Order

OFFICE OF THE
MAYOR
CITY OF SAN LUIS

No. 2023-11

AN ORDER OF THE MAYOR AND CITY COUNCIL OF THE CITY OF SAN LUIS, ARIZONA APPROVING THE DOWNTOWN SAN LUIS MASTER DRAINAGE PLAN.

WHEREAS, the City of San Luis is working on revitalizing the downtown area through the implementation of the adopted General Plan and Downtown Redevelopment Plan; and

WHEREAS, the City of San Luis contracted James Davey and Associates, Inc. to develop a drainage master plan for the downtown area; and

WHEREAS, the Downtown San Luis Master Drainage Plan area is that portion of the City of San Luis that was originally platted as the San Luis Townsite and San Luis Townsite Addition No. 1 subdivisions and lies between Mesa Street and Archibald Street to the west, 4th Avenue to the east, Urtuzuastegui Street to the South and Cesar Chavez Blvd. to the north and has a total area of about 116 acres; and

WHEREAS, the City Council of the City of San Luis believes that it is necessary and in the best interest of the City of San Luis, in order to plan for downtown stormwater facilities, to approve the Downtown San Luis Master Drainage Plan prepared by James Davey and Associates, Inc.; and

THEREFORE, IT IS ORDERED by the Mayor and City Council of the City of San Luis, Arizona that the Downtown San Luis Master Drainage Plan prepared by James Davey and Associates, Inc., incorporated herein as Exhibit "A", is hereby approved.

PASSED, ADOPTED and APPROVED by the Mayor and City Council of the City of San Luis, Yuma County, Arizona this ______ day of November 2023.

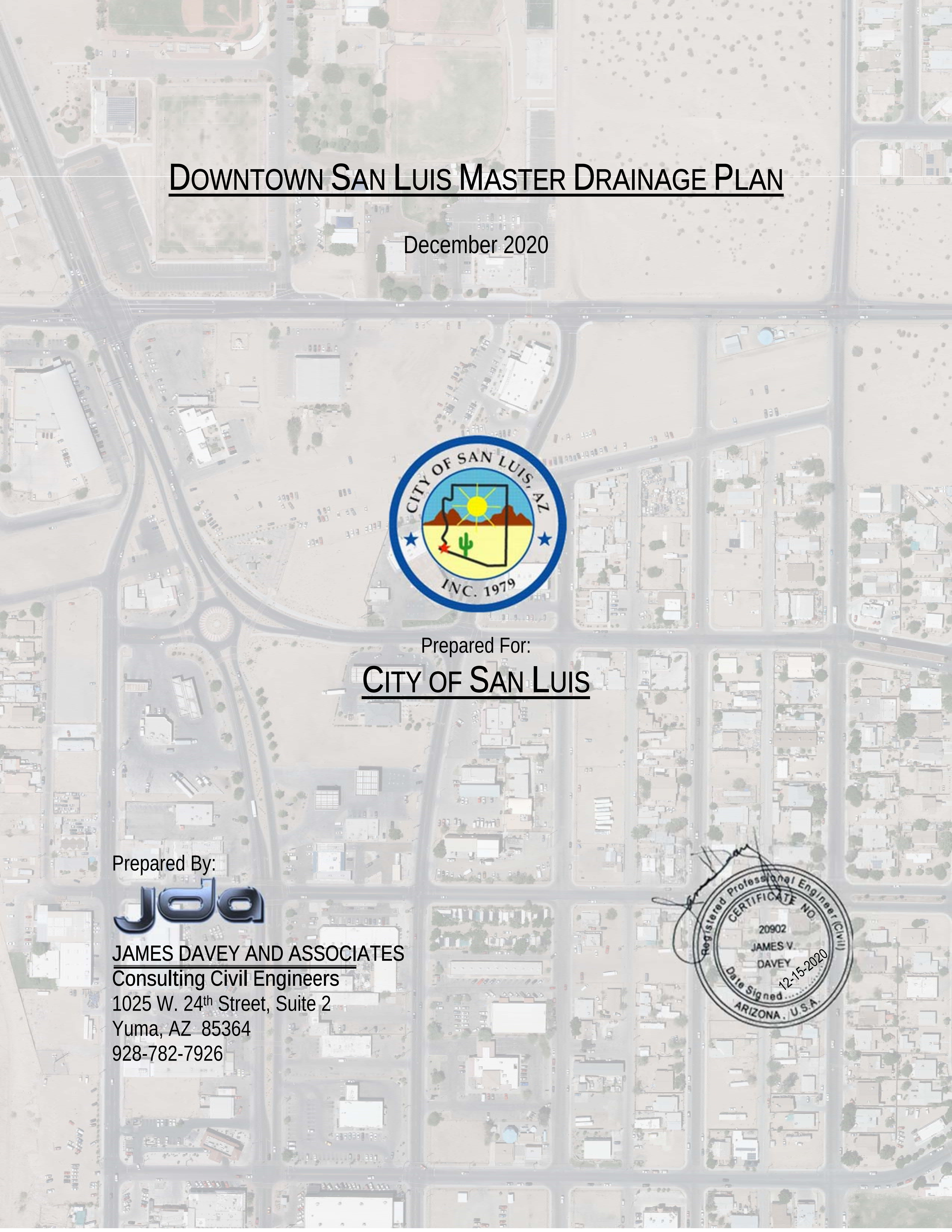
____
Nieves G. Riedel, Mayor

ATTEST:

____
Sonia Cornelio, City Clerk

APPROVED AS TO FORM:

____
Kay Marion Macuil, City Attorney



DOWNTOWN SAN LUIS MASTER DRAINAGE PLAN

December 2020

Prepared For:

CITY OF SAN LUIS

Prepared By:

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Registered Professional Engineer (Civil)
CERTIFICATE NO. 20902
JAMES V. DAVEY
Date Signed 12-15-2020
ARIZONA, U.S.A.

Executive Summary

The City of San Luis retained James Davey and Associates, Inc. to develop a drainage master plan for the downtown area of San Luis, Arizona. The purpose of the master plan is to assess the efficiency of the existing stormwater drainage infrastructure in the downtown San Luis area and to determine the effects of increased urban density on stormwater runoff and the additional infrastructure needed to accommodate such increased urban density. The master plan area is that portion of the City of San Luis that was originally platted as the San Luis Townsite and San Luis Townsite Addition No. 1 subdivisions and lies between Mesa Street and Archibald Street to the west, 4th Avenue to the east, Urtuzuastegui Street (formerly A Street) to the South and Cesar Chavez Blvd. to the north and has a total area of about 116 acres.

The scope of work for the San Luis Area Drainage Master plan included the following:

- Gather Available Data and Information
- Update Existing Aerial Survey and Mapping
- Delineating Drainage Areas
- Performing Hydrological and Hydraulic Analyses
- Assessing the Existing Drainage Conditions and Recommend Drainage Improvements for Existing Conditions
- Recommending Drainage Improvements to allow for Increased Urban Development in the Downtown San Luis Area.

Existing storm drainage features of downtown San Luis include:

- The Downtown San Luis Storm Drain System, a system of storm drain pipes that drains to a retention basin in the Yuma Valley;
- Urtuzuastegui Retention Basins, two retention basins that collect overland flow from the southeast corner of the project area;
- Retention basin in the Bienestar Estates and La Frontera Estates subdivision, which while not in the project area, collect street runoff from the east side of the project area.
- The Highway 95 Storm Drain, a smaller storm drain constructed by ADOT to drain the northerly portion of Highway 95 (Main Street);

Based on the collected and reviewed data and upon the aerial mapping and field reviews, the San Luis Area Master plan area was analyzed as to drainage patterns and existing stormwater runoff quantities. The existing storm drainage systems were then analyzed to determine their adequacy. Conclusions from this review and analysis are:

- Area draining to the Downtown San Luis Storm Drain System – The about 74 acres in the southwestern portion of the project area are drained by the Downtown San Luis Storm Drain System. This storm drain was designed for the 10-year stormwater runoff, though considering flows from existing developed lots without stormwater retention, its actually capacity is less than the 10-year frequency.

  The Downtown Storm Drain was analyzed as having two subbasins – an Archibald Street subbasin, where flows in excess of the storm drain capacity overflow to Urtuzuastegui Street and discharge outside of the downtown area; and a subbasin east of Main Street with potential for flows in excess of the storm drain capacity to pond and potentially cause flood damage at ponding areas at 2nd Avenue and C Street and at 1st Avenue and D Street.

- Areas draining to the Urtuzuastegui Retention Basins – Relatively small areas of downtown San Luis, about 2.3 acres, at Urtuzuastegui between 2nd Avenue and 4th Avenue drain to the two Urtuzuastegui Retention Basins. These basins have capacity for the existing flows from the downtown area but overall retention basin capacities are complicated by flows from the San Luis Industrial Park to the south, in which stormwater is not effectively retained onsite as it was planned to be.

- Areas draining to the Bienestar Estates and La Frontera Estates Retention Basins – The 3 retention basins east of 4th Avenue were calculated to have the approximate capacity to store existing conditions stormwater runoff from about the 7.6 acre area west of 4th Avenue that drains to them.

- Areas draining to the Highway 95 Storm Drain – It was found that only a small area, about 1 acre, of the Highway 95 right-of-way south of Juan Sanchez Blvd. drains to the Highway 95 storm drain and the storm drain was designed to handle the 10-year frequency stormwater runoff. Due to existing pipe capacity and also existing retention basin size, neither the capacity nor area served by the storm drain can be significantly expanded.

- Areas not served by existing storm drains – The remaining 31 acres along the north side of the of the master plan area is not served by existing storm drains. This area consists primarily of larger lots already developed with onsite stormwater retention, and the E Street, F Street, USBR powerline right-of-way corridor which can be developed with onsite stormwater retention. The major exception to the stormwater drainage of the area being able to be handled by onsite retention are the small lots along the northern portion of Mesa Street.

Alternatives for improving stormwater drainage included primarily alternatives for improving the stormwater collection system and alternatives for providing additional stormwater retention to prevent flooding of properties in the 10-year frequency and 100-year frequency stormwater runoff events. The alternatives developed were based on levels of onsite stormwater retention being varied from maintaining existing development conditions, to improving these conditions with full stormwater retention required for all future development, and to eliminating the requirement for onsite stormwater retention. It is noted that as much of the downtown area of the City of San Luis (especially the area drained by the Downtown San Luis Storm Drain system) is already heavily developed and as it consists primarily of small lots, that providing onsite retention of stormwater can be problematic and costly in many cases.

Each alternative developed included hydrologic and hydraulic analysis, storm drain facility sizing and layout and cost estimates. The drainage system improvements recommended are as follow.

Alternatives for area draining to the Downtown San Luis Storm Drain System

Archibald Street Drainage – 3 alternatives were developed for the drainage of the Archibald Street drainage area. These were:

1. *Maintain the current requirement for onsite retention of stormwater for all new development*. This alternative will result in gradual reduction of stormwater flows, though current flows will remain in excess of storm drain and street capacities for the 100-year frequency runoff event for a considerable period of time. There is no public cost for this alternative, though there is a cost to the property owners.

2. *Grandfather in the existing average compliance rate of onsite stormwater retention*. Currently about an average of 50% of stormwater is retained by properties along Archibald Street. If future development is required to also retain this same amount of stormwater (50% of the current standard of 2.25"), then the runoff rates will remain more or less as they are now, with flows still in excess of the storm drain and street capacities. To mitigate these excess flows, improvements to the existing storm drain in Archibald will be required, consisting of adding additional catch basins to maximize storm drain capacity. Cost of this option is estimated at about $116,000.

3. *Provide a stormwater drainage system to handle full 100-year flow without onsite retention.* As the downtown area is already densely developed with little onsite retention and with relatively small lots, providing onsite retention is problematic for many properties. Elimination of most or all onsite stormwater retention requirements would greatly simplify redevelopment of properties. To eliminate onsite retention requirements would require additional storm drainage to be construction, and a C Street Storm Drain is proposed. Cost of the C Street Storm Drain is estimated at about $368,000, plus the $116,000 for additional catch basins, for a total cost of $484,000.

<u>C Street and 2nd Avenue and D Street and 1st Avenue Drainage</u> – Again, 3 alternatives were developed for the drainage of this area.

1. *Maintain the current requirement for onsite retention of stormwater for all new development*. This alternative will result in gradual reduction of stormwater flows, though current flows will be in excess of storm drain and street capacities for the 100-year frequency runoff event. There is no public cost for this alternative, though there is a cost to the property owners and there is potential for flooding lots at the ponding areas until significant additional retention is provided.

2. *Grandfather in the existing average compliance rate of onsite stormwater retention*. Current onsite retention is estimated at about 50%. With future development also retaining this amount of stormwater, then the runoff rates will remain more or less as they are now, with flows still in excess of the storm drain and street capacities. To mitigate these excess flows and potential flooding of lots, a new stormwater detention basin and storm drain collection system is proposed. Cost of the detention basin and collection system is estimated at about $654,000.

3. *Provide a stormwater drainage system to handle full 100-year flow without onsite retention. Again, as* for Archibald Street, it is problematic for many properties in this area to provide onsite stormwater retention and elimination of stormwater retention requirements would greatly simplify redevelopment of properties. To do so, the new detention basin and storm drain system proposed in option 2 above would need to be increased in size. Cost for this option is estimated at $943,000.

Alternatives for area draining to the Urtuzuastegui Retention Basins

The small area draining to the Urtuzuastegui Retention Basins is already developed as parking lots with little stormwater retention, retaining only about 30 percent of the normally required onsite retention. There is also no available land area for expansion of the retention basins. As there is existing capacity in these retention basins for the existing flows (depending on how flows from the San Luis Industrial Park are handled), grandfathering in the existing land uses is possible. Elimination of the retention requirements altogether requires only an additional 2520 cubic feet of stormwater retention in the basins, which is a relatively small quantity, and such would simplify the management of the drainage to these basins.

Alternatives for area draining to the Bienestar Estates and La Frontera Estates Retention Basins

Similar to the Urtuzuastegui Retention Basins, the retention basins of Bienestar Estates and La Frontera Estates have very limited potential for expansion. The existing development that drains to these basins is already developed with only the stormwater retention typical of the residential lots, about 30 percent effective retention. Grandfathering in the existing land uses is again possible but further reduction or elimination of the retention requirements altogether does not appear practical at this time

Areas not served by existing storm drains

The areas not served by storm drains along the north side of the of the master plan area generally function adequately for storm drainage at the present time or can do so if developed with onsite retention. As such, it was recommended that stormwater retention requirements be maintained in place for this area. The exception is that the lots along Mesa Street, which are small lots and are mostly developed without onsite retention, can be provided with storm drainage by an extension of a new C Street Storm Drain as discussed above. Such could result in elimination of most or all retention requirements. Cost of the storm drain extension is about $152,000 (included as a part of the $368,000 total cost of the storm drain.)

Per discussion with the City of San Luis City Council, it is desirable to facilitate development in the downtown San Luis area as much as possible. This would include reducing or eliminating stormwater retention requirements where practical. Base on this discussion, the following are recommended:

1. Archibald Street Drainage Area, including the north portion of Mesa Street – Construct additional catch basins and construct a C Street Storm Drain and eliminate stormwater retention requirements. Cost $484,000
2. C Street/2nd Avenue and D Street/1st Avenue Drainage Area – Construct new storm water detention basin and storm water collection system such that storm water retention requirements can be eliminated. Cost of $943,000.
3. Urtuzuastegui Retention Basins Drainage Area – No improvements recommended and stormwater retention requirements grandfathered in at the current level about 30% of the typical 2.25" of runoff to be retained and increased to no retention required (about 10% effective retention.) Further management of the San Luis Industrial Park flows is required.
4. Bienestar Estates and La Frontera Estates Drainage Area – No improvements recommended but stormwater retention requirements grandfathered in at the current effective level of requiring 70% of the typical 2.25" of runoff to be retained (1.58".)
5. Areas without stormwater drainage facilities – Full stormwater retention (2.25" of runoff) still required.

As the above recommendations are implemented and approved, the new stormwater retention requirements will require the City Council to pass put ordinances to codify the new requirements.

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1.0 Introduction

The City of San Luis retained James Davey and Associates, Inc. to develop a drainage master plan for the downtown area of San Luis, Arizona. The purpose of the master plan is to assess the efficiency of the existing stormwater drainage infrastructure in the downtown San Luis area and to determine the effects of increased urban density on stormwater runoff and the additional infrastructure needed to accommodate such increased urban density.

The master plan area is that portion of the City of San Luis that was originally platted as the San Luis Townsite and San Luis Townsite Addition No. 1 subdivisions and lies between Mesa Street and Archibald Street to the west, 4th Avenue to the east, Urtuzuastegui Street (formerly A Street) to the South and Cesar Chavez Blvd. to the north.

Key features of the master planning area include the westerly edge of the Yuma Mesa located near Mesa and Archibald Streets, where the topography falls about 40 feet to the Yuma Valley; Main Street/U.S. Highway 95, the major street in downtown San Luis; and the US-Mexico Border, located just south of Urtuzuastegui Street. The area is mostly all developed with commercial and residential land uses. The master plan area includes approximately 116 acres.

Figure 1 is a Project Location Map of the Downtown San Luis Master Plan area.

The scope of work for the Downtown San Luis Master Plan includes the following:

- Gather Available Data and Information
- Update Existing Aerial Survey and Mapping
- Delineating Drainage Areas
- Performing Hydrological and Hydraulic Analyses
- Assessing the Existing Drainage Conditions and Recommend Drainage Improvement for the Existing Conditions
- Recommending Drainage Improvements to allow for Increased Urban Development in the Downtown San Luis Area.

The City of San Luis has currently adopted onsite stormwater retention requirements of the Yuma County Flood Control District. Onsite stormwater retention, however, results in portions of lots being set aside as retention areas and as urbanization increases, particularly with increases in lot coverages, this conflicts with stormwater retention requirements. Alternatives will be considered in this plan for the future land uses with reduced on-lot stormwater retention requirements and with the stormwater infrastructure required to handle stormwater runoff form such reduced on-lot retention.

Downtown San Luis
Master Drainage Plan
- Study Area -

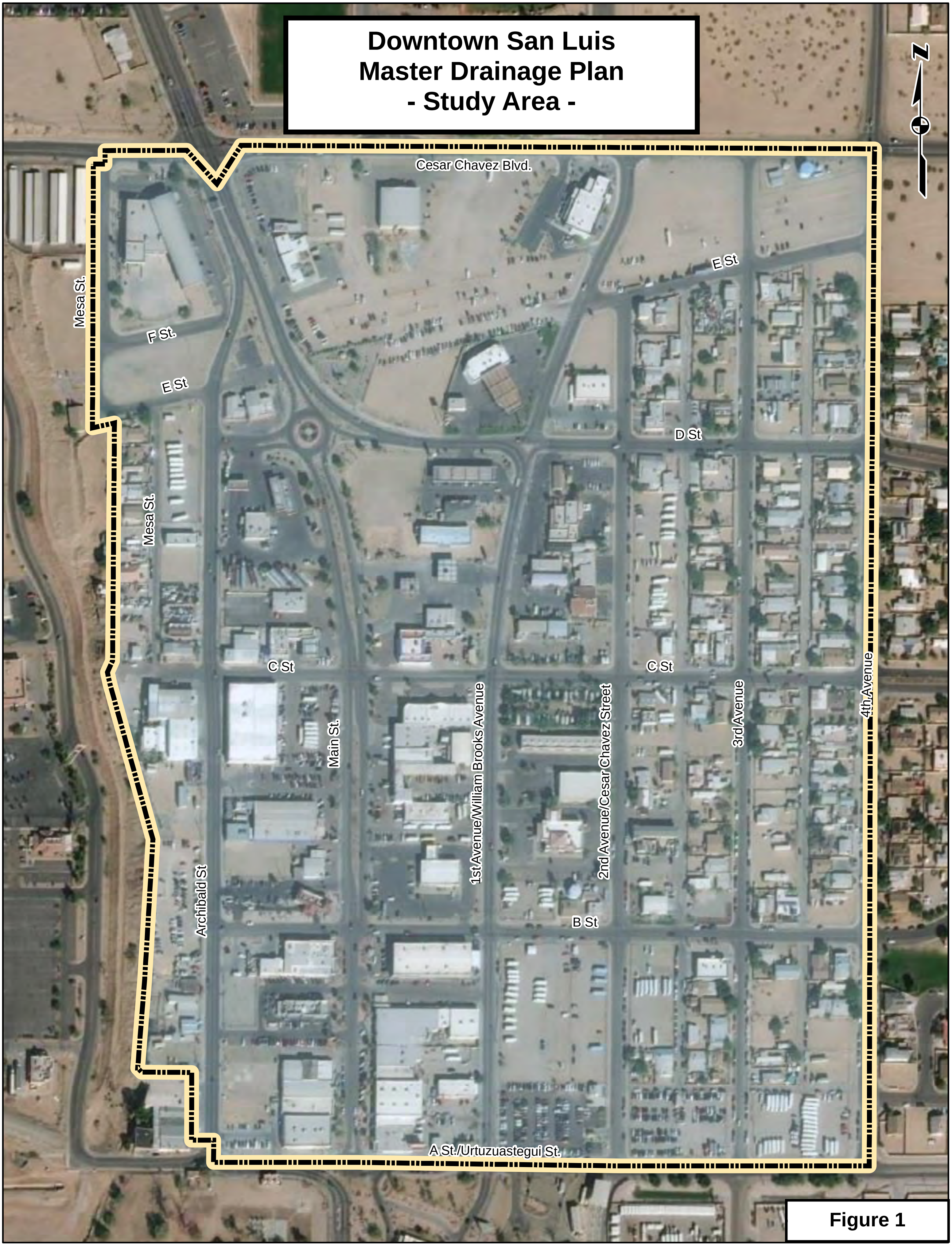


Figure 1

2.0 Project Area

2.1 Overview of the Downtown San Luis Master Planning Area

The City of San Luis is an incorporated community in Yuma County located near the border with Mexico and the Colorado River. The downtown San Luis master plan area is the older portion of the City of San Luis and was developed into lots as a part of the San Luis Townsite and San Luis Townsite Addition No. 1 subdivisions.

Downtown San Luis is located at the edge of the Yuma Mesa, which is the higher land about 40 feet above the Colorado River floodplain of the Yuma Valley to the west of it. The downtown area is about one-half mile north to south from Cesar Chavez Avenue on the north to Urtuzuastegui Street on the south, and about 3/8 of a mile from east to west, from Mesa Street and Archibald Street to 4th Avenue. It is primarily divided into rectangular blocks by the existing street system, except for some irregular blocks formed by the curving alignment of Main Street/Highway 95 and by a powerline right-of-way that runs diagonally from east to west between E and F Streets. Each of the blocks has been divided into lots and these lots are most all of these lots are developed into commercial or residential properties.

While most of the downtown San Luis area is already developed, the residential development is primarily one-story single-family residences and the commercial development is also primarily one-story buildings on individual lots. The undeveloped properties and many of the existing developed properties have the potential to be re-developed at higher densities in the future.

2.2 Topography, Mapping and Soils

The topography of the master plan area consists primarily of level ground except for the westerly edge of it which drops off steeply at the edge of the mesa. Ground elevations range from about 128 feet to about 133 feet above sea level. It appears that little mass grading was done at the time of the initial development of the roadways and lots and as such several low areas occur within the area.

Mapping for the project was primarily based on aerial surveys as provided by Cooper Aerial and flow in 2017 for a previous project. The photography from the 2017 mapping project was reprocessed by Cooper to include additional areas not previously mapped. Overall, aerial mapping covered the full project area except for from about Urtuzuastegui Street to B Street, and this remaining area was field surveyed for critical elevation and features with additional features digitized from aerial photos. The mapping was projected horizontally in Arizona State Plane Coordinates, west zone, North American Datum of 1983 and was calibrated vertically to the North American Vertical Datum of 1988 as established by GPS methods.

Soils in the master plan area are classified as Superstition Sands, a highly permeable sandy soil. Superstition Sands are classified as being hydrologic soil group A and have published percolation rates of from 2.0 to 20.0 inches per hour.

2.3 Existing Storm Drainage Facilities

The San Luis master plan area has two existing storm drains, the Downtown San Luis Storm Drain system which drains the majority of the master plan area, and the much smaller Highway 95 storm drain, which drains only a small portion of Main Street at the north end of the area. In addition, there are five retention basins that collect flows, either from the storm drains or from overland flow, located adjacent to the master plan area.

Figure 2 shows the major drainage features of the master plan area.

2.3.1 Highway 95 Storm Drain

The Highway 95 Storm Drain is an existing 24-inch diameter pipeline that provides drainage for a portion of Main Street/Highway 95 near Cesar Chavez Blvd with the project area and also for the street to the north. It is designed for a 10-year frequency stormwater runoff event. The storm drain discharges to a retention basin, also designed for the 10-year runoff volume, located near the Yuma Valley Main Drain.

The Highway 95 Storm Drain is limited in capacity primarily by the storage capacity of its retention basin. The retention basin cannot be expanded due to adjacent land uses, and as such, its upstream collection system cannot be expanded.

2.3.2 Downtown San Luis Storm Drain System

The Downtown San Luis Storm Drain System is a storm drain network with retention basin constructed as a part of roadway improvements along Archibald, Main Street and 1st Avenue completed several years ago. The storm drain was also expanded to the east as a second phase of work.

The original part of the Downtown Storm Drain was a 15-inch to 30-inch storm drain constructed in Archibald Street from Urtuzuastegui Street to C Street. This storm drain may have been constructed in the late 1990's. With the more recent street improvements, this storm drain was left in place in Archibald Street with the addition of new catch basins. The portion of the storm drain in Urtuzuastegui Street was replaced with new 54-inch storm drain piping.

During the roadway reconstruction project, new storm drain pipe was installed in Urtuzuastegui (48-inch to 54-inch pipe), Main Street (42-inch to 48-inch pipe), B Street (24-inch to 30-inch pipe), C Street (36" to 42" pipe) and 1st Avenue (24-inch to 30-inch pipe.) As a phase two, these storm drains were extended to the east along B Street (18-inch to 24-inch pipe), C Street (18-inch to 36-inch pipe) and D Street (18-inch pipe) to collect flows from these streets and from 2nd and 3rd Avenues.

The Downtown Storm Drain discharges flows to the Yuma Valley Retention Basin located at the west end of Urtuzuastegui Street and between the East Main Canal/242 Lateral Discharge Canal and the Yuma Valley Levee. There is additional area to the west of the retention basin and the basin could be deepened if additional stormwater retention volume is needed.

2.3.3 Bienestar Estates Retention Basins

There are two retention basins located in Tract A and Tract D of the original Bienestar Estates subdivision that receive existing street flows from portions of the project area between 3rd and 4th Avenues. In addition, one retention on Tract A of the La Frontera Estates Subdivision No. 2, located just south of Bienestar Estates also receives flows from this area. The original design report for sizing these retention basins is not available and they were instead surveyed to determine their current capacities.

2.3.3 Urtuzuastegui Retention Basins

There are two retention basins located along the south side of Urtuzuastegui Street between 2nd and 4th Avenues. These basins collect runoff from the Urtuzuastegui right-of-way, from several lots north of Urtuzuastegui and from Cesar Chavez Street in the San Luis Industrial Park to the south. Again, the original design report for sizing these retention basins is not available and they were instead surveyed to determine their current capacities.

2.3 Previous Stormwater Studies

The two principal stormwater drainage studies that previously addressed drainage of the downtown San Luis area are:

- The San Luis Area Drainage Study, prepared by Kimley-Horn and Associates in September 2009
- Final Drainage Report – International Border to Juan Sanchez Blvd, Volume II prepared by Core Engineering in December 2013.

There was also a drainage report understood to be prepared by Huitt-Zollars, Inc. for the first phase of the downtown storm drain but this report was not available and also seems to have been mostly included in the Core Engineering Final Drainage Report.

The Kimley-Horn San Luis Area Drainage Study provides the basic planning framework for a portion of San Luis including the downtown area. It provided the early plans for what was to become (though in a different layout) the Downtown Storm Drain System.

The Core Engineering Final Drainage Report provides the detailed design hydrology and hydraulics for the Downtown Storm Drain System. This design basis was analyzed and used for storm drainage alternatives in this study.

Downtown San Luis Master Drainage Plan
- Existing Drainage Features -
Highway 95 Retention Basin
Highway 95 Storm Drain
(24" Diameter)
Master Plan Area
Cesar Chavez Blvd.
Mesa St.
F St.
E St
D St
Bienestar Estates
Tract A Retention Basin
Downtown San Luis
Storm Drain System
- 18" to 54" Diameter
Mesa St.
C St
C St
Archibald St
Main St.
1st Avenue/William Brooks Avenue
2nd Avenue/Cesar Chavez Street
3rd Avenue
4th Avenue
B St
A St/Urtuzuastegui St.
Bienestar Estates
Tract D
Retention Basin
La Frontera Estates
Tract A
Retention Basin
Yuma Valley
Retention Basin
Urtuzuastegui
Retention Basins
N
Figure 2

3.0 Hydrologic Analysis of the San Luis Area

The hydrologic analysis of the San Luis Drainage Master plan area includes the following components:

- Delineation of Drainage Basin and Subbasin Boundaries
- Characterizing the Drainage Properties of each Drainage Basin
- Quantifying Runoff Volumes and Peak Discharges
- Identifying Potential Drainage Problems and Quantifying the Problems
- Hydrologic and Hydraulic Modelling of Proposed Drainage Solutions for the Affected Drainage Basins

3.1 Major Drainage Areas and Subbasins

As a first step in the hydrologic analysis of the downtown San Luis master plan area, the area was divided into five drainage areas based on the drainage outfall of each area. These five areas are:

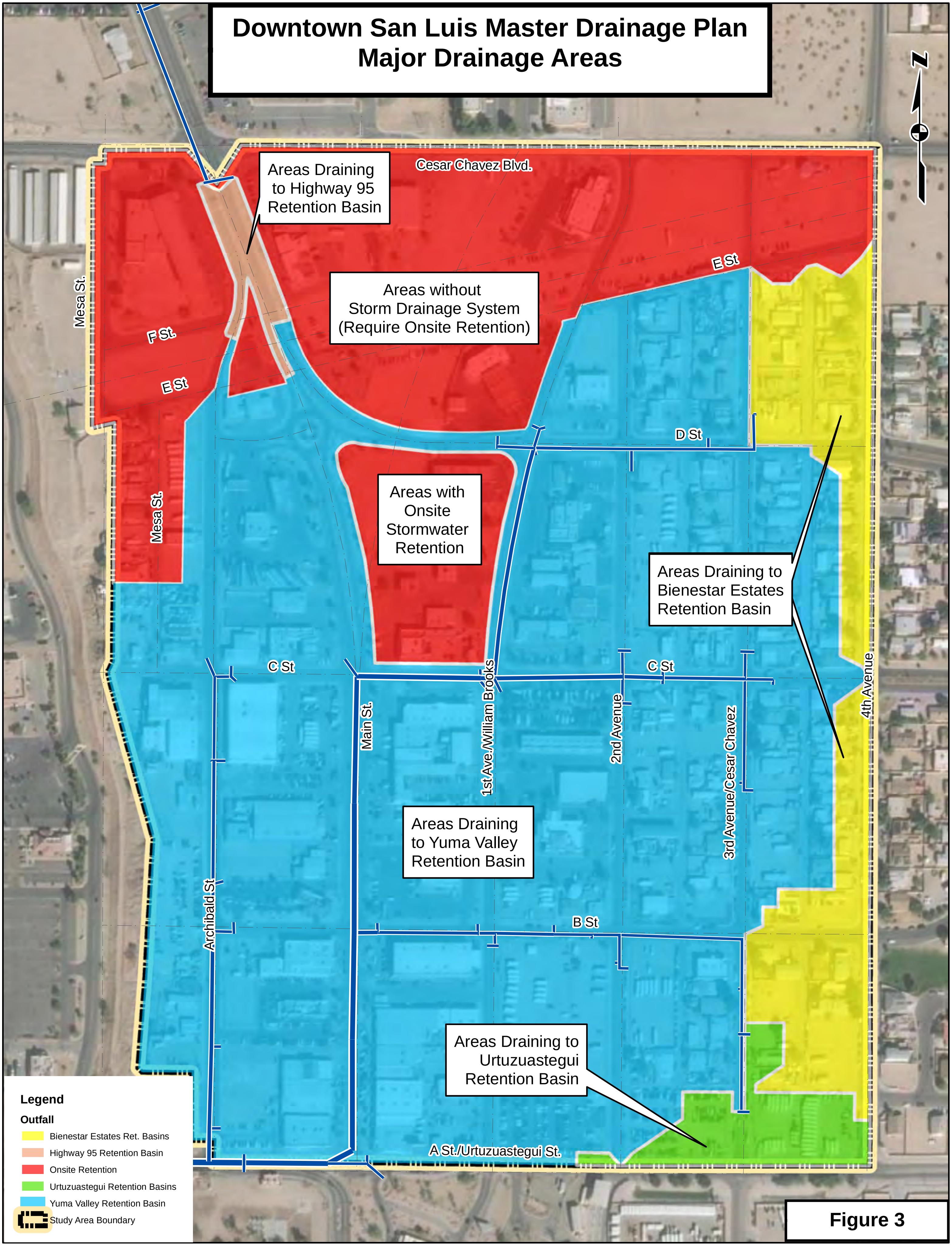
- Areas that drain west to the Yuma Valley Retention Basin
- Areas that drain southeast to the Urtuzuastegui Street Retention Basins
- Areas that drain east to the Bienestar Estates Retention Basins
- Areas that drain north to the Highway 95 Retention Basin
- Areas for which onsite retention of stormwater will be required.

The major drainage areas are shown in Figure 3. These major drainage areas were determined based on analysis of mapping and on field observations to identify the drainage divides at which flows split to flow to the various drainage outfalls.

The majority of the area drains to the Downtown San Luis storm drain system or flows overland to the Yuma Valley Retention Basin. Street grades along the east side and a portion of the south side of the area route flows to the 4th Avenue and the Bienestar Estates retention basins and to the Urtuzuastegui retention basins. The flows to the Highway 95 storm drain appear to be limited to the right-of-way limits of Main Street above the two catch basins at Cesar Chavez Blvd. The remainder of the area, primarily that area along and adjacent to E Street and F Street and the USBR powerline easement between these streets was mapped to be areas of onsite retention. These areas have no current stormwater outfall and the adjacent commercial developments have been developed with onsite stormwater retention.

Stormwater runoff flow patterns were determined to further break the major drainage areas into drainage subbasins. See Figures 4 and 5. Subbasins drainage divides were mapped based on available aerial mapping and field observations. Typical subbasins were based on existing catch basins and other stormwater collection points and with assumptions regarding splitting flows along lot centers (assuming an individual lot would have half of the stormwater flow to the front of the lot and half the flow to the rear – current developments could have more detailed flow splits but future developments could differ and this assumption was used as the best overall method.) Street flow patterns were based on street grades, though it is noted that many of the street have very little slopes or have local high and low points that affect the flows.

A total of 75 subbasins were delineated. It is noted that three subareas were defined in the drainage area that drains to the Yuma Valley Retention Basin, with these subareas addressed in more detail below.


Downtown San Luis Master Drainage Plan
Major Drainage Areas
Cesar Chavez Blvd.
Areas Draining to Highway 95 Retention Basin
Areas without Storm Drainage System (Require Onsite Retention)
Mesa St.
F St.
E St
E St
Areas with Onsite Stormwater Retention
D St
Mesa St.
Areas Draining to Bienestar Estates Retention Basin
C St
C St
Main St.
1st Ave./William Brooks
2nd Avenue
3rd Avenue/Cesar Chavez
4th Avenue
Areas Draining to Yuma Valley Retention Basin
Archibald St
B St
Areas Draining to Urtuzuastegui Retention Basin
A St./Urtuzuastegui St.
Legend
Outfall
Bienestar Estates Ret. Basins
Highway 95 Retention Basin
Onsite Retention
Urtuzuastegui Retention Basins
Yuma Valley Retention Basin
Study Area Boundary
Figure 3

Downtown San Luis Master Drainage Plan - Drainage Divides and Street Drainage

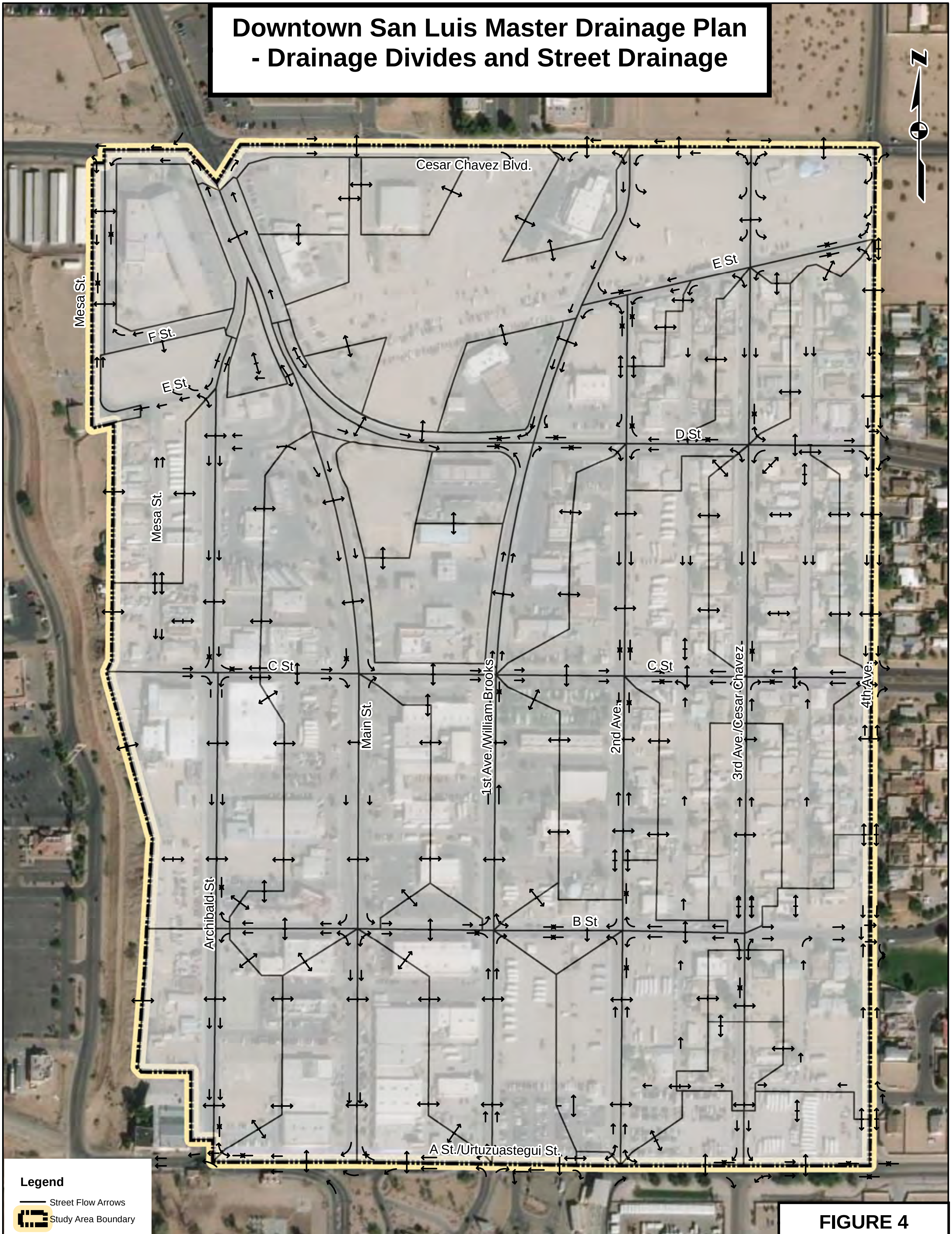


FIGURE 4

Downtown San Luis Master Drainage Plan
- Drainage Subbasins -

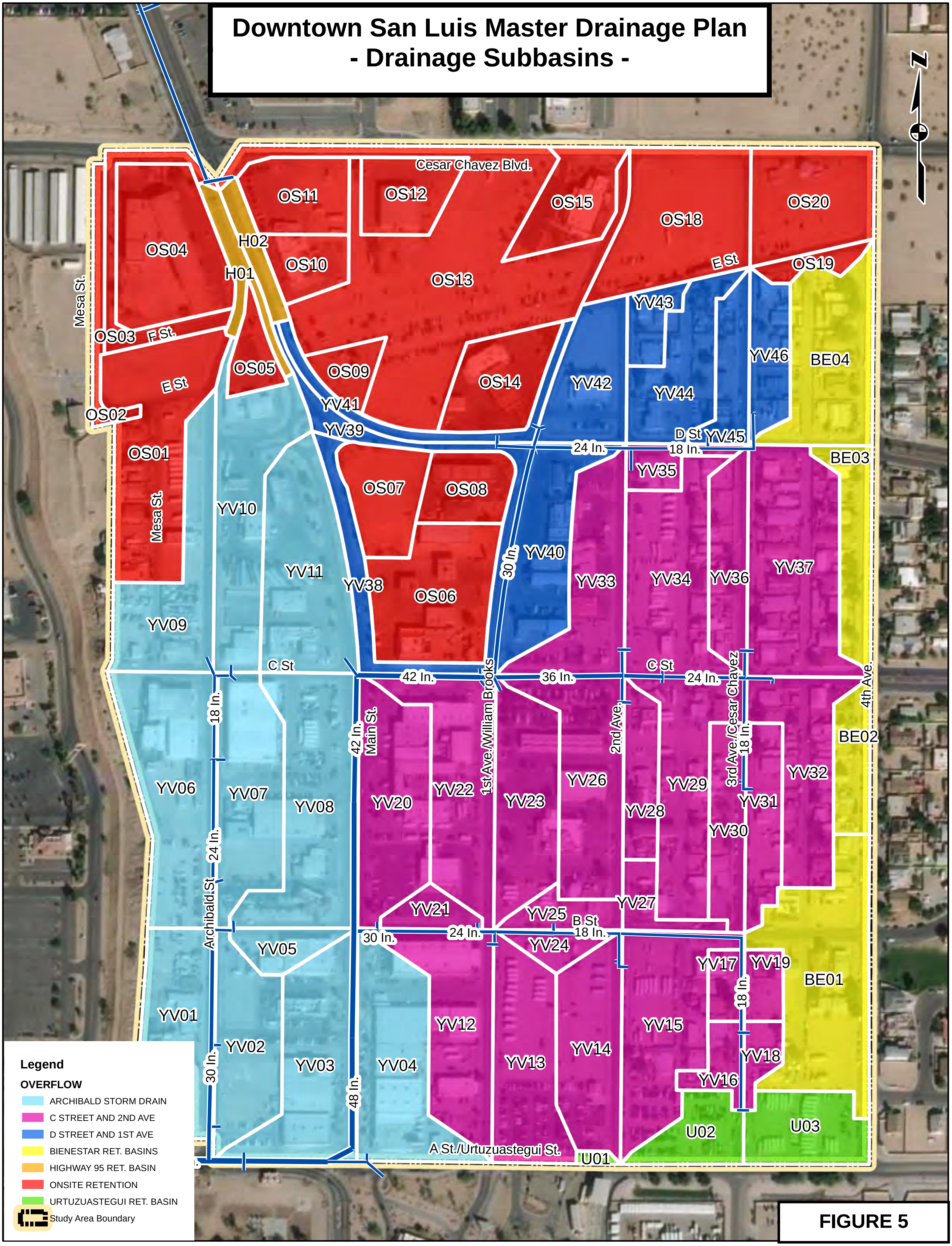


FIGURE 5

3.3 Drainage Basin Hydrologic Characteristics

The runoff coefficients and runoff travel times were tabulated for each subbasin. Runoff coefficients of existing land uses were estimated based on types of existing development (residential, commercial, vacant) and evaluation of current runoff characteristics (existing onsite retention areas, density of development, etc.) Travel times were based primarily on street flow velocities and longest drainage travel paths.

Runoff coefficients (Rational Method C values) were primarily based on observations of contributing impervious areas. A C-value of 0.9 was used for all road right-of-way as they are almost fully impervious and well connected but often with some non-contributing area between sidewalks and right-of-way lines. Residential land uses areas were generally assigned a C value of 0.3 based on the typical size of lots in the San Luis Townsite. It is noted that residential lots typically contribute runoff from the front part of the lots – the driveway and front half of the house roof – while the back part of the lots often are enclosed by a wall or otherwise non-contributing (though with paved alleys in some blocks, there can be runoff from the back part of some lots.)

C values for existing commercial properties were based on averages for the existing development over a drainage subbasin. Observations of existing commercial properties show drainage characteristics ranging from lots with almost complete impervious areas to lots with well designed onsite retention basins, with a variety of types of lots often found within each subbasin. C values used for commercial lots ranged from 0.1 to 0.9 – effectively from 10% to 90% runoff. It was observed that very few lots have either fully effective onsite retention (especially as over time retention areas tend to fill in) nor have fully impervious contributing areas. Weighted subbasin C values used for subbasins with commercial land uses ranged from 0.30 to 0.70.

Times of concentration were computed based on a combination of overland flow and street flow velocities and on field observations as to the runoff characteristics of each drainage basin. Generally, with the street layout of downtown San Luis, street flow velocities were the dominate influence on times of concentration. Street flow velocities were calculated using the Manning equation, with a value of 2.5 feet per second found to be a good average for the area. A minimum time of concentration of 10 minutes was used and all subbasins were calculated to have times of concentration of less than 10 minutes. Rainfall intensities were obtained from the frequency-duration-intensity curves found in Volume III of the Yuma County Public Works Standards.

The portion of the area that drains to the Yuma Valley Retention Basin was divided into 3 subareas for hydrologic analysis. The area generally west of Main Street (subbasins YV01 through YV11) will drain to the basin by the existing street network if the stormwater runoff exceeds the capacity of the Downtown San Luis Storm Drain. Areas east of Main Street, however, drain to two local depressions where flows in excess of the storm drain capacity will pond and have potential for local flooding. The two ponding areas identified are at C Street and 2nd Avenue and at D Street and 1st Avenue, with the subbasins draining to these areas identified as subbasins YV12 through YV37 and YV38 through YV46, respectively. As noted previously, street drainage patterns which were used to determine subbasin boundaries and also how the subbasin flows route when storm drain capacities are exceeded are based on street that often have very little slope or have local high and low points that affect flow patterns.

3.4 Hydrologic Methods and Calculations

The basic hydrologic method used for quantifying stormwater runoff was the rational method (Q=CiA), where Q is the flow in cubic feet per second, C is the runoff coefficient, i is the rainfall intensity, and A is the drainage area in acres. Runoff volumes were computed using V=CpA, where c is the same coefficient as for the rational method and p is the precipitation of a given frequency and duration.

For existing drainage conditions, 10-year and 100-year peak stormwater discharges were calculated for all drainage basins. Similarly. the 100-year frequency volumes for 1-hour, 2-hour, 6-hour and 24-hour storm durations (2.25 inches, 2.44 inches, 3.05 inches and 3.85 inches of rainfall, respectively) were also computed for all drainage basins.

The calculated existing hydrology of the master plan area is shown in Figure 6 – Existing Conditions Peak Discharges and in Table 1 – Existing Hydrology – Flow and Volume Calculations.

Note that Table 1 shows travel times to be almost all below the minimum of 10 minutes and so only the 10-minute rainfall intensities were generally applicable. The exception to this is when combining flow for an entire drainage area and in the case of the Archibald Street storm drain combined for a travel time of 15 minutes and so has lower rainfall intensities. The combined flows to C Street and 2nd Avenue and to D Street and 1st Avenue both were at about 10 minutes travel time and so no changes in intensity were made to these drainage area totals.

For the areas with onsite retention of stormwater runoff, peak flows are not meaningful (as flows are typically all contained within a single parcel of land) and were not calculated. Runoff volumes were also only calculated for the 100-year 2-hour runoff as that is the design volume for onsite retention per Yuma County standards.

Downtown San Luis Master Drainage Plan
- Existing Conditions Peak Discharges -

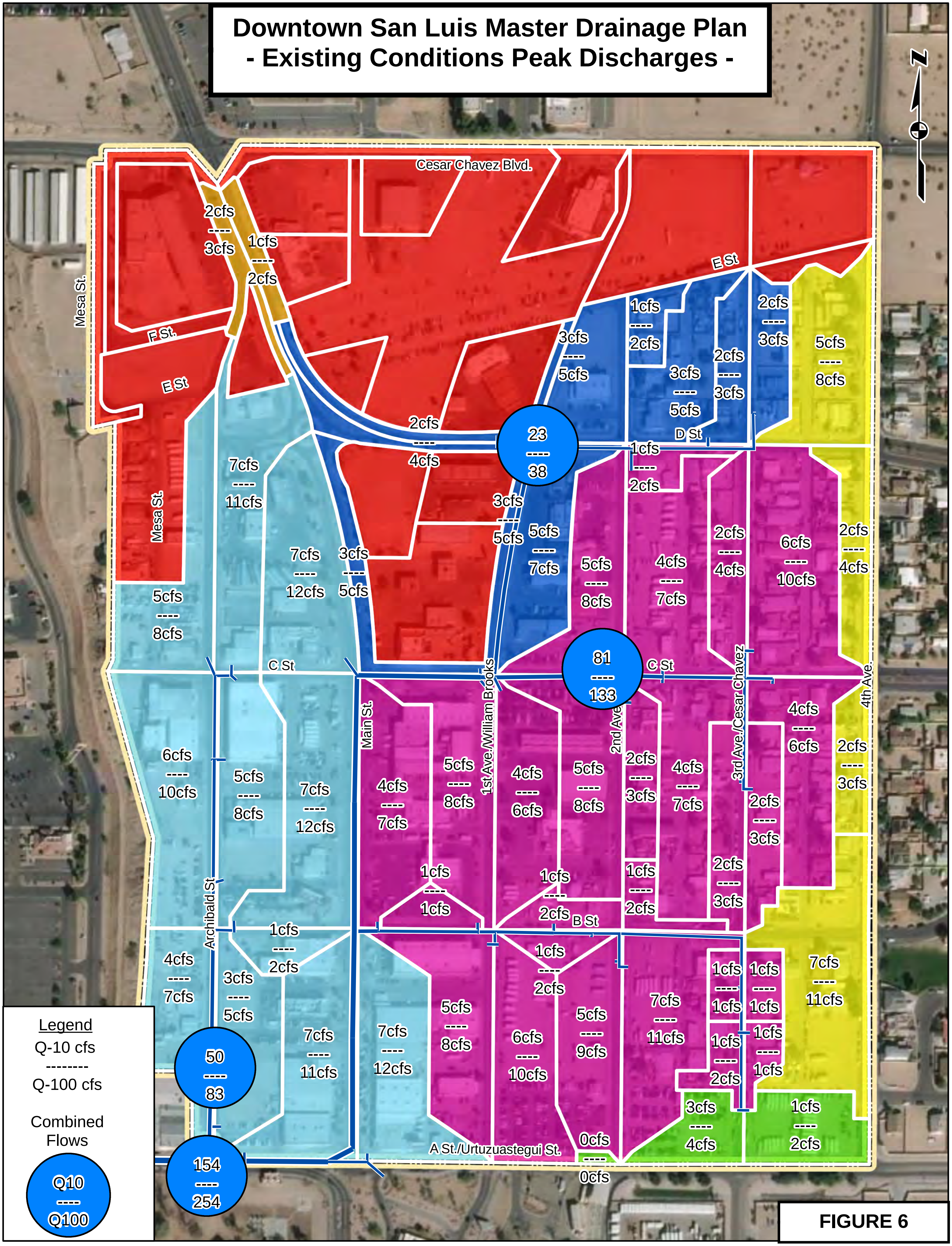


FIGURE 6

Table 1 - Existing Hydrology - Flow and Volume Calculations

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr
Area Draining to Archibald Storm Drain																	
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.55	0.62	430 ft		2.9 min	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	9210 c.f.	9988 c.f.	12484 c.f.	15759 c.f.
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.35	0.47	304 ft	685 ft	2.0 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	7097 c.f.	7696 c.f.	9620 c.f.	12144 c.f.
YV03	116154 s.f.	2.67 Ac.	38530 s.f.	77624 s.f.	0.55	0.67	866 ft		5.8 min	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	14507 c.f.	15732 c.f.	19665 c.f.	24823 c.f.
YV04	110775 s.f.	2.54 Ac.	37843 s.f.	72932 s.f.	0.70	0.77	564 ft		3.8 min	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	15958 c.f.	17306 c.f.	21632 c.f.	27306 c.f.
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.45	0.62	290 ft		1.9 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2852 c.f.	3092 c.f.	3865 c.f.	4879 c.f.
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.45	0.54	773 ft		5.2 min	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	13866 c.f.	15037 c.f.	18796 c.f.	23726 c.f.
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.50	0.59	541 ft	685 ft	3.6 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10801 c.f.	11713 c.f.	14642 c.f.	18482 c.f.
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.45	0.60	886 ft		5.9 min	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	16085 c.f.	17443 c.f.	21804 c.f.	27523 c.f.
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.45	0.61	422 ft		2.8 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	11100 c.f.	12037 c.f.	15046 c.f.	18993 c.f.
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.60	0.72	927 ft	927 ft	6.2 min	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	15270 c.f.	16559 c.f.	20699 c.f.	26128 c.f.
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.60	0.70	580 ft		3.9 min	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	15958 c.f.	17305 c.f.	21632 c.f.	27306 c.f.
Totals		25.70 Ac.			0.52	0.63		2297 ft	15.3 min	3.1 in/hr	5.1 in/hr	50 cfs	83 cfs	132702 c.f.	143908 c.f.	179886 c.f.	227069 c.f.
Area Draining to C Street and 2nd Avenue																	
YV12	99865 s.f.	2.29 Ac.	26681 s.f.	73184 s.f.	0.50	0.61	589 ft		3.9 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	11363 c.f.	12323 c.f.	15404 c.f.	19444 c.f.
YV13	94171 s.f.	2.16 Ac.	23870 s.f.	70301 s.f.	0.70	0.75	755 ft	755 ft	5.0 min	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	13255 c.f.	14374 c.f.	17968 c.f.	22681 c.f.
YV14	84206 s.f.	1.93 Ac.	17860 s.f.	66346 s.f.	0.70	0.74	557 ft		3.7 min	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	11722 c.f.	12712 c.f.	15889 c.f.	20057 c.f.
YV15	111562 s.f.	2.56 Ac.	38515 s.f.	73047 s.f.	0.60	0.70	546 ft		3.6 min	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	14717 c.f.	15960 c.f.	19950 c.f.	25183 c.f.
YV16	22255 s.f.	0.51 Ac.	10758 s.f.	11497 s.f.	0.30	0.59	322 ft		2.1 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2462 c.f.	2670 c.f.	3338 c.f.	4213 c.f.
YV17	17384 s.f.	0.40 Ac.	5540 s.f.	11844 s.f.	0.30	0.49	188 ft		1.3 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1601 c.f.	1736 c.f.	2170 c.f.	2740 c.f.
YV18	16408 s.f.	0.38 Ac.	6797 s.f.	9611 s.f.	0.30	0.55	201 ft		1.3 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1688 c.f.	1830 c.f.	2288 c.f.	2888 c.f.
YV19	18638 s.f.	0.43 Ac.	5598 s.f.	13040 s.f.	0.30	0.48	213 ft		1.4 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1678 c.f.	1820 c.f.	2275 c.f.	2872 c.f.
YV20	103490 s.f.	2.38 Ac.	32600 s.f.	70890 s.f.	0.30	0.49	676 ft		4.5 min	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	9489 c.f.	10290 c.f.	12863 c.f.	16236 c.f.
YV21	19572 s.f.	0.45 Ac.	7560 s.f.	12012 s.f.	0.30	0.53	614 ft		4.1 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1951 c.f.	2116 c.f.	2645 c.f.	3339 c.f.
YV22	109371 s.f.	2.51 Ac.	28682 s.f.	80689 s.f.	0.40	0.53	618 ft		4.1 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10892 c.f.	11811 c.f.	14764 c.f.	18637 c.f.
YV23	89674 s.f.	2.06 Ac.	18966 s.f.	70708 s.f.	0.40	0.51	618 ft	618 ft	4.1 min	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	8504 c.f.	9222 c.f.	11527 c.f.	14551 c.f.
YV24	18882 s.f.	0.43 Ac.	9060 s.f.	9822 s.f.	0.60	0.74	166 ft		1.1 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.	2856 c.f.	3570 c.f.	4507 c.f.
YV25	23873 s.f.	0.55 Ac.	10557 s.f.	13316 s.f.	0.40	0.62	459 ft		3.1 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2780 c.f.	3015 c.f.	3769 c.f.	4757 c.f.
YV26	104992 s.f.	2.41 Ac.	26098 s.f.	78894 s.f.	0.40	0.52	398 ft		2.7 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10321 c.f.	11193 c.f.	13991 c.f.	17661 c.f.
YV27	21457 s.f.	0.49 Ac.	12473 s.f.	8984 s.f.	0.50	0.73	147 ft		1.0 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2947 c.f.	3196 c.f.	3995 c.f.	5043 c.f.
YV28	39654 s.f.	0.91 Ac.	13743 s.f.	25911 s.f.	0.30	0.51	454 ft		3.0 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3777 c.f.	4096 c.f.	5119 c.f.	6462 c.f.
YV29	98239 s.f.	2.26 Ac.	29715 s.f.	68524 s.f.	0.30	0.48	859 ft		5.7 min	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	8869 c.f.	9618 c.f.	12022 c.f.	15176 c.f.
YV30	49247 s.f.	1.13 Ac.	16568 s.f.	32679 s.f.	0.30	0.50	597 ft		4.0 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4634 c.f.	5025 c.f.	6282 c.f.	7929 c.f.
YV31	46669 s.f.	1.07 Ac.	16447 s.f.	30222 s.f.	0.30	0.51	377 ft		2.5 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4475 c.f.	4853 c.f.	6067 c.f.	7658 c.f.
YV32	86703 s.f.	1.99 Ac.	27117 s.f.	59586 s.f.	0.30	0.49	*616 ft*		4.1 min	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	7928 c.f.	8597 c.f.	10746 c.f.	13565 c.f.
YV33	90238 s.f.	2.07 Ac.	26140 s.f.	64098 s.f.	0.50	0.62	511 ft		3.4 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10420 c.f.	11300 c.f.	14125 c.f.	17830 c.f.
YV34	115198 s.f.	2.64 Ac.	38564 s.f.	76634 s.f.	0.20	0.43	275 ft		1.8 min	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	9381 c.f.	10174 c.f.	12717 c.f.	16053 c.f.
YV35	21876 s.f.	0.50 Ac.	11649 s.f.	10227 s.f.	0.40	0.67	513 ft		3.4 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2733 c.f.	2964 c.f.	3704 c.f.	4676 c.f.
YV36	52606 s.f.	1.21 Ac.	17303 s.f.	35303 s.f.	0.30	0.50	600 ft		4.0 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	4906 c.f.	5320 c.f.	6650 c.f.	8394 c.f.
YV37	141531 s.f.	3.25 Ac.	46479 s.f.	95052 s.f.	0.30	0.50	822 ft		5.5 min	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	13190 c.f.	14304 c.f.	17880 c.f.	22570 c.f.
		38.98 Ac.			0.40	0.56		1373 ft	9.2 min	3.7 in/hr	6.1 in/hr	81 cfs	133 cfs	178317 c.f.	193375 c.f.	241719 c.f.	305120 c.f.

Table 1 - Existing Hydrology - Flow and Volume Calculations

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr

Table 1 - Existing Hydrology - Flow and Volume Calculations (Cont.)

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr
Area Draining to D Street and 1st Avenue																	
YV38	37188 s.f.	0.85 Ac.	37188 s.f.	0 s.f.	0.00	0.90	931 ft	931 ft	6.2 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.	6805 c.f.	8507 c.f.	10738 c.f.
YV39	40789 s.f.	0.94 Ac.	40789 s.f.	0 s.f.	0.00	0.90	627 ft	627 ft	4.2 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.	7464 c.f.	9330 c.f.	11778 c.f.
YV40	87648 s.f.	2.01 Ac.	23424 s.f.	64224 s.f.	0.50	0.61	537 ft		3.6 min	3.7 in/hr	6.1 in/hr	5 cfs	7 cfs	9974 c.f.	10816 c.f.	13520 c.f.	17066 c.f.
YV41	30793 s.f.	0.71 Ac.	30793 s.f.	0 s.f.	0.00	0.90	584 ft		3.9 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.	5635 c.f.	7044 c.f.	8891 c.f.
YV42	66986 s.f.	1.54 Ac.	29457 s.f.	37529 s.f.	0.15	0.48	240 ft		1.6 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6026 c.f.	6535 c.f.	8169 c.f.	10312 c.f.
YV43	22674 s.f.	0.52 Ac.	9481 s.f.	13193 s.f.	0.30	0.55	178 ft		1.2 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2342 c.f.	2540 c.f.	3175 c.f.	4008 c.f.
YV44	72026 s.f.	1.65 Ac.	25134 s.f.	46892 s.f.	0.30	0.51	655 ft		4.4 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6879 c.f.	7460 c.f.	9325 c.f.	11771 c.f.
YV45	38785 s.f.	0.89 Ac.	17221 s.f.	21564 s.f.	0.30	0.57	78 ft		0.5 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4119 c.f.	4467 c.f.	5584 c.f.	7048 c.f.
YV46	41047 s.f.	0.94 Ac.	12977 s.f.	28070 s.f.	0.30	0.49	360 ft		2.4 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3769 c.f.	4087 c.f.	5109 c.f.	6449 c.f.
		10.05 Ac.			0.24	0.63		1558 ft	10.4 min	3.7 in/hr	6.1 in/hr	23 cfs	38 cfs	51464 c.f.	55810 c.f.	69762 c.f.	88061 c.f.
Totals for Downtown San Luis Storm Drain System																	
		74.73 Ac.			0.42	0.59						154 cfs	254 cfs	362484 c.f.	393093 c.f.	491367 c.f.	620250 c.f.
Area Draining to Bienestar Estates Retention Basins																	
BE01	144466 s.f.	3.32 Ac.	61847 s.f.	82619 s.f.	0.30	0.56	789 ft		5.3 min	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	15084 c.f.	16358 c.f.	20447 c.f.	25810 c.f.
BE02	34751 s.f.	0.80 Ac.	13473 s.f.	21278 s.f.	0.30	0.53	780 ft		5.2 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3470 c.f.	3763 c.f.	4704 c.f.	5938 c.f.
BE03	49525 s.f.	1.14 Ac.	23075 s.f.	26450 s.f.	0.30	0.58	710 ft		4.7 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5382 c.f.	5836 c.f.	7295 c.f.	9209 c.f.
BE04	102977 s.f.	2.36 Ac.	38061 s.f.	64916 s.f.	0.30	0.52	625 ft		4.2 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10074 c.f.	10925 c.f.	13656 c.f.	17238 c.f.
		7.62 Ac.				0.55				3.7 in/hr	6.1 in/hr	15 cfs	25 cfs	34010 c.f.	36882 c.f.	46103 c.f.	58196 c.f.
Area Draining to Highway 95 Retention Basin																	
H01	23012 s.f.	0.53 Ac.	23012 s.f.	0 s.f.	0.00	0.90	542 ft		3.6 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3883 c.f.	4211 c.f.	5264 c.f.	6645 c.f.
H02	18991 s.f.	0.44 Ac.	18991 s.f.	0 s.f.	0.00	0.90	489 ft		3.3 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	3205 c.f.	3475 c.f.	4344 c.f.	5484 c.f.
		0.96 Ac.				0.90				3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	7088 c.f.	7687 c.f.	9608 c.f.	12129 c.f.
Area Draining to Urtuzuastegui Retention Basins																	
U01	3246 s.f.	0.07 Ac.	3212 s.f.	34 s.f.	0.70	0.90	197 ft		1.3 min	3.7 in/hr	6.1 in/hr	0.2 cfs	0.4 cfs	546 c.f.	593 c.f.	741 c.f.	935 c.f.
U02	39258 s.f.	0.90 Ac.	12951 s.f.	26307 s.f.	0.70	0.77	251 ft		1.7 min	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	5638 c.f.	6114 c.f.	7643 c.f.	9648 c.f.
U03	57120 s.f.	1.31 Ac.	16265 s.f.	40855 s.f.	0.70	0.76	309 ft		2.1 min	3.7 in/hr	6.1 in/hr	1 c.f.	2 c.f.	8107 c.f.	8791 c.f.	10989 c.f.	13872 c.f.
		2.29 Ac.				0.77				3.7 in/hr	6.1 in/hr	6 cfs	11 cfs	14292 c.f.	15498 c.f.	19373 c.f.	24455 c.f.

Table 1 - Existing Hydrology - Flow and Volume Calculations

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr

Table 1 - Existing Hydrology - Flow and Volume Calculations (Cont.)

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr
Area with Onsite Retention																	
OS01	133690 s.f.	3.07 Ac.	40371 s.f.	93319 s.f.	Requirement is for 100-year - 1 hour runoff (2.25") to be retained onsite (no runoff coefficeints used)									25067 c.f.			
OS02	21891 s.f.	0.50 Ac.	15282 s.f.	6609 s.f.										4105 c.f.			
OS03	38530 s.f.	0.88 Ac.	38651 s.f.	-121 s.f.										7224 c.f.			
OS04	106238 s.f.	2.44 Ac.	0 s.f.	106238 s.f.										19920 c.f.			
OS05	22591 s.f.	0.52 Ac.	0 s.f.	22591 s.f.										4236 c.f.			
OS06	103530 s.f.	2.38 Ac.	0 s.f.	103530 s.f.										19412 c.f.			
OS07	52584 s.f.	1.21 Ac.	0 s.f.	52584 s.f.										9860 c.f.			
OS08	41424 s.f.	0.95 Ac.	0 s.f.	41424 s.f.										7767 c.f.			
OS09	21954 s.f.	0.50 Ac.	0 s.f.	21954 s.f.										4116 c.f.			
OS10	31303 s.f.	0.72 Ac.	0 s.f.	31303 s.f.										5869 c.f.			
OS11	52295 s.f.	1.20 Ac.	0 s.f.	52295 s.f.										9805 c.f.			
OS12	45286 s.f.	1.04 Ac.	0 s.f.	45286 s.f.										8491 c.f.			
OS13	309677 s.f.	7.11 Ac.	41225 s.f.	268452 s.f.										58064 c.f.			
OS14	59354 s.f.	1.36 Ac.	0 s.f.	59354 s.f.										11129 c.f.			
OS15	53634 s.f.	1.23 Ac.	10439 s.f.	43195 s.f.										10056 c.f.			
OS18	121888 s.f.	2.80 Ac.	45434 s.f.	76454 s.f.										22854 c.f.			
OS19	14408 s.f.	0.33 Ac.	8979 s.f.	5429 s.f.										2702 c.f.			
OS20	86356 s.f.	1.98 Ac.	32990 s.f.	53366 s.f.										16192 c.f.			
		30.23 Ac.												246869 c.f.			

3.5 Discussion of Previous Hydrology Studies

The previous studies of hydrology for the planning area are the San Luis Area Drainage Study by Kimley-Horn Associates (2009) and the drainage reports by Huitt-Zollars, Inc. in 2012 (copy not available), and by Core Engineering in 2016 (a continuation of the Huitt-Zollars study.

San Luis Area Drainage Study

The San Luis Area Drainage Study looked at a larger area than the downtown of San Luis and also was prepared prior to portions of the existing street system and prior to the construction of the Downtown San Luis Storm Drain. As such it only approximates the current hydrologic conditions. Flows in it, however, can be compared to those calculated in Table 1.

Table 5-3 and 5-6 of the San Luis Area Drainage Study show the calculated 10-year and 100-year peak discharges for their study area. In the study, drainage areas labeled as areas 35, 45, 75 and 80 more or less correspond to the area that now flows to the Yuma Valley Retention Basin (drainage areas 35 and 45 include additional areas to the north, now classified as onsite retention; drainage areas 75 and 80 also include areas that now drain to the Urtuzuastegui and Bienestar Estate Retention Basins; and the area north of C Street and east of 1st Avenue is not included but instead shown to drain to Bienestar Estates.) Comparison of the calculated flows is as follow:

San Luis Drainage Area Study – Drainage Areas 35, 45, 75 and 80

Drainage Area -	78.1 Acres
Q-10	108 c.f.s. (2-hour), 109 c.f.s. (6 hour), *71 c.f.s. (24-hour)*
Q-100	255 c.f.s. (2-hour), 263 c.f.s. (6 hour), *183 c.f.s. (24-hour)*

Current Hydrology – Drainage Areas YV01 through YV46 (Table 1.)

Drainage Area -	73.6 Acres
Q-10	153 c.f.s.
Q-100	252 c.f.s.

As seen in the above table, the areas used for comparison (78.1 acres vs. 73.6 acres) are fairly close, differing by about 6 percent. The Area Drainage Study used the SCS curve number method for calculating peak runoff, a method that weights pervious areas higher than rational method, especially for lower frequency runoff events. The Area Drainage Study also ran 3 different storms for calculating peak flows, the 2-hour, 6-hour and 24-hour storms. Total storm duration, however, has no effect on runoff governed by short time of concentrations (other than some changes in antecedent moisture conditions) and so the results of all 3 storm durations should theoretically be the same. The Area Drainage Study did, however, per review of the Study's HEC-1 output, misapply the design storm precipitation intervals so that their 24-hour storm calculations are incorrect and so these values are shown greyed out above (minimum intervals of 24-minutes were used which missed the peak flows on areas with times of concentration of 6 to 15 minutes.)

The calculated Q-100's of the two studies, overall (ignoring the 24-hours flows from the Area Drainage Study) are fairly close – 255 c.f.s./263 c.f.s. for the Area Drainage Study vs. 252 c.f.s. in Table 1. A greater difference exists in the Q-10's, 108 c.f.s./109 c.f.s. vs. 153 c.f.s. – a difference likely attributable to curve number runoff losses vs rational method runoff losses. This study will continue to use the rational method for runoff losses, feeling that it is more appropriate for urban areas.

The Area Drainage Study proposes a recommended storm drain solution that appears to be the basis of the current Downtown San Luis Storm Drain – having a different configuration but similar pipe sizes. The Study also states that the recommended storm drain will have the capacity to handle the 100-year frequency stormwater runoff (183 c.f.s. to 263 c.f.s.) but the storm drain was analyzed in Study to only have a capacity of 79 c.f.s. (less than a 10-year frequency design.) Documentation of this change in design capacity was not found in the Study.

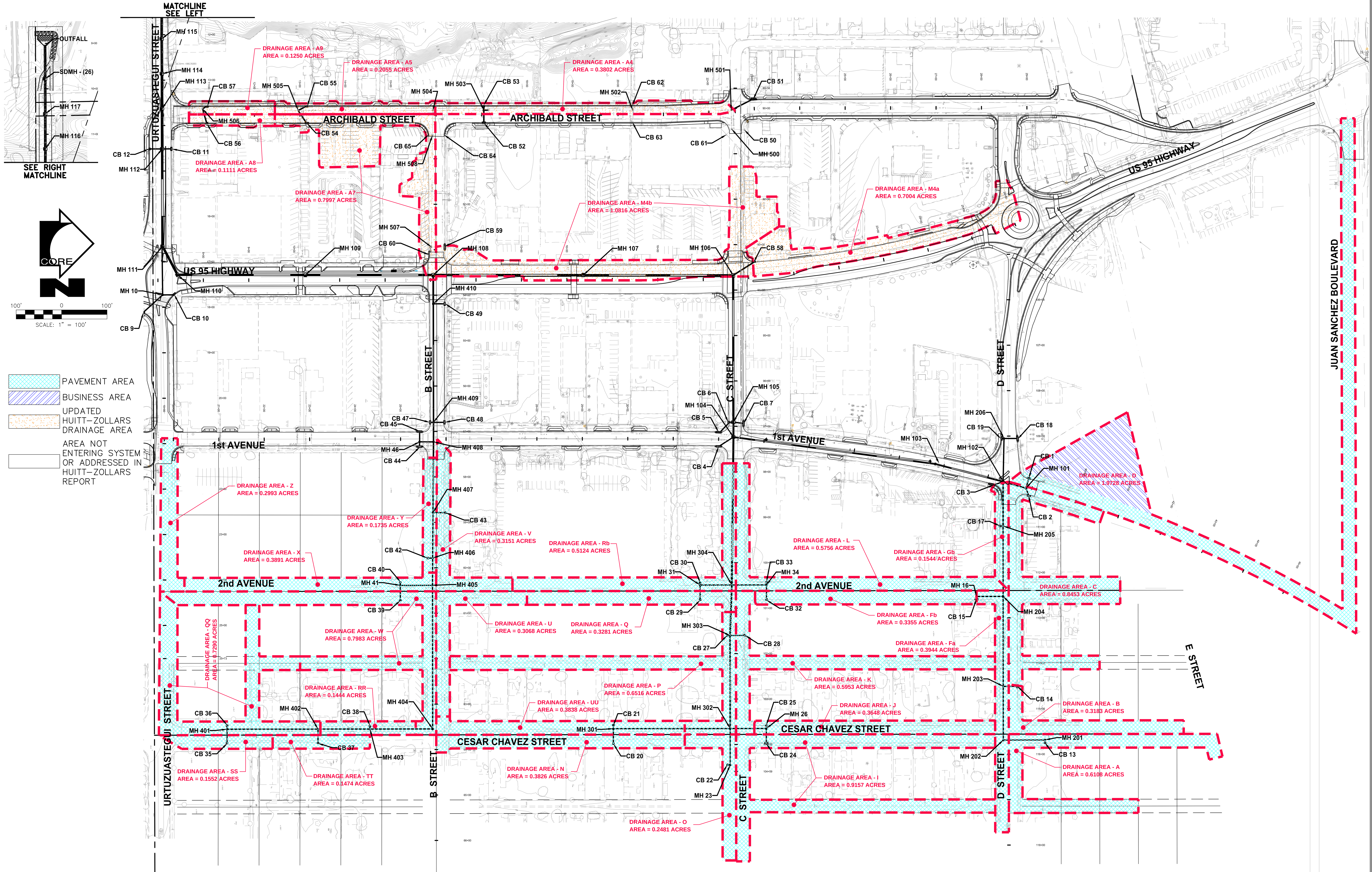
Final Drainage Report – International Border to Juan Sanchez Blvd.

In the Core Engineering Final Drainage Report, and presumably in the Huitt-Zollars Final Drainage Report (copy not available), detailed hydrologic calculations were made for what is called in the document the Downtown San Luis Storm Drain system.

An exhibit titled "Drainage Areas and System Layout" is included in the Core Engineering Final Drainage Report (included in this document as Figure 6.) This exhibit shows the new storm drain and the drainage areas contributing to it. Drainage areas include those for Core Engineering section of the storm drain (the sections of the storm drain east of 1st Avenue) and also drainage areas along Archibald Street labeled "updated Huitt-Zollars Drainage Areas." There are also areas along 1st Avenue, and B, C and D Streets without drainage areas shown but that appear to have been included for flows to catch basins of Huitt-Zollars' portion of the storm drain system.

The drainage areas shown on the exhibit, with only a few exceptions, show contributing flow areas consisting of street right-of-ways only. Flows from residential and commercial properties are not shown with the exception of a couple of minor commercial areas along Archibald and Main Street and one commercial area along 1st Avenue. This is significantly different from the approach used in the San Luis Area Drainage Study, where runoff from commercial and residential lots was considered (as seen in the curve numbers used in that study.) The Final Drainage Report, Section 2.1 – Hydrology, states that "per the San Luis Area Drainage Study, system flow is limited to street runoff only." This statement was not found in the Area Drainage Study and curve numbers used in the Study are based on full areas and land uses. It is possible, however, that a later amendment to the Area Drainage Study was issued that is not now available.

The drainage areas shown on the "Drainage Areas and System Layout" exhibit were used to update flows in Table 1. The updated flows, where the drainage areas contributing to the Yuma Valley Retention Basin were generally limited to street right-of-ways – i.e., where street right-of-ways have a C value of 0.90 and where most commercial and residential lots are considered non-contributing and have a C value of 0.00, are shown in Table 2 – Existing Hydrology – Calculations based on Downtown San Luis Storm Drain System Design. This table shows the Q-10 and Q-100 peak discharges reduced from 153 and 252 c.f.s. to 82 and 134 c.f.s., respectively. The Q-10 of 82 c.f.s. calculated in Table 2 is fairly close to the capacity of the Downtown San Luis Storm Drain as shown in Appendix D of the Final Drainage Report of 79 c.f.s.



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INTERNATIONAL BORDER TO JUAN SANCHEZ BOULEVARD - VOLUME II

SAN LUIS, YUMA COUNTY, ARIZONA

DRAINAGE AREAS AND SYSTEM LAYOUT

Date:	DEC 2013
Designed:	C.E.S.
Drawn:	C.E.G.
Checked:	D.J.N.
Proj. No.:	10-047

SHEET 1 OF 1

FIGURE 7

Table 2 - Existing Hydrology - Calculations based on Downtown San Luis Storm Drain System Design

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr
Area Draining to Archibald Storm Drain																	
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.00	0.18	430 ft		2.9 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2732 c.f.	2963 c.f.	3704 c.f.	4675 c.f.
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.20	0.35	304 ft	685 ft	2.0 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5321 c.f.	5770 c.f.	7213 c.f.	9105 c.f.
YV03	116154 s.f.	2.67 Ac.	38530 s.f.	77624 s.f.	0.00	0.30	866 ft		5.8 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6502 c.f.	7051 c.f.	8814 c.f.	11126 c.f.
YV04	110775 s.f.	2.54 Ac.	37843 s.f.	72932 s.f.	0.00	0.31	564 ft		3.8 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6386 c.f.	6925 c.f.	8657 c.f.	10927 c.f.
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.60	0.71	290 ft		1.9 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	3277 c.f.	3553 c.f.	4442 c.f.	5607 c.f.
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.00	0.18	773 ft		5.2 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4659 c.f.	5053 c.f.	6316 c.f.	7972 c.f.
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.00	0.20	541 ft	685 ft	3.6 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3715 c.f.	4028 c.f.	5035 c.f.	6356 c.f.
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.00	0.30	886 ft		5.9 min	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	7978 c.f.	8652 c.f.	10814 c.f.	13651 c.f.
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.00	0.33	422 ft		2.8 min	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	5920 c.f.	6420 c.f.	8025 c.f.	10130 c.f.
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.00	0.37	927 ft	927 ft	6.2 min	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	7857 c.f.	8521 c.f.	10651 c.f.	13444 c.f.
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.30	0.50	580 ft		3.9 min	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	11363 c.f.	12322 c.f.	15403 c.f.	19443 c.f.
Totals		25.70 Ac.			0.06	0.31		2297 ft	15.3 min	3.1 in/hr	5.1 in/hr	25 cfs	41 cfs	65710 c.f.	71259 c.f.	89073 c.f.	112437 c.f.
Area Draining to C Street and 2nd Avenue																	
YV12	99865 s.f.	2.29 Ac.	26681 s.f.	73184 s.f.	0.00	0.24	589 ft		3.9 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4502 c.f.	4883 c.f.	6103 c.f.	7704 c.f.
YV13	94171 s.f.	2.16 Ac.	23870 s.f.	70301 s.f.	0.00	0.23	755 ft	755 ft	5.0 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4028 c.f.	4368 c.f.	5460 c.f.	6892 c.f.
YV14	84206 s.f.	1.93 Ac.	17860 s.f.	66346 s.f.	0.00	0.19	557 ft		3.7 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	3014 c.f.	3268 c.f.	4085 c.f.	5157 c.f.
YV15	111562 s.f.	2.56 Ac.	38515 s.f.	73047 s.f.	0.00	0.31	546 ft		3.6 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6499 c.f.	7048 c.f.	8810 c.f.	11121 c.f.
YV16	22255 s.f.	0.51 Ac.	10758 s.f.	11497 s.f.	0.00	0.44	322 ft		2.1 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1815 c.f.	1969 c.f.	2461 c.f.	3106 c.f.
YV17	17384 s.f.	0.40 Ac.	5540 s.f.	11844 s.f.	0.00	0.29	188 ft		1.3 min	3.7 in/hr	6.1 in/hr	0 cfs	1 cfs	935 c.f.	1014 c.f.	1267 c.f.	1600 c.f.
YV18	16408 s.f.	0.38 Ac.	6797 s.f.	9611 s.f.	0.00	0.37	201 ft		1.3 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1147 c.f.	1244 c.f.	1555 c.f.	1963 c.f.
YV19	18638 s.f.	0.43 Ac.	5598 s.f.	13040 s.f.	0.00	0.27	213 ft		1.4 min	3.7 in/hr	6.1 in/hr	0 cfs	1 cfs	945 c.f.	1024 c.f.	1281 c.f.	1616 c.f.
YV20	103490 s.f.	2.38 Ac.	32600 s.f.	70890 s.f.	0.00	0.28	676 ft		4.5 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5501 c.f.	5966 c.f.	7457 c.f.	9413 c.f.
YV21	19572 s.f.	0.45 Ac.	7560 s.f.	12012 s.f.	0.00	0.35	614 ft		4.1 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1276 c.f.	1383 c.f.	1729 c.f.	2183 c.f.
YV22	109371 s.f.	2.51 Ac.	28682 s.f.	80689 s.f.	0.00	0.24	618 ft		4.1 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	4840 c.f.	5249 c.f.	6561 c.f.	8282 c.f.
YV23	89674 s.f.	2.06 Ac.	18966 s.f.	70708 s.f.	0.00	0.19	618 ft	618 ft	4.1 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	3201 c.f.	3471 c.f.	4338 c.f.	5476 c.f.
YV24	18882 s.f.	0.43 Ac.	9060 s.f.	9822 s.f.	0.00	0.43	166 ft		1.1 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1529 c.f.	1658 c.f.	2072 c.f.	2616 c.f.
YV25	23873 s.f.	0.55 Ac.	10557 s.f.	13316 s.f.	0.00	0.40	459 ft		3.1 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1781 c.f.	1932 c.f.	2415 c.f.	3048 c.f.
YV26	104992 s.f.	2.41 Ac.	26098 s.f.	78894 s.f.	0.00	0.22	398 ft		2.7 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4404 c.f.	4776 c.f.	5970 c.f.	7536 c.f.
YV27	21457 s.f.	0.49 Ac.	12473 s.f.	8984 s.f.	0.00	0.52	147 ft		1.0 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2105 c.f.	2283 c.f.	2853 c.f.	3602 c.f.
YV28	39654 s.f.	0.91 Ac.	13743 s.f.	25911 s.f.	0.00	0.31	454 ft		3.0 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2319 c.f.	2515 c.f.	3144 c.f.	3968 c.f.
YV29	98239 s.f.	2.26 Ac.	29715 s.f.	68524 s.f.	0.00	0.27	859 ft		5.7 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5014 c.f.	5438 c.f.	6797 c.f.	8580 c.f.
YV30	49247 s.f.	1.13 Ac.	16568 s.f.	32679 s.f.	0.00	0.30	597 ft		4.0 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2796 c.f.	3032 c.f.	3790 c.f.	4784 c.f.
YV31	46669 s.f.	1.07 Ac.	16447 s.f.	30222 s.f.	0.00	0.32	377 ft		2.5 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2775 c.f.	3010 c.f.	3762 c.f.	4749 c.f.
YV32	86703 s.f.	1.99 Ac.	27117 s.f.	59586 s.f.	0.00	0.28	*616 ft*		4.1 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4576 c.f.	4962 c.f.	6203 c.f.	7830 c.f.
YV33	90238 s.f.	2.07 Ac.	26140 s.f.	64098 s.f.	0.00	0.26	511 ft		3.4 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4411 c.f.	4784 c.f.	5980 c.f.	7548 c.f.
YV34	115198 s.f.	2.64 Ac.	38564 s.f.	76634 s.f.	0.00	0.30	275 ft		1.8 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6508 c.f.	7057 c.f.	8822 c.f.	11135 c.f.
YV35	21876 s.f.	0.50 Ac.	11649 s.f.	10227 s.f.	0.00	0.48	513 ft		3.4 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1966 c.f.	2132 c.f.	2665 c.f.	3364 c.f.
YV36	52606 s.f.	1.21 Ac.	17303 s.f.	35303 s.f.	0.00	0.30	600 ft		4.0 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2920 c.f.	3166 c.f.	3958 c.f.	4996 c.f.
YV37	141531 s.f.	3.25 Ac.	46479 s.f.	95052 s.f.	0.00	0.30	822 ft		5.5 min	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	7843 c.f.	8506 c.f.	10632 c.f.	13421 c.f.
		38.98 Ac.			0.00	0.28		1373 ft	9.2 min	3.7 in/hr	6.1 in/hr	40 cfs	66 cfs	88651 c.f.	96137 c.f.	120172 c.f.	151692 c.f.

Table 2 - Existing Hydrology - Calculations based on Downtown San Luis Storm Drain System Design

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr

Table 2 - Existing Hydrology - Calculations based on Downtown San Luis Storm Drain System Design (Cont.)

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots (Ex)	C_Ex	Drainage Length	Comb. Length	Travel Time	I-10	I-100	Q-10	Q-100	V100Yr/1Hr	V100Yr/2Hr	V100Yr/6Hr	V100Yr/24Hr
Area Draining to D Street and 1st Avenue																	
YV38	37188 s.f.	0.85 Ac.	37188 s.f.	0 s.f.	0.00	0.90	931 ft	931 ft	6.2 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.	6805 c.f.	8507 c.f.	10738 c.f.
YV39	40789 s.f.	0.94 Ac.	40789 s.f.	0 s.f.	0.00	0.90	627 ft	627 ft	4.2 min	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.	7464 c.f.	9330 c.f.	11778 c.f.
YV40	87648 s.f.	2.01 Ac.	23424 s.f.	64224 s.f.	0.00	0.24	537 ft		3.6 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3953 c.f.	4287 c.f.	5358 c.f.	6764 c.f.
YV41	30793 s.f.	0.71 Ac.	30793 s.f.	0 s.f.	0.00	0.90	584 ft		3.9 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.	5635 c.f.	7044 c.f.	8891 c.f.
YV42	66986 s.f.	1.54 Ac.	29457 s.f.	37529 s.f.	0.00	0.40	240 ft		1.6 min	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	4971 c.f.	5391 c.f.	6738 c.f.	8506 c.f.
YV43	22674 s.f.	0.52 Ac.	9481 s.f.	13193 s.f.	0.00	0.38	178 ft		1.2 min	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1600 c.f.	1735 c.f.	2169 c.f.	2738 c.f.
YV44	72026 s.f.	1.65 Ac.	25134 s.f.	46892 s.f.	0.00	0.31	655 ft		4.4 min	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4241 c.f.	4600 c.f.	5749 c.f.	7257 c.f.
YV45	38785 s.f.	0.89 Ac.	17221 s.f.	21564 s.f.	0.00	0.40	78 ft		0.5 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2906 c.f.	3151 c.f.	3939 c.f.	4973 c.f.
YV46	41047 s.f.	0.94 Ac.	12977 s.f.	28070 s.f.	0.00	0.28	360 ft		2.4 min	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2190 c.f.	2375 c.f.	2968 c.f.	3747 c.f.
		10.05 Ac.			0.00	0.47		1558 ft	10.4 min	3.7 in/hr	6.1 in/hr	17 cfs	29 cfs	38216 c.f.	41443 c.f.	51804 c.f.	65392 c.f.
Totals for CStreet/2nd Avenue and D Street/1st Avenue Areas						0.32						57 cfs	95 cfs	126867 c.f.	137580 c.f.	171975 c.f.	217084 c.f.
Totals for Downtown San Luis Storm Drain System																	
		74.73 Ac.			0.02	0.32						82 cfs	136 cfs	192577 c.f.	208839 c.f.	261049 c.f.	329520 c.f.

4.0 Analysis of the Existing Storm Drainage Systems

Each major drainage area of Downtown San Luis is discussed in the following sections with regards to the effectiveness of their existing storm drainage systems and potential stormwater problems.

4.1 Areas Draining to Yuma Valley Retention Basin

The area that drains to the Yuma Valley Retention Basin is the largest drainage area in the downtown San Luis area, draining 73.6 of the 119 total acres. It is also the area with the most significant drainage system, the Downtown San Luis Storm Drainage System.

The sizes and design capacities of the Downtown San Luis Storm Drainage System are shown in Figure 8. The storm drain does effectively provide a means of disposal of stormwater runoff to most all of the downtown San Luis area, in particular to areas where localized ponding of stormwater had previously occurred.

The hydraulic design of the storm drain is documented in Core Engineering's Final Drainage Report – International Border to Juan Sanchez Blvd. The appendices of the report include the hydraulic calculations and the hydraulic profiles of the storm Drain. These calculations were reviewed, both by spot checking and by setting up storm using the AutoCAD Storm and Sanitary Analysis module. No significant issues in the storm drain design were found per the review (there does seem to be an issue in time of concentration calculations used for flows for catch basin sizing – some were calculated for a 10-year storm and others for a 100-year storm, but as the main pipe sizes were already set by this phase one of the storm drain project, the overall system capacities do not appear affected.)

The design frequency of the Downtown San Luis Storm Drain is stated in the Final Drainage Report to be for a 10-year frequency storm event. This is different than the San Luis Area Drainage Study where 100-year design criteria was used. The storm drain, as previously discussed, also was designed to primarily collect runoff only from street right-of-way areas, neglecting the on-lot contributions to stormwater runoff.

Below are tabulated the capacity of the Downtown San Luis Storm Drain vs. calculated runoff evens.

Storm Drain Capacity (per Report)	Flows Calculated Based on ROW only (Table 2)		Flows Calculated - Full Drainage Area (Table 1)	
	10-Year	100-Year	10-Year	100-Year
79 c.f.s.	82 c.f.s.	134 c.f.s.	153 c.f.s.	252 cfs

As seen in the table, the Downtown San Luis Storm Drain does approximately meet the 10-year design criteria as laid out in the Final Drainage Report – i.e., a design based on only calculating a drainage area based on street right-of-way. This, however, does not appear to be a physical reality at the current time as numerous residential and commercial lots do contribute runoff to the storm drain. The calculated full 10-year runoff of 153 c.f.s. is almost double the storm drain capacity of 79 c.f.s.

Downtown San Luis Master Drainage Plan
- Downtown San Luis Storm Drain System Design Flows -

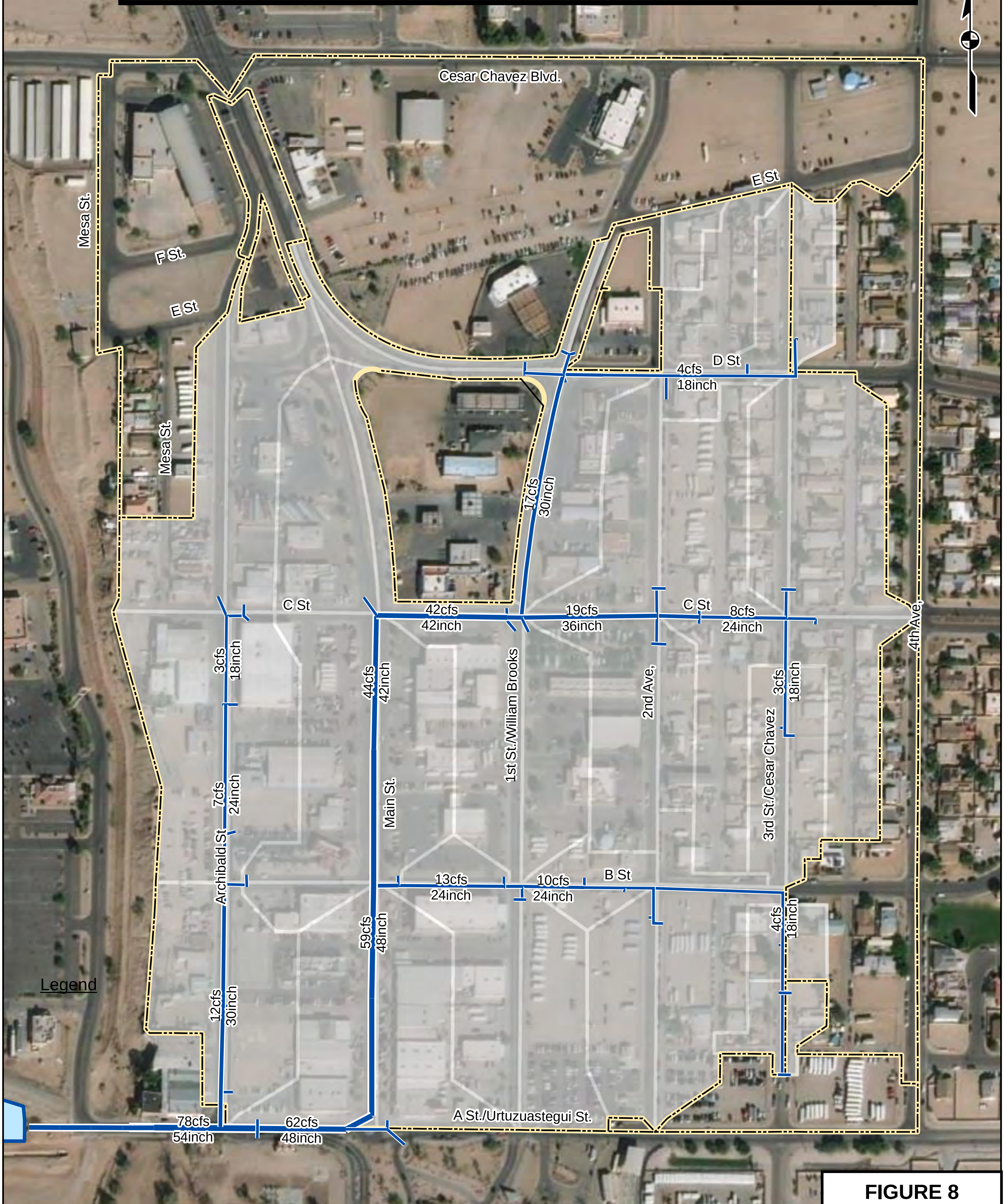


FIGURE 8

The capacity of the Downtown San Luis Storm Drain is limited by those areas at which the hydraulic grade line for flows in the storm drain are closest to the ground elevation. These are the points at which flows would surcharge if capacities were exceeded. Review of the storm drain's hydraulic grade line shows there are two critical areas where the storm drain could surcharge. One of these is at C Street and Cesar Chavez Street (3rd Avenue) where the hydraulic grade line is closest to the surface at catch basins north of the intersection (about 1.5 feet below grade.) The second area is at D Street and 1st Avenue, where the hydraulic grade line is about 2 feet from the surface. These locations are also the two local depression areas noted above in Section 3.3 and shown as points of concentrated flows in Figure 6.

The significance of the local depressions at C Street and D Street is that with the storm drain system having a capacity less than the full 10-year flows and 100-year flows, if these larger runoff events occur then local ponding and possible flooding of properties can occur. While a 10-year frequency storm is considered per Yuma County Standards to be a standard design event for roadway drainage, a 100-year frequency storm is the typical standard to prevent flooding and property damage. Alternatives should be evaluated to achieve this additional level of protection. Below are the storm drain design flows and calculated runoff for the C Street and D Street collection points.

	Storm Drain Capacity (per Report)	Flows Calculated Based on ROW only (Table 2)		Flows Calculated - Full Drainage Area (Table 1)	
		10-Year	100-Year	10-Year	100-Year
D Street and 1st Avenue	17 c.f.s.	16 c.f.s.	27 c.f.s.	22 c.f.s.	36 c.f.s.
C Street and 2nd/3rd Ave	25 c.f.s.	40 c.f.s.	66 c.f.s.	81 c.f.s.	133 c.f.s.
Combined	42 c.f.s.	56 c.f.s.	93 c.f.s.	103 c.f.s.	169 c.f.s.

The Archibald Street portion of the storm drain was also evaluated for capacity. This is an older storm drain that was modified with the recent street improvements project. Its capacity from the Final Drainage Report is given as 12.80 c.f.s. The flows from Archibald Street, however, are shown to enter the main storm drain pipe on Urtuzuastegui at above the top of the downstream pipe. Therefore, it not affected by backwater from the main storm drain line, and as the main storm drain line at that point is beginning its cascade down the slope of Urtuzuastegui Street (i.e., running at critical depth), it has little upstream impact on the main storm drain line in Urtuzuastegui. The Archibald Street storm drain section was therefore re-evaluated to determine its full flow capacity, with flows increased until the hydraulic grade line in the storm drain came within 1-foot of the adjacent street grades – see Table 3 below. Table 3 shows that there is capacity in the Archibald Street storm drain for perhaps 32 c.f.s. total, a substantial potential increase. Additional catch basins would need to be added to the storm drain to capture these additional flows.

Table 3. Archibald Street Storm Drain Capacity Calculations

Cross Street	Catch Basin Flows	Total Flow	Upstream Street Grade	Upstream Water Surface Elev.	Upstream Sta.	Pipe Diameter	Manning N	Hydraulic Gradient	Downstream Sta.	Downstream Water Surface Elev.
C Street	5.0 cfs	5.0 cfs	132.0	132.1	22+58	15 inch	0.013	0.0060 ft/ft	20+30	130.8
B-3/4 St	8.0 cfs	13.0 cfs	131.0	130.8	20+30	24 inch	0.013	0.0033 ft/ft	17+15	129.7
B Street	19.0 cfs	32.0 cfs	129.6	129.7	17+15	30 inch	0.013	0.0061 ft/ft	10+00	125.4
U Street										

(1) - Downstream Water Surface set a top of pipe. Actual flow is at critical depth.

4.2 Areas Draining to the Urtuzuastegui Retention Basins

The Urtuzuastegui Retention Basins are the two small retention basins located on the south side of Urtuzuastegui Street between 2nd Avenue and 4th Avenue. These retention basins collect runoff from the Urtuzuastegui Street right-of-way both across from and east of the retention basins, from Cesar Chavez Street to the south in the San Luis Industrial Park, and from portions of the lots north of the retention basins. Several catch basins in Urtuzuastegui drain to the retention basins. The retention basins drain by percolation.

The retention basins were surveyed to determine their capacity. The east retention basin was found to have a capacity of about 16,500 cubic feet and the west retention basin has a capacity of about 20,250 cubic feet, for a total capacity of 36,750 cubic feet or 0.84 acre-feet.

Drainage subbasins identified as U01, U02 and U03 drain to the basins. These are the southern lots and the street right-of-way of blocks 8 and 9 of the San Luis Townsite Addition. They have a combined area of 2.29 acres and the lots areas are currently used for parking lots and have fairly high rates of runoff with C values of 0.70 used for the lots. Total flows from the subbasins are calculated as Q10 = 6 c.f.s. and Q100 = 11 c.f.s., with runoff volumes of from 8929 cubic feet (100-year – 1 hour) to 15279 cubic feet (100-year – 24 hour.)

The runoff volumes from U01, U02 and U03 to the retention basins represent from about one-quarter to one half of the retention basin volume. The harder flows to quantify are those from Urtuzuastegui to the east and from Cesar Chavez Street in the San Luis Industrial Park to the south. Both the easterly Urtuzuastegui and the south Cesar Chavez Street flows were intended to be retained on adjacent lots (reference City of San Luis Industrial Park subdivision plat) but this on lot retention requirement has not been enforced and so flows from these areas do contribute to the basins.

4.3 Areas Draining to the Bienestar Estates Retention Basins.

The four drainage subbasins along 4th Avenue, BE01, BE02, BE03 and BE04, flow across 4th Avenue and contribute to the retention basins of Bienestar Estates and of La Frontera Estates subdivisions. Cross gutters have been constructed across 4th Avenue to facilitate the drainage flows. Total combined flows from 7.6 combined acres of the four subbasins are a Q-10 of 15 c.f.s. and a Q-100 of 25 c.f.s. and combined volumes of from about 34,000 to about 58,000 cubic feet (0.78 to 1.34 acre-feet) for the 100-year 1-hour to 24-hour runoff volumes.

The Bienestar Estates and La Frontera retention basins were surveyed and found to have the following storage volumes:

Bienestar Estates, Tract A -	260,900 cubic feet (5.99 acre-feet)
Bienestar Estates, Tract D -	141,600 cubic feet (3.25 acre-feet)
La Frontera Estates, Tract A -	87,619 cubic feet (2.01 acre-feet)

From reviewing the Bienestar Estates subdivision plat and calculations in the San Luis Area Drainage Study, a rough design volume for the Bienestar Tract A basin is 6.6 acre feet (75 acres, 2.44 inches of rainfall – the 100-year, 2-hour design standard for subdivisions, and a C value of 0.43) – this is less than the current capacity by about 0.6 acre-feet. For the Tract D basin, the design volume is estimated at 2.18 acre-feet (25 acres, 2.44 inches of rainfall and C of 0.43.) This is less than the current capacity by 1.07 acre-feet. And for La Frontera Tract A basin, design volume is estimated at 1.50 acre-feet (17.17 acres, 2.44 inches of rainfall, C of 0.43.) This basin has about an additional 0.51 acre-feet of capacity.

The San Luis Area Drainage Study includes the following discussion of development at the time of the report preparation –

"A retention basin has been constructed at the corner of 4th Avenue and B Street to provide on-site retention for the development. The streets in the vicinity of the retention basin have been graded and valley gutters installed such that B Street between Cesar Chavez and 4th Avenue will flow into the basin. All runoff from 4th Avenue will flow into the new retention basin or be diverted to existing Basin 6 [the Tract D retention basin.]

This text indicates that some planning went into draining the areas along the east side of the downtown San Luis area (BE01 through BE04) to the retention basins. Overall, flows and retention basin capacities are summarized as follows:

	Bienestar Tract A Basin	Bienestar Tract D Basin	La Frontera Tract A Basin
Surveyed Capacity	5.99 AF	3.25 AF	2.01 AF
Estimated Design Req'm't	6.60 AF	2.18 AF	1.50 AF
Offsite Flows (100yr-2hr)	0.25 AFT (BE04)	0.22 AF (BE02, BE03)	0.38 AF (BE01)
Balance	(-0.86 AF)	+0.85 AF	+0.13 AF

In summary, it appears that the Bienestar Estates Tract A retention basin is lacking about 0.86 acre-feet of capacity while the Tract D basin has about an additional 0.85 acre-feet of capacity and the La Frontera Basin has about 0.13 acre-feet of additional capacity.

4.4 Areas Draining to the Highway 95 Retention Basin

The two minor areas that drain to the Highway 95 retention basin that are within the master planning area, H01 and H02, both consist entirely of road right-of-way. Peak flows from these areas combined are 3 c.f.s. for the 10-year frequency runoff and 5 c.f.s. for the 100-year runoff.

The Highway 95 storm drain system was designed to handle the 10-year flow. This capacity includes both the storm drain piping design and the retention basin sizing. The retention basin has no room for expansion and therefore no additional flows can be added to it without it overflowing to either the Main Drain or adjacent properties.

With the Highway 95 storm drain being designed for the 10-year frequency runoff, flows in excess of the 10-year flows from H01 and H02 will overflow to the west (OS03) and to the east ((OS13) along Cesar Chavez Blvd.

4.4 Areas Requiring Onsite Retention of Stormwater

Much of the northern portion of the downtown San Luis area is either developed with onsite retention of stormwater or is planned to develop as such. The area was broken into subbasin OS01 through OS13 based on existing developments and on street drainage patterns. A major feature of this area is the corridor defined by E Street, F Street and the USBR powerline right-of-way between them that runs from east to west across the downtown area.

West of Main Street/Highway 95 there are five subbasins identified, OS01 through OS05. Subbasins OS04 and OS05 are commercial developments with existing onsite retention that is expected to remain. Subbasins OS02 and OS03 consist of City street right-of-way. Flows from OS02 (the west half of Mesa Street) will need to be retained, likely in the now vacant powerline right-of-way. Subbasin OS03 includes portions of the Cesar Chavez Blvd, Mesa Street and F Street right-of-ways. The Cesar Chavez right-of-way is planned to be developed as a wider roadway with a retention basin planned near the Main Drain to retain its flows. The F Street right-of-way should drain to subbasin OS04 (the Post Office property) but currently needs maintenance of a scupper to be able to do so. The remaining portion of Mesa Street will need to be retained.

Subbasin OS01 consists of a part of the Mesa Street alley with adjacent residential and commercial properties, and also the adjacent E Street and powerline right-of-way. Street improvement to the Mesa Street alley may end up directing flows to the powerline right-of-way where they will be retained, or it is possible that a storm drain extension may be constructed to serve this area.

Between Main Street and 1st Avenue and south of D Street are several larger properties that either already have onsite retention (OS06 and OS08) or will have it when developed (OS07). Similarly, north of D Street between Main Street and 1st Avenue subbasins OS09, OS10, OS11, OS12, OS14 and OS15 already have or will have onsite retention when developed. This area also includes subbasin OS13 which is the E Street, F Street, powerline and Cesar Chavez right-of-ways along with BLM lots along a once planned relocation of Highway 95. Cesar Chavez Blvd is being planned for improvement with retention basins provided. E Street, F Street, the powerline right-of-way and the BLM lots are currently planned for park and parking lot improvements and will have onsite retention.

Subbasin OS18, OS19, and OS20 are located along E Street, F Street and the powerline right-of-way and will be developed with onsite retention. OS18 includes one commercial zoned property which will also have retention when developed.

5.0 Alternatives for Storm Drainage Improvements

Based on the above discussion of the existing hydrology and the existing stormwater drainage for the downtown San Luis area, alternatives for stormwater drainage were developed to

1. Improve the storm drainage system to provide protection for land in downtown San Luis as it is currently developed, and
2. Improve the storm drainage system to allow for more intensive urban development of downtown San Luis.

In development of these alternatives, the storm drain design criteria used were those adopted by the City of San Luis which are based on the Public Works Standards for City of San Luis, Volumes III – Standards for Storm Drainage Facilities. These Standards include design criteria for retention basins, storm drains, and for roadways used for the conveyance of storm drainage.

5.1 Alternatives for the Area Draining to the Yuma Valley Retention Basin

The area draining to the Yuma Valley Retention Basin, as discussed previously, includes the majority of the area of downtown San Luis and has the most significant stormwater infrastructure, the Downtown San Luis Storm Drain system. It can be addressed as two subareas – Archibald Street and its storm drain, and the areas draining to C Street and 2nd Avenue and to D Street and 1st Avenue.

5.1.1 Archibald Street Drainage

The existing 10-year and 100-year peak discharges from Archibald Street are 50 c.f.s. and 83 c.f.s., respectively, while the current storm drain capacity in Archibald Street is about 12.8 c.f.s. Street capacity was also calculated, using average street width of 36 feet and slope for the section from B Street to Urtuzuastegui Street, as about 24 c.f.s, which combined with the storm drain capacity gives a total drainage capacity of about 37 c.f.s. This 37 c.f.s. is about 13 c.f.s. less than the 10-year peak runoff and 46 c.f.s. less than the 100-year peak runoff. As such, under existing conditions the Archibald Street runoff exceeds storm drain capacity and either peak discharges need to be reduced or additional infrastructure added.

Future peak discharges from Archibald Street could (1) be managed to be reduced over time and thus eventually approach the storm drain capacity, or (2) discharges managed to remain approximately as they are now and additional storm drain capacity added to be able to handle the existing flows, or (3) if development were to become more intensive and flows increased from what they are now, then even more additional storm drain capacity would be needed. Table 4 shows the Q-10 and Q-100 runoff from the Archibald Street Drainage areas for the existing drainage conditions and for possible reductions in stormwater retention that would be associated with more intensive development.

Based on these options for managing stormwater flows, three alternatives were developed for the drainage of the Archibald Street drainage area. These are:

1. Maintain the current requirement for onsite retention of stormwater for all new development. This alternative will result in gradual reduction of stormwater flows, though current flows will be in excess of storm drain and street capacities for the 100-year frequency runoff event. The current average C-value for the Archibald drainage area is about 0.52 (ref: Table 1), meaning that about 48% of runoff is retained onsite and 52% runs off. As this is onsite runoff is reduced through redevelopment and providing onsite retention, eventually total flows will be reduced to the existing drainage capacities.

   There is no public cost for this alternative, though there is a cost to property owners in that a portion of their land will be required to be used for retention areas. This option has an uncertain timeline as to when sufficient flow reduction will take place reduce flows to the storm drainage capacity (and if little redevelopment takes place, this could be many years, if at all.) Until such time as flows are sufficiently reduced there could be potential for flooding low lying business in large storm events, especially in the portions of the drainage area closer to Urtuzuastegui Street, and as such this alternative is not generally recommended.

2. Alternative 2 would be to grandfather in the existing average compliance rate of onsite stormwater retention. As currently about 48% of stormwater is retained by properties along Archibald Street, and rounding this to 50%, then future development would also be required to retain this same amount of stormwater (i.e., 50% of the current standard of 2.25" of retention, or retaining 1.13 inches of runoff.) This should allow runoff rates to remain more or less as they are now, though with peak flows still in excess of the storm drain and street capacities.

   To mitigate the excess flows, capacity of the existing storm drain in Archibald will need to be increased. Proposed improvements are to add additional catch basins to the Archibald Street storm drain in order to maximize the storm drain capacity. Per Table 3 in Section 4.1 above, the full capacity of the Archibald Street Storm Drain is calculated as 32.0 c.f.s., vs. its existing configuration where the lack of catch basins constrains its capacity to 12.8 c.f.s.

   The resulting storm drain and street flows for Alternative 2 are tabulated in Table 5 and are shown in Figure 9. For an average C-value of 0.5, Table 5 shows that with the full 100-year runoff that the storm drain with additional catch basins combined with street flow capacities could handle all but 6 c.f.s. of runoff.

   Construction costs for the additional catch basins would include catch basins, storm drain manholes, connector pipes and pavement removal and replacement. Table 6 shows the details of the construction cost estimate, which is estimated at $116,000.

3. Alternative 3 is to provide a stormwater drainage system to handle full 100-year flow with more intensive urban development. This more intensive development would be development without significant onsite stormwater retention, i.e., with stormwater retention with an onsite C-value of 0.90 or greater. As the downtown area is already densely developed with little onsite retention and with relatively small lots, providing onsite retention is problematic for many properties. Elimination of most or all onsite stormwater retention requirements would greatly simplify redevelopment of properties.

With elimination of most onsite retention requirements, Archibald Street flows would increase to where the Q-100 flows would exceed capacity of the existing storm drain, even with additional catch basins, by about 32 c.f.s. (last column, Table 5.) Therefore, a C Street Storm Drain is proposed. The concept of a C Street Storm Drain is based on providing additional catch basins at or near the Archibald Street and C Street intersection to collect excess storm drainage flows and conveying that flow to the Yuma Valley Retention Basin. One alternative for the conveyance of flows is to work with the Yuma County Water Users' Association for use of their abandoned East Main Canal pipeline, a 48-inch reinforced concrete pipe along San Luis Plaza Drive. The Archibald Street Flows with the C Street Storm Drain are shown in Figure 10.

Construction costs for the C Street Storm Drain would include catch basins, storm drain manholes, and connector pipes pipe and mainline pipe to the East Main Canal (30" to 36" diameter.)

An option for the C Street Storm Drain, if constructed, would be to extend the storm drain north to E Street along the Mesa Street Alley alignment. This option would provide drainage for that part of Mesa Street that now drains to the north and allow for more intensive development of the lots along Mesa Street. Table 7 shows the details of the construction cost estimate for the C Street Storm Drain without the Mesa Street Extension, which is estimated at $216,000 and Table 8 shows the costs for the C Street Storm Drain with the Mesa Street Extension, estimated at $368,000. Note that both options also require the $116,000 cost of additional catch basins per Alternative 2.

Table 4 - Hydrology for Archibald Street Storm Drain

Drainage Subbasin	Area (SF)	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100
Existing Condtions - Average Rational Method Coefficient for Lot Areas = 0.49 (=~0.50)										
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.55	0.62	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.35	0.47	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.45	0.62	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.45	0.54	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.50	0.59	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.45	0.60	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.45	0.61	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.60	0.72	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs
Totals		20.49 Ac.			0.49	0.61	3.1 in/hr	5.1 in/hr	39 cfs	64 cfs
Average Rational Method Coefficient for Lot Areas = 0.60 (40% Stormwater Retention)										
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.60	0.66	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.60	0.67	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.60	0.71	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.60	0.66	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.60	0.67	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	9 cfs	14 cfs
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.60	0.71	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.60	0.72	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs
Totals		20.49 Ac.			0.60	0.69	3.1 in/hr	5.1 in/hr	44 cfs	72 cfs
Average Rational Method Coefficient for Lot Areas = 0.70 (30% Stormwater Retention)										
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.70	0.74	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.70	0.74	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.70	0.78	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.70	0.74	3.7 in/hr	6.1 in/hr	9 cfs	14 cfs
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	9 cfs	15 cfs
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.70	0.78	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs
Totals		20.49 Ac.			0.70	0.76	3.1 in/hr	5.1 in/hr	48 cfs	79 cfs
Average Rational Method Coefficient for Lot Areas = 0.80 (20% Stormwater Retention)										
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	10 cfs	16 cfs
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	10 cfs	17 cfs
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	9 cfs	14 cfs
Totals		20.49 Ac.			0.80	0.83	3.1 in/hr	5.1 in/hr	53 cfs	87 cfs
Average Rational Method Coefficient for Lot Areas = 0.90 (0% to 10% Stormwater Retention)										
YV01	79004 s.f.	1.81 Ac.	16192 s.f.	62812 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs
YV02	80642 s.f.	1.85 Ac.	17501 s.f.	63141 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs
YV05	24455 s.f.	0.56 Ac.	9341 s.f.	15114 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs
YV06	136724 s.f.	3.14 Ac.	27610 s.f.	109114 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	10 cfs	17 cfs
YV07	97604 s.f.	2.24 Ac.	22013 s.f.	75591 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs
YV08	143358 s.f.	3.29 Ac.	47276 s.f.	96082 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	11 cfs	18 cfs
YV09	96469 s.f.	2.21 Ac.	35081 s.f.	61388 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs
YV10	112451 s.f.	2.58 Ac.	46561 s.f.	65890 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	9 cfs	14 cfs
YV11	121793 s.f.	2.80 Ac.	40107 s.f.	81686 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	9 cfs	15 cfs
Totals		20.49 Ac.			0.90	0.90	3.1 in/hr	5.1 in/hr	57 cfs	94 cfs

Table 5 - Archibald Street Storm Drainage Requirements - for Various Development Conditions

Archibald Street Flows	Average Rational Method C Value				
	0.5 (Ex.)	0.60	0.70	0.80	0.90
Runoff at C Street	30 cfs	31 cfs	34 cfs	37 cfs	40 cfs
Potential Storm Drain Capacity	5 cfs	5 cfs	5 cfs	5 cfs	5 cfs
Street Flow Capacity	24 cfs	24 cfs	24 cfs	24 cfs	24 cfs
Additional Capacity Needed	-1 cfs	-2 cfs	-5 cfs	-8 cfs	-11 cfs
Runoff at B Street	62 cfs	69 cfs	76 cfs	83 cfs	90 cfs
Potential Storm Drain Capacity	32 cfs	32 cfs	32 cfs	32 cfs	32 cfs
Street Flow Capacity	24 cfs	24 cfs	24 cfs	24 cfs	24 cfs
Additional Capacity Needed	-6 cfs	-13 cfs	-20 cfs	-27 cfs	-34 cfs
Runoff at Urtuzuastegui Street	62 cfs	70 cfs	77 cfs	85 cfs	92 cfs
Potential Storm Drain Capacity	32 cfs	32 cfs	32 cfs	32 cfs	32 cfs
Street Flow Capacity	24 cfs	24 cfs	24 cfs	24 cfs	24 cfs
Additional Capacity Needed	-6 cfs	-14 cfs	-21 cfs	-29 cfs	-36 cfs

Downtown San Luis Master Drainage Plan
- Archibald Street/Existing Flow Conditions (C-avg = 0.49) -
Flow Analysis

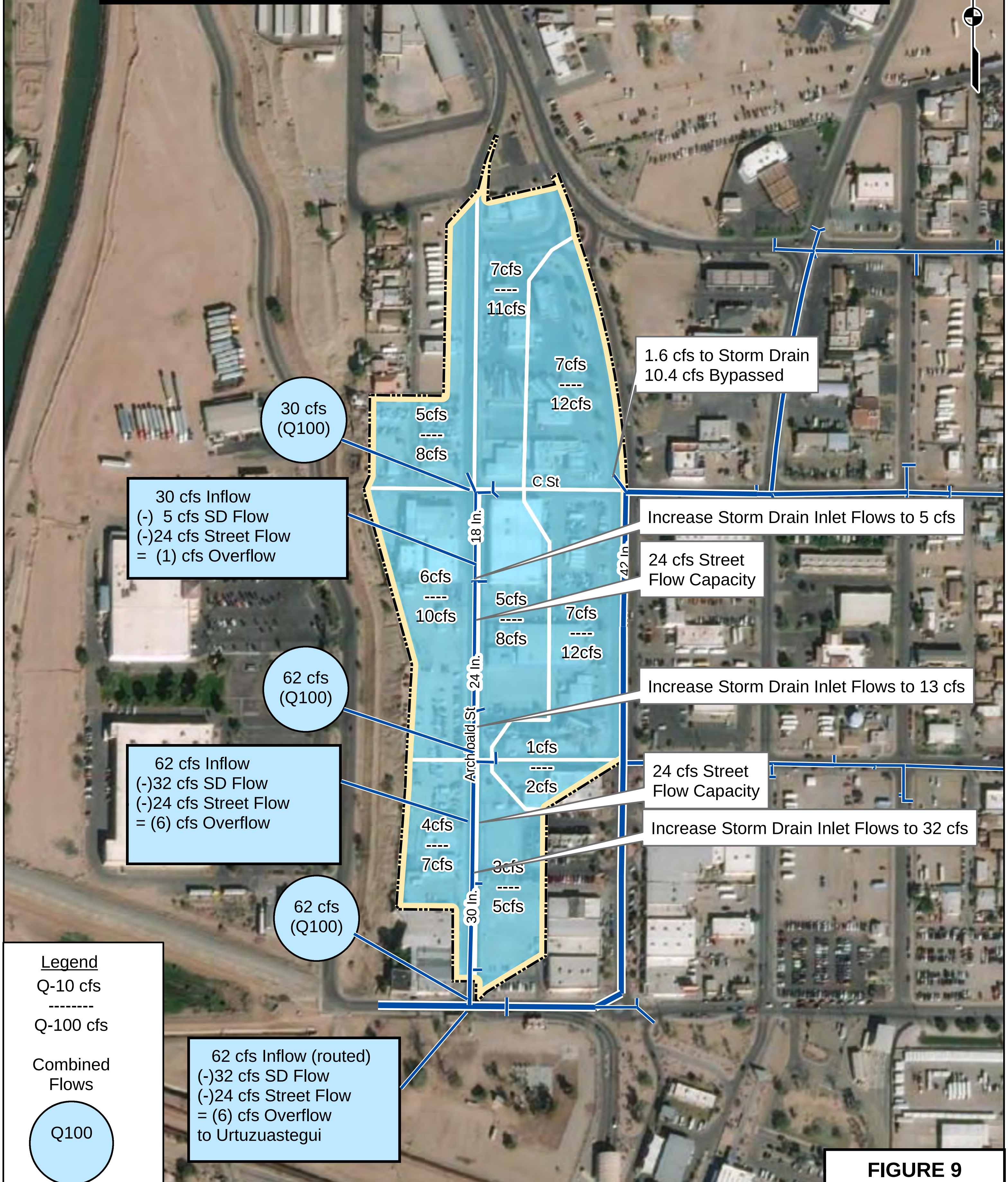


FIGURE 9

Table 6. Archibald Street - Catch Basin Additions
Construction Cost Estimate

Conceptual

Item	Description	Unit	Quantity	Unit Price	Cost
1	Removals and Relocations	LS	1	$7,500	$7,500
2	Asphalt Paving	SY	60	$50	$3,000
3	Vertical Curb and Gutter	LF	60	$15	$900
4	Concrete Sidewalk	SF	240	$8	$1,920
5	Construct Type D Catch Basin	EA	6	$5,000	$30,000
6	5' Dia. Storm Drain Manhole	EA	3	$5,000	$15,000
7	18" Dia. Class III, D1350 RGRCP	LF	40	$125	$5,000
8	24" Dia. Class III, D1350 RGRCP	LF	80	$160	$12,800
				Subtotal	$76,120
				Contingency @ 25%	$19,000
				Construction Costs	$95,120
				Engineering @ 8%	$8,000
				Construction Administation @8%	$8,000
				General Administration @ 5%	$5,000
				TOTAL ESTIMATED COST	$116,000

Downtown San Luis Master Drainage Plan - Archibald Street/Future Conditions - C-Avg = 0.90 - Flow Analysis and Storm Drainage Improvements

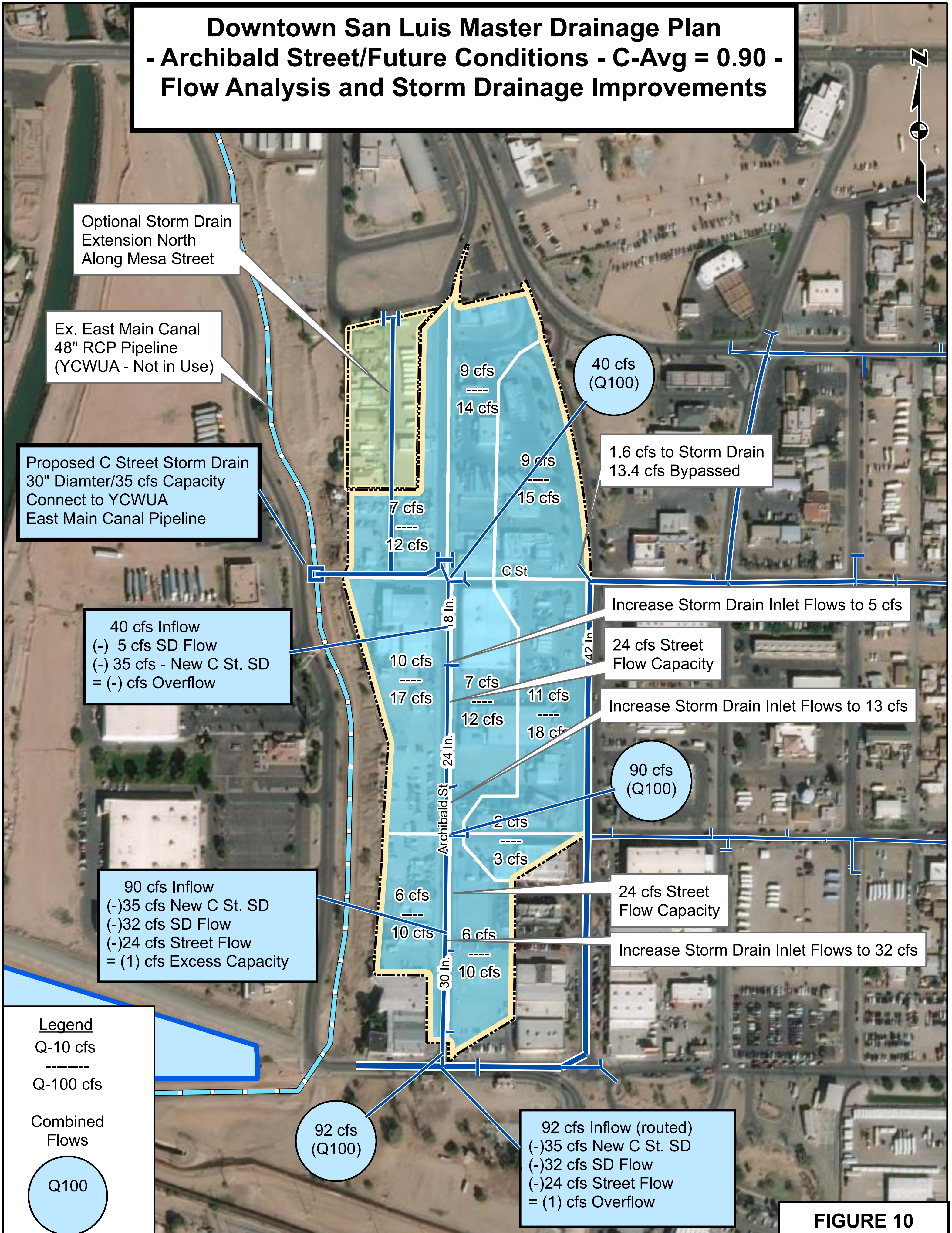


FIGURE 10

Downtown San Luis Master Drainage Plan
- Archibald Street - Summary of Drainage Alternatives -

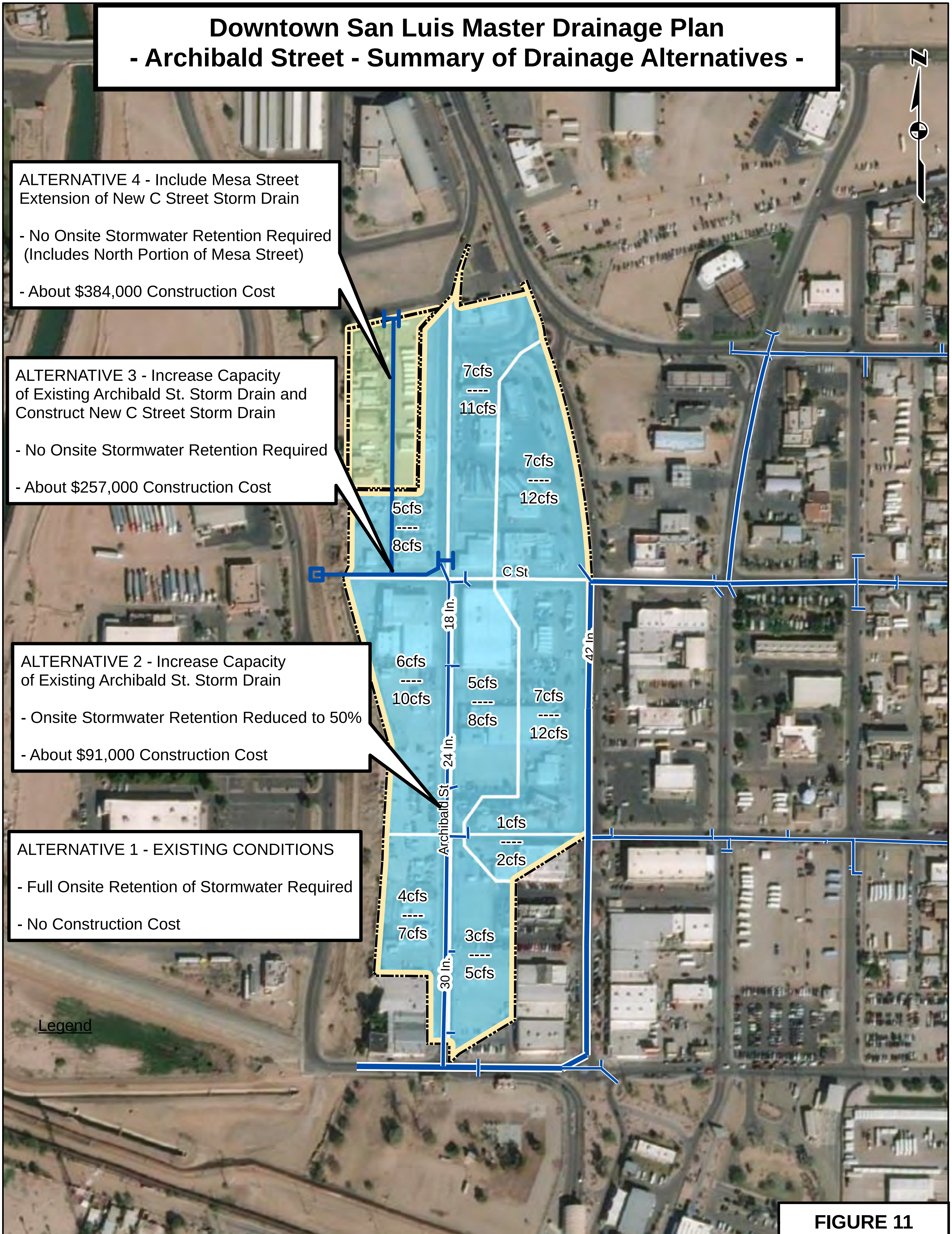


FIGURE 11

Table 7. C Street and Archibald Storm Drain
Construction Cost Estimate (without Mesa Street Extension)

Conceptual

Item	Description	Unit	Quantity	Unit Price	Cost
1	Removals and Relocations	LS	1	$5,000	$5,000
2	Asphalt Paving	SY	1000	$40	$40,000
3	Vertical Curb and Gutter	LF	60	$15	$900
4	Concrete Sidewalk	SF	240	$8	$1,920
5	Construct Type D Catch Basin	EA	4	$5,000	$20,000
6	5' Dia. Storm Drain Manhole	EA	3	$5,000	$15,000
7	30" Dia. Class III, D1350 RGRCP	LF	377	$160	$60,320
				Subtotal	$143,140
				Contingency @ 25%	$36,000
				Construction Costs	$179,140
				Engineering @ 8%	$14,000
				Construction Administation @8%	$14,000
				General Administration @ 5%	$9,000
				TOTAL ESTIMATED COST	$216,000

Table 8. C Street and Archibald Storm Drain
Construction Cost Estimate (with Mesa Street Extension)

Conceptual

Item	Description	Unit	Quantity	Unit Price	Cost
1	Removals and Relocations	LS	1	$10,000	$10,000
2	Asphalt Paving	SY	1000	$40	$40,000
3	Vertical Curb and Gutter	LF	60	$15	$900
4	Concrete Sidewalk	SF	240	$8	$1,920
5	Construct Type D Catch Basin	EA	8	$5,000	$40,000
6	5' Dia. Storm Drain Manhole	EA	5	$5,000	$25,000
7	24" Dia. Class III, D1350 RGRCP	LF	660	$100	$66,000
8	30" Dia. Class III, D1350 RGRCP	LF	377	$160	$60,320
				Subtotal	$244,140
				Contingency @ 25%	$61,000
				Construction Costs	$305,140
				Engineering @ 8%	$24,000
				Construction Administation @8%	$24,000
				General Administration @ 5%	$15,000
				TOTAL ESTIMATED COST	$368,000

5.1.2 Drainage of C Street/2nd Avenue and D Street/1st Avenue Local Depressions

The combined existing 10-year and 100-year peak discharges flowing to the C Street and 2nd Avenue intersection and the D Street and 1st Avenue intersection are calculated at 104 c.f.s. and 172 c.f.s., respectively. The total Downtown San Luis Storm Drain capacity at C Street and 2nd Avenue is 42 c.f.s. (or 59 c.f.s., considering flows from the B Street extension of the storm drain) , significantly less that both the combined 10-year and 100-year peak discharges. These flows are broken down into a Q-10 of 81 c.f.s. and a Q-100 of 133 c.f.s. at the C Street and 2nd Avenue Intersection vs. storm drain capacity of 25 c.f.s., and a Q-10 of 23 c.f.s. and a Q-100 of 38 c.f.s. at the D Street and 1st Avenue intersection, vs. a storm drain capacity of 17 c.f.s.

Flows in excess of the storm drain capacity at either intersection will result in ponding of storm water at the intersections and possible flooding of nearby residences and businesses. As such, under existing conditions, either peak discharges need to be reduced or additional storm drainage infrastructure added. Future peak discharges to the C Street and D Street intersections can be managed by (1) enforcing full onsite retention of stormwater for future developments and in turn peak discharges will be reduced over time and thus eventually approach the storm drain capacity, or (2) discharges can be managed to remain approximately as they are now and additional storm drainage capacity added to be able to handle the existing flows, or (3) if development were to become more intensive over time, flows will increase from what they are now, then even more additional storm drain capacity will be needed.

Table 9 shows the peak runoff (Q-10 and Q-100) and also the 100-year, 1-hour runoff volume to the C Street and D Street intersections for existing conditions, at the current average C-value of 0.37 (rounded to 0.40) for the lot areas and also for increased C-values, up to 0.90, which would be effectively requiring no onsite retention of stormwater.

Based on these options for managing stormwater flows, three alternatives were developed for the drainage of the C Street and D Street intersections. These are:

1. Maintain the current requirement for onsite retention of stormwater for all new development. This alternative will result in gradual reduction of stormwater flows, though current flows will be in excess of storm drain and street capacities for the 100-year frequency runoff event. The current average C-value for the C Street and D Street area is about 0.37 (see Table 1), meaning that about 63% of the runoff is now retained onsite and about 37% runs off. As this onsite runoff is reduced though redevelopment which will provide onsite retention, eventually flows will be reduced to existing storm drain capacities.

   There is no public cost for this alternative, though there is a cost to the property owners in that a portion of their land will be required to be used for retention areas. This option has an uncertain timeline as to when sufficient flow reduction will take place to reduce flows to the storm drainage capacity – this could take many years, if at all. Until such time flooding potential will persist. Therefore, this alternative is not recommended.

2. Grandfather in the existing average compliance rate of onsite stormwater retention. With current onsite retention at about 60%, future development would also have this same

requirement so as not to create worse conditions. But while conditions would not worsen, flooding potential adjacent to the depressed intersections will still remain and storm drainage improvements will be required.

The proposed improvements consist of a new stormwater detention basin and storm drain collection system. The detention basin would be designed to store the difference in peak flows between the storm drain capacity and the 100-year peak runoff, with flows being released to the storm drain as soon as the peak flow has passed. Figure 12 shows the sample stormwater hydrograph for such a detention basin.

The detention basin would ideally be located along 2nd Avenue between C Street and D Street to be able to easily drain both the C Street and 2nd Avenue and D Street and 1st Avenue intersections. Figure 13 shows potential locations for such a detention basin along with Q-100 flows that would need to either be routed through the detention basin or carried by the existing storm drains. Storm drain piping would need to be extended from the detention basin to C Street (about 36-inch diameter piping) and to D Street (about 24-inch diameter piping) and additional catch basins installed.

The construction costs for the 2nd Avenue detention basin and additional storm drain sized to handle the existing flows is estimated at $654,000, including costs for purchasing 2 typical lots for the detention basin. See Table 11.

3. Alternative 3 is to provide a stormwater drainage system to handle full 100-year flow with increased urbanization. Again, as for Archibald Street, this more intensive development would be developed without significant onsite stormwater retention, i.e., with stormwater retention with an onsite C-value of 0.90 or greater. As much of the downtown area is already densely developed with little onsite retention and with relatively small lots, providing onsite retention is problematic for many properties. Elimination of most or all onsite stormwater retention requirements would greatly simplify redevelopment of properties.

   This would result in total peak flows to the C Street and D Street intersections increasing to about 269 c.f.s. Table 10 shows the changes in flows and detention requirements as onsite retention requirements are reduced. At a C-value of 0.90, about 4 lots will need to be purchased for the detention basin and additional storm drain piping to the detention basin increased in size to 30” and 42”.

   Construction costs for this alternative for the 2nd Avenue detention basin and associated storm drain improvements are estimated at $943,000. Costs are shown in Table 2.

Figure 14 shows a summary of the alternatives for the C Street and D Street intersections.

Table 9 - Hydrology for C Street and 2nd Avenue/D Street and 1st Avenue
Varied by C Value for Flows from Lots

Drainage Subbasin	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100	V100Yr/1Hr
Existing Condtions - Average Rational Method Coefficient for Lot Areas = 0.37 (=~0.40)										
Area Draining to C Street and 2nd Avenue										
YV12	2.29 Ac.	26681 s.f.	73184 s.f.	0.50	0.61	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	11363 c.f.
YV13	2.16 Ac.	23870 s.f.	70301 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	13255 c.f.
YV14	1.93 Ac.	17860 s.f.	66346 s.f.	0.70	0.74	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	11722 c.f.
YV15	2.56 Ac.	38515 s.f.	73047 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	14717 c.f.
YV16	0.51 Ac.	10758 s.f.	11497 s.f.	0.30	0.59	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2462 c.f.
YV17	0.40 Ac.	5540 s.f.	11844 s.f.	0.30	0.49	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1601 c.f.
YV18	0.38 Ac.	6797 s.f.	9611 s.f.	0.30	0.55	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1688 c.f.
YV19	0.43 Ac.	5598 s.f.	13040 s.f.	0.30	0.48	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1678 c.f.
YV20	2.38 Ac.	32600 s.f.	70890 s.f.	0.30	0.49	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	9489 c.f.
YV21	0.45 Ac.	7560 s.f.	12012 s.f.	0.30	0.53	3.7 in/hr	6.1 in/hr	1 cfs	1 cfs	1951 c.f.
YV22	2.51 Ac.	28682 s.f.	80689 s.f.	0.40	0.53	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10892 c.f.
YV23	2.06 Ac.	18966 s.f.	70708 s.f.	0.40	0.51	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	8504 c.f.
YV24	0.43 Ac.	9060 s.f.	9822 s.f.	0.60	0.74	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.
YV25	0.55 Ac.	10557 s.f.	13316 s.f.	0.40	0.62	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2780 c.f.
YV26	2.41 Ac.	26098 s.f.	78894 s.f.	0.40	0.52	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10321 c.f.
YV27	0.49 Ac.	12473 s.f.	8984 s.f.	0.50	0.73	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2947 c.f.
YV28	0.91 Ac.	13743 s.f.	25911 s.f.	0.30	0.51	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3777 c.f.
YV29	2.26 Ac.	29715 s.f.	68524 s.f.	0.30	0.48	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	8869 c.f.
YV30	1.13 Ac.	16568 s.f.	32679 s.f.	0.30	0.50	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4634 c.f.
YV31	1.07 Ac.	16447 s.f.	30222 s.f.	0.30	0.51	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4475 c.f.
YV32	1.99 Ac.	27117 s.f.	59586 s.f.	0.30	0.49	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	7928 c.f.
YV33	2.07 Ac.	26140 s.f.	64098 s.f.	0.50	0.62	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10420 c.f.
YV34	2.64 Ac.	38564 s.f.	76634 s.f.	0.20	0.43	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	9381 c.f.
YV35	0.50 Ac.	11649 s.f.	10227 s.f.	0.40	0.67	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2733 c.f.
YV36	1.21 Ac.	17303 s.f.	35303 s.f.	0.30	0.50	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	4906 c.f.
YV37	3.25 Ac.	46479 s.f.	95052 s.f.	0.30	0.50	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	13190 c.f.
	38.98 Ac.			0.40	0.56	3.7 in/hr	6.1 in/hr	81 cfs	133 cfs	178317 c.f.
Area Draining to D Street and 1st Avenue										
YV38	0.85 Ac.	37188 s.f.	0 s.f.	0.00	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.
YV39	0.94 Ac.	40789 s.f.	0 s.f.	0.00	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.
YV40	2.01 Ac.	23424 s.f.	64224 s.f.	0.50	0.61	3.7 in/hr	6.1 in/hr	5 cfs	7 cfs	9974 c.f.
YV41	0.71 Ac.	30793 s.f.	0 s.f.	0.00	0.90	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.
YV42	1.54 Ac.	29457 s.f.	37529 s.f.	0.15	0.48	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6026 c.f.
YV43	0.52 Ac.	9481 s.f.	13193 s.f.	0.30	0.55	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2342 c.f.
YV44	1.65 Ac.	25134 s.f.	46892 s.f.	0.30	0.51	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6879 c.f.
YV45	0.89 Ac.	17221 s.f.	21564 s.f.	0.30	0.57	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	4119 c.f.
YV46	0.94 Ac.	12977 s.f.	28070 s.f.	0.30	0.49	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	3769 c.f.
	10.05 Ac.			0.24	0.63	3.7 in/hr	6.1 in/hr	23 cfs	38 cfs	51464 c.f.
Totals	49.03 Ac.			0.37	0.57			104 cfs	172 cfs	229781 c.f.

Table 9 - Hydrology for C Street and 2nd Avenue/D Street and 1st Avenue
Varied by C Value for Flows from Lots

Drainage Subbasin	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100	V100Yr/1Hr
Average Rational Method Coefficient for Lot Areas = 0.50										
Area Draining to C Street and 2nd Avenue										
YV12	2.29 Ac.	26681 s.f.	73184 s.f.	0.50	0.61	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	11363 c.f.
YV13	2.16 Ac.	23870 s.f.	70301 s.f.	0.50	0.60	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	13255 c.f.
YV14	1.93 Ac.	17860 s.f.	66346 s.f.	0.50	0.58	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	11722 c.f.
YV15	2.56 Ac.	38515 s.f.	73047 s.f.	0.50	0.64	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	14717 c.f.
YV16	0.51 Ac.	10758 s.f.	11497 s.f.	0.50	0.69	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2462 c.f.
YV17	0.40 Ac.	5540 s.f.	11844 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1601 c.f.
YV18	0.38 Ac.	6797 s.f.	9611 s.f.	0.50	0.67	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1688 c.f.
YV19	0.43 Ac.	5598 s.f.	13040 s.f.	0.50	0.62	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1678 c.f.
YV20	2.38 Ac.	32600 s.f.	70890 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs	9489 c.f.
YV21	0.45 Ac.	7560 s.f.	12012 s.f.	0.50	0.65	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1951 c.f.
YV22	2.51 Ac.	28682 s.f.	80689 s.f.	0.50	0.60	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs	10892 c.f.
YV23	2.06 Ac.	18966 s.f.	70708 s.f.	0.50	0.58	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	8504 c.f.
YV24	0.43 Ac.	9060 s.f.	9822 s.f.	0.50	0.69	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.
YV25	0.55 Ac.	10557 s.f.	13316 s.f.	0.50	0.68	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2780 c.f.
YV26	2.41 Ac.	26098 s.f.	78894 s.f.	0.50	0.60	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	10321 c.f.
YV27	0.49 Ac.	12473 s.f.	8984 s.f.	0.50	0.73	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2947 c.f.
YV28	0.91 Ac.	13743 s.f.	25911 s.f.	0.50	0.64	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	3777 c.f.
YV29	2.26 Ac.	29715 s.f.	68524 s.f.	0.50	0.62	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	8869 c.f.
YV30	1.13 Ac.	16568 s.f.	32679 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	4634 c.f.
YV31	1.07 Ac.	16447 s.f.	30222 s.f.	0.50	0.64	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	4475 c.f.
YV32	1.99 Ac.	27117 s.f.	59586 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	7928 c.f.
YV33	2.07 Ac.	26140 s.f.	64098 s.f.	0.50	0.62	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	10420 c.f.
YV34	2.64 Ac.	38564 s.f.	76634 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	9381 c.f.
YV35	0.50 Ac.	11649 s.f.	10227 s.f.	0.50	0.71	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2733 c.f.
YV36	1.21 Ac.	17303 s.f.	35303 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4906 c.f.
YV37	3.25 Ac.	46479 s.f.	95052 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	13190 c.f.
	38.98 Ac.			0.50	0.62	3.7 in/hr	6.1 in/hr	90 cfs	148 cfs	178317 c.f.
Area Draining to D Street and 1st Avenue										
YV38	0.85 Ac.	37188 s.f.	0 s.f.	0.50	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.
YV39	0.94 Ac.	40789 s.f.	0 s.f.	0.50	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.
YV40	2.01 Ac.	23424 s.f.	64224 s.f.	0.50	0.61	3.7 in/hr	6.1 in/hr	5 cfs	7 cfs	9974 c.f.
YV41	0.71 Ac.	30793 s.f.	0 s.f.	0.50	0.90	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.
YV42	1.54 Ac.	29457 s.f.	37529 s.f.	0.50	0.68	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	6026 c.f.
YV43	0.52 Ac.	9481 s.f.	13193 s.f.	0.50	0.67	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2342 c.f.
YV44	1.65 Ac.	25134 s.f.	46892 s.f.	0.50	0.64	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	6879 c.f.
YV45	0.89 Ac.	17221 s.f.	21564 s.f.	0.50	0.68	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	4119 c.f.
YV46	0.94 Ac.	12977 s.f.	28070 s.f.	0.50	0.63	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	3769 c.f.
	10.05 Ac.			0.50	0.71	3.7 in/hr	6.1 in/hr	26 cfs	43 cfs	51464 c.f.
Totals	49.03 Ac.			0.50	0.64			116 cfs	192 cfs	229781 c.f.

Table 9 - Hydrology for C Street and 2nd Avenue/D Street and 1st Avenue
Varied by C Value for Flows from Lots

Drainage Subbasin	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100	V100Yr/1Hr
Average Rational Method Coefficient for Lot Areas = 0.60										
Area Draining to C Street and 2nd Avenue										
YV12	2.29 Ac.	26681 s.f.	73184 s.f.	0.60	0.68	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	11363 c.f.
YV13	2.16 Ac.	23870 s.f.	70301 s.f.	0.60	0.68	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	13255 c.f.
YV14	1.93 Ac.	17860 s.f.	66346 s.f.	0.60	0.66	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	11722 c.f.
YV15	2.56 Ac.	38515 s.f.	73047 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	14717 c.f.
YV16	0.51 Ac.	10758 s.f.	11497 s.f.	0.60	0.75	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2462 c.f.
YV17	0.40 Ac.	5540 s.f.	11844 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1601 c.f.
YV18	0.38 Ac.	6797 s.f.	9611 s.f.	0.60	0.72	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1688 c.f.
YV19	0.43 Ac.	5598 s.f.	13040 s.f.	0.60	0.69	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1678 c.f.
YV20	2.38 Ac.	32600 s.f.	70890 s.f.	0.60	0.69	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	9489 c.f.
YV21	0.45 Ac.	7560 s.f.	12012 s.f.	0.60	0.72	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1951 c.f.
YV22	2.51 Ac.	28682 s.f.	80689 s.f.	0.60	0.68	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	10892 c.f.
YV23	2.06 Ac.	18966 s.f.	70708 s.f.	0.60	0.66	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	8504 c.f.
YV24	0.43 Ac.	9060 s.f.	9822 s.f.	0.60	0.74	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.
YV25	0.55 Ac.	10557 s.f.	13316 s.f.	0.60	0.73	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2780 c.f.
YV26	2.41 Ac.	26098 s.f.	78894 s.f.	0.60	0.67	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	10321 c.f.
YV27	0.49 Ac.	12473 s.f.	8984 s.f.	0.60	0.77	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2947 c.f.
YV28	0.91 Ac.	13743 s.f.	25911 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	3777 c.f.
YV29	2.26 Ac.	29715 s.f.	68524 s.f.	0.60	0.69	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	8869 c.f.
YV30	1.13 Ac.	16568 s.f.	32679 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4634 c.f.
YV31	1.07 Ac.	16447 s.f.	30222 s.f.	0.60	0.71	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4475 c.f.
YV32	1.99 Ac.	27117 s.f.	59586 s.f.	0.60	0.69	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	7928 c.f.
YV33	2.07 Ac.	26140 s.f.	64098 s.f.	0.60	0.69	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	10420 c.f.
YV34	2.64 Ac.	38564 s.f.	76634 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	9381 c.f.
YV35	0.50 Ac.	11649 s.f.	10227 s.f.	0.60	0.76	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2733 c.f.
YV36	1.21 Ac.	17303 s.f.	35303 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4906 c.f.
YV37	3.25 Ac.	46479 s.f.	95052 s.f.	<u>0.60</u>	<u>0.70</u>	3.7 in/hr	6.1 in/hr	<u>8 cfs</u>	<u>14 cfs</u>	<u>13190 c.f.</u>
	38.98 Ac.			0.60	0.69	3.7 in/hr	6.1 in/hr	100 cfs	165 cfs	178317 c.f.
Area Draining to D Street and 1st Avenue										
YV38	0.85 Ac.	37188 s.f.	0 s.f.	0.60	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.
YV39	0.94 Ac.	40789 s.f.	0 s.f.	0.60	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.
YV40	2.01 Ac.	23424 s.f.	64224 s.f.	0.60	0.68	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	9974 c.f.
YV41	0.71 Ac.	30793 s.f.	0 s.f.	0.60	0.90	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.
YV42	1.54 Ac.	29457 s.f.	37529 s.f.	0.60	0.73	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	6026 c.f.
YV43	0.52 Ac.	9481 s.f.	13193 s.f.	0.60	0.73	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2342 c.f.
YV44	1.65 Ac.	25134 s.f.	46892 s.f.	0.60	0.70	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	6879 c.f.
YV45	0.89 Ac.	17221 s.f.	21564 s.f.	0.60	0.73	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	4119 c.f.
YV46	<u>0.94 Ac.</u>	12977 s.f.	28070 s.f.	<u>0.60</u>	<u>0.69</u>	3.7 in/hr	6.1 in/hr	<u>2 cfs</u>	<u>4 cfs</u>	<u>3769 c.f.</u>
	10.05 Ac.			0.60	0.76	3.7 in/hr	6.1 in/hr	28 cfs	46 cfs	51464 c.f.
Totals	49.03 Ac.			0.60	0.71			128 cfs	211 cfs	229781 c.f.

Table 9 - Hydrology for C Street and 2nd Avenue/D Street and 1st Avenue
Varied by C Value for Flows from Lots

Drainage Subbasin	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100	V100Yr/1Hr
Average Rational Method Coefficient for Lot Areas = 0.70										
Area Draining to C Street and 2nd Avenue										
YV12	2.29 Ac.	26681 s.f.	73184 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	6 cfs	11 cfs	11363 c.f.
YV13	2.16 Ac.	23870 s.f.	70301 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	13255 c.f.
YV14	1.93 Ac.	17860 s.f.	66346 s.f.	0.70	0.74	3.7 in/hr	6.1 in/hr	5 cfs	9 cfs	11722 c.f.
YV15	2.56 Ac.	38515 s.f.	73047 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	14717 c.f.
YV16	0.51 Ac.	10758 s.f.	11497 s.f.	0.70	0.80	3.7 in/hr	6.1 in/hr	2 cfs	2 cfs	2462 c.f.
YV17	0.40 Ac.	5540 s.f.	11844 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1601 c.f.
YV18	0.38 Ac.	6797 s.f.	9611 s.f.	0.70	0.78	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1688 c.f.
YV19	0.43 Ac.	5598 s.f.	13040 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1678 c.f.
YV20	2.38 Ac.	32600 s.f.	70890 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	9489 c.f.
YV21	0.45 Ac.	7560 s.f.	12012 s.f.	0.70	0.78	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1951 c.f.
YV22	2.51 Ac.	28682 s.f.	80689 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	10892 c.f.
YV23	2.06 Ac.	18966 s.f.	70708 s.f.	0.70	0.74	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs	8504 c.f.
YV24	0.43 Ac.	9060 s.f.	9822 s.f.	0.70	0.80	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.
YV25	0.55 Ac.	10557 s.f.	13316 s.f.	0.70	0.79	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2780 c.f.
YV26	2.41 Ac.	26098 s.f.	78894 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	10321 c.f.
YV27	0.49 Ac.	12473 s.f.	8984 s.f.	0.70	0.82	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2947 c.f.
YV28	0.91 Ac.	13743 s.f.	25911 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	3777 c.f.
YV29	2.26 Ac.	29715 s.f.	68524 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	8869 c.f.
YV30	1.13 Ac.	16568 s.f.	32679 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4634 c.f.
YV31	1.07 Ac.	16447 s.f.	30222 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4475 c.f.
YV32	1.99 Ac.	27117 s.f.	59586 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs	7928 c.f.
YV33	2.07 Ac.	26140 s.f.	64098 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	10420 c.f.
YV34	2.64 Ac.	38564 s.f.	76634 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	8 cfs	12 cfs	9381 c.f.
YV35	0.50 Ac.	11649 s.f.	10227 s.f.	0.70	0.81	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2733 c.f.
YV36	1.21 Ac.	17303 s.f.	35303 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	3 cfs	6 cfs	4906 c.f.
YV37	3.25 Ac.	46479 s.f.	95052 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	9 cfs	15 cfs	13190 c.f.
	38.98 Ac.			0.70	0.76	3.7 in/hr	6.1 in/hr	110 cfs	181 cfs	178317 c.f.
Area Draining to D Street and 1st Avenue										
YV38	0.85 Ac.	37188 s.f.	0 s.f.	0.70	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.
YV39	0.94 Ac.	40789 s.f.	0 s.f.	0.70	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.
YV40	2.01 Ac.	23424 s.f.	64224 s.f.	0.70	0.75	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs	9974 c.f.
YV41	0.71 Ac.	30793 s.f.	0 s.f.	0.70	0.90	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.
YV42	1.54 Ac.	29457 s.f.	37529 s.f.	0.70	0.79	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	6026 c.f.
YV43	0.52 Ac.	9481 s.f.	13193 s.f.	0.70	0.78	3.7 in/hr	6.1 in/hr	2 cfs	2 cfs	2342 c.f.
YV44	1.65 Ac.	25134 s.f.	46892 s.f.	0.70	0.77	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	6879 c.f.
YV45	0.89 Ac.	17221 s.f.	21564 s.f.	0.70	0.79	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	4119 c.f.
YV46	0.94 Ac.	12977 s.f.	28070 s.f.	0.70	0.76	3.7 in/hr	6.1 in/hr	3 cfs	4 cfs	3769 c.f.
	10.05 Ac.			0.70	0.80	3.7 in/hr	6.1 in/hr	30 cfs	49 cfs	51464 c.f.
Totals	49.03 Ac.			0.70	0.77			140 cfs	230 cfs	229781 c.f.

Table 9 - Hydrology for C Street and 2nd Avenue/D Street and 1st Avenue
Varied by C Value for Flows from Lots

Drainage Subbasin	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100	V100Yr/1Hr
Average Rational Method Coefficient for Lot Areas = 0.80										
Area Draining to C Street and 2nd Avenue										
YV12	2.29 Ac.	26681 s.f.	73184 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	11363 c.f.
YV13	2.16 Ac.	23870 s.f.	70301 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	13255 c.f.
YV14	1.93 Ac.	17860 s.f.	66346 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	11722 c.f.
YV15	2.56 Ac.	38515 s.f.	73047 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	14717 c.f.
YV16	0.51 Ac.	10758 s.f.	11497 s.f.	0.80	0.85	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2462 c.f.
YV17	0.40 Ac.	5540 s.f.	11844 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1601 c.f.
YV18	0.38 Ac.	6797 s.f.	9611 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1688 c.f.
YV19	0.43 Ac.	5598 s.f.	13040 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1678 c.f.
YV20	2.38 Ac.	32600 s.f.	70890 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	9489 c.f.
YV21	0.45 Ac.	7560 s.f.	12012 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1951 c.f.
YV22	2.51 Ac.	28682 s.f.	80689 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	10892 c.f.
YV23	2.06 Ac.	18966 s.f.	70708 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	8504 c.f.
YV24	0.43 Ac.	9060 s.f.	9822 s.f.	0.80	0.85	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.
YV25	0.55 Ac.	10557 s.f.	13316 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2780 c.f.
YV26	2.41 Ac.	26098 s.f.	78894 s.f.	0.80	0.82	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	10321 c.f.
YV27	0.49 Ac.	12473 s.f.	8984 s.f.	0.80	0.86	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2947 c.f.
YV28	0.91 Ac.	13743 s.f.	25911 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	3777 c.f.
YV29	2.26 Ac.	29715 s.f.	68524 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	8869 c.f.
YV30	1.13 Ac.	16568 s.f.	32679 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	3 cfs	6 cfs	4634 c.f.
YV31	1.07 Ac.	16447 s.f.	30222 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4475 c.f.
YV32	1.99 Ac.	27117 s.f.	59586 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	7928 c.f.
YV33	2.07 Ac.	26140 s.f.	64098 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	10420 c.f.
YV34	2.64 Ac.	38564 s.f.	76634 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	9381 c.f.
YV35	0.50 Ac.	11649 s.f.	10227 s.f.	0.80	0.85	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2733 c.f.
YV36	1.21 Ac.	17303 s.f.	35303 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	4906 c.f.
YV37	3.25 Ac.	46479 s.f.	95052 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	10 cfs	17 cfs	13190 c.f.
	38.98 Ac.			0.80	0.83	3.7 in/hr	6.1 in/hr	120 cfs	198 cfs	178317 c.f.
Area Draining to D Street and 1st Avenue										
YV38	0.85 Ac.	37188 s.f.	0 s.f.	0.80	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.
YV39	0.94 Ac.	40789 s.f.	0 s.f.	0.80	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.
YV40	2.01 Ac.	23424 s.f.	64224 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	6 cfs	10 cfs	9974 c.f.
YV41	0.71 Ac.	30793 s.f.	0 s.f.	0.80	0.90	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.
YV42	1.54 Ac.	29457 s.f.	37529 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	6026 c.f.
YV43	0.52 Ac.	9481 s.f.	13193 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2342 c.f.
YV44	1.65 Ac.	25134 s.f.	46892 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	6879 c.f.
YV45	0.89 Ac.	17221 s.f.	21564 s.f.	0.80	0.84	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4119 c.f.
YV46	0.94 Ac.	12977 s.f.	28070 s.f.	0.80	0.83	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	3769 c.f.
	10.05 Ac.			0.80	0.85	3.7 in/hr	6.1 in/hr	32 cfs	52 cfs	51464 c.f.
Totals	49.03 Ac.			0.80	0.84			152 cfs	250 cfs	229781 c.f.

Table 9 - Hydrology for C Street and 2nd Avenue/D Street and 1st Avenue
Varied by C Value for Flows from Lots

Drainage Subbasin	Area (Ac.)	Area-ROW	Area-Lots	C-Lots	C	I-10	I-100	Q-10	Q-100	V100Yr/1Hr
Average Rational Method Coefficient for Lot Areas = 0.90										
Area Draining to C Street and 2nd Avenue										
YV12	2.29 Ac.	26681 s.f.	73184 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	11363 c.f.
YV13	2.16 Ac.	23870 s.f.	70301 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	12 cfs	13255 c.f.
YV14	1.93 Ac.	17860 s.f.	66346 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	6 cfs	11 cfs	11722 c.f.
YV15	2.56 Ac.	38515 s.f.	73047 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	9 cfs	14 cfs	14717 c.f.
YV16	0.51 Ac.	10758 s.f.	11497 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2462 c.f.
YV17	0.40 Ac.	5540 s.f.	11844 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1601 c.f.
YV18	0.38 Ac.	6797 s.f.	9611 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1688 c.f.
YV19	0.43 Ac.	5598 s.f.	13040 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1678 c.f.
YV20	2.38 Ac.	32600 s.f.	70890 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	9489 c.f.
YV21	0.45 Ac.	7560 s.f.	12012 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	1951 c.f.
YV22	2.51 Ac.	28682 s.f.	80689 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	8 cfs	14 cfs	10892 c.f.
YV23	2.06 Ac.	18966 s.f.	70708 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	8504 c.f.
YV24	0.43 Ac.	9060 s.f.	9822 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	1 cfs	2 cfs	2634 c.f.
YV25	0.55 Ac.	10557 s.f.	13316 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2780 c.f.
YV26	2.41 Ac.	26098 s.f.	78894 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	8 cfs	13 cfs	10321 c.f.
YV27	0.49 Ac.	12473 s.f.	8984 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2947 c.f.
YV28	0.91 Ac.	13743 s.f.	25911 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	3777 c.f.
YV29	2.26 Ac.	29715 s.f.	68524 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	8 cfs	12 cfs	8869 c.f.
YV30	1.13 Ac.	16568 s.f.	32679 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	4634 c.f.
YV31	1.07 Ac.	16447 s.f.	30222 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	4 cfs	6 cfs	4475 c.f.
YV32	1.99 Ac.	27117 s.f.	59586 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	7928 c.f.
YV33	2.07 Ac.	26140 s.f.	64098 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	10420 c.f.
YV34	2.64 Ac.	38564 s.f.	76634 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	9 cfs	15 cfs	9381 c.f.
YV35	0.50 Ac.	11649 s.f.	10227 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2733 c.f.
YV36	1.21 Ac.	17303 s.f.	35303 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	4 cfs	7 cfs	4906 c.f.
YV37	3.25 Ac.	46479 s.f.	95052 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	11 cfs	18 cfs	13190 c.f.
	38.98 Ac.			0.90	0.90	3.7 in/hr	6.1 in/hr	130 cfs	214 cfs	178317 c.f.
Area Draining to D Street and 1st Avenue										
YV38	0.85 Ac.	37188 s.f.	0 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6276 c.f.
YV39	0.94 Ac.	40789 s.f.	0 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	6883 c.f.
YV40	2.01 Ac.	23424 s.f.	64224 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	7 cfs	11 cfs	9974 c.f.
YV41	0.71 Ac.	30793 s.f.	0 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	4 cfs	5196 c.f.
YV42	1.54 Ac.	29457 s.f.	37529 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	5 cfs	8 cfs	6026 c.f.
YV43	0.52 Ac.	9481 s.f.	13193 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	2 cfs	3 cfs	2342 c.f.
YV44	1.65 Ac.	25134 s.f.	46892 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	6 cfs	9 cfs	6879 c.f.
YV45	0.89 Ac.	17221 s.f.	21564 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	4119 c.f.
YV46	0.94 Ac.	12977 s.f.	28070 s.f.	0.90	0.90	3.7 in/hr	6.1 in/hr	3 cfs	5 cfs	3769 c.f.
	10.05 Ac.			0.90	0.90	3.7 in/hr	6.1 in/hr	33 cfs	55 cfs	51464 c.f.
Totals	49.03 Ac.			0.90	0.90			163 cfs	269 cfs	229781 c.f.

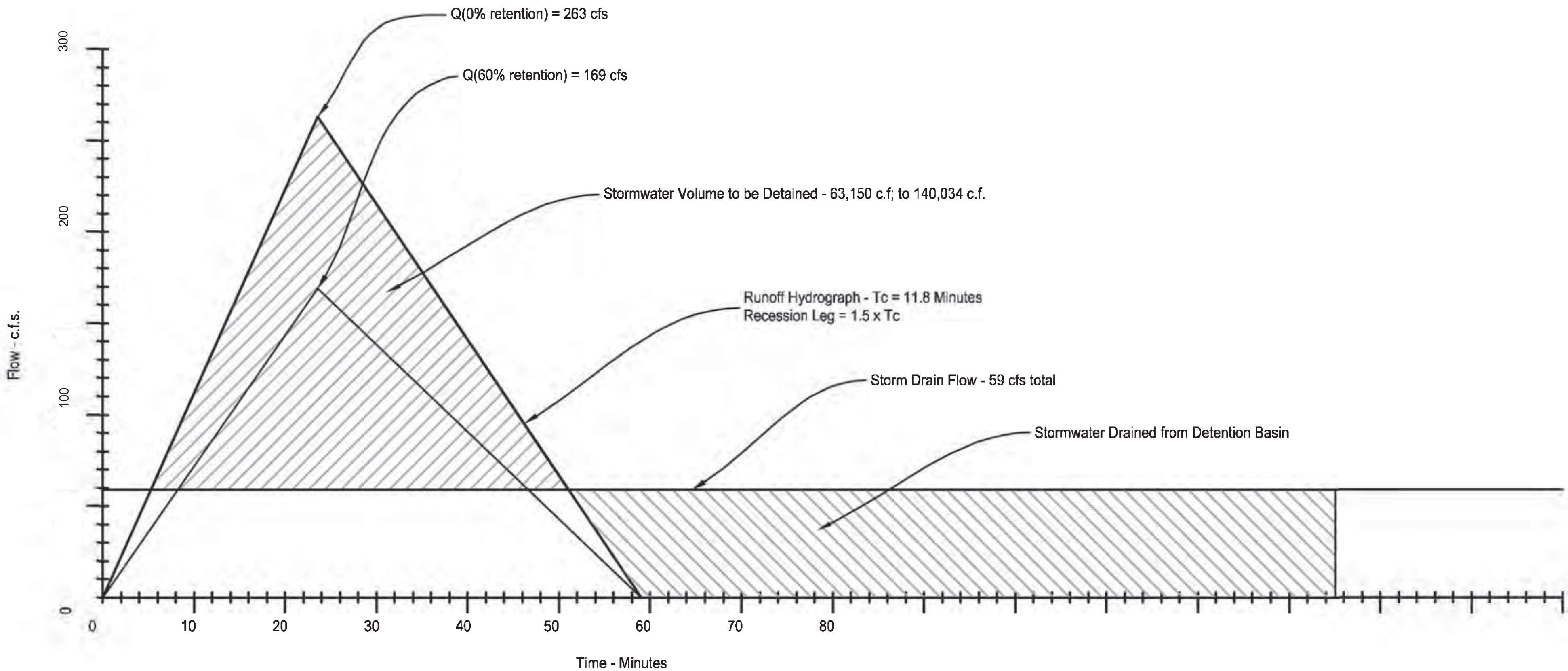


Figure 12 - Hydrograph of Proposed 2nd Avenue Stormwater Detention Basin

Table 10. Onsite Retention Requirements vs. Public Detention Basin Sizes - Areas Draining to C Street & 2nd Avenue and to D Street and 2nd Avenue

% Retention Required	C Value (1)	Q-100	Storm Drain Flow	Bypass Flow	Detention Vol. Req'd.	Lots Req'd. @ 4' Deep (90'x113' Lots)
0%	0.90	269 cfs	59 cfs	210 cfs	145229 c.f.	4 Lots (3)
10%	0.90	269 cfs	59 cfs	210 cfs	145229 c.f.	4 Lots (3)
20%	0.83	250 cfs	59 cfs	191 cfs	128966 c.f.	4 Lots
30%	0.77	230 cfs	59 cfs	171 cfs	112853 c.f.	4 Lots
40%	0.70	211 cfs	59 cfs	152 cfs	96930 c.f.	3 Lots
50%	0.63	192 cfs	59 cfs	133 cfs	81255 c.f.	3 Lots
60%	0.57	172 cfs	59 cfs	113 cfs	65400 c.f.	2 Lots
70% (2)	0.50	8 cfs	59 cfs	-51 cfs	284003 c.f.	94668 s.f.
80% (2)	0.43	7 cfs	59 cfs	-52 cfs	341451 c.f.	113817 s.f.
90% (2)	0.37	6 cfs	59 cfs	-53 cfs	420024 c.f.	140008 s.f.
100% (2)	0.37	6 cfs	59 cfs	-53 cfs	420024 c.f.	140008 s.f.

(1) - C Value based on all road right-of-way assigned a C of 0.9 and all lots assigned a C of (1 - % Retention) - See Table 6

(2) - Existing development estimated to have on lot C values of 0.4/effective on lot retention of 60%. More restrictive retention not considered.

(3) - 4 Lots at 4.5' Deep

Downtown San Luis Master Drainage Plan
- C Street and 2nd Avenue/D Street and 1st Avenue -
Proposed Storm Drainage Improvements - Detention Basin

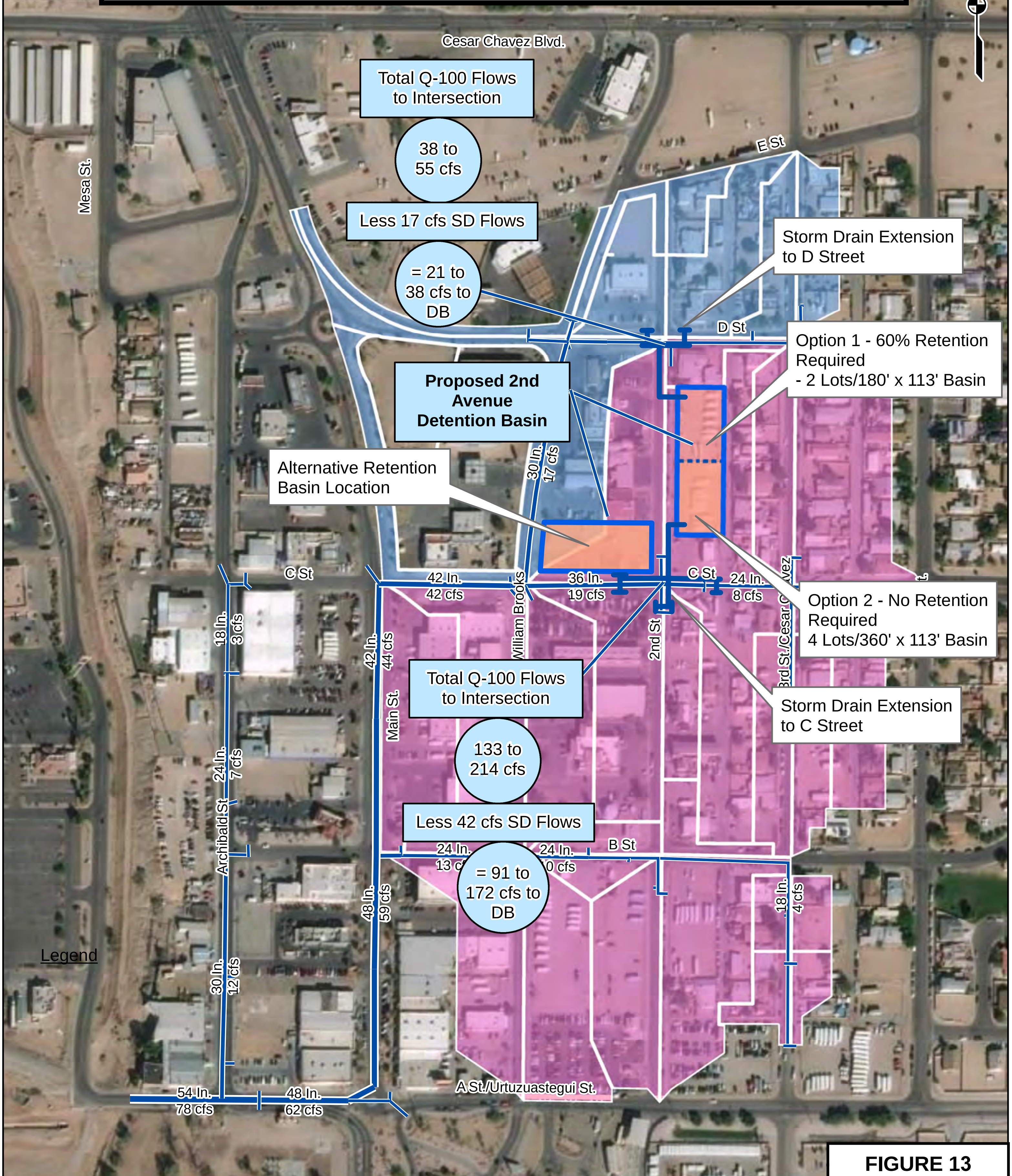
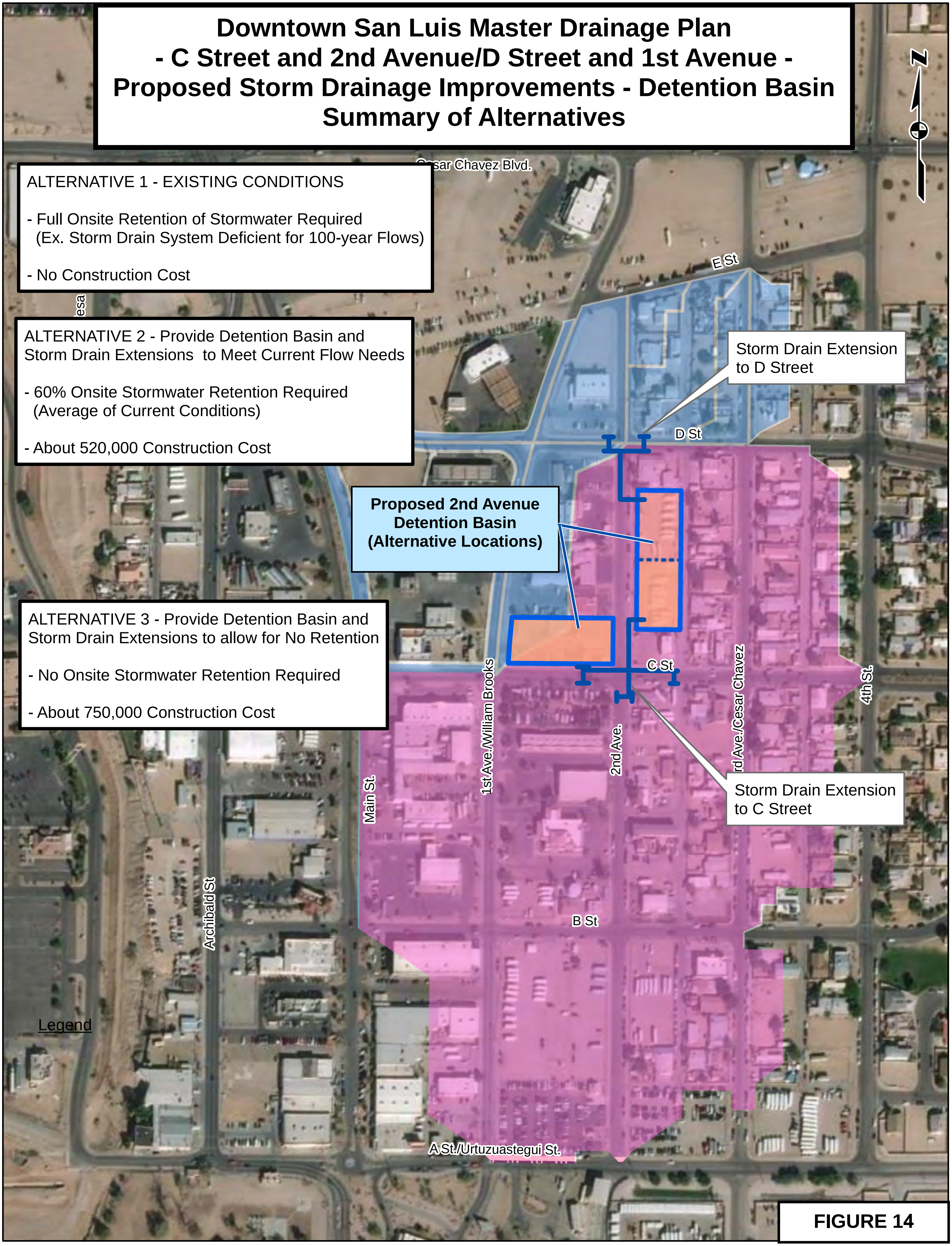


FIGURE 13



Downtown San Luis Master Drainage Plan
- C Street and 2nd Avenue/D Street and 1st Avenue -
Proposed Storm Drainage Improvements - Detention Basin
Summary of Alternatives
ALTERNATIVE 1 - EXISTING CONDITIONS
- Full Onsite Retention of Stormwater Required (Ex. Storm Drain System Deficient for 100-year Flows)
- No Construction Cost
ALTERNATIVE 2 - Provide Detention Basin and Storm Drain Extensions to Meet Current Flow Needs
- 60% Onsite Stormwater Retention Required (Average of Current Conditions)
- About 520,000 Construction Cost
ALTERNATIVE 3 - Provide Detention Basin and Storm Drain Extensions to allow for No Retention
- No Onsite Stormwater Retention Required
- About 750,000 Construction Cost
Proposed 2nd Avenue Detention Basin (Alternative Locations)
Storm Drain Extension to D Street
Storm Drain Extension to C Street
N
Cesar Chavez Blvd.
E St
D St
C St
B St
A St./Urtuzuastegui St.
Main St.
1st Ave./William Brooks
2nd Ave.
rd Ave./Cesar Chavez
4th St.
Archibald St
esa
Legend

FIGURE 14

Table 11. 2nd Avenue Detention Basin
60% Onsite Retention Required

Conceptual

Item	Description	Unit	Quantity	Unit Price	Cost
1	Removals and Relocations	LS	1	$20,000	$20,000
2	Lots for Retention Baisn	EA	2	$60,000	$120,000
3	Excavate Retention Basin	CY	2445	$10	$24,450
4	Retention Basin Wall/Fencing	LF	586	$40	$23,440
5	Landscape Retention Basin	LS	1	$15,000	$15,000
6	Vertical Curb and Gutter	LF	100	$15	$1,500
7	Concrete Sidewalk	SF	400	$8	$3,200
8	Construct Type D Catch Basin	EA	10	$5,000	$50,000
9	5' Dia. Storm Drain Manhole	EA	9	$5,000	$45,000
10	18" Dia. Class III RGRCP	LF	232	$90	$20,880
11	24" Dia. Class III RGRCP	LF	675	$120	$81,000
12	36" Dia. Class III RGRCP	LF	170	$170	$28,900
				Subtotal	$433,000
				Contingency @ 25%	$108,000
				Construction Costs	$541,000
				Engineering @ 8%	$43,000
				Construction Administation @8%	$43,000
				General Administration @ 5%	$27,000
				TOTAL ESTIMATED COST	$654,000

Table 12. 2nd Avenue Detention Basin
No Onsite Retention Required

Conceptual

Item	Description	Unit	Quantity	Unit Price	Cost
1	Removals and Relocations	LS	1	$20,000	$20,000
2	Lots for Retention Baisn	EA	4	$60,000	$240,000
3	Excavate Retention Basin	CY	5379	$10	$53,790
4	Retention Basin Wall/Fencing	LF	946	$40	$37,840
5	Landscape Retention Basin	LS	1	$30,000	$30,000
6	Vertical Curb and Gutter	LF	100	$15	$1,500
7	Concrete Sidewalk	SF	400	$8	$3,200
8	Construct Type D Catch Basin	EA	10	$5,000	$50,000
9	5' Dia. Storm Drain Manhole	EA	9	$5,000	$45,000
10	18" Dia. Class III RGRCP	LF	80	$90	$7,200
11	24" Dia. Class III RGRCP	LF	155	$120	$18,600
12	30" Dia. Class III RGRCP	LF	495	$150	$74,250
13	48" Dia. Class III RGRCP	LF	170	$250	$42,500
				Subtotal	$623,880
				Contingency @ 25%	$156,000
				Construction Costs	$779,880
				Engineering @ 8%	$62,000
				Construction Administation @8%	$62,000
				General Administration @ 5%	$39,000
				TOTAL ESTIMATED COST	$943,000

5.3 Alternatives for the Area Draining to the Urtuzuastegui Retention Basins

Figure 15 shows the remaining areas to be considered for storm drainage alternatives – those areas draining to the Urtuzuastegui Retention Basins, those areas draining to the Bienestar Estates and La Frontera Retention Basins, and those areas with onsite retention.

The small area draining to the Urtuzuastegui Retention Basins is already developed as parking lots with little stormwater retention, retaining only about 30 percent of the normally required onsite retention. The total runoff to the retention basins is about 15,500 cubic feet for the 100-year, 2-hour storm out of a total retention basin capacity calculated to be about 36,800 cubic feet. There is also little available land area for expansion of the retention basins.

As there is existing capacity in these retention basins for the existing flows (depending on how flows from the San Luis Industrial Park are handled), grandfathering in the existing land uses is possible. Elimination of the retention requirements altogether requires only an additional 2520 cubic feet of stormwater retention in the basins, a relatively small quantity, and such would simplify the management of the drainage to these basins.

5.4 Alternatives for the Areas Draining to the Bienestar Estates Retention Basins

Similar to the Urtuzuastegui Retention Basins, the retention basins of Bienestar Estates and La Frontera Estates have limited potential for expansion. The existing development that drains to these basins is already developed with only the stormwater retention typical of the residential lots, about 30 percent effective retention.

Total flows from west of 4th Avenue to the Bienestar and La Frontera retention basins are about 36,900 cubic feet (100-year, 2-hour runoff). Total capacity of the three retention basins is about 490,000 cubic feet and so this flow is less than 10 percent of the total flow. As mentioned previously, there appears to have been some consideration of these flows in the sizing of the retention basins, but lacking a full design analysis of the existing retention basins, routing of additional flows to the retention basins is not recommended.

Overall, grandfathering in the existing land uses is possible but further reduction or elimination of the retention requirements altogether does not appear practical at this time

5.6 Alternatives for the Areas Requiring Onsite Stormwater Retention

The areas not served by storm drains along the north side of the of the master plan area generally function adequately for storm drainage at the present time or can do so if developed with onsite retention. As such, it is recommended that stormwater retention requirements be maintained in place for this area. The exception is that the lots along Mesa Street, which are small lots and are mostly developed without onsite retention, can be provided with storm drainage by an extension of a new C Street Storm Drain as discussed above. Such could result in elimination of most or all retention requirements. Cost of the storm drain extension is about $152,000 (included as a part of the $368,000 total cost of the storm drain.)

Downtown San Luis Master Drainage Plan Alternatives for Bienestar Estates, Urtuzuastegui and Onsite Retention Drainage Areas

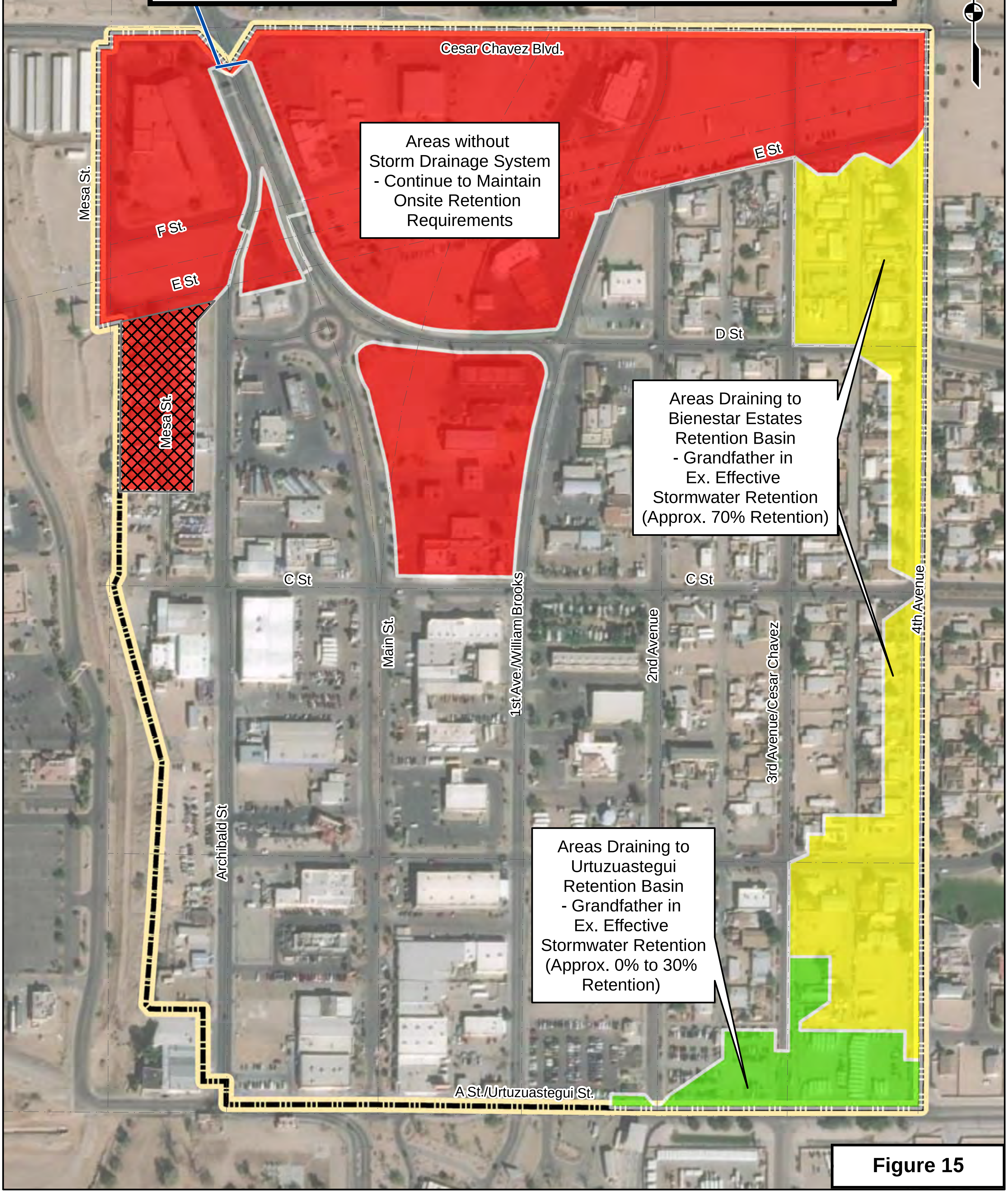


Figure 15

6.0 Stormwater Retention Requirement Recommendations

Based on discussion with the City of San Luis City Council and stall, it was felt that the priority for much of the the downtown San Luis area should be intensive land usages as is typical in urban downtowns. Conversely, it was felt that setting aside excessive property for onsite stormwater retention was not advantageous for the area. Therefore, especially in the Downtown San Luis Storm Drain drainage area, recommended alternatives are those which require increased public storm drainage infrastructure and minimize onsite retention.

The recommended alternatives for each area of the downtown San Luis area, as discussed above, are:

1. Areas draining to Archibald Street, including the northerly portion of Mesa Street –
   - Construct additional catch basins along Archibald Street (cost of $116,000)
   - Construct the C Street Storm Drain, including the Mesa Street Extension (cost of $368,000)
   - Eliminate onsite retention requirements (resulting in an effective runoff C-value of about 0.90)

2. Areas drainage to the C Street and 2nd Avenue and D Street and 1st Avenue intersections –
   - Construct a 2nd Avenue Detention Basin, along with connecting storm drains ($943,000)
   - Eliminate onsite retention requirements (resulting in an effective runoff C-value of about 0.90)

3. Areas draining to the Urtuzuastegui Retention Basins -
   - Grandfather in existing development and stormwater runoff, and to simplify management, eliminate onsite retention requirements and increase effective C-value to 0.90 (no cost)

4. Areas draining to the Bienestar Estates and La Frontera Estates Retention Basins -
   - Grandfather in existing development and stormwater runoff, requiring 70-percent of full retention requirements for each lot (no cost)

5. Areas currently with onsite retention requirements –
   - The area along the northern portion of the master planning area which were identified as having onsite retention of stormwater required should have this requirement maintained (no cost)

Total cost of recommended improvements is $1,427,000

Recommendations 1 through 4 above include changes to existing City of San Luis stormwater management ordinances (recommendation 5 does not involve a change.) As such, once these recommendations are acted on and infrastructure improvements are made, stormwater ordinances will need to be amended by the City. Figure 16 shows a sample stormwater management plans that could become a part of amended ordinances, with it being emphasized that those areas with onsite stormwater retention being eliminated will require the new storm drainage infrastructure constructed prior to the ordinances being amended.

Downtown San Luis Master Drainage Plan
Example Proposed Regional Retention Requirements

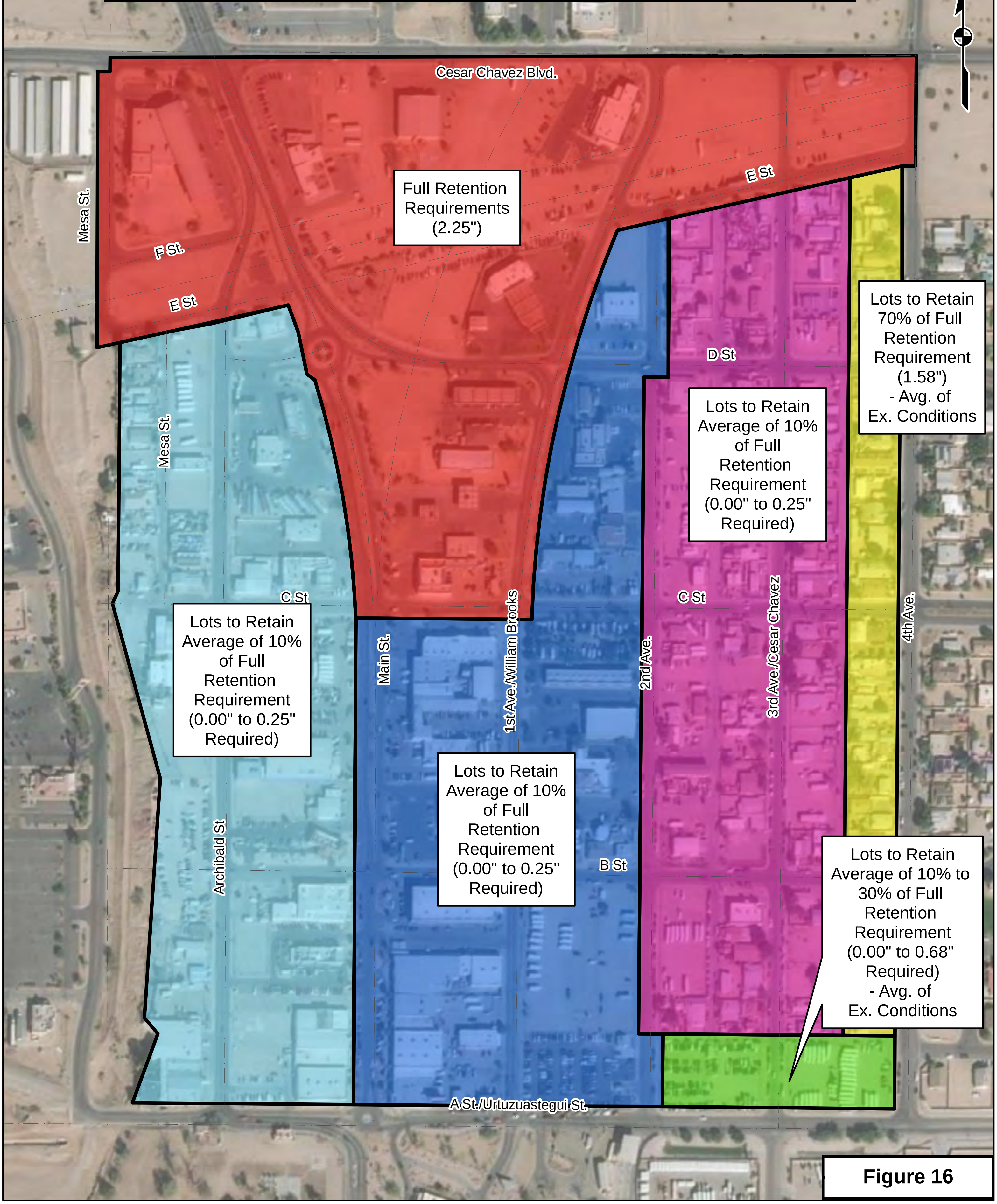


Figure 16