DRAINAGE LETTER REPORT

for

COVERTEC WAREHOUSE BUILDINGS
LOT 24 & 25, CLAREMONT BUSINESS PARK FILING NO. 2

Prepared for:

Covertec Inc.
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August 23, 2017

Prepared by:

JPS ENGINEERING

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JPS Project No. 051704

PPR-17-036

COVERTEC WAREHOUSE BUILDINGS
LOT 24 & 25, CLAREMONT BUSINESS PARK FILING NO. 2A
DRAINAGE REPORT STATEMENTS

1. Engineer's Statement:

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

____

John P. Schwab Colorado P.E. No. 29891

Please date as well.

2. Developer's Statement:

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

By:

____ ______________________

Printed Name: Date
Title:

3. El Paso County Statement:

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

____

Jennifer Irvine, P.E. Date
County Engineer / ECM Administrator

Conditions:

Attached is the current signature blocks, if needed for future use.

I. INTRODUCTION

A. Property Location and Description

Covertec Inc. and Jim Dandy Investment Company LLC are planning construct new warehouse buildings on two adjoining vacant commercial properties described as Lots 24 and 25, Claremont Business Park Filing No. 2 in El Paso County, Colorado. The two adjoining lots (El Paso County Assessor's No. 54081-02-028 and 54081-02-029) comprise a total area of 0.97 acres located at the northwest corner of Cole View and Meadowbrook Parkway. The properties are zoned Commercial Service (CS).

Cole View is a paved private street along the south side of the properties, and Meadowbrook Parkway is a paved public street along the east side of Lot 25. Existing platted commercial / industrial lots adjoin the north, west and south sides of the properties. An existing self-storage site is located to the southeast on the opposite side of Meadowbrook Parkway.

The site development plan consists of proposed 5,000 square-foot warehouse buildings with associated parking and site improvements on both Lot 24 and Lot 25. Access will be provided by new driveways connecting to Cole View on the south side of each of the lots. The proposed internal parking areas will be paved with asphalt and concrete.

B. Scope

In support of the El Paso County Site Development Plan submittal for this project, this report is intended to meet the requirements of a site-specific "Letter Type" drainage report in accordance with El Paso County drainage criteria. This report will provide a summary of site drainage issues impacting the proposed development, including analysis of upstream drainage patterns, site-specific developed drainage patterns, and impacts on downstream facilities. This report is based on the guidelines and criteria presented in the City of Colorado Springs and El Paso County "Drainage Criteria Manual."

C. References

City of Colorado Springs & El Paso County "Drainage Criteria Manual, Volumes 1 and 2," revised May, 2014.

Matrix Design Group, Inc., "Final Drainage Report for Claremont Business Park Filing No. 2," revised November, 2006.

II. EXISTING / PROPOSED DRAINAGE CONDITIONS

According to the Natural Resources Conservation Services (NRCS) web soil survey, on-site soils are comprised of Blakeland loamy sand and Ellicott loamy coarse sand. These soils are classified as hydrologic soils group A. The existing site topography slopes downward to the southwest with grades of approximately 1-4 percent.

Drainage planning for this lot was previously addressed in the “Final Drainage Report for Claremont Business Park Filing No. 2” by Matrix Design Group, Inc. (Matrix) dated November, 2006. The subject property (Lots 24 and 25) was identified as part of Basins E5A and E5C in the subdivision drainage report, and drainage from these lots has been planned to sheet flow in a southwesterly direction and then follow the curb and gutter along Cole View westerly to an existing public storm sewer system, ultimately draining from Cole View into the East Fork Sand Creek drainage channel. The subdivision drainage report assumed full commercial development within Basins E5A and E5C.

As shown on the enclosed Drainage Plan (Figure D1), the proposed development has been delineated as two on-site drainage basins (A1 and A2) flowing southwesterly across the site. The existing private street of Cole View along the frontage of the property has been delineated as Basin OA1.

Recognizing that water quality improvements were not provided during initial development of this subdivision, El Paso County is requiring each lot to provide water quality mitigation as the lots develop. A private Rain Garden will be constructed at the southwest corner of Lot 24 to meet the County water quality requirements for both Lots 24 and 25.

Surface runoff from the developed site will follow the drainage patterns established in the subdivision drainage report, flowing towards the southwest corner of the site. The proposed building pads will be graded with protective slopes to provide positive drainage away from the buildings. Curb and gutter will be installed along the outer perimeter of the new parking areas. The curb, gutter, and crosspans in the parking areas will convey developed flows around the buildings to a private storm sewer system along the south side of the lots. The private storm sewer system will convey developed flows into the Rain Garden at the southwest corner of the site. In the event of clogging of the private storm inlets along the south boundary of the site, overflows will sheet flow to the existing curb and gutter along the north side of Cole View and flow northwesterly to the existing downstream storm sewer system.

Developed flows have been calculated based on the impervious areas associated with the proposed building and parking areas. Developed flows from Basins A1 and A2 combine at Design Point #1 with developed peak flows calculated as Q_5 = 3.5 cfs and Q_{100} = 6.3 cfs. Developed flows from Basins OA1, A1, and A2 combine at Design Point #2 with developed peak flows calculated as Q_5 = 4.1 cfs and Q_{100} = 7.4 cfs.

The subdivision drainage report assumed full commercial development of this site, and the proposed site development plan is entirely consistent with the approved subdivision drainage plan.

Hydrologic calculations for the parcel are detailed in the attached spreadsheet (Appendix A), and peak flows are identified on Figure D1. The contractor will need to implement standard best management practices for erosion control during construction.

III. DRAINAGE PLANNING FOUR STEP PROCESS

El Paso County Drainage Criteria require drainage planning to include a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

As stated in DCM Volume 2, the Four Step Process is applicable to all new and re-development projects with construction activities that disturb 1 acre or greater or that disturb less than 1 acre but are part of a larger common plan of development. The Four Step Process has been implemented as follows in the planning of this project:

Step 1: Employ Runoff Reduction Practices

- Minimize Directly Connected Impervious Areas (MDCIA): The proposed site development will include a Rain Garden at the southwest corner of Lot 24, which will have a grass-lined bottom to encourage stormwater infiltration, providing for the majority of the new site impervious area to drain across this pervious area.
- Grass Swales: The proposed drainage plan incorporates grass swales along the south side of the buildings to encourage stormwater infiltration while providing positive drainage to the private storm sewer system.

Step 2: Stabilize Drainageways

- There are no major drainageways directly adjacent to this site. Routing flows through the on-site Rain Garden will minimize off-site impacts to existing downstream drainageways.

Step 3: Provide Water Quality Capture Volume (WQCV)

- Site drainage will be routed through the proposed Rain Garden (RG), which will capture and slowly release the WQCV over a 12-hour design release period.

Step 4: Consider Need for Industrial and Commercial BMPs

- On-site drainage will be routed through the private Rain Garden (RG) to minimize introduction of contaminants to the County's public drainage system.

IV. STORMWATER QUALITY

The proposed drainage and grading plan for this site includes a private Rain Garden (RG) at the southwest corner of Lot 24 to provide the required stormwater quality mitigation for the site in accordance with current El Paso County drainage criteria.

According to the calculations in Appendix A, the required Water Quality Capture Volume (WQCV) is 791 cubic feet, and the proposed Rain Garden provides a volume of 805 cubic feet.

Recognizing that there is no existing underground storm sewer available for connection of an underdrain, the Rain Garden has been designed for full infiltration and the outlet of the Rain Garden will consist of an overflow chase draining into the existing curb and gutter on the north side of Cole View.

The proposed stormwater quality facilities will be privately owned and maintained by the property owner, and maintenance access is readily available from the existing street.

V. FLOODPLAIN IMPACTS

This site is located in vicinity of the limits of the FEMA 100-year floodplain boundaries for the East Fork Sand Creek channel according to the FEMA floodplain map for this area, FIRM Panel No. 08041C0752F dated March 17, 1997. As noted in the subdivision drainage report, "channel reconstruction has physically altered the floodplain from the heart of the property to immediately north of the site. A Letter of Map Revision (LOMR) has been prepared and submitted…" Following completion of the channel improvements during development of this subdivision, the 100-year floodplain limits do not impact these lots according to the currently approved LOMR, Case No. 06-08-B137P dated December 13, 2006. The current floodplain limits based on the approved LOMR are depicted on the enclosed Floodplain Map (Figure FLD-1, Appendix B).

VI. DRAINAGE BASIN FEES

This site is located within the Sand Creek Drainage Basin. No public drainage improvements are required for development of this site. Required drainage fees have been paid during the previous subdivision platting process, so there are no applicable drainage fees required with the Site Development Plan.

VII. SUMMARY

The developed drainage patterns associated with the proposed Warehouse Buildings on Lot 24 and 25, Claremont Business Park Filing No. 2 will remain consistent with the overall drainage plan for this commercial subdivision. The proposed Rain Garden at the southwest corner of Lot 24 will provide water quality mitigation for both Lots 24 and 25. Proper construction and maintenance of the proposed on-site drainage facilities, in conjunction with proper erosion control practices, will ensure that this developed site has no significant adverse drainage impact on downstream or surrounding areas.

Please add "see final drainage report, Claremont Business park filing no. 2, which references an IGA with the central Marksheffel Metropolitan District."

APPENDIX A

DRAINAGE CALCULATIONS

Hydrologic Soil Group—El Paso County Area, Colorado
(Covertec WH)

Map Scale: 1:659 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 30 60 120 180

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

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

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

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
8	Blakeland loamy sand, 1 to 9 percent slopes	A	0.2	27.4%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	0.7	72.6%
Totals for Area of Interest			**0.9**	**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

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

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

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional “calibration” of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

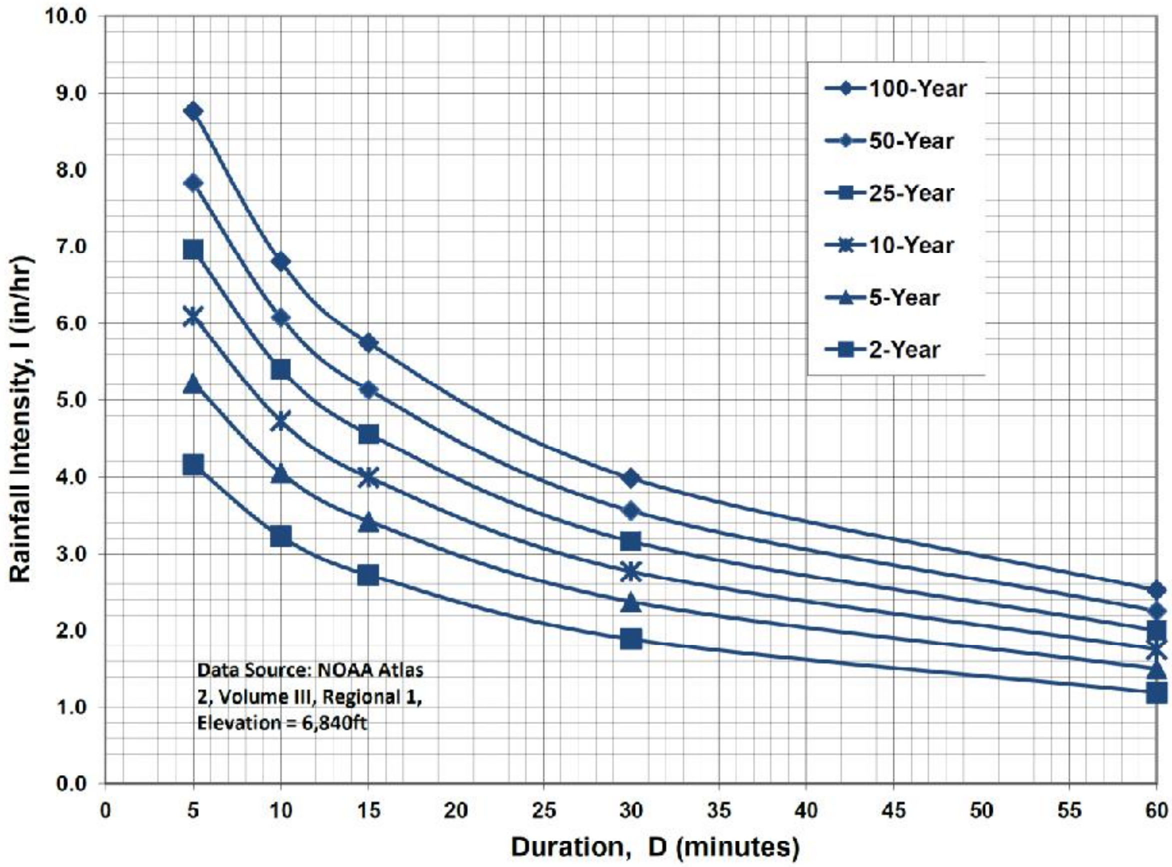
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

COVERTEC WAREHOUSE BUILDINGS - LOTS 24-25, CLAREMONT BUSINESS PARK FILING NO. 2
RATIONAL METHOD

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco[1] (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS[2] VELOCITY (FT/S)	Channel flow Tt[3] (MIN)	TOTAL Tc[4] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
A1	A1	0.49	0.810	0.880	40	0.06	1.9	210	20	0.013	2.31	1.5	3.4	5.0	5.17	8.68	2.05	3.74
A2	A2	0.34	0.810	0.880	40	0.02	2.7	150	20	0.020	2.83	0.9	3.5	5.0	5.17	8.68	1.42	2.60
Tt A1-A2							0.0	100	20	0.020	2.83	0.6	0.6					
A1,A2	1	0.83	0.810	0.880									4.0	5.0	5.17	8.68	3.48	6.34
OA1	OA1	0.14	0.810	0.880	24	0.02	2.1	275	20	0.022	2.95	1.6	3.6	5.0	5.17	8.68	0.59	1.07
A1,A2,OA1	2	0.97	0.810	0.880									4.0	5.0	5.17	8.68	4.06	7.41

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

COVERTEC WAREHOUSE BUILDINGS
STORM INLET SIZING SUMMARY

	BASIN FLOW			INLET FLOW					
INLET	BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET CONDITION / TYPE	INLET SIZE	INLET CAPACITY (CFS)
A1.1	A1	2.1	3.7	60	1.3	2.2	SUMP GRATE TYPE 16		3.0
A1.2	A1	2.1	3.7	40	0.8	1.5	SUMP GRATE TYPE 16		3.0
A2	A2	1.4	2.6	100	1.4	2.6	SUMP GRATE TYPE 16		3.0

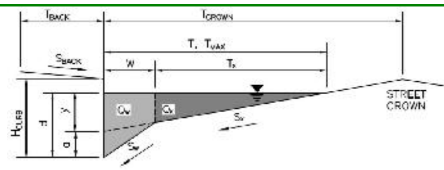
Version 4.05 Released March 2017

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

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

Project: **Covertec Warehouse Buildings - Inlet A1.1 (60% of flow at DP-A1)**

Inlet ID: **Inlet A1.1**



Gutter Geometry (Enter data in the blue cells)

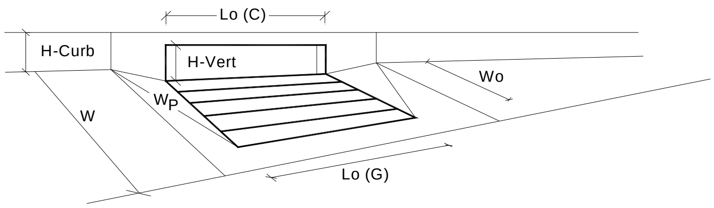
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	10.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	Denver No. 16 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.8	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	3.00	3.00	feet
Width of a Unit Grate		W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	0.60	0.60	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.589	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	1.00	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.6**	**3.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.2	cfs

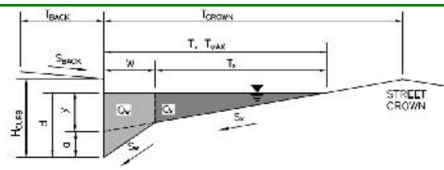
Version 4.05 Released March 2017

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

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

Project: **Covertec Warehouse Buildings - Inlet A1.1 (40% of flow at DP-A1)**

Inlet ID: **Inlet A1.2**



Gutter Geometry (Enter data in the blue cells)

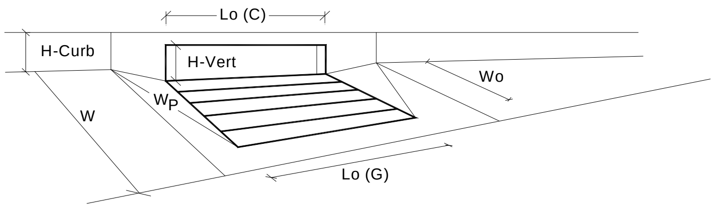
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	10.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLEt IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	Denver No. 16 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.8	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	3.00	3.00	feet
Width of a Unit Grate		W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	0.60	0.60	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.589	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	1.00	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.6**	**3.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	Q PEAK REQUIRED =	0.8	1.5	cfs

Warning 5: The width of unit is greater than the gutter width.

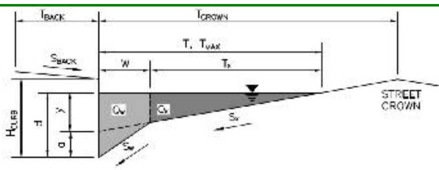
Version 4.05 Released March 2017

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

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

Project: **Covertec Warehouse Buildings - Inlet A2 (Design Point A2)**

Inlet ID: **Inlet A2**



Gutter Geometry (Enter data in the blue cells)

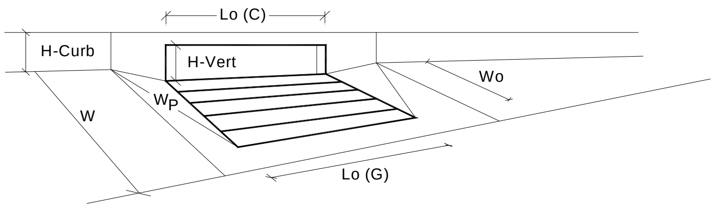
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	10.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Valley Grate)	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.8	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.589	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	1.00	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.6**	**3.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.4	2.6	cfs

Hydraulic Analysis Report

Project Data

Project Title: Covertec WH
Designer: JPS
Project Date: Wednesday, August 23, 2017
Project Units: U.S. Customary Units
Notes:

Channel Analysis: SD-A1

Notes: **Size SD-A1 for Q5 = 3.5 CFS at DP1**

Input Parameters

Channel Type: Circular
Pipe Diameter: 1.0000 ft
Longitudinal Slope: 0.0100 ft/ft
Manning's n: 0.0130
Depth: 1.0000 ft

Result Parameters

Flow: 3.5628 cfs = **Full Pipe Capacity**
Area of Flow: 0.7854 ft^2
Wetted Perimeter: 3.1416 ft
Hydraulic Radius: 0.2500 ft
Average Velocity: 4.5363 ft/s
Top Width: 0.0000 ft
Froude Number: 0.0000
Critical Depth: 0.8057 ft
Critical Velocity: 5.2542 ft/s
Critical Slope: 0.0103 ft/ft
Critical Top Width: 0.79 ft
Calculated Max Shear Stress: 0.6240 lb/ft^2
Calculated Avg Shear Stress: 0.1560 lb/ft^2

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.06, November 2016)

Designer: JPS
Company: JPS
Date: August 22, 2017
Project: Covertec Warehouse Buildings
Location: Lots 24-25, Claremont Business Park Filing No. 2

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 80.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.800
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.26 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 36,155 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = 791 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ____ in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = ____ cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = ____ cu ft
2. Basin Geometry	
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 12 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 0.00 ft / ft
C) Mimimum Flat Surface Area	A_{Min} = 578 sq ft
D) Actual Flat Surface Area	A_{Actual} = 805 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 805 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 805 cu ft
3. Growing Media	Choose One: (●) 18" Rain Garden Growing Media; ( ) Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One: ( ) YES; (●) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = N/A ft
ii) Volume to Drain in 12 Hours	Vol_{12} = N/A cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = N/A in

Design Procedure Form: Rain Garden (RG)

Designer: JPS
Company: JPS
Date: August 22, 2017
Project: Covertec Warehouse Buildings
Location: Lots 24-25, Claremont Business Park Filing No. 2

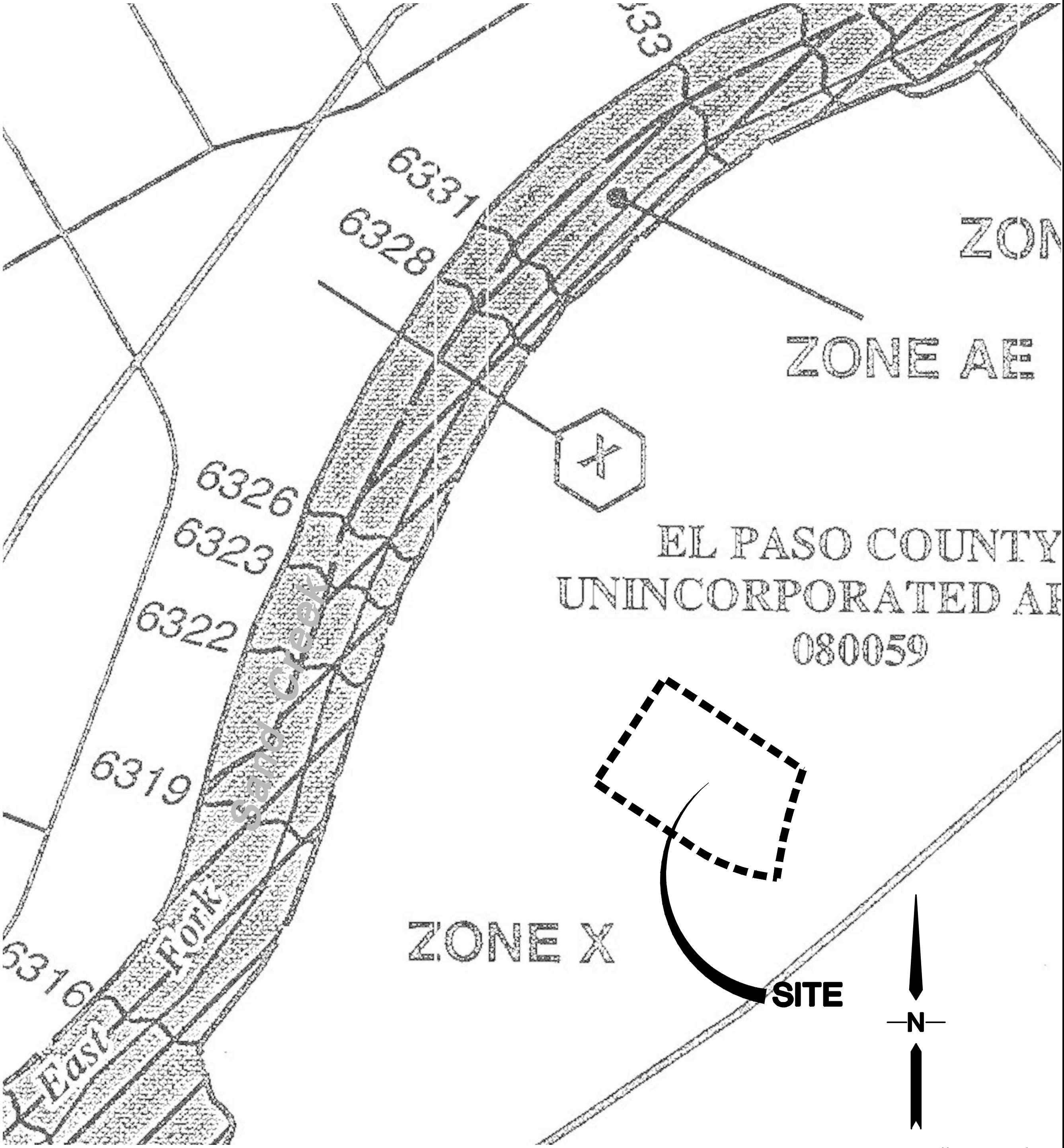
5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6. Inlet / Outlet Control A) Inlet Control	Choose One ○ Sheet Flow- No Energy Dissipation Required ◉ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ○ Seed (Plan for frequent weed control) ◉ Plantings ○ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ○ YES ○ NO

Notes:

Please answer yes or no.

APPENDIX B

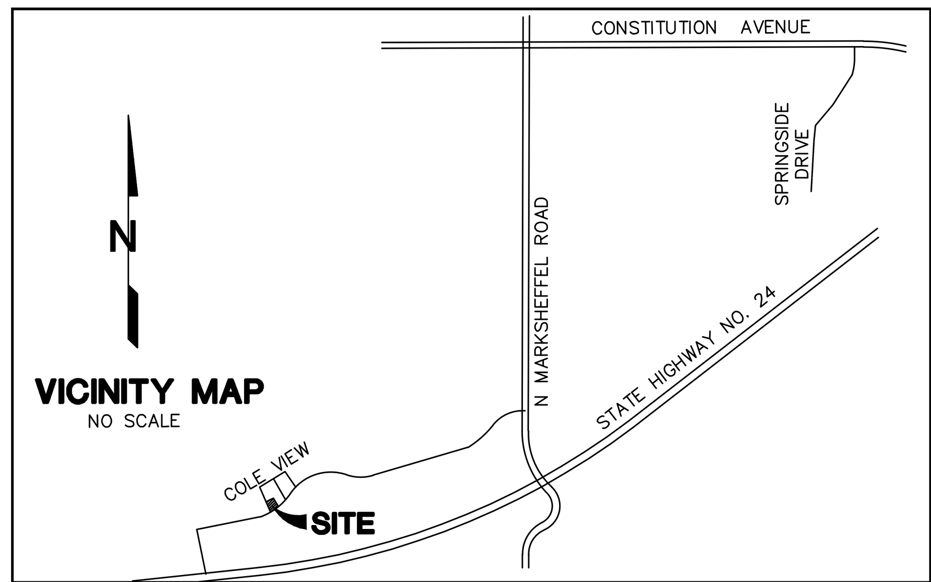
FIGURES



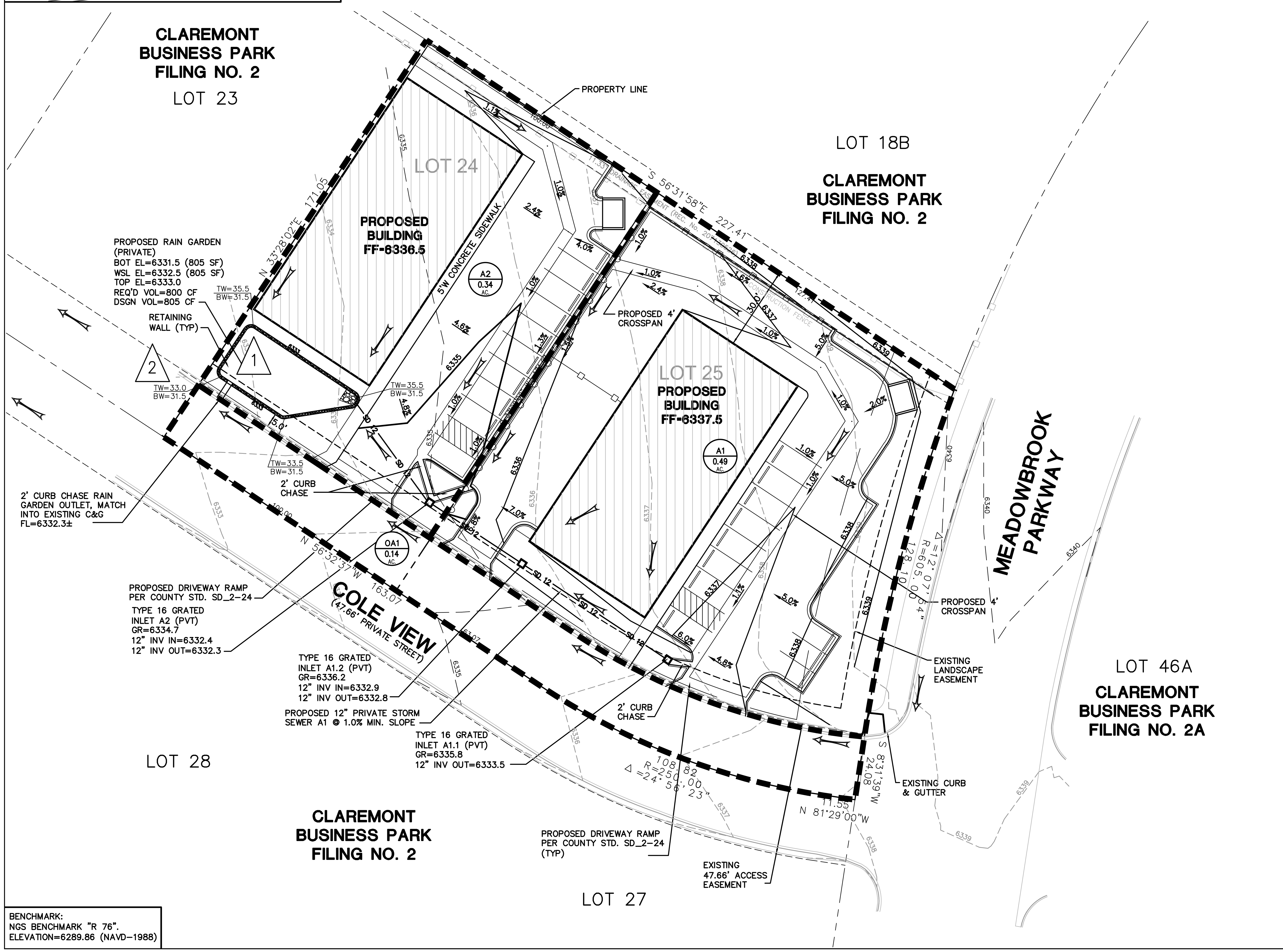
SCALE: 1"=200'

FIRM NO. 08041C0752F DATED 3/17/1997
REVISED BY LOMR CASE NO. 06-08-B137P DATED 12/13/2006

LOT 24-25 CLAREMONT BUSINESS PARK FILING NO. 2 WAREHOUSE BUILDINGS	JPS ENGINEERING	FLOODPLAIN MAP FIGURE FLD-1 JPS PROJ NO. 051704



20' 0 20' 40'
ORIGINAL SCALE: 1"=20' (24"x36" SHEET)
CONTOUR INTERVAL=1'



BENCHMARK:
NGS BENCHMARK "R 76".
ELEVATION=6289.86 (NAVD-1988)

DRAINAGE LEGEND

- RIPRAP
- PROPERTY LINES
- FLOWLINE
- MAJOR DRAINAGE BASIN BOUNDARY
- FLOW DIRECTION ARROW
- 5 — DESIGN POINT
- C14 — DEVELOPED BASIN DESIGNATION
- 23.21 AC — DEVELOPED BASIN AREA (ACRES)

IMPERVIOUS AREA CALCULATIONS:

TOTAL AREA BASINS A1 & A2 = 0.83 AC.

IMPERVIOUS AREAS:

SURFACE TYPE	AREA
PARKING PAVEMENT	17,524 SF
BUILDING (BOTH LOTS)	9,980 SF
SIDEWALK	1,267 SF
TOTAL	28,771 SF
	= 0.66 AC
	= 80% IMPERVIOUS

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	3.5	6.3
2	4.1	7.4

LOT 24-25 WAREHOUSE BUILDINGS
7358-7386 COLE VIEW, COLORADO SPRINGS, COLORADO 80915

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

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

No.	REVISION	BY	DATE

DEVELOPED DRAINAGE PLAN

HORZ. SCALE:	1"=20'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	COMPASS	CHECKED:	JPS
CREATED:	8/14/17	LAST MODIFIED:	8/23/17
PROJECT NO:	051704	MODIFIED BY:	BJJ
SHEET:	D1		