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**Site Design for a Neighborhood-Scale Stormwater Detention Park
in the Proposed Los Angeles River National Urban Wildlife Refuge**

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11 May 2004

ABSTRACT

We propose installation of a detention basin in a small neighborhood (0.07 square miles) as a management technique to lower peak flows in the Los Angeles River and its tributaries by reducing urban and stormwater runoff. Reducing urban and stormwater runoff is a key factor in eventual improvements, such as removing concrete and planting native vegetation, that could be made to the Los Angeles River as part of the proposed Los Angeles River National Urban Wildlife Refuge (LARNUWR). Based on geographic information system data layers, county hydrology data, and on-site reconnaissance, we propose a design treatment that would help to reduce peak flows given a one-inch design rainfall. Our main goal is to determine the amount of space needed to capture the urban and stormwater runoff coming from a typical single-family-home neighborhood in the LARNUWR. We calculated that our study area needs a detention basin approximately four percent of the size of the study area to capture and treat the runoff from the study area during a one-inch storm event.

INTRODUCTION

The Santa Monica Mountains Conservancy (SMMC) is a State of California agency based in Malibu, California. Since its establishment by the California State Legislature in 1980, the SMMC's mission has been to buy, preserve, improve, and develop parkland in both wilderness and urban settings for the enjoyment of the greater Los Angeles metropolitan region.[1] Originally, the SMMC's project zone was specifically the Santa Monica Mountains, excluding the urban basin of the San Fernando Valley. With the establishment of the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy, also known as the Rivers and Mountains Conservancy (RMC), in 1999, the RMC and SMMC were directed to develop a coordinated plan for the entire Los Angeles River (LAR) watershed.[2] The RMC focuses on the San Gabriel and Lower Los Angeles Rivers and the SMMC continues to focus on the Santa Monica Mountains and additionally the Upper Los Angeles River.

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[1] http://smmc.ca.gov/.
[2] http://www.rmc.ca.gov/about/whoweare.html.

With its new mandate to incorporate the upper LAR watershed into its program, the SMMC began considering alternatives for becoming involved with the Upper Los Angeles River watershed. One proposal it is currently considering is the establishment of a Los Angeles River National Urban Wildlife Refuge (LARNUWR). This urban wildlife refuge would strive to create parkland throughout the LARNUWR with the dual purpose of providing both wildlife habitat and new urban parks and open space. While developing the LARNUWR would not necessarily involve changes to the channelized structure of the LAR in the immediate future, it is conceivable that someday sections of the LAR might be redeveloped to include more natural landscaping and riparian habitat.

The LAR was channelized in concrete between 1930 and 1970 (Gumprecht 2001) in efforts to control flooding throughout its reach. If sections of the LAR are ever improved to a more natural state, questions of managing stormwater and urban runoff first have to be addressed. Given the flow equation Q=VA (flow equals velocity times area), and that the factor impacted by increased roughness (i.e., vegetation in the channel) is velocity, there are two options for ensuring that flooding does not occur: change the flow, or change the area of the channel. Conventional wisdom within the Army Corps and Los Angeles County Department of Public Works (LACDPW) has focused on the "area" part of this equation. In other words, given the same flow (runoff), an increase in roughness leads to a decrease in velocity that must be balanced by increased channel area. This need for extra space, and lack thereof in the already built out San Fernando Valley, has generally led to the rapid expulsion of any idea to change the structure of the existing channel.

However, the LACDPW is beginning to come around to the idea that if the area cannot be changed, maybe the flow can be. This is reflected in the LACDPW's recent efforts to combat

flooding along the Tujunga Wash, a tributary of the Los Angeles River, in Sun Valley. The LACDPW sponsors a website called www.sunvalleywatershed.org that contains extensive information about efforts to reduce flooding in the area. One feature of the website is a community survey that questions residents on their willingness to participate in activities that will help to reduce stormwater runoff such as tree planting, installing a cistern, or installing a drywell. This line of questioning shows flow reduction is a possibility that is being considered at the County level. This idea is also embraced by other agencies such as the Pierce College District. Pierce College, located in the proposed LARNUWR, recently converted a playing field into a detention basin. By grading a soccer field slightly, it now is used both as a soccer field and as a detention basin to capture runoff from the nearby parking lot, thus slowing the time runoff takes to reach the storm drain system.

This paper examines a site in the proposed LARUWR that serves as an example of how stormwater management through flow reduction can be implemented so that impacts to the local receiving bodies and watershed, such as high peak flows and pollution, are minimized. The main goal is to determine the amount of space needed to capture the urban and stormwater runoff coming from a typical single-family-home neighborhood in the LARNUWR. The two types of treatments that we design to manage runoff are a detention basin and swales. The following sections discuss our site, analysis, and design.

Site Boundaries and Characteristics

The study area we examine is located in the west San Fernando Valley of the City of Los Angeles, California. Figure 1 and Figure 2 show the location of the study area within the greater Los Angeles metropolitan area and more specifically within the west San Fernando Valley, respectively. The San Fernando Valley is a semi-arid climate. The weather station at Pierce

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College, the closest gauge to our study site, has a period of record from 1949 to 2003. For this period, the average high temperature is 95.3 degrees Fahrenheit (F) in August, the low temperature is 38.7 degrees F in December, and the average total precipitation is 16.54 inches per year, with the majority of precipitation (falling as rain) occurring December through March (Western Regional Climate Center website 2004).

Generally, San Fernando Valley soils are alluvial and vary from coarse sand and gravel near canyon mouths to silty clay and gravel or clay in lower valleys. The alluvium has built up over time so that it is now up to 20,000 feet (ft.) deep in places (Gumprecht 2001). Valley soils are generally well drained and an aquifer underlies much of the valley (LACDPW 1991).

The study area consists of single-family homes that surround an abandoned Los Angeles Unified School District elementary school. This abandoned school is the site we propose for the location of the detention basin that also serves as a park. The neighborhood is bounded by Sherman Way to the west and north, Fallbrook Avenue to the east, and Bell Creek to the south, and is located within the West Hills Neighborhood Council area of the City of Los Angeles. The study area (not including the proposed design site) is approximately 1,891,150 square feet (ft.^{2}) or 0.07 square miles (mi^2). Figure 3 shows a study area map and boundaries.

The abandoned school is located in the center of the neighborhood and its site is approximately 465 ft. by 690 ft. The school grounds consist of a parking lot, five buildings, a jungle gym area, and approximately 370 ft. by 465 ft. of asphalt for the remainder of the playground, or 54 percent of the total area. An antique shop and a vacant field occupy the most western portion of the study area. The antique shop is located in a historic adobe building that once served as the stables for a neighboring estate. Because one of the goals of this project is to

assess the amount of space needed to capture urban and stormwater runoff from a typical single-family home neighborhood, we did not include the field and antique shop area in our analysis.

The study area neighborhood was developed in two phases, the first in 1956 and the second in 1979. The streets are graded to conduct urban and stormwater runoff for several blocks until reaching a catch basin that drains to Bell Creek, the LAR, and ultimately to San Pedro Bay in Long Beach. While topography data from SMMC reveals a slight gradient (approximately 0.5 percent), sloping down to the east, the streets have been paved so that runoff is conducted down the streets into the nearest storm drain catch basin. Figure 4 shows the study area topography, location of catch basins, and direction of stormwater flow.

METHODS

Data Collection

To begin our investigation of this site, we used geographic information system (GIS) files for our study site that were provided by the SMMC. These files included layers of a georeferenced aerial photograph, site topography, parcels, streets, and tributaries to the LAR. In addition to these layers, we used information from the City of Los Angeles website Navigate LA (http://navigatela.lacity.org/) which contains GIS data for the city including location of storm drain inlets, outlets, and stormwater flow direction.

To verify the electronic data for location of storm drains and direction of stormwater flow, we made a site visit on March 26, 2004. During this site visit, we verified the location of the neighborhood catch basins and to the extent possible, also verified the direction of street flow. This was only possible on two streets that had flowing urban runoff from over-watered lawns. We walked the entire neighborhood to get a feel for the area and documented our visit

with photographs. We also took measurements of street width, school ground size, and width of grassy medians between the street and sidewalk. Due to the constraints of traveling to our study site, we did not bring survey equipment and so did not verify the topography of the study area. The study area is relatively flat and when combined with the intentional grading of the streets, there is no indication that the runoff flow reported on the website is incorrect. Because we already have data from the SMMC for topography, we did not attempt an alternative method to determine topography.

For rainfall and soil type data, we first looked at data published by the County of Los Angeles as appendices C and G, respectively, in its Hydrology Manual Addendum.[3] The isohyet map shows the 50-year, 24-hour rainfall that the county uses to design for the capital flood, or maximum storm.[4] This map also contains a scaling factor for the ten- and 25-year storms. Ultimately, we did not use this rainfall data as the 24-hour time period resulted in an exceptionally high precipitation value and instead we used a one-inch event to design our treatments. This amount corresponds to a 10-year, 2-hour storm event in the San Francisco Bay Area. The soil map shows gradients of soil type. Our study area is shown as soil type 016 with type 020 in the immediate vicinity. The 016 designation corresponds to "Yolo loam" and the 020 designation corresponds to "Yolo sandy loam." Figure 5 shows the rainfall and soil map published by Los Angeles County.

In order to calculate runoff from the study area, we needed to determine the impermeable surface area. Impermeable surfaces in the study area include rooftops, paved patios, driveways, sidewalks, alleys, and streets. We used two methods for determining impermeability. First, we printed an aerial photograph of the study site and using an Exacto knife, cut out all the

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[3] http://www.ladpw.org/wrd/publication/engineering/online/ hydrology_method.pdf.
[4] The Army Corps of Engineers uses the 100-year storm as the capital flood for designing channels.

impermeable surfaces. We then pasted the cut out pieces onto another printed aerial of the same

size. We completed this process once for a section of the neighborhood build in 1956 and once

for a section of the neighborhood built in 1979. At the end of this exercise, we had a visual

representation of the percentage of impermeable and permeable surfaces for the neighborhood.

As the two neighborhoods have different levels of impermeable surface, we used the average of

the two values for our impermeable percentage. See Figure 6 for the results of this analysis. The

second method was to use data for impermeable surfaces published by Los Angeles County in its

Hydrology Manual (LACDPW 1991). We also used a third source published by the Mountains

Recreation and Conservation Authority (MRCA) to further support our permeability findings

(Kammerer 2003).

Calculations

For the site design process, we used the following formula to calculate design treatment

volume runoff.

$$V = C * A_{tot} * R_d$$

where V = design treatment volume (cubic feet [ft.[3]])
C = runoff coefficient
A_{tot} = total contributing drainage area (ft.^{2})
R_d = design rainfall (ft.)

We used a design rainfall (R_d) of one inch. The runoff coefficient C is a weighted

average based on the total site surface, which has an area A_{tot}. Based on the permeability

analysis we did for the site, we determined that 65 percent of the study area is impermeable and

35 percent is disturbed permeable. Los Angeles County publishes a percent impermeable factor

of 0.418, or 42 percent, for single-family homes (LACDPW 1991). The MCRA reports that the

range of permeability for our study area is 40 to 70 percent (Kammerer 2003). Because our

calculation of 65 was the higher of the two values and falls within the range of the MCRA values, we decided to use the 65 percent value for our calculations.

The entire site is developed; therefore, we considered all other area that was not completely impervious to be disturbed permeable. Disturbed permeable areas are front and back yards that, for the most part, are grass and gardens. The area used for this runoff calculation was the entire area of the study site, excluding the abandoned school. Because we are proposing a new design for the school site, we calculated the school's runoff independent of the surrounding neighborhood.

In order to calculate the design treatment volume (V), we first determined the C coefficient for runoff based on the above data. This calculation is shown in Table 1. The calculation for treatment volume of our study area, excluding the school site, is shown in Table 2.

Treatment Selection

Before we selected treatments for our design, we completed an analysis of site constraints to consider when selecting treatments. We used California Stormwater Best Management Practice Handbook (Camp Dresser & McKee et. al. 1993) and the Green Streets (Metropolitan Council 2003) book to help determine what type of treatment would be appropriate for the study area. Through site analysis and assessing the various options for stormwater and urban runoff management, we decided to design for swales and a detention basin.

RESULTS

Site Constraints

There are several site constraints revealed through our site constraint analysis that must be considered when selecting a treatment for this site. First, due to the fact that rainfall in Southern California is sporadic, the selected treatments should not rely on a regular supply of water. Second, even if a year-round water supply was available, the threat of West Nile virus is rapidly growing in California with experts predicting an explosion of cases in 2004 (Anderson 2004). Finally, retention basins generally contribute to infiltration. While the idea of designing a groundwater recharge site is appealing given Southern California's thirst for water, we discovered that the site might be polluted. We learned that the Boeing subsidiary, Rocketdyne Propulsion & Power, a company developing aerospace propulsion devices, did extensive testing of its products during the 1960s and 1970s at its Santa Susana Field Laboratory just a few miles west of our study area. There is currently great concern about the possible toxic pollution that has traveled from this site into the west valley. Due to the uncertain status of the existence of contamination in our study area, and taking into consideration other site constraints, we decided that it would be prudent to design a detention basin instead of a retention basin.

Calculations

Based on our design of two building structures and a parking lot, an additional 4,272 ft.^{3} of runoff will be added to the neighborhood runoff bringing the total volume for capture to 167,384 ft.^{3}. See Table 3 for runoff volumes of each of our site design characteristics, neighborhood runoff, and total runoff for which we need to design. We determined that there is currently 6,909 ft. of grassy median that could be converted to swales. At a width of 2.5 ft., 17,273 ft.^{2} of median is available for conversion to swales that will capture and treat 5,182 ft.^{3} of

runoff. With 5,182 ft.^{3} of runoff treated by swales, we designed a detention basin that captures 164,531 ft.^{3}; enough to capture the remaining 162,202 ft.^{3} of runoff. Table 4 shows the calculations for how much grassy median is available for installation of swales. Table 5 shows the total treatment volume capacity of swales and the detention basin. To complete our calculation for capture by swales, we used an effective porosity of 0.3 for loam. Table 6 shows the values for effective porosity of different soil types that is needed to calculate the treatment capacity of the swales. Finally, Table 7 shows the calculations for the size of the orifice for the pipe that will drain the detention basin over a 40-hour period which is equal to 0.25 ft. or three inches.

Site Design

Taking into account our analysis, we arrived at a site design that is first and foremost a response to the hydrological conditions and constraints. We then took into consideration the socio-cultural context within which this site was located and sought to "wrap" the technical solutions in a context-appropriate design that fits the needs of the local community members.

As the first so-called "line of defense" against runoff from individual parcels, we propose neighborhood swales. This neighborhood is particularly well-suited to this treatment because there is a grassy median throughout the neighborhood between the sidewalk and the street which can easily be converted to swales to help reduce runoff. This treatment capitalizes on existing pipes that convey runoff from a given parcel to the street. Existing pipes empty into the swale and also convey any overflow onto the street. See Figure 7 for an illustration of the swale configuration.

Provided that swales capture 5,182 ft.^{3} of the study area total of 163,112 ft^3 of stormwater runoff, 162,202 ft.^{3} needs to be treated by another mechanism. The main feature of our site

design is a stormwater detention basin that holds 164,500 ft.[3]and is large enough to contain all the stormwater runoff from the adjacent residential neighborhood that is not captured by swales during a one-inch rainfall storm event. See Figure 8 for the site design.

Stormwater is directed to the site in the same manner as it is currently diverted to the storm drain system through street grading and in-street channels. As water passes alongside the design site, it is conducted onto the site through a series of perforations in the sidewalk that drain water from the street through the sidewalk and into the detention basin. See Figure 9 for the direction of stormwater flow into and within the design site. The perforations are large enough to allow trash to pass through and into the detention site. This serves to bring trash and debris to one central location from where it can more easily be cleaned out after a storm. See Figure 10 for illustration of perforated sidewalk.

The detention basin is graded so that its deepest point is four feet deep, allowing for three feet of water and one foot of freeboard. This depth is measured from the current street level. The deepest point is kept free of vegetation because we anticipate that the majority of the sediment and trash will settle to this point. Any overflow from the site will run back into the street and be directed to the existing storm drain infrastructure. This detention basin requires a drain orifice of 0.25 ft. in diameter, or three inches, to allow for drawdown of the basin over 40 hours. This drain is located at the southeastern portion of the site, about a distance of 100 feet from the spillover outlet. Maintenance vehicles can access the detention basin by way of the mountable curbs on the northern end of the basin where no trees have been planted in order to maintain easy access to the outlet. See Figure 11 for a cross section of the detention basin, Figure 12 for an illustration of the detention basin wall and drawdown pipe, and Figure 13 for illustration of overflow outlet.

As mentioned, the site includes a parking lot for 30 cars, a picnic area, two buildings to be used as administrative offices for the SMMC, a walking path around the perimeter, and ample grassy open space in the basin suitable for recreational sports. A semi-pervious path runs through an allee of large trees surrounding the site. The trees serve as both a noise and visual buffer for sensitive adjacent neighbors to the park as well as a delightful strolling circuit. Fruit trees outside of the SMMC office shades a patio that may be used as an outdoor meeting office as well as a weekend picnic area and place for parents to watch their children play. Additionally, gentle berms utilize some of the excess soil dug out of the basin and serve as a place to people-gaze as well as observe the hydrological processes when the basin is being utilized for stormwater runoff.

The entrance of the park is sited at the northwestern corner as that is near both the closest major intersection and a hospital. The entrance takes the width of the sidewalk and expands into a mini plaza paved with decomposed granite. A parking lot surrounded by swales is located on either side of the main entrance. These swales contain parking lot runoff. Any overflow is directed into the rock creek channels and into the larger basin/park area.

The rock creeks are an aesthetic response to the need for culverts as well as the lack of year-round rain in a fairly dry climate. These "dry creeks" will be lined with local rocks from the surrounding foothills. Old homes all along the San Gabriel Mountain foothills still exist that were constructed of these smooth "river rocks" and the use in our design helps to create a connection between the design site and the native landscape. Usage of native plants will encourage a more contextual and environmentally appropriate landscape.

DISCUSSION

Calculations

An interesting aspect of this research was the variability in estimations for the percent of impermeable pavement in our study area. The number that Los Angeles County uses is 37 percent lower than the results we got from doing analysis of an aerial photograph. It also falls at the very low end of the range provided by the MRCA (Kammerer 2003). Using different impermeability factors has a significant impact on the C coefficient values.

Treatment Selection

Our proposal includes installing swales and a detention basin. We chose swales because they are an obvious fit for the neighborhood due to the existence of a grassy median between the sidewalk and the street. Many of the homes currently have drains installed that conduct runoff through a pipe from the home site under the sidewalk and grassy median and onto the street. These drains could easily empty into to swales and serve as a swale overflow outlet. For our second treatment, we determined that a detention basin that holds runoff temporarily was more appropriate than a retention basin, which holds water for a longer period of time. We decided this as a result of our site constraints analysis. Issues of West Nile virus and possible contamination make a retention basin an appropriate treatment.

Site Design

We imagine the park as a welcoming and peaceful place for the residents and visitors to the West Hills community. We wanted to use the space effectively and efficiently and feel that the park/detention basin combination achieves this nicely. The ability for the detention basin to be used as a play field when not is use as a detention basin will create a new and much needed

community resource. The gentle vegetated slopes will provide play area for children and adults alike.

Stormwater Flow

The biggest issue that impacts the success of this design is the current direction of stormwater flow. The neighborhood is currently designed to direct runoff through grading and low, in-street channels to exit points that, for the most part, do not flow by our design site. As our design relies on the conveyance of stormwater on the street surface to our design site, without manipulation of the current street structure, a significantly lower amount of runoff will reach the detention basin than that for which we have designed. Adding a single in-street channel would increase the runoff capture, but some runoff would still be side-tracked from the site. See Figure 14 for area now graded to drain to our site and for the area that could easily be diverted. Despite this situation, we believe that it is important to go ahead and design for a capacity to capture the runoff of the full neighborhood. If our design is implemented, it may be below capacity for a number of years, but in time, streets will need to be resurfaced and at such time, can be paved so that water flow is directed to the site.

Retention by Swimming Pools

There are a number of swimming pools in the study area that would capture and retain rainfall thus reducing runoff. This will result in a slight overestimation of runoff for this study area. However, the number of swimming pools in a given west San Fernando Valley neighborhood varies depending on the affluence of the neighborhood and because our research aims to develop a general correlation between neighborhood size and treatment volume size, we did not attempt to estimate the reduction in runoff that occurs when rain is captured in pools.

CONCLUSION

The most intriguing and informative aspect of this research is the quantification of the amount of space needed to capture the stormwater runoff of a single-family home neighborhood. The study area is 0.07 mi.^{2} and needs a detention basin with an average surface area of 0.002 mi.^{2} or approximately four percent of the drainage area. Neighborhoods of single-family homes make up a large part of the LARNUWR and knowing the spatial needs for treatment will greatly help to inform the planning and design process for the refuge. If other runoff reduction mechanisms are implemented at the home level, such as cisterns or permeable pavement, the amount of space need for a neighborhood-wide solution, such as the detention basin proposed in this document, could be even further reduced.

In addition to the spatial needs of such a treatment, it was a challenge to design a park around the basin that addressed a variety of needs hydrologic, social, and ecological concerns. It was particularly difficult to design a compelling public space for this neighborhood because of the auto-oriented nature of Southern California subdivision development. It seems that urban hydrologists have a stake in working to maintain our threatened public culture and domain in urban and suburban areas if we want to have sufficiently large enough spaces in our cities to accommodate natural processes.

Another interesting aspect of this research is the variability of assumptions and values that go into determining runoff. From the size of storm event for which to plan to the percent of impermeable pavement, there are many factors that influence and impact runoff calculations. As we have learned throughout the semester, this is yet another example of how sensitive hydrological calculations and application of design is a sensitive matter requiring extensive consideration of possible outcomes and repercussions for various alternatives.

REFERENCES

Anderson, Troy, April 30, 2004. "West Nile virus is here early: Infected birds also found in Ventura County," Los Angeles Daily News.

Camp Dresser & McKee, Larry Walker Associates, Uribe And Associates, and Resources Planning Associates, March 1993. *California Stormwater Best Management Practice Handbook.*

Cohen, Yoram, August 19, 2003. "The Santa Susan Field Laboratory: Exposure Pathways and Community Exposures – Preliminary Analysis," Presented at the UCLA/SSFL Public Meeting.

Gumprecht, Blake, 1999. *The Los Angeles River: Its Life, Death, and Possible Rebirth*, The Johns Hopkins University Press.

Kammerer, Martin, 2003. *Upper Los Angles River Watershed: Spatial Distribution of Impervious Surfaces*, Mountains Recreation and Conservation Authority Watershed Division.

Los Angles County Department of Public Works, Hydraulic / Water Conservation Division, December 1991. *Hydrology Manual.*

Los Angeles County Department of Public Works, Water Resource Division, June 2002. *Hydrology Method: Addendum to the 1991 Hydrology / Sedimentation Manual.*

Metropolitan Council, 2003. *Green Streets – Innovative Solutions for Stormwater and Stream Crossings.*

Navigate LA website, April 14, 2004. http://navigatela.lacity.org/.

San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy website, April 15, 2004. http://www.rmc.ca.gov/about/about_index.html.

Santa Monica Mountains Conservancy website, April 14, 2004. http://smmc.ca.gov/.

Sun Valley Watershed website, May 5, 2004, http://www.sunvalleywatershed.org/GetInvolved/survey.asp.

Western Regional Climate Center website, April 12, 2004. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?cacano.

TABLES

Table 1: Calculating the C Coefficient	
Surface	**Percentage**
Impervious	65
Disturbed Pervious	35
C coefficient = (1,891,150*0.35*0.3+1,891,150*0.65*0.9) / 1,891,150	0.69

Table 2: Study Area Runoff Volume (excluding design site)	
Inputs	
Size of site (A) (ft.^{2})	1,891,150
Design Rainfall (R) (ft.)	0.13
C coefficient (C)	0.69
Outputs	
Ours	
Volume (ft.^{3}) 1,891,150*0.13*0.69	163,112

Table 3: Design Characteristic and Total Design Runoff Volume				
Characteristic	**Area (sq. ft.)**	**C Coefficient**	**R - 10**	**Volume 10-year (ft.^{3})**
Bridges	6,500	0.9	0.13	2,165
Building 1	3,200	0.9	0.13	1,066
Building 2	7,700	0.9	0.13	2,564
Parking Lot	21,400	0.6	0.13	4,751
Semi-pervious patio	6,400	0.6	0.13	1,421
Walking Path	6,125	0.3	0.13	680
Sub-total				**4,272**
Neighborhood				163,112
Total Design Volume				**167,384**

Table 4: Swale Length Calculation			
	Length of Median (ft.)	**Grass (%)**	**Swale Opportunity (ft.)**
Newer Development	5,960	58	3,457
Older Development	4,795	72	3,452
Total Length (ft.)	10,755		6,909
Total Area (ft.^{2})	**5,960**		**17,273**

Table 5: Swale and Detention Basin Design Treatment Volume	
Swales	
Area (ft.^{2})	17,273
Soil depth (ft.)	1
Porosity	0.3
Treatment Capacity (ft.^{3})	5,182
Detention Basin	
Approximate Full Basin Area (ft.^{2}) (225 ft. x 325 ft.)	73,125
Half Basin Area (ft.^{2}) (225 ft. x 162.5 ft.)	36,563
Average surface area (ft.^{2})	54,844
Depth (ft.)	3
Treatment Capacity (ft.^{3})	164,531
Total Swale and Detention Basin Treatment Capacity (ft.^{3})	**169,713**

Table 6: Default Values of the Effective Porosity	
Sediment Type	**Effective Porosity**
Clay(very fine)	0.20
Clay(medium fine)	0.20
Clay(fine)	0.22
Silty clay	0.25
Silty clay loam	0.27
Clay loam	0.30
Loam	0.30
Silt loam	0.35
Silt	0.27
Sandy Clay	0.24
Sandy clay loam	0.26
Sandy loam	0.25
Loamy Sand	0.28
Sand	0.30
Source: Level 5: Interaction with the SESOIL modeling interface: SESOIL Soil Property Variables website, http://www.shodor.org/~igems/Teacher2/soilslv5teach.html.	

Table 7: Detention Basin Orifice Calculation	
Equation = $((1.75*10^{-6})*A*(H-Ho)^{0.5})/C$	
Where:	
A (average surface area of pond (ft.))	52,800
H (elevation when pond is full (ft.))	3
Ho (elevation when pond is empty (ft.))	0
C (orifice coefficient)	0.66
Area of Flow Control: **Single Orifice With 40-hour Drawdown** **(ft.)**	**0.25**

FIGURES

Shadow
Hills

Tujunga Wash

Panorama
City

Sun
Valley

Canoga
Park

Winnetka

Reseda

Van
Nuys

Valley
Glen

Warner
Center

Lake
Balboa

Tarzana

Sherman
Oaks

Valley
Village

Encino

Los Angeles River

Arroyo Seco

Compton Creek

LA River and Tributaries
Other watercourses
City of Los Angeles

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Miles

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Systems & GIS Division - November 2002

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CITY PLANNING

LOS ANGELES CITY
PLANNING
DEPARTMENT

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INFORMATION
SYSTEMS

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Figure 1: The Los Angeles River and Major Tributaries

ROSCOE BLVD

SATICOY ST

Bell Creek

Canoga
Park

Winnetka

SHERMAN WY

SHERMAN WY

WINNETKA AV

SHERMAN WY

SHERMAN WY

SHERM

Reseda

FALLBROOK AV

TOPANGA CANYON BLVD

Los Angeles
River

TAMPA AV

RESEDA BLVD

PLATT AV

OXNARD ST

VALLEY CIRCLE BLVD

VENTURA BLVD

Tarzana

MULHOLLAND DR

N

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Miles
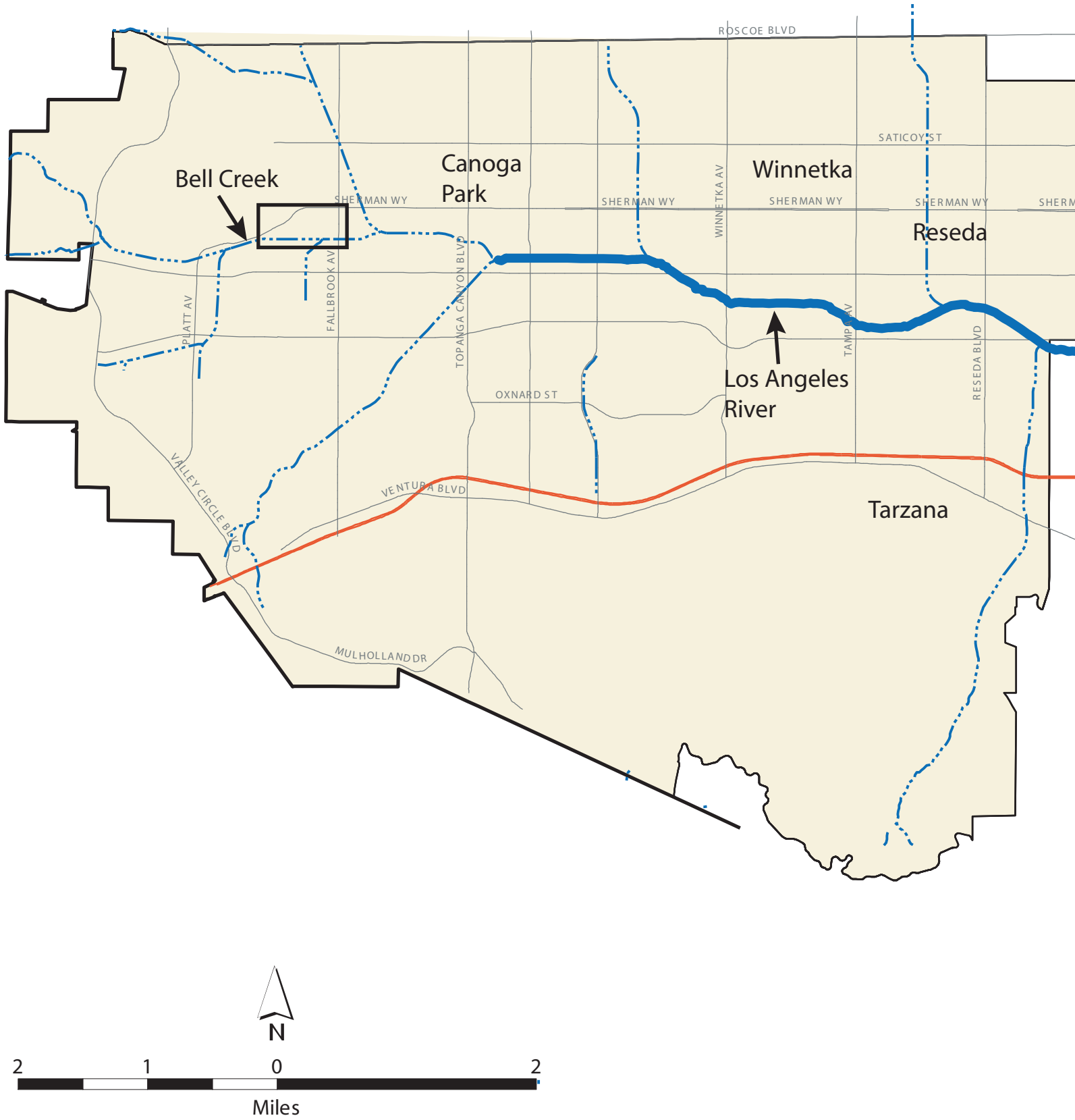
Figure 2: Study Area Environs

Sherman Way

Fallbrook Avenue

Design Site

Bell Creek

Figure 3: Study Area Map

Figure 4: Storm Flow Direction

Storm Flow Direction

820 Elevation

Storm Drain Inlets
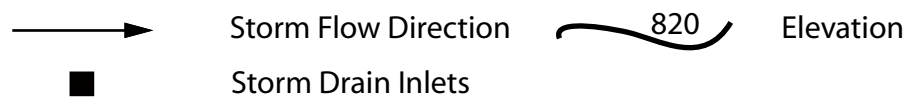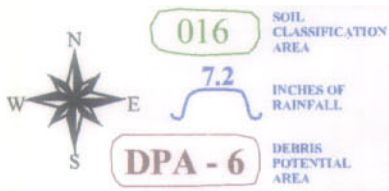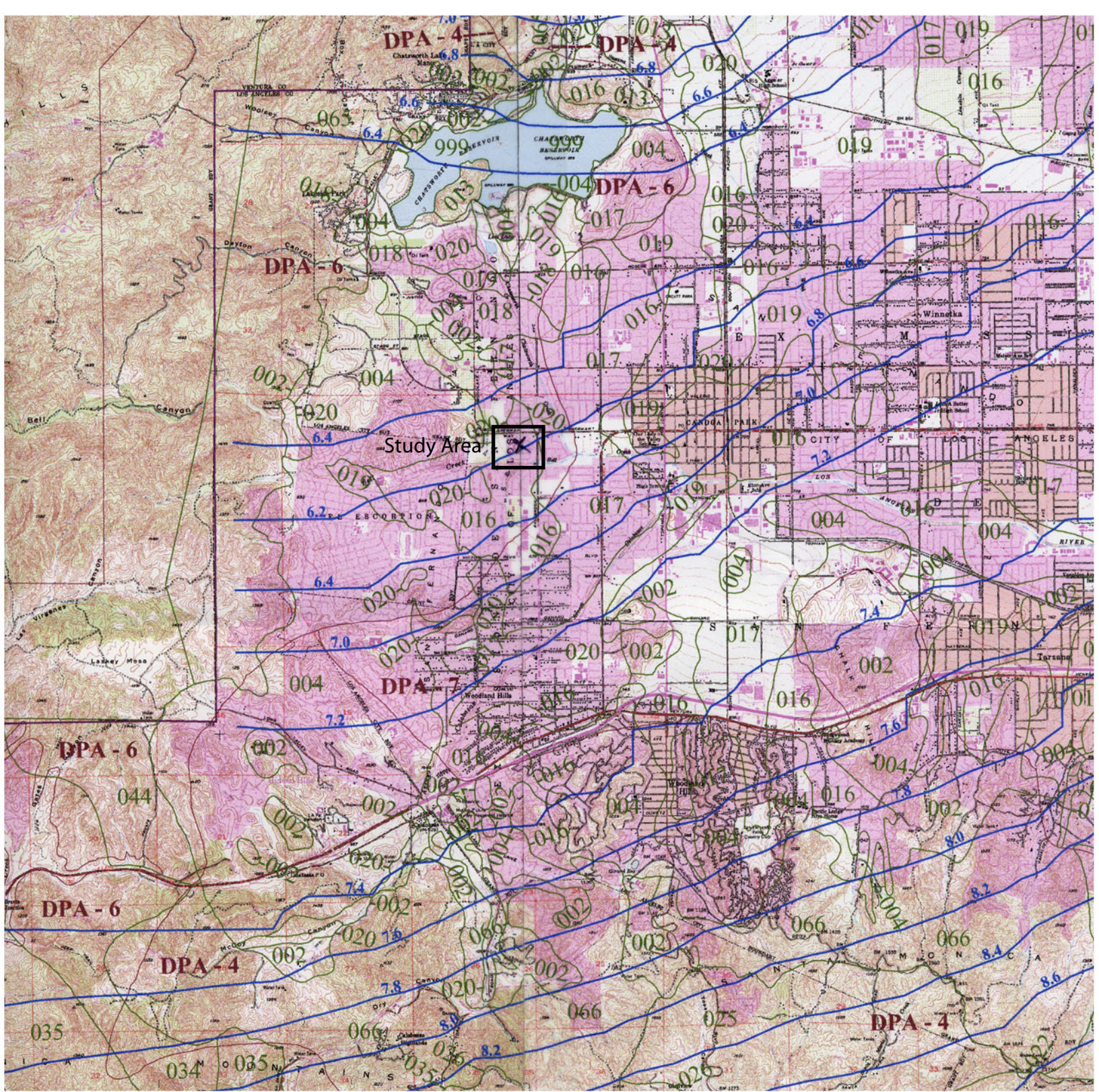
Figure 5: Rain and Soil Map

1956 Homes
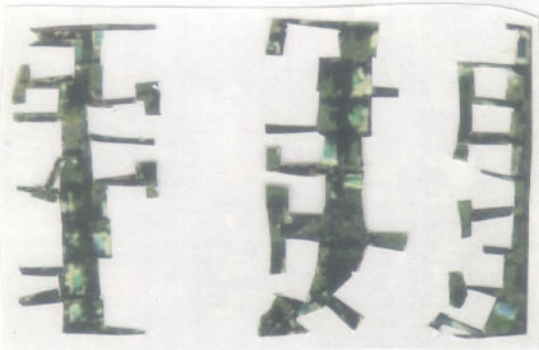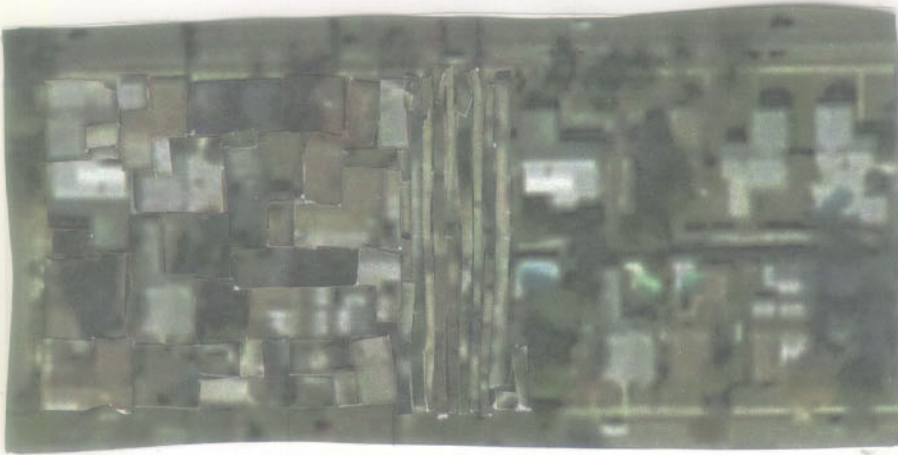
1979 Homes
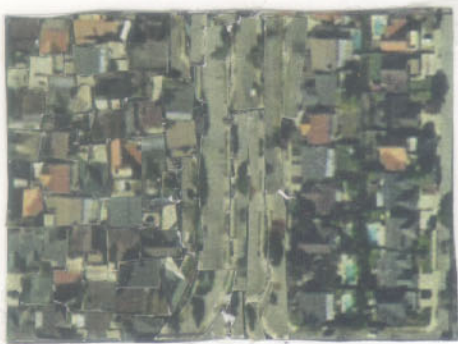
Figure 6: Permeability Analysis Based on Aerial Photographs
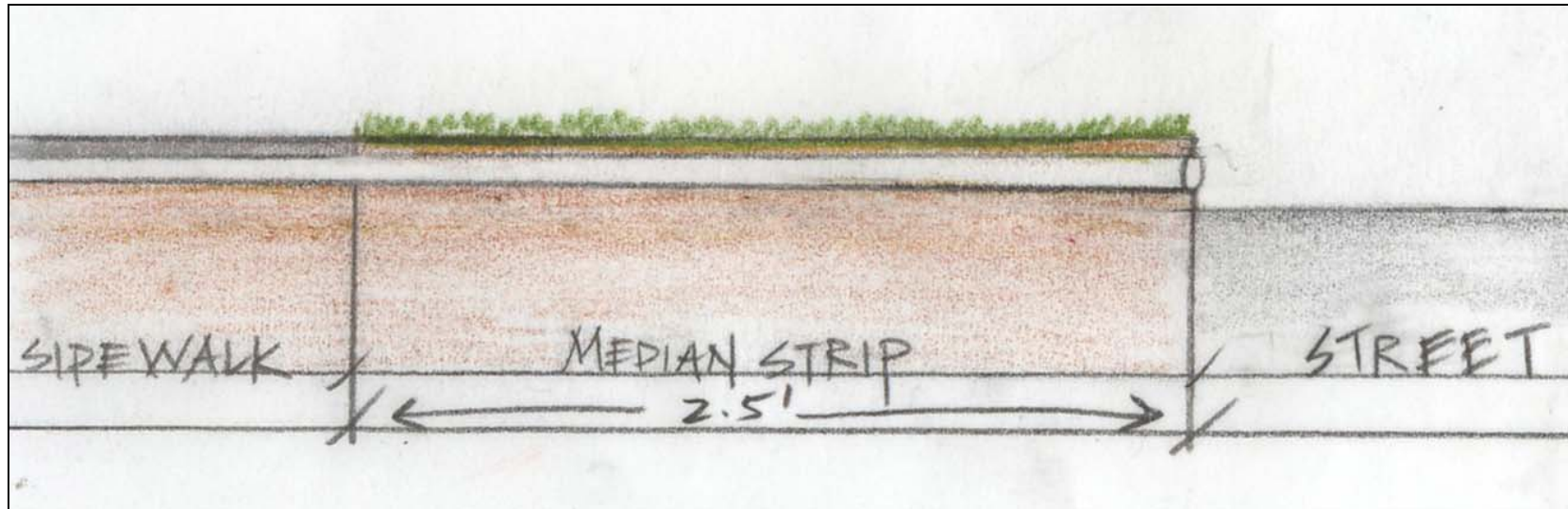
Figure 7:   **Swale Cross-Section**
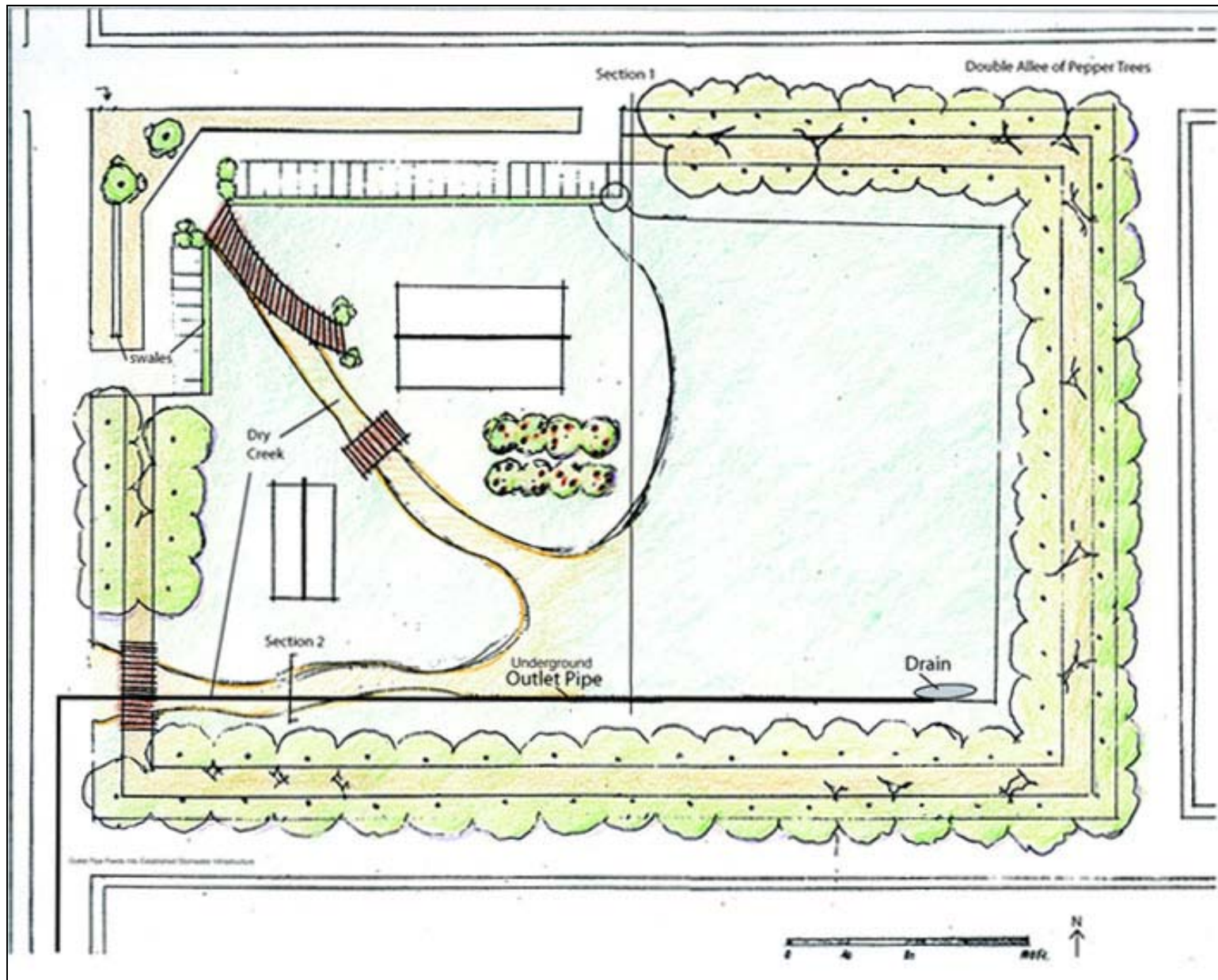
Figure 8: **Site Design**
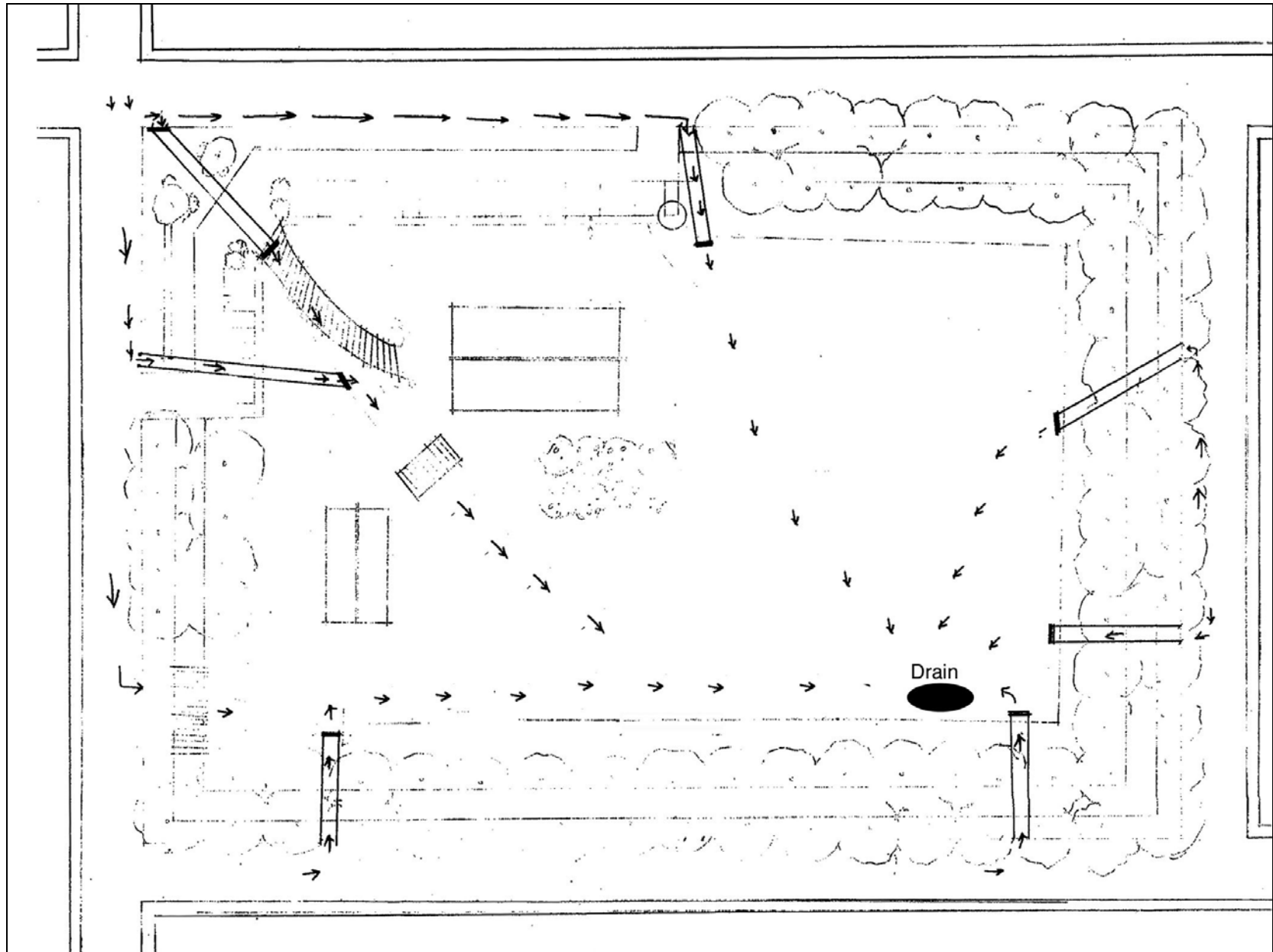
Figure 9:   Direction of Runoff Flow Into Design Site

Figure 10: Perforated Sidewalk Illustration and Cross-Section
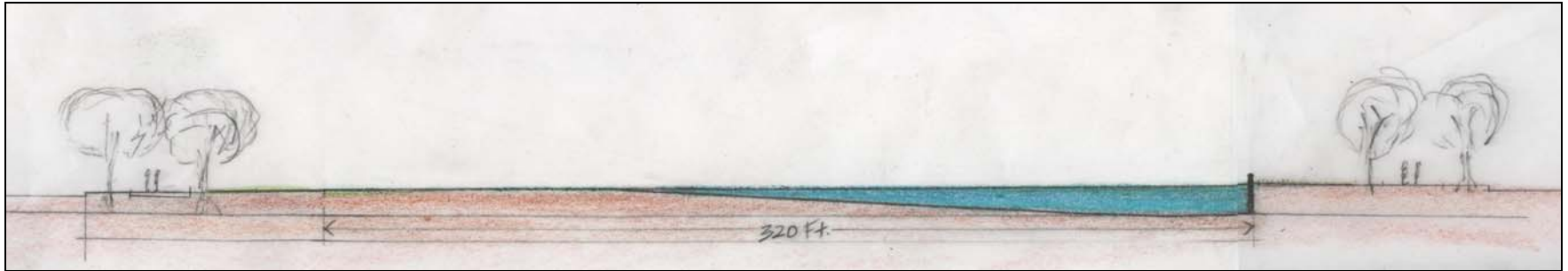
Figure 11:   **Detention Basin Cross-Section**
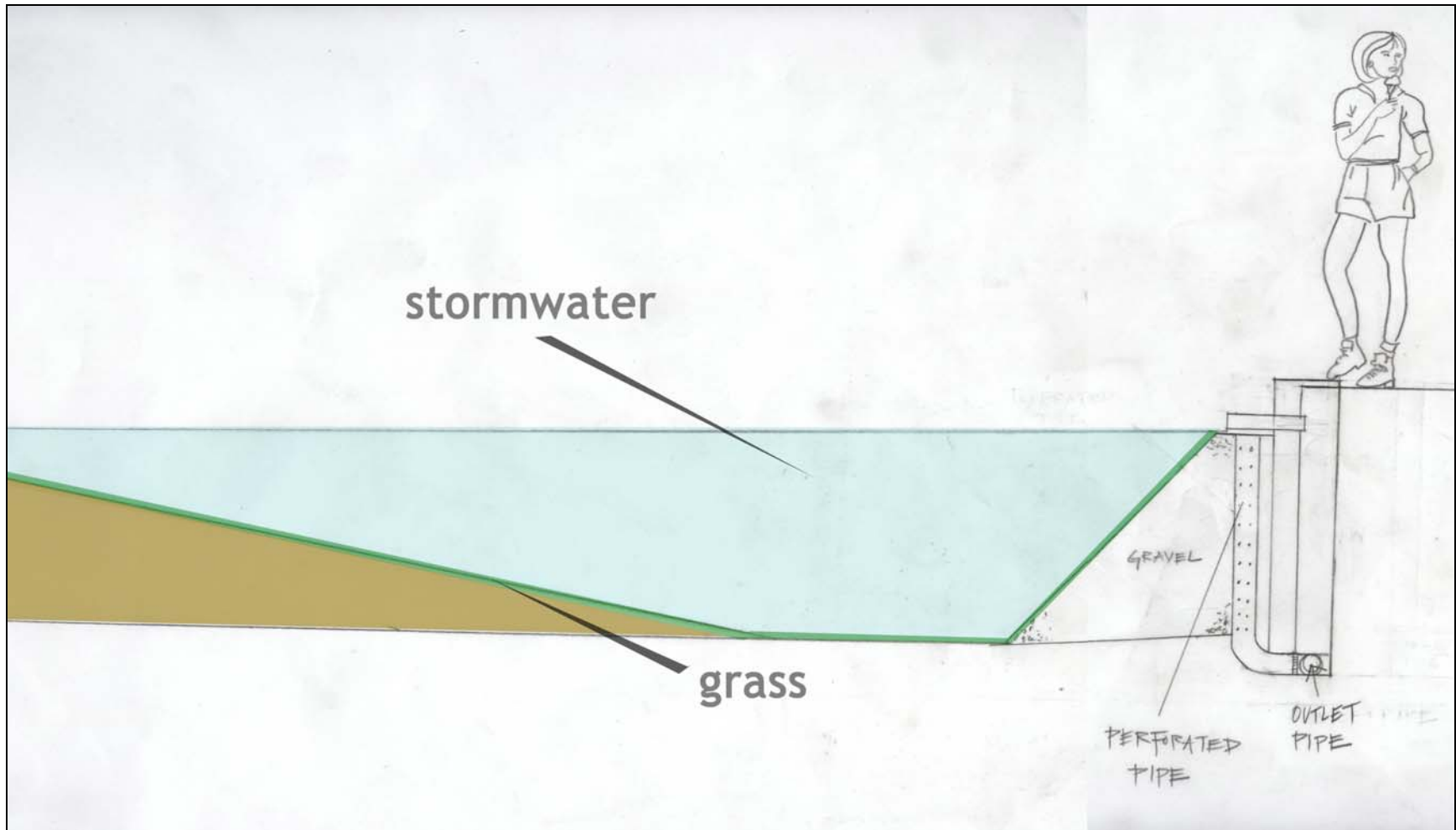
Figure 12: **Outlet Configuration Cross-Section**
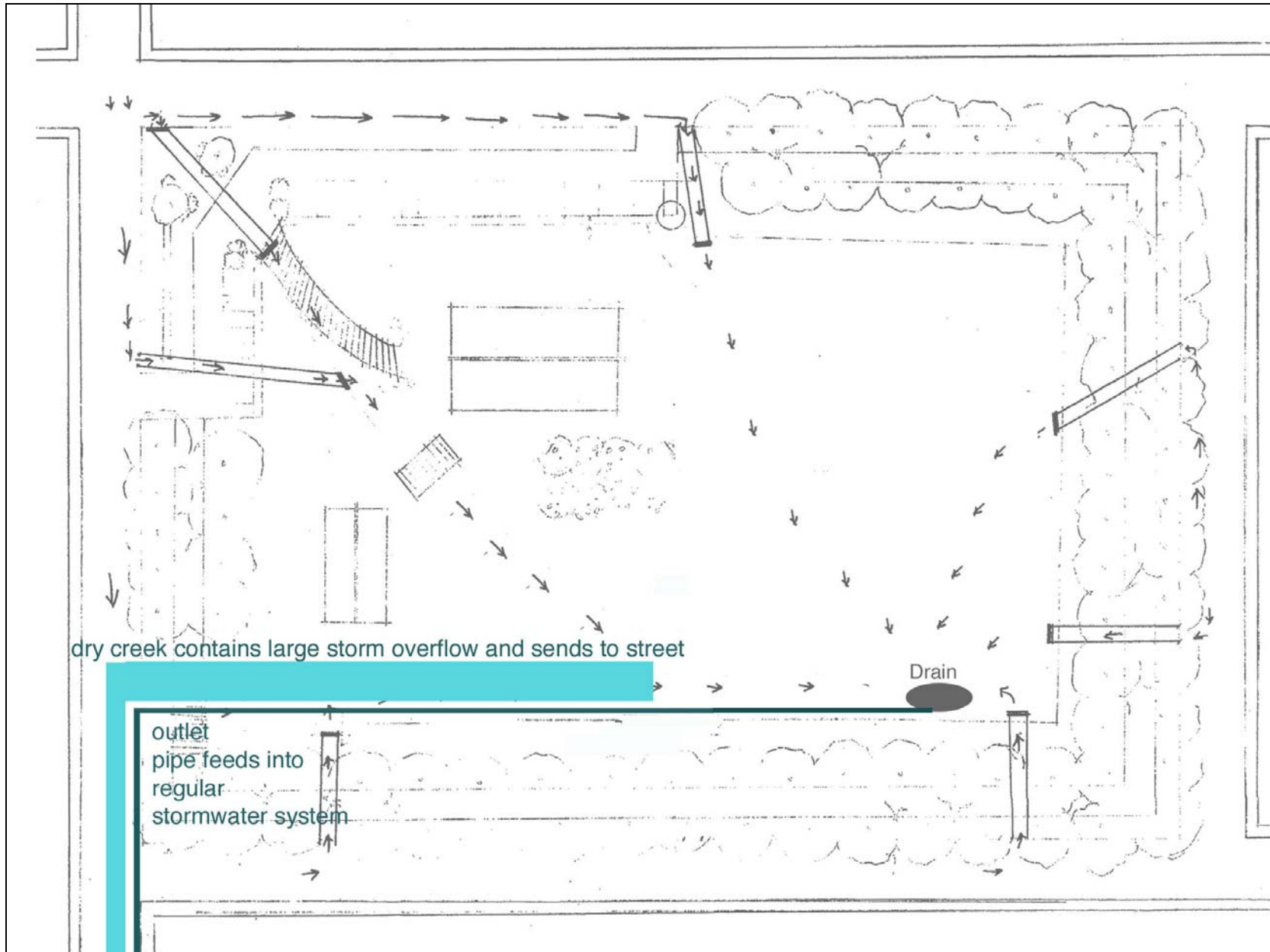
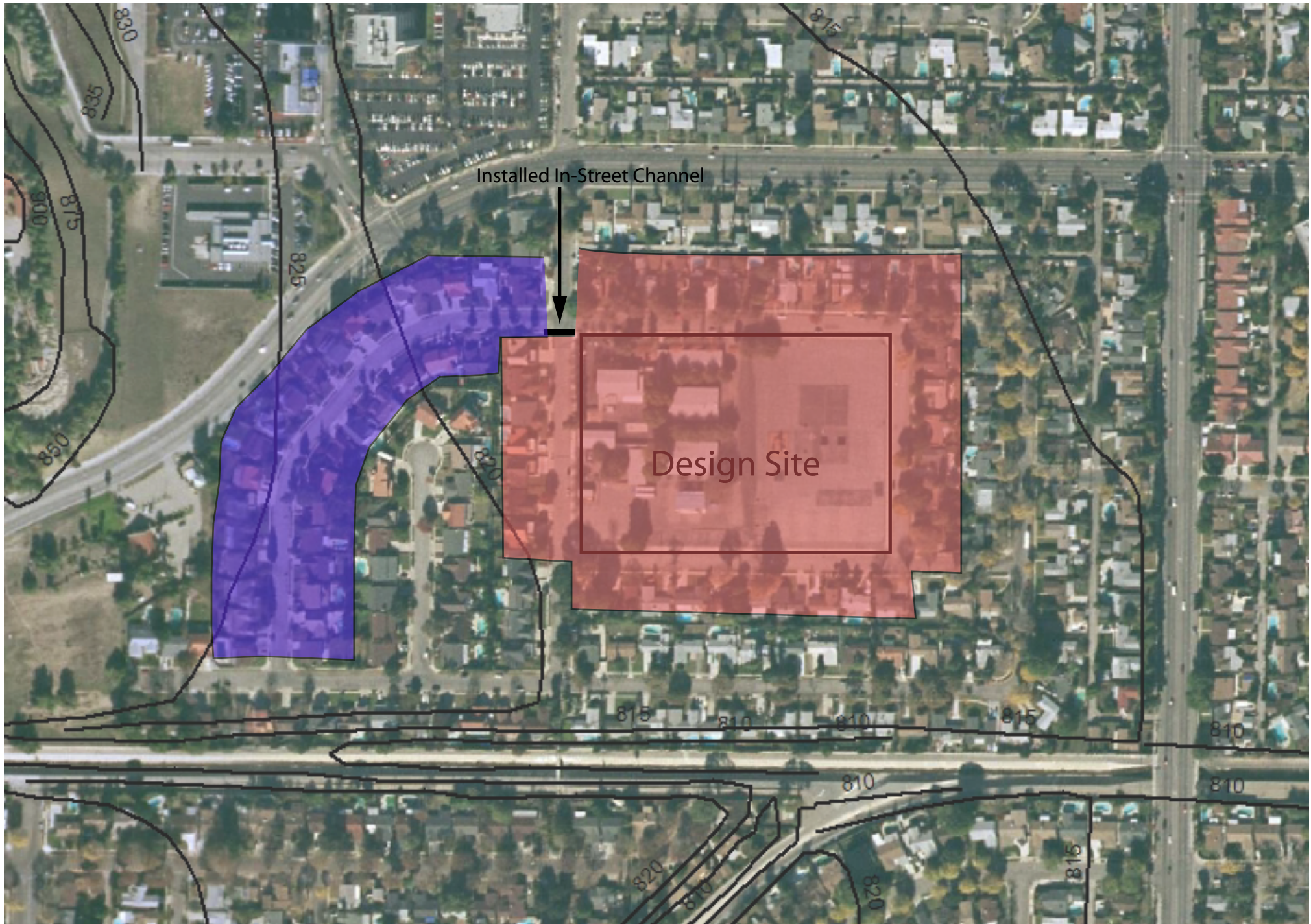**Figure 13:** **Runoff Flow to Design Site and Overflow Outlet Direction**

Installed In-Street Channel

Design Site

Figure 14: Current Area of Runoff Capture and Area Captured with In-Street Channel

Current Area Captured

Potential Area Captured with In-Street Channel