

# LID Street Retrofit

The story of a small California community and its selection and proposal for a LID retrofit



Thank you for taking the time to open up  
and read LID Street Retrofit. Grab an ice  
cold glass of your favorite beverage, kick  
your feet up and enjoy!

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## Executive Summary:

LID Street Retrofit is the beginnings of a California Proposition 84 stormwater grant proposal, for the city of Gonzales. The grant funds will help fund a LID retrofit of Old Town Gonzales' street network. This project begins with a general discussion of Low Impact Development: What is it? What are the benefits? How do you do it? Then the project uses those answers and a rigorous site assessment to select Gonzales from a list of 6 deserving communities. From there, a concept plan is developed illustrating a feasible plan for retrofitting the streets to efficiently infiltrate and treat the Stormwater.

## Introduction:

The earth supports seven billion people with food, air, and water. As the earth's population continues to increase, so too does pollution. Humans have altered the rate and function of nature with pollutants and pavement. For example in America, "about 44% of assessed stream miles, 64% of assessed lake acres, and 30% of assessed bay and estuarine square miles are not clean enough to support uses such as fishing and swimming." (EPA, 2009). Many of the water quality issues today are influenced by altering watershed patterns. Low Impact Development (LID) helps enable watersheds to function like they did before development, while still maintaining existing infrastructure and development.

This project is a Low Impact Development retrofit of a Central Coast community's street system. Seeking funds from the California Proposition 84

stormwater grant, this project includes a discussion on Low Impact Development and strategies, a thorough site assessment and selection, and prepare a concept plan for the selected Central Coast community. This project will provide a foundation, graphics and sections to the Grant Application. The communities considered have predominantly lower income, are small, rely on an agriculture-based economy and are plagued with aging stormwater systems. The communities all experience flooding during major storms and the stormwater drains to federally listed impacted water bodies. These communities--economically sustained by agriculture--require a clean and plentiful supply of water. Managing and cleaning their stormwater will benefit community and environmental health, drinking water, flood hazards, and help ensure agricultural sustainability.



Hite Marina, Utah



Pajaro, California

## What is Low Impact Development?

Low Impact Development (LID) is a land development approach focusing on managing stormwater using the pre-development natural environment as the guide (LIDstormwater.net, 2013). As a counter approach to traditional stormwater system that focuses on the efficient conveyance, LID principles aim to slow the runoff and retain stormwater where it falls. These measures mimic predevelopment hydrologic patterns. They also filter pollutants using vegetation and soil; as well as, reduce the reliance on the existing stormwater system: “Applied on a broad scale, LID can maintain or restore a watershed’s hydrologic and ecological functions,” (EPA, 2013).

There are three primary hydrologic functions of a watershed: collection, storage, and discharge of water. In the natural environment, rain falls and collects on the surface; then the water soaks into the ground until the ground is saturated and discharges as runoff. In contrast, the urban environment collects rain, but rain is unable to soak into the ground and immediately discharges. Due to the extent of impermeable surfaces, there is more water initially collected in an urban environment. When water is unable to infiltrate, the water, as runoff, quickly reaches a receiving body, such as a river or stream that outlets to a lake or ocean (Black, 1996).

The primary difference between the urban and environmental watershed functions is water’s initial ability to store before becoming runoff; this is called infiltration. In a traditional stormwater system, a detention basin can be viewed as a storage function; however, these basins are intended to control runoff volume and speed--detention and retention (NPDES, 2006). These systems are not intended to infiltrate runoff essentially bypassing the environments way of storing water—infiltration. The two main benefits of water infiltrating is groundwater recharge, and soil and vegetation helps

remove pollutants (EPA, 2000, i). The traditional detention basin is great at controlling large scale runoff and removing sediment, however, the detention basin does not infiltrate water into the groundwater, and does not remove other pollutants such as heavy metals, pesticides, bacteria, pathogens and more (EPA, 2000). In conclusion, the conventional detention basin functions similar to a receiving body. Watersheds are complex systems; this simplified version is intended to illustrate the functional differences between the conventional stormwater system and Low Impact Development. There will always be urbanization, buildings, roads, automobiles and pollution and restoring the complete watershed functions and ecology is impossible, but infiltration is a key component to returning towards the pre-development condition.

## Types of LID:

The types of LID listed and discussed below are briefly described in relationship to their watershed and LID function. Then each type will be highlighted through its specific use in the 21st Street, Paso Robles LID project. 21st Street in Paso Robles is an on-going LID street retrofit project in the Central Coast, and will serve as a case study for explaining proper and efficient use of these LID types. However it is important to note, this is not a complete and comprehensive list of all LID types, just a few of the primary types that will be considered for this Grant Proposal.

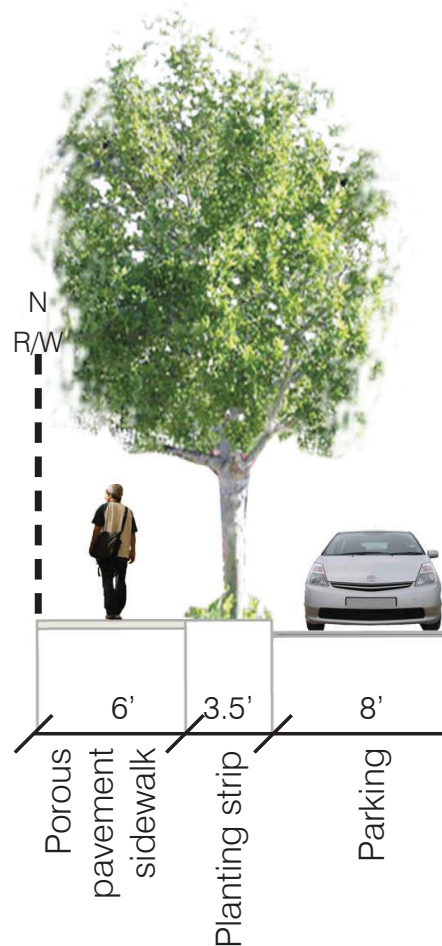


Figure 1: Porous Pavement Sidewalks. (LIDI, 2011)

Materials are the initial difference between the environmental and urban surface condition. In urbanized areas, the majority of surfaces are driveways, parking lots, roofs and streets, which quickly shed water into stormwater systems. These typically impermeable surfaces replaced the permeable environmental surfaces. However, LID addresses the surface condition by encouraging the use of permeable surfaces such as, permeable asphalt, concrete pavers, cobble stones, and gravel (SNH, 5). Having material surfaces that allow water to infiltrate into the ground better replicates the natural environment condition and reduces strain on the stormwater system. However, impermeable surfaces are necessary in the urban environment; for example, streets require a hard and smooth surface primarily for circulation purposes. On the other hand parking lots, walkways and driveways are relatively easy to retrofit, and do not require the hard smooth surface that streets require. Alternative paving materials are expensive in comparison to pavement but they do infiltrate more water and better represent the pre-development condition.

As seen in the 21st Street project, permeable pavers are used for the six-foot sidewalks (LIDI, 2011). Porous pavement is used for the sidewalk because this will help infiltrate rain that falls on the sidewalk and help infiltrate rain from surrounding land draining to 21st street (Figure 1). Permeable pavers can't be used for the street surface, but they could have been effective alongside the allocated parking space. One of the likely reasons for the choice of pavement is the expense of permeable surfaces, and the extensive amount of bio-retention.

Bio-retention is another common tool to successful LID and entirely designed around infiltration. Due to the inability to have completely permeable surfaces in an urban environment, bio-retention helps combat the increased runoff by creating a highly efficient constructed cell. It works similar to the function of a wetland; a highly productive ecosystem, where stormwater will enter, be retained and filtered. Usually these areas have high performance vegetation, defined as vegetation that can filter out pollutants, as well as, succeed in wet and dry soil conditions. These retention cells contain porous or permeable soils that are optimal for infiltration and pollutant removal. They effectively slow water down and reduce the amount of water entering the storm water system. These systems are an infrastructure investment; they require smart design, good construction and upkeep and maintenance. They are more expensive than permeable pavers, but they provide exceptional infiltration and pollutant removal.

Looking at the 21st Street project in Paso, the dwindling groundwater supply is a major issue. The community is dependent on the Paso Robles Basin and the Salinas River underflow for water (PRCity). Due to surrounding agricultural use, the water supply is stressed because of an imbalance in replenishing the ground water aquifer. Along the sides of the street are high performance bio-retention rain gardens/cells (Figure 2). These cells collect water from neighboring streets, as well as, 21st Street. The creek channel in the middle of the street provides some infiltration opportunity, but primarily conveys the clean water from the undeveloped watershed above. This channel is and functions more like an existing surface body and does not receive runoff from 21st Street.



Figure 2: Birds eye view of proposed curb extension bio-retention on side of the street. (LIDI, 2011)

In both urban and environmental contexts, discharge is the final part of a watershed function. In the ideal circumstance, the discharge of an urban environment with LID should replicate the pre-development flow regime. In the natural setting, water is poised to runoff after being collected and stored in a watershed system (Black, 1996); however, due to urban alteration to stormwater infiltration, the increased amount of water, potentially contaminated, is often too fast to be safely discharged. Fast discharge in both contexts is erosive and changes the watershed. Even in a non-urbanized watershed erosion is natural; however, an urban area accelerates erosion altering stream shape and size (USGS, 2013).

Even though LID produces less, when there is discharge, LID often deals with it similar to conventional methods, by using obstructions in front of the outfall to soften the power. In the 21st Street case study, the stormwater that is in the median, creek channel, enters an underground culvert as it goes under the intersections. The flow quickly increases in the culvert becoming more erosive when it comes out. As the water is re-introduced to the open channel in the street, the project uses railroad ties to deflect the water and slow it down (LIDI, 2011). Even though this is the same method and function as the conventional system, the use of railroad ties to check the speed of the runoff is used more often through the project. Typically these are found at the outfall as the water enters a receiving body. The railroad ties are used every intersection to help control the flow throughout the site, rather than just at the end.

The final characteristic of LID's intention of returning to the pre-existing condition is greening the street. LID is an opportunity to add aesthetic appeal, comfort and sustainability to the streets. The urban environment's materials and activities absorb and produce heat creating the phenomenon, urban heat island. One significant contributor is streets, the dark material absorbs sunshine and radiates retained heat. Furthermore, the streets also prevent the natural

cooling effect of evapotranspiration, the transport of water to the atmosphere, evaporation (from soils) and transpiration (from plants). LID can't restore the full pre-existing levels evapotranspiration, but it can provide opportunity for more vegetation, water-retention, and less pavement. Furthermore, established trees provide excellent retention: "...typical street tree can intercept in its crown range from 760 gallons/tree/year to 4,000 gallons/tree/year." (CRWA, 2009). Oakland is currently conducting a 40 year study monitoring stormwater contaminants; 1,800 trees were planted and so far have had a tremendous impact and social acceptance: "The study also found that trees reduce stormwater runoff, particularly for small storms. Furthermore, nutrient levels in the runoff from the block with less canopy cover were consistently higher than those from the city block with more canopy cover." (UrbanReleaf, 2008). Vegetation and trees are excellent resources to successful LID: increased water retention and reduce urban heat island.

As seen in the 21st Street project, one of the primary goals is to, "Shade the street with trees." Each sidewalk has dedicated three and a half feet to vegetation and trees. Furthermore, each retention rain garden/cell has vegetation. The added vegetation will reduce urban heat island, as well as, infiltrate more water.

Low Impact Development is a new, evolving approach to urban design. New ideas and solutions are being created, revised, recreated and revised again. These ideas can be anything from paving materials to public artwork to swales on the side of the road. Different areas of the country have developed their own unique successful designs and systems. Even though some of these early tests have failed, LID can and has been demonstrated as a critical approach to restore the functions of watersheds, provide safe infrastructure and beautify a town.

## LID Street Right of Way:

The street provides the greatest opportunity for a successful LID retrofit. Street right of way for the intent of this project is the space between the curbs. Technically, the street right of way includes the city property allocated for streets, which usually includes more than the space between the curbs. LID can also be retrofitted for the area outside the street, but for cost and ease this project only considers the space between the curbs. Streets are approximately 70% of an urban environments impervious surface (Lee and Heaney, 2003), and the backbone of community function. Streets are also great collectors of contaminants: from automobiles, people, or the surrounding environment. Streets, like stormwater systems, have been over engineered for efficiency--designed for the worst case scenarios. However, the status-quo behind both of these systems are changing. In new urbanist studies, wide streets are more dangerous due to unrestricted physical constraints to travel speed (Nmmainstreet). Traditional

streets were designed to accommodate maximum capacity at the speed limit; therefore, when streets are not at full capacity, the street does not restrict speeds--only the fear of law enforcement. Thankfully, communities all over the state contain these over-engineered streets because large streets provide more opportunity for LID street retrofit. Furthermore, California mandates street design to accommodate all users through the Complete Street Act, signed in 2008 (Calbike, 2011). When working within the street right of way, parking must also be a major concern. Parking is a universal desire and necessity for communities and LID retrofit in existing urban spaces can reduce the availability and ease of parking. To gain community support, parking must be considered. Streets must be viewed as a bi-functional urban form: a functioning stream of urban runoff and the backbone of circulation. The goal is achieving a healthy balance between the two.

## Curb Extension:

One form of a LID street retrofits easily incorporated into the street right-of-way is called a curb extension (also referred to as a bulb out). Both of these encroach into the street right of way transforming parking and driving space into possible areas of infiltration and retention. Furthermore, the addition of plants and the LID encroachment within the street right of way is an effective form of calming traffic (Fehr&Peers, 2013). A bulb-out refers to a curb extension on the corner of a street, while a curb extension is the more general term for an extension into the street. Lowering speeds is the first step to providing a safer street environment. The street retrofit project must comply with the Complete Streets Act (CSA, AB1358) and facilitate all modes of transportation. The CSA, signed in 2008 by Arnold Schwarzenegger, requires cities

when updating their General Plan, to comply with the Office of Planning and Research Complete Street Guidelines. Even if the selected community has not updated their General Plan, this project will comply with the CSA. Selecting the location of the curb extension must also consider pedestrian and driving characteristics, but this projects primary intention is stormwater concern. This project utilizes the curb contain the bio-retention cell because of flexibility in location possibilities, improvement to pedestrian circulation, reduction of traffic speed.



## Project Proposal:

Common stormwater problems plague small, disadvantaged communities across the country. This project details the steps taken to select a community, and develop a LID concept plan. The project's goal is to help produce a grant application to garner funds for a disadvantaged community along the Central Coast to implement a community wide LID street retrofit. These disadvantaged communities tend to be agriculture based and deal with some of the most severe environmental problems.

Proposition 84 is a California storm water grant. A portion of the funds allocated from the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 are reserved for cleaning up pollutant discharge as part of the NPDES. The intention is to bring funding to a community on the central coast who is disadvantaged and less likely to meet and improve the NPDES pollutant discharge standards. Furthermore, this

project with funding from Proposition 84 is the first part of a comprehensive healthy community plan for a small disadvantaged community (DAC). Another crucial part of the Grant proposal is the incorporation of Education. The grant must include an educational component and incorporate the community with the process and understanding of LID.

My senior project focuses on grant proposal site assessment and community selection, developing a conceptual plan for LID performing curb-extensions and bulbouts, help coordinating and assisting the development of an Operations and Maintenance Plan, and assisting with a Cost-benefit analysis. I am working with multiple organizations, including the Morro Bay Foundation (MBF), the Low Impact Development Initiative, Central Coast Regional Water Quality Control Board (CCRWQCB), and RICK Engineering Company.

**MBF:**

The Morro Bay Foundation is a nonprofit based in Morro Bay. Their mission is “to provide leadership in restoring, enhancing and protecting the Marine Resources and Watersheds of Morro Bay, Estero Bay and The Central Coast.” (Guidestar, 2013). The non-profit is partners with LIDI, CCRWQCB and Cal Poly.

**CCRWQCB:**

One of nine California state regional entities tasked with implementing water quality regulations. The regional boundaries are based on hydrologic areas. The organization is responsible for implementing enhanced stormwater regulations for new large-scale developments.

**LIDI:**

LIDI is a sponsored initiative group under the MBF in partnership with UC Davis and Cal Poly. The aim of the organization is to support the vision of healthy watersheds and communities through LID implementation. Some notable projects include the 21st Street project in Paso Robles promoting a walkable, healthy and green street in the Central Coast.

**RICK Engineering Co.:**

RICK Engineering Company is a south-west based multi-disciplinary firm. I’m working with Frank Lopez from the San Luis Obispo office. LIDI and CCRWQCB are bringing RICK Engineering along to learn about successful LID protocol. This will expand the LID engineering experience and knowledge in the Central Coast. One notable project of RICK engineering includes the US Olympic training facility in Chula Vista, Ca.

The proposal respects community beliefs, while addressing environmental and safety concerns. Three primary objectives for the project include improving receiving surface waters, infiltrating water into the ground, and promote a healthy community. Communities under consideration are particularly sensitive to the changes being proposed. The list of co-effects is immeasurable, here is a list of some expected after a street retrofit implementation: increased economic activity, increased property values and improved air quality (EPA, 2013, 3). Even though these could be viewed as co-benefits, co-benefits imply a positive outcome. In this project, co-effects shall be monitored to be aware potential ill effects and other impacts possible with upgrading community infrastructure.

### Site Assessment:

For this project the site assessment was broken up into two parts, a desktop survey and a windshield survey. First a desktop survey was conducted based on Southern California Low Impact Development Manual site assessment to prioritize each community based on social and environmental data (CASQA, 2010). Then personal visits were conducted to check the characteristics that would impact implementation success.

### Desktop Site Assessment:

With help from LIDI and the CCRWQCB, six different communities were selected for an initial desktop assessment based on social, hydrologic, geologic and physical characteristics. The individual site-specific problems, opportunities, constraints and community acceptance are vastly different between the prospective communities. All of these communities would benefit greatly from a street retrofit, making the selection of one especially tricky. The six communities considered were Las Lomas, Pajaro, Boronda, Gonzales, Greenfield and Guadalupe (Figure 3). There are several other candidates; however, we had to limit scope. These were based on information from CCRWQB staff and the county of Monterey. Furthermore, the majority of the communities are located in the northern region because this region is projected to experience the most growth. Furthermore, these communities contribute to federally listed contaminated receiving water bodies.

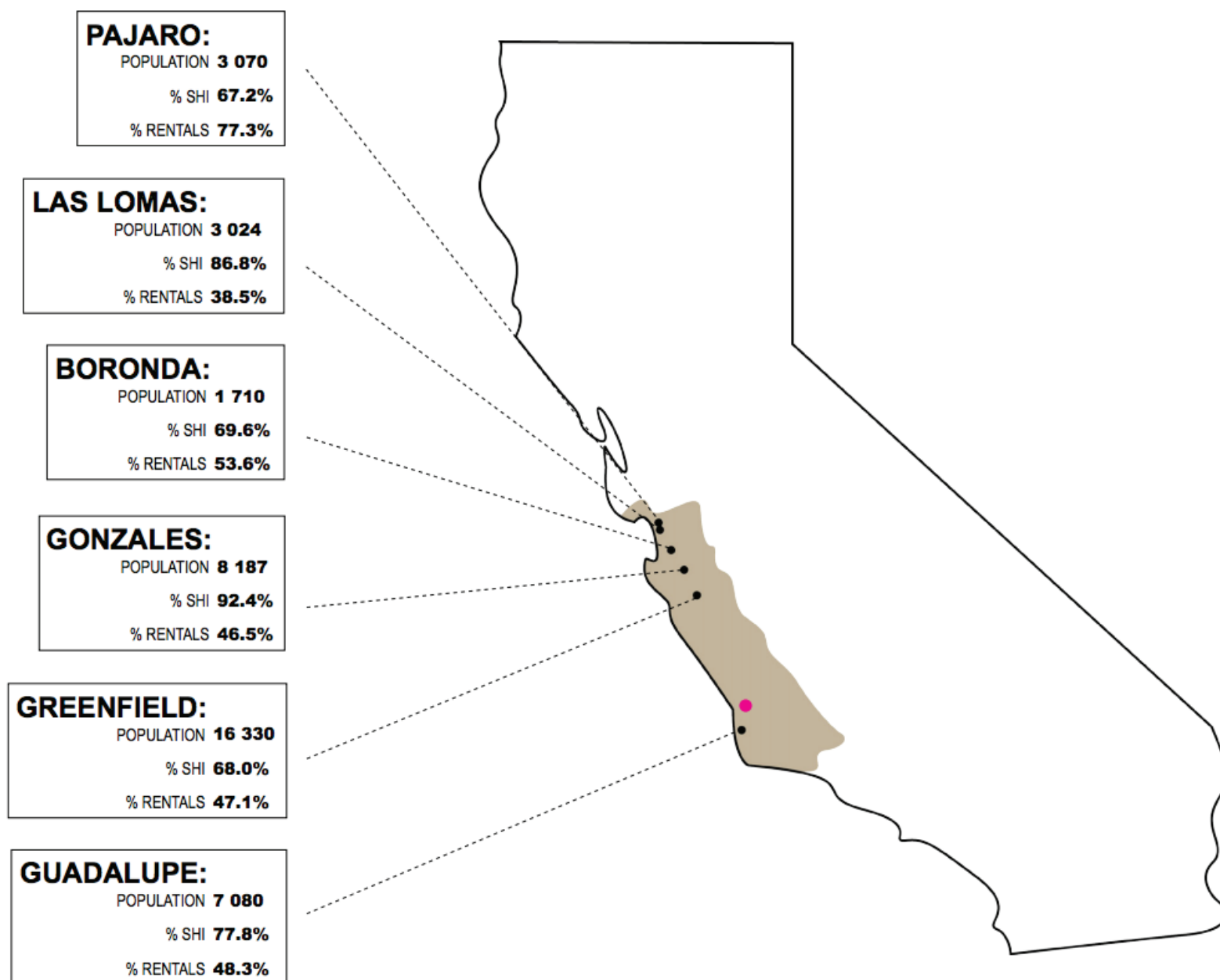


Figure 3: Location of selected communities within California, their population, their percentage of State Household Income, and their relationship to San Luis Obispo. (American Fact Finder, 2010)

The selected criteria came from the Southern California Low Impact Development handbook and CCRWQCB regulations as a guide for the desktop site assessment. The criteria used for evaluation of the communities is as follows: soil type, soil permeability, depth to ground water, contaminated receiving bodies and pollutant type, population and existing curb and gutter system. All of these characteristics are critical to successful implementation, but some are inherently more critical to a successful retrofit. The communities were ranked based on suitability for each characteristic. The following bullets illustrate the general order of importance regarding each criteria:

- A community with curbs and gutters is more suited for a curb extension LID retrofit.
- A community with more permeable Soils is better suited for a LID retrofit.
- A community with a greater depth to groundwater is better suited for a LID retrofit.
- A community that drains to more contaminated surface bodies is better suited for a LID retrofit.
- A community with a greater population is more suitable for a LID retrofit.
- A community with a lower State Household Income is more suited for a LID retrofit.

In order to achieve a level and fair set of criteria all of the communities, context, environmental conditions, census information and current infrastructure were analyzed and prioritized in a chart. I will first briefly

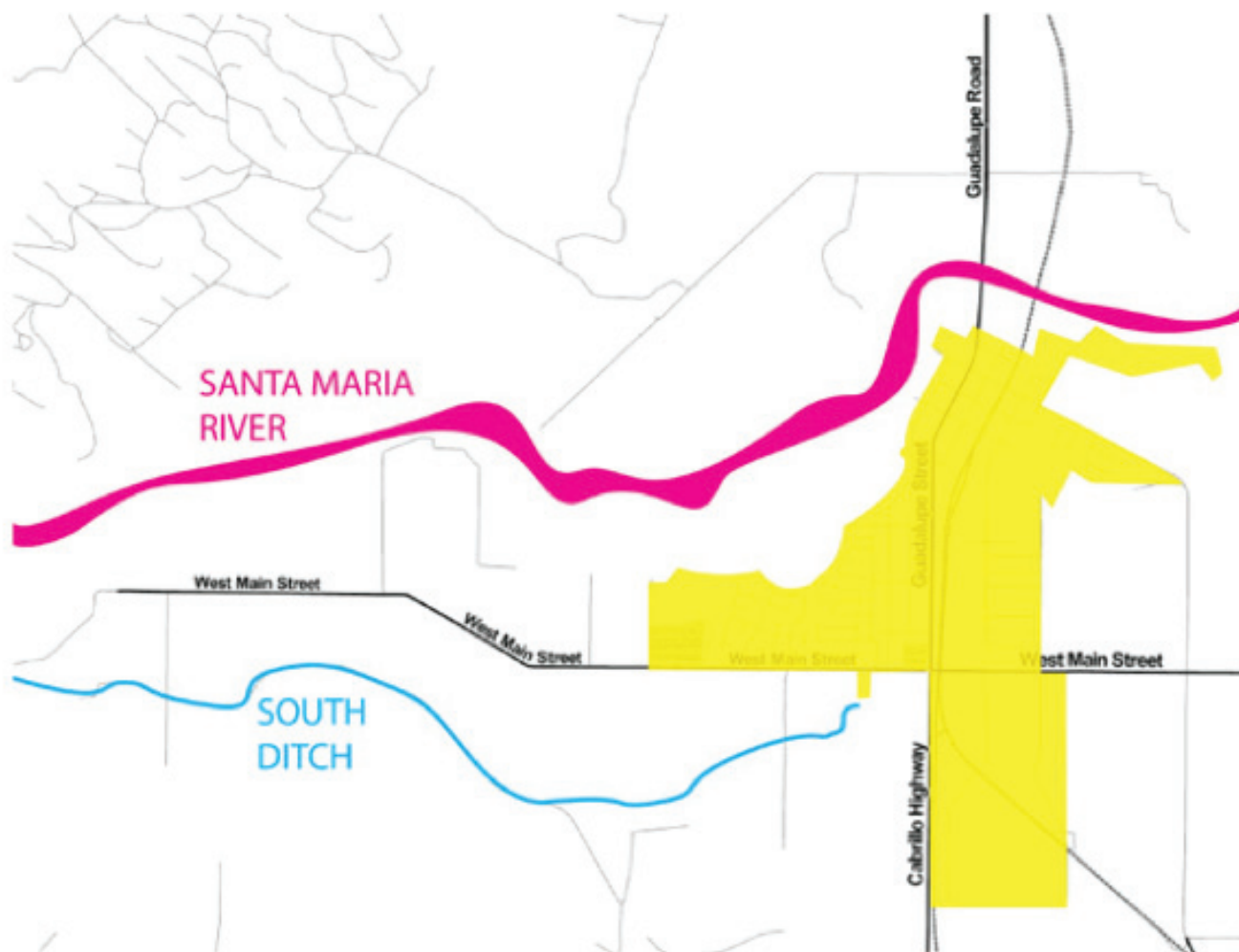
discuss the method for each criterion and then explain why the best community is optimal for a LID street retrofit. This information is used for general site assessment.

## Hydrology Assessment:

The hydrology maps (Figure 4-Figure 9) graphically represent the receiving body of waters where stormwater from each community ends up. The surface bodies, color coded by 303d status (pink is listed, blue is unlisted), highlight the federally recognized contaminated bodies of water (CWA 303d). 303d refers to section 303d of the Clean Water Act, nationally recognized bodies of waters that do not meet California quality standards. Each contaminated body of water has a proposed Total Maximum Daily Load (TMDL) date of completion. LID is one way to meet the TMDL requirements of the National Pollutant Discharge Elimination System. To comprehensively integrate the retrofit into the existing stormwater infrastructure, the hydrologic context is extremely important in determining placement and hierarchy. Because cities are tremendous nonpoint sources of pollutants, they aren't under mandatory scrutiny of TMDLs. Furthermore, the hierarchy of surface water body qualifications for this section involve two critical aspects into consideration: TMDL date and pollutant types.

# GUADALUPE

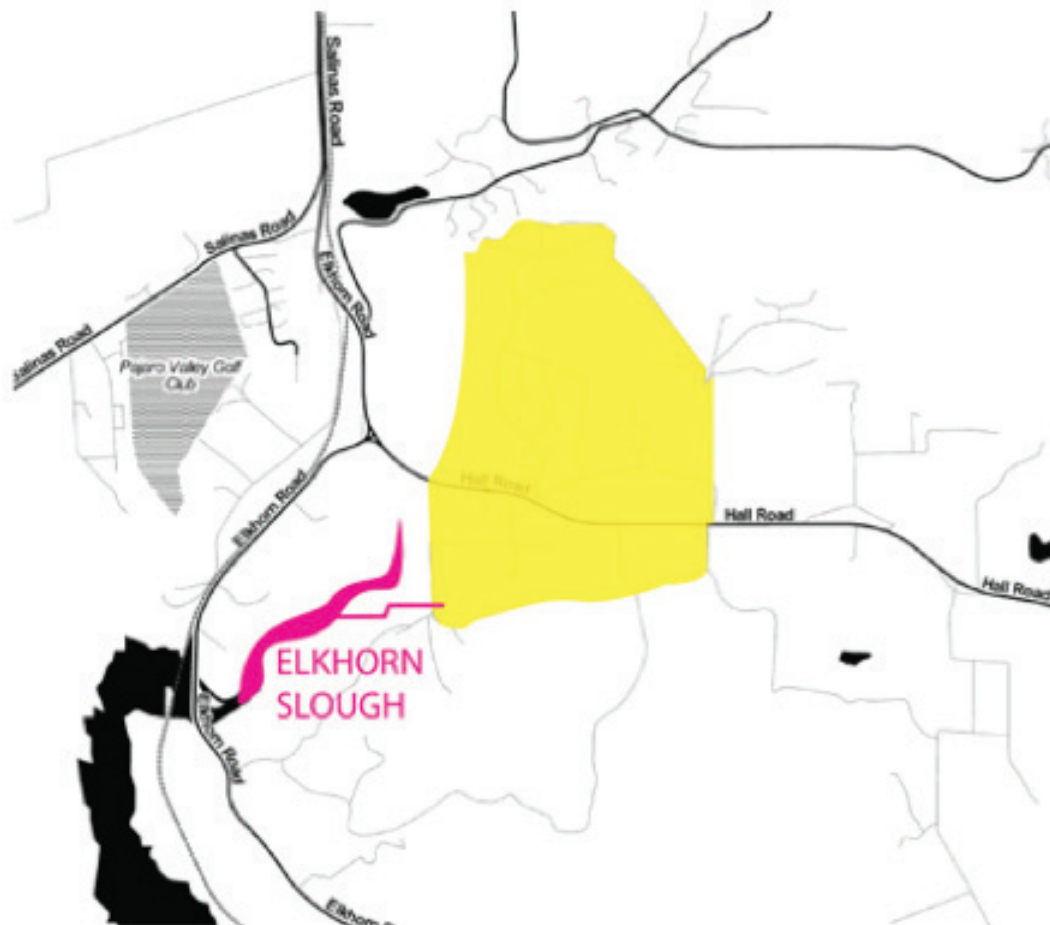
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**SANTA MARIA RIVER** PESTICIDE  
NUTRIENTS  
TOXICITY

Figure 4: Federally listed contaminated waterbodies, Santa Maria River, pollutants, and the Guadalupe city limit in yellow. (CCRWOQB, 303d list, 2006)

# LAS LOMAS

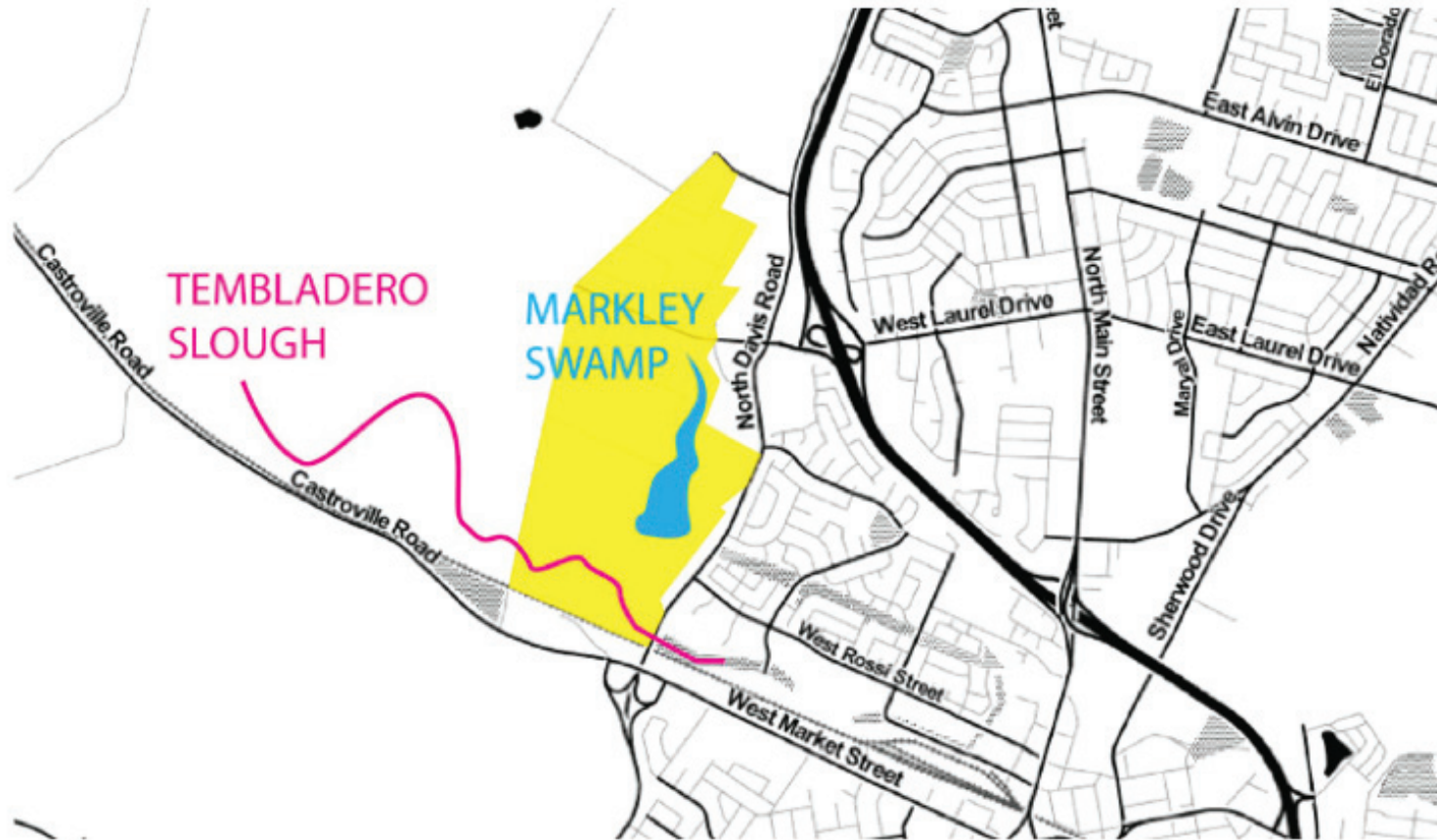


**ELKHORN SLOUGH** PESTICIDE  
PATHOGEN/BACTERIA  
OTHER

Figure 5: Federally listed contaminated waterbodies, Elkhorn Slough, pollutants, and the Las Lomas city limit in yellow. (CCRWQCB, 303d list, 2006)

# BORONDA

25



**TEMBLADERO SLOUGH** PESTICIDE  
NUTRIENT  
PATHOGEN/BACTERIA  
TOXICITY  
OTHER

Figure 6: Federally listed contaminated waterbodies, Tembladero Slough, pollutants, and the Boronda city limit in yellow. (CCRWQCB, 303d list, 2006)

## GONZALES

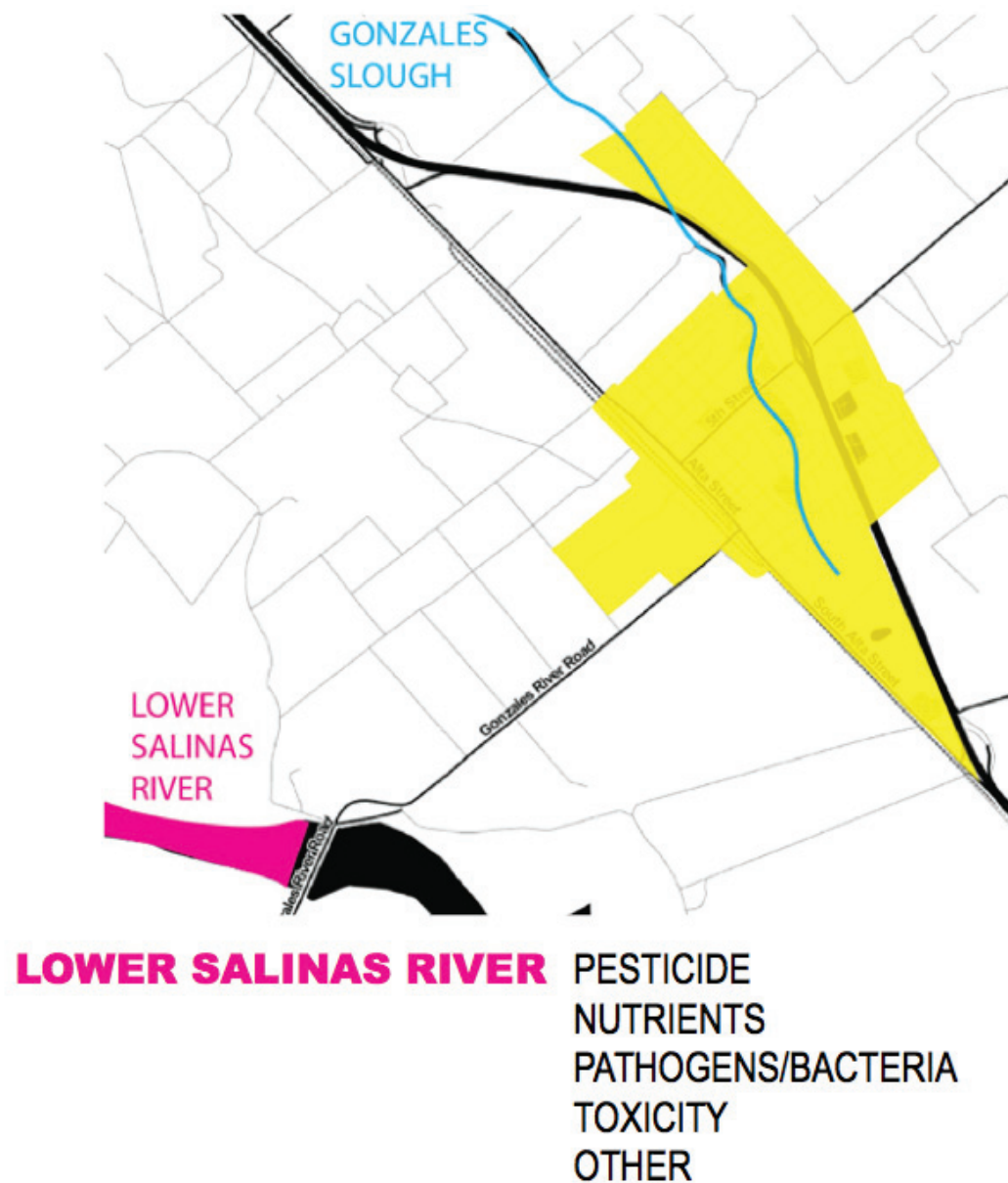


Figure 7: Federally listed contaminated waterbodies, Lower Salinas River, pollutants, and the Gonzales city limit in yellow. (CCRWQCB, 303d list, 2006)

# GREENFIELD

27

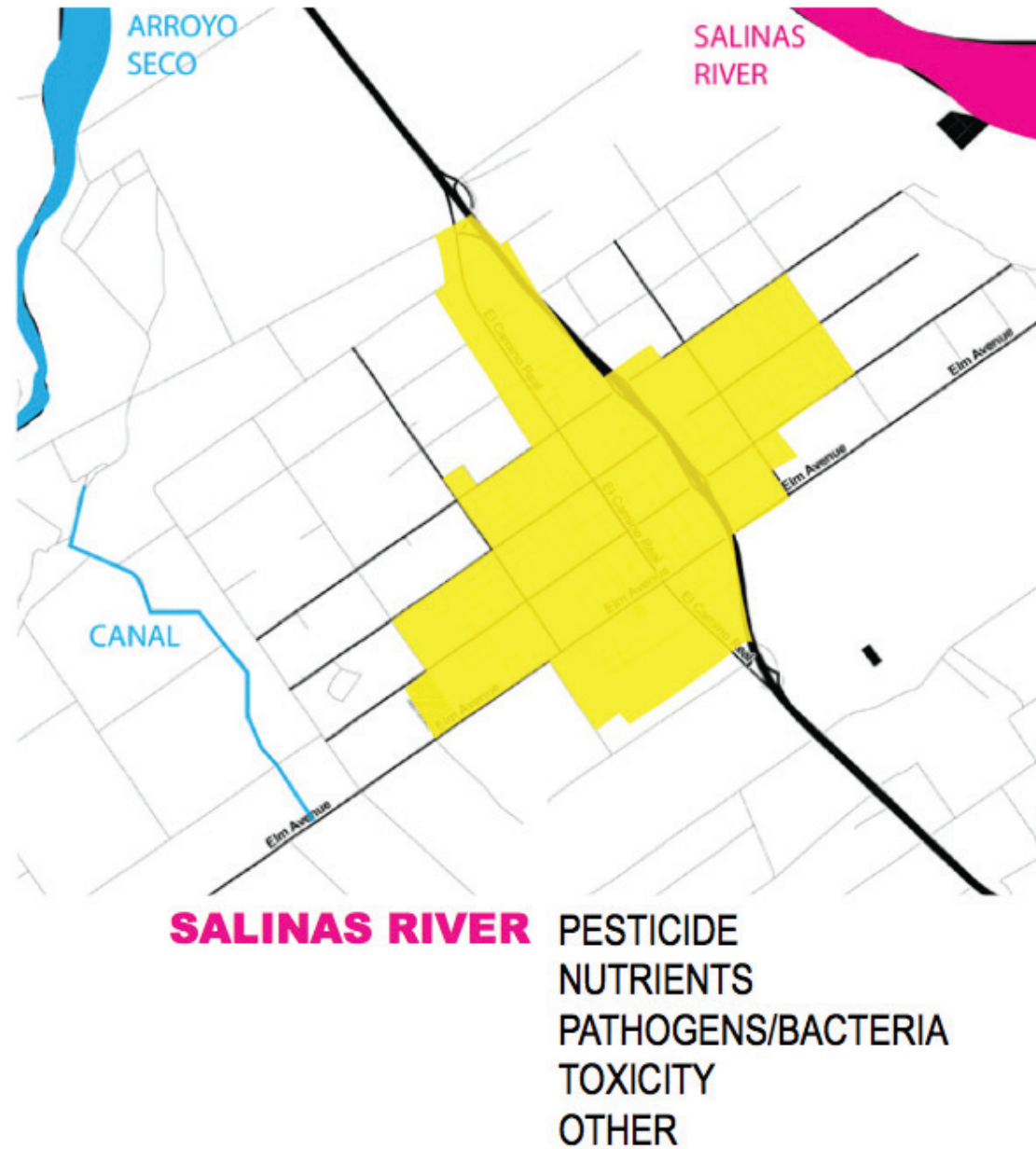
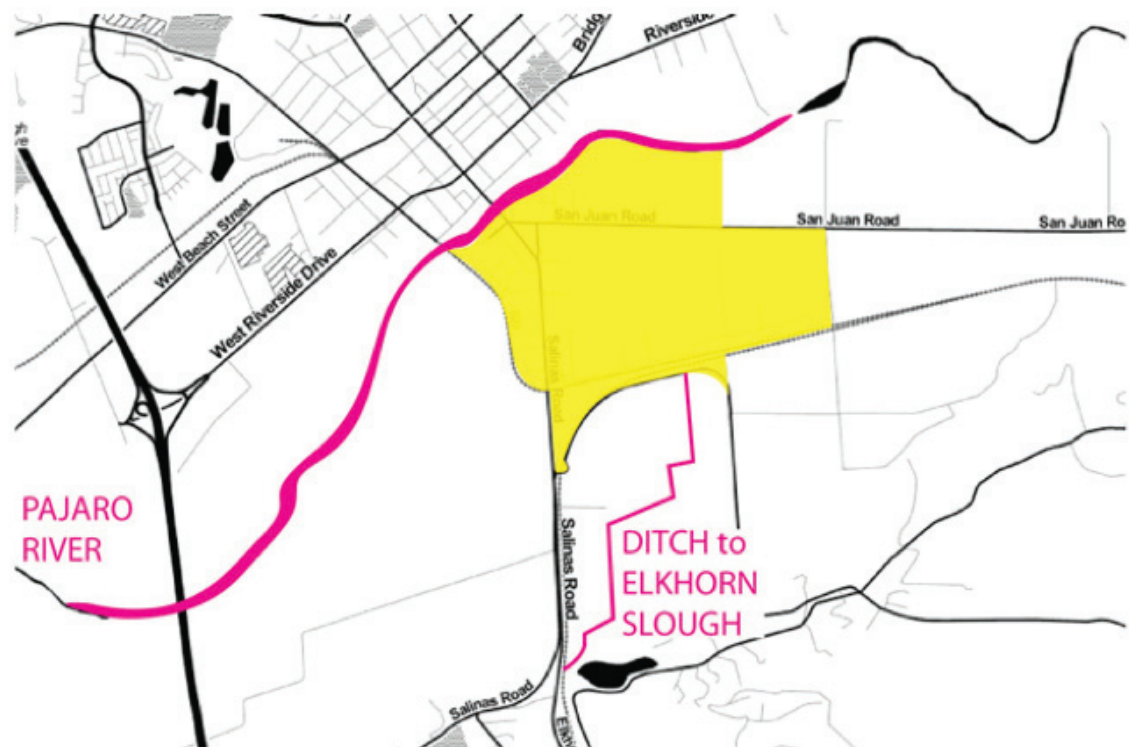


Figure 8: Federally listed contaminated waterbodies, Salinas River, pollutants, and the Greenfield city limit in yellow. (CCRWQCB, 303d list, 2006)



<b>PAJARO RIVER</b>	PESTICIDE
	NUTRIENT
	PATHOGEN/BACTERIA
	OTHER
	METALS
<b>DITCH TO ELKHORN</b>	PESTICIDE
	PATHOGEN/BACTERIA
	OTHER

Figure 9: Federally listed contaminated waterbodies, Pajaro River and the Ditch to Elkhorn Slough, pollutants, and the Pajaro city limit in yellow. (CCRWQCB, 303d list, 2006)

### Pajaro Hydrology:

Both of Pajaro's stormwater outfalls lead directly to a contaminated waterways and it has the highest number of standard violations. The Pajaro river, which borders the community, was designated as America's most endangered river in 2006 (Americanrivers, 2006).



## Soil Assessment

Then each community was analyzed by soil type and soil characteristics optimal for LID. A community typically covers multiple soil types with different infiltration rates and depth to groundwater. These maps illustrate the each part of the community in relationship to each soil (Figure 10-Figure 15). The soils were mapped using the United States Department of Agriculture's Natural Resources Conservation Service's Web Soil Survey (2009), a soil typology map was developed for each community. Having the relationship between soil and street is crucial for a LID street retrofit project, because it will help prioritize which streets will have a greater impact. The soil chart, attached to the soil map, provides LID meaning to the map by illustrating each soil's specific qualities. Soil permeability is measured using the NRCS classification of low-high (infiltration based on inches per hour) and depth to groundwater measured in inches up to 80 inches (2009). The 'best' LID soils are located in the upper right, high permeability and more than 80in to groundwater, and the 'worst' have less permeable soils and a shallow water table. A shallow water table can have inverse effects and cause flooding with big storms. Furthermore, impermeable soils will place a higher stress and burden on the new infrastructure. In conclusion, Greenfield has the best soil qualities for LID because each soil within the reserve line has moderately high to high soil permeability and greater than 80 inches to groundwater table.

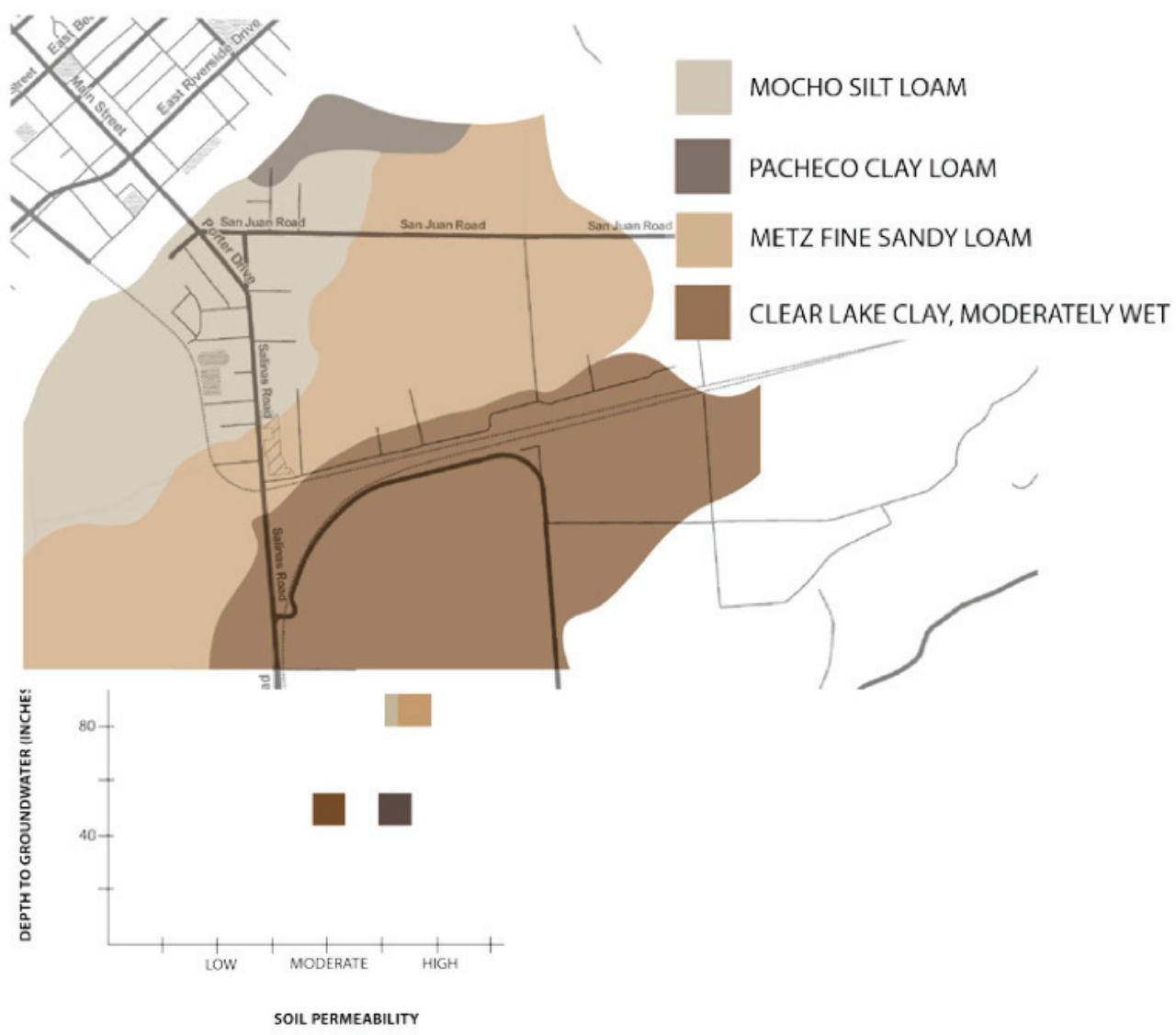


Figure 10: The community of Pajaro's soil map and soil chart. (NRCS, 2009)

# LAS LOMAS

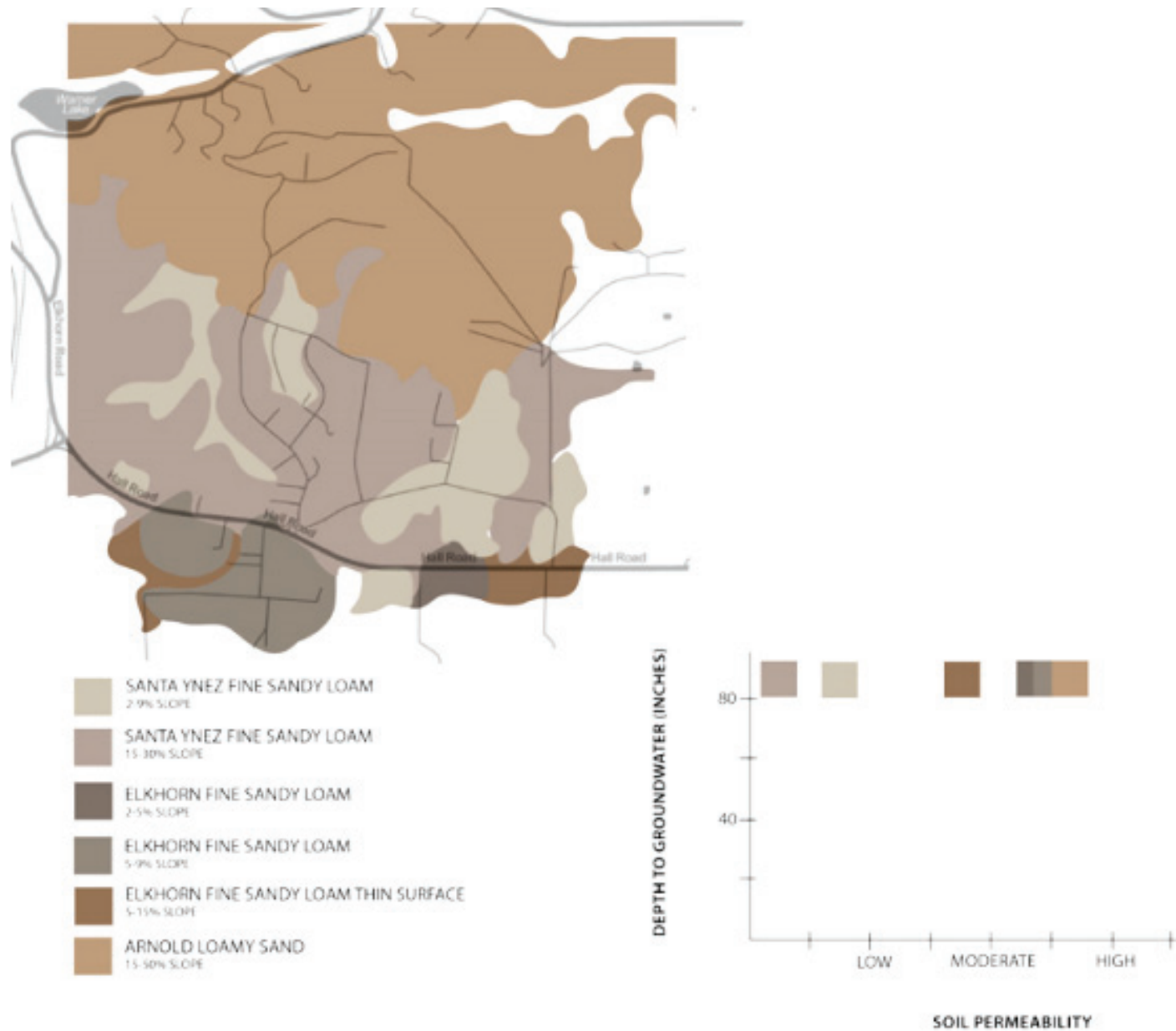


Figure 11: The community of Las Lomas's soil map and soil chart. (NRCS, 2009)

# BORONDA

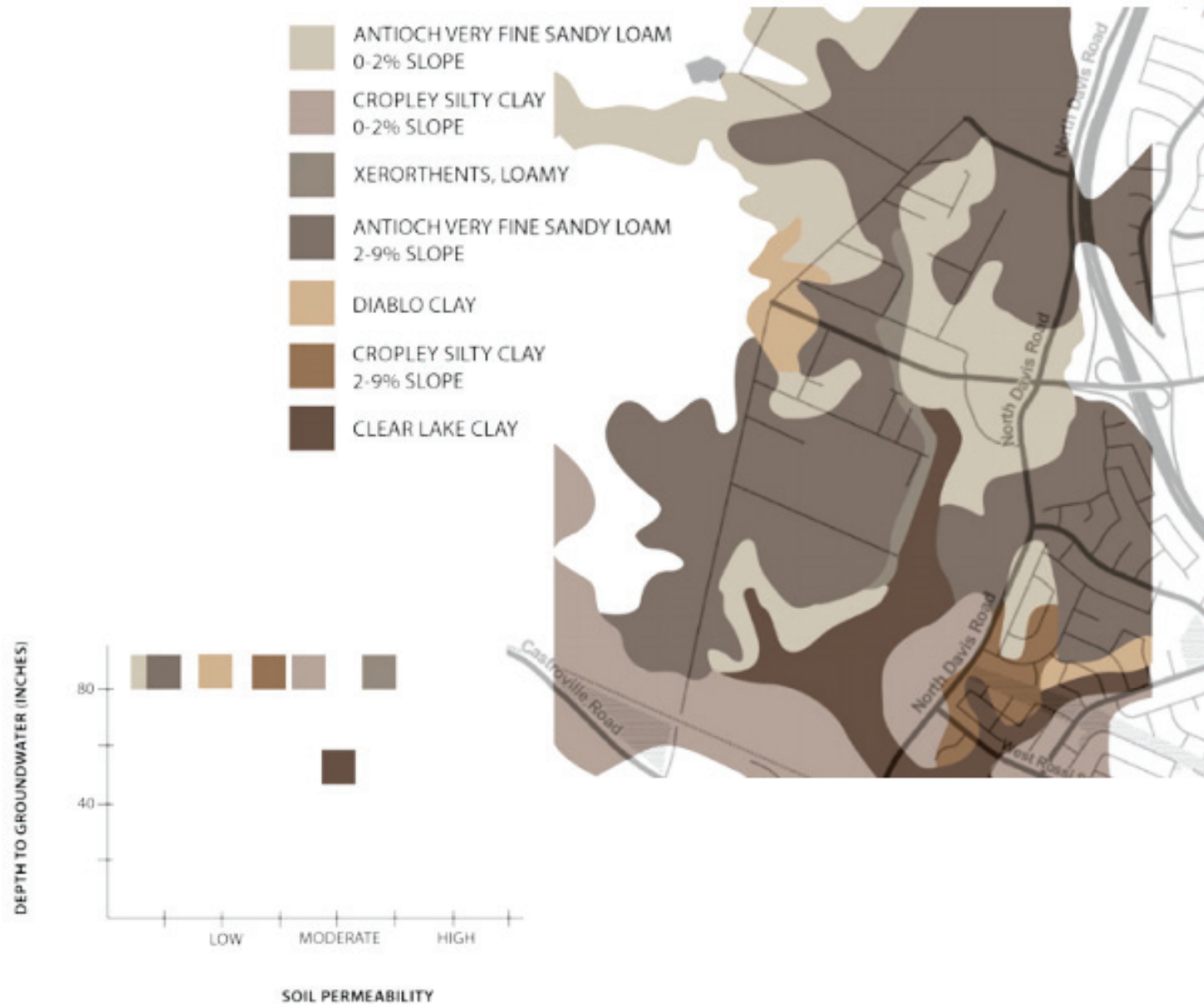


Figure 12: The community of Boronda's soil map and soil chart.  
(NRCS, 2009)

# GONZALES

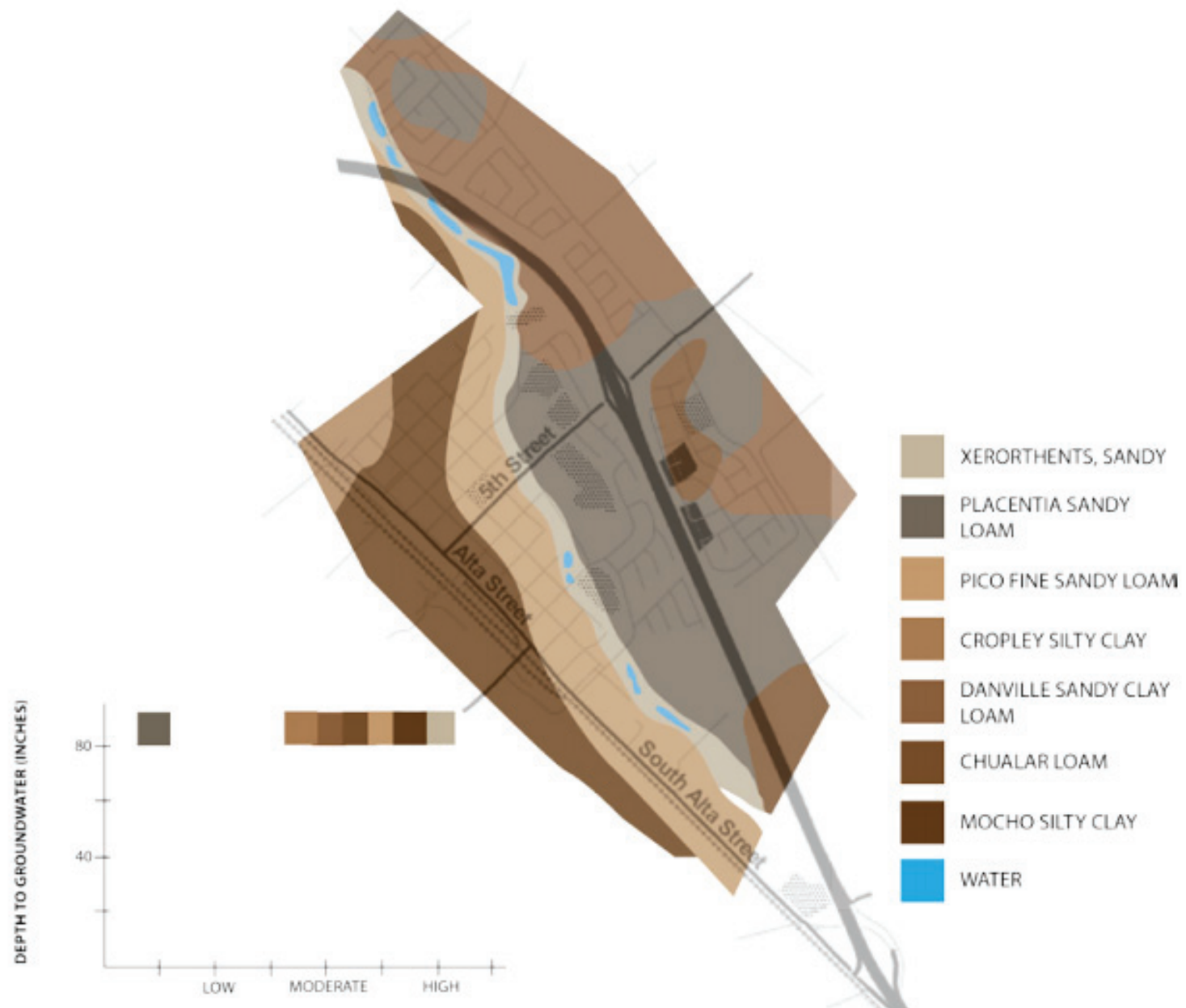


Figure 13: The community of Gonzales's soil map and soil chart. (NRCS, 2009)

# GREENFIELD

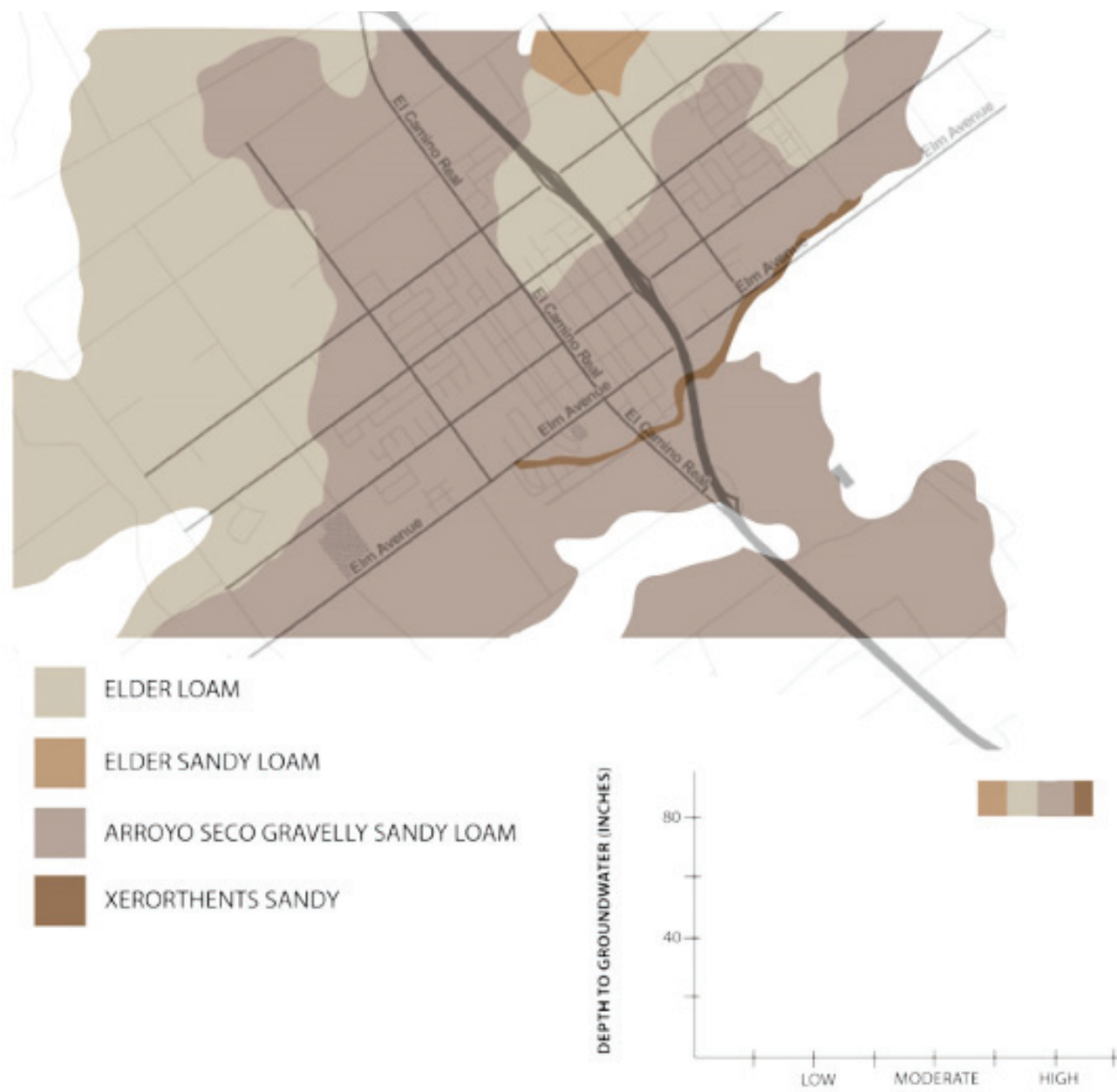


Figure 14: The community of Greenfield's soil map and soil chart. (NRCS, 2009)

# GUADALUPE

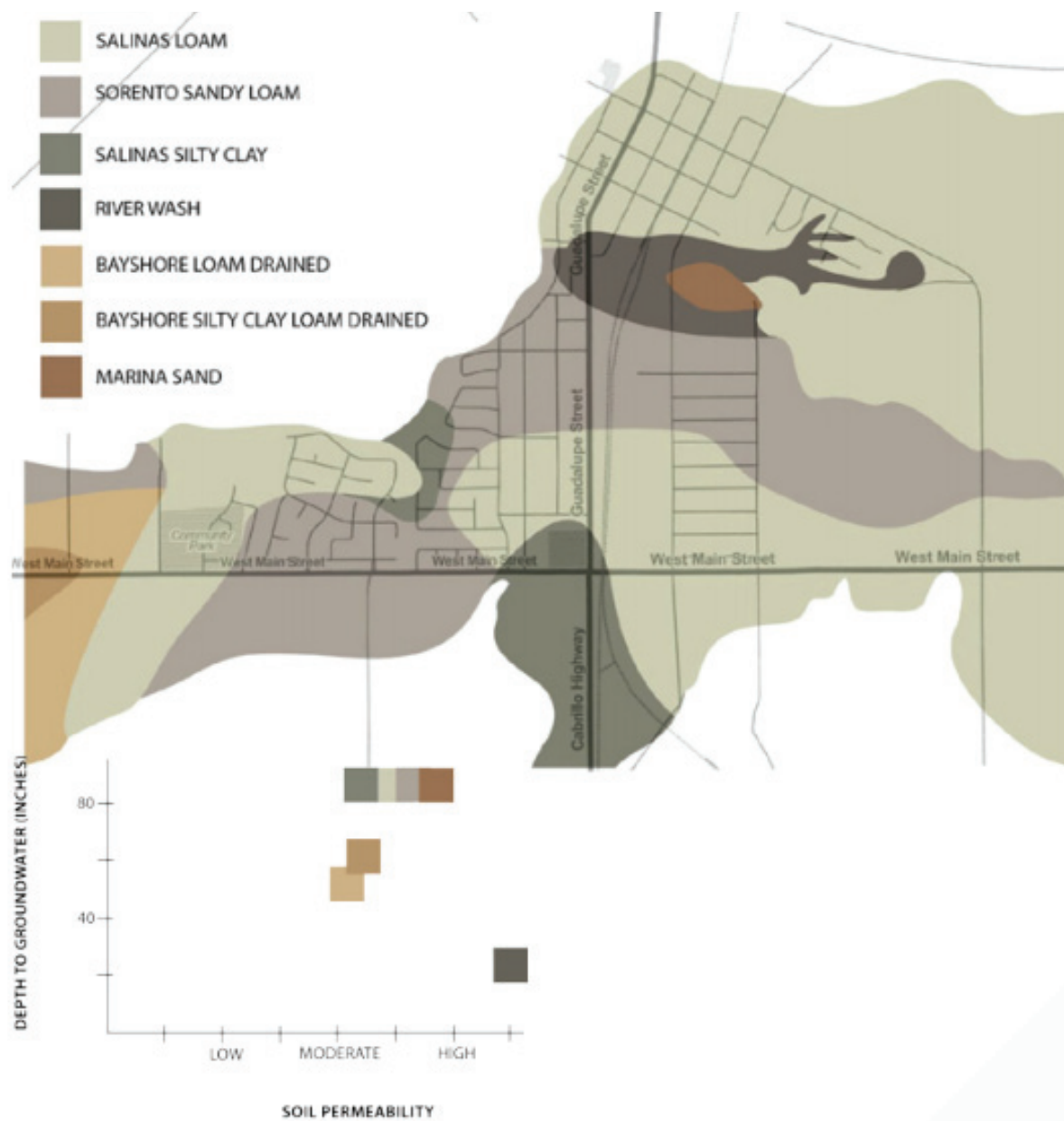


Figure 15: The community of Guadalupe's soil map and soil chart. (NRCS, 2009)

## Social Assessment:

After the environmental site assessment criteria, the desktop site assessment focused on the social aspects of the communities using 2010 census data and infrastructure presence--population, economic, housing and curb and gutter. There are three categories within the Proposition 84 grant proposal determining classification of disadvantaged community (DAC). These categories are based on population and percent of state household income.

- DAC classification A: Small and severely disadvantaged, is a population under 20,000 people and a State median Household Income (SHI) less than 60% (there were no DAC A communities in this study).
- DAC classification B, Small and disadvantaged, is also less than 20,000 people with a SHI between 60 and 80%.
- DAC classification C, disadvantaged, is a community with more than 20,000 people and less than 80% SHI (there were no DAC) communities in this study) (Proposition 84).

Population plays an important role because contaminant levels are associated with population levels, as well as land uses. Generally speaking, if there are more people, there will be more urban contaminants (from cars, fertilizers etc). Furthermore, the benefit of LID on water quality will be more beneficial to a greater population and environmental pollutant loads (USGS, 2013).

The analysis of household income in percentage of the state's level illustrates the level of poverty with each of the communities (Figure 3). Prioritizing the communities based on the lowest SHI percent gives the communities with less ability more priority by prioritizing the poorest communities. Finally, while not required by the Proposition 84 grant classification, the project compared the communities based on percent of households that are rentals. This is a critical

statistic to track after the project has been implemented. Tracking these communities renter percentage and combatting gentrification due to LID changes before it displaces and changes an entire neighborhood or community should be mandatory. The last community aspect that was analyzed using Google street view, is the presence of curb and gutters. This was confirmed during the site visit. The choice to use Google street view was determined because community codes could be ahead of streets on implementation and provides data within the past 5 years.

All of the communities currently have curb and gutter except for Las Lomas. Greenfield, a population of 16,000 significantly has the highest population nearly doubling second highest, Gonzales. Pajaro has the lowest percent state household income with 67.2% but according to Proposition 84 qualifications, is in the same classification group as Boronda, Greenfield and Guadalupe.

The following charts are summaries of the criteria based on each community--the lower the overall score, the better suited the community for LID retrofit. The chart does not consider the Rental percentage due to the uncertainty of future effects.

Most of the selected communities provide an excellent prospective community for a LID street retrofit. The difficult part becomes combining the findings to determine the community 'best' suited. Greenfield was ranked number one, because of the overall soil performance and having the greatest population. Greenfield's soils will efficiently facilitate infiltration and also benefit the most people. A very close second was Pajaro; the most underserved community, with especially contaminated surface water bodies.

However, Pajaro lies completely within a 100-year floodplain, and has shallow groundwater issues. Guadalupe, has the second best performing soils, but has relatively low concentrations of surface water body contaminants. Gonzales, with the second highest population and contaminants, is a good candidate; however, the community does not technically fit within the Proposition 84 grant proposal DAC classifications. The fifth best-

sited community is Boronda, a DAC Category B, however, it has the lowest population and second lowest performing soils. The final community is Las Lomas, a residential community on a steep hillside, is the only community without a curb and gutter system, making this type of street retrofit nearly impossible (Figure 16).

### PAJARO:

	1	2	3	4	5	6
SOIL			✓			
CURB	✓					
TOXINS	✓					
% SHI	✓					
POPULATION				✓		

### LAS LOMAS:

	1	2	3	4	5	6
SOIL						✓
CURB						✓
TOXINS						✓
% SHI					✓	
POPULATION					✓	

### BORONDA:

	1	2	3	4	5	6
SOIL					✓	
CURB	✓					
TOXINS			✓			
% SHI			✓			
POPULATION						✓

### GONZALES:

	1	2	3	4	5	6
SOIL				✓		
CURB	✓					
TOXINS		✓				
% SHI						✓
POPULATION		✓				

### GREENFIELD:

	1	2	3	4	5	6
SOIL	✓					
CURB	✓					
TOXINS				✓		
% SHI		✓				
POPULATION	✓					

### GUADALUPE:

	1	2	3	4	5	6
SOIL		✓				
CURB	✓					
TOXINS					✓	
% SHI				✓		
POPULATION			✓			

Figure 16: The community ranks after all the criteria was considered. Greenfield did the best

### Site Assessment Windshield:

There are political and contextual information that can be difficult to accurately gather by desktop. The windshield survey and meeting with local officials helped ground the assessment in reality and further assure a smooth and successful implementation. Some of the contextual information included photographs, documenting existing infrastructure, and contextual relationships. If a community is physically unable or politically unwilling to invest in an LID investment, the project, proposal and implementation is worthless. Furthermore, if the grant is awarded to a community unable or unwilling to complete it, the funding must be returned leaving a bad reputation for the applicant. These communities were analyzed based first on expressed community and political desire and then by the results from the desktop survey. The Monterey Planning Department was very interested and excited about two of their northernmost communities: Pajaro and Las Lomas. Furthermore, Frank Lopez, an engineer with RICK engineering, expressed interest in Gonzales. There were two separate windshield site assessments conducted. The first visit was on Friday, April 17th, 2013 and the second visit was on Friday, May 10th, 2013.

**April 17th, 2013:**

Each community visited, a tour was taken by car and on foot. This allowed for photo documentation, street measurements, existing stormwater infrastructure documentation, stormwater directions and land use analysis, communication with local residents and even sampling the communities' delicacies. We visited three communities (Pajaro, Las Lomas, and Gonzales), ultimately settling on Gonzales.

**Pajaro:**

Pajaro was the first community visited because of its high priority from the desktop survey. Darla Inglis and I met Monterey County Public Works employees Ogarita Carranza and Tom Harty, and RICK Engineering Frank Lopez at 9.30 AM in Pajaro. Pajaro is a community with 3,070 residents. It is directly across the bridge from Watsonville, contains industry, residential, and is surrounded by agriculture. Some of the surprising businesses noted include a fish processing plant and a day care for migrant farm workers children. Even with sharing a border with the Pajaro River, the majority of Pajaro's stormwater is directed south to the Elkhorn Slough, (only in unique cases does stormwater go to the Pajaro River).

The sites were chosen by their relationship to the stormwater infrastructure. The first site was the eastern urban and agriculture edge of Pajaro, along Railroad Ave. Along Railroad Ave. is one of the primary stormwater drains for Pajaro. The majority of the traffic was tractors, and much of the road was dirt with curbs (Figure 17). This edge is critical because during large rain



Figure 17: The road to the east was dirt, and tractors were the primary mode of documented traffic



Figure 18: The majority of runoff from this section travels over agriculture, and is carried through open culverts.



Figure 19: The residential neighborhood to the north is narrow and has parking problems, even during the middle of the day in the work week.



Figure 20: The overflow outfall has either been poorly designed or overused due to serious erosion underneath.

events on top of a shallow groundwater and gradual sloping topography towards the urban core, the agriculture land sheds a tremendous amount of stormwater into the community; however, the exact amount is uncertain. Furthermore, stormwater is primarily carried in open dirt culverts, until it reaches a street or the railroad where it proceeds through a pipe (Figure 18). Due to the size and shallow groundwater, this area will be challenging to contain, infiltrate, and treat the amount of agriculture stormwater runoff before entering the stormwater system.

The second visited site was the northern residential portion. This area had narrow streets and during 11-12 noon on a Friday had tremendous parking issues, with cars parked on the street, driveways and yards (Figure 19). Ogarita and Tom confirmed that it's common for multiple families to occupy one household. During the time we were there, we witnessed children playing in street. In conclusion, this residential area did could not support the space for an LID retrofit.

The third spot visited in Pajaro, was an overflow and the emergency outfall into the Pajaro river. This area is notorious for homeless encampment. Tom said this outfall is designed to open under pressure only before the city is about to flood. Underneath the spout is heavily eroded, illustrating a poor design or over-reliance on the emergency system (Figure 20).

The final spot visited in Pajaro was a residential area located on the west end of town. This area consisted of interconnected, wide streets with sufficient of right of way, available parking and gutters. However, there were no drop structures for the gutter system; the gutters merely channeled water

along the curbs to the western agriculture and urban edge. At this edge, was a small vacant parcel that could serve as an interesting retention, infiltration spot (right side of Figure 21). The location shares one side with the street, agriculture fields and an elementary school. This part of town seemed to be the most feasible opportunity for LID, due to the available space, the location with gutter flow direction and opportunity for educational purposes.

In conclusion, there was one spot that provided an opportunity for LID. It receives a large part of the residential stormwater, and has educational opportunity; however the rest of the assessed community faced serious challenges. The community's depth to groundwater is currently challenging the traditional stormwater system and infiltration based LID techniques will be impacted to an even greater extent. While this community would benefit some of the most underserved, and contaminated water bodies, the implementation would be inefficient and difficult.

#### Las Lomas

Las Lomas is a community approximately three miles south of Pajaro. The community is located on a hill with a high SHI percentage. However, when assessing Las Lomas, Ogarita Carranza and Tom Harty, of Monterey County Public Works mentioned the census is technically accurate, but the statistic is really skewed because of a few wealthy ranchers living on top of the hill. In agreement with the desktop survey, Las Lomas does not have curbs and gutters, making this community an inefficient selection.



Figure 21: Shows the one excellent LID retrofit opportunity. The entire neighborhood channels storm runoff here, on the right is a vacant lot next to the school, that would serve as a great retention area. The stormwater flows from where this photo was taken to agriculture fields behind.



Figure 22: This is a typical street in Old Town Gonzales, It highlights the damaged road, a wide street right of way and lots of available parking.

### Gonzales

The Gonzales site visit, involved Frank Lopez and Darla Inglis. Frank Lopez is an engineer and resident of Gonzales. US 101 divides the community, to the east is more recently developed suburban housing and agriculture and to the west lies the historic town laid out on a grid. Gonzales' SHI is 92.4%; however, there is an overall wealth disparity between the two sides. The west side has three schools, and a variety of unique shops, including an authentic bakery. The Gonzales slough is a receiving surface body of water that runs through the eastern portion of old town, neighboring the three schools. Old town is based on a traditional grid; the streets are wide with plenty of available parking. (Figure 22)

When visited at 2pm on a Friday, there were no parking issues in the commercial and residential portion of downtown. Furthermore, many of the East/West streets are cracked with lots of potholes (Figure #). Potholes are signs of aging infrastructure; as seen in Figure #, streets that have flooding problems often experience greater street damage due to the additional water. The original US101 historically ran along the western edge of town, Alta Street, which was updated in 2002/2003. This is important because Alta Street is in good condition. Frank mentioned that in big storms the north western edge of town and by the high school floods frequently. The majority of old town Gonzales drains to the north into a culvert that runs north, eventually draining into the Salinas River. The other portion drains to the Gonzales Slough. Due to agriculture interference, the slough does not reach the Salinas River anymore.

Gonzales is a community with lots of potential. Frank Lopez is a very active resident with family in City Government and is very enthusiastic about improving stormwater in his community. Furthermore, the old portion of town

contains streets with lots of space and available parking. The streets are in poor condition and the community floods regularly, a sign of aging infrastructure. However, the community does not technically qualify under Proposition 84's DAC qualifications. Darla Inglis, the CCRWQCB and LIDI representative believes that proving the portion of the community that the retrofit is going is disadvantaged, and homes across town are skewing the census data will be sufficient for the Grant Proposal. Furthermore, as illustrated in the desktop survey and confirmed in the site visit, Gonzales contains very suitable soils, drains to a contaminated water body, has the second highest population, floods frequently, has curbs and gutters, adequate parking and a wide street right of way.

**May 10th, 2013:**

The site assessment on May 10th involved an in depth gathering of design specific information. The trip was made to document the existing conditions, including intersections, the curb and gutter system throughout Old Town Gonzales. Pictures were taken at 7 different street locations documenting different street layouts across Old Town, and documented current drop structures. Old Town Gonzales has a ridge that runs near Day Street, where the runoff to the west runs west and east of the ridge runs to the Slough. There are very few drop structures; only along Alta street to the west of Old town with one or two exceptions. When visited, the grates on top of the drop structures were lifted, to better accommodate the flooding issues. The culvert carries the majority of the town's runoff in large storms north to the Salinas River.



Figure 23: GIS map of existing stormwater infrastructure for Old Town Gonzales, in green. This also highlights the Gonzales slough and the wide gridded streets.

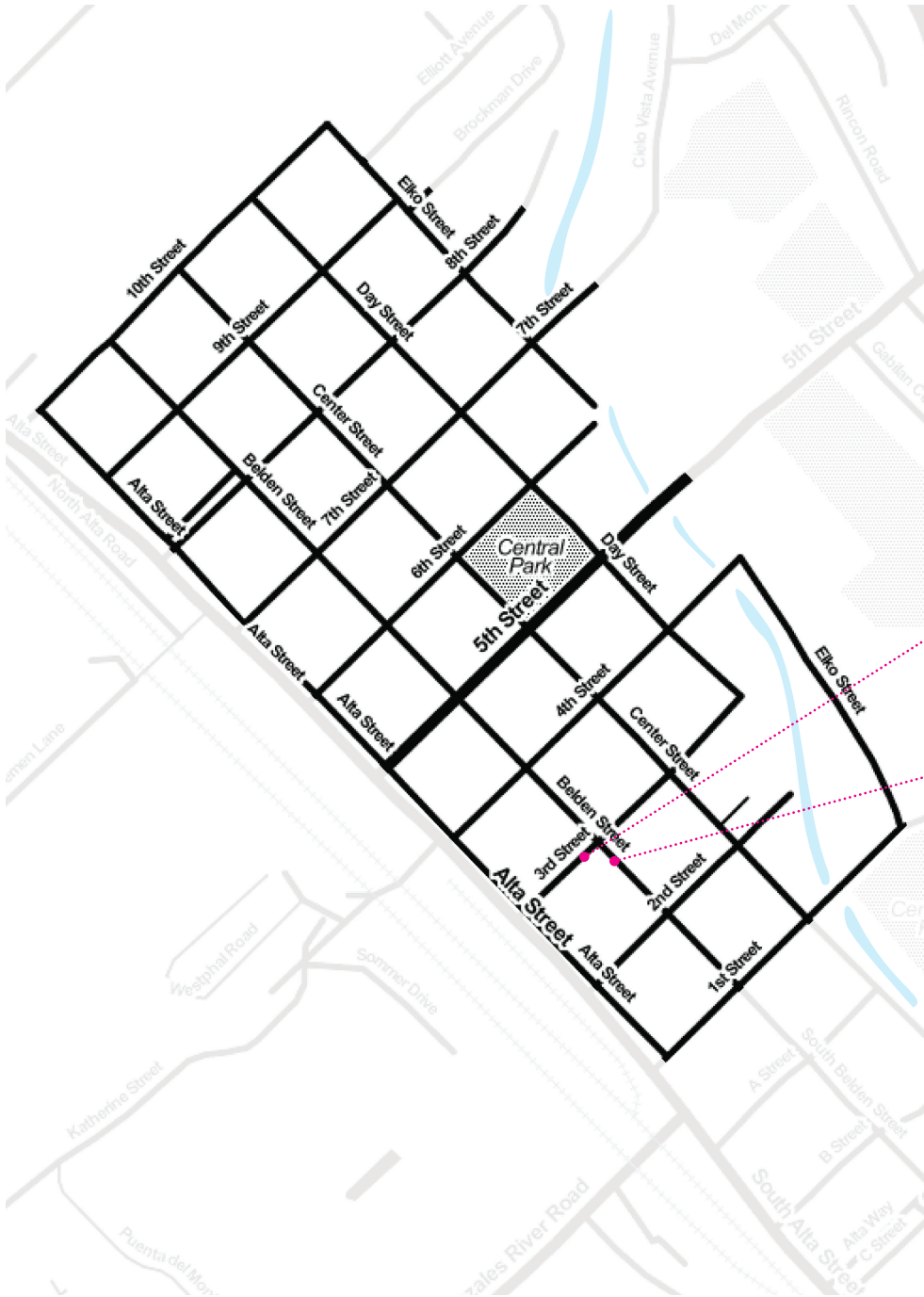


Figure 24: This is the north east view from 3rd street. This was taken around 5pm illustrating there is little parking concerns and a wide open street. This street is in decent condition and existing trees.



Figure 25: This is looking south east down the residential Belden street. This street is in poor condition but shows Curb and gutter, and existing vegetation.



Figure 26: This is looking north east on 7th Street. This is a street that Frank Lopez had recommended for a possible Green Street; however, ideally the green street would be, this project focuses on a complete community wide LID storm water plan.



Figure 27: This is looking north east on 4th street. This street is in poor condition but shows Curb and gutter, and another wide right of way.



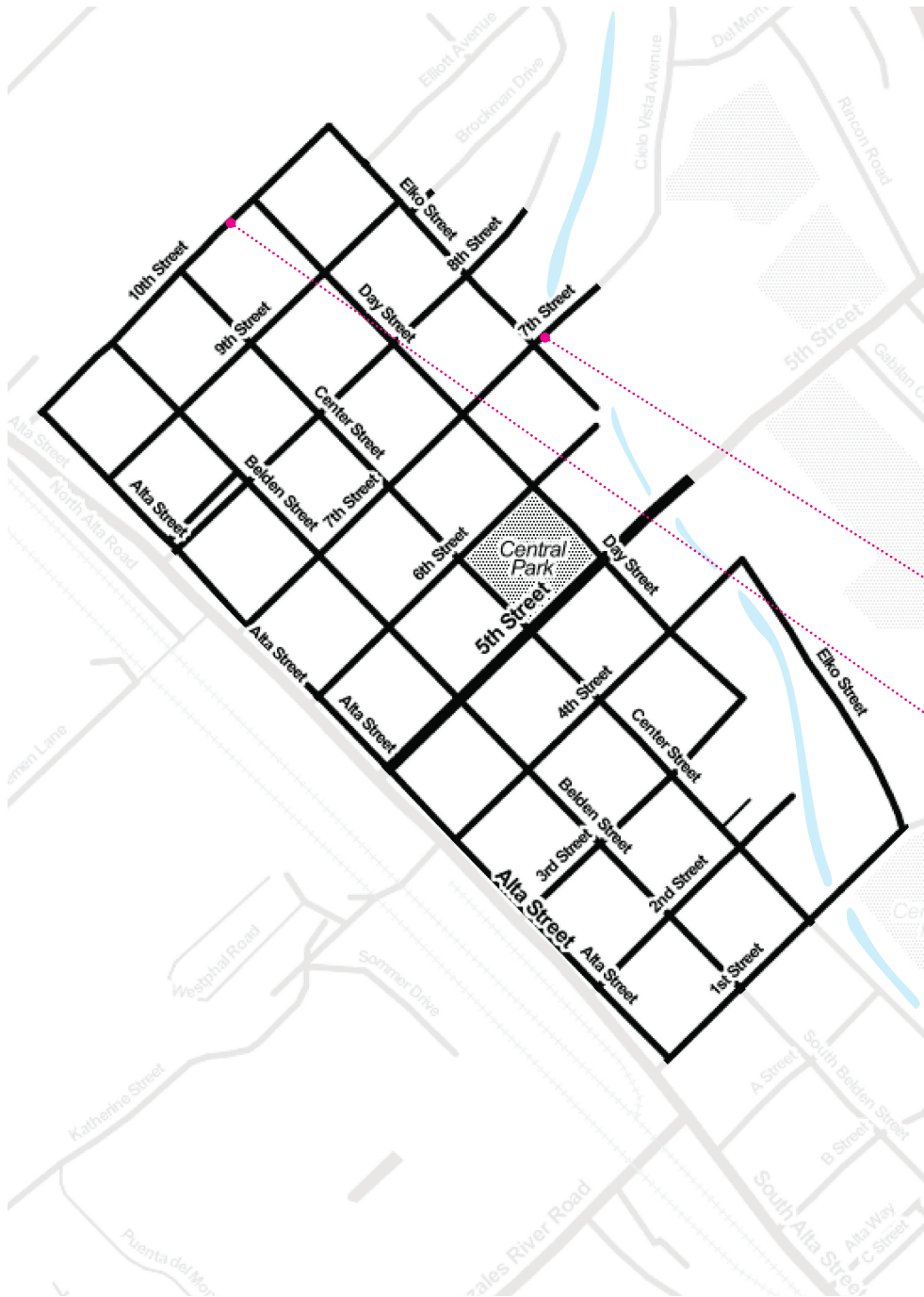


Figure 28: This is looking north east on 7th street. This street is behind the school, the slough drains under it, where stormwater enters it. This is a narrow street.



Figure 29: This is looking south west on 10th Street. This street is narrow, but only has one side of houses. There is lots of existing vegetation on the north.



Figure 30: This is looking north west on Alta Street. This street is two fast lanes, was once US101, but shows the primary stormwater drainage system for the City of Gonzales.



Figure 31: This shows two drop structures, on either side of 10th street with their grates removed due to a recent rain and flooding of this area.





## Opportunities:

The following list attempts to document and qualify the findings from both site assessments into a list reflecting LID street retrofit opportunities. An opportunity is an aspect that will facilitate the overall process.

### Soil & Hydrology:

- About 75% Mocho Silty Clay: > 80 in. to Water Table & Mod. high perm
- About 20% Pico Fine Sandy Loam: >80 in. to Water table & Mod. High to High perm
- About 0-2% slope throughout project site
- Gonzales slough runs along the eastern boundary of the project site
- The Lower Salinas River is a federally listed contaminated river.
- Available parking when visited at 5PM on a Friday.

### Street Infrastructure:

- Streets are improved, curbed and crowned 2 lane streets, with parallel parking and have a curb to curb distance of 50'.
- Some streets damaged with pot holes, and would benefit from a street retrofit.
- 2nd street drains to Slough
- 7th street receives offsite runoff from neighboring parking lots

### Social:

- The historic portion of town, old Town Gonzales contains a central park, which is home to events in Gonzales, and borders a High school, Middle school and Elementary school.

## Constraints:

The following list attempts to document and qualify the findings from both site assessments into a list reflecting LID street retrofit constraints. A constraint is an aspect that is an initial challenge to the overall process; however, a carefully concerned constraint can become an opportunity.

### Soil & Hydrology:

- Flooding in big storms.

### Street Infrastructure:

- Drop structures are relatively shallow with lots of sediment in the bottom.
- Some streets have minimal right of way, 30' curb to curb, two lane streets with impacted parking.
- Some streets have diagonal parking.
- Alta street, on top of stormwater system, has recently been renovated, unable for retrofit.

### Social:

- Community does not meet Proposition 84 DAC classification.

### Concept Plan:

Old Town Gonzales is 33 blocks west of US101 and the Elkhorn slough; troubled with floods, the area contributes stormwater contaminants to the lower salinas river. Gonzales is part of a rapidly developing area. Proposing a concept that implements LID over a major portion of a community will set a regional example and lead the way for other small communities to think about stormwater. However, it is also unrealistic to have a zero runoff community. Therefore, to have the best possible results from the Proposition 84 grant funds, this concept is a balance between cost and performance.

## Location Maps:



Figure 33: CCRWQCB within California

One of Nine California State Waterboards, based on natural geologic characteristics

Water boards regulate surface and ground waters



Figure 34: Gonzales location within the Waterboard

Approximately 16 miles South of Salinas along US 101

Size:	1.96 Sq. Miles
Population:	8,187
Elevation:	135'

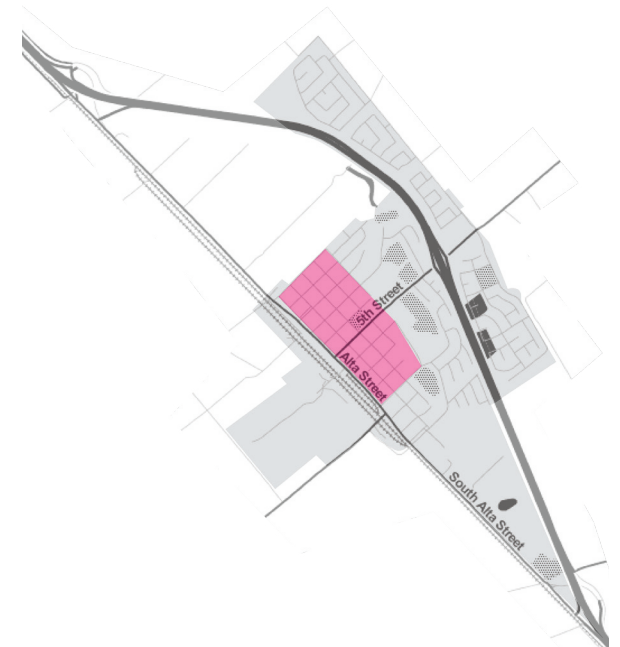


Figure 35: Project site located within Gonzales city limits

Often floods with heavy rain  
 Along Gonzales Slough  
 Borders High, Middle and Elementary School  
 Size: 33 Blocks (~.17 Sq. Miles)  
 Drains: Salinas River & Gonzales Slough



Figure 36: A concept map of the topography, and existing drainage patterns throughout Old Town Gonzales.

Figure 36 represents the general topography and flow patterns of Gonzales. There is a north south slope that runs parallel to the slough and along Day Street. This generally sheds water east to the Slough and West to the Salinas River.

The thick blue lines represents the majority or primary flow currently. The most flooded area is the north west corner, where stormwater is collected from the majority of the project area.

The thin blue lines represent secondary flow. This flow falls on the rooftops, and the north west, south east oriented streets. These streets will be the target of this concept plan because they contribute runoff to the primary streets and these streets can accept more smaller and cheaper curb extensions.

This Concept plan represents the general location of the curb extensions. If the proposal is selected by the Proposition 84 Grant committee, the precise location of these curb extensions should be re-evaluated. Locating the curb extensions this way will accommodate traffic better, as well as, have a tremendous infiltration and water quality benefits to these secondary streets. The idea is that these spread out curb extensions will help reduce flooding by retaining more water from the heavily impacted streets. Furthermore, these streets are traveled less; therefore, impacting bus routes and general circulation less. Locating these also takes into consideration the existing vegetation. These curb extensions are located where there are large established trees making the retention cells more efficient and have a more immediate impact.



Figure 37: A concept map of the curb extension lay out. There are 21 curb extensions located on the secondary stormwater streets to spread out and help reduce the flow to primary streets.





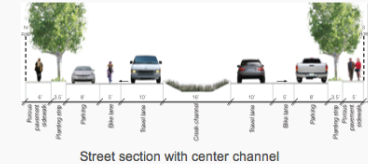
## Appendix:

- A) Case Study:  
 21st Street LID Street Retrofit  
 Paso Robles, Ca  
 Central Coast LIDI, 21st Street LID  
[http://www.centralcoastlidi.org/Central\\_Coast\\_LIDI/Paso\\_Robles\\_21st\\_Street.html](http://www.centralcoastlidi.org/Central_Coast_LIDI/Paso_Robles_21st_Street.html)

## Paso Robles 21st Street Complete, Green Street

21st Street is a commercial and residential street near the Paso Robles Event Center, home of the California Mid-State Fair. The street was established decades ago in a natural drainageway. A large area of west Paso Robles is tributary to 21st Street. Stormwater cannot infiltrate due to excessive paving. Large storms flood the street, cause erosion, and create traffic hazards. The City would like to upgrade five contiguous blocks of 21st Street, between Vine Street and Riverside Avenue, to a green/complete street that meets several objectives, including:

- Reduce the volume and intensity of stormwater runoff;
- Increase groundwater recharge;
- Improve pedestrian and bicyclist mobility;
- Improve community health and reduce air pollution;
- Shade the street with trees; and
- Promote infill and redevelopment.



The City envisions a linear park-like street with narrow roadways, bike lanes, pervious sidewalks, park benches, natural drainage features, multiple shade trees, and storyboards explaining the design for the public. The street would be a unique local example of how green design can provide multiple community benefits. It would help the City educate the development community and design professionals about green streets, and inform City efforts to change its storm drain master plan into a green streets master plan.

### Community Workshop

On June 16th, 2011 the City of Paso Robles, in partnership with SvR Design Company and the Central Coast LIDI, hosted the Paso Robles Complete Green Street Workshop. Participants attended from throughout the Central Coast region, and included municipal staff, private consultants, and staff from non-governmental institutions. Resources from the workshop, including slideshow presentations with speakers notes, documents prepared for the 21st Street project and general information on complete and green streets are provided below.

[Complete Green Street Workshop Presentation.pdf](#)

[Complete Green Street Workshop Presentation.pptx](#)

#### Project Documents

[Paso Robles Urban Greening Grant Application.pdf](#)

[21st-Street-Design-Considerations-Matrix\\_2010-09-10.pdf](#)

[21st Street Concept Plan Files](#)

(zipped folder, AutoCAD needed to open DWG files)

[Paso Robles RFP for Final Design of 21st Street Improvements](#)



21st Street existing conditions along the corridor



Birds eye view of proposed green, complete street

### Project Info

**LOCATION:** Paso Robles

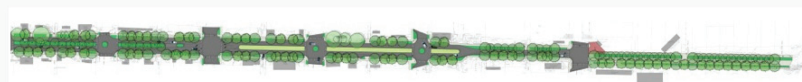
**ADDRESS:** 21st Street (Vine St. to Riverside Ave.)

**LID STRATEGIES:** bioretention channel, bioretention rain gardens, pervious pavers, structural soil

**CONTACT:** Matt Thompson, City of Paso Robles, 805.227.7200

**CONSULTANTS:** SvR Design Company, Cannon

**SCHEDULE:** Construction in 2012



21st Street Concept plan



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