Discovering the City Beneath the City

Daylighting Stormwater Infrastructure In San Francisco

KEITH SCOTT SENIOR PROJECT 2013

Discovering the City Beneath the City

CREATING VISIBLE STORMWATER INFRASTRUCTURE ON MARKET STREET IN SAN FRANCISCO

KEITH SCOTT | SPRING 2013 | SENIOR PROJECT

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what's inside...

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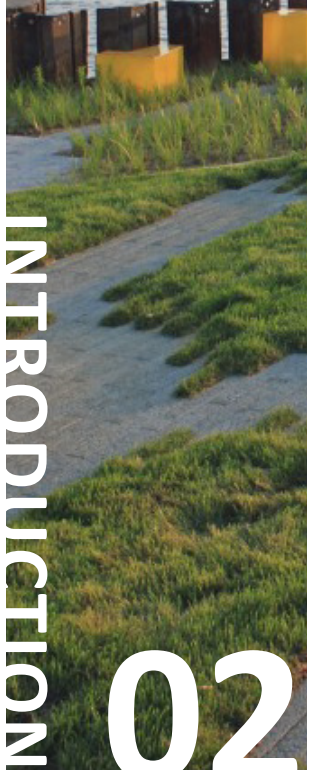

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ABSTRACT

Rainfall is a natural process that is highly modified in an urban environment once that water hits a hard surface. Most people are more concerned with finding shelter rather then what is happening with the stormwater. In urban areas like San Francisco, stormwater encounters impervious surfaces that are engineered to direct it away as quickly as possible. This journey that the water is taking in urban environments is drastically altered from the journey that water makes in the natural environment. As water runs along an impervious surface, it picks up contaminates and pollutants that are harmful to riparian and aquatic habitats. The speed of the flow also increases the peak flow which can induce flooding. Reducing flood events is one reason to manipulate the journey water takes in urban areas to mimic that of the natural systems.

My project is based in the Market Street area of San Francisco, CA. This is a highly used area that is almost completely covered with impervious surfaces. All of the stormwater in this area is moved into catchment tanks and later sent to a water treatment plant to be filtered and released back into the bay. The goal of my project is to bridge the separation between the urban areas and the natural environment. To accomplish this I am intercepting the water before it goes underground and treated everything on-site through best management practices and other innovative stormwater management techniques. This allows the users in this area to recognize and understand what is happening with the stormwater on-site.

ACKNOWLEDGMENTS

TO MY COMMITTEE MEMBERS: Thank you for all of your guidance and support throughout this process. I was always able to turn to you for inspiration whenever I was stuck. Thank you, Heath Massey, Kevin Perry, Brett Milligan.

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PORT OF
Starbucks

INTRODUCTION: The Site

The City of San Francisco is the only costal city in California to run on a “combined” sewer system. The sewage and stormwater are combined and sent to a waste water plant to be cleaned before being sent back into the surrounding bay (San Francisco Combined Sewers, 2013). This process takes the purification of water away from biotic processes and moves it into an engineered system. These types of systems can cause cities and nature to become disconnected. My project will improve the connection between an urban area like San Francisco and nature while creating visible, educational, and sustainable infrastructure. To accomplish this I will bring the “city” beneath the city above ground through innovative stormwater solutions that will help retain water on site.

The research site for this investigation site is located in downtown San Francisco in the area around the ferry building(See Fig.1.21). This area is heavily used by pedestrians and public transportation. It acts as one of the main transportation nodes for the city. This area is composed of highly impervious surfaces. Stormwater hits the surface and is rushed into the nearest storm drain to be cleansed at the nearest stormwater plant. The high traffic of this area causes the stormwater to become extremely polluted and full of contaminants as it travels to the drain. My intervention provides a number of different areas where the water can be purified, cleansed, and infiltrate into the soil. This will improve the water quality and quantity on the site of study. This will help bridge the gap between urban

areas and the natural environment and can serve as an example for the rest of the city.

Why is stormwater so important in an urban setting? There are a couple of things that should be considered when thinking about this question. Stormwater effects the sustainability, economy, and environment of a city. The population of the world is constantly increasing. The population in the United States in 2012 was 313,933,954 compared to 309,346,972 in 2010 (United States Census Bureau). This is a difference of over four and a half million people in two years. As the population increases, the addition of grey water systems can help reuse water and reduce the outflow of polluted water to the San Francisco Bay. A large part of any city is it's massive infrastructure that is needed for the city to function. In 2008 $63.6 billion was spent in the United States to help control combined sewer overflow systems (EPA, 2013). More green infrastructure in cities will result in less underground infrastructure. In turn this can have a positive effect on the economy of a city. Lastly stormwater is clear indicator of the separation between the urban and natural environment. As mentioned above, how we handle our water effects the environment and other biotic organisms around us.

INTRODUCTION: DEFINITIONS

This is some of the language that will be used throughout this document. Theses definitions should help the reader better understand some of the concepts and ideas that are being illustrated. These definitions may differ from the normal meaning of these terms.

Stormwater infrastructure:

-The basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise: the social and economic infrastructure of a country. (Webster, 2013)

Visible:

-Currently there are a lot of people that are unaware of the fact that there is stormwater running underneath the ground in pipes when it rains. A visible system is one that will show users of the site what is happening with the stormwater. (Thayer, 1994)

Sustainable:

Sustainable infrastructure treats water as a valuable resource. This system will improve the quality of the water while restoring the natural hydrological functions. A number of green infrastructure methods are combined to create sustainable infrastructure. Some of these methods are green gutters, vegetated swale, stormwater planters and rain gardens. A sustainable system should also be cost effective, reducing the amount of money spent on underground infrastructure. Lastly to become sustainable the system must reduce the volume and flow of the stormwater. (Perry, 2012)

Educational:

-Educational refers to informing the users of a site what is taking place with their stormwater. This includes information on water quality, where the water is going and water usage.

INTRODUCTION: OBJECTIVES & GOALS

Overall the goal of this project was to find new and innovative methods to handle stormwater in a urban setting. A strong emphasise was place on trying to rethink how stormwater is viewed by environmental professionals and the everyday user. The techniques and methods found in this study can serve as inspiration for future projects.

Fig. 1.10
Water Feature serving as a wayfinding device.

Education:

-Make stormwater visible to users so they can learn about the process and benefits of the water. There are a lot of people that use Market Street everyday, providing a great opportunity to educate them on what is happening with their stormwater. Educational signs and creative interventions will guide users to this knowledge.

Fig. 1.11
Polluted stormwater runoff dumping into a wetland area.

Water Quality:

-Improve the water quality of the area of study and San Francisco overall/reduce the stress on the combined sewer system. These facilities improve the quality of the water by using vegetation to clean out toxins. There is a lot of vehicle traffic along Market Street so the water is polluted by brake dust and other chemicals.

Water Quantity:

-The stormwater facilities will reduce the flow of water during heavy storm events. During heavy rainfall, San Francisco's sewer system is put under a lot of stress. This project will help relieve some of that stress by holding a percentage of the water on site.

Fig. 1.12
Stormwater flowing onto the street.

Integrate Nature:

-Create a connection between the urban and natural environment. Cities should mimic the natural environment and its ecological functions. This project will bring more functional landscape into the city.

Fig. 1.13
Hills of Switzerland, capturing the unaltered environment.

Pervious vs Impervious:

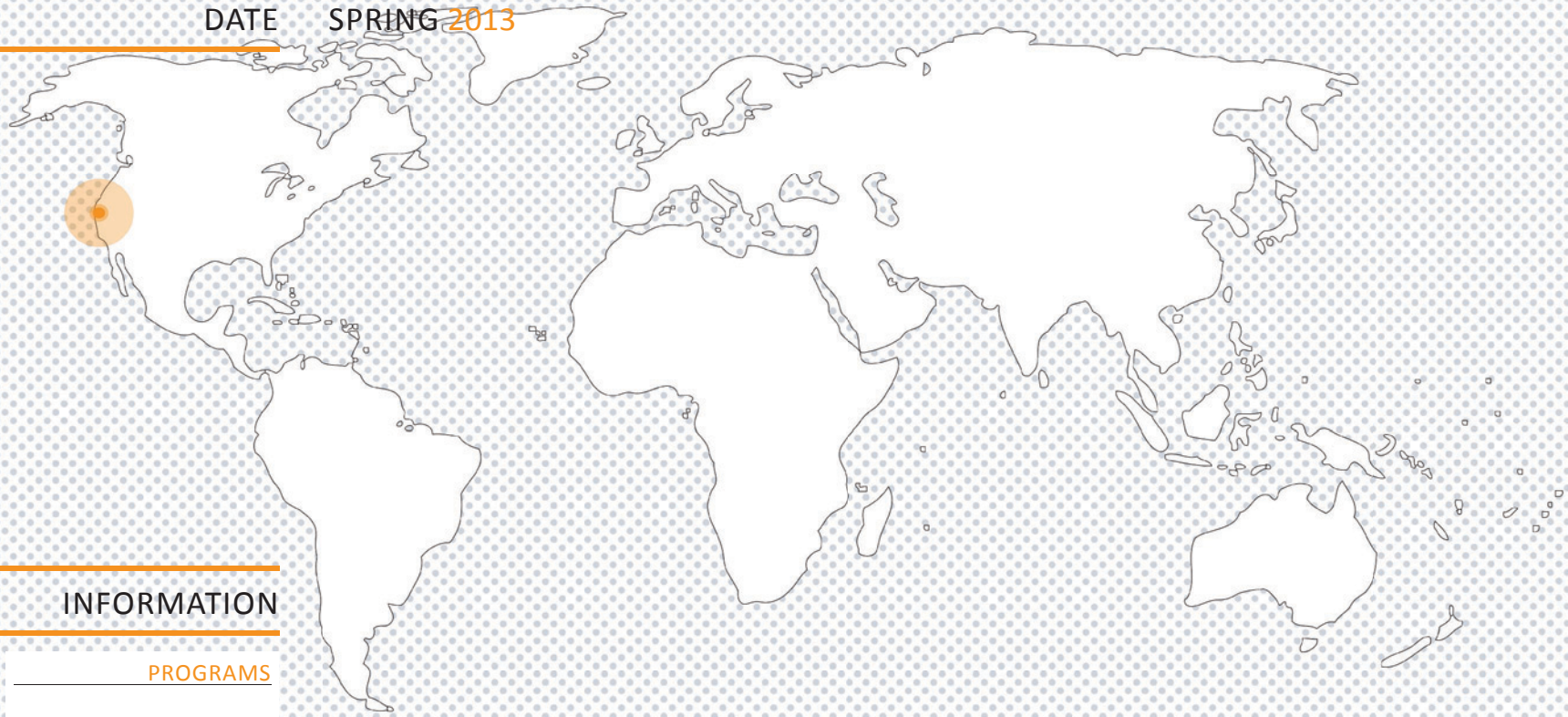
-The site is currently covered with mostly impervious surfaces. This project will attempt to increase the amount of pervious areas through a number of techniques. This will allow more stormwater to infiltrate into the ground and stay on site.

Fig. 1.14
Pervious Parking lot.

PROJECT LOCATION **SAN FRANCISCO, CA**

PROJECT SITE MARKET STREET

DATE SPRING 2013



INFORMATION

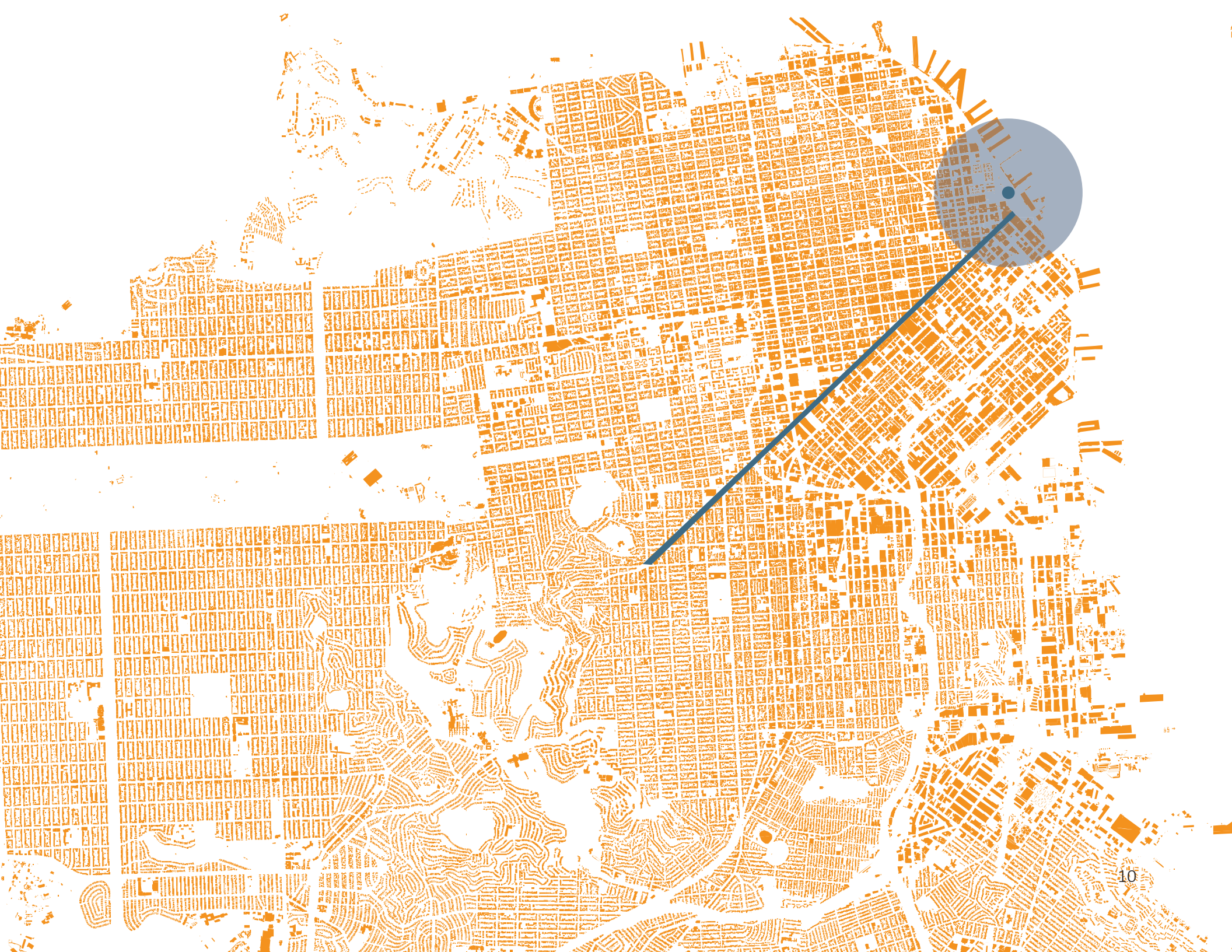
PROGRAMS

Stormwater Facilities

Education

Conveyance

Infiltration



BACKGROUND

SAN FRANCISCO

MARKET STREET

LOCATION

The site is located in downtown San Francisco between Market St. and Embarcadero. The site is a transportation hub and the center of a lot of foot traffic.


22.28
INCHES PER YEAR
IN SAN FRANCISCO

Context & Background

Over the years, urban areas have become disconnected from nature. This is largely due to the development of highly engineered landscapes. These areas tend to move water off site as quickly as possible. This is one of the main reason that urban areas like San Francisco are composed of nature-less buildings and impermeable streets. The concrete jungle has had detrimental affects on the structure and infrastructure of the city (Strang, 2012). The city has turned into large, upright buildings with concrete from wall to wall and vegetation sparsely spread around to soften the concrete edges. During the Roman era, stormwater infrastructure was integrated into the city, but today cities like San Francisco use their space for other purposes, forcing the infrastructure underground and out of the view of the everyday user. These facilities have been out of the view for so long that the average person does not know what is going on with their stormwater. Where is the water going? Why is the water important?

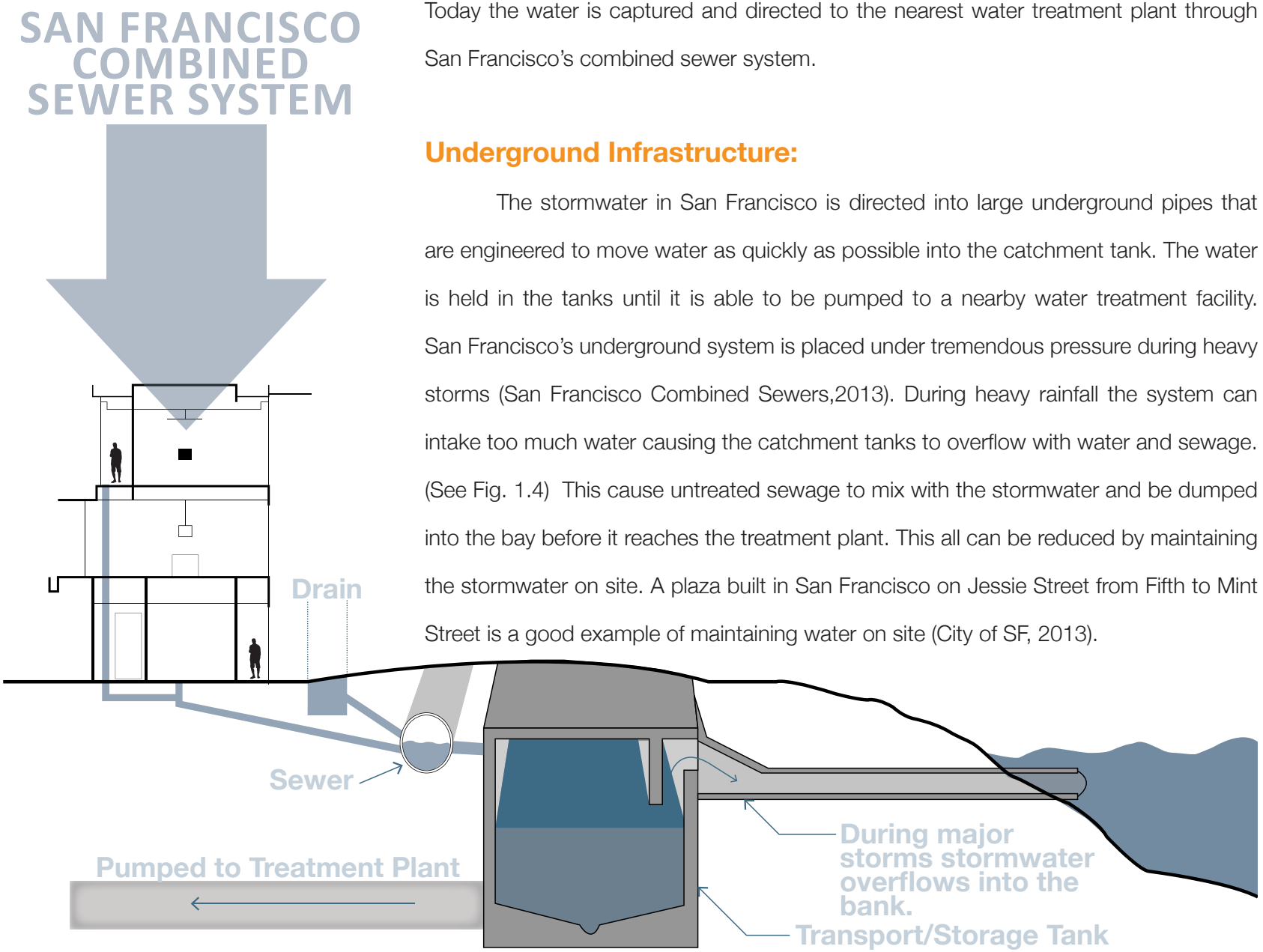
22.28
INCHES PER YEAR

History:

San Francisco is settled into a area of California where there tends to be a Mediterranean Climate. San Francisco has a range from moist winters to dry summers. So the amount of stormwater that falls throughout the year can vary. In contrast to other cities around the bay area, San Francisco is surrounded on three sides by major bodies of water. This tends to lead to cooler temperatures and fog throughout the year.

Before San Francisco was developed into an urban jungle it was composed of a number of different habitats. Some of these habitats include oak woodlands, native grasslands, riparian areas, wetlands, and sand dunes. All of these areas helped the city convey, capture, and infiltrate its stormwater. The San Francisco Bay was lined with

Fig. 1.4



wetlands that did a good job of filtering the water before it was released back into the bay. Today the water is captured and directed to the nearest water treatment plant through San Francisco's combined sewer system.

Underground Infrastructure:

The stormwater in San Francisco is directed into large underground pipes that are engineered to move water as quickly as possible into the catchment tank. The water is held in the tanks until it is able to be pumped to a nearby water treatment facility. San Francisco's underground system is placed under tremendous pressure during heavy storms (San Francisco Combined Sewers,2013). During heavy rainfall the system can intake too much water causing the catchment tanks to overflow with water and sewage. (See Fig. 1.4) This cause untreated sewage to mix with the stormwater and be dumped into the bay before it reaches the treatment plant. This all can be reduced by maintaining the stormwater on site. A plaza built in San Francisco on Jessie Street from Fifth to Mint Street is a good example of maintaining water on site (City of SF, 2013).

WATER

WATER FLOW

EMBARCADERO

DESCRIPTION

The flow of stormwater is shaped by the form of the landscape around it. It is important to account for the water once it hits a surface.

Water

Stormwater is the water that results from rain. It flows, travels, infiltrates, and evaporates in a number of different forms throughout the landscape. How these processes take place depend on the landscape or built environment that it is traveling through. The form of the landscape directly effects the route of the water. To truly understand how water can benefit the site it is important to understand this interaction.

POSITIVES PERVIOUS PAVEMENT

- \+ Can reduce the amount of stormwater infrastructure needed.
- \+ Allows water to infiltrate into back into the soil.
- \+ Highly versatile in the urban environment.

NEGATIVES PERVIOUS PAVEMENT

- — Can be expensive to install large amounts.
- — Does not work as well with soils that do not drain well.
- — Needs to be on a surface with a small slope.

KEVIN PERRY

How Does water move?

When rain falls it can land on a mix of different pervious and impervious surfaces. These surfaces include concrete, asphalt, vegetation, porous pavement, pavers and many more. When the surface is “pervious”, it allows the water to flow, infiltrate, and evaporate. This is beneficial during heavy rainfall to help slow down water and reduce the peak flow. On the other hand, when a site is composed of a lot of impervious surfaces it is more likely to be directed to the neatest drain. San Francisco is composed of mostly impervious surfaces not allowing for water to infiltrate. This is causing water to pick up anything that is in its path along to way to the drain.

Water Pollution/ Quality:

The urban fabric is composed of a lot of toxins and pollutants that can be collected by water during the travel period. A range of brake dust, oil, and other debris can be

collected by water in a short amount of time. All of these things are collected and sent directly into the stormwater system without treatment. From there outflow is usually in a lake, river, or bay which can be harmful for the environment and wildlife.

There are always pollutants in an urban setting. The goal is not to get rid of these pollutants but to clean them before they reach the drain. This can be accomplished through different techniques that are discussed in more detail in the green infrastructure section(see Pg. 36). Some of these include green gutters, vegetated swales, and rain gardens. The process of having the water run through these vegetated systems removes pollutants naturally. These systems can also slow down the flow of the water.

Water Quantity:

Impervious areas cause more stormwater runoff during rain events. There is less water infiltrating the soil or evaporating into the atmosphere. In turn, this water is now running into drains and putting more stress on the stormwater system. This causes cities like San Francisco to pay large amounts of money of massive infrastructure. This infrastructure is not used most of the year but the infrastructure is created to handle the largest storms of the years. In San Francisco, their system is not sufficient to handle some of their storms. This causes about 9.88 sewer overflows in the channel water basin a year. (SF Water. 2013)

Water Conveyance VS Infiltration:

My project is focusing on capturing water to the surface to be “treated”, before it reaches the underground system. This will allow the water to be more visible to the users of the site. This is why it is important to pick and choose when the water will be conveyed through the landscape and when it will infiltrate. The conveyance of the water allows users to see what is taking place while helping guide them through the site. As the water guides users throughout the site, it is being directed to different stormwater facilities where the infiltration process can occur. As the water moves through a stormwater system, vegetation filters and cleans it as the water percolates into the soil.

Drumm Street: Grey Water System

The Drumm Street grey water system uses a combination of natural and artificial filtration processes to clean stormwater. The water is captured from the street and the surrounding roof. Once the water is captured it is ran through a rain garden that overflows into a underground cistern for storage. The water is then pumped back into the building to flush the toilets.

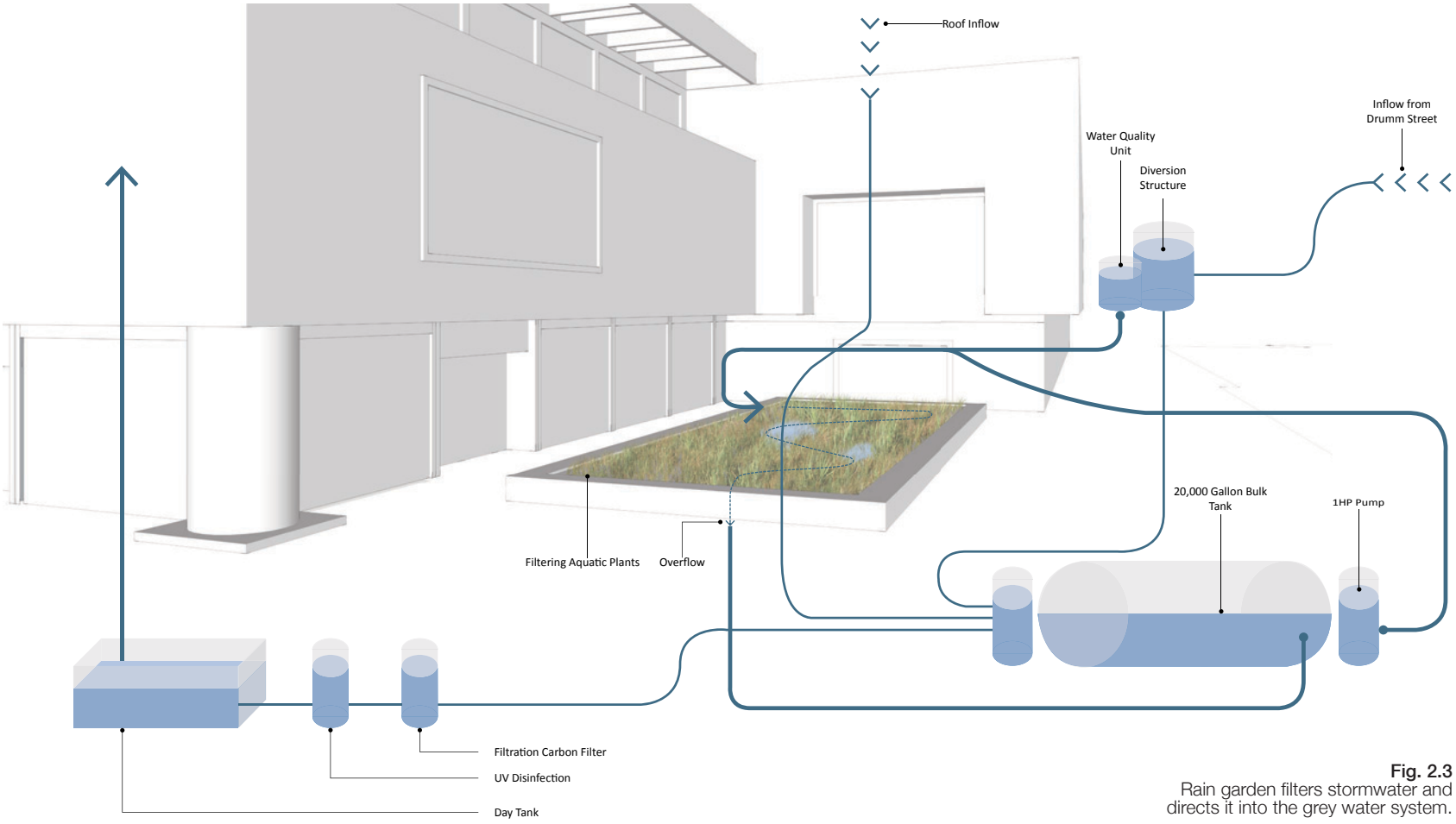


Fig. 2.3
Rain garden filters stormwater and directs it into the grey water system.

Green Infrastructure: Strategies

Green infrastructure strategies include a number of different methods that storm water can be handled without using underground infrastructure. Some of these methods can be a little more time consuming and difficult to install so they are not used as much. A combination of these techniques can improve the water quality of a site dramatically.

Fig. 2.41

Vegetated Swale

A vegetated swale is a vegetated area mainly used to direct stormwater. They can also capture and infiltrate stormwater.

+ Cleans and directs water
+ Very simple with a easy installation process.
+ Most well know stormwater management strategy.

— Often need to be long in order to effectively manage water.
— Can be hard for pedestrians to cross.
— Cannot manage a lot of stormwater.

Fig. 2.42

Stormwater Planter

A stormwater planter is a vegetated area that are designed to capture, infiltrate, and clean stormwater. These planters can be used together to handle more stormwater.

+ Good way to handle stormwater in urban areas like San Francisco.
+ Stormwater can infiltrate or flow through.
+ Can help slow down stormwater in heavy storm events.

— Planters do require some infrastructure
— Not good for smaller areas.

Rain Garden

A rain garden is a lager stormwater treatment area. These areas are extremely flexible and can handle as much stormwater as you design for.

+ Can handle large amounts of stormwater.
+ Stormwater can infiltrate or flow through.
+ Can help slow down stormwater in heavy storm events.

— Not wet year around, plant selection.
— Need a larger area for installation.
— Often needs constant maintenance.

Fig. 2.43

Green Gutter

A green gutter is a small strip of vegetation normally place along a road or path. Can catch the water from the path and direct it to a destination.

+ Good to convey water to a destination.
+ Easy installation.

— Can't handle large amounts of water.
— Does not allow for a lot of water to infiltrate into the soil.
— Needs to be long to be effective.

Fig. 2.44

Stormwater Overhang

A stormwater overhang is any catchment system that catches water from above ground and directs it into a stormwater treatment area.

+ Can catch water that is not normally available.
+ Water is usually already clean.
+ Can be used as grey water.

— Can be expensive.
— Hard to install in most situation.
— Hard to maintain.

Fig. 2.45

CASE STUDIES

INSPIRATION

GUIDANCE

DESCRIPTION

Case studies had a strong influence on the design of my site. Looking at work that was successful with stormwater and building on those concepts.


CHARTWELL SCHOOL

CASE STUDY: CHARTWELL SCHOOL

LEED PLATINUM

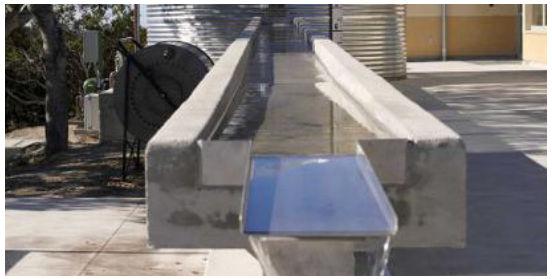
About the Study:

The Chartwell school is a good case to show how stormwater management can become an educational process (EDHH, 2013). The school is equipped with stormwater cisterns that capture water in a storm event. The water captured is used to flush the toilets inside of the school. This is an creative way to use water that was being displaced by the impervious surface of the building footprint. In most cases the water that fell on the school would have been directed to the nearest storm drain. Now the water is used by the building so they can preserve water and reduce the peak flow during storm events.

Fig. 3.1
Kids playing with the runnel.

Fig. 3.21
Stormwater runnel outflow.

Fig. 3.22
Chartwell School at night.



The school uses water as one of the main wayfinding techniques to navigate users

(mostly kids) throughout the site. The water is more interactive then a regular signage. The kids run their hands through the water as they make their way to a destination. The water encourages kids to be active in the site and learn about the purpose of stormwater. In this case, the schools stormwater system covers both the environmental and social aspects of the 3 E's of sustainability.

Effect on my Site:

The main influence that the Chartwell school had on the site of study was adding the aspect of education. Their design took place on a campus so incorporating education came natural. The site of study is not a school but this is a high traffic area that will receive a lot of attention from a variety of users. The site will have easy to read sign that help demonstrate the different functions of the water. The wayfinding aspect can also be translated to the site of study. The users will be able to follow the water through the site as it is conveyed , directed, and infiltrated.

FINDINGS

-Water is an intriguing way to guide people.

-People tend to learn more when the are able to interact.

Case Study: Potsdamer Plaza

DGNB SILVER
SUSTAINABLE URBAN DISTRICT

"Rain water should be used where it falls"
-Atelier Dreiseitl

Fig. 3.31-3.32

About the Study:

Potsdamer Plaza is an urban plaza spanning across 3 acres of Berlin. This site has become one of the most visited areas in Berlin due to its creative use of water throughout the design. There are a number of shallow steps directing water through the site as they create shimmering waves across the surface of the water. The design of the space was based on the concept of water being used wherever it may fall. The water that falls on site is directed through different vegetated biotypes that filter a circulate the water. Once the water is clean it is utilized by the surrounding buildings to flush toilets and irrigate. This cuts down on the price to clean the water in a wastewater plant as well as the price that would be associated with bringing in new water for irrigation.

Effect on Current Site:

Potsdamer is closely related to Justin Herman Plaza. They both started out as large under utilized areas in an urban setting. This is why there are a lot of aspects of Potsdamer that can be applied to the site in San Francisco. The interaction between water and users was important to the design. Water is not only present throughout the whole site, it invites users to interact and enjoy the water. This is applicable to San Francisco because there are numerous people that pass through this area, work close by, or catch the ferry.

Fig. 3.33

Fig. 3.34

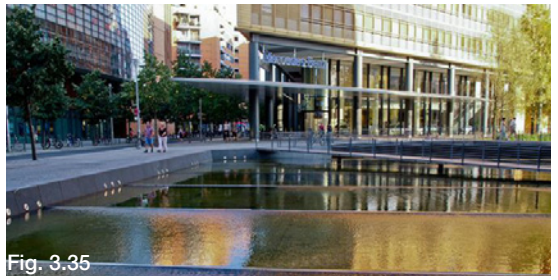


Fig. 3.35

Fig. 3.36

BERLIN, GERMANY

Case Study: Erie Street Plaza

STOSS
DESIGN TEAM

About the Study:

The Erie Street Plaza is a waterfront plaza located in the City of Milwaukee. This space is a large open space that was designed to accommodate everyday activities as well as larger events. This site is one of many located on the Milwaukee Riverwalk. So this area serves as a rest spot for people walking or biking. Stormwater that falls on the plaza is directed into a environmental cycle that adds to the sustainability of the site. This cycle includes sending the water through marshes and wetlands to be cleaned before recharging the

Fig. 3.41

MILWAUKEE, WI

groundwater and irrigated other vegetation. Lastly this site was also designed to create small intimate spaces while at the same time having the ability to open up and handle larger events like festivals and gatherings(Stoss, 2010).

Erie Street Plaza does a good job of blending the landscape in with the hardscape. This gradual transition blurs the two areas and helps build a stronger connection between nature and urban space. Justin Herman Plaza can benefit from a stronger connection with the landscape. The blending aesthetic also acts as a design language for the site of study.

Fig. 3.42
Overview of Erie Plaza

Fig. 3.43
Jagged edge pervious pavement

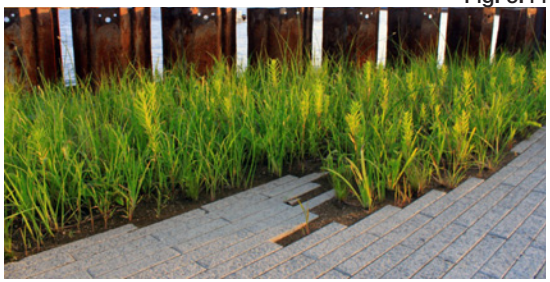


Fig. 3.44

THE DESIGN

TRAM STATION

JUSTIN HERMAN PLAZA

DESIGN: INTRODUCTION

The goal of this design was to rethink stormwater. This includes where it falls, where it is directed and how the water travels to its destination. Once I had a strong grasp on these concepts the design was used to mold new and innovative methods of handling the stormwater. Most of the techniques used in this study were sculpted to work for the site in San Francisco but can easily be altered to fit other urban areas.

About the Study:

The design looked and three main areas in the downtown area of San Francisco. These areas include the Embarcadero tram station, Justin Herman Plaza, and Drumm Street. A master plan was created for these three areas while more detailed design work took place for the plaza and tram station. The goal was to look at these vary different urban environments and find ways to clean, direct and infiltrate the water without shipping it to one of the wastewater plants nearby.

Fig. 4.21
Area of study map

As design and technology advances it is important to find a balance between the two. These advances have modified the environment that we live in today. The stormwater of San Francisco has changed completely due to these innovations. It is important to take this into consideration when designing a highly modified area like San Francisco. Design doesn't always need to move forward, sometimes we can look into the past and find the best solution. The design of this site was able to restore some of the balance that has

been loss between the city and nature.

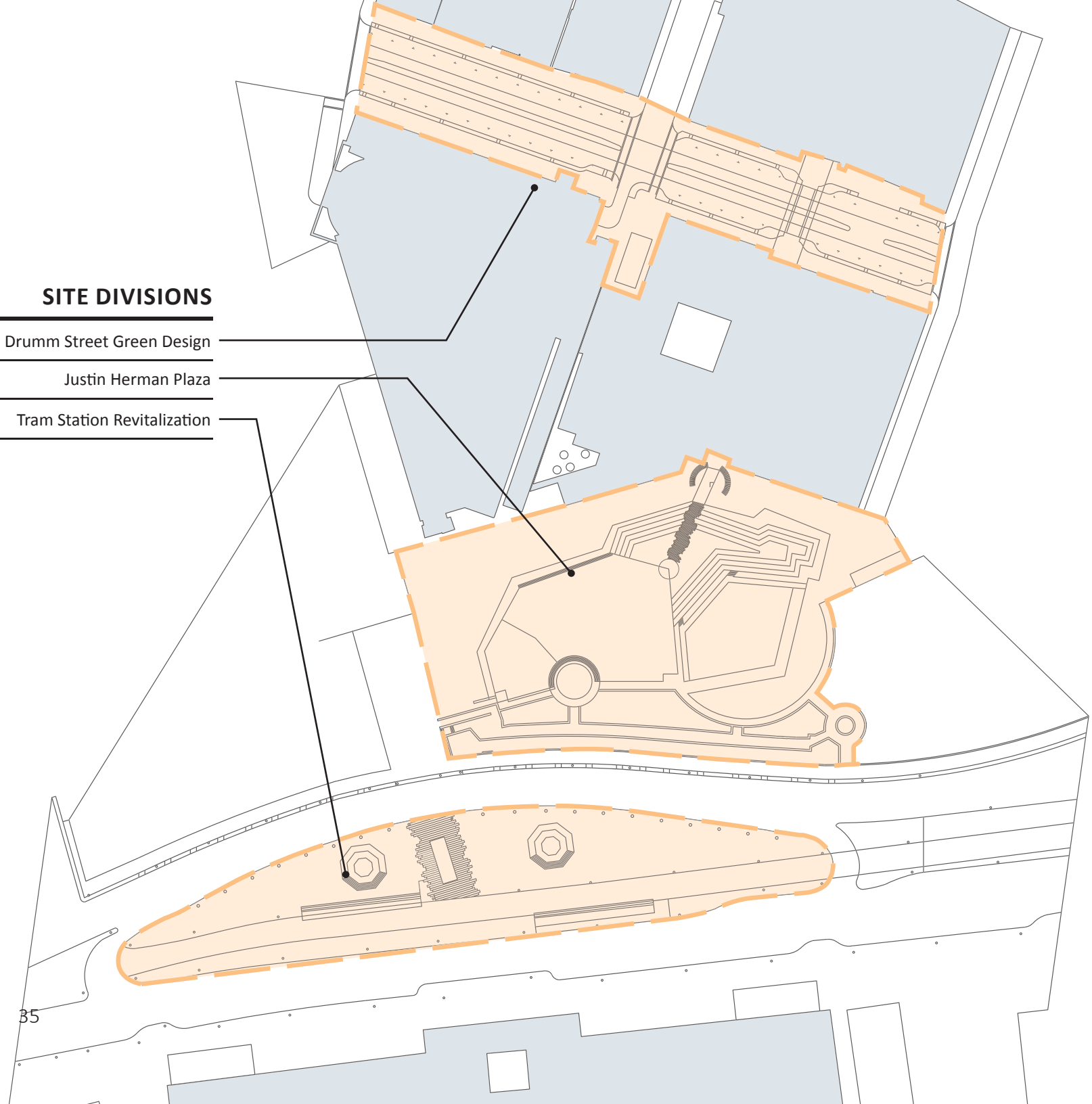
The site for this project was chosen as a place to display some of the innovative methods to handle stormwater. The areas of focus allow the design to showcase how to handle stormwater in different urban environments. Each design finds creative ways to handle stormwater while engaging the users of the area.

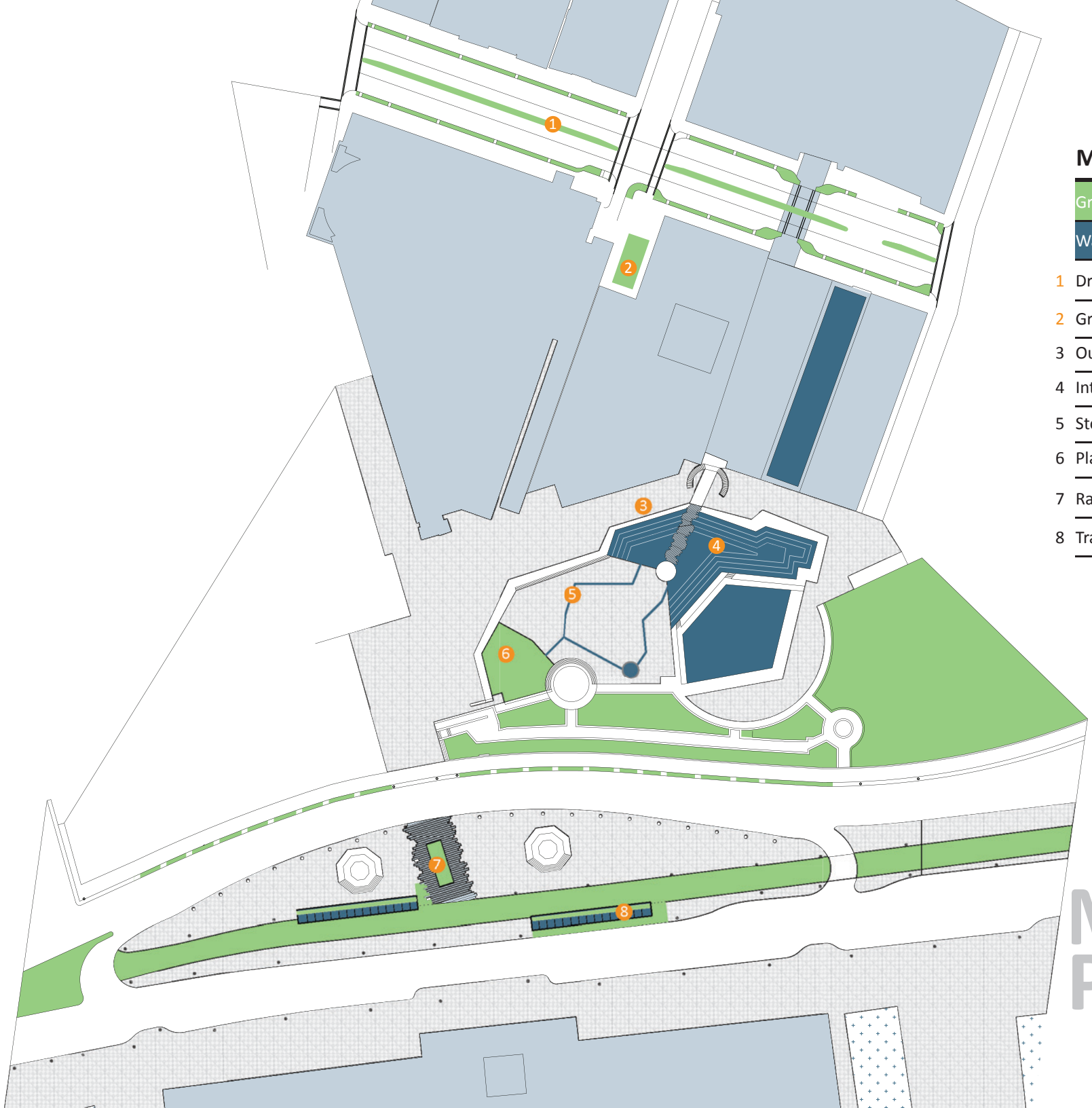
SITE DIVISIONS

Drumm Street Green Design

Justin Herman Plaza

Tram Station Revitalization





MASTER PLAN

Green Space/ Stormwater Facility

Water Facilities

1 Drumm Green Street

2 Gray Water Rain Garden

3 Outdoor Dining

4 Interactive Water Area

5 Stormwater Runnels

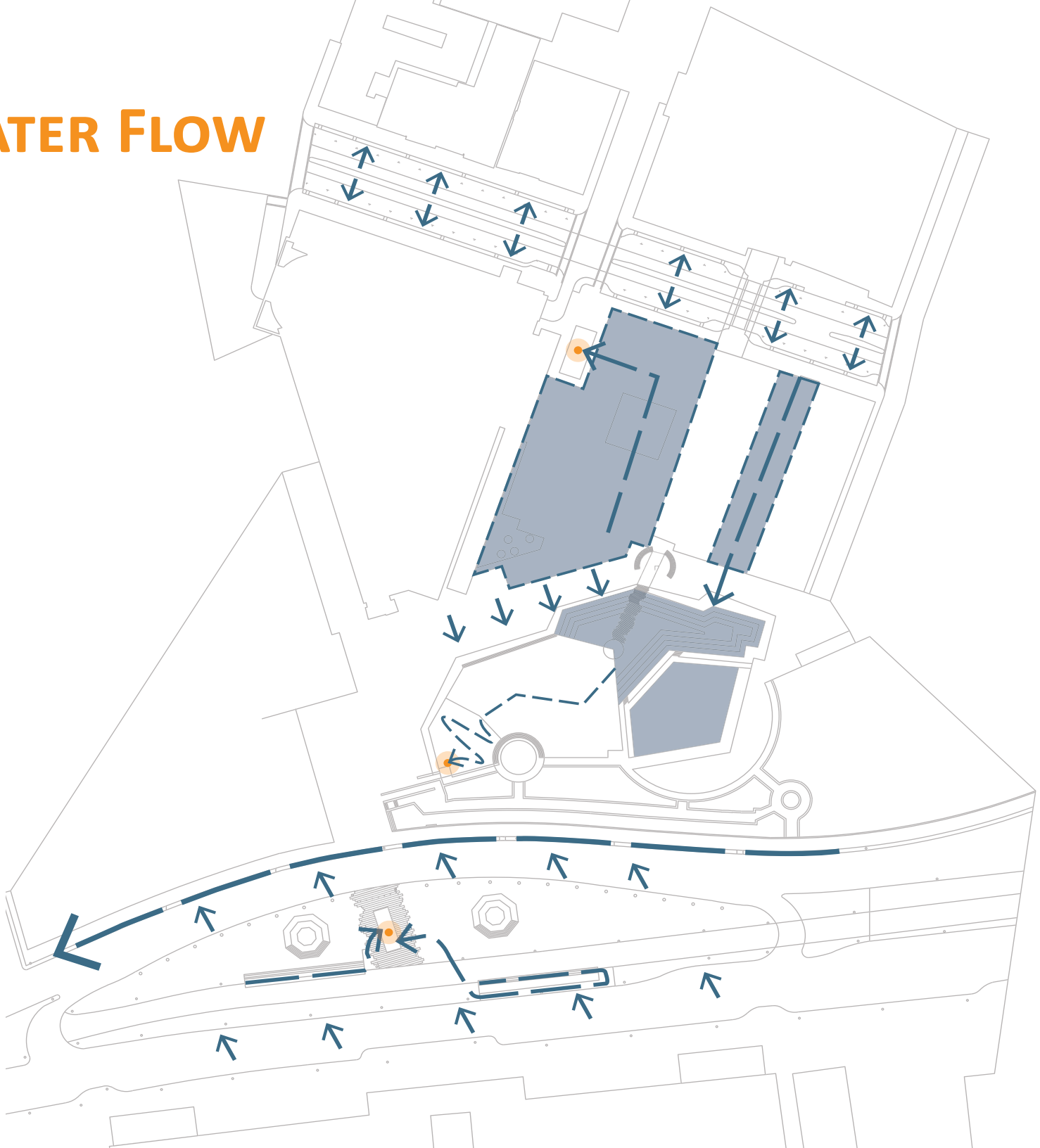
6 Plaza Rain Garden

7 Rain Garden/Wayfinding

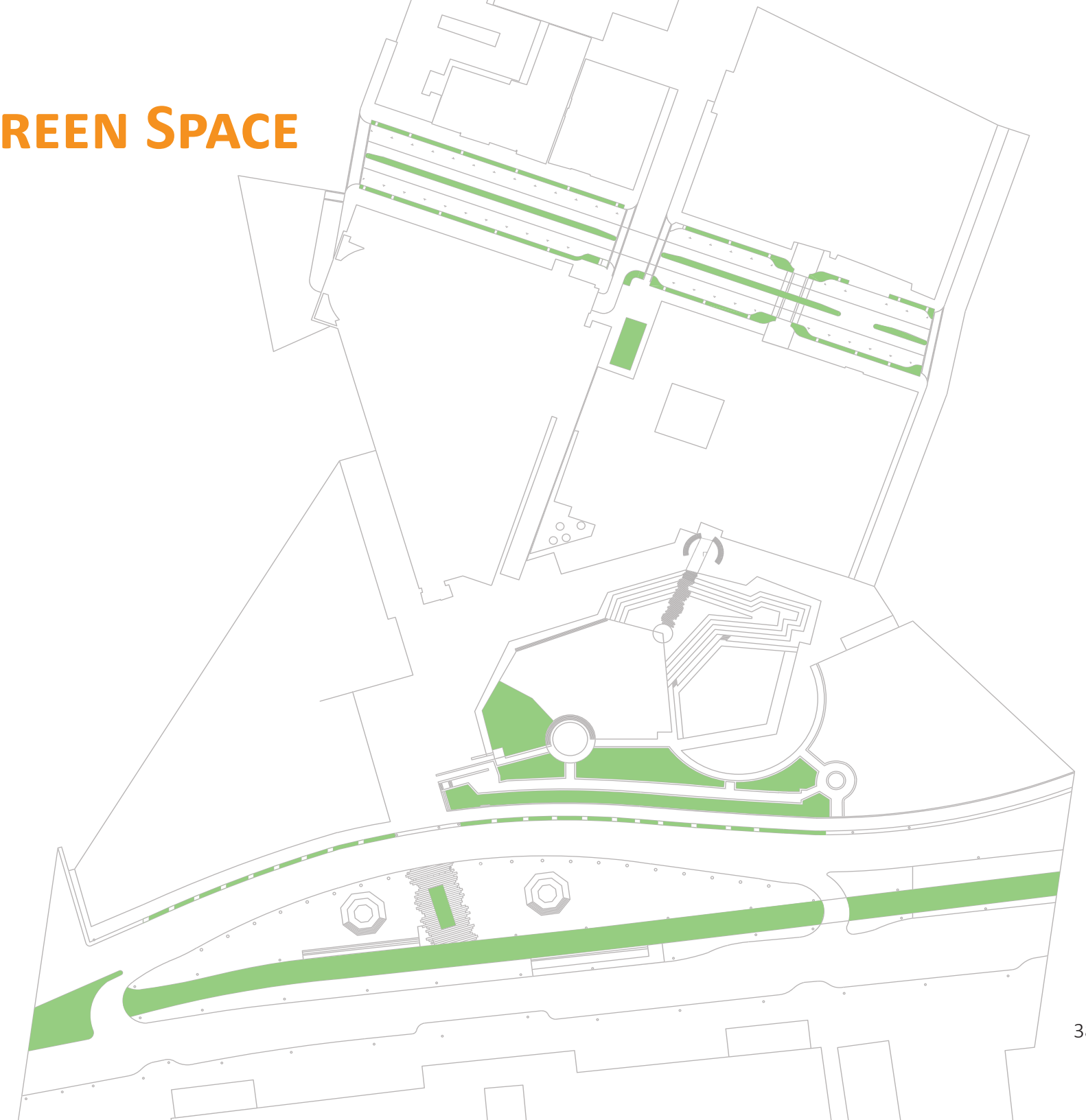
8 Tram Station/Overhead Swale

MASTER PLAN

Water Flow



Green Space



DESIGN

TRAM STATION

DESCRIPTION


F MARKET
1061
PORT
150 YEARS
A PLACE FOR
SHIPS
TRAIN COMING
WHEN FLASHING

TRAM STATION: EXISTING CONDITIONS

The slab of concrete behind the tram station is currently a wasted space. People have no need to walk on this side of the railing. This area provides the opportunity for stormwater management from the plaza as well as the street.

Users of the site tend to use the steps as a place for different recreational activities. Some of these include biking and skating.

The current overhang protects users from the sun, rain, and other natural elements.

There are two areas where users tend to cross the street. These street are extremely busy and a lot of people use these crosswalks.

Fig. 4.41

TRAM STATION: SITE ANALYSIS

Tram:

The tram line cuts through the middle of the embarcadero and has stops along both sides of the median. The trams run throughout the day and cause a lot of noise. The overhead structures at the tram stations provide an opportunity for an overhead stormwater system. There is also a lot of unused space of the back side of the stations.

Recreation:

There are a lot of skateboarders and bicyclists that use the middle plaza as a place to hang out. They use the statue figures to preform tricks as well as sit on. The farmers market is held along the outside of the ferry building.

Circulation:

Pedestrians have to go through the center of the site to get from the ferry building to Justin Herman Plaza and Market Street. They have to cross through six travel lanes and the tram tracks. The plaza serves as a pedestrian island, offering shelter from the oncoming traffic.

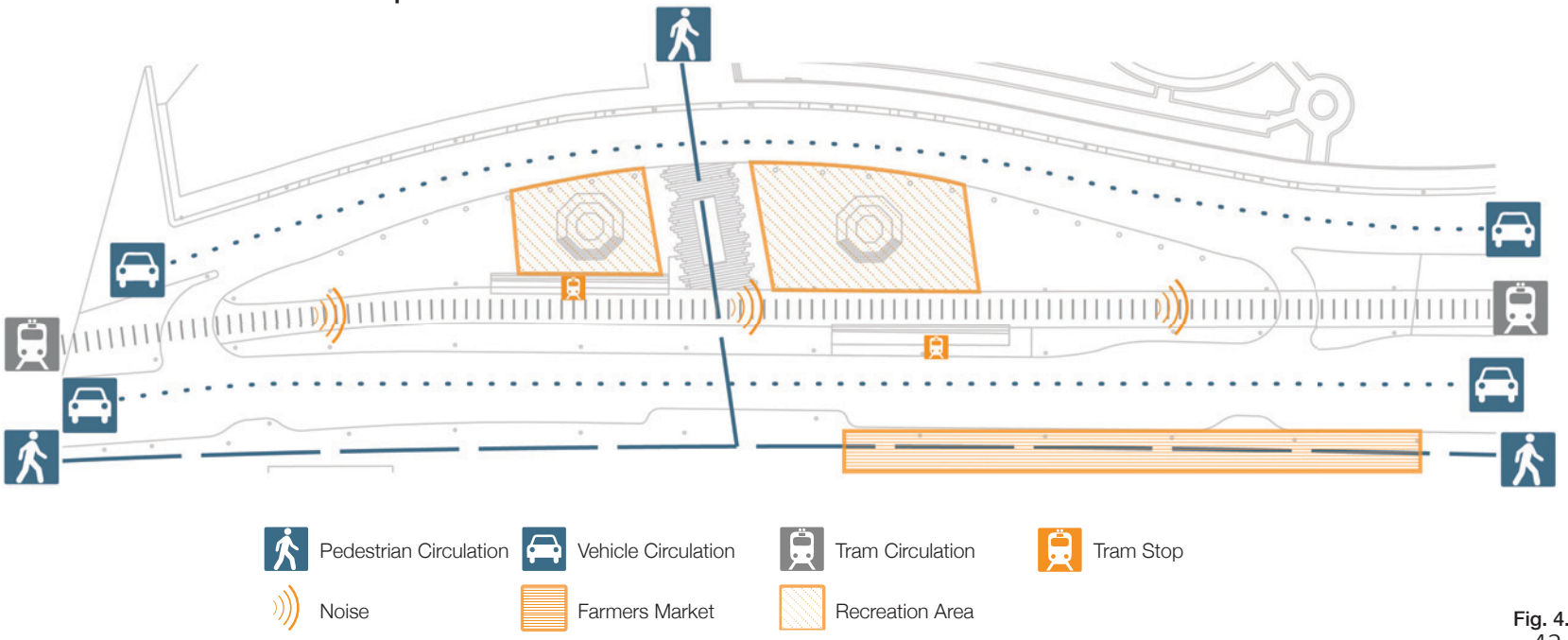


Fig. 4.5

Tram Station: Detailed Plan

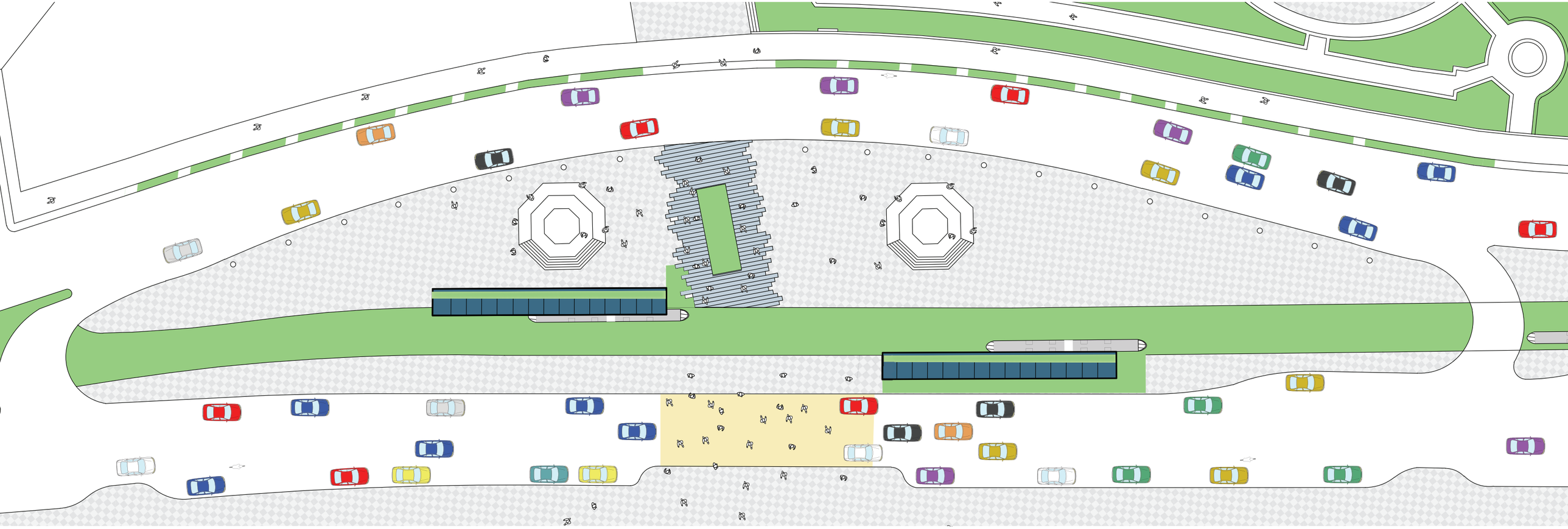


Fig. 4.6

Tram Station: Site Interventions

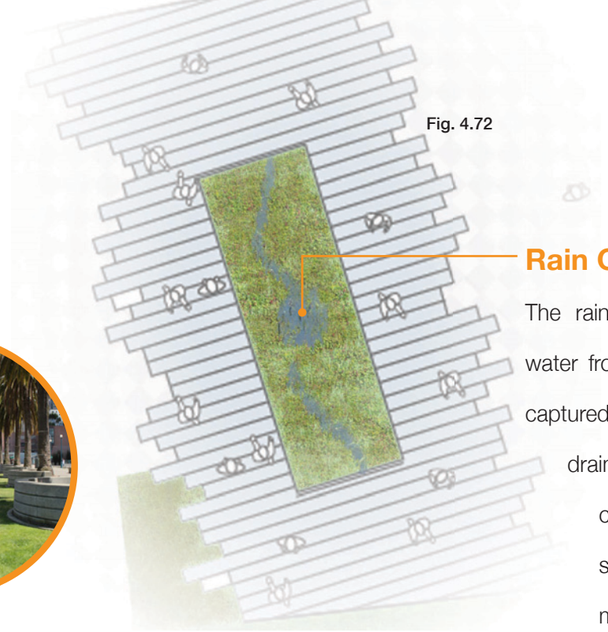


Fig. 4.72

Rain Garden:

The rain garden is where most of the water from the tram station plaza will be captured and filtered. There is an overflow drain to handle excess water in the case of a large storm. The space is surrounded by a jagged deck that matches the bridge from the plaza.

Overhead Swale:

This vegetated swale on top of the overhang has two purposes. First it directs the water down to the ground. Secondly the plants help regulate temperature allowing the solar panels to function better.

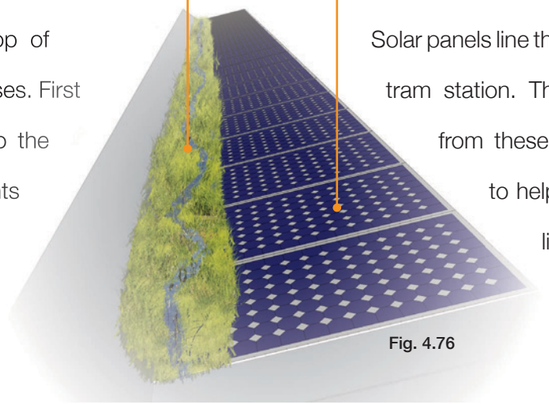


Fig. 4.76

Solar Panels:

Solar panels line the overhang of the tram station. The power gained from these devices is used to help power the tram line that runs on electricity.

The Embarcadero has a wide sidewalks lined with large palm trees. The design captures the space between the trees for stormwater management. The water runs through a stormwater planter to be cleansed. The planters are equipped with check dams that help slow the flow of the water.

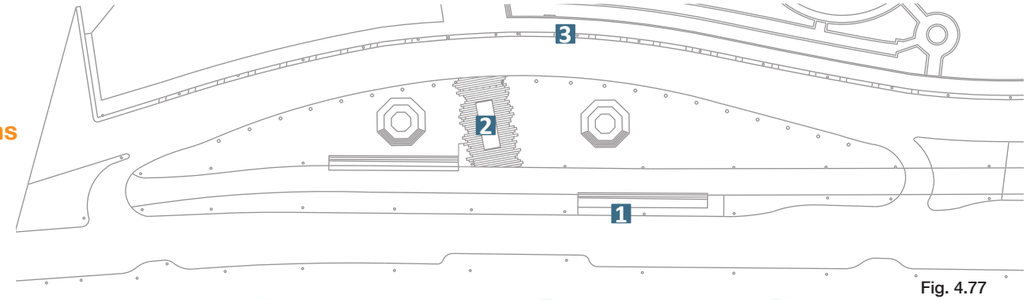


Fig. 4.77

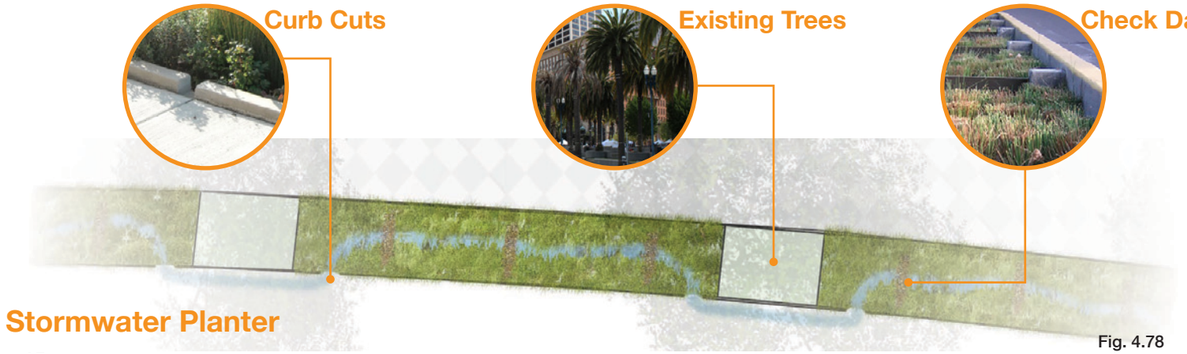


Fig. 4.78

1 OVERHEAD SWALE

2 RAIN GARDEN

3 STORMWATER PLANTER

Fig. 4.8

A new look at transportation infrastructure. The embarcadero tram station has been manipulated to not only service public transit user but also handle stormwater at the same time. A combination of impervious surfaces and stormwater facilities allow the tram station to handle the stormwater from the street as well.

DESIGN

JUSTIN HERMAN PLAZA

JUSTIN HERMAN PLAZA: EXISTING CONDITIONS

Street vendors occupy the edge of the plaza on a daily basis. They sell a varied of different merchandise to the users and tourist of the area. These vendors tend to stay close to Market Street.

The turf area is an important spot for the regular users of the site. There are a number of people from the surrounding buildings use this space to eat their lunch or sit an enjoy the day.

The existing water feature is a monumental structure for the city of San Francisco. There are tourist that come to visit this feature everyday.

The plaza space is a wide open blank slate that is only used a couple of times a year.

Fig. 5.01

Fig. 5.02-5.04

Justin Herman Plaza: Site Analysis

Plaza:

Justin Herman Plaza is an open plaza area surrounded by busy streets, people and mixed use buildings. People that occupy the surrounding buildings use the space as a relaxing get away. Filled with a lot of different recreational activities from shopping to sitting on step.

Fig. 5.1

Existing Water Feature:

This water feature as been a large part of this area for a long time and gets a lot of tourist visits. When in circulation there is a lot of water running through the feature.

Use:

People use this area to lounge in a number of different ways. The grass area is a place where people can lay down and enjoy the surroundings. The steps tend to be sat on by users who are eating or socializing. The center of the plaza is a large open space

Justin Herman Plaza: Detailed Plan

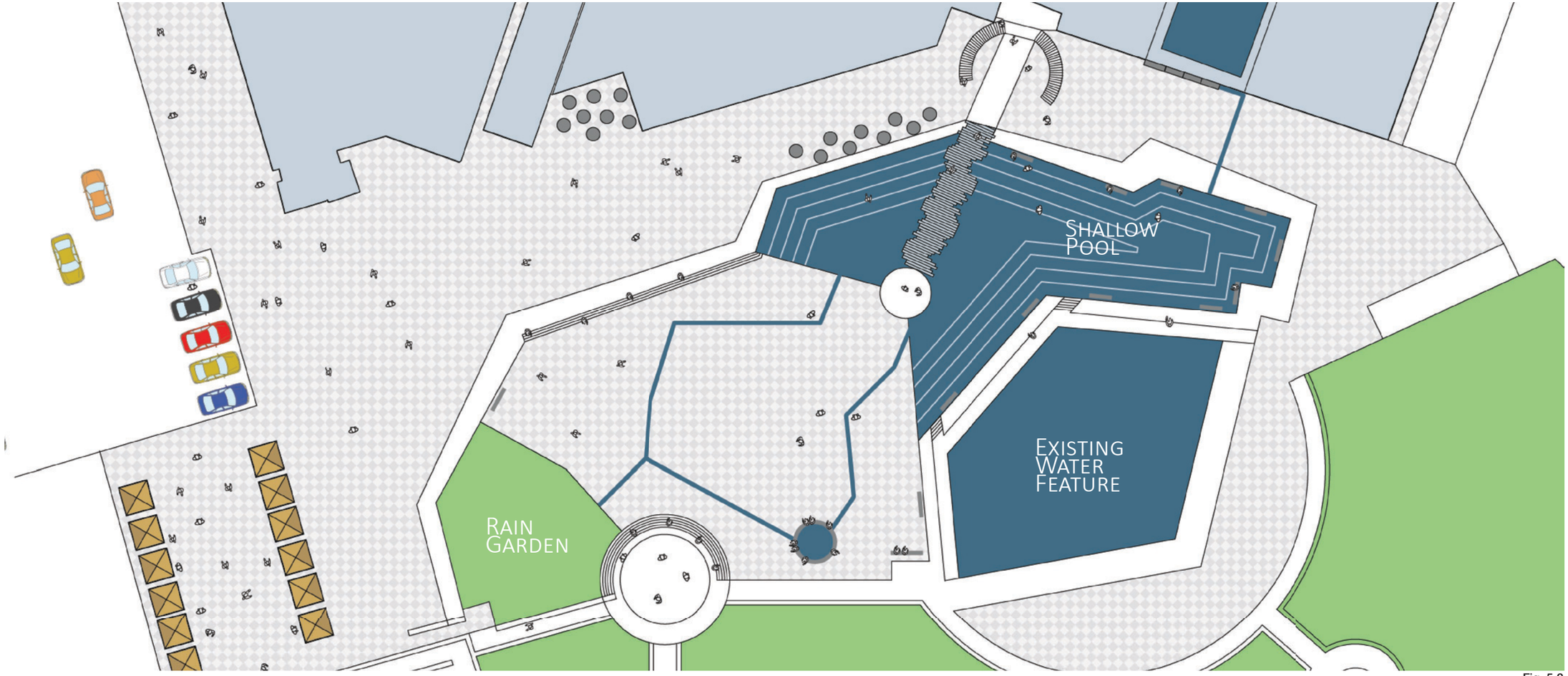


Fig. 5.2

Justin Herman Plaza: Site Interventions

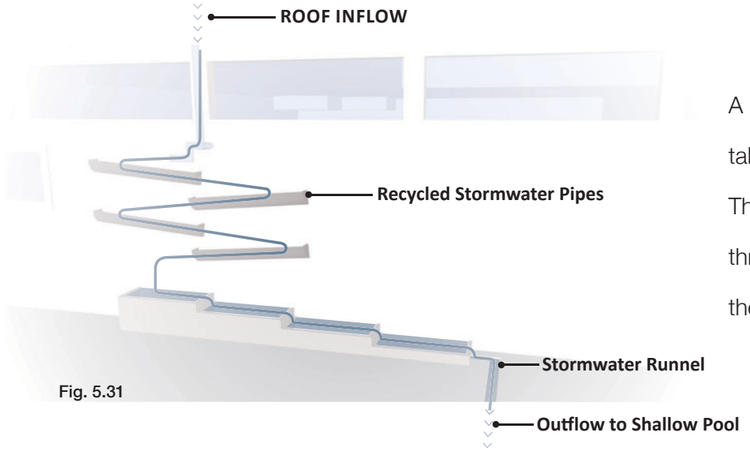


Fig. 5.31

Roof Water Collection

A roof water canopy covers the roof of the tall sky scraper along the edge of the plaza. The stormwater is collected and direct down through the recycled water feature. After this the water is conveyed through the shallow pool area.

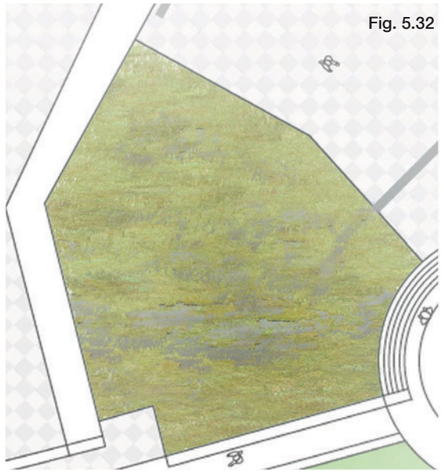


Fig. 5.32

Plaza Rain Garden

The Plaza rain garden collects water from the surrounding plaza as well as the roof top. The rain garden collects, filters and infiltrates the stormwater with using an off site water treatment plant. Any excess water will be collected by an overflow pipe located in the rain garden.

Pedestrian Walkway

The pedestrian walkway crosses over the shallow pool for people who don't want to get their feet wet. The design of the walkway allows user to sit on the edge an enjoy the water passing by.

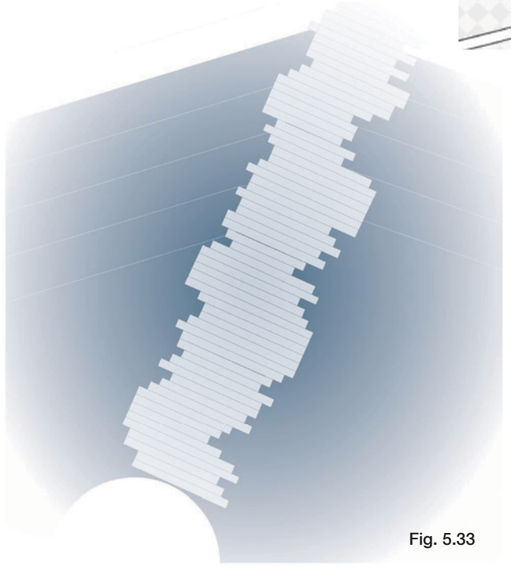


Fig. 5.33

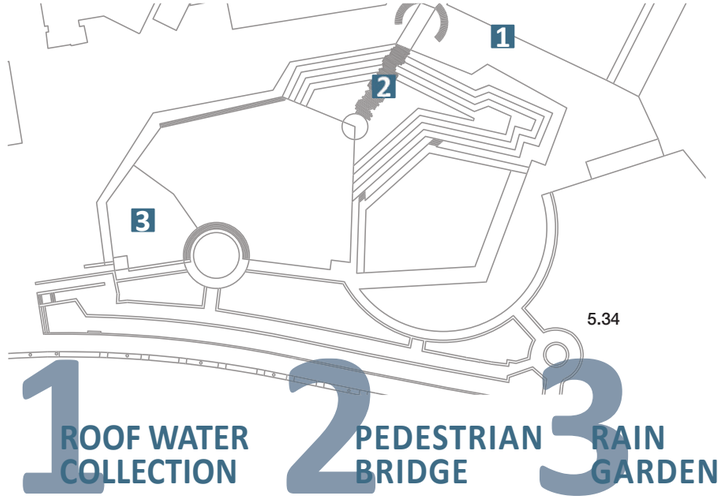
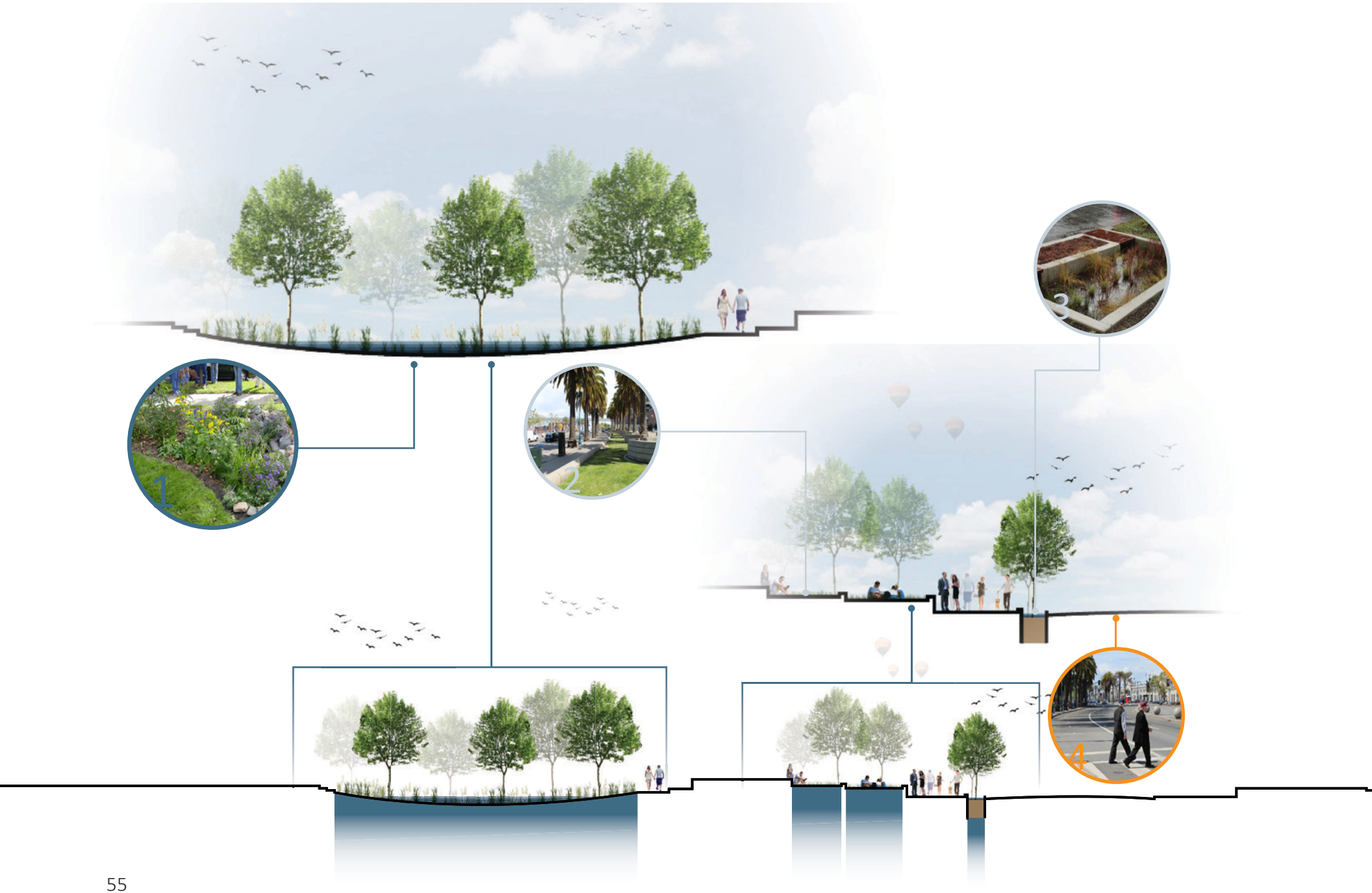


Fig. 5.4

The shallow water feature. Water collected from the rooftop of this sky scraper is directed to this area. The shallow sheet of water invites the users to interact with the area by playing in the water or simply getting their feet wet. After the water runs through the feature it is directed to a runnel that takes the water to the rain garden.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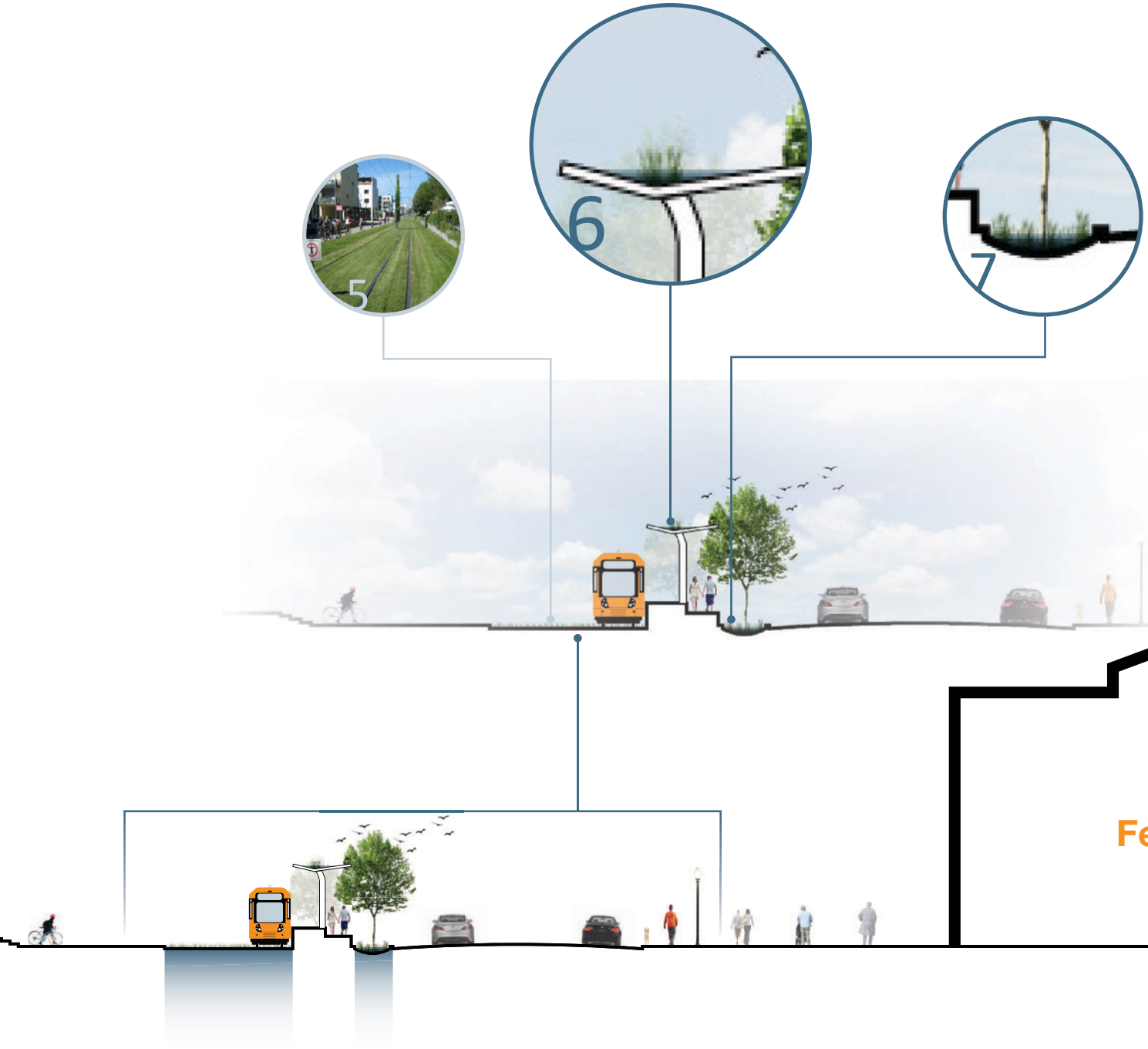

SECTIONS

Stormwater Facilities

Pervious Areas

Impervious Areas

1 Plaza Rain Garden

2 Turf Sitting Area

3 Storm Water Planter

4 Embarcadero Street

5 Green Tram Tracks

6 Overhead Swale/ Solar Panels

7 Vegetated Swale

8 Ferry Building

Fig. 5.5

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THANK YOU!