Preliminary Drainage Report

Brighton Boulevard Preliminary Design: 44th Street to Race Court

Denver, Colorado

This document prepared for:
City and County of Denver
201 W. Colfax Ave
Denver, Colorado 80202

Prepared by:
Short Elliott Hendrickson Inc.
Colorado Center Tower One
2000 S. Colorado Boulevard
Denver, Colorado 80222

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1. General Location and Description

The following drainage report has been prepared by SEH for the City and County of Denver (CCD), Department of Public Works. This report describes the drainage analysis for the Brighton Boulevard Preliminary Design: 44th Street to Race Court ("Project"). The location of the Project is outlined in blue on Figure 1.

A. Location

The Project involves the reconstruction of Brighton Boulevard from 44th Street to Race Court. The Project begins south of Interstate 70 at the intersection of Brighton Boulevard and 44th Street and ends north of Interstate 70 at the intersection of Brighton Boulevard and Race Court. The Project site is located in the NE ¼ of Section 23 and the SE ¼ of Section 14, Township 3 South, Range 68 West of the 6th Principal Meridian in the City and County of Denver, Colorado. Developments near the Project site include the National Western Stock Show Complex (NWSSC) on the west side of Brighton Boulevard and residential and commercial properties on the east side of Brighton Boulevard.

B. Description of Property

The Project is approximately 0.7 miles of roadway improvements between 44th Street and Race Court. It includes roadway and intersection improvements and the addition of walkways and/or cycle tracks on each side of Brighton Boulevard. The walkways and cycle tracks will be incorporated into the future improvements associated with the redevelopment of the NWSSC. Drainage improvements are included as part of this Project. These improvements will collect stormwater primarily through Denver Type 14 and CDOT Type R Curb Inlets. Streetside Stormwater Planters (CCD, 2014) will be used to capture and treat a portion of the Water Quality Capture Volume (WQCV) from the new pavement area between 44th Street and Race Court. The disturbed area of the project is approximately 4.89 acres. Currently, there are no major drainageways or drainage facilities in the project corridor. The South Platte River generally runs parallel to Brighton Boulevard, approximately 0.4 to 0.5 miles west of the street alignment. No soil data is available through the National Resource Conservation Service (NRCS). As a result, the area is assumed to have a Hydrologic Soil Group designation of Type C. This soil type was recommended by the City staff for the 2014 update of the Denver Storm Drainage Master Plan (SDMP) (CCD, 2014). Residential and commercial properties are found along the street corridor with trees and shrubs in some areas. However, this vegetation does not affect the computations for the storm drainage system. Once the roadway is constructed, flows will drain to the curb inlets to the east or west from the crown of Brighton Boulevard.

The SDMP states that the existing drainage system generally cannot convey stormwater above a 2-year event and that significant widespread areas of potential inundation could be expected during a 100-year event. No specific historical flooding for the project area was discussed in the SDMP. Currently, there are no known drainage easements within the project limits.

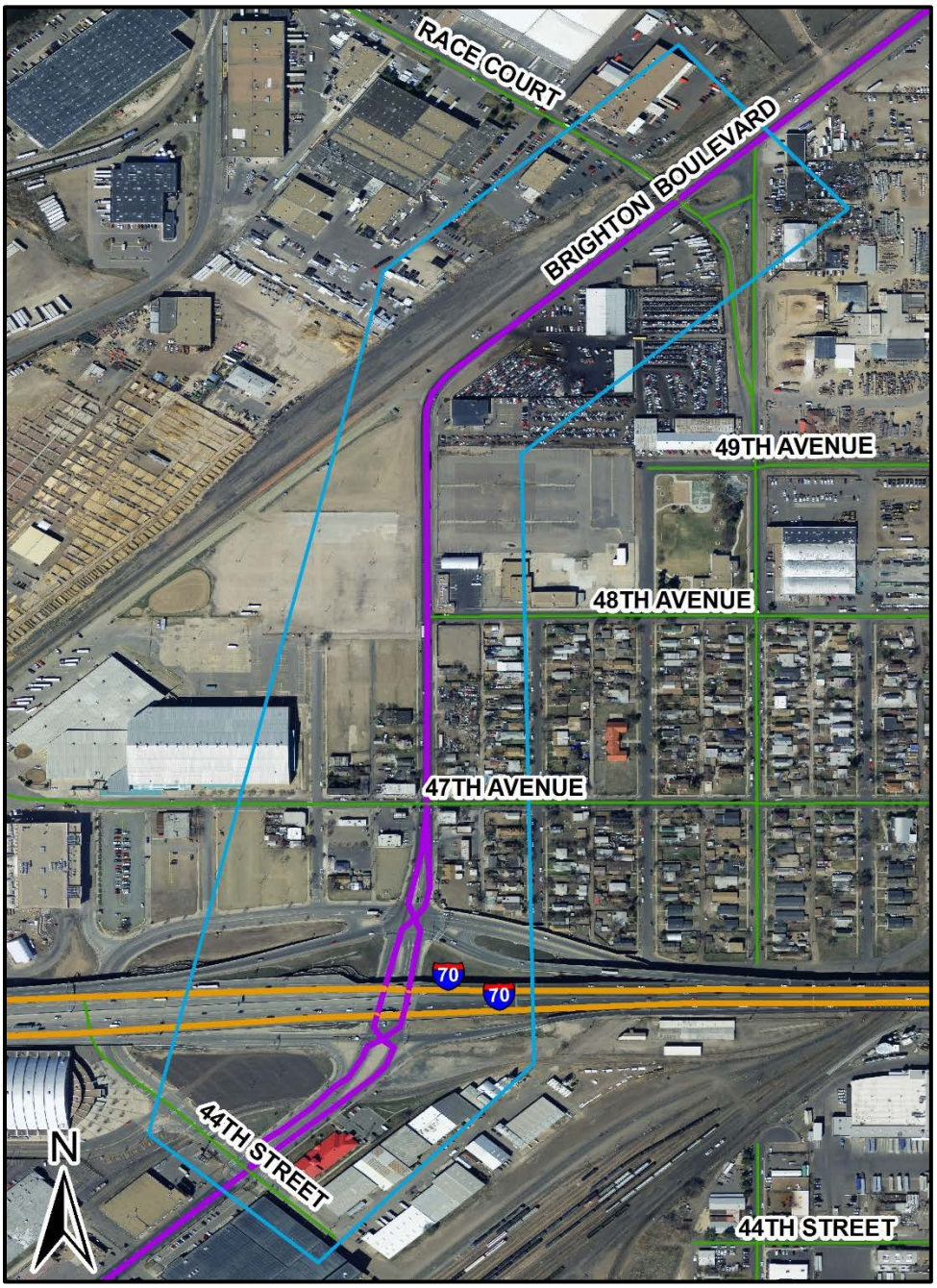


Figure 1. Vicinity Map (Not to scale)

2. Major Drainage Basins and Sub-basins

A. Major Basin Description

The drainage basins for the street reconstruction are shown on the Preliminary Drainage Plan in Appendix A. The Project site lies in Basin 0060-02 in the excerpt from the SDMP as shown in Appendix B. This basin is a 1.46 square mile (934 acres) watershed that is fully developed, consisting of residential land use in the upper reaches and industrial/commercial land uses in the lower reaches. The topography of the basin generally runs from southeast to northwest at an overall average grade of 2.5%. This basin outfalls to the South Platte River. Currently, the stormwater is conveyed through several storm drains which convey minor storms. There are 12 existing outlets that discharge stormwater from Basin 0060-02 to the South Platte River. The largest outfall (larger than 48 inches) exists at Race Court upstream of the Burlington Ditch headgate. This outfall alone drains 597 acres of tributary areas. According to the SDMP, the existing drainage system has less than a 2-year level of capacity.

The headwaters for Basin 0060-02 begin in the vicinity of Colorado Boulevard, north of 40th Street and west of the Park Hill Golf Course. Runoff in this area generally drains to the north toward the existing storm drain trunk line along 45th Avenue. This trunk line runs west along E. 45th Avenue to York Street. Several laterals drain flows to the trunk line from the residential areas along 43rd Avenue and 44th Avenues. The trunk line turns north along York Street, passing under Interstate 70 to 47th Avenue. This line then turns west along 47th Avenue to Race Street. The system turns north at Race Street and northwest at Brighton Boulevard, eventually draining into the South Platte River near the Franklin Street bridge crossing. Throughout the watershed, several smaller lateral drains convey flows from the adjacent residential, industrial, and commercial areas to the trunk line, as shown in Appendix B. The basin is currently fully developed. However, the SDMP indicates that some of the industrial areas of the basin are shown as “areas of change”.

Drainage improvements will be incorporated into the proposed lowering and reconstruction of Interstate 70 (I-70 East Project) by the Colorado Department of Transportation (CDOT). The lowering of Interstate 70 will subdivide the watershed and eliminate the flow in the trunk line on York Street, north under the interstate. Currently, the Montclair Outfall Systems Planning Study and the SDMP are being evaluated to account for this major change in the basin flow characteristics. For reference, an additional excerpt from the SDMP, showing the proposed improvement projects for Basin 0060-02, is shown in Appendix C. These are the improvements that were considered for the Basin before the I-70 East Project was taken into account.

There are no known existing irrigation facilities in the corridor study area.

The existing FEMA Flood Insurance Rate Map (FIRM), as seen in Figure 2 (FEMA, November, 2013), shows that the north portion of the Project (north of 47th Street) is outside of the 0.2-percent-annual chance floodplain (500-year, Zone X). The panel for the south portion of the Project (south of 47th Street) is not printed as it is all Zone X. No Flood Hazard Area Delineations are available for this area. The Denver Storm Drainage Master Plan shows “potential inundation areas” within the

west portion of Basin 0060-02, east of Brighton Boulevard. The other areas of potential flooding are a result of overland, cross basin flows from the Montclair Basin (Basin 4500-01, SDMP), south of Basin 0060-02. Excess runoff enters the basin south of I-70 near 40th Avenue and High Street, 40th Avenue and York Street, and the area just east of 40th Avenue and Madison Street.

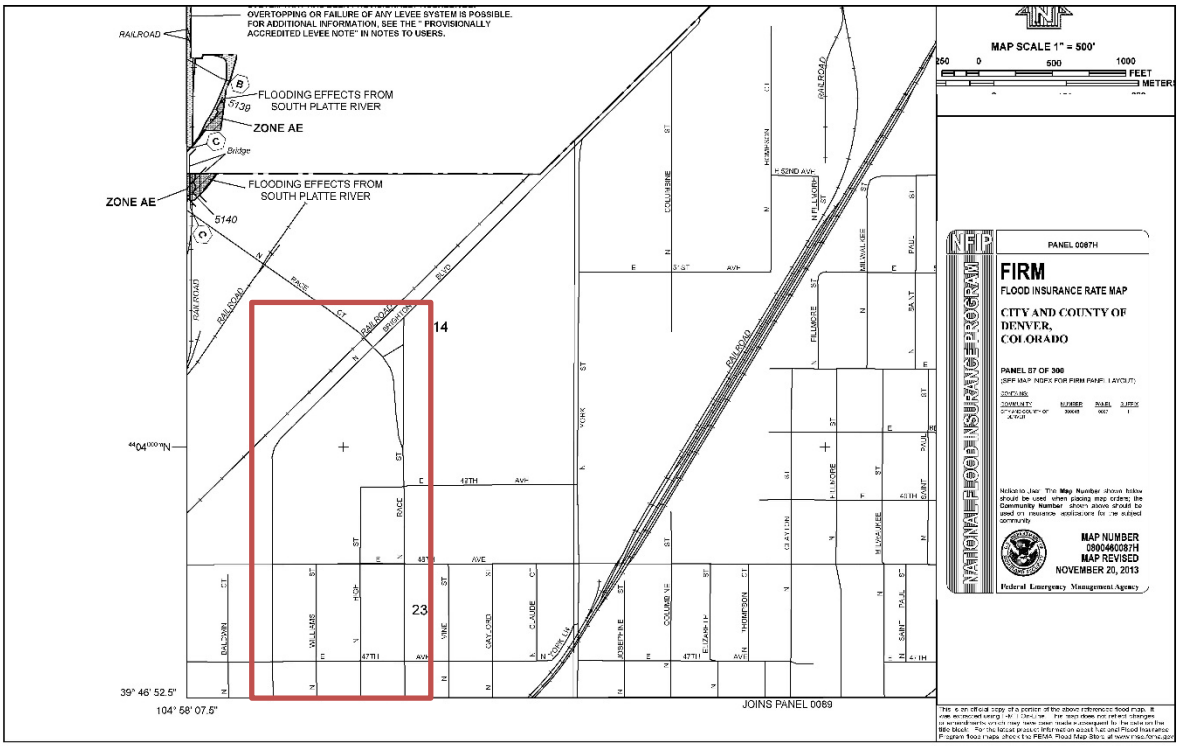


Figure 2. FIRM Map of Project North of 47th Street

B. Sub-basin Description

Onsite flows from the new street cross section of Brighton Boulevard between 44th Street and Race Court were the only areas considered for this analysis. This includes the street pavement, sidewalks, and cycle tracks along the corridor between the project limits. No offsite flows were taken into account for the design of the storm drain system for the reconstruction of Brighton Boulevard

3. Drainage Facility Design

A. General Concept

The drainage improvements are designed to convey the 5-year (minor) and 100-year (major) storm events, as per the requirements of the CCD Storm Drainage Design and Technical Criteria (CCD, 2006), and the UDFCD Urban Storm Drainage Criteria, Volumes 1-3 (UDFCD, 2010). No deviations from the standards are planned with this design.

As discussed earlier, no offsite flows were taken into account for the design of the storm drainage system in the Brighton Boulevard corridor between 44th Street and Race Court. This project is a part of the overall redevelopment of the NWSSC. When complete, offsite flows will be accounted for in the drainage systems designed for the new developments on the east and west sides of Brighton Boulevard.

Onsite flows consist of drainage from the pavement sections as well as the new sidewalks and cycle tracks in the reconstructed cross sections of the street. Curb inlets were placed along the street at locations as per CCD and UDFCD design criteria. The overall drainage plan is shown in Figure 3, included in Appendix A of this report. This figure shows the locations of the proposed drainage inlets, laterals, and the main trunk line along Brighton Boulevard, as well as the flow paths and drainage basins to each inlet. As Figure 3 shows, stormwater drains from the crown of the reconstructed roadway section to inlets along the east and west sides of the street. The subbasin areas along Brighton Boulevard are also shown in Figure 3. The discharges and volumes for the basin areas to each drainage inlet are summarized in Table 1.

Table 1. Summary of Stormwater Flows and Volumes

Subbasin	**Area (acres)**	**5-Year Storm**		**100-Year Storm**	
		Peak Flow (cfs)	*Total Volume (cf)*	*Peak Flow (cfs)*	*Total Volume (cf)*
1	0.51	0.65	2073	1.50	4667
2	0.46	0.59	1847	1.36	4158
3	0.49	0.78	1990	1.77	4480
4	0.39	0.58	1570	1.31	3535
5	0.34	0.49	1366	1.13	3075
6	0.24	0.32	971	0.73	2186
7	0.35	0.56	1428	1.27	3214
8	0.26	0.38	1063	0.88	2392
9	0.68	0.95	2741	2.17	6170
10	0.52	0.71	2120	1.63	4771
11	0.27	0.42	1079	0.95	2429
12	0.29	0.42	1155	0.96	2600
13	0.29	0.42	1166	0.96	2625
14	0.28	0.46	1143	1.04	2573
15	0.33	0.53	1321	1.19	2974
16	0.36	0.58	1448	1.31	3260

B. Specific Details

The project is designed to convey stormwater from the minor and the major storm. The 16 subbasins delineated for the project are all less than 160 acres. As per the guidelines in the UDFCD Criteria Manual, Volume 1, the Colorado Urban Hydrograph Procedure (CUHP) was used to calculate the 5-year and 100-year discharges and runoff volumes (UDFCD, September 2014).

The peak flows and volumes for the minor and major storms are presented in Table 1 and subbasin delineations are found in Appendix A. It was assumed all subbasins are 100% impervious. In addition, the WQCV (inches) is the same for all subbasins as imperviousness is assumed to be 100% with a drain time is 12 hours. The method used to treat the WQCV is discussed later in this report.

The SDMP shows an existing drainage system scattered throughout various portions of the project area. Immediately northeast of 44th Street, storm drain inlets collect flows along the south side of Brighton Boulevard. According to the SDMP, these flows are conveyed by the existing drainage system to the southwest and eventually to the 40th Avenue trunk line. The SDMP also shows clusters of drainage inlets at the 46th Avenue and 47th Avenue intersections with Brighton Boulevard. The drainage laterals that collect the flows from these inlets convey the runoff to the east, and drain into the trunk line in N. Race Street. One additional storm drain system is shown along Brighton Boulevard in the north portion of the project area, after the street turns northeast toward North Race Court. Stormwater collected by inlets in this area is conveyed northeast to the North Race Court trunk line.

The drainage inlets shown in Figure 3 in Appendix A are intended to collect runoff from the reconstructed pavement sections of Brighton Boulevard. Drainage improvements are also planned as part of the I-70 East Project currently being designed for CDOT. These drainage improvements include the construction of a box culvert to drain stormwater from the Interstate 70 roadway and convey these flows to the west along the south side of the interstate. These flows will eventually drain to the 40th Street outfall to the South Platte River. The inlets shown on Brighton Boulevard, south of Interstate 70 (Figure 3), will be connected to this box culvert proposed by CDOT. One additional proposed inlet, south of the railroad crossing, will convey flows to the existing drainage system. Detailed information on the most recent revisions to the drainage systems, due to the reconstruction of Interstate 70, are summarized in a Letter of Recommendation from the Multi-Agency Technical Team (MATT, January 2015).

North of Interstate 70 to 49th Avenue, the stormwater on Brighton Boulevard will be collected in a series of inlets along each side of the street. The flow will drain to the east and west from the crown of the reconstructed street section. The proposed stormwater conveyance system consists of street inlets at low points (sumps) in the roadway and before intersections. Runoff will be collected in CDOT Type R inlets at sumps and Denver No. 14 inlets at all other inlet locations. The capacity of inlets to handle both minor and major storm flows was analyzed using the UD-Inlet software (UDFCD, November 2013). All inlets are capable of handling both minor and major storm flows, per CCD and UDFCD depth and spread width criteria. Runoff is then directed to a 78 inch trunk line that runs north from 47th Street to a point approximately 260 feet north of 48th Avenue. From this point, the flow is conveyed west in a 78 inch pipe through the NWSSC and eventually to the South Platte River. The 78 inch trunk line begins with a 10 foot by 10 foot Type B Manhole at the intersection of Brighton Boulevard and 47th Avenue. This manhole is sized to accommodate the trunk line of the future storm drainage system that will convey flows west along 47th Avenue to Brighton Boulevard from York Street as shown in the CCD SDMP. At the end of the Brighton Boulevard trunk line, north of 48th Avenue, another 10 foot by 10 foot Type B Manhole is used to accommodate the future storm drain

line that will convey flows west through the NWSSC and eventually to the South Platte River. Information on this trunk line, including the pipe invert elevation for the connection to the Brighton Boulevard system, was taken from the National Western Center (NWC), Infrastructure Plan (NWC, January 2015).

Storm inlets immediately south of 49th Avenue are connected to laterals that will drain stormwater to the Type B Manhole between 48th Avenue and 49th Avenue. Further north, CDOT Type R Inlets are located in the sag of the roadway profile, immediately northeast of the turnout lanes for the future Regional Transportation District (RTD) facility on the northwest side of Brighton Boulevard. Flows from these inlets will be conveyed northeast to the existing storm line at Race Court.

No storage facilities are included for this design. The storm drainage system will only convey flows from the reconstructed street section as described above.

The upstream basin (0060-02) is fully-developed. Therefore, no drainage impact on future development has been considered. This project does not affect upstream and downstream properties, other than providing a future connection for upstream drainage at the intersection of 47th Avenue and Brighton Boulevard. The drainage system is only designed to collect onsite stormwater from the reconstructed street section and no offsite flows were considered in the design. No specific drainage problems were encountered in the design of the stormwater system. It is anticipated that CCD will be responsible for the maintenance of the stormwater system and maintenance will be performed as per CCD guidelines. Access to the inlets for maintenance purposes is achieved through the manhole cover on the top of each box. Since these covers are located near the sidewalks, maintenance could be performed with minimal disruption to traffic if maintenance vehicles are permitted to access the structures from the sidewalk area. For the larger Type B Manholes and the 78 inch trunk line, maintenance access will be through the manhole cover on the top of the box. These manholes are located within the traffic lanes of the street and maintenance for these structures will require lane closures as per CCD guidelines. The drainage system is in compliance with local, state, and federal requirements. Best management practices (BMPs) will be an integral part of the stormwater management design. A component of the drainage system is to treat the required WQCV from the reconstructed pavement section as per UDFCD criteria. This is accomplished using the Streetside Stormwater Planters (SSPs) as outlined in the CCD Green Infrastructure Manual (CCD, 2014). More details will be provided in the next section.

4. Conclusions

A. Compliance with Standards

- CCD and UDFCD Criteria - The storm drainage system is designed as per the requirements of the City and County of Denver, Storm Drainage and Technical Criteria Manual and the Denver Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual.

- Major Drainageway Planning Studies - The storm drainage system is designed in accordance with the proposed improvements shown in the 2014 City and County of Denver, Storm Drainage Master Plan, and the 2015 National Western Center, Infrastructure Master Plan.
- Denver's Municipal Colorado Discharge Permit System (CDPS) Stormwater Permit – The drainage system is in compliance with the conditions of the city stormwater permit. The WQCV is treated using BMPs as per CCD and UDFCD standards. The treatment of the WQCV is described later in this report.
- No waivers from design criteria are expected in this project.

B. Drainage Concept

The storm drainage inlets shown in Figure 3 and described earlier in this report were analyzed using the UD-Inlet computer software developed by the UDFCD. The results of the calculations for each inlet(s) show that the inlets are capable of intercepting and conveying the flows from the minor and major storm events, as per CCD and UDFCD Criteria. As discussed earlier in this report, the watershed (Basin 0060-02) is fully developed and will likely not influence the discharges in the existing CCD SDMP or the updated analysis currently underway for the I-70 East Project. This project will also not influence upstream or downstream properties since the drainage system is only designed to capture and convey flows from the reconstructed pavement sections of Brighton Boulevard.

C. Water Quality

In order to meet the requirements of the state water quality regulations under the Colorado Discharge Permit System (CDPS), all public and private projects in the City of Denver must integrate Best Management Practices (BMPs) into the design of the project to enhance the quality of stormwater runoff. For the Brighton Boulevard Preliminary Design, stormwater quality BMPs were designed using the guidelines from the CCD Green Infrastructure Manual (CCD, 2014). It was determined that the most appropriate BMP was the Streetside Stormwater Planter (SSP). The SSP is located in the street right-of-way between the traffic lanes and bike/pedestrian paths. It provides treatment of stormwater runoff from the street, bicycle, and pedestrian zones through bioretention. The planter is designed for stormwater runoff to enter the system and disperse through the surface. The stormwater runoff then infiltrates through bioretention media and filter material layers. The treated stormwater runoff leaves the system through an underdrain, connected to the storm drainage inlets. The SSP structures fit with the vision of the redevelopment of the NWSSC, providing amenities for the planned public plazas, cycle tracks, sidewalks, and transportation facilities.

The water quality capture volumes (WQCV) were calculated using the guidelines from Volume 3 of the UDFCD manual. For the Brighton Boulevard street cross section, the criteria requires a 12-hour drain time for the WQCV. The WQCV is calculated as follows:

$$WQCV = a(0.91*I^3-1.19*I^2+0.78*I)$$

Where:

WQCV = Water quality capture volume (watershed inches)

a = Coefficient corresponding to WQCV = 0.8 for a 12 hour drain time

I = Imperviousness (%/100) = 1.0

Using this equation, the WQCV computed for this project is 0.4 inches. This depth of flow, along with the available treatment volume in the SSP, and the street cross section width, was used to determine the length of pavement that could be treated by a given length of the SSP. For example, the preliminary calculations indicate that for a street width of 34 feet, a pavement length of as much as 113 feet could be treated by a single SSP, 40 feet in length and 3.5 feet in width. For a 49 foot street width, a planter width of 3 feet will treat a street length of nearly 68 feet. Using the design details from the CCD Green Infrastructure Manual (CCD, 2014), it was determined that a SSP, with a maximum length of 40 feet (ft) and a minimum width of 3 ft, will capture and treat approximately 0.0025 acre-feet (AF) or 110 cubic feet (cf) of water quality runoff, assuming 100% impervious conditions. Computations were also performed to determine the percentage of the WQCV that was being intercepted and treated by the SSP structures along the street. For this preliminary design, the minimum efficiency is around 81%. During the design, obstructions along the east side of Brighton Boulevard and the proposed RTD facility on the west side of the street limited the placement of SSPs. As a result, the efficiencies in these areas were reduced. In further design phases, the capture efficiencies could be increased as the development plans for the RTD facility and the areas along the east side of Brighton Boulevard progress. The designs in these areas may provide additional sidewalks, curbs, or other structures where stormwater treatment amenities could be placed.

5. References

City and County of Denver, Department of Public Works, ***Green Infrastructure Manual***, Denver, CO., 2014.

City and County of Denver, Department of Public Works, ***Storm Drainage Master Plan,*** Denver, CO., 2009.

City and County of Denver, Department of Public Works, ***Storm Drainage Master Plan***, Denver, CO., 2014.

City and County of Denver, Department of Public Works, ***Storm Drainage Design and Technical Criteria****, Denver, CO., January 2006*. Amended November 2013.

Denver Urban Drainage and Flood Control District, ***Urban Storm Drainage Criteria, Volumes 1 – 3***. Denver, CO. Volumes 1 and 2, June 2001, Revised April 2008. Volume 3, November 2010.

Denver Urban Drainage and Flood Control District, ***Colorado Urban Hydrograph Procedure (CUHP), Computer Software, Version 1.4.4***. Denver, CO., September 2014.

Denver Urban Drainage and Flood Control District, ***UD-Inlet, Computer Software, Version 3.14***. Denver, CO., November 2013.

Department of Homeland Security, Federal Emergency Management Agency, ***Flood Insurance Rate Map (FIRM), City and County of Denver, Colorado***. https://msc.fema.gov, Washington D.C., 2013

Multi-Agency Technical Team (MATT), ***Letter of Recommendation***, Regional Transportation District (RTD), City and County of Denver (CCD), Urban Drainage and Flood Control District (UDFCD), and the Colorado Department of Transportation (CDOT), January 2015. Describes MATT recommended technical solutions for interagency collaboration for coordinated infrastructure improvements, meeting the drainage needs of: CDOT I-70 East Project, RTD North Metro Rail Line, CCD North Denver Cornerstone Collaborative (NDCC).

National Western Center, ***Infrastructure Master Plan***, Denver, CO., January 2015.

Appendices

Appendix A – Preliminary Drainage Plan

B-15 | .33 | 100

B-11 | .27 | 100

B-16 | .36 | 100

I-70

FUTURE CDOT
BOX CULVERT
(I-70 EAST PROJECT)

B-5 | .34 | 100

B-3 | .49 | 100

B-14 | .28 | 100

B-9 | .68 | 100

47TH AVE.

B-7 | .35 | 100

BRIGHTON BLVD.

MATCH BELOW

MATCH ABOVE

A

A

48TH AVE.

B-4 | .39 | 100

B-6 | .24 | 100

49TH AVE.

B-10 | .52 | 100

B-8 | .26 | 100

B-1 | .51 | 100

B-2 | .46 | 100

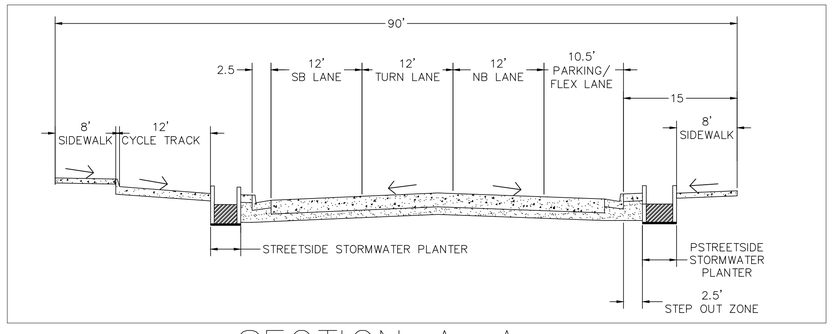
FUTURE RTD BUS PULLOUT LANES

B-12 | .29 | 100

B-13 | .29 | 100

N

50 0 50 100
scale 25 feet



SECTION A-A

LEGEND

A
B | C

A= BASIN DESIGNATION
B=AREA IN ACRES
C= % IMPERVIOUSNESS
→ = FLOW DIRECTION

30% REVIEW

NO.	REVISIONS	DATE	BY
1			
2			
3			
4			
5			

COLORADO LAW (SENATE BILL 93-155) REQUIRES PERSONS TO NOTIFY THE UTILITY NOTIFICATION CENTER OF COLORADO 2 BUSINESS DAYS PRIOR TO MAKING OR BEGINNING AN EXCAVATION. NOTIFICATION MAY BE MADE BY CALLING:
811

DESIGNED KJR DATE 07/01/2015
DRAWN BAW DATE 07/01/2015
CHECKED CRW DATE 07/01/2015

DENVER
THE MILE HIGH CITY

SEH
PHONE: 720.540.6800
2000 S. COLORADO BLVD.
TOWER ONE, SUITE 6000
DENVER, CO 80222-7938

BRIGHTON BOULEVARD
PRELIMINARY DESIGN
DRAINAGE PLAN

FIGURE 3
PRELIMINARY DRAINAGE PLAN

SHEET NO.

SEH PROJECT NO. 131161 | DATE ISSUED July 2, 2015 | SHEET OF___

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Appendix B- Storm Drainage Master Plan – Basins 0060-01 and 0060-02 – Summary of Existing and Proposed Storm Drainage Systems


BASINS 0060-01 & 0060-02
(I-70 & COLORADO BLVD)
DENVER STORM DRAINAGE MASTER PLAN
Legend
Thalweg
Topographic Basin Boundary
Collection System Boundary
Sec-Collection System Boundary
Sub-Collection System Boundary
County Boundary
Park
Existing Transit Line
Future Transit Line
100-Year Floodplain
Potential Inundation Area
UDFCD Study Recommendations
Open Channel
Pipe/RCBC
Drop/Check Structure
Crossing Structure
CUHP/UDSWM Routing
Basin Label
Design Point
Routing Element
Detention Element
Existing Storm Sewer
Horiz. Diam. 0 - 18 in.
Horiz. Diam. 18 - 30 in.
Horiz. Diam. 30 - 48 in.
Horiz. Diam. 48 - 60 in.
Horiz. Diam. >60 in.
Storm Sewer Manhole
Storm Sewer Inlet
Surface Flow
Existing Detention Basin
Designed Improvement
Proposed Improvements
Horiz. Diam. 18 - 30 in.
Horiz. Diam. 30 - 48 in.
Horiz. Diam. 48 - 60 in.
Horiz. Diam. > 60 in.
Open Channel
Proposed Manhole
Proposed Check Dam
Proposed Pipe Disconnect
Proposed Detention Basin
Feet
HYDROLOGIC SUMMARY TABLE: BASIN 0060-01, 0060-02
DENVER WATER OSP OUTFALL (Improvements by Others)
BRIGHTON BLVD
VASQUEZ BLVD
DAHLIA ST
COLORADO BLVD
YORK ST
40TH AVE
38TH AVE
PARK HILL GOLF COURSE
0059-01
0060-01
0060-02
4400-02
4500-02
4500-01
70
Key Map
I-70
Sand Creek
Cherry Creek
I-25
S. Platte River

Appendix C- Storm Drainage Master Plan – Basin 0060-02 – Summary of Proposed Projects

Basin 0060-02 (I-70 & York)

Existing System Description:

This collection system basin consists of 934 acres (1.46 square miles) and is fully built-out with older neighborhood residential in the upper reaches and industrial in the lower reaches. The National Western Stock Show grounds are located within this drainage basin. ***Blueprint Denver*** shows the industrial portions of the basin as "Areas of Change". Only the residential neighborhoods are shown as "Areas of Stability". All drainage from this basin outfalls to the South Platte River.

Intercepted stormwater is discharged to the South Platte River via at least 12 storm drainage outfalls. However, the only one major (larger than 48inch) outfall exists at Race Court just upstream of the Burlington Ditch headgate. This outfall (Design Point 1549) locally drains 597 acres tributary areas discharging via a 78-inch pipe and parallel 42-inch pipe which have a total capacity of about 410 cfs. Following the criteria of an 80% full flow pipe, the existing system has less than a 2-year level of service, whereas current criteria requires a 5-year level of service for commercial/industrial areas.

Constraints to drainage infrastructure in this basin include:

- Crossing a major rail switching yard west of Blake Street
- Crossing I-70
- Crossing the BNSF Railroad next to Brighton Boulevard
- An elevated section of the Metro Sewer, along the South Platte River, creating a wall barrier for drainage

While this basin is locally served by several small storm drains with a master planned goal of conveying the minor 2- or 5-year event, the basin also experiences "pass through" flow from other basins during a major storm event. A total of four trans-basin overland flowpaths are observed in this basin during the major-event. Three of these are inflows from basin 4500-01 (Montclair) at the upstream (south) portion of the basin. Specifically, inflows occur at the UPRR Intermodal Facility at 40th Avenue and High Street; at 40th Avenue and York Street; and at the Market Lead just east of 40th Avenue and Madison Street. Additionally, one inflow from basin 0060-01 (originally from 4400-02) flows west along Smith Road and the UPRR, and enters this basin at the Market Lead west of Colorado Boulevard.

Some of this trans-basin major-event runoff continues through basin 0060-02 and enters basin 0060-01 at various points. These locations include along Brighton Boulevard and the BNSF Railroad, along the UPRR near I-70 and York Street, and across I-70 at Fillmore Street.

Potential Inundation Areas:

Hydraulic analysis shows areas around the National Western Stock Show Complex to be subject to potential inundation during major storm events. These areas are located along the South Platte River Valley and at localized areas and sumps. Redevelopment of the site would warrant drainage improvements in this area.

A second area of potential inundation in this basin is the result of overflow from Basins 4400-02 and 0060-01. Runoff from these basins enters Basin 0060-02 along Smith Road and crosses 46th Avenue between N. Clayton Street and N. Steel Street, and flows overland back into Basin 0060-01. Alternative drainage improvements in these basins may reduce the threat of potential inundation in this area.

Another area of potential inundation is the result of overland flow from the Montclair Basins (4500). Runoff in excess of the pipe capacity will enter basin 0060-02 south of I-70 near 40th Avenue and continue to flow in a northerly and northwesterly direction through the basin. Drainage improvements associated with CDOT's proposed lowering and reconstruction of I-70 will need to address this off-site runoff from Montclair. This is currently being evaluated in the ***Montclair Outfall Systems Planning Study*** by the Urban Drainage & Flood Control District (UDFCD), funded by the UDFCD and Denver.

Drainage Deficiencies:

The existing drainage system generally ponds water beyond a 2-year storm event, with significant widespread areas of potential inundation expected to occur during a 100-year event.

Proposed Capital Improvements:

The trans-basin overland flows were not taken into consideration when sizing the proposed projects identified herein. If upstream proposed projects are constructed, for the 100-year storm event, the trans-basin flows will be intercepted by the proposed systems in each basin and there will be no more trans-basin flow.

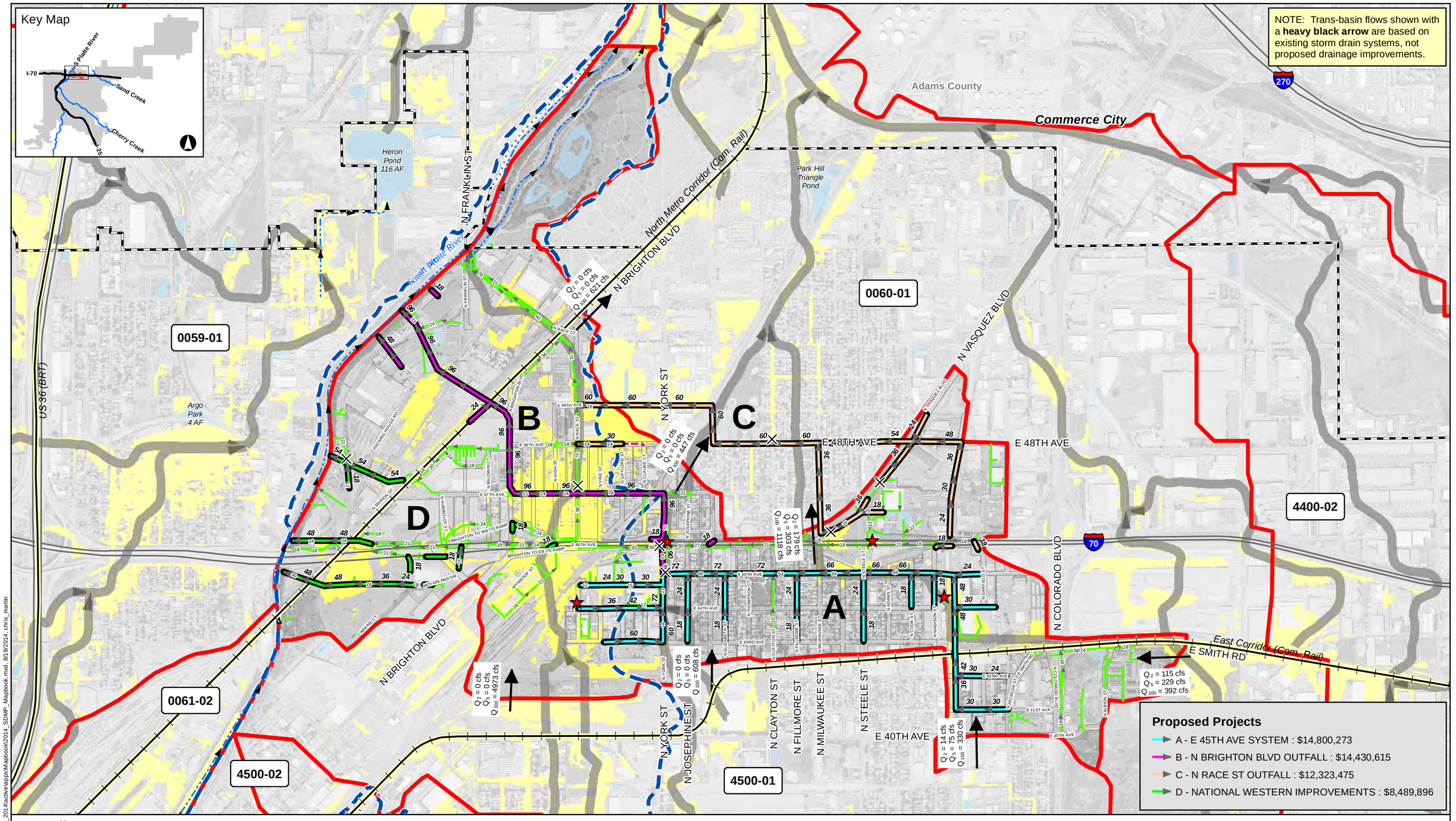
Four major storm drain projects have been proposed in this basin to increase the level of service from a 2-year capacity to a 5-year capacity.

<u>Project A: East 45th Avenue System</u>
This project includes an extension of the lateral network south of I-70. Currently, stormwater is collected in 45th Avenue. These improvements extend the storm drains into 44th and 43rd Avenues.

<u>Project B: North Brighton Boulevard Outfall</u>
This project involves construction of a new outfall at a new location. There is no easy or obvious new outfall route to the South Platte River; access is either restricted by I-70 or the Stock Show complex. To maximize the use of the existing pipe network, a new 96-inch outfall has been proposed from York Street & 45th Avenue, through the National Western Stock Show grounds to the South Platte River. Negotiations are needed to obtain an easement for a new drainage outfall in this area, if the existing outfall is to remain without replacement. Other minor outfall pipes also need to be upsized in order to improve the level of service in the area.

<u>Project C: North Race Street Outfall</u>
This project involves upsizing existing storm pipe north of I-70. The railroad is a major barrier for constructing new pipe in this area. There are few roadway crossings of the railroad in the area. The 91-acre area (sub-basin 520) northeast of Vasquez Boulevard and I-70 is currently drained by an 18-inch pipe under I-70. The proposed pipe follows a new alignment in 48th Avenue to avoid construction in the I-70 corridor.

<u>Project D: National Western Improvements</u>
This project involves enlarging existing storm drain outfalls near I-70. Specifically, a 30-inch outfall south of I-70 (Design Point 610) is upsized to a 48-inch pipe. A 24-inch outfall north of I-70 (Design Point 600) is upsized to a 48-inch pipe. A 30-inch outfall north of I-70 (Design Point 590) is upsized to a 54-inch pipe. Preliminary design may consider parallel pipes for this project rather than complete replacement.



N

0 600 1,200

Feet

1 inch equals 1,200 feet

For Detailed Hydrology See Technical Appendix and Work Map

Legend

- Collection System Boundary
- Topographic Basin Boundary
- Thalweg
- Proposed Storm Pipe
- UDFCD Study Recommendations
- Proposed Pipe Disconnect
- Existing Storm Pipe
- Designed Storm Improvement
- Existing Surface Flow
- Significant Flooding Location
- Proposed Detention Basin
- Existing Basin
- Potential Inundation Area
- Planned Transit Line
- Existing Transit Line
- City and County Boundary
- Other Municipalities
- Other Counties

Basin 0060-02
I-70 & York

Denver Storm Drainage Master Plan

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