THE TOWN OF APPLE VALLEY

STORMWATER IMPACT FEE FACILITIES PLAN

JANUARY 2020

PREPARED BY:

SUNRISE ENGINEERING

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I. INTRODUCTION

This Stormwater Impact Fee Facilities Plan has been prepared for the Town of Apple Valley, located in Washington County, Utah, east of St. George and Hurricane along State Route 59. The Town of Apple Valley was established in 2004 with approximately 700 residents. Since then the town has continued to experience growth. As this growth has occurred, the construction of homes, roads and other improvements typical of developed communities has altered the natural terrain upon which the community was built. These alterations have resulted in an increase in stormwater runoff generated by storm events and have changed the routes by which storm runoff is directed through the Town.

The Town's existing stormwater drainage improvements include borrow ditches, street culverts, a bridge, and a curb and gutter with integrated storm drain inlet boxes and piped systems. These improvements have been analyzed with regard to build out conditions based on current zoning.

This study analyzes those areas which are currently developed and/or which directly route stormwater runoff through the Town. Undeveloped drainage basins falling within the Town boundary were not analyzed in this study. It is assumed that runoff from these areas will flow directly into Little Creek.

This Plan includes general requirements for the sizing, maintenance, and configuration of a stormwater management system in the Town of Apple Valley and makes recommendations for addressing specific problem areas in the Town.

In addition, this Plan provides operation and maintenance recommendations for existing and future stormwater improvements.

It is intended that this 2019 Stormwater Master Plan will help the Town of Apple Valley manage current and future stormwater routing scenarios.

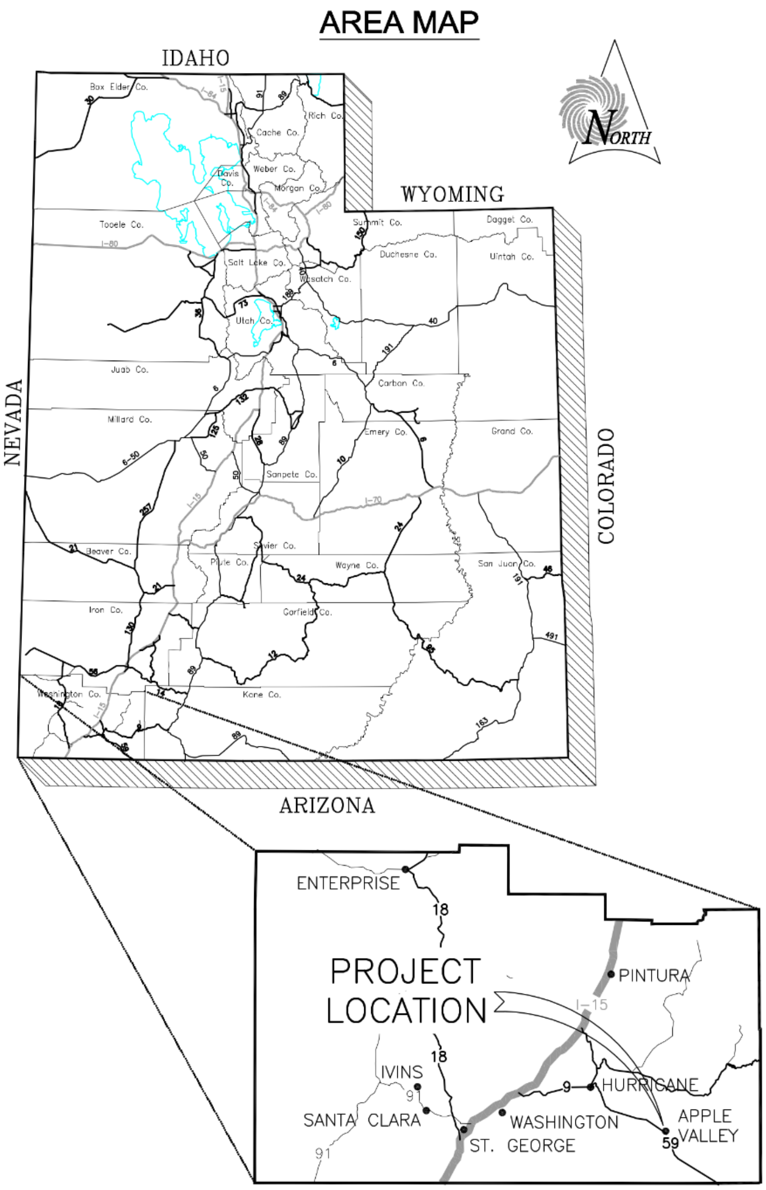


Figure I-1: Area Map

II. BASIN DESCRIPTION & DATA COLLECTION

A. FIELD INVESTIGATION

The Town of Apple Valley is located south and east of Hurricane along SR-59 in Washington County, Utah. The Town boundaries include Rockville to the east, and Hildale to the south. The community can be classified as rural and suburban due to varied land uses within the Town. These land uses range from pasture and farmland to moderate density residential housing and light commercial use. Development in the Town has had a direct impact on the natural drainage patterns and native ground cover historically found in the area. These changes in ground cover and drainage patterns are the primary cause of stormwater problems and potential flooding in the Town.

To assist with preparation of this Plan, Sunrise Engineering's staff conducted a detailed field investigation of the Town. The overall purpose of the field investigation was to collect information regarding existing drainage improvements, drainage patterns, and existing problematic areas throughout Apple Valley. The findings of the field investigation were compared to digitized information and supplemented by maps obtained from various entities regarding soil types, land uses, and digital elevation models. The gathered information was used in a hydrologic analysis of the study area to determine the amount of runoff generated by specific precipitation events and to evaluate the ability for existing infrastructure to convey runoff flows.

B. EXISTING DRAINAGE FACILITIES

Roadway Conveyance

Excess stormwater generated by a given rainfall event typically sheet flows to roadside borrow ditches lining the street drainage area. These ditches route stormwater runoff in the direction of highest gradient to the nearest drainage. Where necessary culverts are located at street intersections to route stormwater underneath the intersection. Due to the large watershed and non-ridged drainage channels sheet flow can cause problems by overtopping ditches and flowing into residential properties. Some of these specific problem areas and solutions are discussed in later sections.

Storm Drain Pipe System

Storm drain pipe systems are located near the towns gas station and bridge. These systems include catch basins, cleanout boxes, pipe segments, and outfall structures which discharge storm-water to natural drainage features and ultimately to Little Creek. The majority of Apple Valley does not include storm drain piping. A comprehensive map of the existing drainage improvements has been included as Figure IV.C.1 in Appendix A.

Drainage Channels

The primary natural drainage channel in Apple Valley is Little Creek. Little Creek runs next to SR 59 for the majority of its path through Apple Valley. This ephemeral creek is the major drainage feature for Apple Valley. All subsequent washes and drainage improvements ultimately drain into the Little Creek.

A. WATERSHED INFORMATION

Work performed during the data collection and field investigation phase of this study included a detailed review of how stormwater runoff within the Town of Apple Valley is routed to the primary drainage channels and pipe systems previously described, and ultimately to Little Creek. The direction of stormwater flow was established for local developments and existing stormwater conveyance facilities were reviewed to understand how they route stormwater to the major drainage channels. After these patterns were determined, watershed drainage basins were delineated.

A drainage basin is a portion of a greater watershed area that has specific, well-defined boundaries and produces runoff at a downstream point location. Dividing larger watershed areas into individual drainage basins and allows more detailed and accurate analyses of the individual areas. These individual analyses can then be combined to generate data for the large basins and the watershed as a whole. This process was followed for this Plan.

The Town of Apple Valley contains several drainage basins. The basins on the east side of the mesa merge together and drain directly into Little Creek. The basins on the west of the mesa drain at separate points into Little Creek. Figure II.C.1 in Appendix A illustrates the drainage basins as they exist presently.

B. SOIL TYPE INFORMATION

The soil type within a watershed area has a significant impact on how much excess stormwater is available for runoff because the soil type determines the precipitation infiltration rate. This infiltration rate is the rate at which water moves from the ground surface into subsurface soil layers. If the infiltration rate is very high, stormwater runoff generated by precipitation events is lower because a greater volume of moisture is absorbed by the soil. Conversely, if the infiltration rate is low, higher volumes of runoff are generated because minimal absorption occurs in the subsurface soil layers. The Soil Conservation Service (SCS) has studied soil types throughout the United States and has grouped soils according to their type and infiltration rates. These groups are described in the list below:

Group A: These soils have a high infiltration rate. They are chiefly deep, well drained sands or gravel, deep loess, or aggregated silts. *They have low runoff potential.*

Group B: These soils have a moderate infiltration rate when thoroughly wet. They are moderately deep and well drained and of moderately fine to moderately coarse texture. Examples are shallow loess and sandy loam.

Group C: These soils have a slow infiltration rate when wet. They are soils with a layer that impedes downward movement of water and typically have moderately fine to fine texture. Examples are clay loams or shallow sandy loams. These soils are typically low in organic content and high in clay content.

Group D: These soils have a very slow infiltration rate. They are chiefly clay soils with high swelling potential. A high water table is often permanent. Clay pan is often found at or near the surface. A shallow layer of soil may cover a nearly impervious material. Examples include heavy plastic clays and certain saline soils. *They have high runoff potential.*

The United States Department of Agriculture, National Resource Conservation Service (NRCS) has performed several studies of soils throughout the United States including those in the Town of Apple Valley and the surrounding area. These studies reveal that the soil types located in the study area are primarily of groups B, B/C, and C Soil data used for the study area consisted primarily of data from the SSURGO database which was obtained from the NRCS Web Soil Survey website. This data was supplemented by data from the STATSGO database which was obtained from the NRCS Soil Data Mart website. The data collected was used in the watershed analysis described by this Plan. A map of the SCS soil types in the study area is included as Figure II.D.1 in Appendix A.

C. LAND USE PATTERNS

The type of land use in a given watershed area is a factor that significantly affects the magnitude of stormwater flow and runoff volume generated by precipitation events. Land uses that have relatively higher percentages of impervious surfaces such as parking lots, shopping areas, storage yards and high density residential housing tracts generate more stormwater runoff than areas with lower percentages of impervious surfaces such as parks and grasslands.

The Town's current zoning map was used to evaluate the land use conditions in Apple Valley assuming a build out condition in the study area. Additionally, review of current aerial photographs and information collected during the field investigation was used to refine the land use categories used in this Plan. The Town has a variety of developed land uses including:

Commercial: This includes retail shopping, restaurants, hotels, Town offices, churches, and other businesses.

Low Density Residential: This use includes residential housing on average lot sizes of 5 or more acres.

Medium Density Residential: This use includes residential housing from 1 to 5 acres.

High Density Residential: This use includes residential housing on average lot sizes of 1 acre.

Multi-Family/PCD/Mobile Home: This use includes residential housing on average lot sizes of 6,000 square feet or less.

Open Space: This use includes public recreation grounds and facilities, other grassy areas, and some agricultural land.

Brush Terrain: This area includes regions of undeveloped natural brush terrain.

Over the past several years, Apple Valley has experienced periods of high to moderate growth and periods of very low growth. Development in the Town has been governed by and has generally followed guidelines established by adopted zoning ordinances. It was assumed, for the purposes of this study and for predicting future land use patterns within the Town, that development and land use will follow the current Apple Valley Town Zoning Map. The current zoning map has been included as Figure II.E.1 in Appendix A.

D. HISTORY OF FLOODING & COMPLAINTS

The data collection and field investigation process completed for this study included a review of locations within the Town where flooding due to precipitation events has been a problem. A summary of the problem areas as provided by Apple Valley Town are summarized below:

East Zion Circle: Runoff during large precipitation events flows into the cul-de-sac causing the road and adjacent houses to be partially flooded and distributes large sediment deposits. The area is a relative low point (belly) that holds water until it can be conveyed away by ditches. Runoff from these streets is intended to sheet flow to the side of the street in which it is generated and cross only in designated locations such as culverts or other storm water improvements.

1240 Apple Blossom Ln: Runoff during medium to large storm events overruns existing borrow ditches causing flow to pass through neighborhood homes around 1240 Apple Blossom Ln. Homes yards are being eroded away from the floods. The flow follows the predevelopment geological flow path. Borrow ditches have been constructed to re-route water for this area but have not been sized large enough to handle the larger storm events.

Borrow Ditches: Borrow ditches throughout the town have caused localized flooding. Borrow ditches fill with sediment when flow goes through the ditches. If the ditches are not maintained it causes areas with localized flooding. This flooding has washed out driveways and sent water through yards in the town.

N. Apple Valley Dr: Runoff during medium to large storm events causes water to overtop North Apple Valley Drive. The drive has a section that was constructed to dip down into an existing flow path. When the watershed receives significant rain, the storm water erodes the lowered portion of the road.

III. HYDROLOGICAL ANALYSIS

A. INTRODUCTION

After the field investigation and data collection process outlined in Section II of this Plan was performed, a hydrologic analysis of the drainage basins which contribute runoff flow to the Apple Valley study area was completed. The HEC-GEOHMS software package was used to determine the basin characteristics required by HEC-HMS as inputs. HEC-HMS, a system developed by the Army Corps of Engineers, was used in this analysis to determine peak and total volume flows generated in the drainage basins. The main purpose of this analysis is to provide reference information for future analyses, basic data for future designs, and to ensure that no current systems within the Town of Apple Valley are largely undersized or under designed.

Certain assumptions and modeling parameters that mathematically describe precipitation and runoff characteristics of the study area were required for development of the computer model. These parameters include:

Method of Analysis
Basin Delineation
Rainfall Data
Design Storm
Soil Type and Land Use Characteristics
Lag Time

A discussion of these input parameters and the process of creating the hydrologic model is given in Section B below. Results generated by the computer model are discussed in Section C.

E. HYDROLOGICAL MODEL

Method of Analysis

Numerous methods have been developed for performing hydrologic analyses for given watersheds. Each of the methods has its strengths and weaknesses; therefore, particular methods are better suited to specific watershed characteristics and configurations. The method chosen to analyze the Town of Apple Valley watershed was the SCS Unit Hydrograph Method. This method, developed by the Soil Conservation Service, is best suited for urban or rural conditions with drainage basin areas ranging from one to 2,000 acres. Data required for input includes rainfall intensities, predominant soil types, land use patterns, runoff times of concentration (T_c) for individual basins and runoff curve numbers (CN) for individual basins. Output results are runoff hydrographs from which peak flows and volumes can be determined.

In the Unit Hydrograph Method, input data is used to create a direct hydrograph that results from one inch of excess rainfall uniformly distributed over the watershed area for a specific duration storm event. After the unit hydrograph is created, it can be used to generate flood hydrographs for design storms (i.e. 10-year 3-hour, 100-year 3-hour, etc.) based on the theory that individual hydrographs resulting from successive increments of rainfall excess that occur throughout a storm period will be proportional in discharge throughout their length. The HEC-GEOHMS and HEC-HMS software package has the ability to run the SCS method to generate stormwater discharge hydrographs based on the required input data. Hence, this package was appropriately suited for analysis of the Town of Apple Valley watershed.

Basin Delineation

In order to effectively model precipitation and runoff scenarios for the Town of Apple Valley watershed, the study area was divided into drainage basins as described in Section II. Figure II.C.1 included in Appendix A shows the basin delineations. Basins were automatically delineated from a digital elevation model (DEM) imported into HEC-GEOHMS from the Utah AGRC website and corrected based on information obtained from the field investigation. These basins represent the current storm runoff configuration for the Town.

Rainfall Data

Rainfall data necessary for input into the computer model was taken from the National Oceanic Atmospheric Administration (NOAA) website ATLAS 14. The table provides information regarding design storm depth-duration-frequency (DDF) of rainfall depths as given in Table III.B.1 in Appendix B. The precipitation data given in a DDF table can be used to create a DDF curve which is a relationship between the depth, duration, and frequency or return period of a given storm event. This, in turn, can be used to produce a storm temporal distribution. This distribution is a relationship between the percentage of rain produced given the amount of time that has elapsed. These distributions are related to the design storm duration and the distribution used in this study can be found in Table III.B.2 in Appendix B.

Design Storm

The design storm for a hydrologic analysis is normally chosen based upon data observations that reveal the type of precipitation event that produces the highest peak flows and volumes for a given watershed under realistic rainfall event conditions. In the western United States and especially arid areas, storms that generally produce the highest levels of runoff are thunderstorms. Historically, the rainfall event frequency used to size storm drain conveyance facilities in Utah has been either the 5-year or 10-year 3-hour storm while the 100-year 3-hour storm has generally been used to size detention facilities.

It has been concluded for this Plan that runoff conveyance facilities for the Town of Apple Valley should be designed for the 10-year 3-hour storm and detention facilities to be designed for the 100-year 3-hour storm. This standard is consistent with that used in most areas of Utah and is the same as the design criteria for storm drain systems in St. George Town.

Soil Type and Land Use Characteristics

One factor that significantly affects the amount of runoff generated by a particular watershed is the soil type within the watershed. Different soils have different infiltration rates, or rates at which water can move through the surface to subsurface layers and thus be held from flowing off the watershed via surface drainage. If the infiltration rate is high, the runoff generated from storms is decreased. If the infiltration rate is comparatively low, precipitation will flow off the watershed rather than being absorbed.

Another important factor that affects the amount of runoff generated by a watershed is land use. Developed areas have a higher percentage of impervious surfaces like streets, driveways, parking lots and roofs while undeveloped areas are typified by pervious surfaces and plant features that are more efficient at absorbing precipitation, preventing it from leaving the watershed as runoff. The results is that higher rates are expected with increased development than are typically observed from a watershed in its natural condition.

The effect of soil types and land uses on watershed runoff flows and volumes is accounted for within the SCS Unit Hydrograph method for hydrologic analysis by the runoff curve number (CN). The Soil Conservation Service has calculated CN values for each soil group based on particular land uses. Representative curve numbers were calculated by the computer model according to soil maps and land use maps imported into the model under build out conditions. These soil type maps and land use maps are given in Figure II.D.1 and Figure II.E.1 in Appendix A. Each basin was assigned by the model a composite CN value based on a weighted average of the different soil and land use types located within each basin. Curve number values assigned to each of the basins are included in tabular form in Table III.B.3 in Appendix B.

Time of Concentration

The final input parameter required for the hydrologic model is the lag time (T_l) which is generally defined as the time between the center of mass of effective rainfall and the inflection point on the recession (falling limb) of the direct runoff hydrograph. This is often related to the time of concentration which is defined as the time that must elapse before the entire basin area is contributing runoff at the outflow point of the basin. This parameter helps to define the shape and peak of the resulting hydrographs from rainfall events. Factors that determine the lag time are the length of overland flow (*L*) which is the maximum distance that water must travel from the upper extremity of the basin to the outflow point, the curve number (*CN*) which accounts for the soil infiltration capacity, and the slope (*S*) which is the average surface slope within the basin.

Of the various methods used to calculate the lag time, the SCS lag method is well suited for the hydrologic conditions characteristic of the Town of Apple Valley watershed area. The SCS lag equation was developed from observations of agricultural watersheds where overland flow paths were poorly defined and channel flow was absent, but the method has been adapted to small urban watersheds less than 2,000 acres in area and performs reasonably well for areas that are completely paved. Hence, the method can be applied to each of the basins within the Town of Apple Valley study area. The SCS lag equation is expressed as follows:

$$T_l = \frac{L^{0.8}\left(\left[\frac{1000}{CN} - 10\right] + 1\right)^{0.7}}{1900 * \sqrt{S}}$$

where T_l is the lag time in hours, *L* is the basin hydraulic length in feet, *CN* is the SCS runoff curve number and *S* is the average surface slope of the basin in percentage.

Evaluation of the lag time equation reveals that as the length of the basin decreases and the SCS runoff curve number and slope increase, the calculated lag time decreases. It is important to note that the time of concentration and the lag time has a significant effect on the size and timing of the peak flow from a watershed basin; therefore, care must be taken to accurately calculate this parameter. The lag time was calculated in HEC-GEOHMS for each basin within the study area. Table III.B.3 in Appendix B includes a column that lists the calculated lag times for each basin.

F. HYDROLOGICAL MODEL RESULTS

Information regarding basins, rainfall data, design storms, land uses, soil types and times of concentration were compiled using HEC-GEOHMS watershed modeling software. Following the compilation of the watershed and rainfall information, an analysis using HEC-HMS was run which generated runoff hydrographs for each basin in the watershed area. The runoff hydrographs provided values on peak flows and total runoff volumes for each basin. Peak flows and volumes resulting from the 10-year 3-hour storm event and the 100-year 3-hour event under build out conditions in the Town of Apple Valley are summarized in Table III.B.3 in Appendix B.

IV. SYSTEM ANALYSIS

A. INTRODUCTION

After the hydrologic analysis described in Section III of this Plan was completed, a general overall evaluation of existing drainage conditions and facilities in the Town of Apple Valley was performed to determine the adequacy of existing storm drain conveyance and routing facilities. This evaluation included hydraulic analyses of existing drainage features such as roadways, storm drain pipe systems, drainage swales, etc. The results of this analysis were used to reveal locations of flooding potential, to indicate where additional storm drain systems, improvements, or repairs are needed, and to provide insight on the prioritization of future projects and improvements. This evaluation involved studying the hydrologic data and discussion from Section III and a confirmation of the compiled data from the field investigation.

The discussion presented in this section includes an analysis of existing storm drain facilities, recommendations for repairs to the existing system, and proposed construction of additional storm drain facilities. A brief and general description of the existing storm drain facilities is given in Subsection B. Subsection C presents the recommended improvements and changes to the Apple Valley Town stormwater system which are needed to alleviate present problems.

B. EXISTING FACILITIES

Primary stormwater conveyance facilities existing in the Town of Apple Valley include borrow ditches, storm drain pipe systems, culverts and natural drainage channels. A brief discussion of the role and conveyance capabilities of each is given in the following highlighted subsections. This subsection is meant to be informative and provide details regarding the design methods used to determine system improvements.

Swales

Similar to the roadway conveyance systems in the Town, a specific inventory of all the swales within the Town will not be listed here, but any specific problem areas will be discussed later on in this section. The stormwater conveyance capacity of a swale is governed primarily by its cross sectional shape. Like any other conveyance channel, the longitudinal slope and surface roughness also strongly influences the capacity. Assuming these governing factors, the swale capacity can be approximated by Manning's equation:

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Where *Q* is the flow capacity of the swale in cubic feet per second, *n* is Manning’s roughness coefficient, *A* is the area of fluid flow in square feet, *R* is the hydraulic radius in feet and *S* is the longitudinal slope of the swale in foot per foot.

Since the majority of the swales in the Town of Apple Valley are somewhat vegetated the n-value used for this analysis was a conservative value of 0.025. Also, to simplify the analysis process, all the swales in the Town were assumed to be triangular shaped, with a depth of 2’ and 1:1 side slopes. With these assumptions the above equation was simplified to the following equation:

$$Q = 188.7 * S^{1/2}$$

If the street has swales on both sides then the capacity is doubled since this equation is for a single swale. Table IV.B.1 in Appendix C presents the conveyance capacity of the typified roadway swale outlined above based on slope.

Storm Drain Pipe Systems

Storm drain pipe systems are currently installed in few areas of the Town. These systems generally include catch basins, cleanout boxes, pipe segments, and outfall structures. The storm drain pipe is located at the fire station and the bridge. These systems function as complete isolated systems and do not tie into larger Town storm drain mains. Each of the storm drains discharge into the Clear Creek Wash.

The isolated systems are functioning as designed and are effectively conveying stormwater out of the nearby streets and developed areas. Table IV.B.2 in Appendix A presents the conveyance capacity of several types of piped systems based on slope.

Excess stormwater routed into these systems generally enters the storm drain pipe system through catch basins and inlet boxes. Covers and grates for these inlet boxes have many different sizes and configurations which affect the amount of stormwater that can be captured by these boxes. If the actual grate is smaller or becomes choked with debris or is otherwise clogged, the capture capacity is reduced. Limited capacity at a grate may cause localized flooding and may also cause flooding at downstream grate locations due to the reduced amount of water being captured at upstream locations. Future storm drain system designs and development requirements should respect these facts.

Culverts

The majority of the conveyance facilities in the Town of Apple Valley are comprised of natural drainage channels along the edge of the road. With this being the case, several culverts are located throughout the Town to convey stormwater under roadways or other such embankments.

The shapes of these culverts may vary, but most are understood to be circular. Culvert construction materials also vary. Many are made from steel, concrete, and plastics. Culvert inlet and outlet configurations also vary. All these factors, including the size of the culvert, contribute to the conveyance capacity.

G. SYSTEM IMPROVEMENTS

The runoff results of the hydrologic analysis (summarized in Table III.B.3 and Table III.B.4) were compared to the flow capacities of the existing improvements near the location of the basin outlets. This comparison was the basis for the improvement recommendations provided in this section.

In general, the runoff generated in the existing drainage basin which drains the majority of the developed portion of the Town does not exceeds the capacity of the existing downstream improvements. A portion of the town has areas where the runoff exceeds the existing structure capacity. These conditions exist on the East side of town. The recommended improvements focus on routing large runoff amounts around the east end of town as identified in Section II.F of this report.

A map of the recommended improvements has been included as Figure IV.C.2 in Appendix A.

Recommended Improvements

East Apple Valley Drainage Channel

Install a 16' channel that increases to a 45' drainage channel on the East side of town. The channel is positioned on the west side of parcels AV-1321-A, AV-1328-B, AV-1329, and AV-1343-A-1.

Install a detention basin capable of holding 4,500,000 gallons of water at the north east section of town. The detention basin lies on parcel AV-1329.

24-inch HDPE storm drain system from Mt. Zion Circle between Parcels AV-AVR-3-4 and AV-AVR-3-5-B-1 along S. Mt. Zion Drive that fronts parcels AV-1-2-29-3101, AV-1330-E, AV 1330-D-1, and AV 1330-C.

Install 96-inch CMP culvert under N Apple Valley Drive. See exhibit IV.C.2 for location.

Install 84-inch CMP culvert under N Apple Valley Drive. See exhibit IV.C.2 for location.

Borrow Ditch Improvements

The town has given direction to keep borrow ditches as the standard vehicle for drainage with the town boundaries. Borrow ditches will need to be cleaned and expanded in around half of the streets in Apple Valley.

For main streets and areas where additional development is expected to take place, the Town should consider having the developer install curb & gutter.

Incorporating these improvements would alter the basin delineation described previously in this report. The changes to the drainage basin delineation based on completing the recommended improvements are shown in Figure IV.C.3 in Appendix A.

H. NATURAL DRAINAGE CHANNEL INFRASTRUCTURE

Due to the critical nature of the natural drainage channels for conveying and routing stormwater runoff within the Apple Valley Town boundaries, it is recommended that the Town take proper action to preserve and protect them for this purpose. It is recommended that the Town adopt an ordinance to preserve these existing channels as drainage rights-of-way to be maintained and preserved by the Town as part of the stormwater facilities owned and operated by the Town.

It is not economical for the Town to construct infrastructure consisting of underground stormwater conveyance trunk lines as long as these natural channels remain unobstructed and in working condition. With this intended use of the natural drainage channels, it also recommended that future developments in the Town shall not obstruct these channels. In the event that this is not possible, for one reason or another, then it should be the responsibility of the developer to reconstruct an open channel or an underground piping system to convey the flows through the development. In turn, future developments within the should be allowed to discharge stormwater produced in the development into these natural drainage channels at the same natural rate prior to development. Doing so will most likely require construction of a detention facility. The developer will be responsible for determining the historical discharge rate produced by the land being developed and the proper capacity of the detention facility. Such determination by developer should be subject to review and acceptance by the Town.

In order to prevent excessive pollutants from entering these natural channels, it is also recommended that stormwater be partially treated before being discharged into the channels. Possible treatment could include the removal of suspended solids, trash, debris, and oil. See Subsection F for further information regarding water quality improvements.

I. MAINTENANCE AND MISCELLANEOUS IMPROVEMENTS

There are several improvements and practices that will enhance the ability for the Town of Apple Valley to manage stormwater runoff. These improvements include both structural and non-structural items. They are:

Pave or Chip Seal Unimproved Roads: Sedimentation that occurs in storm drain systems is often caused by erosion from construction areas as well as unpaved roads within the Town and can result in significant costs and maintenance to the system. The total amount of sedimentation in the storm drain system can be greatly reduced or eliminated by paving or chip sealing unimproved roads.

Reshape Existing Roads: Some of the roads in Apple Valley Town lack the ideal 2% cross slope to centerline. Without a proper crown in the roadway, the ability of the roadway to convey stormwater and drain properly is diminished. It is recommended that as roadways are resurfaced, care be taken to ensure that the proper cross slope is established.

Complete Regular Street Sweeping: A comprehensive street sweeping and cleanup program should be developed to remove sediment and trash from the streets and gutters so debris is not washed to downstream storm drain control facilities and ultimately into the Little Creek. It is anticipated that this simple maintenance procedure will greatly reduce future costs for maintenance of the storm drain system.

Complete Regular Facility Cleaning: A comprehensive facility maintenance program should be established to clean inlet boxes, manholes, pipe systems, and any future pollution control structures. Regular maintenance will ensure the proper functionality of these structures, prolong life expectancy and reduce future maintenance costs.

Ensure Proper Grate Orientation: Ensure that the catch basins in the Apple Valley Town storm drain system that are fitted with directional grates have the directional grates installed in the correct orientation to function at maximum efficiency. Maintenance of the storm drain system should include a procedure to ensure that the grates on every catch basin are oriented properly.

Establish Standard Maintenance Program: It is recommended that the Town develop a regular storm drain system maintenance program with proper tracking and record keeping. This process is most easily accomplished using current computer technology including mapping and record keeping software. Implementing such a system will allow the Town to maintain the storm drain system at the highest level of efficiency.

Maintain a Current System Map: It is strongly recommended that Apple Valley Town maintain a thorough storm drain system map. Modern computer technology makes this task relatively simple and having the map will significantly reduce storm drain system maintenance costs. If possible, this map should include sizes, materials, and slopes of existing improvements.

J. WATER QUALITY IMPROVEMENT MEASURES

One of the primary goals of a stormwater management plan is to enhance the quality of water discharged to downstream stormwater conveyance facilities. Runoff generated from urban and suburban areas often contains pollutants such as sediments, road salts, oils, greases, solvents, pesticides, fertilizers, detergents, trash and many other forms of pollutants which may be discharged to downstream rivers and lakes. The Environmental Protection Agency (EPA) requires that these pollutants be controlled, mitigated and otherwise eliminated before they are discharged.

The first line of defense against pollution discharges are detention basin facilities installed near low segments of storm drain systems. Detention basins control peak flows that would otherwise be routed directly to receiving discharge facilities. As stormwater runoff is held in the detention basin, flow velocity of the water is minimized and many of the suspended pollutants are able to settle out. Some of the pollutants are broken down organically while the physical debris, such as trash and sediment, can be manually cleaned from the detention basin and disposed of properly. This study recommends installation of local detention basin facilities in future developments in the Town. These would be implemented by individual developers.

The second line of defense against pollution discharges are Best Management Practice (BMP) structures such as oil and grease separation structures. These structures are devices that are designed to remove oils, greases and other similar materials from stormwater before it is discharged to downstream receiving facilities. It is recommended that a structure of this type be installed at each of the detention basins to ensure that these pollutant types are removed from stormwater before it is discharged from the storm drain system into the Little Creek. It should be noted that these facilities require regular maintenance. If not cleaned and maintained properly, these devices cease to function and no pollutants are removed from the discharge flows.

V. COST & PROPOSED IMPACT FEES

A. SYSTEM IMPROVEMENT

The recommended storm drain improvements were outlined in the Recommended Improvements list given in the previous section of this study. Unit costs were applied to the recommended improvements and cost estimates were derived for the purpose of future financial planning. Table V.A.1 in Appendix E is the Engineer's Opinion of Probable Cost for each of the recommended improvements. It should be noted that these cost estimates are based on current, 2020, market prices.

K. STORM DRAIN IMPACT FEES

As detailed throughout this report, Apple Valley Town is in need of additional storm drain system infrastructure to meet the needs of current and future drainage scenarios. The Town is responsible for the current deficiencies in the storm drain system, but future development that occurs within the drainage area analyzed will further add to the deficiencies in the system. Because of this, an appropriate share of the costs associated with the recommended improvements should be borne by development.

To determine this appropriate share, the total area of undeveloped land within the drainage area analyzed, but understood to be developable, was divided by the total area of the drainage area. This percentage was taken to be the portion of the improvement costs that is impact fee eligible. The figure delineating the undeveloped versus developed land is included as Figure V.B.1 in Appendix A. The current Build-out Study prepared by the Eastern Washington County Rural Planning Organization was used as the basis for this delineation.

Table V.B.1 in Appendix E shows the calculations used to determine the maximum impact fee per acre of land. The interest from new debt service shown in the calculation is based on a 30-year loan using an interest rate of 2.5%.

The maximum impact fee allowable based on this calculation is $2,886 per acre. It is the responsibility of the Town to set the actual impact fee, but it is recommended that the impact fee be set so that the Town will have sufficient funds to cover annual expenses resulting from improvement projects.

It should be noted that no estimate was included for curb and gutter improvements recommended in this report and costs for these improvements were not included in the impact fee calculation. The primary reason for this is because curb and gutter improvements for areas that have previously been developed are understood to be ineligible to be paid for using impact fees. In addition, it is understood that curb and gutter improvements will be constructed by developers in areas where new development takes place.

It should also be noted that this study recommends not charging impact fees for development falling outside of the major drainage basins which route storm water flow through the Town. The reason for this is because the areas falling outside of this boundary route storm water directly to the Little Creek without first passing through the Town. In other words, these developments will not impact the existing infrastructure of the Town. The developers will be responsible to construct adequate storm water improvements without increasing the downstream runoff to these natural drainage channels.

If the Town determines not to move forward with the recommended project as proposed, then the Town should consider not implementing impact fees as proposed to ensure that the Town is in compliance with the Impact Fee Act. If the Town determines to move forward with the recommendations in this report in phases or as funds become available to cover the costs of phased improvements, the Town will be responsible to ensure that impact fees collected are projected to be incurred or encumbered within six years of collecting the impact fee to ensure compliance with the Impact Fee Act.

The Impact Fee Analysis contained herein:

includes only the costs for qualifying public facilities that are:

a) allowed under the Impact Fee Act;
b) projected to be incurred or encumbered within six years after each impact fee is paid;
c) contains no cost for operation and maintenance of public facilities;
d) offsets costs with grants or other alternate sources of payment;
e) does not include costs for qualifying public facilities that will raise the level of service for the facilities, through impact fees, above the level of service that is supported by existing residents, and;
f) complies in each and every relevant respect with the Impact Fees Act.

This certification is valid as long as the recommendations outlined in this report are followed and as long as the Town expends impact fees collected on qualifying expenses within 6 years from the date of collection. See Appendix F for more information regarding this certification.

L. PROPOSED FINANCING PLAN

A possible financing plan for the recommended improvements has been included as Table V.C.1 in Appendix E. This financing plan is submitted only as a guide and should be used only as such. It should be noted that an increase in drainage rates would be required in order to proceed with a project covering all of the recommended improvements. This increase will be explained in the following sub-section.

M. DRAINAGE RATE ANALYSIS

The Town of Apple Valley currently charges for drainage according to the following rate structure. The differing rates are based on the zoning type.

Residential	$10 per month
Commercial	$25 per month

The Town currently has 318 residential customers and 1 commercial customers. The average rate per billing is $10.05.

In order to proceed with one project covering all of the recommended projects, financing would need to be obtained for the capital expense associated with the project and a rate increase would be needed. The revenues generated must be sufficient to cover the expenses incurred by the construction, maintenance, and administration of the storm water system. These administrative expenses include debt service, insurance, personnel salaries, legal and professional fees, and other miscellaneous items.

If the Town were to move forward with the project in 2022, the first year of debt service would need to be paid in 2023. The Town budget from fiscal year ending in 2018, 2019, and 2020 were used as a source to determine existing expenses relating to the Drainage utility. The expenses were projected assuming a 3% annual inflation rate to estimate the expenses in fiscal year 2023.

In order to determine the required average drainage fee rate, the total expenses estimated were reduced by the estimated amount of impact fees to be collected. This amount was determined by using the growth rate projections given to SEI by the town. As shown in Table V.C.1 in Appendix E, the projected number of impact fees to be collected in fiscal year 2023 is 22.

The amount of expenses remaining after taking into account the projected income from impact fees, was divided by the projected number of customers in fiscal year 2023. As shown in Table V.C.1 in Appendix E, the number of customers projected is 377. The final average monthly rate per customer was determined by dividing the number calculated above by the 12 months of the year. Based on the financing plan and drainage rate analysis described previously, the average monthly rate per customer required to move forward with a single project including all of the recommended projects is $15.21. This calculation is shown on the Proposed Financing Plan included as Table V.C.1 in Appendix E.

Drainage rates and related fees should be evaluated regularly to ensure that they are sufficient to cover actual expenses incurred by the utility.

N. CASH FLOW ANALYSIS

Using the information from the proposed financing plan, a cash flow analysis was performed for the life of the loan associated with the project. This analysis assumes an annual rate increase of 3%. The analysis also includes a renewal and replacement fund equal to 5% of the projected annual expenses to be used for ongoing maintenance and replacements. It is strongly recommended that the Town incorporate this type of fund into the budget for the drainage utility.

The Cash Flow Analysis has been included as Table V.E.1 in Appendix E.

APPENDIX A – MASTER PLAN FIGURES

Figure II.C.1

EXISTING DRAINAGE BASINS

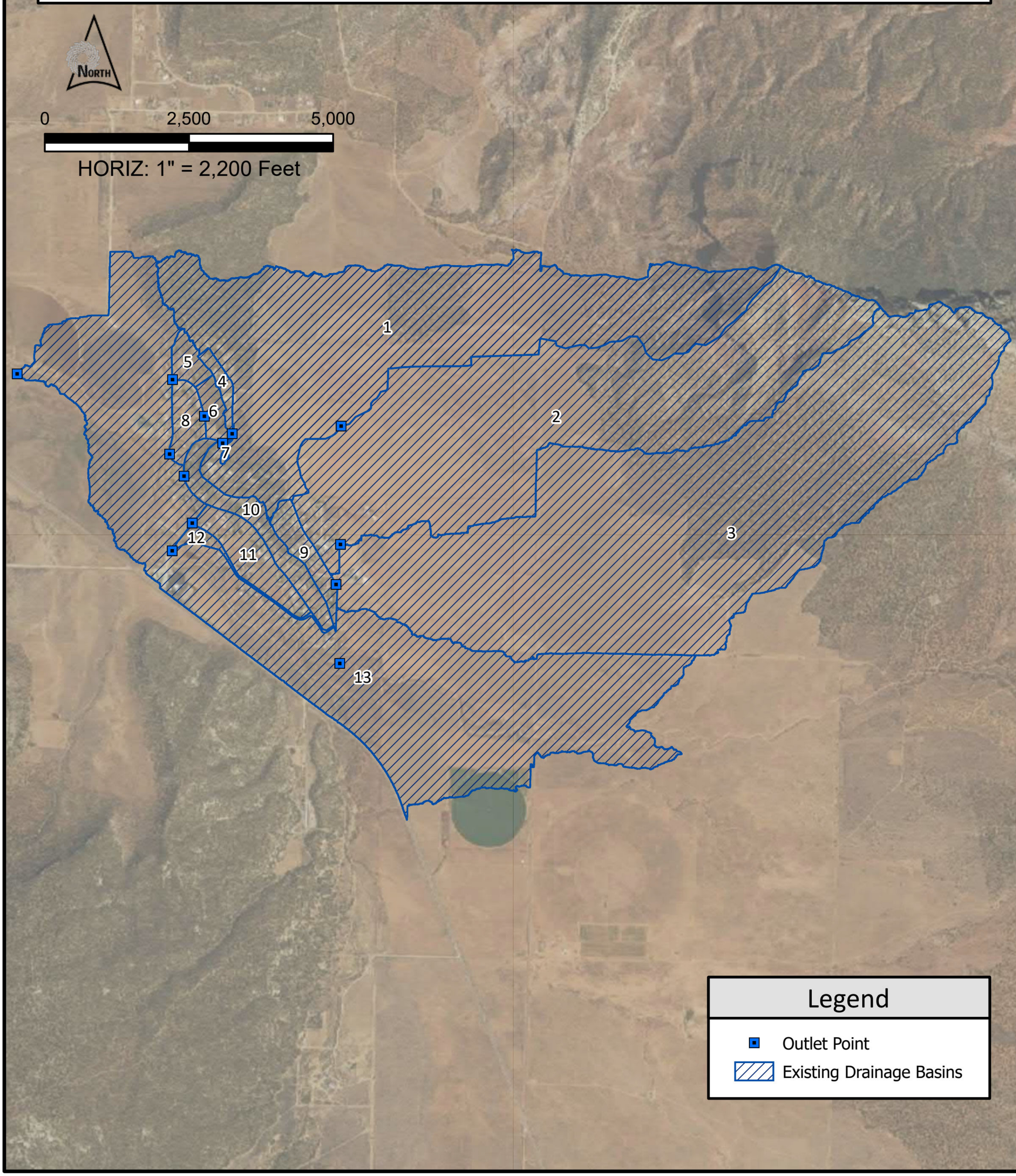


Figure II.B.1

SOILS MAP

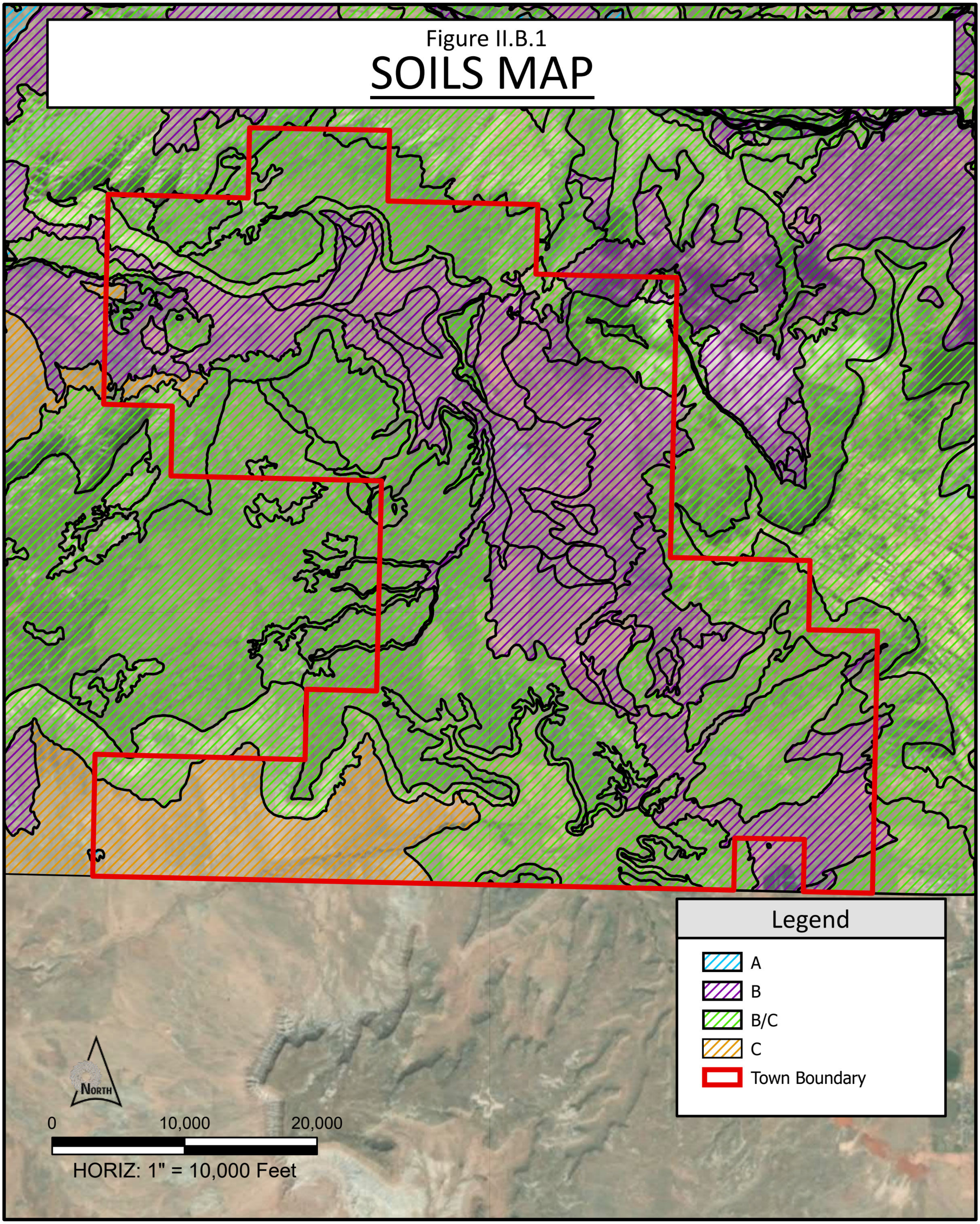
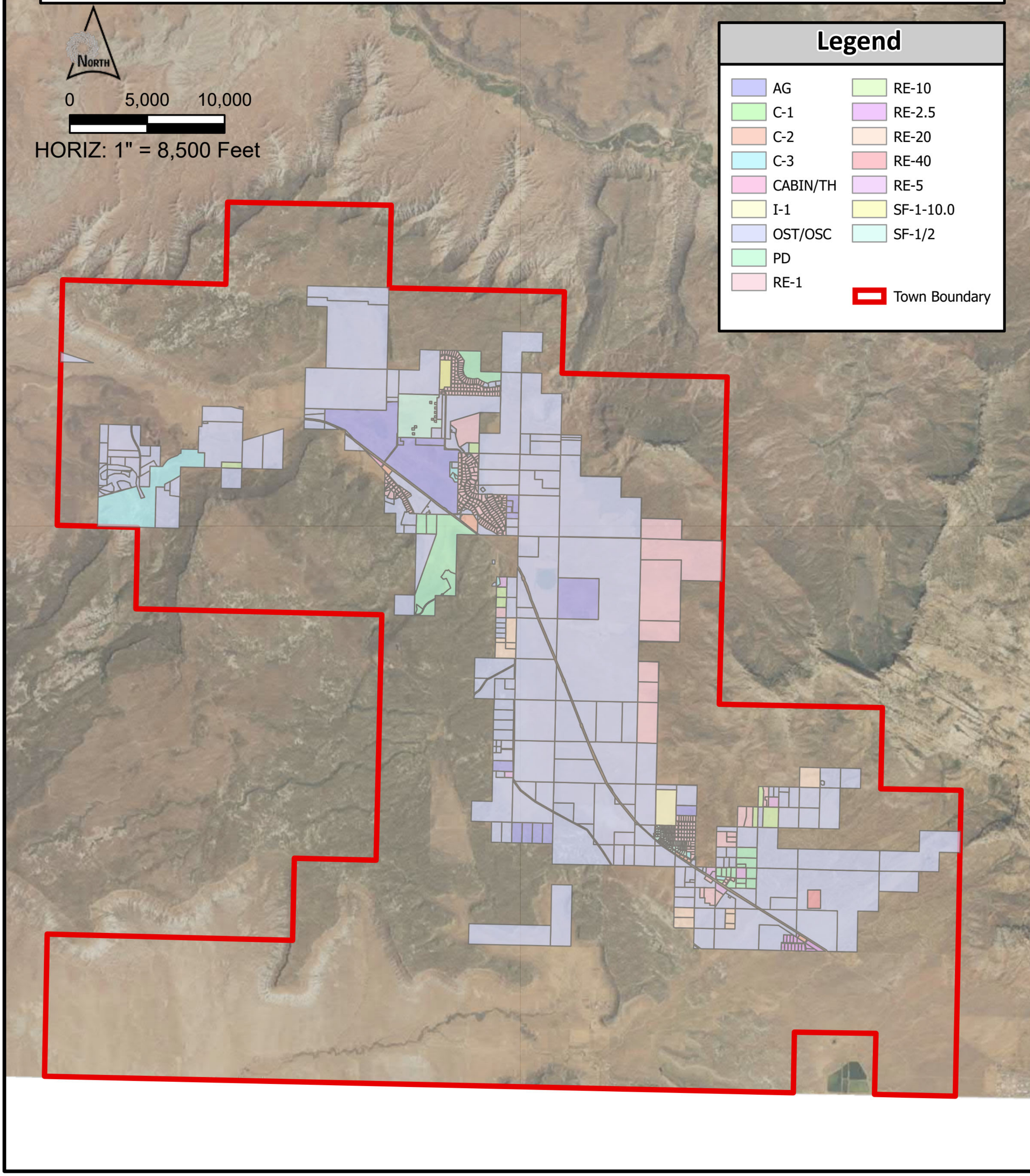


Figure II.E.1

Apple Valley Zoning Map



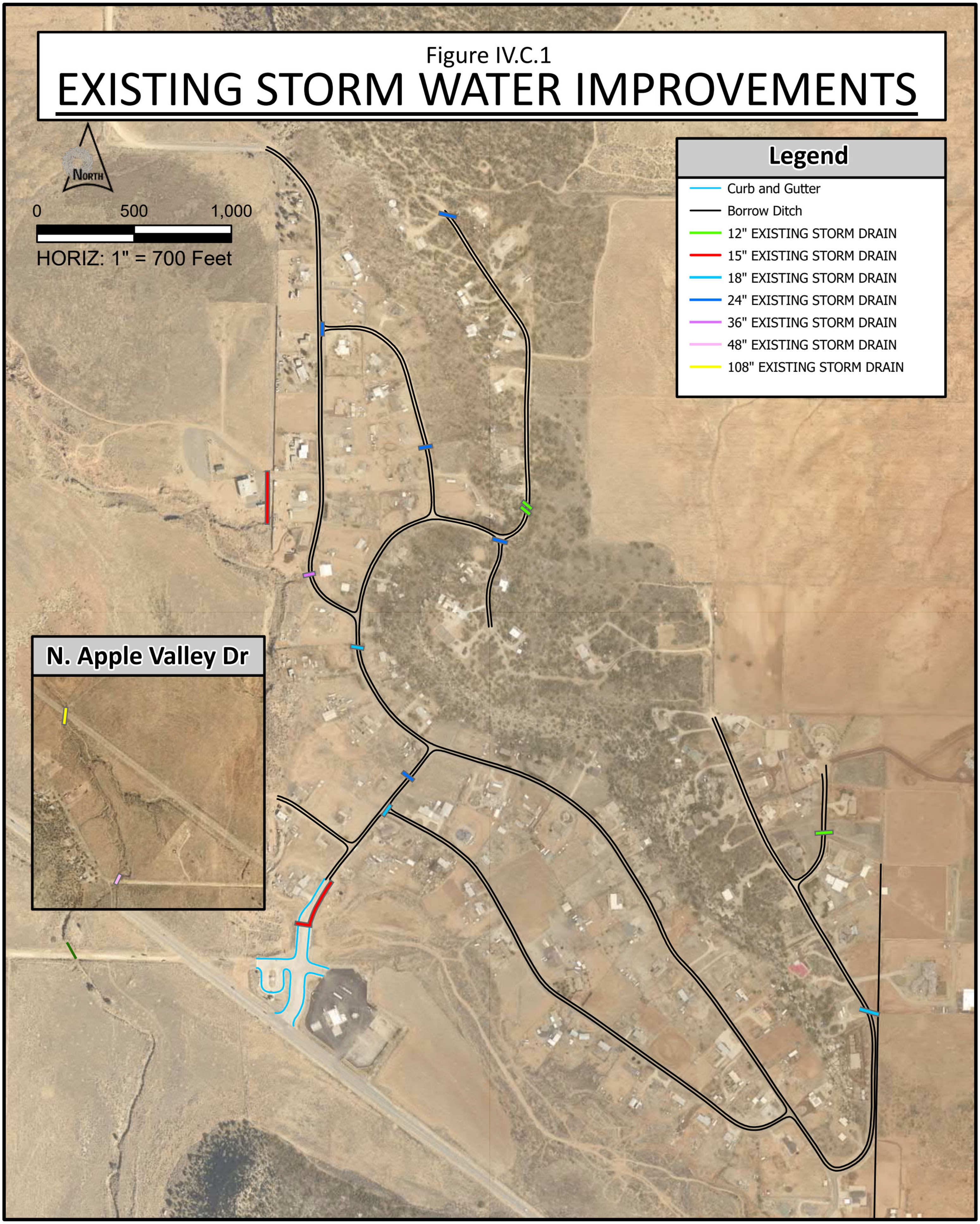


Figure IV.C.1
EXISTING STORM WATER IMPROVEMENTS
NORTH
0
500
1,000
HORIZ: 1" = 700 Feet
Legend
Curb and Gutter
Borrow Ditch
12" EXISTING STORM DRAIN
15" EXISTING STORM DRAIN
18" EXISTING STORM DRAIN
24" EXISTING STORM DRAIN
36" EXISTING STORM DRAIN
48" EXISTING STORM DRAIN
108" EXISTING STORM DRAIN
N. Apple Valley Dr

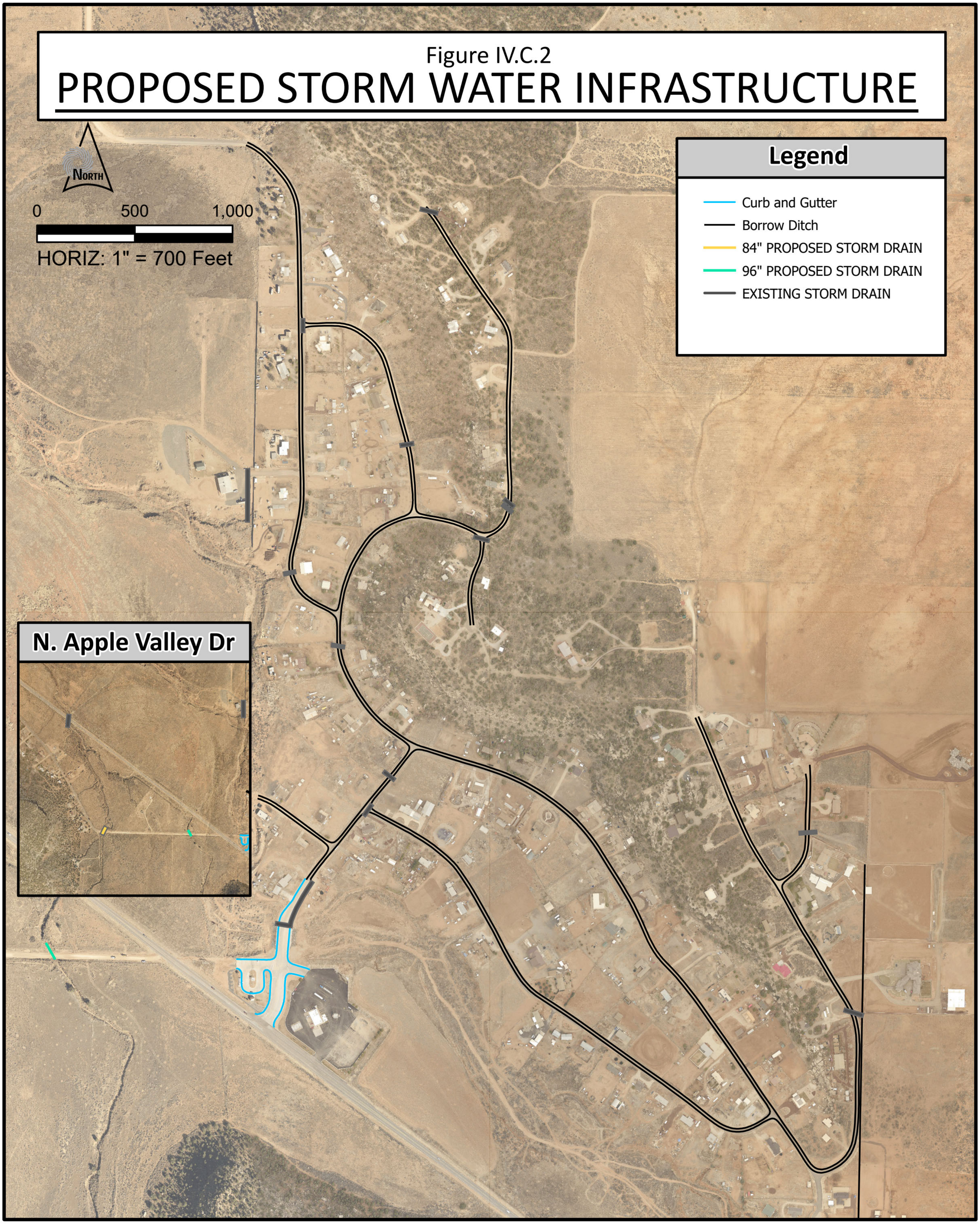
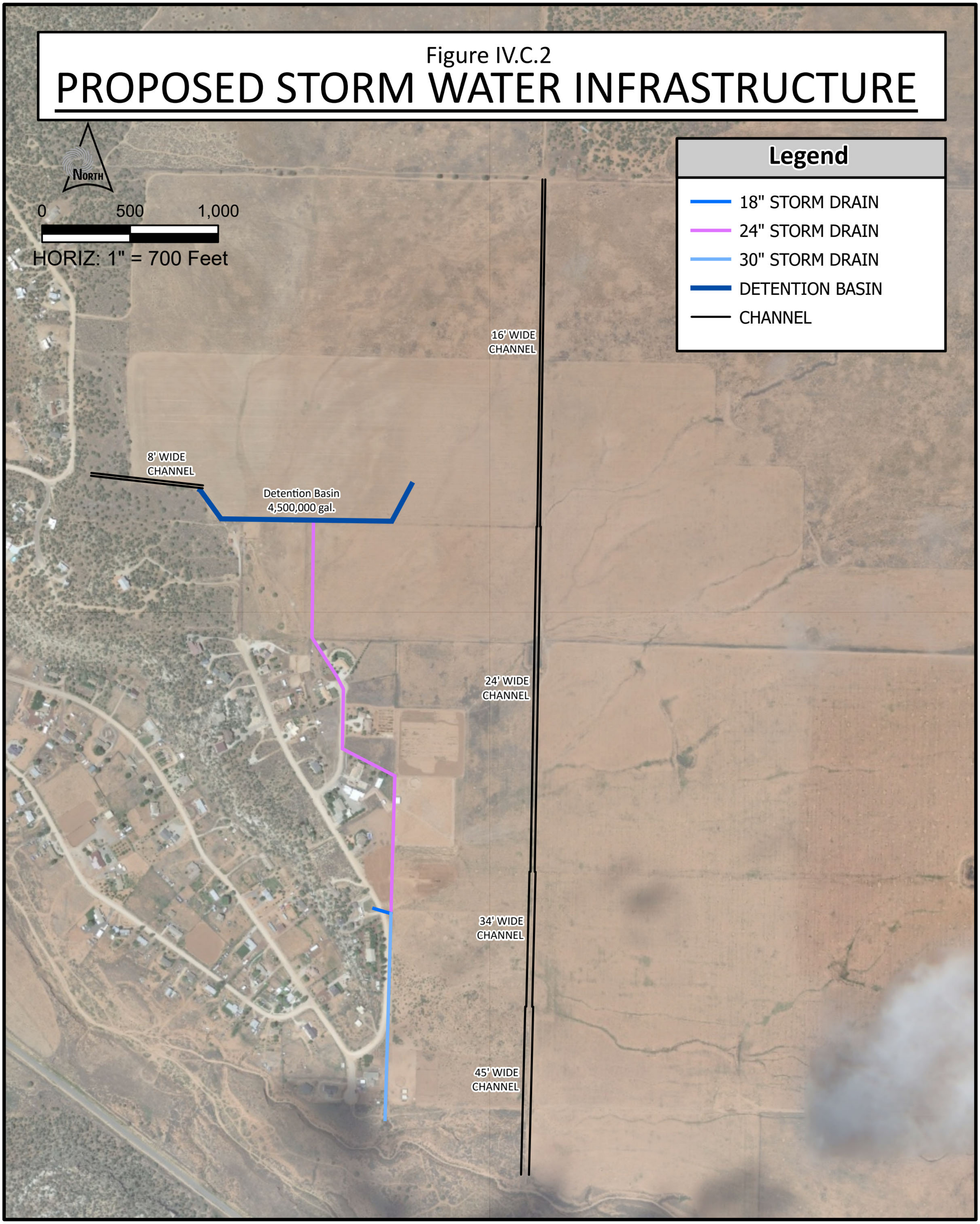


Figure IV.C.2
PROPOSED STORM WATER INFRASTRUCTURE
NORTH
0
500
1,000
HORIZ: 1" = 700 Feet
Legend
Curb and Gutter
Borrow Ditch
84" PROPOSED STORM DRAIN
96" PROPOSED STORM DRAIN
EXISTING STORM DRAIN
N. Apple Valley Dr

Figure IV.C.2

PROPOSED STORM WATER INFRASTRUCTURE



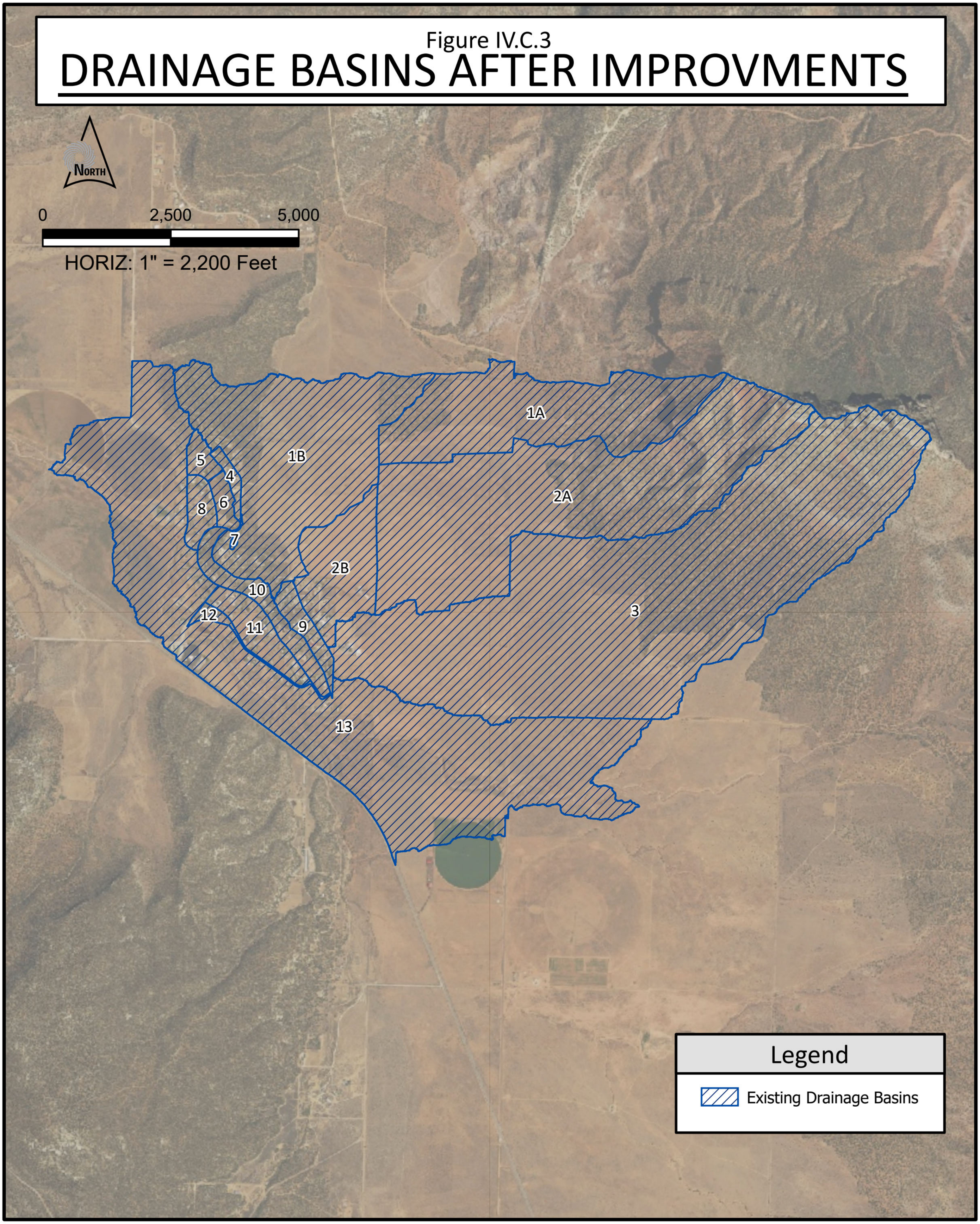
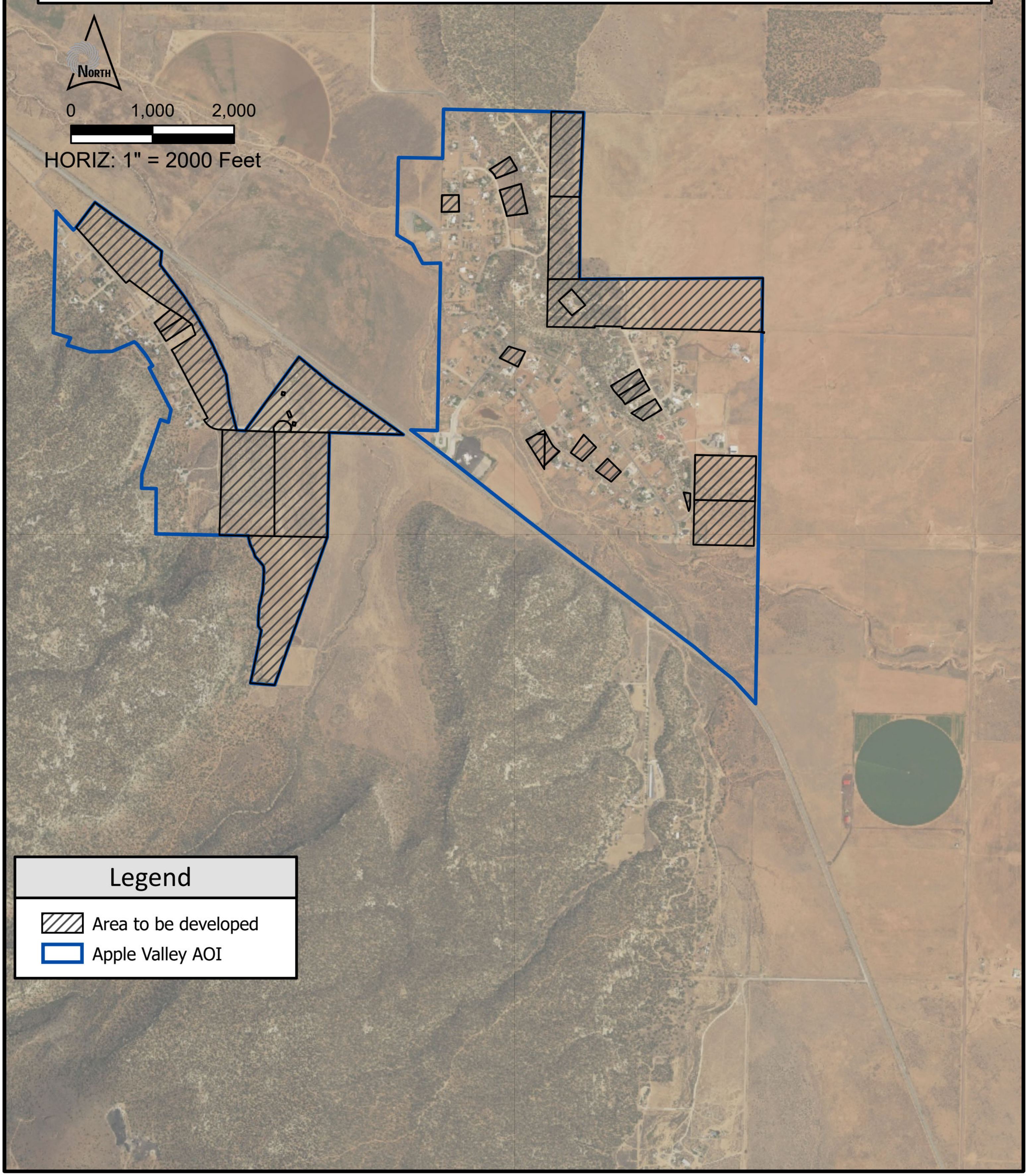


Figure IV.C.3
DRAINAGE BASINS AFTER IMPROVMENTS
NORTH
0
2,500
5,000
HORIZ: 1" = 2,200 Feet
1A
1B
2A
2B
3
4
5
6
7
8
9
10
11
12
13
Legend
Existing Drainage Basins

Figure V.B.1

AREA TO BE DEVELOPED



APPENDIX B – MASTER PLAN TABLES

Table III.B.1
NOAA Precipitation Data

Rainfall Depth-Duration-Frequency (DDF)						
	Rainfall Depth, in inches					
	Storm Frequency, in years					
Duration	2	5	10	25	50	100
5-min	0.19	0.26	0.32	0.42	0.50	0.59
10-min	0.29	0.40	0.49	0.63	0.76	0.90
15-min	0.36	0.49	0.61	0.79	0.94	1.12
30-min	0.48	0.66	0.82	1.06	1.27	1.51
1-hour	0.60	0.82	1.01	1.31	1.57	1.87
2-hour	0.71	0.94	1.14	1.45	1.72	2.03
3-hour	0.79	1.02	1.22	1.52	1.77	2.08
6-hour	0.99	1.25	1.47	1.80	2.06	2.35
12-hour	1.24	1.56	1.82	2.17	2.44	2.73
24-hour	1.48	1.85	2.15	2.56	2.89	3.22

NOAA Atlas 14, Volume 1, Version 5
Location name: Hurricane, Utah, USA*
Latitude: 37.1029°, Longitude: -113.1227°
Elevation: 4775.6 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.147 (0.126-0.173)	0.189 (0.162-0.224)	0.259 (0.221-0.308)	0.321 (0.271-0.380)	0.416 (0.345-0.493)	0.499 (0.407-0.590)	0.594 (0.474-0.708)	0.704 (0.547-0.845)	0.875 (0.653-1.07)	1.03 (0.742-1.27)
10-min	0.223 (0.192-0.263)	0.288 (0.247-0.342)	0.395 (0.336-0.468)	0.489 (0.412-0.579)	0.633 (0.526-0.750)	0.759 (0.620-0.899)	0.904 (0.722-1.08)	1.07 (0.832-1.29)	1.33 (0.994-1.62)	1.56 (1.13-1.93)
15-min	0.277 (0.237-0.326)	0.357 (0.306-0.423)	0.489 (0.417-0.580)	0.607 (0.511-0.718)	0.785 (0.652-0.930)	0.941 (0.769-1.11)	1.12 (0.895-1.34)	1.33 (1.03-1.59)	1.65 (1.23-2.01)	1.94 (1.40-2.40)
30-min	0.372 (0.320-0.440)	0.480 (0.412-0.570)	0.659 (0.562-0.781)	0.817 (0.689-0.967)	1.06 (0.877-1.25)	1.27 (1.03-1.50)	1.51 (1.21-1.80)	1.79 (1.39-2.15)	2.22 (1.66-2.71)	2.61 (1.89-3.23)
60-min	0.461 (0.396-0.544)	0.595 (0.510-0.706)	0.816 (0.696-0.967)	1.01 (0.852-1.20)	1.31 (1.09-1.55)	1.57 (1.28-1.86)	1.87 (1.49-2.23)	2.21 (1.72-2.66)	2.75 (2.05-3.36)	3.23 (2.33-3.99)
2-hr	0.559 (0.487-0.645)	0.707 (0.616-0.818)	0.937 (0.814-1.08)	1.14 (0.983-1.32)	1.45 (1.23-1.68)	1.72 (1.43-1.99)	2.03 (1.66-2.37)	2.39 (1.90-2.81)	2.94 (2.25-3.51)	3.43 (2.54-4.15)
3-hr	0.624 (0.552-0.711)	0.785 (0.694-0.899)	1.02 (0.899-1.17)	1.22 (1.07-1.39)	1.52 (1.31-1.74)	1.77 (1.51-2.04)	2.08 (1.74-2.40)	2.42 (1.98-2.82)	2.95 (2.34-3.54)	3.44 (2.66-4.19)
6-hr	0.787 (0.703-0.891)	0.985 (0.883-1.12)	1.25 (1.12-1.42)	1.47 (1.31-1.67)	1.80 (1.57-2.04)	2.06 (1.78-2.34)	2.35 (2.01-2.68)	2.69 (2.26-3.10)	3.24 (2.65-3.79)	3.72 (2.98-4.41)
12-hr	0.990 (0.888-1.11)	1.24 (1.11-1.39)	1.56 (1.39-1.75)	1.82 (1.62-2.04)	2.17 (1.91-2.43)	2.44 (2.13-2.75)	2.73 (2.36-3.09)	3.03 (2.59-3.45)	3.49 (2.92-4.02)	3.94 (3.26-4.60)
24-hr	1.19 (1.09-1.29)	1.48 (1.36-1.61)	1.85 (1.70-2.01)	2.15 (1.97-2.34)	2.56 (2.34-2.79)	2.89 (2.62-3.15)	3.22 (2.91-3.52)	3.57 (3.20-3.91)	4.04 (3.58-4.45)	4.41 (3.87-4.89)
2-day	1.36 (1.25-1.47)	1.69 (1.57-1.84)	2.12 (1.96-2.30)	2.47 (2.27-2.68)	2.95 (2.70-3.20)	3.33 (3.04-3.62)	3.72 (3.37-4.06)	4.12 (3.72-4.51)	4.68 (4.16-5.16)	5.12 (4.51-5.68)
3-day	1.47 (1.36-1.60)	1.84 (1.70-2.00)	2.31 (2.13-2.50)	2.69 (2.48-2.91)	3.21 (2.95-3.48)	3.62 (3.31-3.94)	4.05 (3.68-4.42)	4.50 (4.05-4.92)	5.11 (4.55-5.63)	5.59 (4.93-6.20)
4-day	1.59 (1.47-1.72)	1.99 (1.84-2.15)	2.49 (2.30-2.70)	2.90 (2.68-3.14)	3.47 (3.19-3.76)	3.92 (3.58-4.25)	4.39 (3.99-4.78)	4.88 (4.39-5.33)	5.54 (4.93-6.10)	6.07 (5.34-6.73)
7-day	1.89 (1.73-2.06)	2.37 (2.18-2.58)	2.99 (2.74-3.25)	3.48 (3.19-3.79)	4.16 (3.79-4.53)	4.68 (4.25-5.11)	5.23 (4.72-5.73)	5.79 (5.19-6.37)	6.56 (5.81-7.27)	7.16 (6.28-7.98)
10-day	2.10 (1.93-2.30)	2.65 (2.43-2.89)	3.36 (3.08-3.66)	3.92 (3.60-4.27)	4.70 (4.29-5.13)	5.31 (4.82-5.81)	5.94 (5.35-6.52)	6.59 (5.89-7.26)	7.48 (6.60-8.30)	8.18 (7.15-9.15)
20-day	2.71 (2.49-2.94)	3.40 (3.13-3.69)	4.23 (3.89-4.60)	4.87 (4.47-5.29)	5.72 (5.23-6.21)	6.36 (5.79-6.91)	7.00 (6.35-7.64)	7.64 (6.88-8.38)	8.49 (7.57-9.37)	9.13 (8.07-10.1)
30-day	3.30 (3.03-3.59)	4.14 (3.81-4.50)	5.15 (4.74-5.61)	5.93 (5.44-6.45)	6.94 (6.34-7.55)	7.69 (7.00-8.37)	8.44 (7.65-9.22)	9.18 (8.27-10.1)	10.1 (9.06-11.2)	10.8 (9.63-12.0)
45-day	3.92 (3.59-4.29)	4.94 (4.52-5.40)	6.21 (5.68-6.78)	7.18 (6.56-7.85)	8.48 (7.71-9.27)	9.47 (8.57-10.4)	10.5 (9.43-11.5)	11.5 (10.3-12.7)	12.8 (11.3-14.2)	13.8 (12.2-15.4)
60-day	4.57 (4.16-5.02)	5.76 (5.24-6.33)	7.25 (6.59-7.97)	8.40 (7.62-9.23)	9.91 (8.97-10.9)	11.1 (9.97-12.2)	12.2 (11.0-13.5)	13.4 (11.9-14.9)	15.0 (13.2-16.7)	16.1 (14.1-18.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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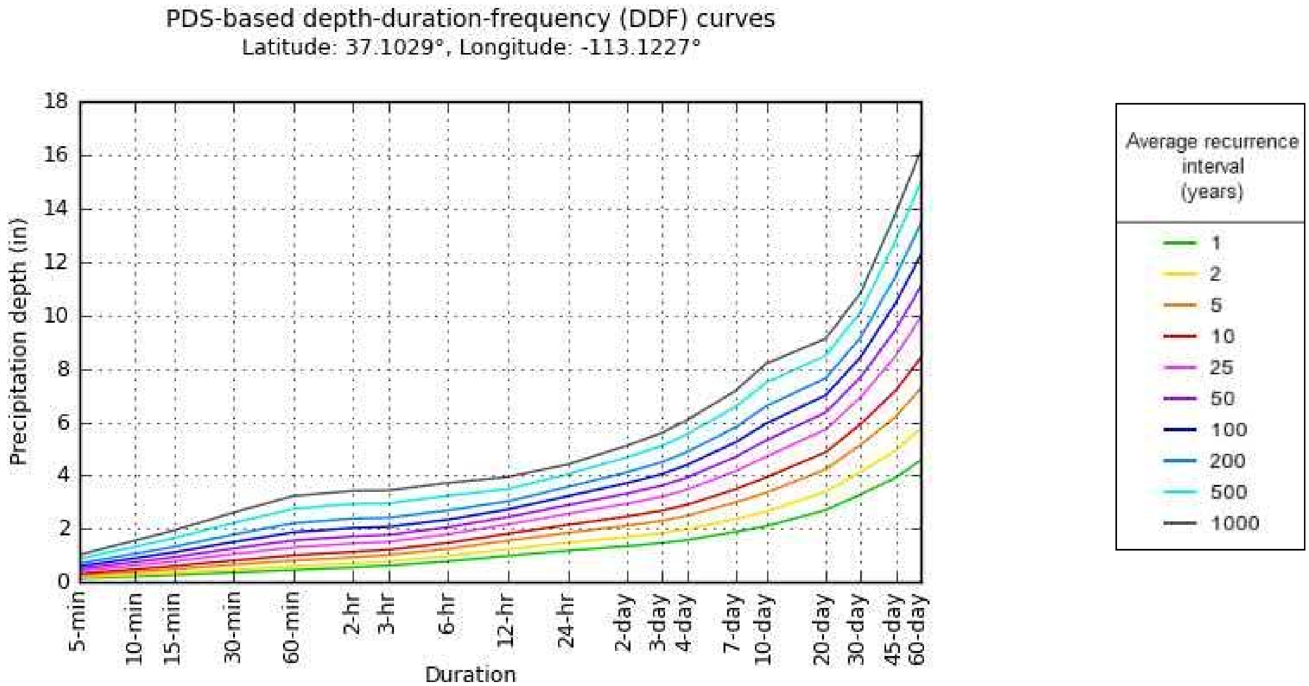
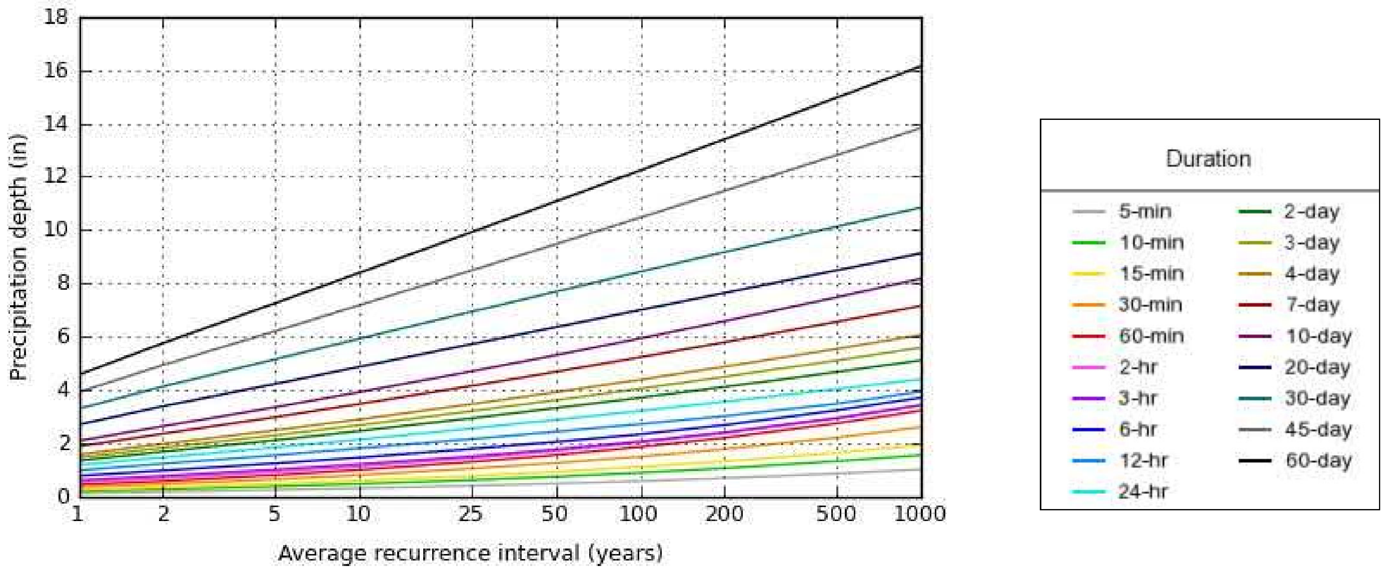
PF graphical





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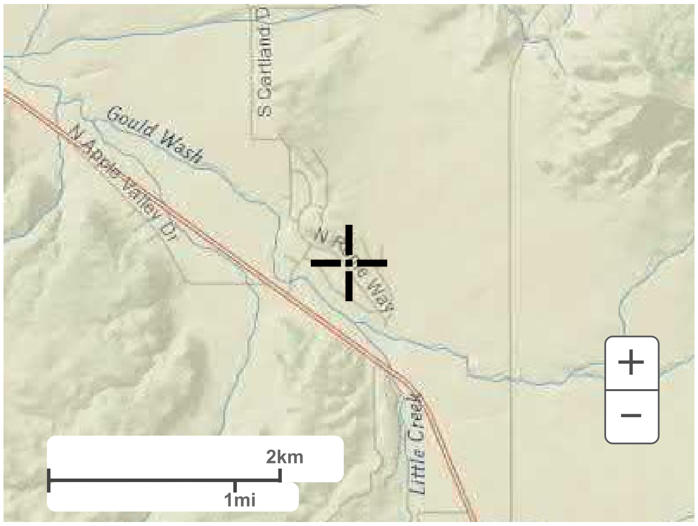
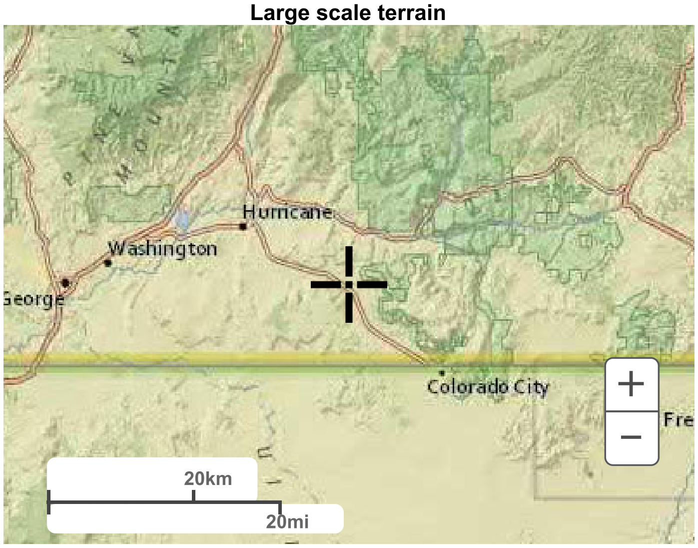
Maps & aerials

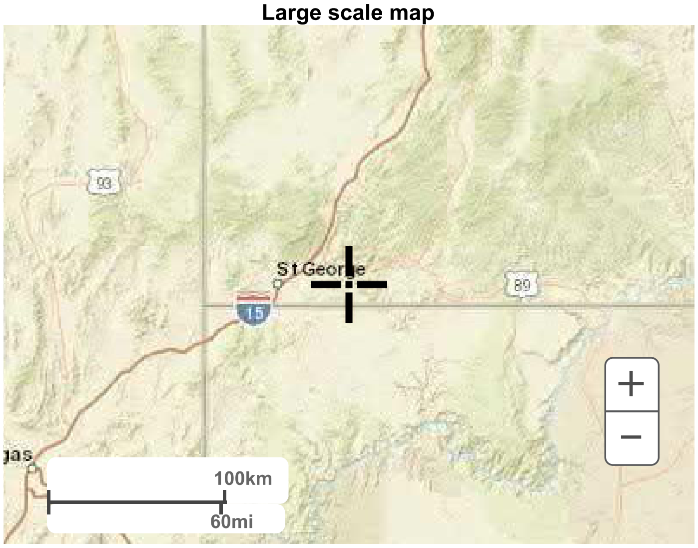
Small scale terrain



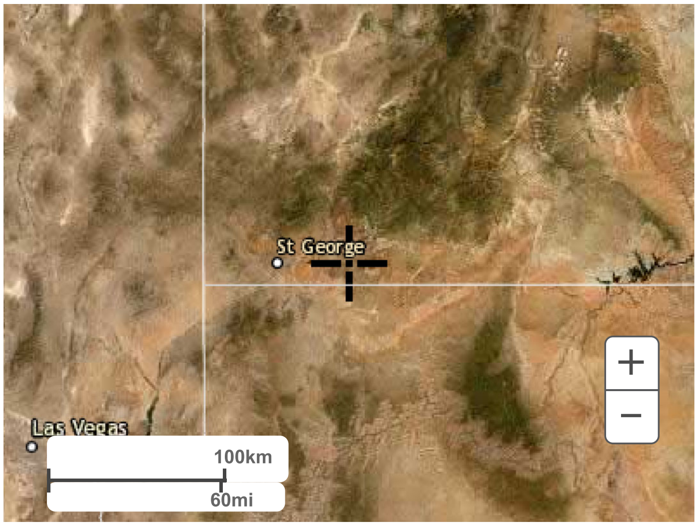
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table III.B.2
Rainfall Distribution

Time	Inches (incremental)	* Inches (cumulative)	Difference	Distributed	Cumulative	Percentage
0	0.0000	0.00	0.000	0.000	0.000	0.00
15	0.0405	0.61	0.607	0.020	0.020	1.64
30	0.0272	0.82	0.210	0.020	0.040	3.28
45	0.0203	0.91	0.097	0.033	0.073	5.94
60	0.0168	1.01	0.097	0.033	0.105	8.61
75	0.0139	1.04	0.033	0.097	0.202	16.52
90	0.0119	1.08	0.033	0.607	0.809	66.27
105	0.0105	1.11	0.033	0.210	1.019	83.48
120	0.0095	1.14	0.033	0.097	1.115	91.39
135	0.0086	1.16	0.020	0.033	1.148	94.06
150	0.0079	1.18	0.020	0.033	1.180	96.72
165	0.0073	1.20	0.020	0.020	1.200	98.36
180	0.0068	1.22	0.020	0.020	1.220	100.00

* Taken from the NOAA Atlas 14 data and interpolated for unknown points.

Actual data from Atlas 14
Interpolated data from Atlas 14

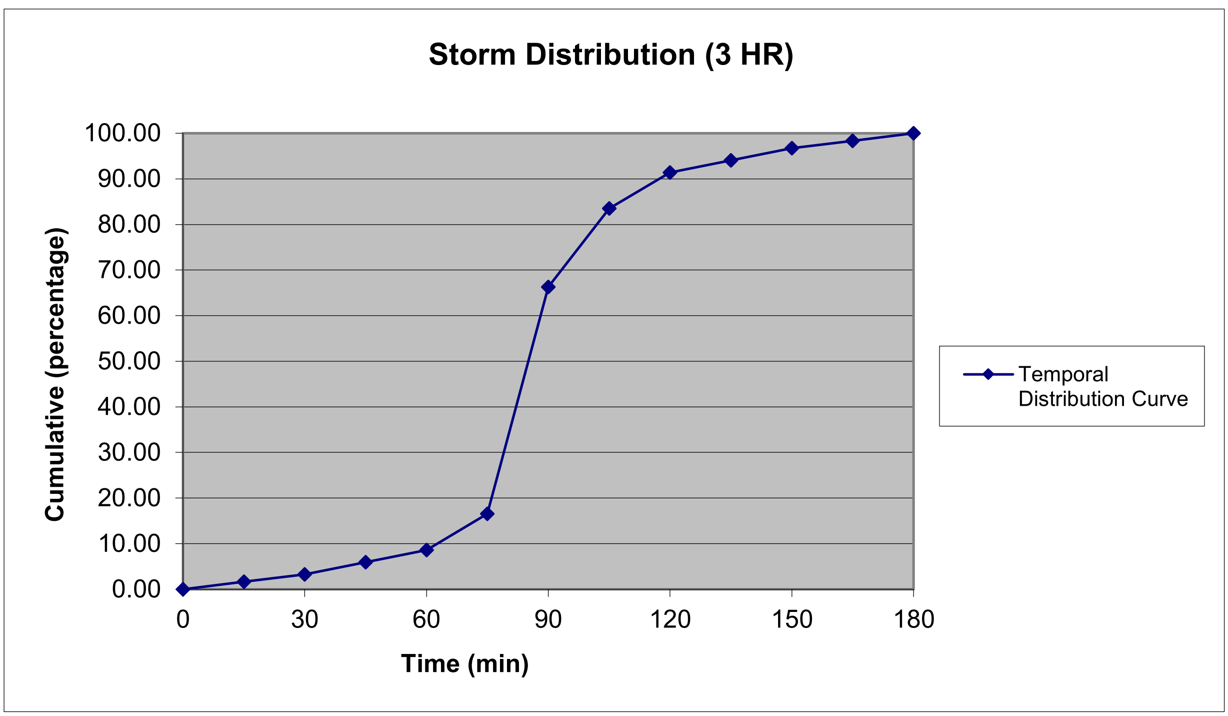

Table III.B.3
Drainage Basin Parameters Analysis Results (1 of 2)

Basin Name	Basin Area (mi2)	Basin Slopes (ft/ft)	CN	Lag Time (hr)	10-Year 3-Hour		100-Year 3-Hour	
					Peak Flow (cfs)	Total Flow (Ac-Ft)	Peak Flow (cfs)	Total Flow (Ac-Ft)
1	0.714	0.079	82.8	0.685	74.8	8.5	270.3	28.1
2	0.739	0.158	84.8	0.439	128.5	11.0	419.7	33.3
3	1.135	0.156	83.9	0.615	142.4	15.3	510.7	48.1
4	0.010	0.092	83.0	0.138	2.4	0.1	9.6	0.4
5	0.015	0.219	87.8	0.047	6.8	0.3	20.1	0.8
6	0.014	0.153	84.4	0.063	4.3	0.2	15.7	0.6
7	0.001	0.037	81.4	0.071	0.3	0.0	1.2	0.0
8	0.023	0.097	87.3	0.112	10.0	0.4	30.7	1.2
9	0.027	0.061	87.9	0.178	9.8	0.5	29.4	1.5
10	0.048	0.146	84.6	0.212	10.9	0.7	36.1	2.2
11	0.047	0.013	87.3	0.489	10.3	0.9	30.3	2.5
12	0.010	0.015	86.8	0.480	2.1	0.2	6.2	0.5

Table III.B.3
Drainage Basin Parameters Analysis Results (2 of 2)

Outlet	10-Year 3-Hour		100-Year 3-Hour	
	Peak Flow (cfs)	Total Flow (Ac-Ft)	Peak Flow (cfs)	Total Flow (Ac-Ft)
Junction 1	197.0	19.6	684.4	61.4
Junction 2	343.9	35.5	1216.2	111.0
Junction 3	324.0	35.6	1174.4	111.5
Junction 6	12.4	1.1	36.5	3.0
Junction 7	12.1	1.1	36.2	3
Junction 8	2.4	0.1	9.6	0.4
Junction 9	2.5	0.1	10.4	0.5
Junction 10	12.9	0.8	44.2	2.6
Junction 12	4.3	0.2	15.7	0.6
Junction 13	18.4	1	60.4	2.7
Junction 14	6.8	0.3	20.1	0.8

Table III.B.4 (1 of 2)
Drainage Basin Parameters Analysis Results (After Improvements)

Basin Name	Basin Area (mi2)	Basin Slopes (ft/ft)	CN	Lag Time (hr)	10-Year 3-Hour		100-Year 3-Hour	
					Peak Flow (cfs)	Total Flow (Ac-Ft)	Peak Flow (cfs)	Total Flow (Ac-Ft)
1a	0.304	0.137	82.8	0.389	42.2	3.6	166.9	12.0
1b	0.410	0.036	82.8	0.564	48.6	4.9	184.0	16.2
2a	0.624	0.184	84.8	0.390	112.8	9.3	394.5	28.1
2b	0.115	0.016	84.8	0.605	16.4	1.7	55.8	5.2
3	1.135	0.156	83.9	0.615	142.4	15.3	510.7	48.1
4	0.010	0.092	83.0	0.138	2.4	0.1	9.6	0.4
5	0.015	0.219	87.8	0.047	6.8	0.3	20.1	0.8
6	0.014	0.153	84.4	0.063	4.3	0.2	15.7	0.6
7	0.001	0.037	81.4	0.071	0.3	0.0	1.2	0.0
8	0.023	0.097	87.3	0.112	10.0	0.4	30.7	1.2
9	0.027	0.061	87.9	0.178	9.8	0.5	29.4	1.5
10	0.048	0.146	84.6	0.212	10.9	0.7	36.1	2.2
11	0.047	0.013	87.3	0.489	10.3	0.9	30.3	2.5
12	0.010	0.015	86.8	0.480	2.1	0.2	6.2	0.5

Table III.V.4 (2 of 2)
Drainage Basin Parameters Analysis Results (After Improvements)

Outlet	10-Year 3-Hour		100-Year 3-Hour	
	Peak Flow (cfs)	Total Flow (Ac-Ft)	Peak Flow (cfs)	Total Flow (Ac-Ft)
Junction 1	42.2	3.6	166.9	12.0
Junction 2	151.4	13.0	537.5	40.2
Junction 3	150.6	13.0	510.1	40.3
Junction 4	291.7	28.9	1027.3	90.1
Junction 5	272.7	29.0	993.9	90.5
Junction 6	12.4	1.1	36.5	3.0
Junction 7	12.1	1.1	36.2	3
Junction 8	2.4	0.1	9.6	0.4
Junction 9	2.5	0.1	10.4	0.5
Junction 10	12.9	0.8	44.2	2.6
Junction 12	4.3	0.2	15.7	0.6
Junction 13	18.4	1	60.4	2.7
Junction 14	6.8	0.3	20.1	0.8

APPENDIX C – HYDROLOGIC EVALUATION RESOURCES

Table IV.B.1
Conveyance Capacity of Roadway Swales

Slope (%)	One Swale		Two Swales	
	Q (cfs)	Q (gpm)	Q (cfs)	Q (gpm)
0.25	9.44	4,235	18.87	8,469
0.5	13.34	5,989	26.69	11,977
1	18.87	8,469	37.74	16,939
2	26.69	11,977	53.38	23,955
3	32.69	14,669	65.37	29,339
4	37.74	16,939	75.48	33,877
5	42.20	18,938	84.39	37,876
6	46.22	20,746	92.45	41,491
7	49.93	22,408	99.86	44,815
8	53.38	23,955	106.75	47,910
9	56.61	25,408	113.23	50,816
10	59.68	26,782	119.35	53,565

Table IV.B.2 (1 of 2)
Conveyance Capacity of Pipe Storm Drain Systems

CMP			Slope =	0.0025
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	0.36	161	1.03
10	0.022	0.65	291	1.19
12	0.022	1.06	474	1.34
15	0.022	1.91	859	1.56
18	0.022	3.11	1,397	1.76
21	0.022	4.69	2,107	1.95
24	0.022	6.70	3,008	2.13
30	0.022	12.15	5,454	2.48
36	0.022	19.76	8,868	2.80
42	0.022	29.81	13,377	3.10
48	0.022	42.55	19,098	3.39
60	0.022	77.16	34,628	3.93

RCP			Slope =	0.0025
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	0.61	272	1.74
10	0.013	1.10	493	2.01
12	0.013	1.79	802	2.27
15	0.013	3.24	1,453	2.64
18	0.013	5.27	2,364	2.98
21	0.013	7.94	3,565	3.30
24	0.013	11.34	5,090	3.61
30	0.013	20.56	9,229	4.19
36	0.013	33.44	15,007	4.73
42	0.013	50.44	22,638	5.24
48	0.013	72.01	32,320	5.73
60	0.013	130.57	58,601	6.65

HDPE			Slope =	0.0025
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	0.88	393	2.51
10	0.009	1.59	712	2.91
12	0.009	2.58	1,158	3.29
15	0.009	4.68	2,099	3.81
18	0.009	7.61	3,414	4.30
21	0.009	11.47	5,150	4.77
24	0.009	16.38	7,352	5.21
30	0.009	29.70	13,331	6.05
36	0.009	48.30	21,677	6.83
42	0.009	72.86	32,699	7.57
48	0.009	104.02	46,685	8.28
60	0.009	188.60	84,645	9.61

CMP			Slope =	0.0050
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	0.51	227	1.45
10	0.022	0.92	412	1.68
12	0.022	1.49	670	1.90
15	0.022	2.71	1,215	2.21
18	0.022	4.40	1,975	2.49
21	0.022	6.64	2,979	2.76
24	0.022	9.48	4,254	3.02
30	0.022	17.18	7,712	3.50
36	0.022	27.94	12,541	3.95
42	0.022	42.15	18,918	4.38
48	0.022	60.18	27,009	4.79
60	0.022	109.12	48,971	5.56

RCP			Slope =	0.0050
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	0.86	385	2.45
10	0.013	1.55	697	2.85
12	0.013	2.53	1,134	3.22
15	0.013	4.58	2,056	3.73
18	0.013	7.45	3,343	4.21
21	0.013	11.23	5,042	4.67
24	0.013	16.04	7,199	5.11
30	0.013	29.08	13,052	5.92
36	0.013	47.29	21,224	6.69
42	0.013	71.33	32,014	7.41
48	0.013	101.84	45,708	8.10
60	0.013	184.66	82,874	9.40

HDPE			Slope =	0.0050
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	1.24	555	3.55
10	0.009	2.24	1,007	4.11
12	0.009	3.65	1,638	4.65
15	0.009	6.62	2,969	5.39
18	0.009	10.76	4,828	6.09
21	0.009	16.23	7,283	6.75
24	0.009	23.17	10,398	7.37
30	0.009	42.01	18,853	8.56
36	0.009	68.31	30,656	9.66
42	0.009	103.04	46,243	10.71
48	0.009	147.11	66,022	11.71
60	0.009	266.73	119,707	13.58

CMP			Slope =	0.0100
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	0.72	321	2.05
10	0.022	1.30	583	2.38
12	0.022	2.11	947	2.69
15	0.022	3.83	1,718	3.12
18	0.022	6.22	2,793	3.52
21	0.022	9.39	4,213	3.90
24	0.022	13.40	6,016	4.27
30	0.022	24.30	10,907	4.95
36	0.022	39.52	17,736	5.59
42	0.022	59.61	26,754	6.20
48	0.022	85.11	38,197	6.77
60	0.022	154.31	69,255	7.86

RCP			Slope =	0.0100
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	1.21	544	3.47
10	0.013	2.20	986	4.03
12	0.013	3.57	1,603	4.55
15	0.013	6.48	2,907	5.28
18	0.013	10.53	4,727	5.96
21	0.013	15.89	7,130	6.61
24	0.013	22.68	10,180	7.22
30	0.013	41.13	18,458	8.38
36	0.013	66.88	30,015	9.46
42	0.013	100.88	45,275	10.49
48	0.013	144.03	64,641	11.46
60	0.013	261.14	117,201	13.30

HDPE			Slope =	0.0100
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	1.75	785	5.01
10	0.009	3.17	1,424	5.82
12	0.009	5.16	2,316	6.57
15	0.009	9.36	4,199	7.62
18	0.009	15.21	6,828	8.61
21	0.009	22.95	10,299	9.54
24	0.009	32.76	14,705	10.43
30	0.009	59.41	26,662	12.10
36	0.009	96.60	43,355	13.67
42	0.009	145.72	65,398	15.15
48	0.009	208.04	93,370	16.56
60	0.009	377.21	169,291	19.21

CMP			Slope =	0.0150
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	0.88	394	2.51
10	0.022	1.59	714	2.92
12	0.022	2.59	1,160	3.29
15	0.022	4.69	2,104	3.82
18	0.022	7.62	3,421	4.31
21	0.022	11.50	5,160	4.78
24	0.022	16.42	7,368	5.23
30	0.022	29.76	13,358	6.06
36	0.022	48.40	21,722	6.85
42	0.022	73.01	32,766	7.59
48	0.022	104.24	46,781	8.29
60	0.022	188.99	84,820	9.63

RCP			Slope =	0.0150
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	1.48	666	4.25
10	0.013	2.69	1,208	4.93
12	0.013	4.38	1,964	5.57
15	0.013	7.93	3,560	6.46
18	0.013	12.90	5,789	7.30
21	0.013	19.46	8,733	8.09
24	0.013	27.78	12,468	8.84
30	0.013	50.37	22,606	10.26
36	0.013	81.91	36,760	11.59
42	0.013	123.55	55,451	12.84
48	0.013	176.40	79,168	14.04
60	0.013	319.83	143,542	16.29

HDPE			Slope =	0.0150
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	2.14	962	6.14
10	0.009	3.89	1,744	7.13
12	0.009	6.32	2,836	8.05
15	0.009	11.46	5,143	9.34
18	0.009	18.63	8,362	10.54
21	0.009	28.11	12,614	11.69
24	0.009	40.13	18,010	12.77
30	0.009	72.76	32,654	14.82
36	0.009	118.31	53,098	16.74
42	0.009	178.47	80,095	18.55
48	0.009	254.80	114,354	20.28
60	0.009	461.98	207,338	23.53

CMP			Slope =	0.0200
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	1.01	454	2.90
10	0.022	1.84	824	3.37
12	0.022	2.99	1,340	3.80
15	0.022	5.41	2,429	4.41
18	0.022	8.80	3,950	4.98
21	0.022	13.28	5,959	5.52
24	0.022	18.96	8,507	6.03
30	0.022	34.37	15,425	7.00
36	0.022	55.89	25,083	7.91
42	0.022	84.30	37,835	8.76
48	0.022	120.36	54,018	9.58
60	0.022	218.23	97,942	11.11

RCP			Slope =	0.0200
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	1.71	769	4.91
10	0.013	3.11	1,394	5.70
12	0.013	5.05	2,267	6.43
15	0.013	9.16	4,111	7.46
18	0.013	14.90	6,685	8.43
21	0.013	22.47	10,084	9.34
24	0.013	32.08	14,397	10.21
30	0.013	58.16	26,104	11.85
36	0.013	94.58	42,447	13.38
42	0.013	142.67	64,029	14.83
48	0.013	203.69	91,416	16.21
60	0.013	369.31	165,748	18.81

HDPE			Slope =	0.0200
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	2.48	1,111	7.09
10	0.009	4.49	2,014	8.23
12	0.009	7.30	3,275	9.29
15	0.009	13.23	5,938	10.78
18	0.009	21.52	9,656	12.18
21	0.009	32.45	14,566	13.49
24	0.009	46.34	20,796	14.75
30	0.009	84.01	37,705	17.12
36	0.009	136.62	61,313	19.33
42	0.009	206.07	92,486	21.42
48	0.009	294.22	132,045	23.41
60	0.009	533.45	239,413	27.17

Table IV.B.2 (2 of 2)
Conveyance Capacity of Pipe Storm Drain Systems

CMP			Slope =	0.0500
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	1.60	719	4.59
10	0.022	2.90	1,303	5.32
12	0.022	4.72	2,118	6.01
15	0.022	8.56	3,841	6.97
18	0.022	13.92	6,246	7.88
21	0.022	20.99	9,421	8.73
24	0.022	29.97	13,451	9.54
30	0.022	54.34	24,389	11.07
36	0.022	88.37	39,659	12.50
42	0.022	133.29	59,823	13.85
48	0.022	190.31	85,411	15.14
60	0.022	345.05	154,860	17.57

RCP			Slope =	0.0500
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	2.71	1,216	7.76
10	0.013	4.91	2,205	9.01
12	0.013	7.99	3,585	10.17
15	0.013	14.48	6,500	11.80
18	0.013	23.55	10,570	13.33
21	0.013	35.53	15,944	14.77
24	0.013	50.72	22,764	16.15
30	0.013	91.96	41,273	18.73
36	0.013	149.54	67,115	21.16
42	0.013	225.58	101,238	23.45
48	0.013	322.06	144,541	25.63
60	0.013	583.93	262,070	29.74

HDPE			Slope =	0.0500
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	3.91	1,756	11.21
10	0.009	7.10	3,185	13.01
12	0.009	11.54	5,178	14.69
15	0.009	20.92	9,389	17.05
18	0.009	34.02	15,268	19.25
21	0.009	51.32	23,030	21.33
24	0.009	73.26	32,881	23.32
30	0.009	132.84	59,617	27.06
36	0.009	216.01	96,944	30.56
42	0.009	325.83	146,233	33.87
48	0.009	465.20	208,781	37.02
60	0.009	843.46	378,546	42.96

CMP			Slope =	0.0750
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	1.96	880	5.62
10	0.022	3.56	1,596	6.52
12	0.022	5.78	2,595	7.36
15	0.022	10.48	4,704	8.54
18	0.022	17.04	7,650	9.65
21	0.022	25.71	11,539	10.69
24	0.022	36.71	16,474	11.68
30	0.022	66.56	29,870	13.56
36	0.022	108.23	48,572	15.31
42	0.022	163.25	73,268	16.97
48	0.022	233.08	104,606	18.55
60	0.022	422.60	189,663	21.52

RCP			Slope =	0.0750
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	3.32	1,489	9.51
10	0.013	6.02	2,700	11.03
12	0.013	9.78	4,391	12.46
15	0.013	17.74	7,961	14.45
18	0.013	28.84	12,946	16.32
21	0.013	43.51	19,527	18.09
24	0.013	62.12	27,880	19.77
30	0.013	112.63	50,549	22.95
36	0.013	183.15	82,199	25.91
42	0.013	276.27	123,991	28.72
48	0.013	394.44	177,026	31.39
60	0.013	715.17	320,969	36.42

HDPE			Slope =	0.0750
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	4.79	2,151	13.73
10	0.009	8.69	3,900	15.93
12	0.009	14.13	6,342	17.99
15	0.009	25.62	11,499	20.88
18	0.009	41.66	18,699	23.58
21	0.009	62.85	28,206	26.13
24	0.009	89.73	40,271	28.56
30	0.009	162.69	73,016	33.14
36	0.009	264.55	118,732	37.43
42	0.009	399.06	179,098	41.48
48	0.009	569.75	255,704	45.34
60	0.009	1033.03	463,622	52.61

CMP			Slope =	0.1000
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	2.26	1,016	6.49
10	0.022	4.11	1,842	7.53
12	0.022	6.68	2,996	8.50
15	0.022	12.10	5,432	9.86
18	0.022	19.68	8,833	11.14
21	0.022	29.69	13,324	12.34
24	0.022	42.39	19,023	13.49
30	0.022	76.85	34,491	15.66
36	0.022	124.97	56,086	17.68
42	0.022	188.51	84,602	19.59
48	0.022	269.14	120,789	21.42
60	0.022	487.98	219,004	24.85

RCP			Slope =	0.1000
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	3.83	1,720	10.98
10	0.013	6.95	3,118	12.74
12	0.013	11.30	5,070	14.38
15	0.013	20.48	9,193	16.69
18	0.013	33.31	14,948	18.85
21	0.013	50.24	22,548	20.89
24	0.013	71.73	32,193	22.83
30	0.013	130.06	58,369	26.49
36	0.013	211.49	94,915	29.92
42	0.013	319.01	143,173	33.16
48	0.013	455.46	204,412	36.24
60	0.013	825.81	370,623	42.06

HDPE			Slope =	0.1000
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	5.53	2,484	15.86
10	0.009	10.03	4,504	18.40
12	0.009	16.32	7,323	20.78
15	0.009	29.59	13,278	24.11
18	0.009	48.11	21,592	27.22
21	0.009	72.57	32,570	30.17
24	0.009	103.61	46,501	32.98
30	0.009	187.86	84,311	38.27
36	0.009	305.48	137,100	43.22
42	0.009	460.80	206,805	47.89
48	0.009	657.89	295,261	52.35
60	0.009	1192.83	535,344	60.75

CMP			Slope =	0.1500
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	2.77	1,245	7.94
10	0.022	5.03	2,256	9.22
12	0.022	8.18	3,669	10.41
15	0.022	14.82	6,653	12.08
18	0.022	24.10	10,818	13.64
21	0.022	36.36	16,318	15.12
24	0.022	51.91	23,298	16.52
30	0.022	94.12	42,243	19.17
36	0.022	153.06	68,691	21.65
42	0.022	230.87	103,616	24.00
48	0.022	329.62	147,935	26.23
60	0.022	597.65	268,225	30.44

RCP			Slope =	0.1500
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	4.69	2,106	13.44
10	0.013	8.51	3,819	15.60
12	0.013	13.84	6,210	17.62
15	0.013	25.09	11,259	20.44
18	0.013	40.79	18,308	23.08
21	0.013	61.53	27,616	25.58
24	0.013	87.85	39,428	27.96
30	0.013	159.29	71,488	32.45
36	0.013	259.02	116,247	36.64
42	0.013	390.71	175,350	40.61
48	0.013	557.83	250,352	44.39
60	0.013	1011.41	453,919	51.51

HDPE			Slope =	0.1500
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	6.78	3,042	19.42
10	0.009	12.29	5,516	22.53
12	0.009	19.99	8,969	25.45
15	0.009	36.24	16,262	29.53
18	0.009	58.92	26,445	33.34
21	0.009	88.88	39,890	36.95
24	0.009	126.90	56,952	40.39
30	0.009	230.08	103,260	46.87
36	0.009	374.14	167,912	52.93
42	0.009	564.36	253,284	58.66
48	0.009	805.75	361,620	64.12
60	0.009	1460.92	655,660	74.40

CMP			Slope =	0.2000
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.022	3.20	1,437	9.17
10	0.022	5.81	2,606	10.64
12	0.022	9.44	4,237	12.02
15	0.022	17.12	7,682	13.95
18	0.022	27.83	12,492	15.75
21	0.022	41.99	18,843	17.46
24	0.022	59.94	26,903	19.08
30	0.022	108.68	48,778	22.14
36	0.022	176.73	79,318	25.00
42	0.022	266.59	119,645	27.71
48	0.022	380.62	170,821	30.29
60	0.022	690.10	309,719	35.15

RCP			Slope =	0.2000
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.013	5.42	2,432	15.52
10	0.013	9.82	4,409	18.01
12	0.013	15.98	7,170	20.34
15	0.013	28.97	13,000	23.60
18	0.013	47.10	21,140	26.66
21	0.013	71.05	31,888	29.54
24	0.013	101.44	45,528	32.29
30	0.013	183.93	82,547	37.47
36	0.013	299.09	134,230	42.31
42	0.013	451.15	202,477	46.89
48	0.013	644.12	289,082	51.26
60	0.013	1167.87	524,140	59.48

HDPE			Slope =	0.2000
d (in)	Mannings n	Q (cfs)	Q (gpm)	Flowing Full V (fps)
8	0.009	7.83	3,513	22.42
10	0.009	14.19	6,369	26.02
12	0.009	23.08	10,357	29.38
15	0.009	41.84	18,778	34.10
18	0.009	68.04	30,535	38.50
21	0.009	102.63	46,061	42.67
24	0.009	146.53	65,762	46.64
30	0.009	265.67	119,234	54.12
36	0.009	432.01	193,888	61.12
42	0.009	651.66	292,467	67.73
48	0.009	930.40	417,562	74.04
60	0.009	1686.92	757,091	85.91

APPENDIX D – HYDROLOGIC MODEL OUTPUT

10-Year 3-Hour Storm (Existing)

Global Summary Results for Run "10 Year 3 Hour Storm"

Project: Improvements Simulation Run: 10 Year 3 Hour Storm

Start of Run: 01Jan2000, 00:00 Basin Model: Basin 1
End of Run: 01Jan2000, 23:15 Meteorologic Model: Met 1
Compute Time: 04Apr2020, 17:42:17 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Junction-1	1.45160	197.0	01Jan2000, 02:15	0.25
Reach-1	1.45160	197.7	01Jan2000, 02:15	0.25
2	0.73810	128.5	01Jan2000, 02:15	0.28
3	1.13470	142.4	01Jan2000, 02:15	0.25
1	0.71350	74.8	01Jan2000, 02:30	0.22
9	0.02660	9.8	01Jan2000, 01:45	0.39
Junction-2	2.61290	343.9	01Jan2000, 02:15	0.25
Reach-2	2.61290	324.0	01Jan2000, 02:15	0.26
Junction-3	2.61290	324.0	01Jan2000, 02:15	0.26
13 Outlet	0.89610	164.3	01Jan2000, 02:15	0.31
Reach-6	0.01148	2.1	01Jan2000, 01:45	0.23
4	0.01010	2.4	01Jan2000, 01:45	0.23
Reach-3	0.00000	2.1	01Jan2000, 01:45	n/a
Junction-8	0.01010	2.4	01Jan2000, 01:45	0.23
Reach-5	0.01010	2.3	01Jan2000, 01:45	0.23
7	0.00138	0.3	01Jan2000, 01:45	0.19
Junction-9	0.01148	2.5	01Jan2000, 01:45	0.23
10	0.04840	10.9	01Jan2000, 02:00	0.27
Junction-10	0.05988	14.9	01Jan2000, 02:00	0.31
11	0.04710	10.3	01Jan2000, 02:15	0.36
12	0.00980	2.1	01Jan2000, 02:15	0.35
Junction-6	0.05690	12.4	01Jan2000, 02:15	0.36
Reach-4	0.05690	12.1	01Jan2000, 02:15	0.36
Junction-7	0.05690	12.1	01Jan2000, 02:15	0.36
8	0.02340	10.0	01Jan2000, 01:45	0.36
5	0.01480	6.8	01Jan2000, 01:45	0.38
Junction-14	0.01480	6.8	01Jan2000, 01:45	0.38
Reach-9	0.01480	5.2	01Jan2000, 01:45	0.39
6	0.01440	4.3	01Jan2000, 01:45	0.27
Junction-12	0.01440	4.3	01Jan2000, 01:45	0.27
Reach-8	0.01440	3.2	01Jan2000, 01:45	0.27
Junction-13	0.05260	18.4	01Jan2000, 01:45	0.34

100-Year 3-Hour Storm (Existing)

Global Summary Results for Run "100 Year 3 Hour Storm"

Project: Improvements   Simulation Run: 100 Year 3 Hour Storm

Start of Run: 01Jan2000, 00:00   Basin Model: Basin 1
End of Run: 01Jan2000, 23:15   Meteorologic Model: Met 2
Compute Time: 04Apr2020, 17:42:21   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: (•) IN ( ) AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Junction-1	1.45160	684.4	01Jan2000, 02:15	0.79
Reach-1	1.45160	696.5	01Jan2000, 02:15	0.79
2	0.73810	419.7	01Jan2000, 02:15	0.85
3	1.13470	510.7	01Jan2000, 02:15	0.79
1	0.71350	270.3	01Jan2000, 02:30	0.74
9	0.02660	29.4	01Jan2000, 01:45	1.03
Junction-2	2.61290	1216.2	01Jan2000, 02:15	0.80
Reach-2	2.61290	1174.4	01Jan2000, 02:15	0.80
Junction-3	2.61290	1174.4	01Jan2000, 02:15	0.80
13 Outlet	0.89610	521.9	01Jan2000, 02:15	0.89
Reach-6	0.01148	9.1	01Jan2000, 01:45	0.76
4	0.01010	9.6	01Jan2000, 01:45	0.75
Reach-3	0.00000	8.7	01Jan2000, 01:45	n/a
Junction-8	0.01010	9.6	01Jan2000, 01:45	0.75
Reach-5	0.01010	9.2	01Jan2000, 01:45	0.76
7	0.00138	1.2	01Jan2000, 01:45	0.67
Junction-9	0.01148	10.4	01Jan2000, 01:45	0.75
10	0.04840	36.1	01Jan2000, 02:00	0.83
Junction-10	0.05988	52.9	01Jan2000, 01:45	0.96
11	0.04710	30.3	01Jan2000, 02:15	0.98
12	0.00980	6.2	01Jan2000, 02:15	0.96
Junction-6	0.05690	36.5	01Jan2000, 02:15	0.98
Reach-4	0.05690	36.2	01Jan2000, 02:15	0.98
Junction-7	0.05690	36.2	01Jan2000, 02:15	0.98
8	0.02340	30.7	01Jan2000, 01:45	0.98
5	0.01480	20.1	01Jan2000, 01:45	1.02
Junction-14	0.01480	20.1	01Jan2000, 01:45	1.02
Reach-9	0.01480	16.8	01Jan2000, 01:45	1.04
6	0.01440	15.7	01Jan2000, 01:45	0.82
Junction-12	0.01440	15.7	01Jan2000, 01:45	0.82
Reach-8	0.01440	12.9	01Jan2000, 01:45	0.84
Junction-13	0.05260	60.4	01Jan2000, 01:45	0.96

10-Year 3-Hour Storm (After Improvements)

Global Summary Results for Run "10 Year 3 Hour Storm"

Project: APPLE VALLEY DRAINAGE   Simulation Run: 10 Year 3 Hour Storm

Start of Run: 01Jan2000, 00:00   Basin Model: Basin 1
End of Run: 01Jan2000, 23:15   Meteorologic Model: Met 1
Compute Time: 03Apr2020, 15:57:34   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
3	1.13470	142.4	01Jan2000, 02:15	0.25
1a	0.30400	42.2	01Jan2000, 02:00	0.22
Junction-2	0.92800	151.4	01Jan2000, 02:15	0.26
Junction-1	0.30400	42.2	01Jan2000, 02:00	0.22
Junction-3	0.92800	150.6	01Jan2000, 02:15	0.26
Reach-2a	0.92800	150.6	01Jan2000, 02:15	0.26
Reach-1	0.30400	42.1	01Jan2000, 02:15	0.22
2a	0.62400	112.8	01Jan2000, 02:00	0.28
Reach-2b	0.92800	145.5	01Jan2000, 02:15	0.26
9	0.02660	9.8	01Jan2000, 01:45	0.39
Junction-4	2.08930	291.7	01Jan2000, 02:15	0.26
Reach-3	2.08930	272.7	01Jan2000, 02:15	0.26
Junction-5	2.08930	272.7	01Jan2000, 02:15	0.26
13 Outlet	0.89610	164.3	01Jan2000, 02:15	0.31
1b	0.41000	48.6	01Jan2000, 02:15	0.22
2b	0.11460	16.4	01Jan2000, 02:15	0.28
Reach-6	0.01148	2.1	01Jan2000, 01:45	0.23
4	0.01010	2.4	01Jan2000, 01:45	0.23
Junction-8	0.01010	2.4	01Jan2000, 01:45	0.23
Reach-5	0.01010	2.3	01Jan2000, 01:45	0.23
7	0.00138	0.3	01Jan2000, 01:45	0.19
Junction-9	0.01148	2.5	01Jan2000, 01:45	0.23
10	0.04840	10.9	01Jan2000, 02:00	0.27
Junction-10	0.05988	12.9	01Jan2000, 02:00	0.27
11	0.04710	10.3	01Jan2000, 02:15	0.36
12	0.00980	2.1	01Jan2000, 02:15	0.35
Junction-6	0.05690	12.4	01Jan2000, 02:15	0.36
Reach-4	0.05690	12.1	01Jan2000, 02:15	0.36
Junction-7	0.05690	12.1	01Jan2000, 02:15	0.36
Reach-9	0.01480	5.2	01Jan2000, 01:45	0.39
Reach-8	0.01440	3.2	01Jan2000, 01:45	0.27
5	0.01480	6.8	01Jan2000, 01:45	0.38
6	0.01440	4.3	01Jan2000, 01:45	0.27
8	0.02340	10.0	01Jan2000, 01:45	0.36
Junction-14	0.01480	6.8	01Jan2000, 01:45	0.38
Junction-12	0.01440	4.3	01Jan2000, 01:45	0.27
Junction-13	0.05260	18.4	01Jan2000, 01:45	0.34

100-Year 3-Hour Storm (After Improvements)

Global Summary Results for Run "100 Year 3 Hour Storm"

Project: APPLE VALLEY DRAINAGE   Simulation Run: 100 Year 3 Hour Storm

Start of Run: 01Jan2000, 00:00   Basin Model: Basin 1
End of Run: 01Jan2000, 23:15   Meteorologic Model: Met 2
Compute Time: 03Apr2020, 15:57:39   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN / AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
3	1.13470	510.7	01Jan2000, 02:15	0.79
1a	0.30400	166.9	01Jan2000, 02:00	0.74
Junction-2	0.92800	537.5	01Jan2000, 02:00	0.81
Junction-1	0.30400	166.9	01Jan2000, 02:00	0.74
Junction-3	0.92800	510.1	01Jan2000, 02:15	0.82
Reach-2a	0.92800	510.1	01Jan2000, 02:15	0.82
Reach-1	0.30400	154.8	01Jan2000, 02:15	0.74
2a	0.62400	394.5	01Jan2000, 02:00	0.85
Reach-2b	0.92800	507.6	01Jan2000, 02:15	0.82
9	0.02660	29.4	01Jan2000, 01:45	1.03
Junction-4	2.08930	1027.3	01Jan2000, 02:15	0.81
Reach-3	2.08930	993.9	01Jan2000, 02:15	0.81
Junction-5	2.08930	993.9	01Jan2000, 02:15	0.81
13 Outlet	0.89610	521.9	01Jan2000, 02:15	0.89
1b	0.41000	184.0	01Jan2000, 02:15	0.74
2b	0.11460	55.8	01Jan2000, 02:15	0.85
Reach-6	0.01148	9.1	01Jan2000, 01:45	0.76
4	0.01010	9.6	01Jan2000, 01:45	0.75
Junction-8	0.01010	9.6	01Jan2000, 01:45	0.75
Reach-5	0.01010	9.2	01Jan2000, 01:45	0.76
7	0.00138	1.2	01Jan2000, 01:45	0.67
Junction-9	0.01148	10.4	01Jan2000, 01:45	0.75
10	0.04840	36.1	01Jan2000, 02:00	0.83
Junction-10	0.05988	44.2	01Jan2000, 01:45	0.82
11	0.04710	30.3	01Jan2000, 02:15	0.98
12	0.00980	6.2	01Jan2000, 02:15	0.96
Junction-6	0.05690	36.5	01Jan2000, 02:15	0.98
Reach-4	0.05690	36.2	01Jan2000, 02:15	0.98
Junction-7	0.05690	36.2	01Jan2000, 02:15	0.98
Reach-9	0.01480	16.8	01Jan2000, 01:45	1.04
Reach-8	0.01440	12.9	01Jan2000, 01:45	0.84
5	0.01480	20.1	01Jan2000, 01:45	1.02
6	0.01440	15.7	01Jan2000, 01:45	0.82
8	0.02340	30.7	01Jan2000, 01:45	0.98
Junction-14	0.01480	20.1	01Jan2000, 01:45	1.02
Junction-12	0.01440	15.7	01Jan2000, 01:45	0.82
Junction-13	0.05260	60.4	01Jan2000, 01:45	0.96

APPENDIX E – FINANCIAL TABLES

SUNRISE ENGINEERING, INC.

11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Apple Valley Storm Drain Improvements 21-Apr-20
Town of Apple Valley ncw/

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	5%	LS	$ 79,300.00	$ 79,300.00
2	Dust Control & Watering	1	LS	$ 40,000.00	$ 40,000.00
3	Materials Sampling & Compaction Testing	1	LS	$ 10,000.00	$ 10,000.00
4	Clearing and Grubbing	32,000	SY	$ 0.50	$ 16,000.00
5	Earthwork/Grading	1	LS	$ 700,000.00	$ 700,000.00
6	Armored Rock Bank with Filter Fabric	32,000	SY	$ 25.00	$ 800,000.00
7	SWPPP & Erosion Control	1	LS	$ 20,000.00	$ 20,000.00
			SUBTOTAL		**$ 1,665,500.00**
			CONTINGENCY	15%	**$ 250,000.00**
			CONSTRUCTION TOTAL		**$ 1,915,500.00**
INCIDENTALS					
1	Funding & Adminstrative Services		LS	$ 35,000.00	$ 35,000.00
2	Engineering Design	5.1%	LS	$ 116,000.00	$ 116,000.00
3	Bidding & Negotiating	0.3%	HR	$ 7,000.00	$ 7,000.00
4	Engineering Construction Services	5.8%	HR	$ 133,500.00	$ 133,500.00
5	Geotechnical Report	0.3%	EST	$ 8,000.00	$ 8,000.00
6	Land & RoW Acquisition	2.2%	EST	$ 50,000.00	$ 50,000.00
7	Land & RoW Negotiation	0.3%	EST	$ 6,000.00	$ 6,000.00
8	Bond Attorney	0.7%	EST	$ 15,000.00	$ 15,000.00
9	Miscellaneous Engineering Services	0.4%	EST	$ 10,000.00	$ 10,000.00
			SUBTOTAL		$ 380,500.00
			TOTAL PROJECT COST		**$ 2,296,000.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Apple Valley Storm Drain Improvements 21-Apr-20
Town of Apple Valley ncw/

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	5%	LS	$ 73,000.00	$ 73,000.00
2	Dust Control & Watering	1	LS	$ 40,000.00	$ 40,000.00
3	Materials Sampling & Compaction Testing	1	LS	$ 60,000.00	$ 60,000.00
4	24" HDPE Storm Drain Pipe	2,460	LF	$ 75.00	$ 184,500.00
5	30" HDPE Storm Drain Pipe	1,180	LF	$ 105.00	$ 124,000.00
6	Earthwork	63,400	CY	$ 5.00	$ 317,000.00
7	Armored Rock Bank with Filter Fabric	22,100	SY	$ 25.00	$ 552,500.00
8	Reworking Borrow Ditches	16,000	LF	$ 10.00	$ 160,000.00
9	SWPPP & Erosion Control	1	LS	$ 20,000.00	$ 20,000.00
			SUBTOTAL		**$ 1,531,000.00**
			CONTINGENCY	15%	**$ 230,000.00**
			CONSTRUCTION TOTAL		**$ 1,761,000.00**
INCIDENTALS					
1	Funding & Adminstrative Services		LS	$ 40,000.00	$ 40,000.00
2	Engineering Design	4.8%	LS	$ 108,000.00	$ 108,000.00
3	Bidding & Negotiating	0.3%	HR	$ 7,000.00	$ 7,000.00
4	Engineering Construction Services	5.5%	HR	$ 122,500.00	$ 122,500.00
5	Geotechnical Report	0.4%	EST	$ 8,000.00	$ 8,000.00
6	Land & RoW Acquisition	6.7%	EST	$ 150,000.00	$ 150,000.00
7	Land & RoW Negotiation	0.5%	EST	$ 12,000.00	$ 12,000.00
8	Bond Attorney	0.7%	EST	$ 15,000.00	$ 15,000.00
9	Miscellaneous Engineering Services	0.4%	EST	$ 10,000.00	$ 10,000.00
			SUBTOTAL		$ 472,500.00
			TOTAL PROJECT COST		**$ 2,233,500.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Apple Valley Storm Drain Improvements 21-Apr-20
Town of Apple Valley ncw/

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	5%	LS	$ 17,000.00	$ 17,000.00
2	Traffic Control	1	LS	$ 4,000.00	$ 4,000.00
3	Dust Control & Watering	1	LS	$ 9,000.00	$ 9,000.00
4	SWPPP	1	LS	$ 9,000.00	$ 9,000.00
5	Subsurface Investigation	1	LS	$ 9,000.00	$ 9,000.00
6	Construction Staking	1	LS	$ 12,000.00	$ 12,000.00
7	Materials Sampling and Testing	1	LS	$ 14,000.00	$ 14,000.00
8	Clearing, Grubbing, Saw Cutting, and Demolition	1	LS	$ 18,500.00	$ 18,500.00
9	Import Granular Borrow	1,100	Cu Yd	$ 41.00	$ 45,500.00
10	Earthwork and Grading	1	LS	$ 70,000.00	$ 70,000.00
11	84" CMP	70	LF	$ 400.00	$ 28,000.00
12	96" CMP	70	LF	$ 450.00	$ 31,500.00
13	6" Untreated Base Course	64,500	SF	$ 0.90	$ 58,500.00
14	Double Chip Seal	8,000	SY	$ 2.50	$ 20,000.00
15	5-Strand Barbed Wire Fence	1,000	LF	$ 4.25	$ 4,250.00
			SUBTOTAL		**$ 350,250.00**
			CONTINGENCY	15%	**$ 53,000.00**
			CONSTRUCTION TOTAL		**$ 403,250.00**
INCIDENTALS					
1	Geotechnical Report	1.5%	LS	$ 7,250.00	$ 7,250.00
2	Design Survey & ROW	1.7%	LS	$ 8,000.00	$ 8,000.00
3	Civil Engineering Design	7.5%	LS	$ 35,500.00	$ 35,500.00
4	Bidding & Negotiating	0.6%	HR	$ 3,000.00	$ 3,000.00
5	Engineering Construction Services	4.2%	HR	$ 20,000.00	$ 20,000.00
			SUBTOTAL		$ 73,750.00
			TOTAL PROJECT COST		**$ 424,000.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

TABLE V.B.1
THE TOWN OF APPLE VALLEY
STORM WATER MASTER PLAN
IMPACT FEE CALCULATION

4/21/20

IMPACT FEE ELIGIBILITY CALCULATION

Total Area Draining through Basins Analyzed	603	acres
Undeveloped Land within Drainage Boundary	197	acres
Percent of Cost Impact Fee Eligible:		**32.6%**

PROPOSED IMPROVEMENT PROJECTS

Total Non-Grant Estimated Project Costs			$1,237,500	
Total Interest From New Debt Service			$504,000	
% of Project Cost Due to New Growth	32.6%	$	404,000	
% of Interest Due to New Growth	32.6%	$	164,500	
Impact Fee Eligible Cost		$	568,500	

MAXIMUM IMPACT FEE CALCULATION

Total Impact Fee Eligible Cost	$	568,500	
Undeveloped Land within Drainage Boundary		197	acres
Maximum Impact Fee per Acre of Land within Drainage Boundary	$	2,886	/ acre

PROPOSED IMPACT FEE

Proposed Impact Fee	**$**	**2,886**	**/ acre**

Zone	Average Lot Size	Impact Fee
R-A-1	1.00	$ 2,886
R-1-14	0.32	$ 923
R-1-10	0.23	$ 664
R-1-8	0.18	$ 519
R-3-6	0.14	$ 404

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TABLE V.C.1

APPLE VALLEY IMPACT FEE FACILITIES PLAN
FY 2023 PROPOSED FINANCING PLAN

TOTAL PROJECT COST			**$ 4,953,500**
FY 2023 EXPENSES			
Proposed Funding:	**Rate**	**Term in Yrs.**	**Principal**
Self Participation			$75,000
FEMA Grant (75%)			$3,716,000
CIB Loan (25%)	2.50%	30	$1,162,500
TOTAL PROJECT FUNDING:			**$4,953,500**
EXPENSES: (First Year of New Debt Serv. Pmt.)			
Personal Services			$6,556
Contracted Services			$0
Operating & Maintenance			$13,113
Other Supplies & Expenses			$0
Depreciation Expense			$0
Subtotal Expenses:			**$19,669**
EXISTING DEBT SERVICE			
			$0
Subtotal Existing Annual Debt Service:			**$0**
NEW DEBT SERVICE			
New Loan(s)			$55,542
Loan Reserve (Payment/10)			$5,554
Subtotal New Annual Debt Service:			**$61,096**
Renewal and Replacement Fund			$983
GRAND TOTAL EXPENSES:			**$81,748**
ANNUAL INCOME			
New Impact Fees	$404	22	$8,888
Total Number of Customers			399
Average Monthly Rate/Customer			**$15.21**
TOTAL ANNUAL INCOME:			**$81,748**

TABLE V.E.1
CASH FLOW ANALYSIS

Annual Population Growth Rate		6.00%	6.00%	6.00%	6.00%	6.00%	5.00%	5.00%	5.00%	5.00%	5.00%	4.00%	4.00%	4.00%
Annual Rate Increase	3.00%													
Annual Inflation Rate	3.00%													
Fiscal Year Beginning July 1	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Ending June30	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Average Rate Per Customer	$ 10.05	$ 10.05	$12.44	**$14.83**	$15.27	$15.73	$16.20	$16.69	$17.19	$17.71	$18.24	$18.79	$19.35	$19.93
Connection Fee	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Base Residential Impact Fee	$860	$860	$860	**$391**	$391	$391	$391	$391	$391	$391	$391	$391	$391	$391
System Users:														
Total Residential Customers	318	337	357	379	401	426	447	469	493	517	543	565	587	611
Total Commercial Customers	1	1	1	1	1	1	1	1	2	2	2	2	2	2
New Customers	19	19	20	22	23	24	21	22	24	25	26	22	23	24
Total Customers:	338	357	377	399	422	446	467	489	513	538	564	586	609	633
REVENUES:	40,768													
User Fees (Drainage Fee)	40,768	43,058	56,299	71,018	77,353	84,213	90,812	97,965	105,851	114,366	123,479	132,163	141,442	146,114
Connection Fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Late Fees & Penalties	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Impact Fees	16,460	16,340	17,200	8,602	8,993	9,384	8,211	8,602	9,384	9,775	10,166	8,602	8,993	9,384
TOTAL REVENUE:	**$57,228**	**$59,398**	**$73,499**	**$79,620**	**$86,346**	**$93,597**	**$99,023**	**$106,567**	**$115,235**	**$124,141**	**$133,645**	**$140,765**	**$150,435**	**$155,498**
EXPENSES: (Inc. O&M & Debt Serv.)														
Personal Services	6,000	6,180	6,365	6,556	6,753	6,956	7,165	7,380	7,601	7,829	8,064	8,306	8,555	8,812
Contracted Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating & Maintenance	12,000	12,360	12,731	13,113	13,506	13,911	14,328	14,758	15,201	15,657	16,127	16,611	17,109	17,622
Other Supplies & Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation Expense	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Operation & Maintenance	**$18,000**	**$18,540**	**$19,096**	**$19,669**	**$20,259**	**$20,867**	**$21,493**	**$22,138**	**$22,802**	**$23,486**	**$24,191**	**$24,917**	**$25,664**	**$26,434**
EXISTING DEBT SERVICE (810-820)														
None	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Existing Debt Service	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
NEW DEBT SERVICE (810-820)														
New Loan	0	0	0	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607
Loan Reserve (Payment/10)	0	0	0	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361
Self Participation	0	0	$75,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Debt Service	**$0**	**$0**	**$75,000**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**
Total Debt Service	**$0**	**$0**	**$75,000**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**
OTHER SERVICE														
Renewal and Replacement Fund (590)	0	0	955	983	1,013	1,043	1,075	1,107	1,140	1,174	1,210	1,246	1,283	1,322
Total Renewal and Replacement Fund	$0	$0	$955	$983	$1,013	$1,043	$1,075	$1,107	$1,140	$1,174	$1,210	$1,246	$1,283	$1,322
Storm Water Impact Fee Facilities Plan Update	$0	$0	$0	$0	$50,000	$0	$0	$0	$0	$55,000	$0	$0	$0	$0
TOTAL EXPENSES:	**$18,000**	**$18,540**	**$95,051**	**$79,620**	**$130,240**	**$80,878**	**$81,536**	**$82,213**	**$82,910**	**$138,628**	**$84,369**	**$85,131**	**$85,915**	**$86,724**
Net Cashflow	**$39,228**	**$40,858**	**($21,551)**	**$0**	**($43,894)**	**$12,719**	**$17,487**	**$24,354**	**$32,324**	**($14,488)**	**$49,276**	**$55,634**	**$64,520**	**$68,774**
CASH ON HAND														
*Fund Balance	39,228	80,086	58,535	58,535	14,641	27,360	44,847	69,201	101,526	87,038	136,314	191,948	256,469	325,243
Renewal and Replacement Account Balance:	0	0	955	1,938	2,951	3,995	5,069	6,176	7,316	8,491	9,700	10,946	12,229	13,551
New Bond Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**$39,228**	**$80,086**	**$59,490**	**$60,473**	**$17,592**	**$31,355**	**$49,917**	**$75,378**	**$108,842**	**$95,529**	**$146,015**	**$202,894**	**$268,698**	**$338,794**

**Fund Balance is obtained by adding the previous year's balance to the net cash flow, minus any self funded portion of future projects. Fund Balance includes Impact Fees.*

TABLE V.E.1
CASH FLOW ANALYSIS

Annual Population Growth Rate	4.00%	4.00%	3.00%	3.00%	3.00%	3.00%	3.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Annual Rate Increase														
Annual Inflation Rate														
Fiscal Year Beginning July 1	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**
Ending June30	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**
Average Rate Per Customer	$20.53	$21.15	$21.78	$22.43	$23.10	$23.79	$24.50	$25.24	$26.00	$26.78	$27.58	$28.41	$29.26	$30.14
Connection Fee	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Base Residential Impact Fee	$391	$391	$391	$391	$391	$391	$391	$391	$391	$391	$391	$391	$391	$391
System Users:														
Total Residential Customers	635	661	681	701	722	744	766	781	797	813	829	846	863	880
Total Commercial Customers	2	2	2	2	2	2	2	2	3	3	3	3	3	3
New Customers	25	25	20	20	21	22	22	15	16	16	16	17	17	17
Total Customers:	658	683	703	723	744	766	788	803	819	835	851	868	885	902
REVENUES:														
User Fees (Drainage Fee)	156,533	167,711	177,888	188,692	200,159	212,322	225,218	236,661	248,663	261,245	274,430	288,343	302,909	318,260
Connection Fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Late Fees & Penalties	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Impact Fees	9,775	9,775	7,820	7,820	8,211	8,602	8,602	5,865	6,256	6,256	6,256	6,647	6,647	6,647
TOTAL REVENUE:	**$166,308**	**$177,486**	**$185,708**	**$196,512**	**$208,370**	**$220,924**	**$233,820**	**$242,526**	**$254,919**	**$267,501**	**$280,686**	**$294,990**	**$309,556**	**$324,907**
EXPENSES: (Inc. O&M & Debt Serv.)														
Personal Services	9,076	9,348	9,628	9,917	10,215	10,521	10,837	11,162	11,497	11,842	12,197	12,563	12,940	13,328
Contracted Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating & Maintenance	18,151	18,696	19,257	19,835	20,430	21,043	21,674	22,324	22,994	23,684	24,395	25,127	25,881	26,657
Other Supplies & Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation Expense	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Operation & Maintenance	**$27,227**	**$28,044**	**$28,885**	**$29,752**	**$30,645**	**$31,564**	**$32,511**	**$33,486**	**$34,491**	**$35,526**	**$36,592**	**$37,690**	**$38,821**	**$39,985**
EXISTING DEBT SERVICE (810-820)														
None	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Existing Debt Service	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
NEW DEBT SERVICE (810-820)														
New Loan	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607	$53,607
Loan Reserve (Payment/10)	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361	$5,361
Self Participation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Debt Service	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**
Total Debt Service	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**	**$58,968**
OTHER SERVICE														
Renewal and Replacement Fund (590)	1,361	1,402	1,444	1,488	1,532	1,578	1,626	1,674	1,725	1,776	1,830	1,885	1,941	1,999
Total Renewal and Replacement Fund	$1,361	$1,402	$1,444	$1,488	$1,532	$1,578	$1,626	$1,674	$1,725	$1,776	$1,830	$1,885	$1,941	$1,999
Storm Water Impact Fee Facilities Plan Update	$60,000	$0	$0	$0	$0	$65,000	$0	$0	$0	$0	$70,000	$0	$0	$0
TOTAL EXPENSES:	**$147,556**	**$88,414**	**$89,297**	**$90,208**	**$91,145**	**$157,110**	**$93,105**	**$94,128**	**$95,184**	**$96,270**	**$167,390**	**$98,543**	**$99,730**	**$100,952**
Net Cashflow	**$18,752**	**$89,072**	**$96,410**	**$106,305**	**$117,224**	**$63,813**	**$140,715**	**$148,398**	**$159,735**	**$171,231**	**$113,297**	**$196,447**	**$209,826**	**$223,954**
CASH ON HAND														
*Fund Balance	343,995	433,066	529,477	635,782	753,006	816,820	957,535	1,105,933	1,265,668	1,436,899	1,550,195	1,746,643	1,956,469	2,180,423
Renewal and Replacement Account Balance:	14,912	16,314	17,759	19,246	20,778	22,357	23,982	25,657	27,381	29,157	30,987	32,871	34,813	36,812
New Bond Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**$358,907**	**$449,381**	**$547,235**	**$655,028**	**$773,785**	**$839,176**	**$981,517**	**$1,131,589**	**$1,293,049**	**$1,466,056**	**$1,581,182**	**$1,779,514**	**$1,991,281**	**$2,217,235**

**Fund Balance is obtained by adding the previous year's balance to the net cash flow, minus any self funded portion of future projects. Fund Balance includes Impact Fees.*