upstream of this outlet, the 72-inch pipe will pick up additional flow from an existing 29"x42" arch pipe under Wolfensberger Road. This pipe will connect to a new manhole on the south side of the road. A new 36-inch RCP will be extended to a manhole on the 72-inch pipe. The flow through this system was designed by using the CUHP run from the Preliminary Study, which determined the peak flow from both offsite and onsite basins to be 528 cfs. (Reference 6). The calculations are provided in Appendix B.

Beyond the end of the 72-inch pipe outlet, approximately 400 feet of the channel will remain in its natural condition other than the addition of riprap slope protection. This channel will lead directly to a drop structure into detention "Pond A". The detention pond outlet structure is designed to detain the water quality volume and 10-year storage volume. The release structure and a weir handle the 100-year release. Due to the volume of the release through the weir, a sloping boulder drop structure is incorporated at this point as well.

Specific Details

Most of the storm sewer system was designed to carry the 5-year runoff. The lines in Coachline Road west of the high point and basin A were designed to convey the 100-year storm. If the easterly inlet in basin A at design point 1 on this line were to overflow onto Coachline, the runoff would proceed easterly down Coachline instead of to the west and into "Pond A". All of the inlets at design points 1, 2, 3 and 5, in sump conditions, have an emergency overflow swale to convey runoff into Coachline in the event of inlet blockage.

The existing drainage channel will be improved by the installation of pipe, outlet protection and riprap slope protection. The channel improvements begin at the southwest corner of the site at "Drop A". A twin 72-inch RCP culvert will carry flows under the proposed Coachline Road. A single 72-inch RCP then continues in a northeasterly direction for approximately 950 feet. Bank improvements will be required at the 72-inch pipe outlet. The natural channel then continues through "Drop E" and into the on-stream detention pond "A". Downstream of the pond the

channel continues, unimproved, to an existing culvert at Wolfensberger Road . The channel calculations are provided in Appendix B.

Detention "Pond A" was designed in accordance with the preliminary study for this parcel (Reference 6). The CUHP run for the off-site basin shows peak flows of 485 cfs and 71 cfs for the 100-year and 10-year storms respectively at the southwest property line. The runoff from the future multi-family site west of Auburn Drive will be captured in "Pond A" via a swale located between lots 21 & 22.

The release structure is a three-stage structure consisting of a water quality riser, 10-year orifice and a 100-year weir with one-foot of freeboard. The required water quality volume is 48,000 cubic feet (CF) and the pond provides 51,700 CF of water quality storage. The water quality riser was designed to drain this volume over a 40 hour time period. The 10-year required storage volume is 104,100 CF and the pond provides 108,900 CF of storage. The outlet structure utilizes a 36" RCP (ref. 5, page 97, table 4). The pipe opening does not require an orifice plate since the calculated orifice diameter was 36". The 100-year required volume is 442,950 CF per the CUHP runs performed with the preliminary drainage study. The pond provides 447,600 CF of storage at an elevation of 6292.4. The 100-year release is accommodated by the 36" RCP conveying 110 cfs and 389.1 cfs flowing through the weir at a depth of 1.7'. The top of weir elevation is 6290.7 and the top of berm elevation is 6294.0, which provides 1.6' of freeboard. A drop structure has been designed on the back side of this weir to reduce channel velocity to acceptable levels before resuming the natural stream configuration.

EROSION CONTROL

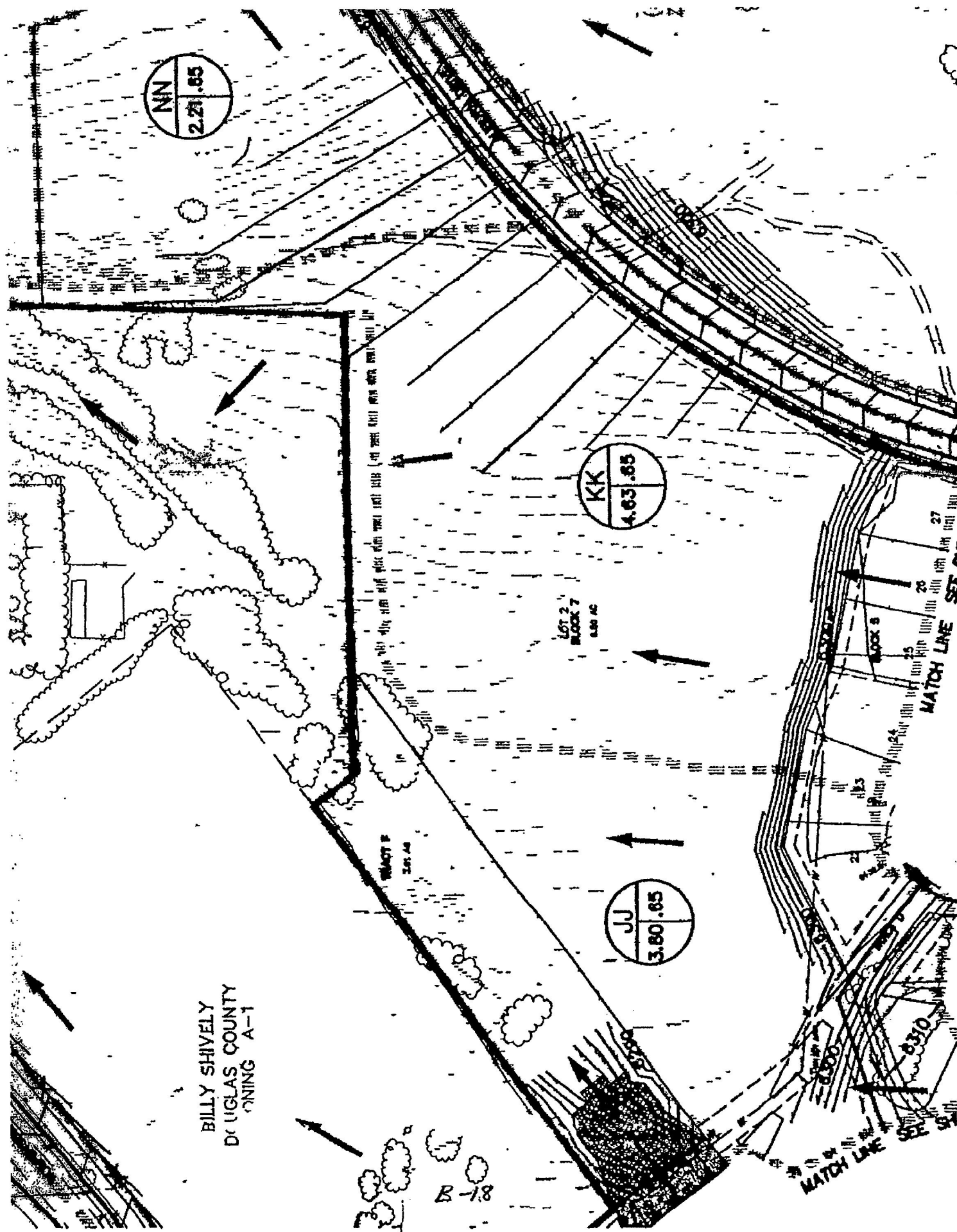
An erosion control plan has been provided to meet the requirements of the Town of Castle Rock. Specifically, the plan(s) address:

1. Overall Erosion Control measures.
2. Rip-rap dissipation devices at all storm drain outlets.
3. Criteria to mitigate erosion potential in all swales/channels.
4. Temporary and permanent erosion control measures for all improvements to off-site channels.

Calculations are provided in Appendix C.

CONCLUSIONS

The storm water conveyance system for Castle Highlands includes a storm sewer network, channel system and street system. Design calculations show the level of protection provided for the minor and major storm. Detention will be provided in an on-stream detention pond that will be located on site. Final design calculations for the storm sewer, detention ponds and channel improvements are provided in Appendix B.



FAA Pond Volume

Pond Volume
(FAA Method)

Subdivision Castle Highlands Filing No. 2
 Location Southwest of Auburn Drive and Wolfensberger Road
 Volume = $\frac{1}{3} \times \text{Depth} \times (A+B+(A \times B)^{0.5})$
 A - Upper Surface
 B - Lower Surface

Project Name: Castle Highlands Filing No. 2
 Project No. 231605
 By: rdc
 Checked By:
 Date: 6/21/99

POND A

Elevation	Surface Area (square feet)	$A+B+(A \times B)^{0.5}$	1/3	Depth (feet)	Volume (cubic feet)	Cumulative Volume (cubic feet)
6283.00	0					
6284.00	2000	2000.00	666.67	1.00	667	667
6286.00	29600	39294.15	13098.05	2.00	26196	26863
6286.70	41731	106476.95	35492.32	0.70	24845	51707
6287.90	53974	143164.73	47721.58	1.20	57266	108973
6288.00	64260	177127.28	59042.43	0.10	5904	114878
6290.00	75400	209267.50	69755.83	2.00	139512	254389
6292.00	84100	239131.28	79710.43	2.00	159421	413810
6292.40	84880	253469.10	84489.70	0.40	33796	447606
6294.00	88000	259305.92	86435.31	1.60	138296	585902

REQUIRED WATER QUALITY VOLUME = 48,800 CUBIC FEET
 PROVIDED VOLUME = 51,700 CF @ WSE=6286.7

REQUIRED 10-YEAR VOLUME = 104,100 CUBIC FEET
 PROVIDED VOLUME = 108,900 CF @ WSE=6287.9

REQUIRED 100-YEAR VOLUME = 442,950 CUBIC FEET
 PROVIDED VOLUME = 447,800 CF @ WSE=6292.4

Total Provided
Pond Volumes

Project Name:	Castle Highlands Filing No. 2
Project No.	2316.05
Calculated By:	rdc
Checked By:	
Date:	1/6/99

Subdivision Castle Highlands Filing No. 2
Location Southwest of Auburn Drive and
Design Storm 100 Year

[illegible]

PROJECT CASTLE HIGHLANDS #2 BY RDC CHK. BY gjf
SUBJECT DETENTION POND A DESIGNDATE 10/14/99

SHEET NO. _____ OF _____

DETENTION POND A IS AN ON-STREAM POND WITH LARGE OFF-SITE FLOWS OF 510 cfs. THIS POND WILL DETAIN RUNOFF FOR BASINS A-KK. THE RELEASE STRUCTURE IS DESIGNED TO ENSURE THAT THE 10 + 100 YEAR VOLUMES AS WELL AS THE WATER QUALITY VOLUME IS DETAINED IN THE PERTINENT EVENTS. IN THE 10-YEAR + 100 YEAR DESIGN STORMS, THE ON-SITE BASINS HAVE A SHORTER TIME OF CONCENTRATION AND THE REQUIRED VOLUMES ARE STORED WITH THE APPROPRIATE RELEASE RATES. WHEN THE OFF-SITE FLOWS REACH THE POND IN THE 100-YEAR STORM, EXCESS FLOWS ARE ROUTED OVER THE WEIR IN THE POND BANK ABOVE THE OUTLET PIPE.

PROJECT CASTLE HIGHLANDS #2 BY RDC

CHK.
BY

gls

DATE 10/14/99

SUBJECT DETENTION POND RELEASE

SHEET NO. _____ OF _____

FROM "CASTLE HIGHLANDS PRELIMINARY DRAINAGE STUDY"
SEPT. 1, 1999, JR ENGINEERING

OFFSITE 100 YEAR PEAK = 485 cfs

OFFSITE 10 YEAR PEAK = 71 cfs

10-YEAR RELEASE

71 cfs + (PEAK basins A-KK) - (Basins JJ+KK) ^{UNDRAINED}

$$71 \text{ cfs} + 19.3 \text{ cfs} - (13.7 + 16.7) = 59.9 \text{ cfs} \leftarrow$$

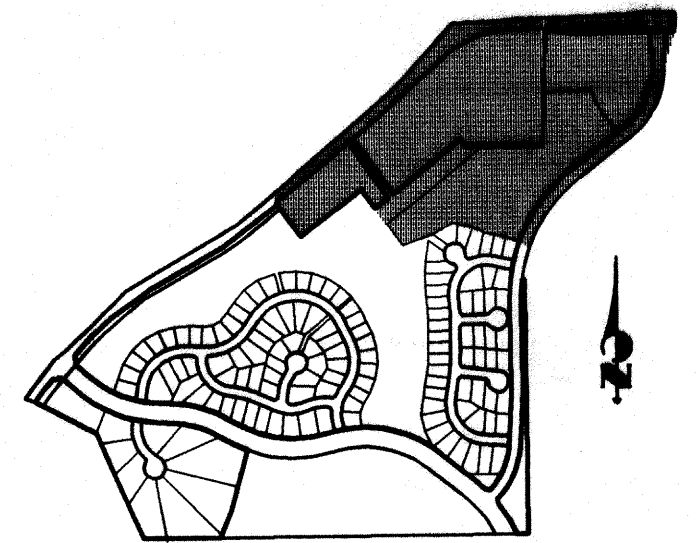
100-YEAR RELEASE

$$485 \text{ cfs} + 71.4 \text{ cfs} - (25.8 + 31.5) = 499.1 \text{ cfs} \leftarrow$$

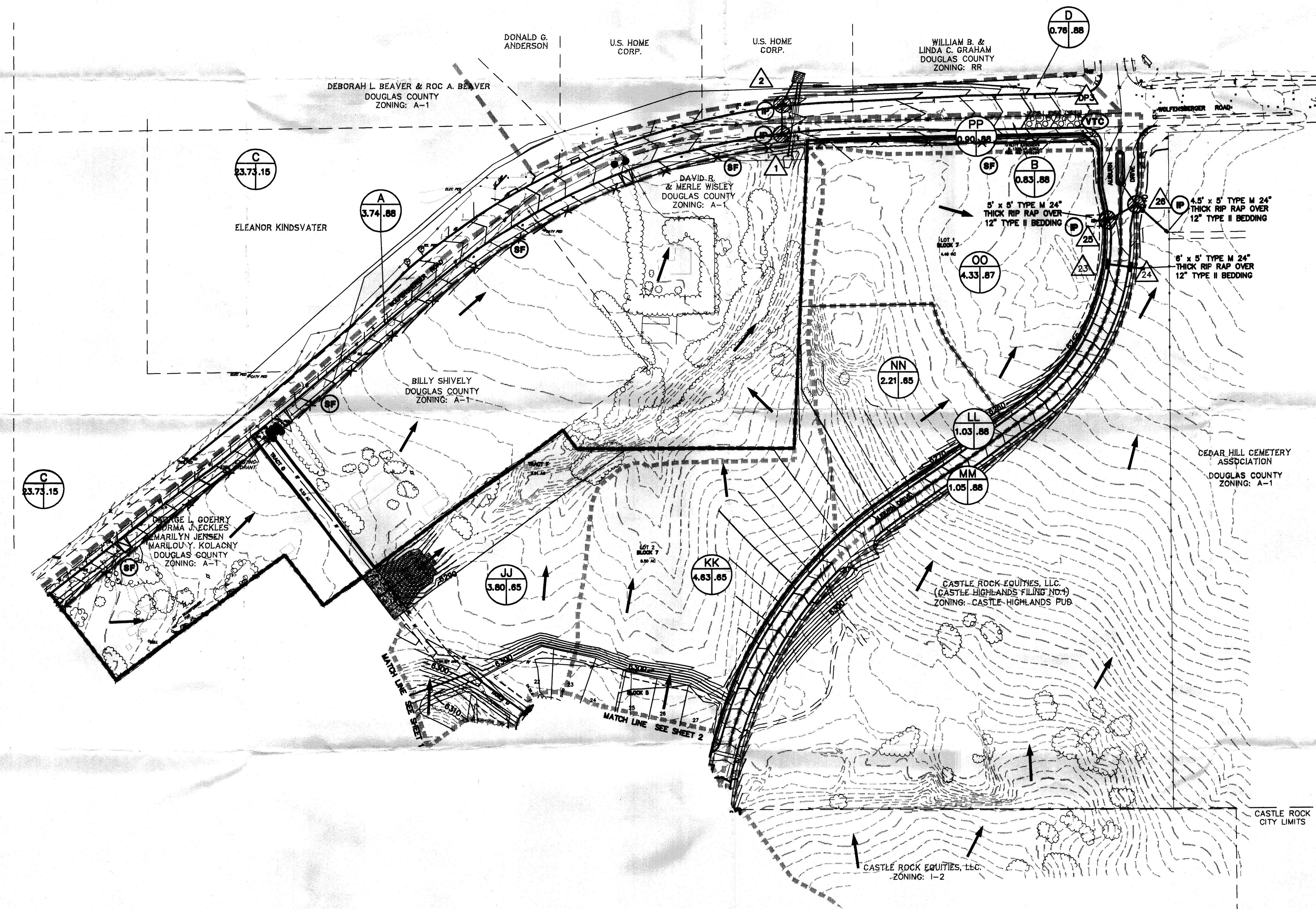
Impervious Area Calulation

Basin	Area	% Impervious	Area x % Imp.
A	3.59	0%	0.00
B	3.41	0%	0.00
C	5.47	0%	0.00
D	1.43	100%	1.43
E	1.16	22%	0.26
F	1.62	22%	0.36
G	1.86	22%	0.41
H	2.33	22%	0.51
I	0.36	100%	0.36
J	0.57	100%	0.57
K	0.54	41%	0.22
L	1.36	41%	0.56
M	2.29	41%	0.94
N	2.32	41%	0.95
O	1.24	100%	1.24
P	1.09	41%	0.45
Q	3.30	41%	1.35
R	3.30	41%	1.35
S	1.86	41%	0.76
T	1.59	41%	0.65
U	1.02	41%	0.42
V	8.07	0%	0.00
W	6.68	0%	0.00
X	0.98	100%	0.98
Y	0.23	100%	0.23
Z	1.80	41%	0.74
AA	0.99	0%	0.00
BB	0.23	100%	0.23
CC	1.05	100%	1.05
DD	0.98	100%	0.98
EE	2.12	41%	0.87
FF	1.86	41%	0.76
GG	1.81	41%	0.74
HH	2.20	0%	0.00
II	4.88	41%	2.00
JJ	3.80	70%	2.66
KK	4.63	70%	3.24
Total	84.02		0.32

PHASE III DRAINAGE MAP
CASTLE HIGHLANDS FILING NO. 2
 A PORTION OF SECTION 3 AND SECTION 10, TOWNSHIP 8 SOUTH,
 RANGE 67 WEST OF THE 6TH PRINCIPAL MERIDIAN
 TOWN OF CASTLE ROCK, COUNTY OF DOUGLAS, STATE OF COLORADO



KEY MAP
 1"=1000'

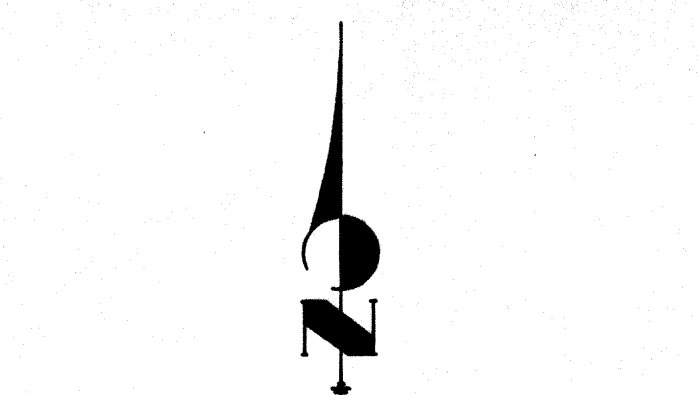


LEGEND

- 5665 — EXISTING CONTOUR
- 5665 — PROPOSED CONTOUR
- ➔ DRAINAGE DIRECTION
- | |
|---|
| A |
| B |
| C |

 A - BASIN DESIGNATION
 B - BASIN AREA
 C - 5-YEAR RUNOFF COEFFICIENT
- | |
|---|
| N |
|---|

 N - DESIGN POINT



100 50 0 100 200

SCALE: 1" = 100'

PHASE III DRAINAGE MAP
 CASTLE HIGHLANDS FILING NO. 2
 JOB NO. 2316.05
 JULY 23, 1999 REV. 12/10/99
 SHEET 2 OF 2

JR Engineering, Ltd.
 8020 Greenwood Plaza Blvd.
 Englewood, Colorado 80111
 Tel. (303) 740-9393
 FAX (303) 721-9019

ENGINEERING/PLANNING/SURVEYING

POND VOLUME CALCULATIONS

SUBDIVISION AUBURN VILLAS (AUBURN RIDGE LOT 2)

CALCULATED BY AMA

DATE 1/12/2016

POND	ELEV	AREA (ft ²)	VOLUME (ft ³)	VOLUME _{sum} (ft ³)	METHOD
Proposed WQ Basin	6269	0	0	0	prismoidal
	6270	554	184.73	184.73	
	6271	1509	992.56	1,177.30	
	6272	2470	1,970.05	3,147.35	
	6273	3779	3,101.66	6,249.01	
	6274	4582	4,173.96	10,422.97	
	6275	5600	11,789.84	14,937.19	

$V_{WQ}(ft^3) = 7,492.32$

By Interpolation

$Elev_{WQ}(ft) = 6273.30$

Spillway

Project Description

Solve For Headwater Elevation

Input Data

Discharge	39.45	ft ³ /s
Crest Elevation	6273.30	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	3.00	US
Crest Length	18.00	ft

Results

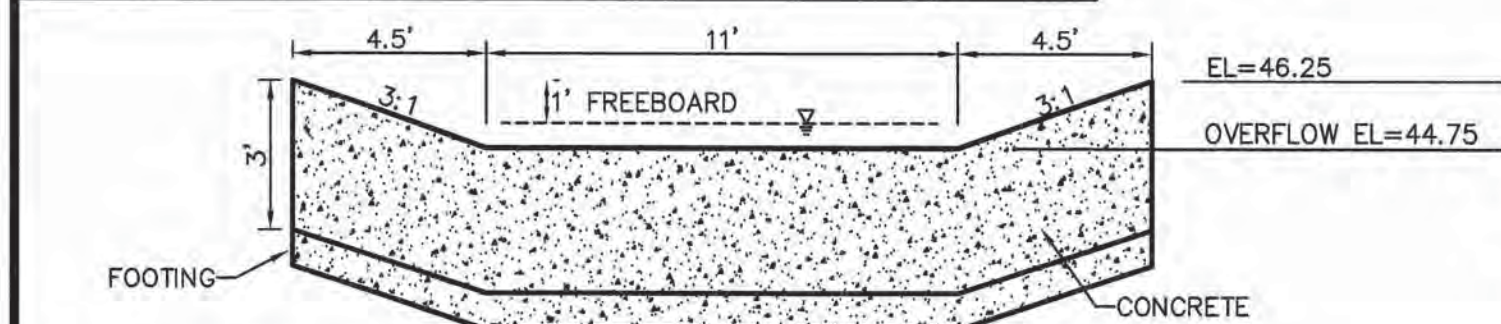
Headwater Elevation	6274.11	ft
Headwater Height Above Crest	0.81	ft
Tailwater Height Above Crest	-6273.30	ft
Equal Side Slopes	0.25	ft/ft (H:V)
Flow Area	14.77	ft ²
Velocity	2.67	ft/s
Wetted Perimeter	19.67	ft
Top Width	18.41	ft

DOCUMENT CONTROL

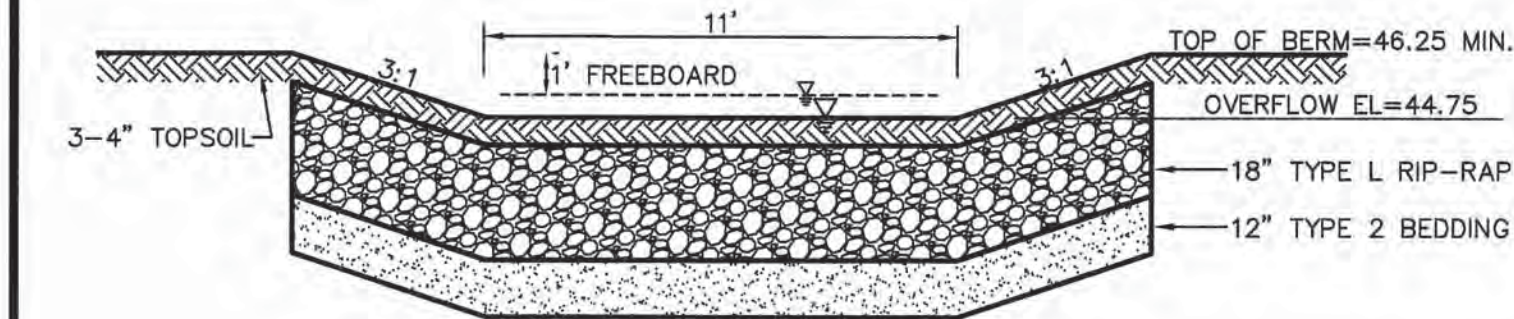
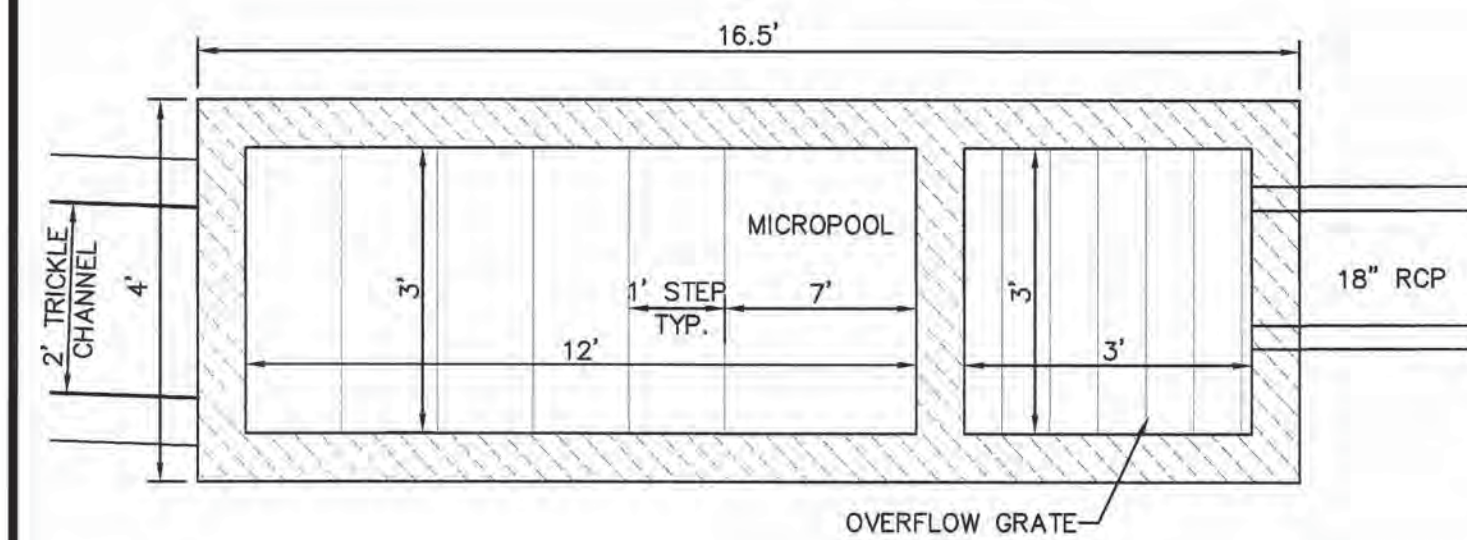
PERMIT SET: APPROVED FOR CONSTRUCTION

DATE

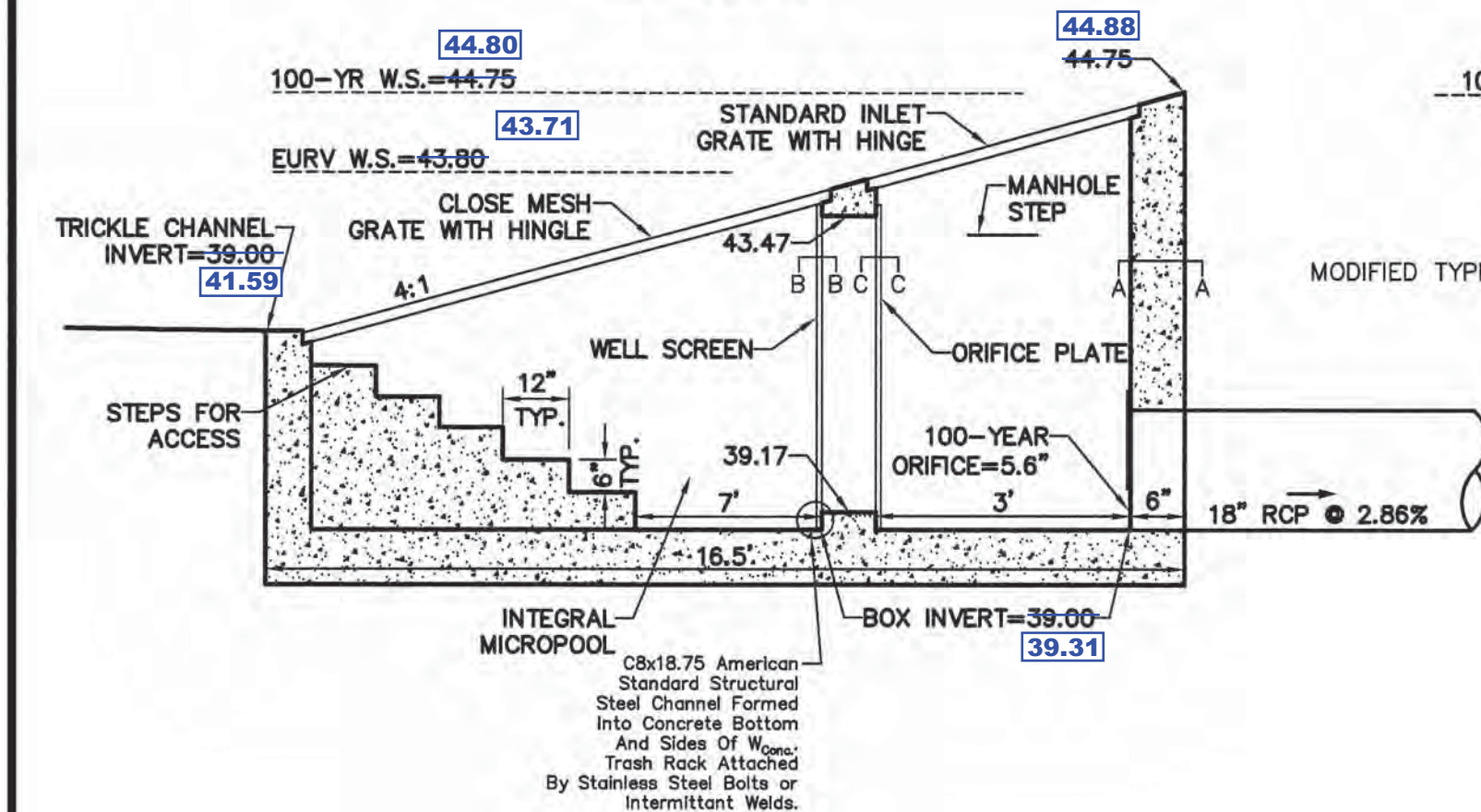
2/28/13



NOTE: THIS CUT-OFF WALL SHALL BE DESIGNED BY A STRUCTURAL ENGINEER

LOT 1
CUT-OFF WALLLOT 1
EMERGENCY OVERFLOW WEIR

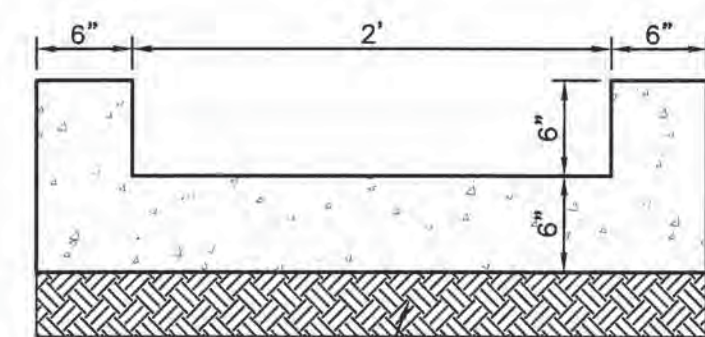
TOP VIEW



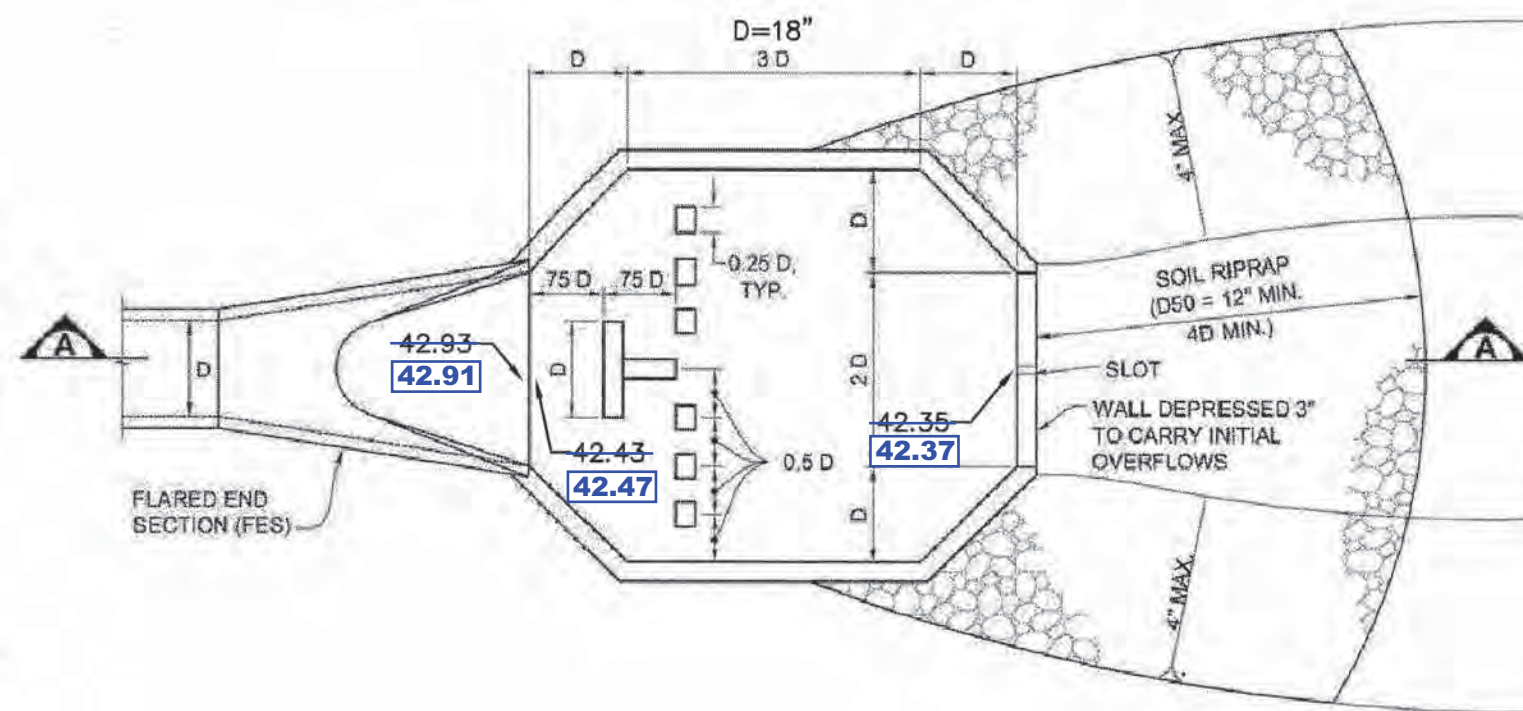
SECTION B-B

WATER QUALITY FACILITY OUTLET STRUCTURE

LOT 1

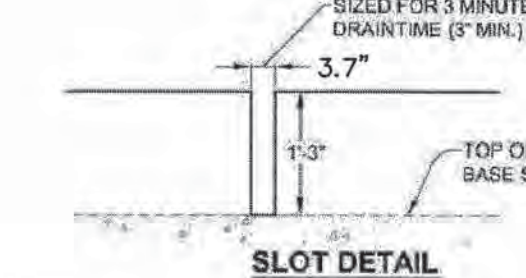


NOTE: PROVIDE CONTROL JOINT EVERY TEN (10) FEET.

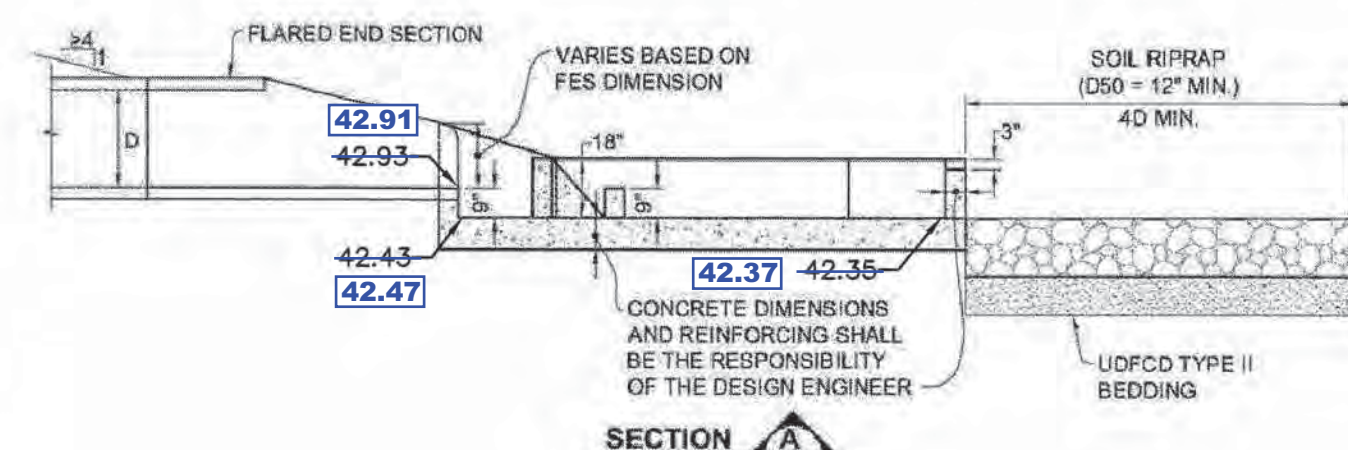
2' TRICKLE CHANNEL
NTSTHE ASBUILT INFORMATION SHOWN HEREON,
WAS MADE UNDER MY SUPERVISION, AND
REPRESENTS MEASUREMENTS MADE IN THE
FIELD ON 12-1-2014DOUGLAS ORT, PLS
ACCURATE ENGINEERING
A MANHARD CONSULTING DIVISIONFIGURE 14-9
CONCEPT FOR INTEGRAL FOREBAY AT END SECTION
LOT 1

PLAN

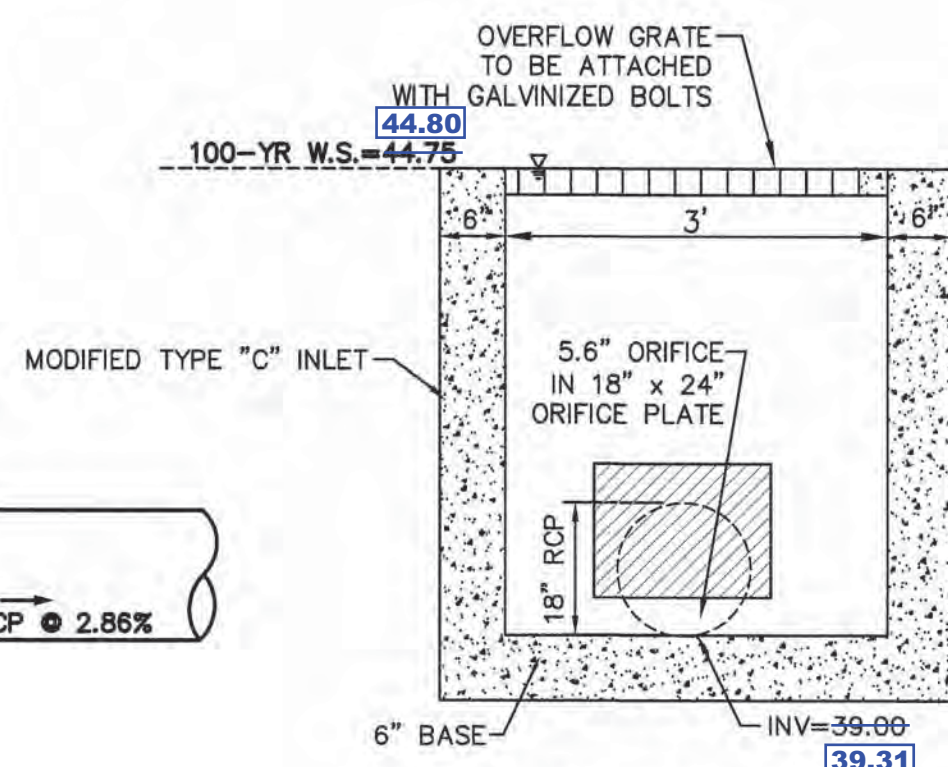
- NOTES:
- DIMENSIONS SHOWN ARE MINIMUMS AND APPLY TO FOREBAYS WITHIN MODIFIED EXTENDED DETENTION BASINS. FOREBAYS IN STANDARD EXTENDED DETENTION BASINS SHALL BE SIZED BASED ON UDFCD CRITERIA.
 - FOR D > 2.5 FEET, FOREBAY REQUIRES RAMP INTO BOTTOM AND ACCESS ROAD LEADING TO STREET.



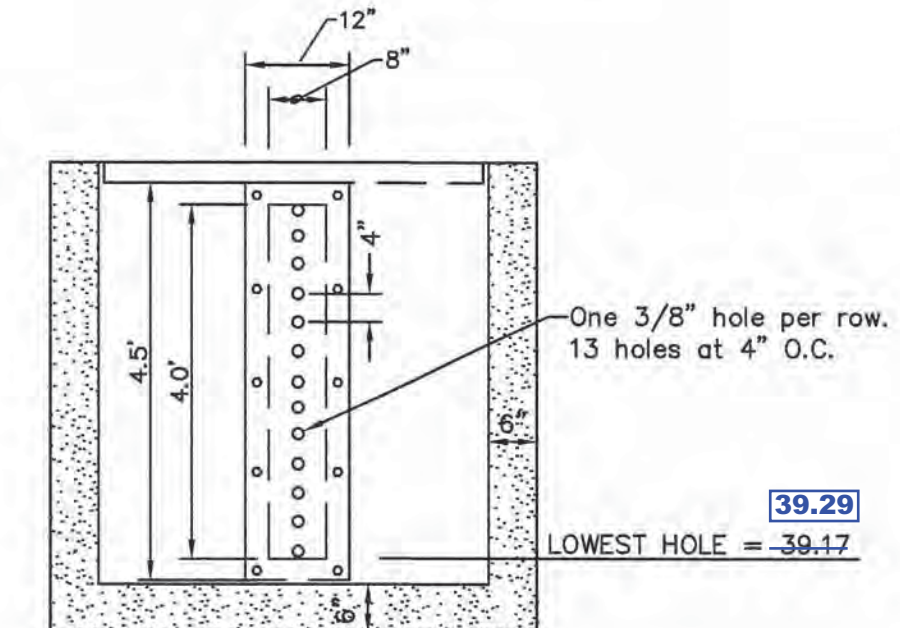
SLOT DETAIL



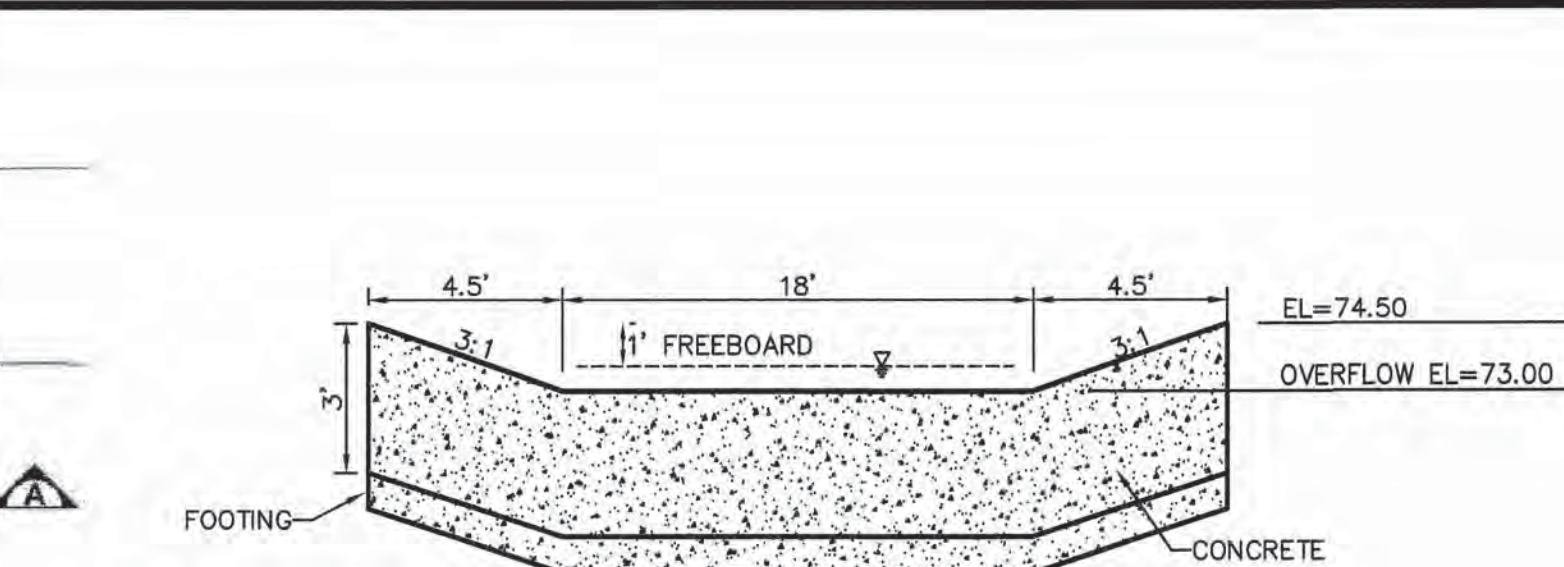
SECTION A-A



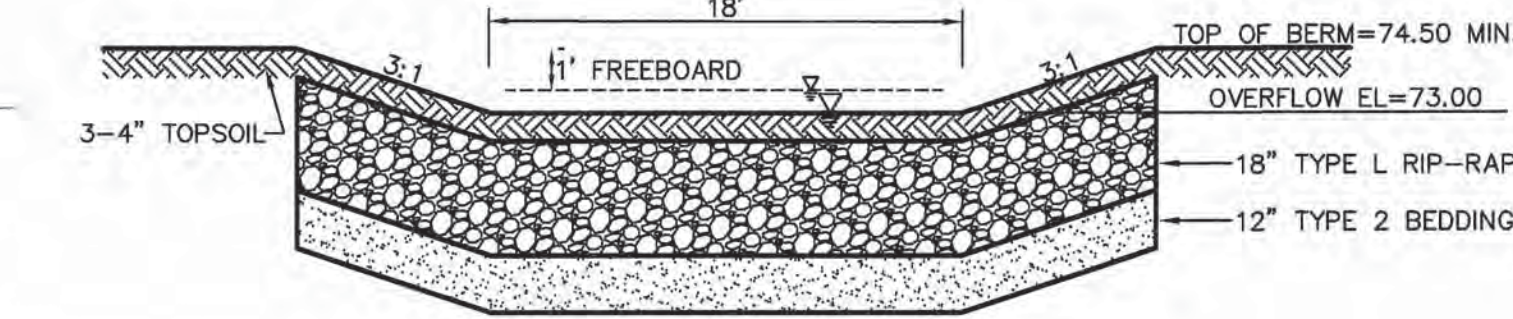
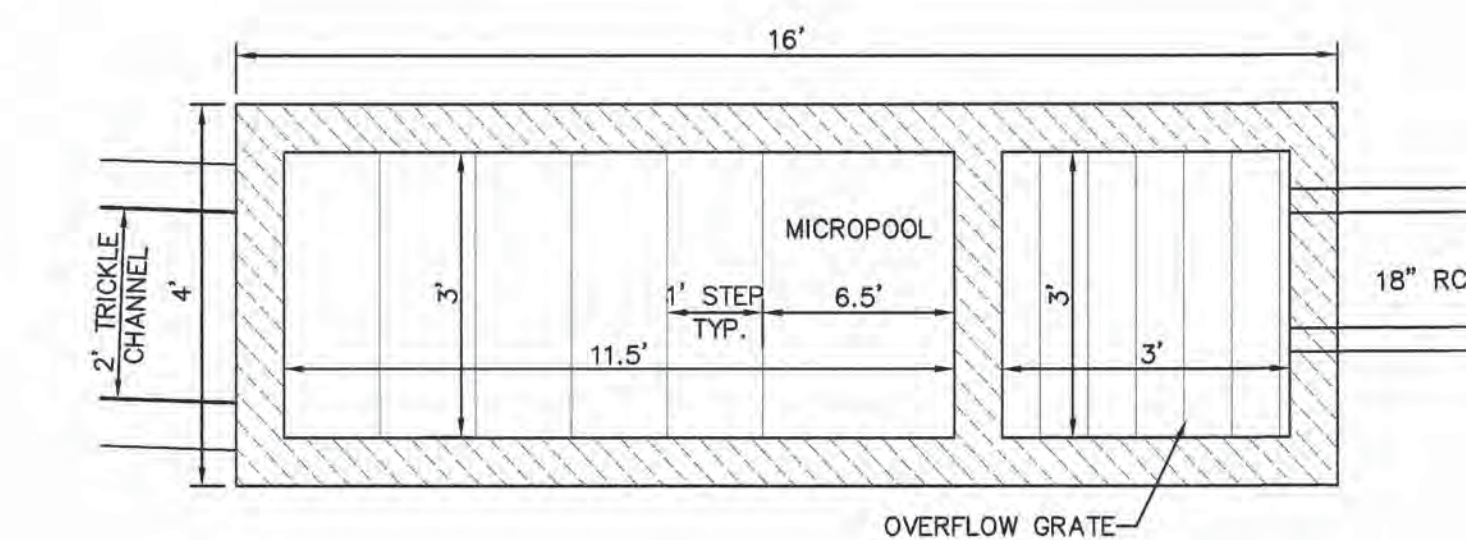
SECTION A-A



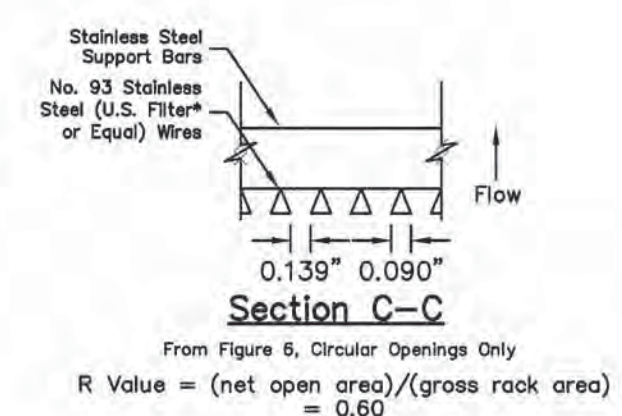
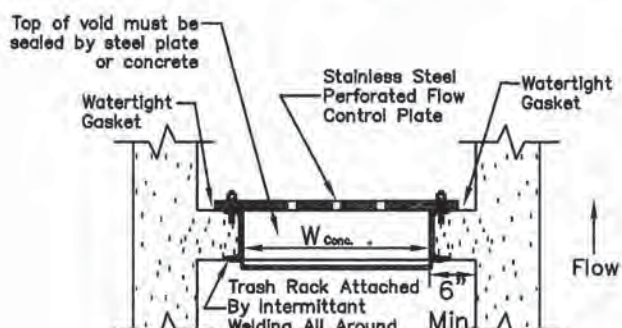
SECTION C-C



NOTE: THIS CUT-OFF WALL SHALL BE DESIGNED BY A STRUCTURAL ENGINEER

LOT 2
CUT-OFF WALLLOT 2
EMERGENCY OVERFLOW WEIR

TOP VIEW

Section C-C
From Figure 6, Circular Openings Only
R Value = (net open area)/(gross rack area) = 0.60

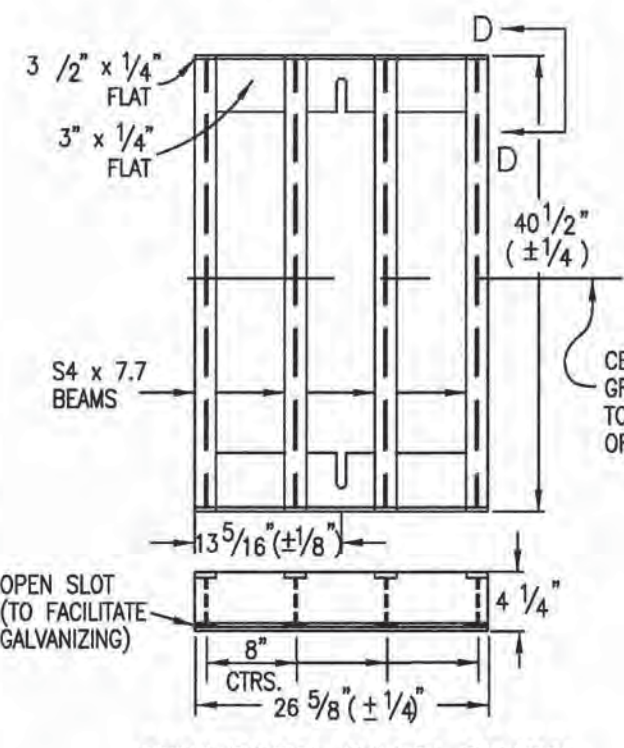
Section B-B - Plan View

- From Figure 6, Circular Openings Only
Limits for this Standardized Design:
- All outlet plate openings are circular.
 - Maximum diameter of opening = 2 inches.
- *U.S. Filter, St. Paul, Minnesota, USA

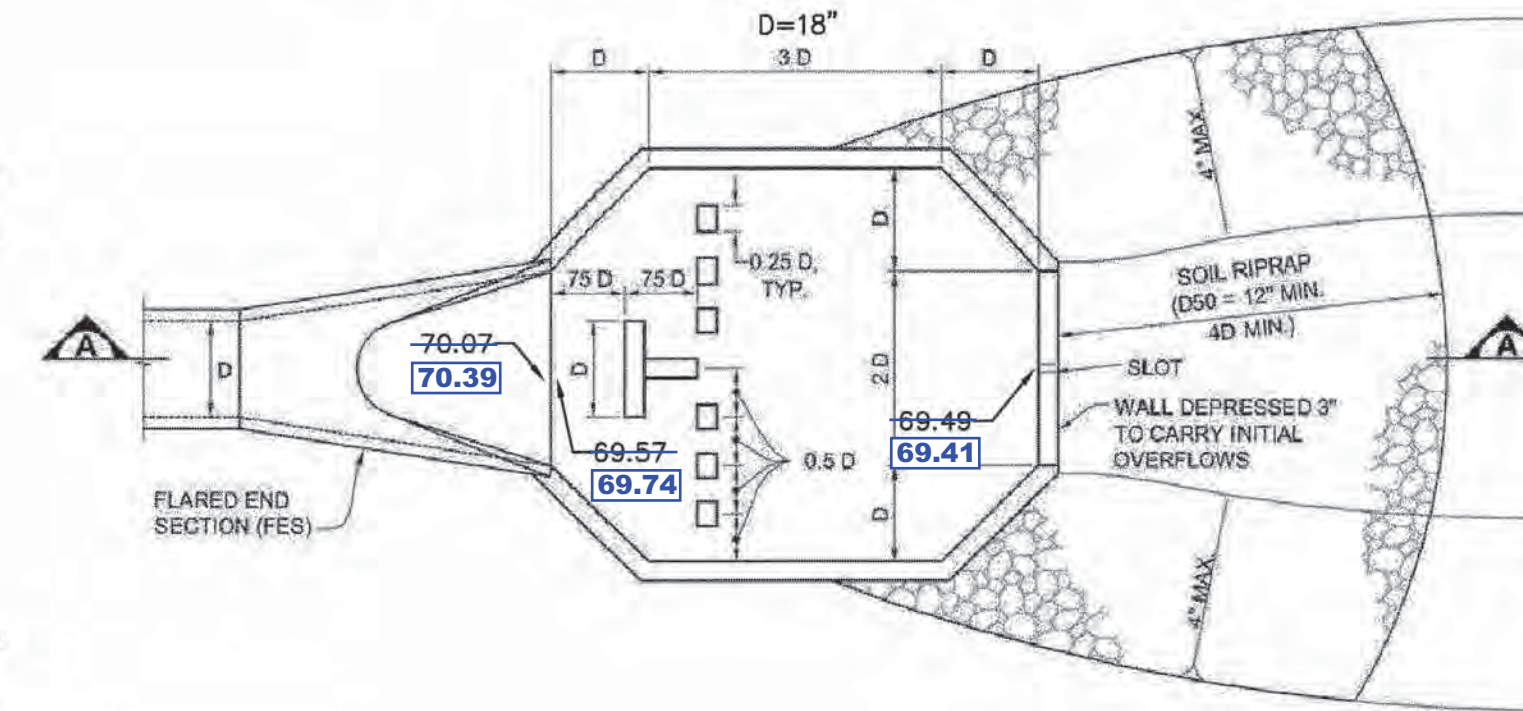
WQCV Trash Racks:

- Well-screen trash racks shall be stainless steel and shall be attached by intermittent welds along the edge of the mounting frame.
- Bar grate trash racks shall be aluminum and shall be bolted using stainless steel hardware.
- Trash Rack widths are for specified trash rack material. Finer well-screen or mesh size than specified is acceptable, however, trash rack dimensions need to be adjusted for materials having a different open area/gross area ratio (R value).
- Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

TRASH RACK DETAIL

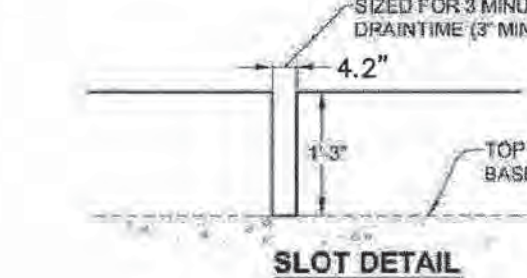


STANDARD INLET GRATE

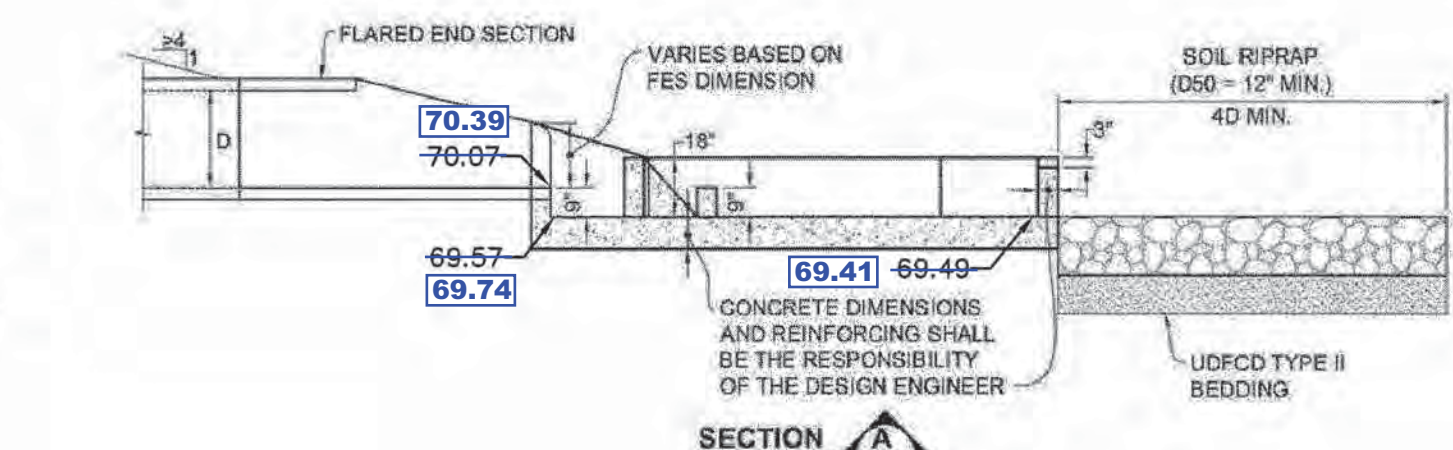
FIGURE 14-9
CONCEPT FOR INTEGRAL FOREBAY AT END SECTION
LOT 2

PLAN

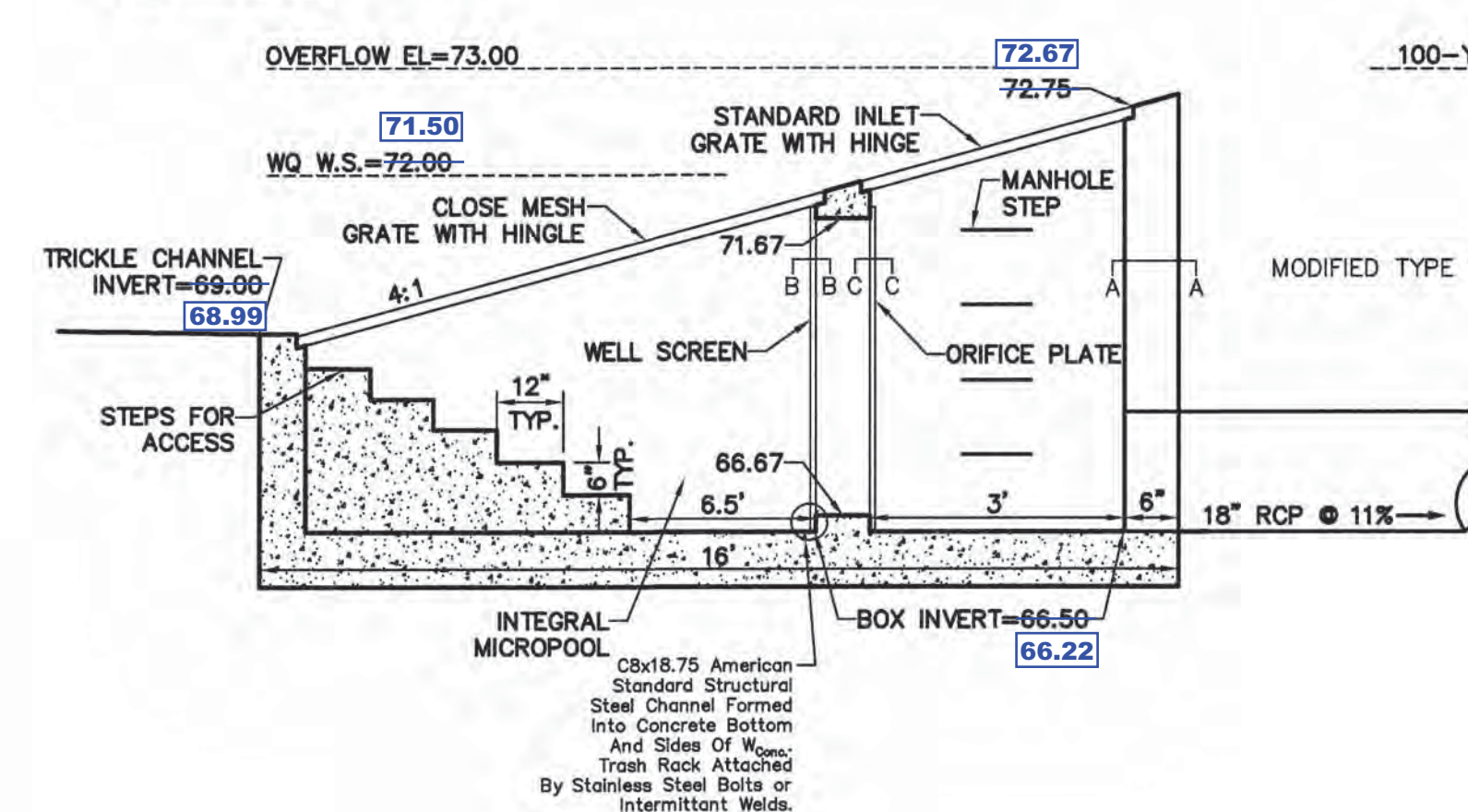
- NOTES:
- DIMENSIONS SHOWN ARE MINIMUMS AND APPLY TO FOREBAYS WITHIN MODIFIED EXTENDED DETENTION BASINS. FOREBAYS IN STANDARD EXTENDED DETENTION BASINS SHALL BE SIZED BASED ON UDFCD CRITERIA.
 - FOR D > 2.5 FEET, FOREBAY REQUIRES RAMP INTO BOTTOM AND ACCESS ROAD LEADING TO STREET.



SLOT DETAIL



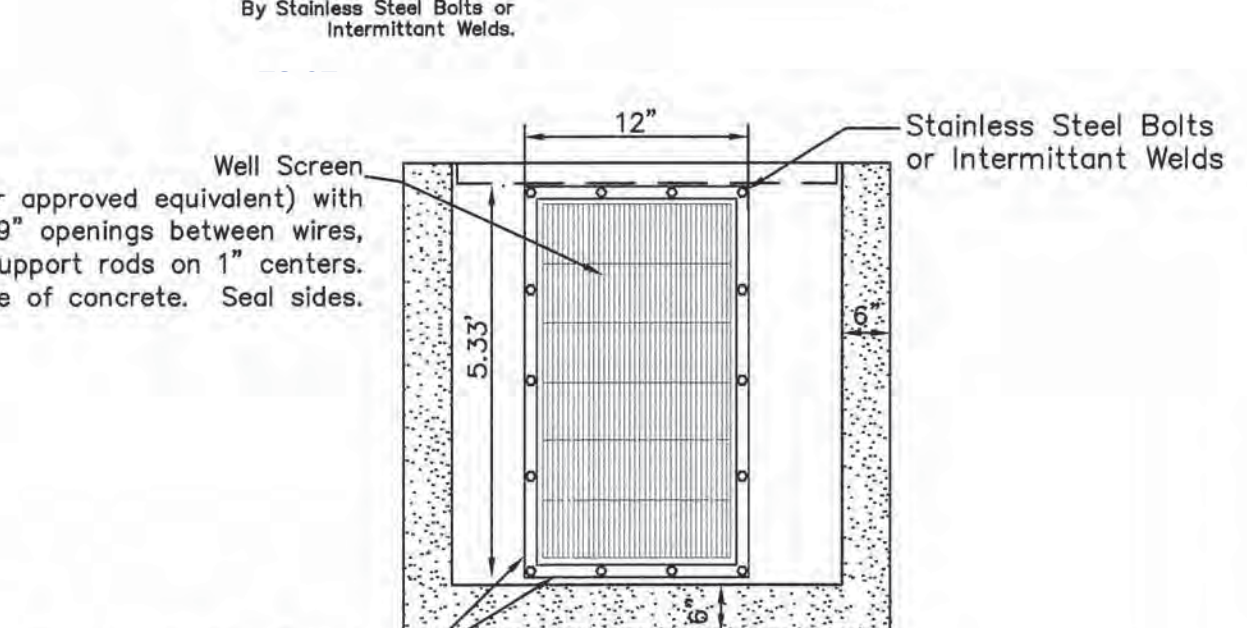
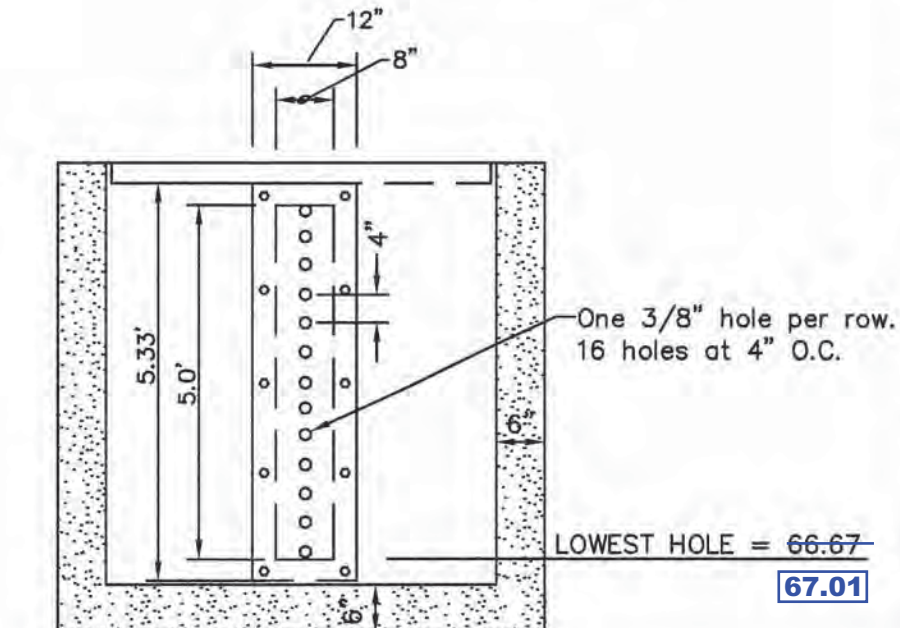
SECTION A-A



SECTION B-B

DETENTION FACILITY OUTLET STRUCTURE

LOT 2

Structural Steel Channel
Formed Into Concrete.

SECTION C-C

CONSULTANT ENGINEER CERTIFICATION

I HEREBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS WERE PREPARED UNDER MY DIRECT SUPERVISION, IN ACCORDANCE WITH ALL APPLICABLE TOWN OF CASTLE ROCK AND STATE OF COLORADO STANDARDS AND STATUTES, RESPECTIVELY; AND THAT I AM FULLY RESPONSIBLE FOR ALL DESIGN AND REVISIONS RELATIVE TO SAID PLANS.

BRIAN KROMBEIN, PE, PLS
COLORADO NO. 34294
FOR AND ON BEHALF OF
VERMILION PEAK ENGINEERING LLC

TOWN OF CASTLE ROCK APPROVALS

THESE PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL.

RECOMMEND APPROVAL BY:
ENGINEERING DIVISIONApproved
Development Services
DATE
MAR 1 0 2013APPROVED BY:
DEVELOPMENT SERVICESTown of Castle Rock
DATE

UNTIL SUCH TIME AS THESE
DRAWINGS ARE APPROVED
BY THE APPROPRIATE
VERMILION PEAK
ENGINEERING APPROVES
THEIR USE ONLY FOR THE
PURPOSES DESIGNATED BY
WRITTEN AUTHORIZATION.

PREPARED FOR
AUBURN VENTURES, LP
19557 NO. 81ST STREET #101
SCOTTSDALE, AZ 85260
480-256-0506



DATE	BY	REVISION	NO.	AS SHOWN	H-SCALE	V-SCALE	DATE	DESIGNED BY	DRAWN BY	CHECKED BY
2/28/13	BK	1	1				2/28/13	BK	BK	BK

AUBURN RIDGE

DRAINAGE DETAILS

SHEET C11 OF 14

JOB NO. 12014

Table 6-5. Runoff coefficients, *c*

Total or Effective % Impervious	NRCS Hydrologic Soil Group A						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
2%	0.01	0.01	0.01	0.01	0.04	0.13	0.27
5%	0.02	0.02	0.02	0.03	0.07	0.15	0.29
10%	0.04	0.05	0.05	0.07	0.11	0.19	0.32
15%	0.07	0.08	0.08	0.1	0.15	0.23	0.35
20%	0.1	0.11	0.12	0.14	0.2	0.27	0.38
25%	0.14	0.15	0.16	0.19	0.24	0.3	0.42
30%	0.18	0.19	0.2	0.23	0.28	0.34	0.45
35%	0.21	0.23	0.24	0.27	0.32	0.38	0.48
40%	0.25	0.27	0.28	0.32	0.37	0.42	0.51
45%	0.3	0.31	0.33	0.36	0.41	0.46	0.54
50%	0.34	0.36	0.37	0.41	0.45	0.5	0.58
55%	0.39	0.4	0.42	0.45	0.49	0.54	0.61
60%	0.43	0.45	0.47	0.5	0.54	0.58	0.64
65%	0.48	0.5	0.51	0.54	0.58	0.62	0.67
70%	0.53	0.55	0.56	0.59	0.62	0.65	0.71
75%	0.58	0.6	0.61	0.64	0.66	0.69	0.74
80%	0.63	0.65	0.66	0.69	0.71	0.73	0.77
85%	0.68	0.7	0.71	0.74	0.75	0.77	0.8
90%	0.73	0.75	0.77	0.79	0.79	0.81	0.84
95%	0.79	0.81	0.82	0.83	0.84	0.85	0.87
100%	0.84	0.86	0.87	0.88	0.88	0.89	0.9
Total or Effective % Impervious	NRCS Hydrologic Soil Group B						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
2%	0.01	0.01	0.07	0.26	0.34	0.44	0.54
5%	0.03	0.03	0.1	0.28	0.36	0.45	0.55
10%	0.06	0.07	0.14	0.31	0.38	0.47	0.57
15%	0.09	0.11	0.18	0.34	0.41	0.5	0.59
20%	0.13	0.15	0.22	0.38	0.44	0.52	0.61
25%	0.17	0.19	0.26	0.41	0.47	0.54	0.63
30%	0.2	0.23	0.3	0.44	0.49	0.57	0.65
35%	0.24	0.27	0.34	0.47	0.52	0.59	0.66
40%	0.29	0.32	0.38	0.5	0.55	0.61	0.68
45%	0.33	0.36	0.42	0.53	0.58	0.64	0.7
50%	0.37	0.4	0.46	0.56	0.61	0.66	0.72
55%	0.42	0.45	0.5	0.6	0.63	0.68	0.74
60%	0.46	0.49	0.54	0.63	0.66	0.71	0.76
65%	0.5	0.54	0.58	0.66	0.69	0.73	0.77
70%	0.55	0.58	0.62	0.69	0.72	0.75	0.79
75%	0.6	0.63	0.66	0.72	0.75	0.78	0.81
80%	0.64	0.67	0.7	0.75	0.77	0.8	0.83
85%	0.69	0.72	0.74	0.78	0.8	0.82	0.85
90%	0.74	0.76	0.78	0.81	0.83	0.84	0.87
95%	0.79	0.81	0.82	0.85	0.86	0.87	0.88
100%	0.84	0.86	0.86	0.88	0.89	0.89	0.9