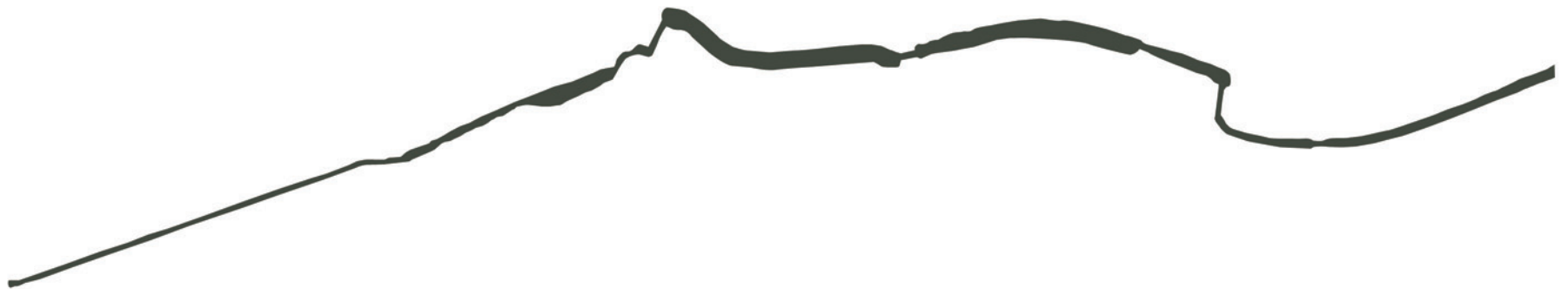


# Reimagining Urban Waterscapes

Creek Enhancement in South Sacramento





A Senior Project presented to the  
Landscape Architecture Department at the  
University of California, Davis

In partial fulfillment of the requirement for  
the degree of Bachelor of Science in Landscape  
Architecture

Accepted and Approved by

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Stephen Wheeler, Senior Project Advisor

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Claire Napawan, Faculty Committee  
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Skip Mezger, Committee Member



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And finally, thank you to my fellow classmates. Being able to count on your support, advice, and friendship has helped me through every challenging project, late night, and stressful moment for the last three years. I couldn't have done it without you.

# Dedication

For My Mom, and Dad

Your support, advice and assurance means the world to me. Thank you for everything.



# Abstract

This project explores how creeks can be more effectively integrated into the framework of our existing urban environments. In most modern cities there is a strong disconnect between our built environment and natural systems. Historically, we have fought to control urban creeks by engineering them into underground pipes and concrete channels. There are, however, alternative ways of dealing with urban creeks. By using innovative design strategies, it is possible to enhance the ecological and social values of urban creeks in ways which are mutually beneficial. Through research, case studies, analysis and design, this project highlights the hidden potentials of urban creeks and strategies for creating new integrated design models.

# Table of Contents

Abstract	Table of Contents
Signature Page	List of Figures
Acknowledgments	

## Chapter 1: Background

- 9 Introduction
- 10 Project Outline
- 10 Project Goals
- 11 Why Redesign Urban Creeks?
- 12 Natural Creeks
- 13 Urban vs Natural Creeks
- 14 Urban Creek Design Challenges

## Chapter 2: Case Studies

- 17 Introduction to Case Studies
- 18 San Luis Obispo Creek
- 21 Thornton Creek Water Quality Channel

## Chapter 3: Analysis

- 24 Sacramento Creeks
- 24 Strawberry Creek
- 26 Project Site
- 30 A Dysfunctional Creek
- 32 A Creek Full of Possibilities

## Chapter 4: Design

- 37 Design Goals
- 38 Master Plan
- 40 Connectivity
- 42 A Transformed Commercial Space
- 44 An Integrated Residential Corridor
- 46 An Educational Natural Park



# List Of Figures

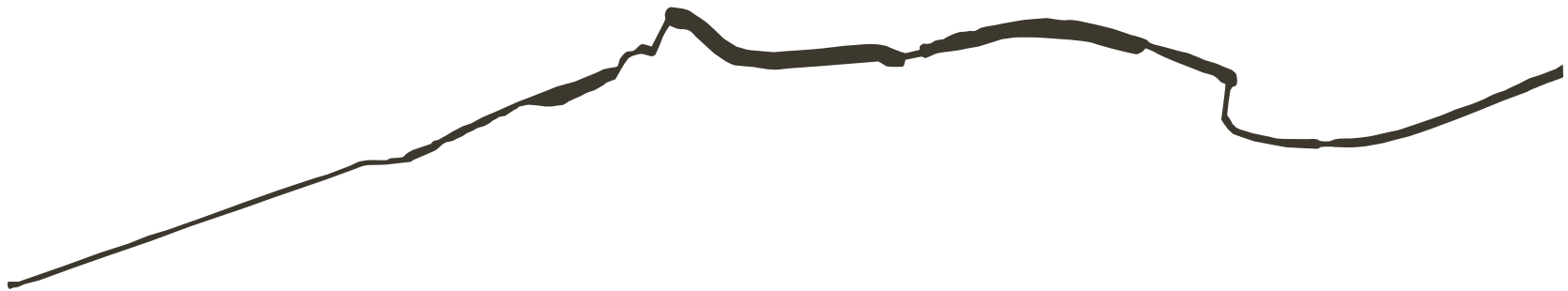
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32. **Commercial Area Plan:** H. Levy
33. **Residential Corridor Section:** H. Levy
34. **Residential Corridor Plan** H. Levy
35. **Educational Park Section** H. Levy
36. **Educational Park Plan** H. Levy



# Chapter 1

Background

When a City Meets a Creek





# Introduction

A creek is dynamic. Part of a larger watershed, a creek is in a constant state of flux, perpetually moving, growing, shrinking and changing. From the beginnings of a mountain snow melt, to a river that meets the ocean, a watershed both shapes, and is shaped by, the landscape. Creeks are a fundamental part of any watershed. Creeks also provide the framework for intricate riparian habitats, which are as ecologically important as they are enchanting. Problems arise, however, when a creek meets a city. Our built environment, with its abundance of hardscape, straight lines and planter boxes, rarely adapts itself to accommodate a natural system, such as a creek. More often than not, our response to an urban creek is to direct it into a pipe underground

or to a concrete channel surrounded by a chain link fence. As our urban areas continue to expand and our existing urban creeks become increasingly degraded, it is imperative that we explore new ways of designing with, not against, urban creeks for the health of our watersheds and our cities (Phillips, 2011).



*Figure 1: A Pristine Natural Creek*

# Project Outline

This project begins by examining the conventional treatment of creeks within an urban context, and the opportunities presented by an urban creek enhancement project. Chapter Two looks at two case studies focused on alternative design strategies for urban waterways. Chapter Three delves into an analysis of Strawberry Creek in South Sacramento, and in Chapter Four a new, conceptual vision for the future of Strawberry Creek is proposed.

## 3 Project Goals...

*To raise awareness of the importance of preserving, maintaining, and enhancing our urban creeks*

*To highlight effective alternatives to traditional urban creek management practices*

*To propose strategies for enhancing the ecological and social opportunities for Strawberry Creek In South Sacramento*

## Why Redesign?

A successful urban creek restoration and enhancement project has direct and long-lasting benefits for the surrounding community. Restoration strategies reduce flooding and erosion risks, while the addition of native riparian vegetation removes pollutants and toxins from the water. Parks and public spaces along a restored creek instill a sense of community and increase quality of life for residents of nearby neighborhoods. Access to natural green space provides a fascinating play and learning environment for children as well as adults. A well designed creek enhancement project attracts people and helps to revitalize local economies, while raising adjacent property values. Additionally, trails, bike paths, and greenways create attractive pedestrian paths which are removed from traffic.

The benefits to restoring a degraded urban creek extend far beyond a creek's intimate surroundings. Cleaner water, habitat creation, native plantings, groundwater recharge, and healthy flow patterns help to improve a watershed long after the initial project has come to an end. (Wolf Creek Community Alliance, 2013).



*Figure #: A child enjoys Cheonggyecheon Stream in Seoul, South Korea. The urban creek design project was completed in 2005.*

## A Natural Creek...

Before beginning the redesign or restoration process for an urban creek, it is crucial to understand the ecological process and functions of a natural creek. A creek belongs to a larger watershed which begins at a high elevation and collects water across hundreds or even thousands of miles until it reaches a lake, wetland, or ocean. Every creek also has its own smaller watershed which is comprised of all of the runoff, snow melt, tributaries and other water sources directly entering the creek. As water travels through the watershed, its speed, depth, width, temperature, and organic content drastically change. These changes, along with climate and environmental changes, create many different environments and habitat types across a watershed. The animals and vegetation which depend upon riparian systems also change as creek and watershed environments change (Department of Ecology, 2008).

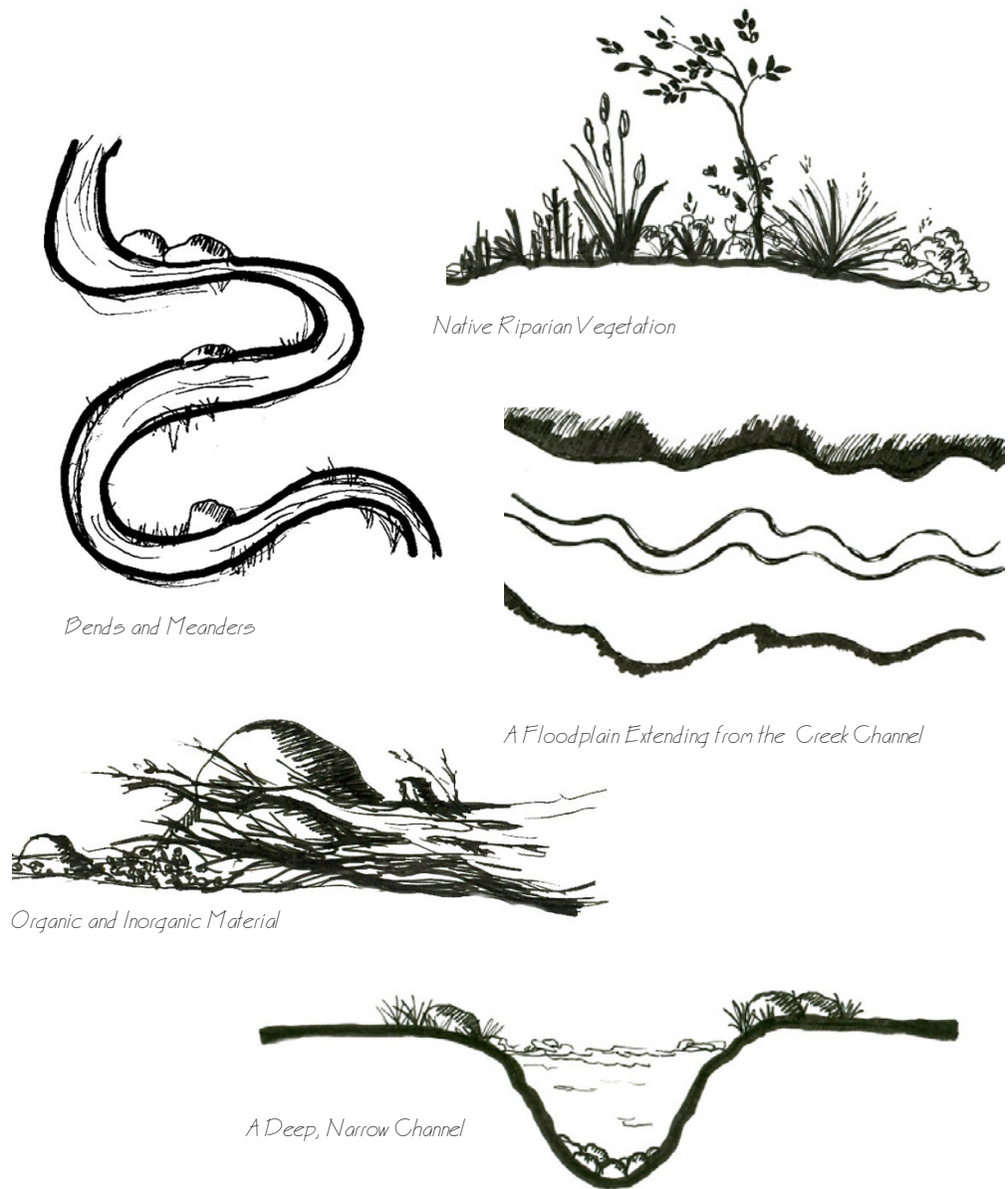


Figure 3 Elements of a Healthy Creek



## Differences Between Natural and Urban Creeks...

The differences between a natural and urban creek are often quite extreme. Natural creeks bend and meander through the landscape, while most urban creeks have been engineered to flow in a straight line. The lack of meandering in an engineered urban creek creates faster water flows, which leads to degraded habitat and bank erosion. Natural creek systems have floodplains to deal with excess water during peak flow periods, but our urban creeks have been engineered not to flood. Without floodplains, we are forced to construct large flood walls and concrete channels which are designed to move water away from the surrounding landscape as quickly as possible. Increased flow rates and engineering prevent water from percolating into the earth and recharging our groundwater. These heavily engineered systems are also expensive to maintain as they become out of date and repairs are needed. Urban creeks are usually devoid of the organic matter that is essential for maintaining a healthy creek ecosystem. Without both living and dead organic matter it is impossible to sustain

a viable riparian ecosystem. Huge amounts of urban runoff brings toxins and pollutants into our creeks. And, finally, the fundamental water cycles of creeks in urban areas have been permanently altered by the addition of urban runoff. Where many natural creeks are dry in the summer and full in the winter, a constant supply of water from irrigation and other urban runoff has created entirely new systems that contain water all year long (Metropolitan Sewer District, 2012).



*Figure 4: A child plays near an extensively engineered urban creek*

## A Bit of a Challenge...

There are many challenges to overcome when considering a creek enhancement or restoration project. Existing buildings or other adjacent infrastructure can constrain the size and shape of the project. Other times the creek might be completely underground. Altered flow, habitat, water levels, and surrounding environment make it impossible to completely restore an urban creek back to its natural state. When considering a restoration project within an urban context, human access and use must also be taken into account. It takes support and collaboration from local governments and community members, as well as the expertise of ecologists, engineers, city planners, and landscape architects to successfully undertake an urban creek revitalization project (Bernhardt & Palmer, 2007).

A successful urban creek project embraces the fact that it can be neither a solely restorative, nor a solely urban, design project. Instead, an urban creek enhancement

project should act as a hybrid, linking our built and natural environments. Designing with, and around, urban creeks requires a lot of creativity, but with every new project we learn more about how to effectively balance social and environmental components and build fantastic resources for local communities and cities (Riley, 1998).

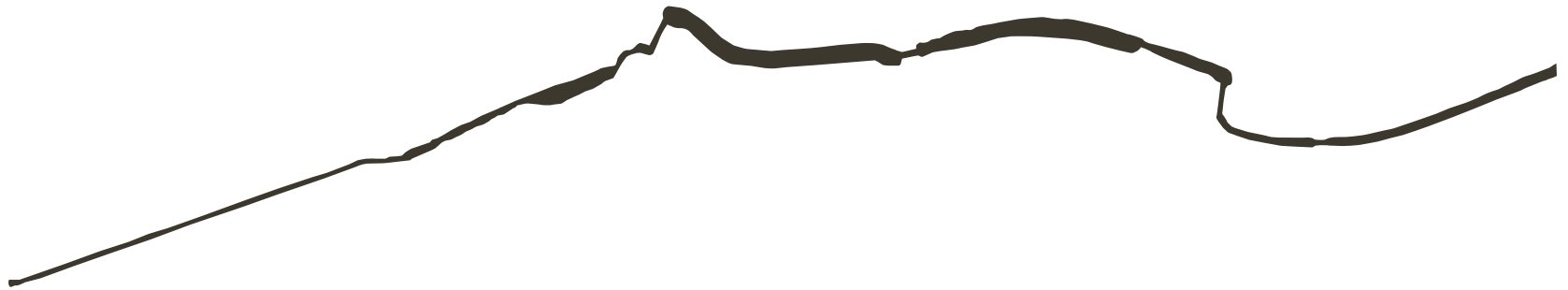


*Figure 5: Urban creek projects require a balance of restoration and urban design strategies*

# Chapter 2

## Case Studies

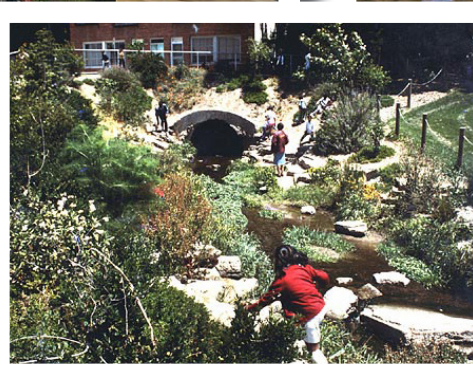
### A New Perspective on Urban Creeks





## Urban Creeks are Gaining More Attention...

In the last 50 years a slow shift has begun to take place in the way creeks, streams, and rivers are viewed and treated within an urban context. Beginning with one or two experimental projects, new and innovative ways of treating urban waterways have started to show up in cities around the world (Riley, 1998).



*Figure 6: Cheonggyecheon Stream in Seoul, South Korea*

*Figure 7: City Creek in Salt Lake City, UT*

*Figure 8: Conceptual Image of Waller Creek in Austin, TX*

*Figure 9: Daylighted Strawberry Creek in Berkeley, CA*

# San Luis Obispo Creek

San Luis Obispo Creek runs straight through the heart of downtown San Luis Obispo, but in the 1940s the creek was treated as a dump. Filled with old tires, car parts and trash, the creek had highly eroded banks and extremely low habitat value. The adjacent downtown was also struggling, with many closed shops and vacant motels. In the early 1950s a college art teacher assigned her students' a project to come up with concepts for beautifying the struggling downtown. A group of three students proposed closing down a portion of Monterey Street and creating a pedestrian plaza with a focus on the creek. The students proposal gained a lot of attention, but the mayor at the time was adamantly apposed to closing down a portion of the busy street. However, in 1960 a new mayor was elected who supported the creek and plaza revitalization project. The mayor, supported by city council members, community members, and local business owners, decided to move forward with the project and construction began in 1970 (Parks and



*Figure 10: In the 1960s San Luis Obispo Creek was highly polluted and degraded*

Recreation, 2011). Today the project is considered a success by both the city and environmental groups. The creek is healthier due to major pollution reduction and restoration efforts, but perhaps the most successful parts of the project are the social aspects associated

with the creek revitalization. Businesses along the creek have reversed their storefronts and now face the popular pedestrian walk along the creek. Farmers markets, creekside cafes, art walks, and annual festivals can all be found alongside the creek and attract both tourists and local residents. The strong connection between the downtown and the creek has helped create a vibrant city center with a strong tourism base. The degraded condition of San Luis Obispo Creek in the 1940s can be compared to the condition of thousands of urban creeks across America today. The long-term environmental and economic benefits gained from the San Luis Obispo Creek project have helped to strengthen the case for future urban creek enhancement projects (City of San Luis Obispo, 2013).

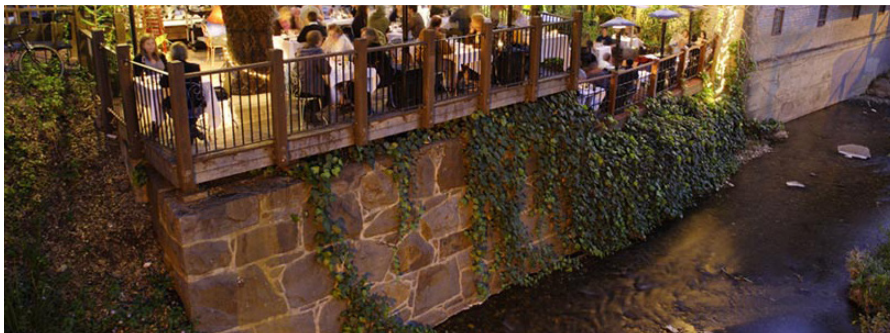


Figure 11: Outdoor restaurant patios along San Luis Obispo Creek



Figure 12: Children explore San Luis Obispo Creek



Figure 13: A pedestrian walk along San Luis Obispo Creek

## San Luis Obispo Creek Construction...

Since 1970, many different construction and design strategies have been implemented onto the San Luis Obispo creek and its adjacent banks. The channel has been regraded to control flows and reduce water velocity. With the help of a stream morphologist, rocks and boulders have been added to create pools that are essential for a healthy fish habitat. Flood walls from the 1940s have been set back, and native riparian trees have been planted in the newly created floodplain. Above the floodplain, a pedestrian path was built which creates a link between the creek and downtown. In 1999 the initial creek design was revisited in order to improve its ecological values. Parts of the creek were temporarily diverted into plastic pipes and culverts while the banks were regraded and barriers, which impaired the movement of fish, were removed. Today San Luis Obispo Creek supports one of the only regular steelhead trout runs to occur within an urban creek (Santa Lucia Group, 2001).



*Figure 14: Construction on 1999 San Luis Obispo Creek habitat enhancement project*



# Thornton Creek Water Quality Channel

Located in Seattle, WA, the Thornton Creek Water Quality Channel is an innovative project which fully integrates urban development with a human engineered water channel. The Thornton Creek Channel was originally an underground pipe which delivered storm water from surrounding urban areas to the nearby Thornton Creek. If you had visited the the site of the Thornton Creek Channel in 2004, you would find yourself in the middle of a vast paved parking lot with no water, vegetation, or buildings, but by 2009, the site had been completely transformed. Today the area contains dense housing units all centrally focused around a beautiful 2.7-acre green space with the day-lit water channel running down the middle. Runoff, from 680 surrounding acres, is directed into the channel,. The water is cleaned as it passes though several levels of vegetated terraces and bioswales before entering the natural portion of Thornton Creek (SVR Design Company , 2009).



*Figure 15: The Thornton Creek Water Quality Channel is a focal point in the landscape*

The Thornton Creek Water Quality Channel was designed with three main goals:

- 1 "To improve the water quality of flows entering Thornton Creek by removing sediments and associated pollutants from 91 percent of the annual runoff from the 680 acre drainage area."
- 2 "To provide public open space and native vegetation."
- 3 "To facilitate economic development within the Northgate (Seattle) area by integrating the Project's design with adjacent private development."

Even though Thornton Creek Water Quality Channel is not a natural creek channel, the goals, design strategies, and end results are applicable to most urban creek projects. The Thornton Creek Water Quality Channel exemplifies how a naturalistic drainage system can be integrated into an urban setting awhile effectively enhancing environmental qualities and improving the quality of life for local residents (Journal Staff, 2010).



Figure 16: Thornton Creek Water Quality Channel Master Plan

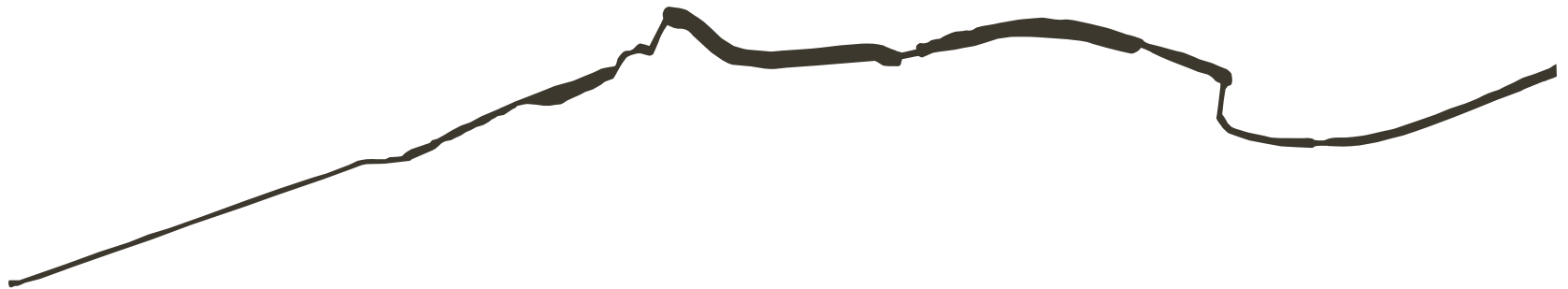


Figure 17: Wetland terraces clean storm water

# Chapter 3

## Analysis

### A Creek In Need of Help



# Sacramento Creeks

Located in the heart of the Central Valley, Sacramento County contains an abundance of urban creeks. There are over 40 named creeks within the county, as well as 60 miles of above-ground storm water channels. Development in Sacramento County is generally very sprawled, and extensive development has altered almost every creek located within the county (Bettis, 1998).

## Strawberry Creek

Strawberry Creek is a highly engineered creek which flows west through Sacramento County and eventually meets the Sacramento River. The creek is divided into two forks called the North Fork and the Middle Fork. The North Fork flows through the census-designated "Vineyard" area of Sacramento County. At the west end of the North Fork the creek briefly flows through the city of Elk Grove. The Middle Fork begins when Strawberry Creek enters an unincorporated area of Sacramento County and flows parallel to Calvine Road. Once the creek crosses under the highway it flows through the

Valley High/North Laguna area of Sacramento city. Strawberry Creek's watershed consists of 3,700 acres. As you move along the creek, its conditions fluctuate significantly. Some areas are made up of concrete or rock-lined channels of varying widths, while other areas are wider and contain vegetation. Common trends across the entire creek include adjacent development, numerous road crossings, very limited public access, and low habitat value (City of Elk Grove, 2011).

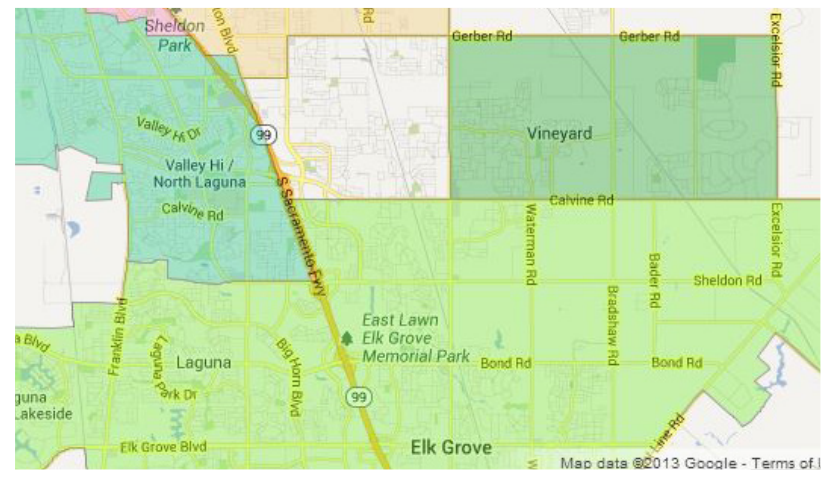


Figure 18: Strawberry Creek flows through several areas of Sacramento County

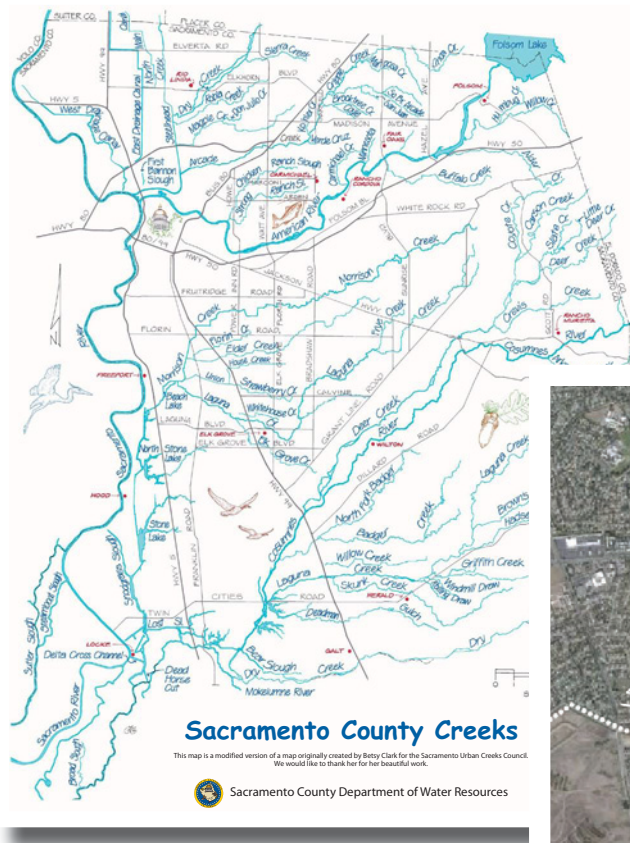


Figure 19: A Map of Creeks in Sacramento County



Figure 20: Strawberry Creek's surrounding context

## Project Site

This project is focused on a one-mile-long stretch of Strawberry Creek's Middle Fork. The site is graded to have a trapezoidal shape (see Figure 24) and is vegetated. The creek is exposed to numerous environments along the one-mile stretch, including residential and commercial development, as well as a few undeveloped areas. Surface streets cross the creek seven times and Highway 99 creates a major divide between the east and west ends of the site. The site is surrounded by a typical suburban landscape, and single family

homes built in the early 90s make up most of the adjacent residential space. Away from the residential areas, the landscape is dominated by cars, roads, and parking lots. The busy streets, combined with narrow sidewalks and a dangerous freeway overpass, discourage pedestrians from walking the short distances between nearby houses, schools and commercial spaces.

*Commercial*

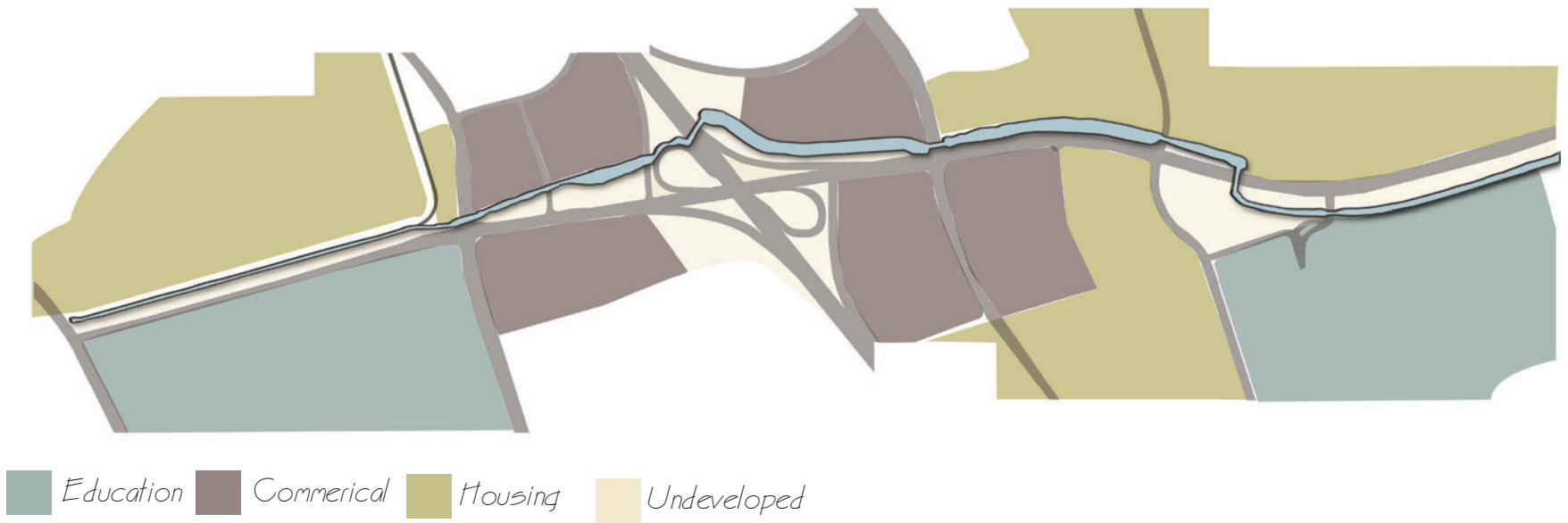
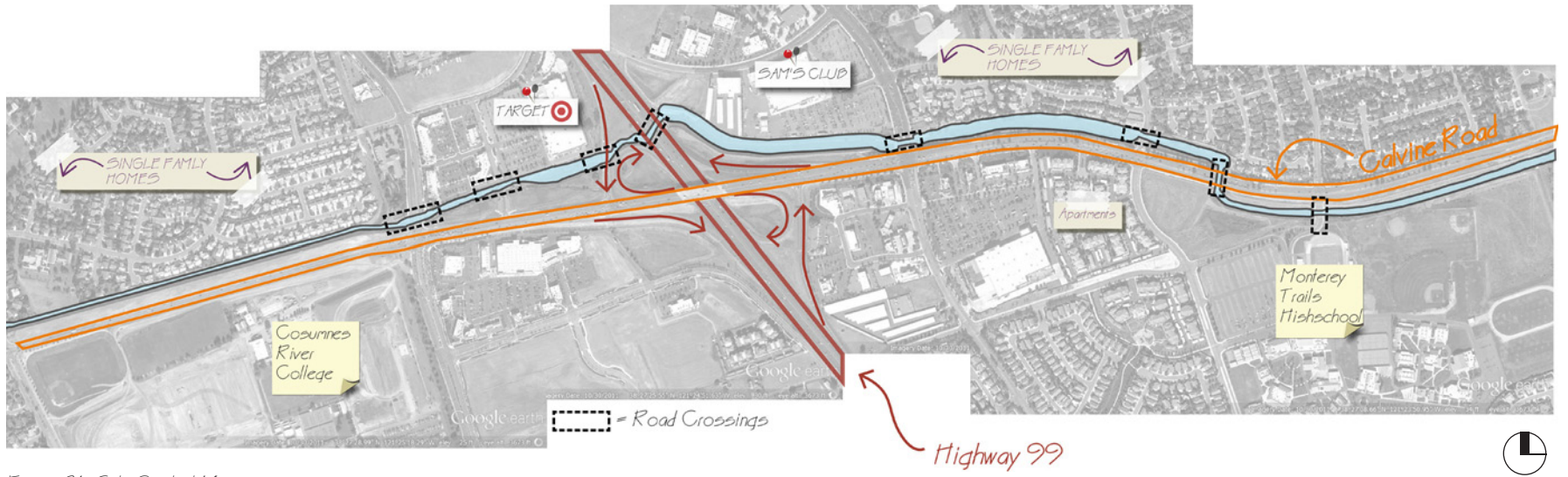


Figure 22: Surrounding Land Cover



Strawberry Creek Snapshots  
Figure 23



Chainlink fence blocks access to creek



# 7



# 6



# 10

Empty unused space



# 12



# 5



# 11 Open space has potential for ecological enhancement



# 9



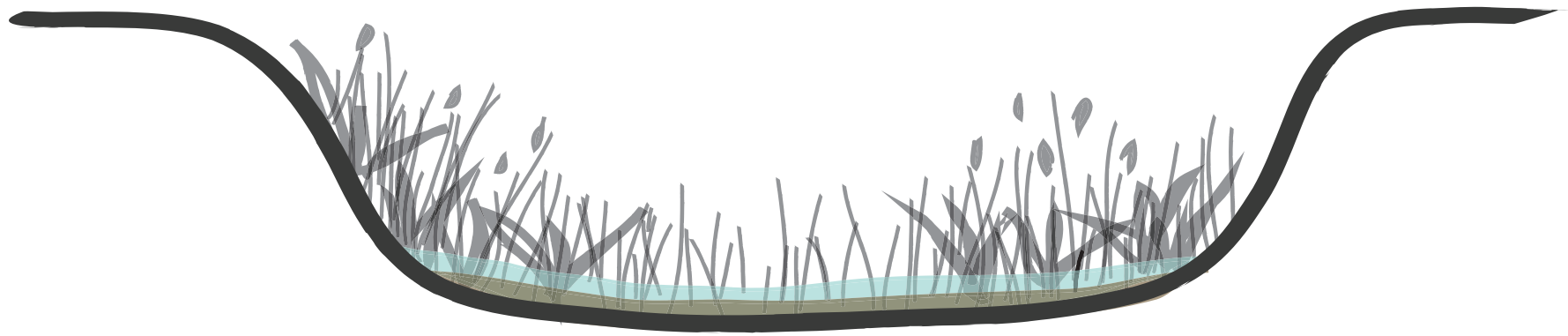
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Very wide creek channel creates a shallow flow with low habitat value

## A Dysfunctional Creek...

Extensive engineering and modification of Strawberry Creek has resulted in a creek which is dysfunctional, unattractive, and detached from its surrounding environment. The creek channel is very wide, in some cases over 90 feet, with steep banks on both sides. Vegetation along the creek consists primarily of cattails and bulrush. Due to the channel's steep banks there are almost no trees able to grow within reach of the creek's water table. In winter, the creek experiences large influxes of fast-moving water, which flattens much of

the vegetation. Each time a road crosses the creek, it is directed into narrow pipes, which creates disconnected creek patches instead of a continuous creek corridor. The creek is completely surrounded by fences and walls with no public access to the site. The cumulation of all of these factors has resulted in a creek which is unable to provide any of the benefits or functions that a natural creek would. Currently, Strawberry Creek does very little to enhance the social or ecological values of the surrounding urban landscape.



*Figure 24: Strawberry Creek has been engineered to have a trapezoidal shape. The steep banks limit where vegetation can grow and the wide shallow base creates unhealthy flow patterns.*

*Sidewalk adjacent to a busy road*



*Inaccessible creek area*

*Figure 25: A block wall separates Strawberry Creek from the adjacent road and sidewalk.*



*Figure 26: The creek is directed into small pipes to cross beneath roads.*

## A Creek Full of Possibilities...

Strawberry Creek has the potential to become a fantastic resource for the surrounding community. The linear form of the creek makes it a natural corridor, which can be used to unite the existing fragmented landscape. Riparian plants can be used to clean urban runoff for a safer, healthier environment, while a naturalistic green space would create a peaceful urban oasis. The creek's close proximity to a high school supports the creation of interactive and educational spaces. There is potential to incorporate the creek into shopping areas on the west end of the site, as well as to create a larger park area on the east end. A system of paths and trails along the creek corridor would provide safe, pedestrian-oriented paths of travel between housing, school, and commercial areas. By better incorporating Strawberry Creek into the existing landscape, it's possible to benefit the economy, aesthetics, environment, and health of the surrounding neighborhood.

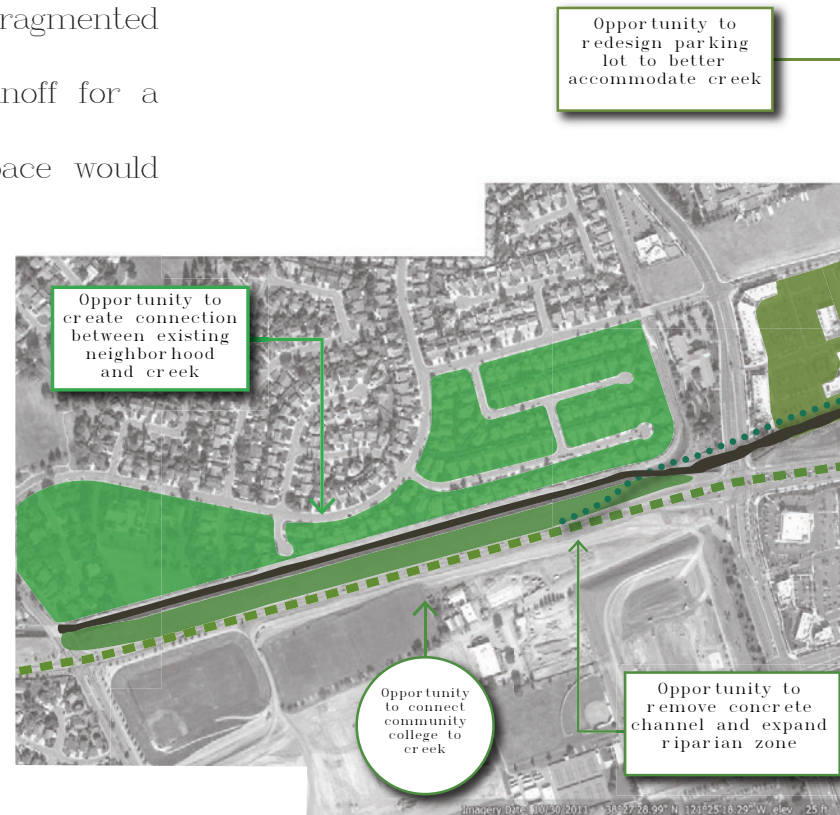


Figure 27: Strawberry Creek Opportunities

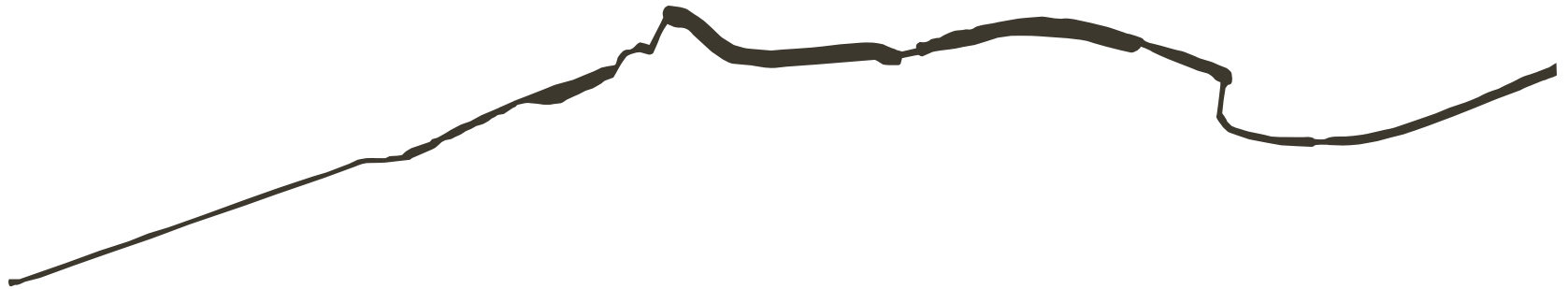




# Chapter 4

## Design

### A Reimagined Creek



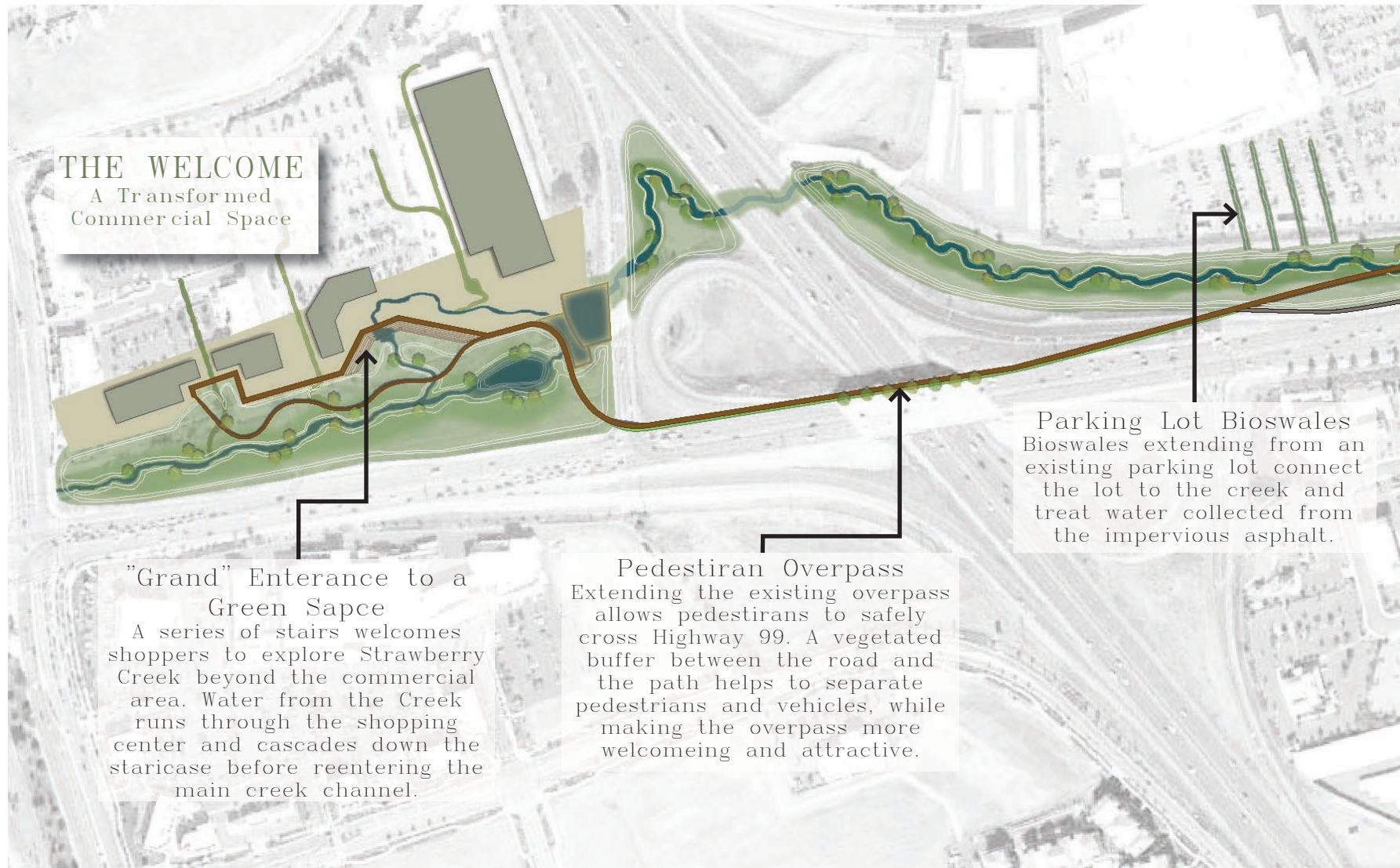


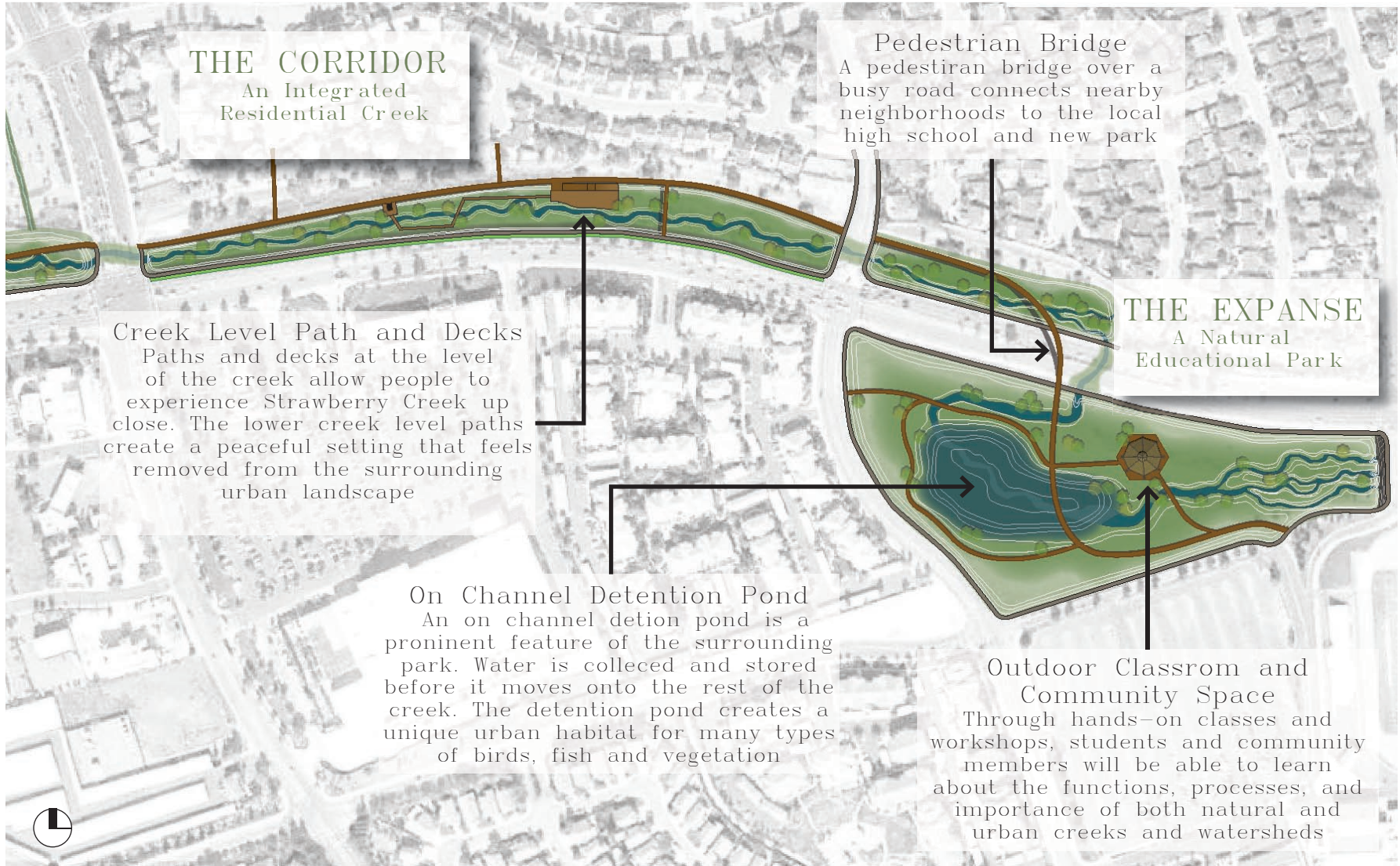


# Design Goals for Strawberry Creek

1. Create a pedestrian-oriented path with a strong connection to the creek.
2. Use the creek to link pedestrians to nearby schools, commercial areas, and residential communities.
3. Provide pedestrian access to the creek.
4. Regrade the creek channel to create a narrower, meandering channel with a floodplain.
5. Replant native riparian vegetation.
6. Create better creek channel connectivity.
7. Educate users about creek systems.
8. Redefine Strawberry Creek as a prominent feature of the existing urban landscape.

# Strawberry Creek Master Plan





**THE CORRIDOR**  
An Integrated Residential Creek

**Pedestrian Bridge**  
A pedestrian bridge over a busy road connects nearby neighborhoods to the local high school and new park

**Creek Level Path and Decks**  
Paths and decks at the level of the creek allow people to experience Strawberry Creek up close. The lower creek level paths create a peaceful setting that feels removed from the surrounding urban landscape

**THE EXPANSE**  
A Natural Educational Park

**On Channel Detention Pond**  
An on channel detention pond is a prominent feature of the surrounding park. Water is collected and stored before it moves onto the rest of the creek. The detention pond creates a unique urban habitat for many types of birds, fish and vegetation

**Outdoor Classroom and Community Space**  
Through hands-on classes and workshops, students and community members will be able to learn about the functions, processes, and importance of both natural and urban creeks and watersheds



## Pedestrian Connectivity...

A new path system ties the creek together, while creating a continuous corridor for people to move through the landscape. The path system stretches for over a mile along Strawberry Creek and is, for the most part, removed from surface streets. An elevated pedestrian bridge creates a safe connection between the high school and neighborhoods on the north side of Calvine Road. By extending the existing Highway 99 overpass, pedestrians are able to safely cross over the

highway to easily move between residential and commercial spaces. In other areas the path branches off and pedestrians are able to travel at the same level as the creek. Changes in elevation and environment across the trail system enforce the idea of a continuous creek system which unifies the surrounding urban landscape.

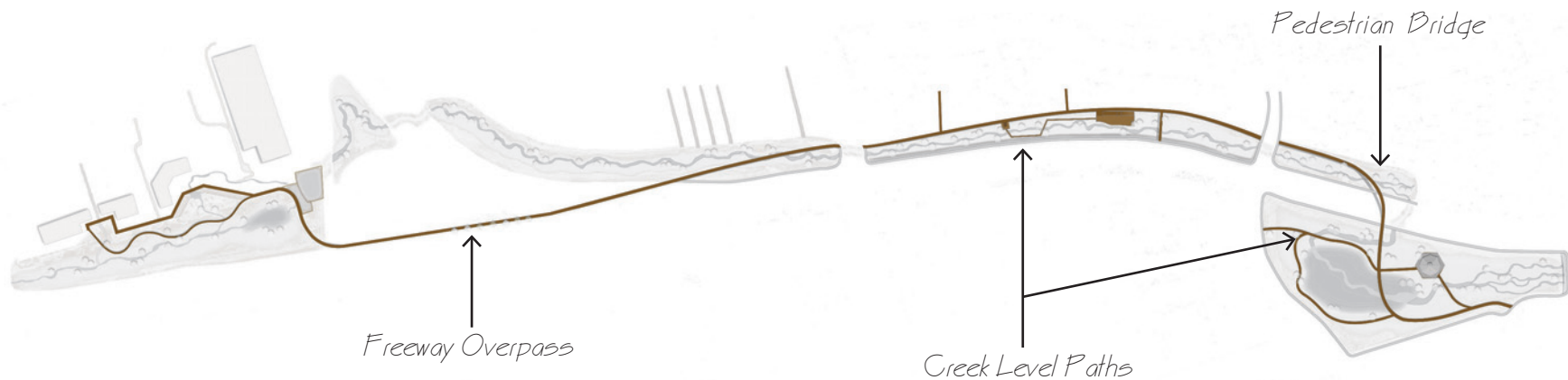


Figure 29: Strawberry Creek Pedestrian Paths

## Creek Connectivity...

Creek connectivity and habitat value is enhanced by widening the areas where Strawberry Creek crosses beneath a road. Larger openings allow the water to move, uninterrupted, across the whole creek system. Stretches of dry land on either side of the creek crossings create room for the water to naturally fluctuate and provide a way for animals to easily move between all sections of the creek. Larger openings help to minimize interruptions to the natural creek system and create a healthier riparian habitat.



*Figure 30: Large creek underpasses help create connected creek corridors*

# The Welcome: A Transformed Commercial Space

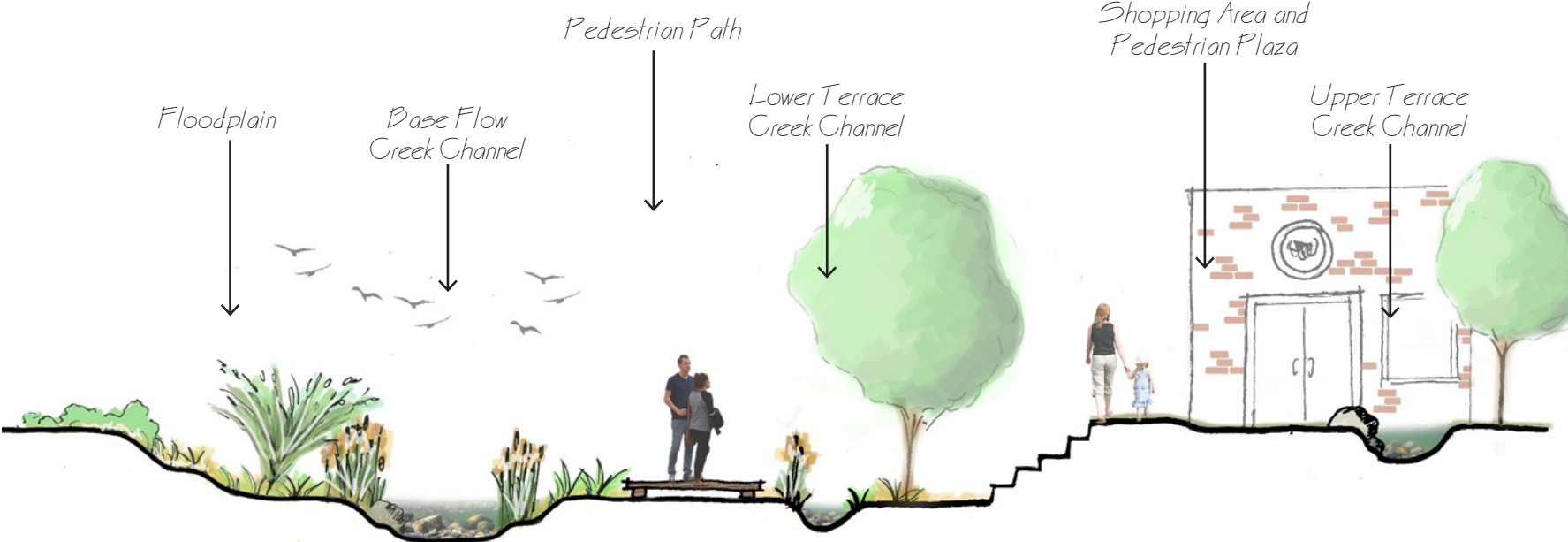
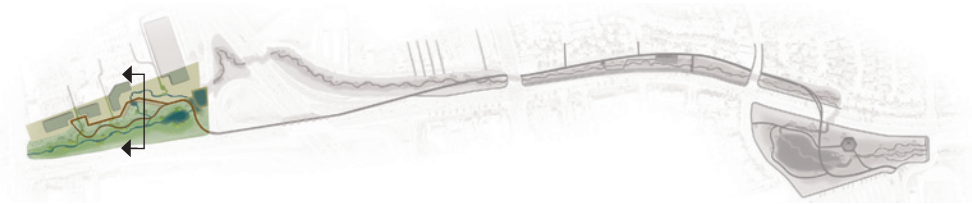


Figure 31: Commercial Area Section



As users move through this commercial area, the relationship between the shopping center and Strawberry Creek is highlighted. Large wetland terraces are a prominent feature on the east end of the site. The terraces greet pedestrians as they enter from the freeway overpass, and are visible to cars exiting the highway. Water is cleaned as it moves through the terraces before entering the main creek channel. A portion of the creek's water is diverted into a smaller channel which runs through a pedestrian plaza on the shopping level. Even if users choose not to venture down to the main creek channel, they are still aware of Strawberry Creek flowing through the site. The upper creek channel terminates when the water cascades down a large staircase and rejoins the main creek channel. The stairs invite users to move beyond the plaza areas and

explore the creek. Vegetated swales reach out from the shopping area and connect the surrounding landscape to the creek.



Figure 32: Commercial Area Plan

# The Corridor: An Integrated Residential Creek

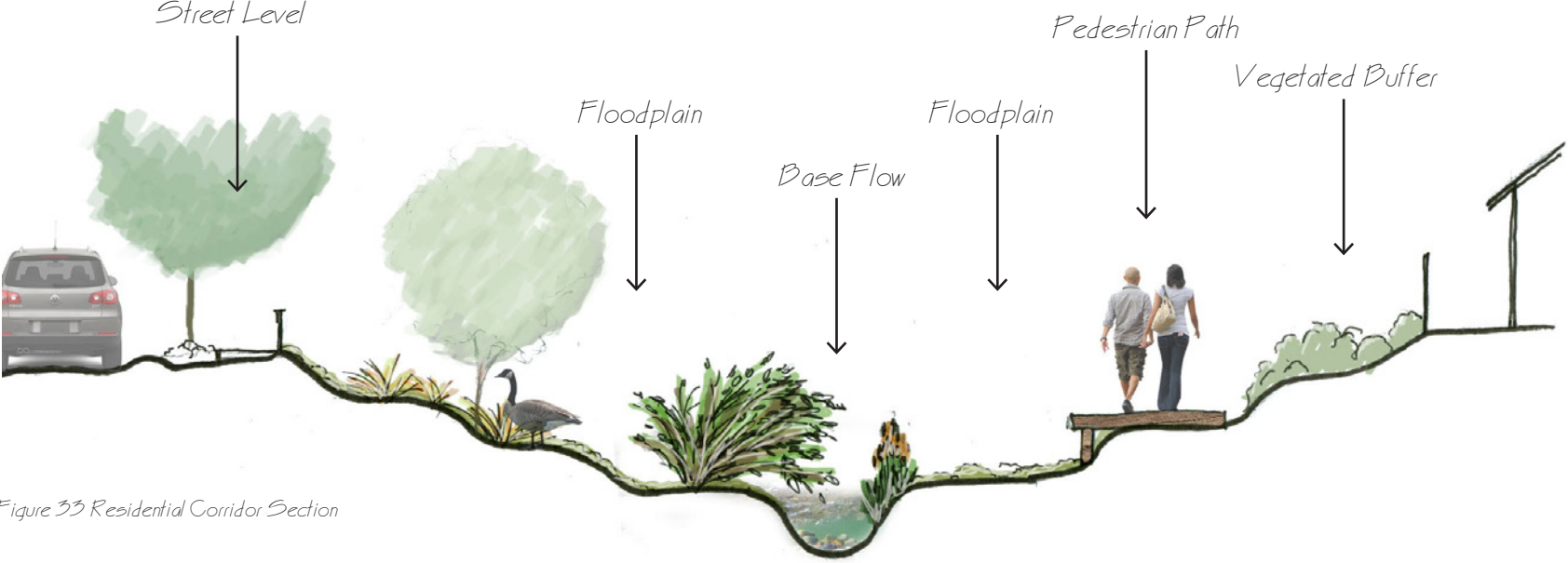
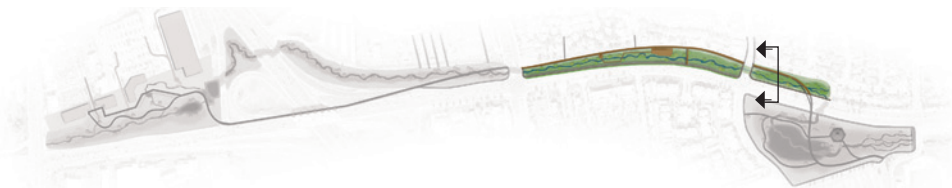


Figure 33 Residential Corridor Section





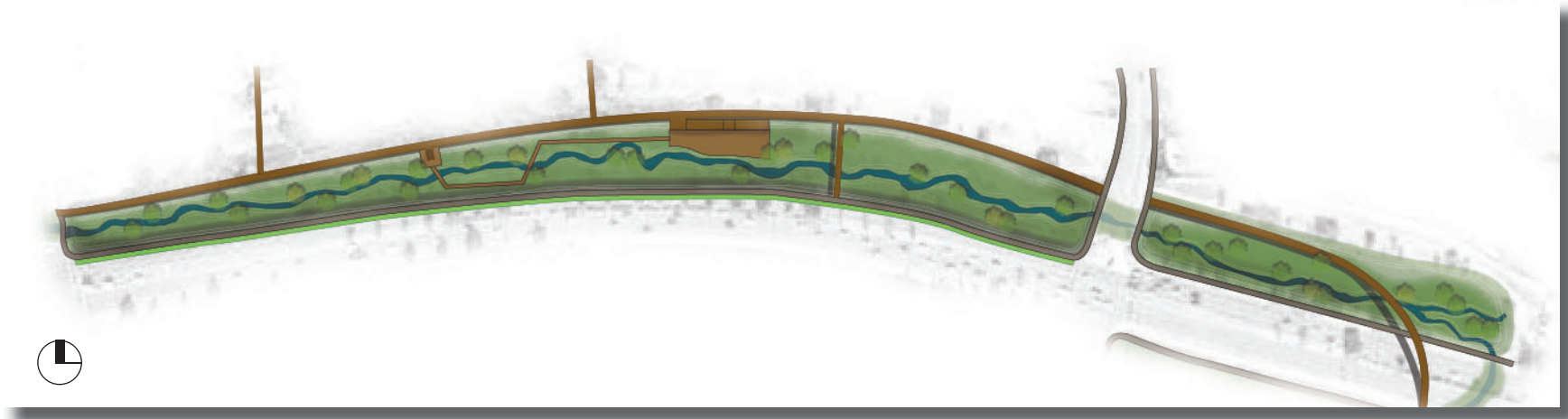


Figure 34: Residential Corridor Plan

Here, the design takes advantage of the linear form of the Strawberry Creek channel to create an urban creek corridor for people and animals alike. Terraces leading down to the creek create transitional zones between street level and the flowing creek. Each terrace is utilized in a different way. Lower terraces act as a floodplain and support diverse riparian vegetation. A pedestrian path is located on an upper terrace. The highest terrace is used to create a vegetated buffer zone between Strawberry Creek and

adjacent residential backyards. New paths extending into the residential area on the north side of the creek provide access to the site and strengthen the connection between the neighborhood and the creek. In two areas, decks connected by a smaller path, allow users to move off of the main path and experience the creek up close.

# The Expanse: A Natural Educational Park

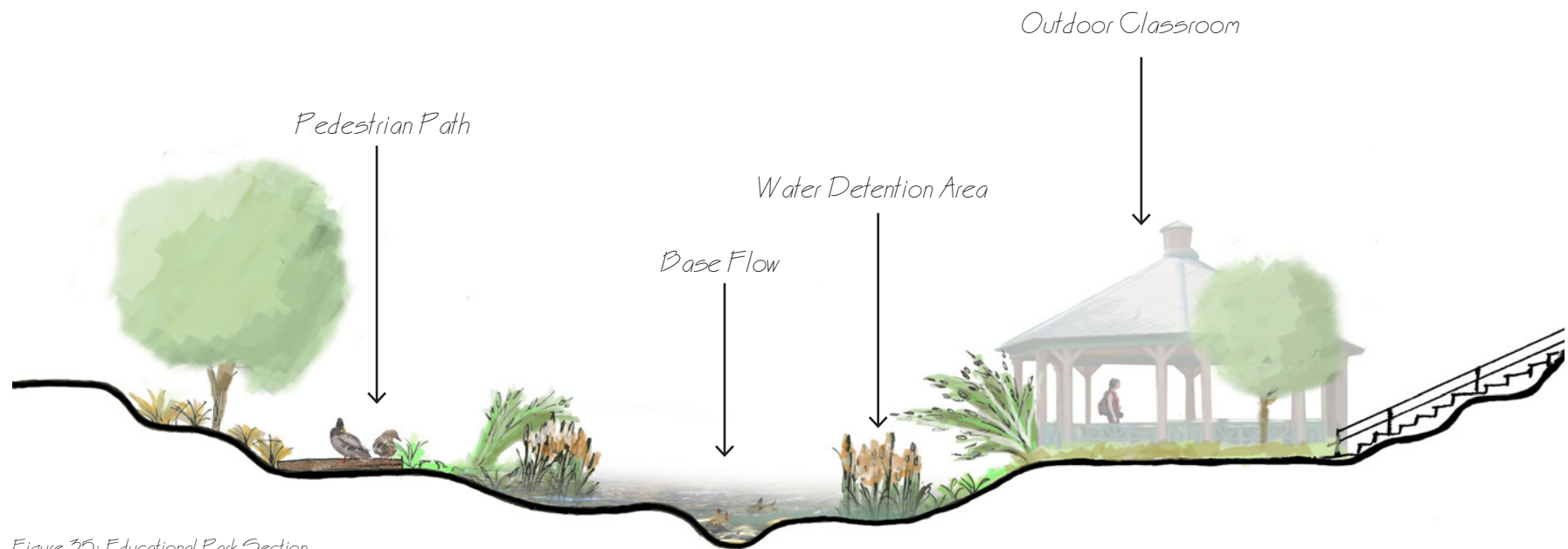


Figure 35: Educational Park Section



An eight-acre park defines the west end of the Strawberry Creek project. The park is situated next to a school and across the street from a large neighborhood and apartment complexes. The large amount of available space allows for the creation of an on-channel detention pond, several different paths, an outdoor classroom, and extensive areas of riparian and native grassland plantings. The movement of Strawberry Creek through the park mimics a watershed. Water enters the site and flows into several smaller channels, which come together to form the primary creek channel. The water then enters the detention pond before eventually rejoining the primary creek channel. A low base flow, channel ensures that there is always a minimum amount of water moving through the detention pond. The different treatments of water throughout the park allow for a range of educational and experiential

opportunities. The park encourages hands-on science classes, children's adventure play, recreational walking and jogging, and an overall awareness and appreciation for creeks and native riparian habitat.



Figure 36: Educational Park Plan



## Conclusion....

Strawberry Creek is by no means unique. There are thousands of degraded creeks in cities around the world which contain the potential to become a fantastic community and environmental resources. Through creative design approaches we can begin to bridge the gap between our built and natural systems for the health and benefit of all.

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