



# SMART GROWTH IMPLEMENTATION ASSISTANCE

CAÑO MARTÍN PEÑA, SAN JUAN, PUERTO RICO

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Many communities want to foster economic growth, protect environmental resources, enhance public health, and plan for development, but might lack the tools, resources, and information to achieve their goals. In response to this demand, EPA developed the Smart Growth Implementation Assistance (SGIA) Program in 2005.

The SGIA program started with annual, competitive solicitations open to state, local, regional, and tribal governments (and nonprofits that partnered with a governmental entity) that wanted to incorporate smart growth techniques into their future development. Beginning in 2015, EPA is working with regional staff to identify and select communities rather than issue a Request for Letters of Interest.

Once selected, communities receive direct technical assistance from a team of national experts in one of two areas: policy analysis (e.g., reviewing state and local codes, school siting guidelines, transportation policies, etc.) or public participatory processes (e.g., visioning, design workshops, alternative analysis, build-out analysis, etc.). The assistance is tailored to the community's individual situation and priorities.

EPA provides the assistance through a contractor team, not a grant. Through a multiple-day site visit and a detailed final report, the multidisciplinary teams provide options the community can consider implementing to achieve its goal of encouraging growth that fosters economic progress and environmental protection.

EPA's goals for the SGIA program include:

- Supporting communities interested in implementing smart growth policies.
- Creating regional examples of smart growth that can catalyze similar projects in the area.
- Identifying common barriers and opportunities for smart growth development.
- Creating tools other communities can use.

More information is available at <https://www.epa.gov/smartgrowth/smart-growth-implementation-assistance>

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# PROJECT SITES AND THE EXISTING COMMUNITY CONDITIONS



FIGURE 1 *Illustrating project sites and the existing community conditions.*

1 ALBERT EINSTEIN HIGH SCHOOL  
AND HAYDEE REXACH ELEMENTARY

3 RESIDENTIAL URBAN PLAZA  
BUENA VISTA SANTURCE

5 PASEO BUENA VISTA  
SANTURCE

2 SAN ANTONIO ASÍS PLAZA

4 BUENA VISTA SANTURCE  
WATER PLAZA

6 ISRAEL-BITUMUL GATEWAY  
WATER PLAZA

# 1 EXECUTIVE SUMMARY

The Caño Martín Peña (CMP) is a 3.75-mile long tidal channel located within the San Juan Bay Estuary (SJBE) system in Puerto Rico, the only tropical estuary in the U.S. Environmental Protection Agency's National Estuary Program. The CMP is one of 19 locations that are part of the EPA's Urban Waters Federal Partnership.

The eastern portion of the CMP, historically between 200 and 400 feet wide, is currently obstructed by sediment, debris and solid waste, blocking the hydraulic flow between the San Jose Lagoon and San Juan Bay. The eight communities surrounding the CMP – which make up the Special Planning District of the Caño Martín Peña – have a history of poverty, overcrowding, unsafe living conditions, exposure to significant environmental and health dangers, lack of essential infrastructure, marginalization, and social invisibility, despite its location adjacent to the financial district of San Juan.

Several of these communities, including Buena Vista Santurce, developed as informal settlements during the beginning of the 20th century. As a consequence, the District lacks adequate infrastructure, including the absence of sanitary sewer systems, inadequate storm drainage systems, narrow streets, few public spaces and few opportunities for recreational water activities. The obstruction of the CMP results in frequent flooding with untreated stormwater and sanitation, affecting large areas of the District. During every rain event, schools, homes, streets and businesses suffer from flooding, exposing residents to pollutants. In 2002, 39% of households reported at least one incident of flooding with contaminated water during the previous year. The number increased to 70% in 2012. In 2000, over 3,000 structures in the District and in the Cantera Peninsula lacked a sanitary sewer system and therefore discharged waste without treatment directly into the CMP through the storm drainage system. As a result of this, the CMP has reported fecal coliform counts 60 times higher than the EPA water quality standards.

The Corporación del Proyecto ENLACE del Caño Martín Peña (ENLACE) emerged as a solution to the problems of environmental degradation of the CMP, and as an innovative initiative of environmental justice and social transformation to restore the CMP. ENLACE promotes inclusive, livable and resilient communities through community participation and

the creation of partnerships in the public and private sectors. The eight communities surrounding the CMP, organized and represented by the Grupo de las Ocho Comunidades Aledañas al Caño Martín Peña, Inc. (G-8), the Fideicomiso de la Tierra del Caño Martín Peña (Fideicomiso) and ENLACE implement the Comprehensive Development and Land Use Plan for the Special Planning District of the Caño Martín Peña (CMP District Plan).

Approved in 2006, the CMP District Plan addresses environmental, social, economic, housing, and urban issues that promote smart growth and increased resiliency for the eight communities within the CMP Special Planning District: Barrio Obrero Oeste, Barrio Obrero San Ciprián, Barrio Obrero Marina, Buena Vista Santurce, Parada 27, Las Monjas, Buena Vista Hato Rey, and Israel-Bitumul. The CMP District Plan includes substantial sanitary and storm drainage infrastructure improvements, dredging of the channel to improve the flow between the San Jose Lagoon and the San Juan Bay, rehabilitation of existing housing and construction of new housing, economic development through job creation and tourism, and the relocation of families impacted by these projects.

ENLACE applied for and received assistance from the U.S. Environmental Protection (EPA) Agency's Smart Growth Implementation Assistance (SGIA) program to help advance the design of much-needed public open spaces identified within the CMP District Plan. EPA funded a design team to collaborate with ENLACE, Fideicomiso and the G-8 in the development of conceptual design options for six sites in the Buena Vista Santurce and Israel-Bitumul neighborhoods. Each site is intended to represent a type of open space like a park, water plaza or trail that can be located throughout the CMP district. The options show how green infrastructure—design elements that mimic nature by slowing and filtering stormwater before it reaches either the conventional storm drainage system or a natural body of water—can be used to mitigate flooding by working in tandem with the proposed improvements to the conventional drainage infrastructure system. Additionally, some design options also include elements that improve walking and biking (often referred to as “complete streets” elements) that can better connect the parks and plazas and encourage residents and visitors to explore the CMP. This EPA design

assistance is intended to complement the ongoing infrastructure and open space projects included in the CMP District Plan.

ENLACE's key partners in this endeavor are:

- + **G-8:** A non-profit organization that brings together the community leadership of the eight communities adjacent to the CMP. The G-8 is the entity that unites community-based, civic and recreational organizations in each of the communities. The main purpose is to guarantee the permanence of these communities and ensure the democratic participation of residents in the decision-making processes regarding the implementation of the CMP District Plan.
  
- + **Fideicomiso:** A novel collective land tenure mechanism that addresses the historical problem of lack of ownership, avoids involuntary community displacement as a result of market forces, guarantees affordable housing, allows income to be reinvested in the area, thereby, overcoming poverty.



FIGURE 2 *Illustrating the project area in relation to a larger context.*



## 2 INTRODUCTION



FIGURE 3 A diagram illustrating the scope of work of the project.

- 1 ALBERT EINSTEIN HIGH SCHOOL AND HAYDEE REXACH ELEMENTARY SCHOOL
- 2 SAN ANTONIO ASÍS PLAZA
- 3 RESIDENTIAL URBAN PLAZA BUENA VISTA SANTURCE

- 4 BUENA VISTA SANTURCE WATER PLAZA
- 5 PASEO DEL CAÑO NORTE
- 6 ISRAEL-BITUMUL GATEWAY WATER PLAZA
- 7 MANGROVE RESTORATION/ CAÑO MARTÍN PEÑA ECOSYSTEM RESTORATION PROJECT AREA

The Caño Martín Peña (CMP) is a 3.75-mile long tidal channel located within the San Juan Bay Estuary (SJBE) system in Puerto Rico, the only tropical estuary in the EPA's National Estuary Program. The SJBE is home to important natural, commercial, and tourist resources such as the main seaport, airports, hotels, centuries-old communities, and urban centers. The CMP is an important hydrological link that connects the San José Lagoon with the San Juan Bay. During the early part of the 20th century, rural families relocated to the city in search of jobs. Due to a lack of housing, informal settlements were built in the mangrove wetland areas bordering the channel using refuse and debris as fill material. Housing was developed without the construction of basic utilities, and large segments of these communities are still not connected to the sanitary sewer system, with households discharging their untreated sewage directly into CMP or to the stormwater drainage system. As a result, the functioning of the CMP has been significantly affected by the great amount of solid waste, sediment and fill material present in the channel today.

Historically, the channel was between 200 and 400 feet wide but has been reduced to 3 feet wide at some points and has a current depth of between 3.94 feet to 0 feet. According to the Final Feasibility Report for the CMP Ecosystem Restoration Project (CMP-ERP) prepared by ENLACE and approved in 2016 by the U.S. Army Corps of Engineers (USACE), the sedimentation rates within the eastern CMP are nearly twice as high as in other parts of the estuary due to urbanization and extremely limited water flow<sup>1</sup>. Sediments include a combination of debris, household refuse, and other waste. Habitat degradation has in turn decreased the ability for the channel to properly manage stormwater and a reduction in ecosystem functions and values, including losses of economic and recreation opportunities.

Due to the channel's lack of conveyance to manage stormwater, the communities bordering the CMP frequently suffer from flooding events, not only under major rainfall (e.g., 25, 50 or 100-year storm events), but from minor and more frequent rainfall (e.g., 2-10 year storm events). Over half of families along the CMP report flooding in their homes, streets, or schools, and are frequently exposed to polluted water, which causes increased rates of gastrointestinal, skin, and respiratory ailments<sup>2</sup>. The communities bordering the CMP have a long history of

poverty, overcrowding, unsafe living conditions, exposure to significant environmental and health hazards, marginalization, blight, social invisibility, and governmental neglect. According to the American Community Survey, approximately 64.6% of the households in these communities live under the poverty level, while 55% of the households had an income equal or less than \$10,000 per year<sup>3</sup>.

ENLACE, a non-federal co-sponsor, and USACE, the lead agency, are working on the implementation of the CMP-ERP, which seeks to re-establish the tidal connection between the San José Lagoon and the San Juan Bay by dredging and channeling the CMP. The CMP-ERP project is estimated to cost \$215 million, 65% of which will be provided by federal funding, and 35% which the government of Puerto Rico through ENLACE must provide as part of its local cost share. ENLACE will provide the local cost share through a combination of cash contributions, in-kind services and the land, easements, rights of way, relocations, and disposal/borrow areas (LERRD) required for construction, operation, and maintenance of the project. The CMP-ERP project will return the channel to 100 feet wide and 10 feet deep and includes the restoration of 34.4 acres of mangrove forest. Additionally, the project budget includes funding for public open space and recreational components within the limits of the federal project.

ENLACE is a public corporation created under Act No. 489 on September 24, 2004 whose mission is to oversee and implement the CMP District Plan in coordination with the G-8 and Fideicomiso. The CMP District Plan includes substantial sanitary and storm drainage infrastructure improvements; dredging of the channel to improve the flow between the San José Lagoon and the San Juan Bay; rehabilitation of existing housing and construction of new housing, economic development through job creation and tourism; and the relocation of families impacted by these projects. ENLACE's key partners in this endeavor are the G-8 (leadership representing the eight communities) and Fideicomiso (community land trust).

In 2016, ENLACE requested technical assistance from the EPA through the Smart Growth Implementation Assistance (SGIA) program to support the design of the recreational and open space components from the CMP District Plan. EPA funded a design team to assess flood prone areas of the

CMP and to collaborate with community stakeholders, ENLACE, and residents to develop design options that create much-needed open spaces that integrate green infrastructure and complete streets practices. Green infrastructure is a cost-effective approach to improving and increasing the capacity of conventional drainage infrastructure systems that also provides multiple community benefits. These strategies are designed to mimic nature by slowing and filtering stormwater before it reaches either the traditional storm drainage system or a natural body of water.

The design options are intended to address stormwater management and flooding problems in tandem with the proposed improvements to the CMP's traditional drainage infrastructure system and ecosystem restoration project while also providing parks and plazas, and making the neighborhoods in the CMP more walkable and bikeable. Additionally, the design options utilize the principles of complete streets to encourage pedestrians and bicyclists to explore the land surrounding the CMP and make physical connections between the various open spaces easier. The term "green and complete streets" is used for streets that combine both green infrastructure and complete streets elements.

EPA collaborated with ENLACE and the community to develop design options for six interconnected sites in the Buena Vista Santurce and Israel-Bitumul neighborhoods—each representative of the type of open space (a park, plaza, or trail) that can be located throughout the CMP district. Three of the project sites are located directly alongside the CMP and include open space for recreational activities and access directly to the water. The other three sites are connected to the CMP and each other by green and complete streets. They include:

- + **Site 1: Albert Einstein High School and Haydee Rexach Elementary School.** The design options for this site illustrate how typical green spaces or parks defined and identified in the CMP District Plan can incorporate green infrastructure and educational elements.
- + **Site 2: San Antonio Asís Plaza.** Design options for this site illustrate the creation of a community campus, connecting the adjacent school, church, and community center and establishing programmatic elements that serve the needs of these organizations.
- + **Site 3: Residential Urban Plaza Buena Vista Santurce.** Design options for Sites 2 and 3 illustrate two variations on how green infrastructure can be incorporated into a typical residential plaza. These design options can be integrated within the existing neighborhood framework.
- + **Site 4: Buena Vista Santurce Water Plaza.** Design options for this site illustrate how water plazas may be incorporated into vacant land areas and pedestrian trails.
- + **Site 5: Paseo del Caño Norte.** Design options for this site illustrate improvements to the pedestrian and bicycling experience in this area. This design builds upon the existing conceptual design of the Paseo del Caño Norte, linking proposed water plazas and open spaces and existing housing.
- + **Site 6: Israel - Bitumul Gateway Water Plaza.** Design options for this site illustrate how a water plaza can be designed as an entryway into the CMP project area, welcoming visitors to the area and promoting ecotourism.

The design options, in conjunction with the improvements to the sanitary sewer and dredging of the channel, will help manage the rainwater from a 25-year storm. They will provide needed recreation space for the community that will better connect neighborhoods with each other and the CMP, and increase access for visitors.

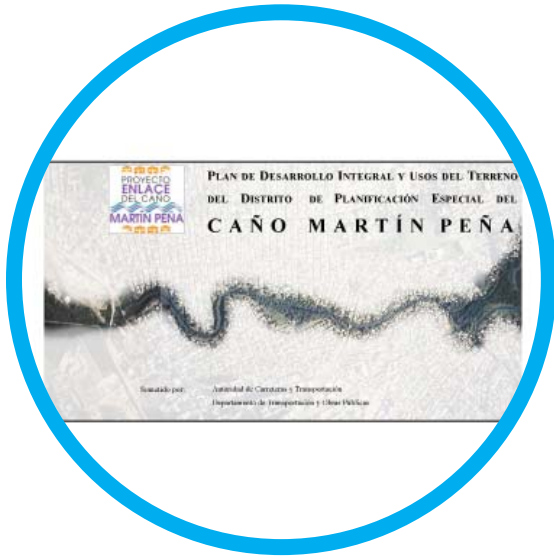
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<sup>1</sup> *Final Feasibility Report Delivery Package*, ENLACE and U.S. Army Corps of Engineers. February 2016.

<sup>2</sup> *Health Impact Assessments for Environmental Restoration: The Case of Caño Martín Peña*. *Annals of Global Health*, vol. 80, no. 4, July 2014.

<sup>3</sup> Statistics for the Caño Martín Peña from the American Community Survey, 2006-2010.

The design team's efforts were built on the foundation provided by previous planning and engineering studies provided by ENLACE. The primary studies used in the preparation of the design proposals were the following:



Comprehensive Development Plan for the Special Planning District of the Caño Martín Peña, 2004



Feasibility Report & Environmental Impact Statement for the Caño Martín Peña Ecosystem Restoration Project, 2016



Planning Report for the Stormwater Collection System Conceptual Design for Buena Vista Santurce Community, 2016

# 3 COMMUNITY ENGAGEMENT

## WORKSHOP DESCRIPTION

From March 8 to 10 of 2017, a three-day workshop was held with various sectors of the CMP Martín Peña community to identify the needs and aspirations of residents and stakeholders with respect to the design of public spaces. With the support of ENLACE in the coordination of the workshop, the activities were carried out at ENLACE's office, the Albert Einstein High School and the Buena Vista Santurce Community Center, which allowed the project to reach a diverse group of participants. A session with government agency representatives, engineers, local technical and non-profit program leaders focused on discussing the technical aspects of integrating green infrastructure into local public policy. The session also explored the logistics of implementing the CMP District Plan, the CMP-ERP Project, and began the process of identifying potential funding sources. Other sessions with community leaders, students participating in ENLACE's environmental awareness programs, and community residents focused on identifying public space uses and programs, on including green infrastructure applications to improve water quality and reduce flooding in their communities, and on connectivity and transportation issues between communities and the immediate urban context.

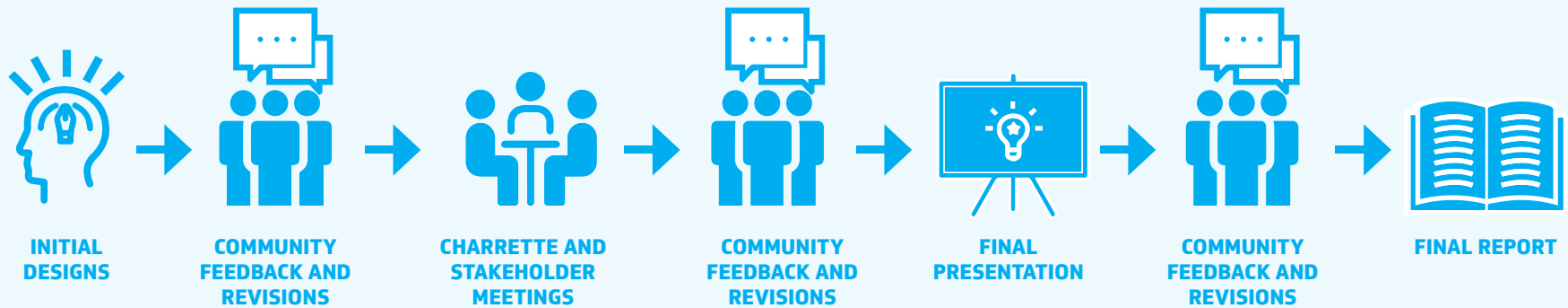


*The design team conducted a workshop to explore design opportunities with the students of Estudiantes Dispuestos a la Restauración Ambiental del Caño Martín Peña.*



*Many design options were presented during an open community meeting, where the public was invited to speak and contribute to the final design options.*

## THE DESIGN PROCESS



## WORKSHOP DESCRIPTION

### Participants were particularly interested in the following:

- + Build off the plans and projects already developed through an inclusive participatory process, as a starting point for the further development of suitable complementary proposals.
- + Restore the estuary ecosystem through the use of innovative technologies that improve the quality of stormwater runoff flowing into the CMP.
- + Involve the community in the planning, implementation, and maintenance of public spaces to ensure their sustainability.
- + Promote community economic development.
- + Improve health and quality of life by providing safe and accessible public spaces for residents and visitors.
- + Identify pilot projects that are feasible to implement in the short term.
- + Design flexible spaces that can incorporate a diversity of programs for a variety of populations, but at the same time reflect and strengthen the identity of the community.
- + Connect proposed projects with existing urban assets through multimodal transportation proposals.
- + Use public space as an educational tool for environmental issues.

## 4 EXISTING CONDITIONS



*An aerial image of developments encroaching the CMP. This ultimately narrowed the width of the CMP and decreased mangroves along its buffer zone.*

Reference:  
*Planning Report for the Stormwater Collection System Conceptual Design for Buena Vista Santurce Community, 2016.*



*Due to the physical changes of the CMP, surrounding communities are now faced with higher and frequent inundation.*

Reference:  
Building and Social Housing Foundation. <https://www.bshf.org/world-habitat-awards/winners-and-finalists/cano-martin-pena-community-land-trust/>

### THE BUENA VISTA SANTURCE COMMUNITY

The community of Buena Vista Santurce borders the CMP to the south, Haydee Rexach Avenue to the north, the Barrio Obrero Marina community to the west, and Avenue Barbosa—a main artery of the city—to the east. It is a predominantly residential community mixed with commercial activity, including grocery stores, coffee shops, bars, barber shops, and beauty salons, in the interior of the community and towards Rexach Avenue. Many of the buildings have been elevated as an adaptive measure to avoid the flooding of the area while others have been abandoned. Narrow streets with no sidewalks create an undefined space for pedestrians,

vehicles, and cyclists. The neighborhood lacks safe and accessible public and recreational spaces. The little existing vegetation is limited mainly to the edge of the CMP. Like most G-8 communities, Buena Vista Santurce has access to power and street lighting through a disorganized aerial network. Also, it is mainly flatland with elevations slightly above sea level. It has a poor stormwater drainage system and lacks a sanitary sewer system, exposing its residents to sewage-polluted waters and bacterial contamination during the frequent flood events that occur in the area.



- 1 ALBERT EINSTEIN HIGH SCHOOL AND HAYDEE REXACH ELEMENTARY SCHOOL
- 2 SAN ANTONIO ASÍS PLAZA
- 3 RESIDENTIAL URBAN PLAZA BUENA VISTA SANTURCE
- 4 BUENA VISTA SANTURCE WATER PLAZA
- 5 PASEO DEL CAÑO NORTE
- 6 ISRAEL-BITUMUL GATEWAY WATER PLAZA

- ↑ Stormwater Runoff
- ↑ Groundwater Overflow

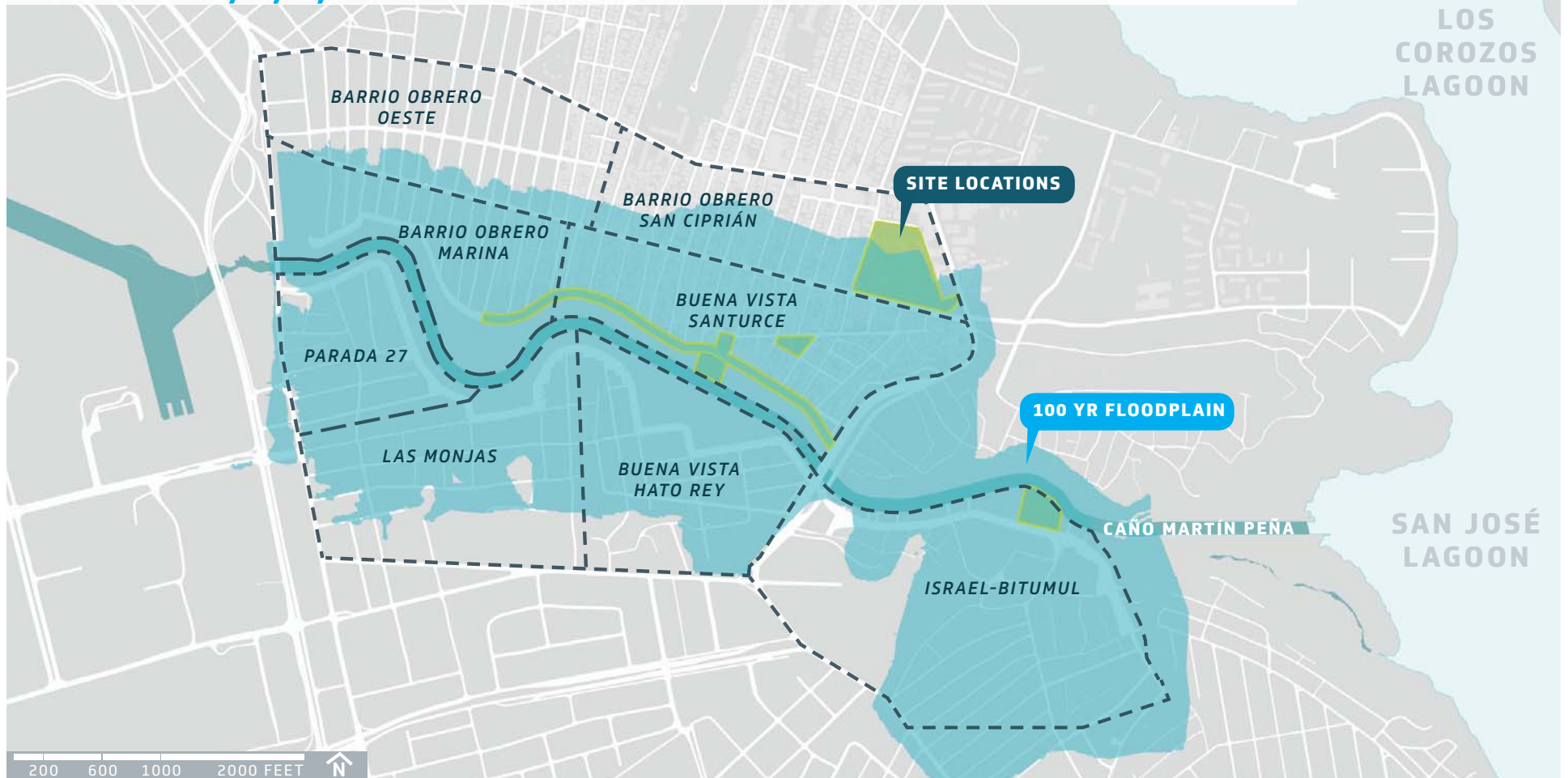
*Stormwater runoff from Barrio Obrero San Ciprián flow to Buena Vista Santurce. Water from Buena Vista Santurce flows to the CMP, the river floods, and it's pushed back into the Buena Vista Santurce community.*

References:  
 Planning Report for the Stormwater Collection System Conceptual Design for Buena Vista Santurce Community, 2016.  
 Conceptual Design Stormwater Collection System- Buena Vista Santurce Community Watershed

**FIGURE 4** Illustrating existing catchment areas between the two neighborhoods.



# 73% OF SITE 1 IS WITHIN THE 100 YEAR FLOODPLAIN; SITES 2,3,4,5 AND 6 ARE 100% WITHIN THE FLOODPLAIN



**FIGURE 5** Illustrating areas of the 100 year flood zones.

Reference:  
CMA-UNIPRO, 2002. Hydrological Study

- Flood level is less than 3' above Ground
- Site Locations



**FIGURE 6** Neighborhoods affected by storm flood category 1.

- Flood level is more than 6' above Ground
- Flood level is more than 3' above Ground
- Flood level is less than 3' above Ground
- Site Locations



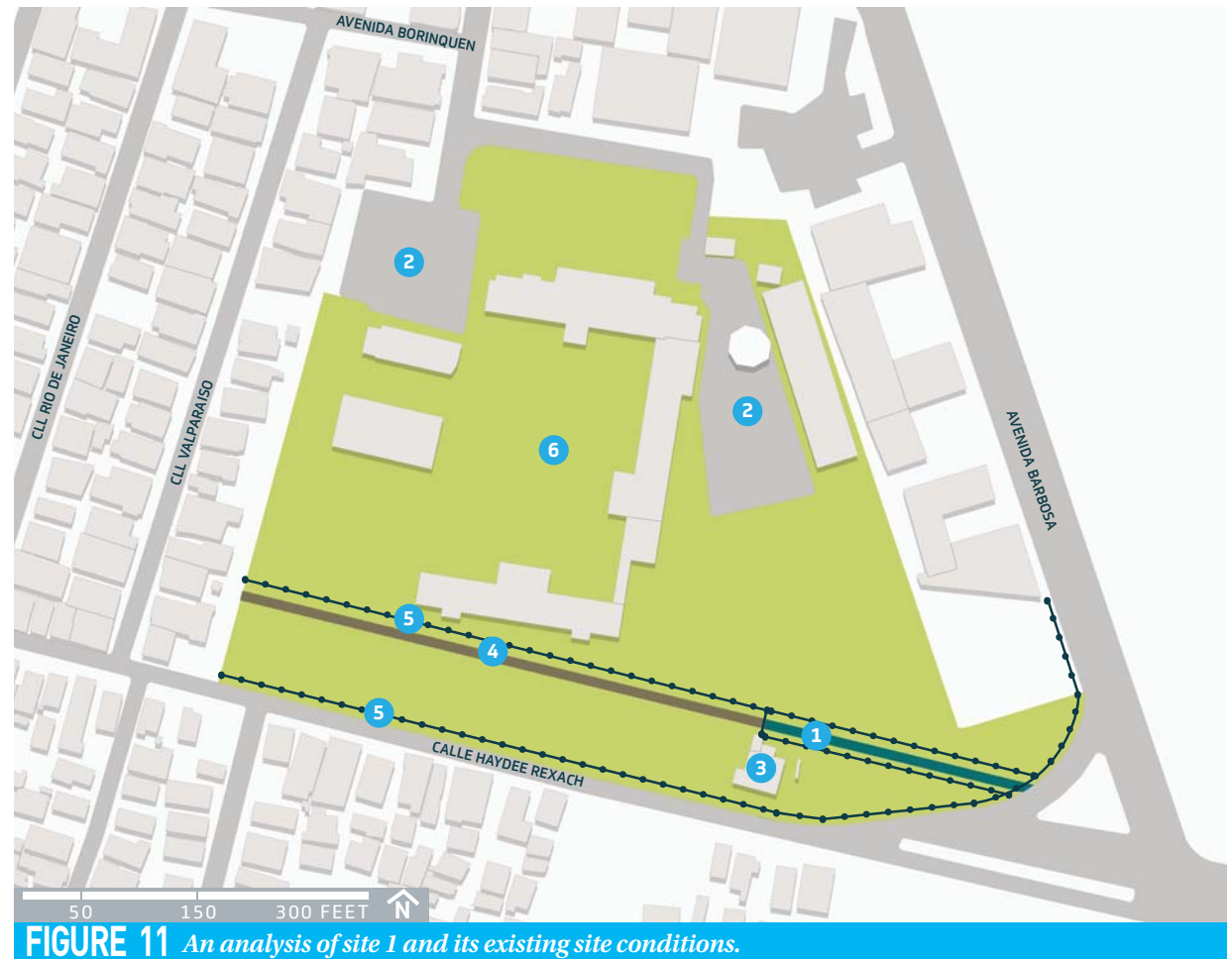
**FIGURE 7** Neighborhoods affected by storm flood category 5.

*The project sites lie within major flood zones. During a category 1 storm, the project sites could experience up to 3 feet of water, and during a category 5 storm hurricane, project sites could be inundated with up to 6 feet of water.*

Reference:  
NOAA . <http://noaa.maps.arcgis.com>

## SITE 1: ALBERT EINSTEIN HIGH SCHOOL & HAYDEE REXACH ELEMENTARY SCHOOL

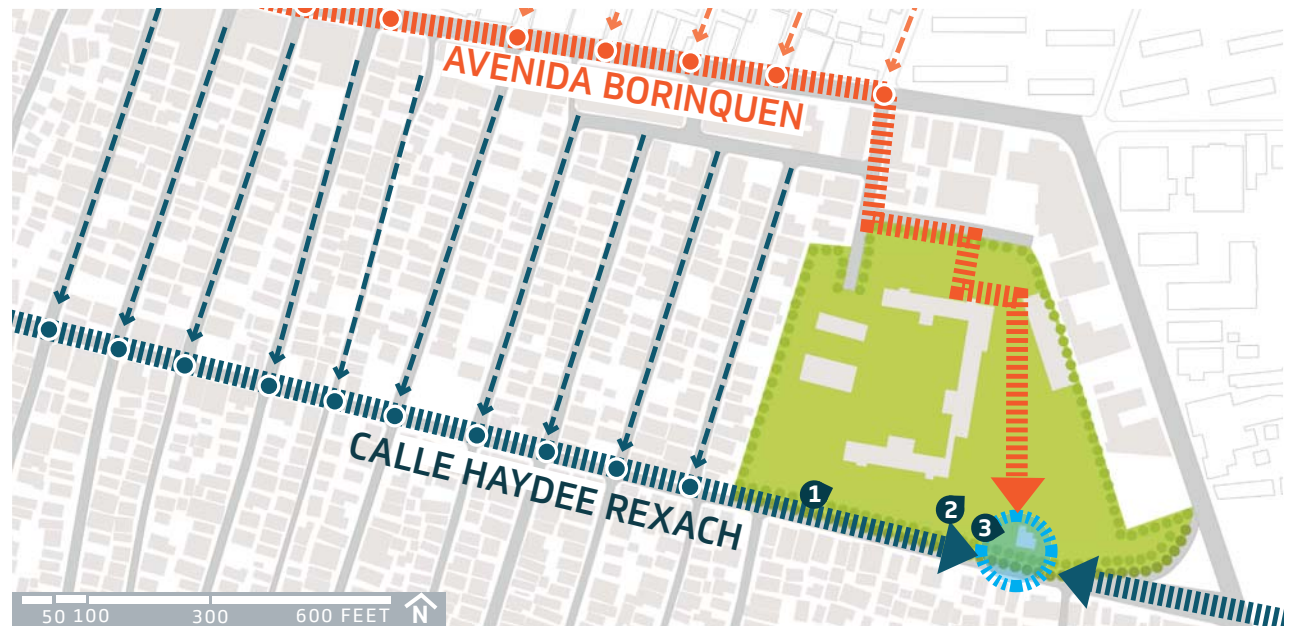
With approximately 345,000 square feet, Albert Einstein High School site is the most generous green space in the project area (images 1 and 2). It naturally functions as a stormwater runoff catchment area from the Barrio Obrero San Ciprián community, located just north of Buena Vista Santurce. It also holds the Rexach pump station (image 3) that collects stormwater from the Rexach Avenue, the Cantera district and the Barrio Obrero San Ciprián community, before disposing to the CMP. Nevertheless, as the capacity and the flow of the CMP are compromised, the waters revert to the Buena Vista Santurce community, causing flooding impacts. The site also has a strategic location, immediate to public transportation routes between Haydee Rexach Avenue and Barbosa Avenue, as well as being located at the intersection with the CMP Special District of the Cantera Peninsula. Although the School has not capitalized on its' strategic location, it offers opportunities for pedestrian and vehicular access to the avenues and immediate commercial areas. Programmatically, the Albert Einstein High School community has adopted this space for recreational activities such as soccer and baseball, parking for faculty and administration, and as the site for a school garden. The school garden initiative is led by Estudiantes Dispuestos a la Restauración Ambiental del Caño Martín Peña (EDRA), an environmental awareness program coordinated by ENLACE and comprised of approximately 23 high school students.



**FIGURE 11** An analysis of site 1 and its existing site conditions.

- |                |   |
|----------------|---|
| 1 OPEN CANAL   | 4 SIDEWALK                              |
| 2 PARKING LOTS | 5 FENCE                                 |
| 3 PUMP STATION | 6 INTERNAL COURTYARD (BASKETBALL COURT) |

The water flows to the pump stations through channels along Avenida Borinquen and Calle Haydee Rexach. Stormwater coming from Avenida Borinquen travels directly through the eastern side of the site.



**FIGURE 12** An analysis of water collection at site 1.



## SITE 2: SAN ANTONIO ASÍS PLAZA

It's the smaller of the public spaces proposed, with 25,000 square feet, and currently dedicated to single-family housing units. Located in the heart of the community of Buena Vista Santurce, the site is enclosed by the Jaime Rosario Báez Elementary School, the Centro de Usos Múltiples (community center, image 1), religious organizations, and a low density residential typology. Some of the challenges presented by the site are the relocation of families currently on the site of the proposed project (images 2 and 3) and the tendency of flooding during average daily rain events. However, despite its scale, the site provides the opportunity to programmatically consolidate this public space as a center for community and education activity.

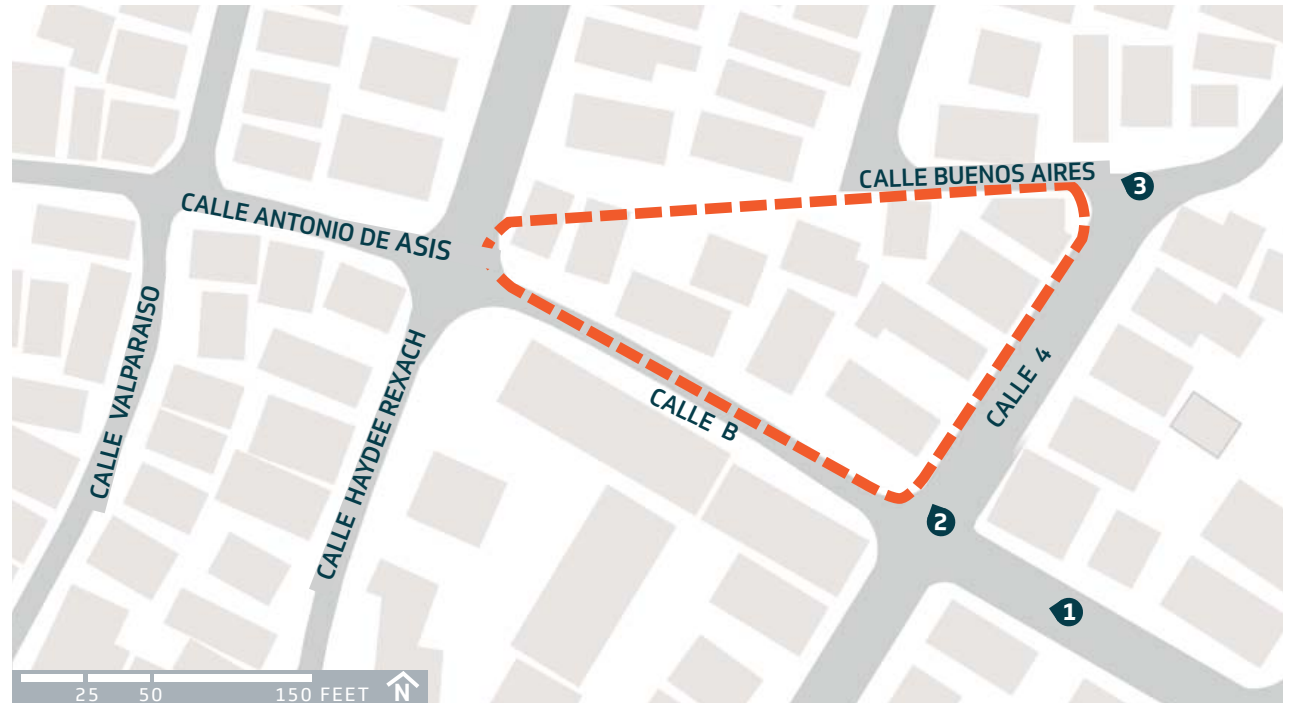


FIGURE 13 A spatial analysis of site 2.



## SITES 3 AND 4: RESIDENTIAL URBAN PLAZA BUENA VISTA SANTURCE AND BUENA VISTA SANTURCE WATER PLAZA

Both areas, although separated by the Paseo del Caño Norte (described below), are understood as an extension that interweaves the residential area of Buena Vista Santurce with the littoral/shoreline of CMP. Together, the area amounts to approximately 50,000 square feet, currently mostly occupied by residences (images 1 and 2), also religious centers and small businesses (image 3). This site is located between Main Street, Bartolomé de las Casas Street, B Street, and the proposed extension of Dolores Street to the Paseo del Caño Norte. To the west of this area is a basketball court that the community has expressed a desire to remove and relocate. Like Plaza San Antonio de Asis, these public spaces provide an opportunity for stormwater runoff collection and water quality improvement before they flow into the channel. On the other hand, this set of spaces, including the Paseo del Caño Norte, would connect the residential interior of Buena Vista Santurce with a more exposed landscape towards the banks of the rehabilitated CMP.

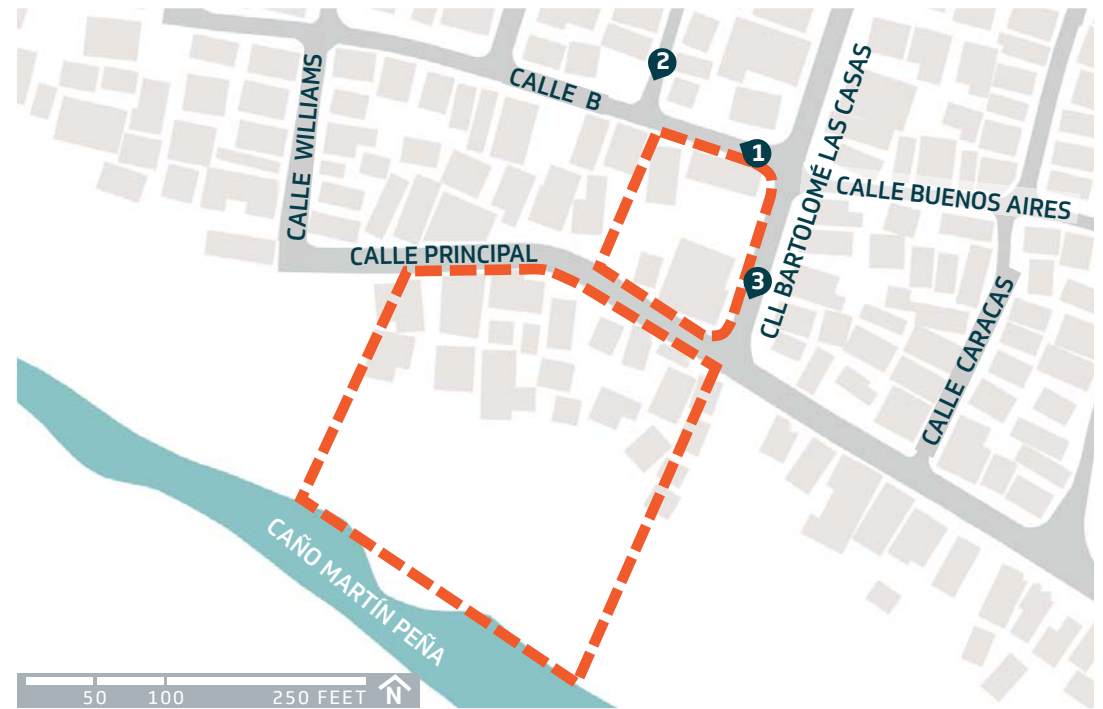


FIGURE 14 A spatial analysis of site 3 and 4.



## SITE 5: PASEO DEL CAÑO NORTE

Currently Calle Principal is characterized by an undefined geometry, lack of sidewalks, and a narrow street section that varies along its path (image 1). The Paseo would extend Calle Principal, which is cut off before connecting with Calle Martino, on the southern boundary of the residential Buena Vista Santurce context. The Paseo, as proposed in the CMP District Plan, has the vision of connecting the communities of Buena Vista Santurce and Barrio Obrero Marina along the northern limit of the CMP (images 2 and 3), with Ponce de León Avenue and the Sagrado Corazón Urban Train Station to the west, and with Barbosa Avenue to the east. This presents the opportunity to feed these main arteries and urban nodes with the integration of alternative means of transportation, and attractive programming for both the internal community and the immediate urban context. The viability of the Paseo del Caño Norte depends on the acquisitions of structures and relocation of families residing to the south, and the dredging, expansion, and the CMP-ERP. In addition, stormwater and sanitary sewer infrastructure projects yet to be designed and currently in search of financing, must be commissioned prior to the development of the dredging project and consequently of the Paseo del Caño Norte.



FIGURE 15 A spatial analysis of site 5.



## SITE 6: ISRAEL-BITUMUL GATEWAY WATER PLAZA

This site is located on the northern edge of Israel-Bitumul community, connecting it to the CMP, near the mouth of the San José Lagoon (Figure 4). Like sites 3, 4 and 5, since it borders the CMP, its development is dependent on the acquisition of structures, relocation of families and the CMP-ERP (images 1, 2, and 3). Nevertheless, the stormwater, sanitary and Paseo del Caño Sur infrastructure projects are well-advanced in their design phase. The area also connects to the south with the community's urban farming project, and with Israel-Bitumul Park, where there are already recreational facilities for basketball, baseball, and a playground. The Israel-Bitumul Water Plaza was conceptualized in the CMP District Plan, as a "parentheses" through the mangrove mitigation buffers at the banks of the CMP, to visually and physically expose users to the restored body of water. It offers the opportunity to serve residents and visitors, as an emblematic portal to the restoration project, connecting with the rest of the San Juan Bay Estuary.



FIGURE 16 A spatial analysis of site 6.





# 5 DESIGN OPTIONS



FIGURE 17 Areas of all project sites in proximity to existing neighborhoods.

- |   |   |
|---|---|
| 1 ALBERT EINSTEIN HIGH SCHOOL & HAYDEE REXACH ELEMENTARY SCHOOL | 4 BUENA VISTA SANTURCE WATER PLAZA  |
| 2 SAN ANTONIO ASÍS PLAZA  | 5 PASEO DEL CAÑO NORTE  |
| 3 RESIDENTIAL URBAN PLAZA BUENA VISTA SANTURCE                  | 6 ISRAEL-BITUMUL GATEWAY WATER PLAZA  |
|   | 7 MANGROVE RESTORATION/ CAÑO MARTÍN PEÑA ECOSYSTEM RESTORATION PROJECT AREA |

## 5 DESIGN OPTIONS PROPOSED GREEN INFRASTRUCTURE STRATEGIES

Various green infrastructure techniques are proposed in the design options. The site analysis and stakeholder conversations helped influence the stormwater management approach for each site. The green infrastructure tools proposed in the design options are the following:

- + **Bioswale:** a vegetated drainage swale that filters runoff as it flows through the site.
- + **Detention Pond:** a vegetated excavated area that captures, stores, and slows stormwater runoff.
- + **Soil Cells:** engineered structures that suspend the pavement system and increase the soil volume available to trees below paved surfaces. They also provide stormwater storage capacity.
- + **Permeable Paving:** a range of materials that allow for the movement of stormwater through their surface.
- + **Water Plaza:** a combination of a detention basin and a plaza that can hold water during storm events and then drains to function as an urban plaza. These can function at a variety of sizes and shapes and host a range of activities.
- + **Underground Stormwater Detention:** a subsurface system of chambers or tanks that store stormwater.

### References:

Planning Report for the Stormwater Collection System Conceptual Design for Buena Vista Santurce Community, 2016. *Conceptual Design Stormwater Collection System- Buena Vista Santurce Community.*



**FIGURE 9** Illustrating areas of proposed green infrastructures.

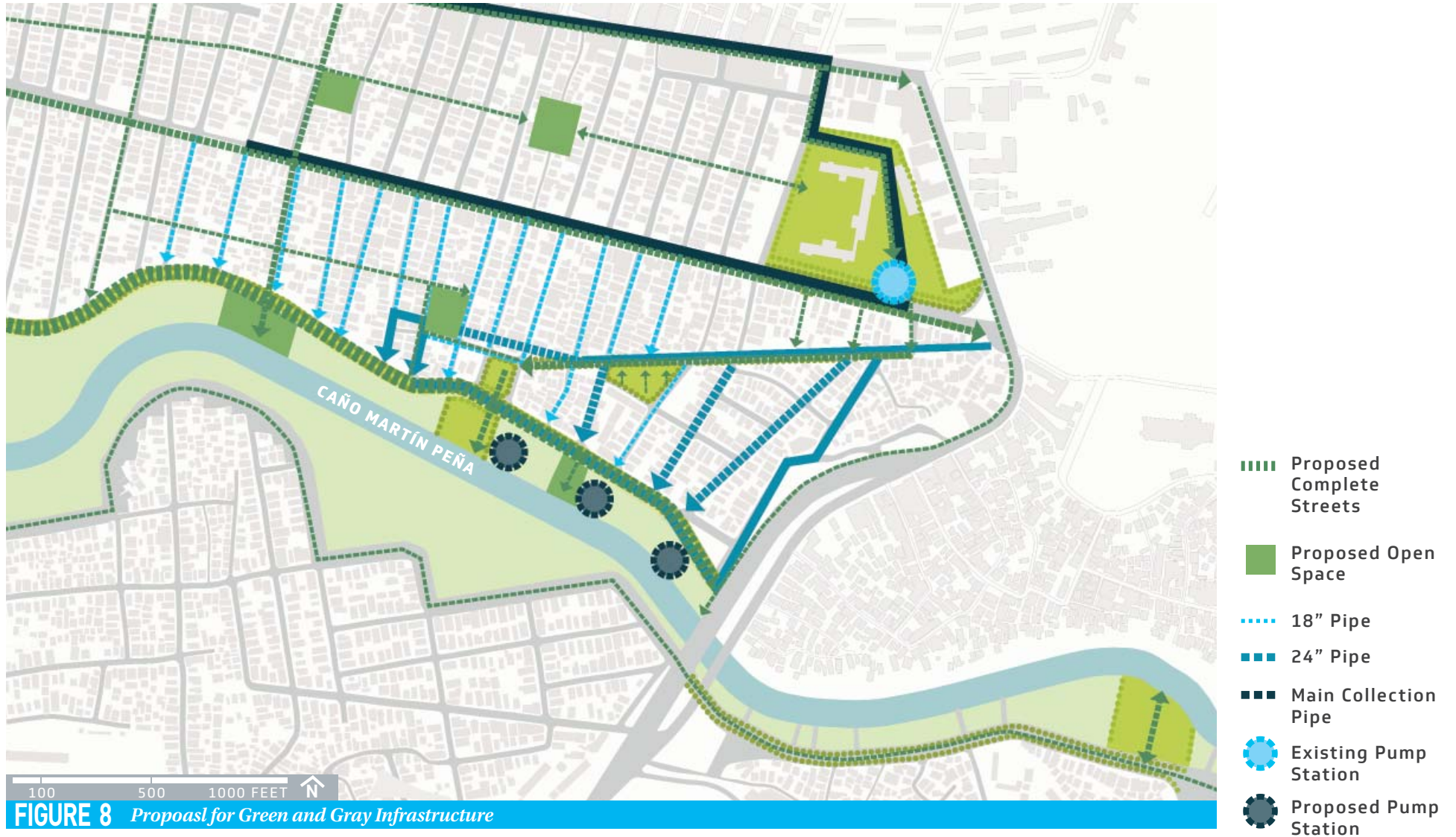
--- Proposed Complete Streets    ■ Proposed Open Space



**FIGURE 10** Illustrating areas of proposed gray infrastructures.

..... 18" Pipe    ■ Main Collection Pipe    ⚙ Existing Pump Station    ⚙ Proposed Pump Station  
 ■ 24" Pipe

5 DESIGN OPTIONS  
**PROPOSED STORMWATER MANAGEMENT DESIGN**



References:  
*Planning Report for the Stormwater Collection System Conceptual Design for Buena Vista Santurce Community, 2016. Conceptual Design Stormwater Collection System- Buena Vista Santurce Community.*

**5** DESIGN OPTIONS  
**SITE 1: ALBERT EINSTEIN HIGH SCHOOL AND HAYDEE REXACH ELEMENTARY SCHOOL**



FIGURE 18 A design proposal for site 1.

## DESIGN OVERVIEW

The design concept for the school campus focuses on managing stormwater through a series of distinct, but interconnected detention basins that conduct and clean water coming from the north of the site to the Rexach stormwater pump station while creating a rich educational environment around the stormwater system. Overall, the new layout increases pedestrian activity throughout the outdoor campus spaces. During the workshop, the EDRA students preferred a scheme with interconnected detention basins and a meandering path that can have unique programs alongside it like an outdoor classroom and library focused on environmental education, an amphitheater, and a school garden. Students also proposed that stations for trash and recycling be located throughout the campus to reduce littering.

## LAYOUT AND PROGRAM





Design elements for the schoolyard are primarily organized around a series of detention ponds. These elements include an outdoor classroom, amphitheater, bio-library, green house, and educational walking path. In addition, a new parking lot is proposed along the northern edge of the site which will include permeable paving, bioswales, and trees.

The interior courtyard of the Albert Einstein High School is programmed for everyday activity. A new shade structure is proposed for the basketball court along with new plantings, and a shelter attached to the building's edge. In addition, trash and recycling stations are located throughout the site for better waste management practices.



FIGURE 19 A stormwater strategy proposal for site 1.

The design also integrates the peripheral campus conditions into the masterplan. The scheme suggests a drop-off and entry points to both the Albert Einstein School and the Haydee Rexach Elementary School from Calle Haydee Rexach along with new street tree plantings. A new permeable parking lot along the northern edge of the site replaces the existing parking to the east of the site and creates a more formal entry to Albert Einstein High School.

-  ABOVE-GROUND WATER STORAGE
-  BELOW-GROUND WATER STORAGE
-  SURFACE WATER DRAINAGE
-  GROUND WATER DRAINAGE

## WATER MANAGEMENT PRACTICES

The site manages stormwater through a series of interconnected detention ponds. Surface runoff from the neighborhood to the northeast of the site and water collected in the pipe beneath Avenida Borinquen are directed into the detention ponds and travel through the system before reaching the stormwater pump station on Calle Haydee Rexach. The detention ponds will slow and temporarily store the water entering the pump station, relieving pressure on the overall system and improving the water quality before it enters the CMP. The existing exposed water channel running parallel to Calle Haydee Rexach and connecting to the pump station is reconfigured and concealed below ground to increase the amount of usable space and remove physical barriers. The site manages approximately 255,000 cubic feet of stormwater above and below ground.

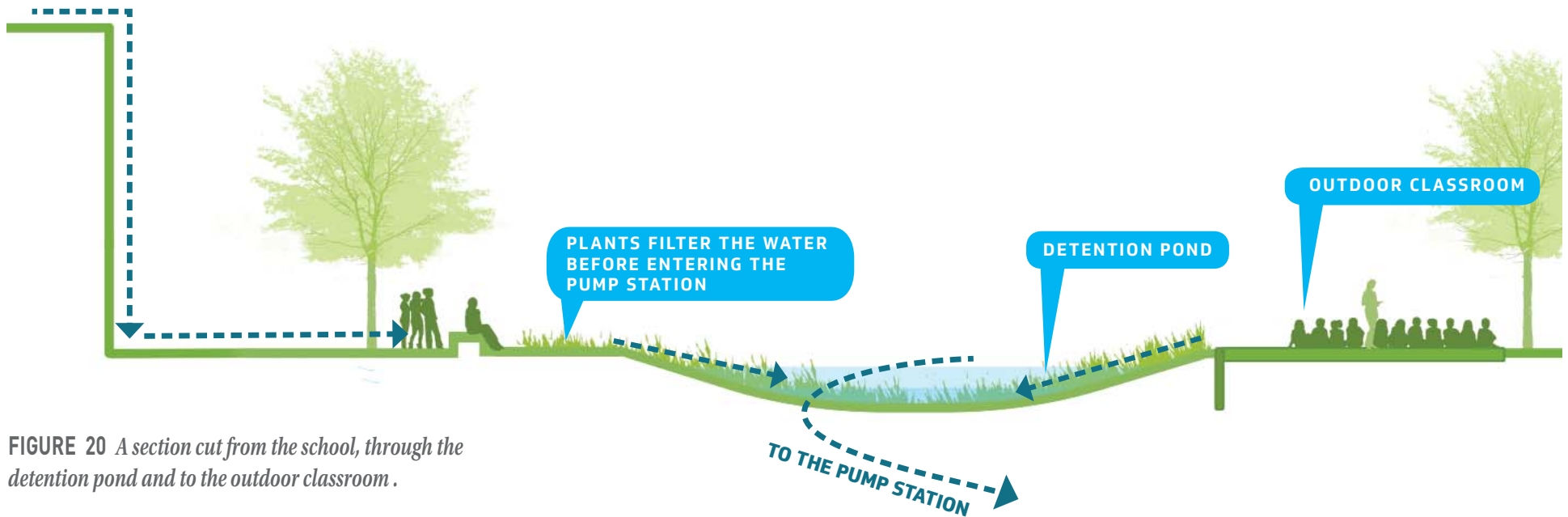


FIGURE 20 A section cut from the school, through the detention pond and to the outdoor classroom .

**FIGURE 21** *An existing view of the schoolyard shows major flooding issues and no clear program for this space.*



**FIGURE 22** *A view of the schoolyard detention ponds slowly filtering rainwater.*



DETENTION PONDS

FIGURE 24 Top: Quartierspark in Freiburg, Germany.  
PHOTO CREDIT AG Open space

FIGURE 25 Right: Manassas Park Elementary School in Manassas Park, VA.  
PHOTO CREDIT Siteworks

*Planted detention ponds store and slow stormwater runoff, mitigating flooding in the surrounding areas. The examples above illustrate how walls or edges can define the detention ponds and create a feature that is easy to maintain and aesthetically appealing. Detention ponds also act as an educational feature, providing community members and students with an outdoor classroom or a space for social gatherings.*



OUTDOOR CLASSROOM & DETENTION POND



5 DESIGN OPTIONS  
 SITE 2: SAN ANTONIO ASÍS PLAZA

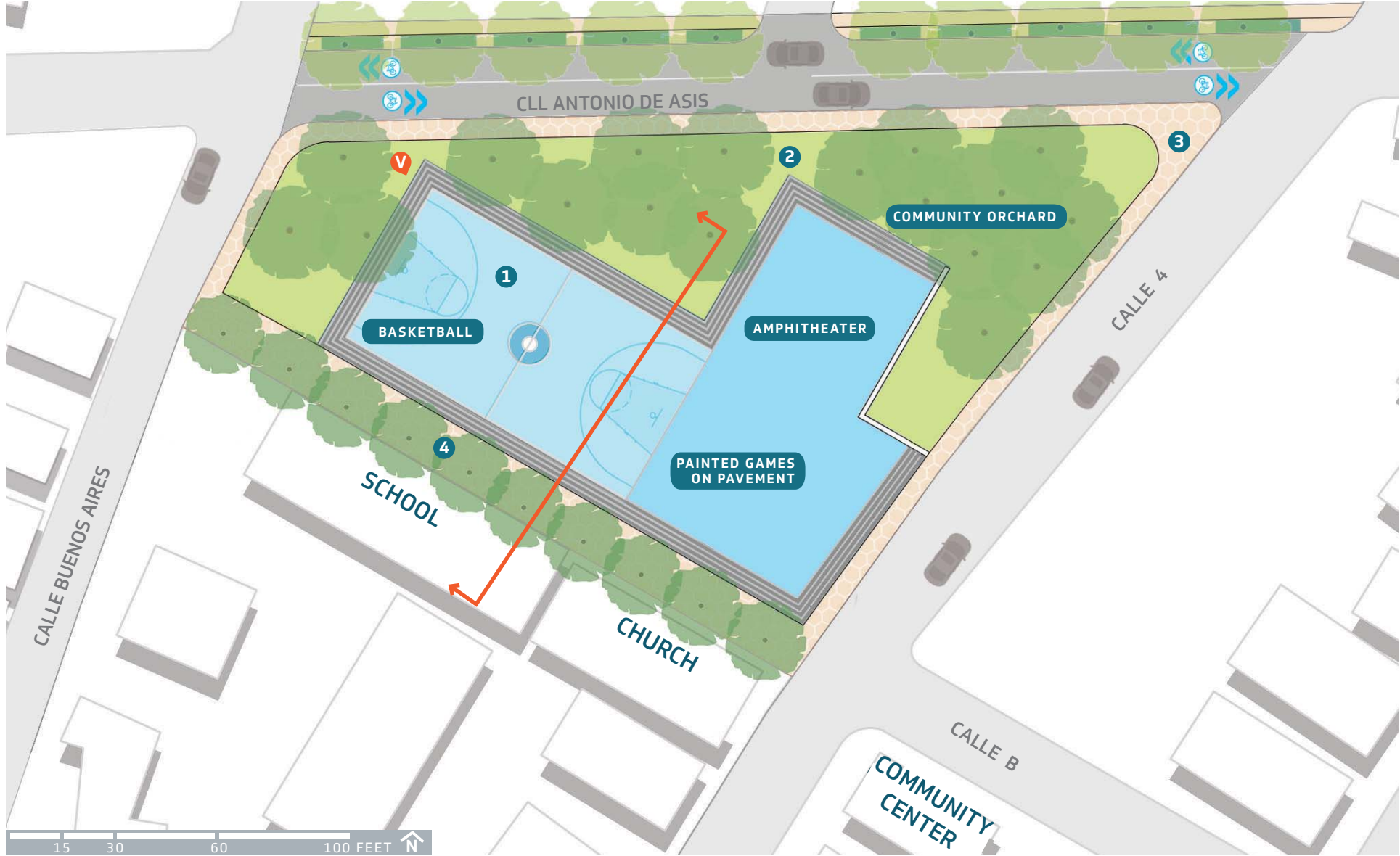


FIGURE 26 A design proposal for site 2.

- 1 WATER PLAZA
- 2 OPEN LAWN
- 3 SIDEWALK
- 4 CLOSE STREET AND CONNECT THE PARK TO THE SCHOOL TO CREATE A UNIFIED CAMPUS
- V PERSPECTIVE VIEW

## DESIGN OVERVIEW

The proposal for San Antonio Asís Plaza creates a community campus, connecting the adjacent school, church, and community center and establishes programmatic elements that serve the needs of these organizations. During the community workshops there was consensus around the types of uses and programs desired in the design of this site. The residents showed support and enthusiasm for closing the portion of the street to increase the connection to the plaza and therefore create a community campus.

## LAYOUT AND PROGRAM

The San Antonio Asís Plaza acts as the “front yard” to the school and church. The design proposes to close a section of the road (Calle B) in order to connect these buildings directly to the plaza. The plaza is centered around a water plaza that features a full-size basketball court, an amphitheater for community events, painted games (e.g. four square, hopscotch), and tables for playing dominoes. An open lawn with trees surrounds the water plaza space and provides a shaded area. Additionally, the Calle Antonio de Asís edge of the plaza functions as a drop-off point for the school, increasing student and pedestrian safety.

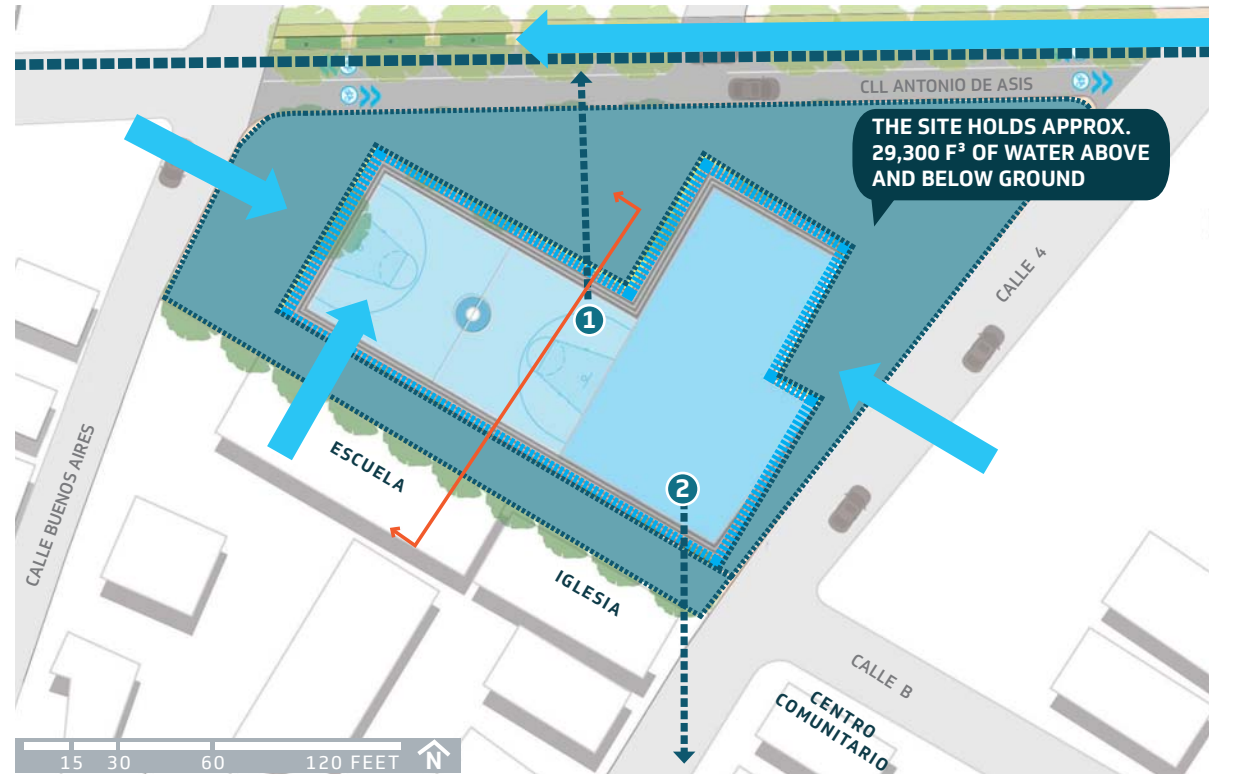






FIGURE 27 A stormwater strategy proposal for site 2.

-  ABOVE-GROUND WATER STORAGE
  -  BELOW-GROUND WATER STORAGE
  -  SURFACE WATER DRAINAGE
  -  GROUND WATER DRAINAGE
- ① OPTION 1: WATER DRAINS TO CALLE ANTONIO DE ASIS
  - ② OPTION 2: WATER DRAINS TOWARDS THE BOX CULVERT ON THE PASEO



**FIGURE 28** *A view of the Water Plaza towards the school. The community can access the Water Plaza after the water has been drained from a storm event.*

## WATER MANAGEMENT PRACTICES

The site manages approximately 29,300 cubic feet of stormwater through both above and below ground strategies and captures stormwater runoff through three main techniques:

- + **Permeable paving:** all hardscape within the plaza will be permeable.
- + **Underground detention beneath the lawn:** Water storage chambers beneath the lawn will capture stormwater runoff.
- + **Water Plaza:** The water plaza acts as a detention basin. During a rain event, surface runoff collects in the recessed portions of the plaza and slowly drains out connecting into either the pipe beneath Calle Antonio de Asís or directly to the proposed box culvert beneath the Paseo. Additional study is necessary to determine the best route for drainage and the ultimate depth of the water plaza areas.



**FIGURE 29** *A view of the Water Plaza during a storm event. The Water Plaza can store rainwater and alleviate pressure on the gray infrastructure system.*

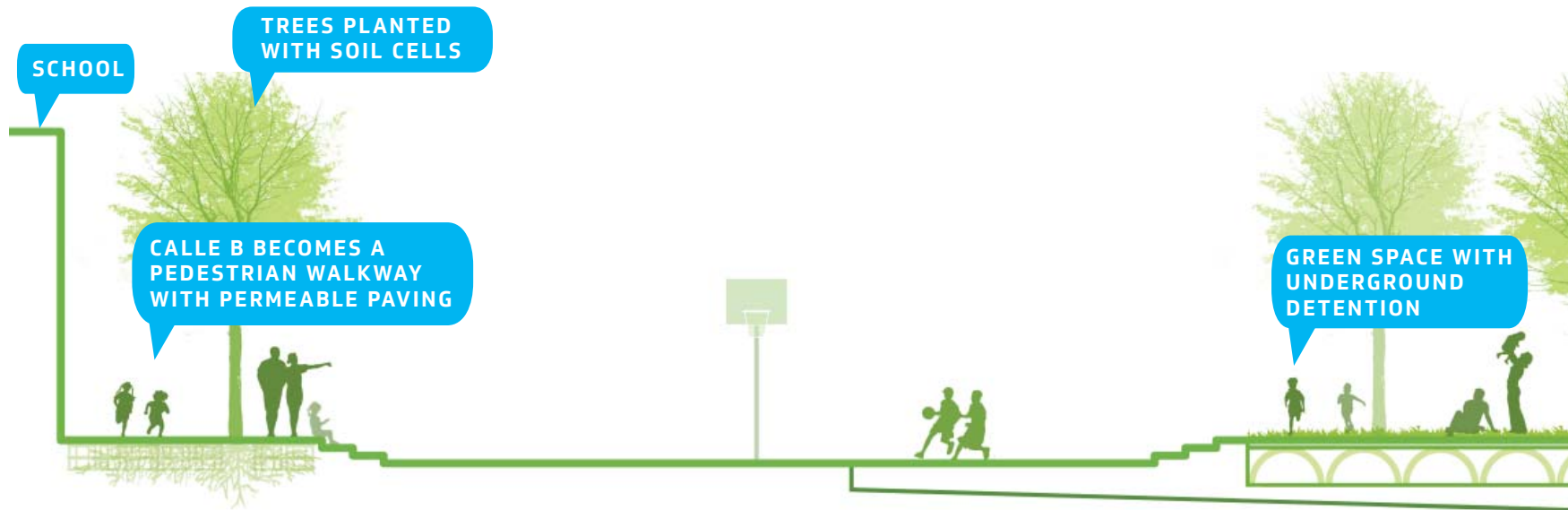


FIGURE 30 A section cut of the school, the Water Plaza and the lawn.

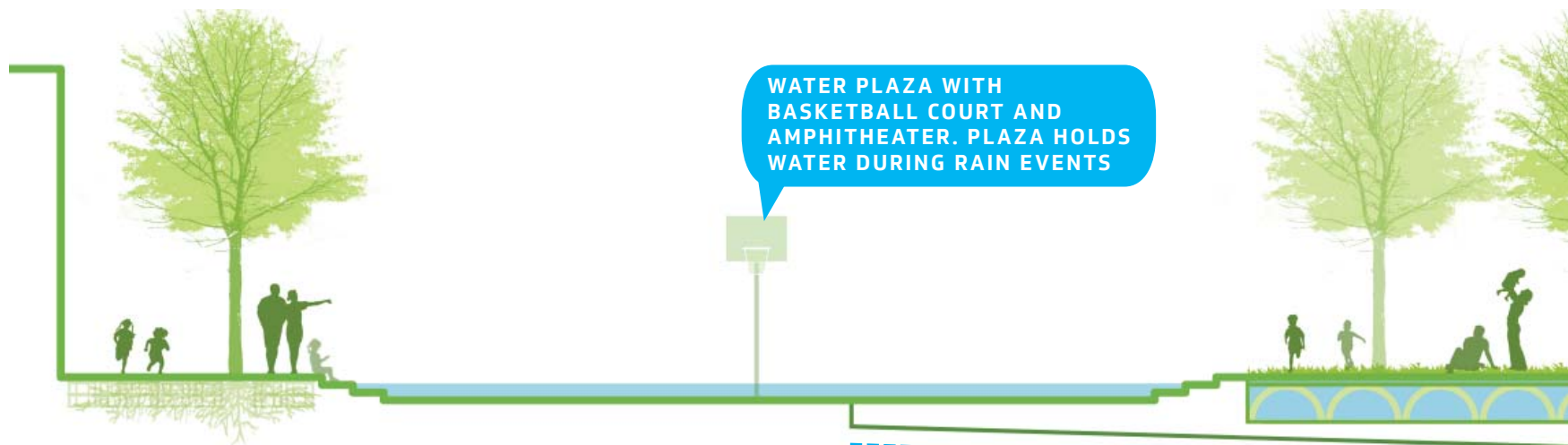
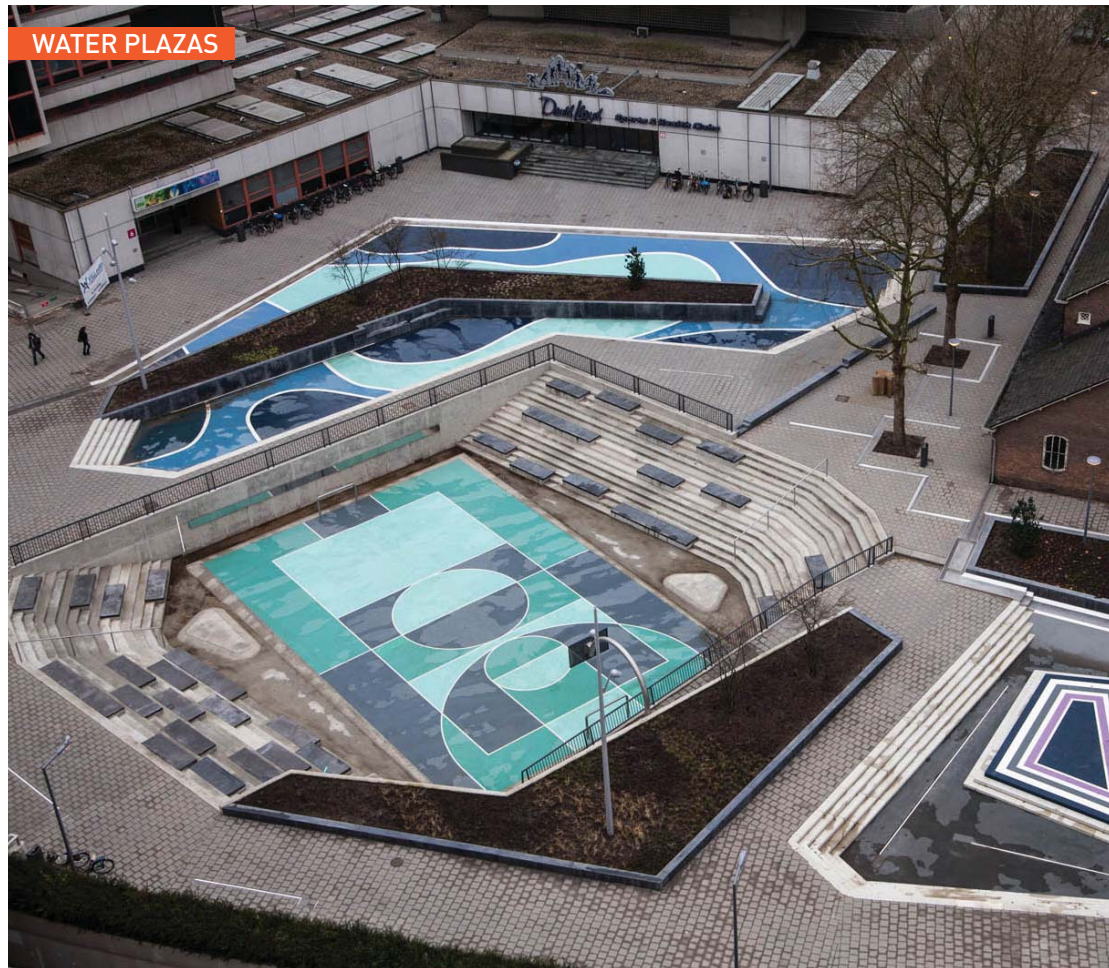


FIGURE 31 A section cut of the school, the Water Plaza and the lawn after a rain even.

WATER DRAINS FROM WATER PLAZA AND CONNECTS TO UNDERGROUND DRAINAGE SYSTEMS ON CALLE ANTONIO DE ASIS OR TOWARDS THE PASEO

## 5 SITE 2: SAN ANTONIO ASÍS PLAZA RELEVANT DESIGN PRECEDENTS



**FIGURE 32** *Water Square Bentheimplein, Rotterdam, NL.*  
PHOTO CREDIT *Ossip Van Duivenbode, Urbanisten.NL*

*The public plaza acts as a stormwater basin during rain events and becomes a public plaza when the water drains. Both plazas and pedestrian friendly streets create additional community gathering spaces and thoroughfare, bringing awareness to local shops and services.*



**FIGURE 33** *Top: Darby Street in Auckland, New Zealand.*  
PHOTO CREDIT *Wikimedia Commons*



**FIGURE 34** *Bottom: A shared space design between vehiculars and pedestrians in New Road, Brighton.*  
PHOTO CREDIT *Ghel Architects*

**5** DESIGN OPTIONS  
 SITES 3 AND 4: RESIDENTIAL URBAN PLAZA BUENA VISTA SANTURCE  
 AND BUENA VISTA SANTURCE WATER PLAZA



FIGURE 35 A design proposal for sites 3 and 4.

## DESIGN OVERVIEW

The overarching design concept is to combine two proposed open spaces on either side of the Paseo del Caño Norte and promotes enhanced pedestrian access to, and activity near, the CMP. The sites can function as two distinct spaces or as one large space, by closing the paseo to vehicular traffic, during community events or festivals. The combined space integrates the elements of the Paseo del Caño Norte into the overall design. The design scheme organizes spaces around green infrastructure “pods” and integrates specific programmatic elements with stormwater management elements throughout the site. Given the site’s relationship to the CMP, the overall design acknowledges the city’s dredging project and the varying water levels within the CMP. The community feedback focused on the elements they wanted to see that would best support community events and celebrations like public restrooms, infrastructure for markets, and a stage.

## LAYOUT AND PROGRAM

Though this design is technically comprised of two different sites, the overall layout merges the Urban Plaza and the Water Plaza to create a more powerful, seamless connection from the community to the CMP. The water plaza connects directly to the CMP, where users can participate in recreational activities along the water’s edge or travel out into the CMP via a water taxi or kayak.

The overall layout can be seen as a gradient, distributing highly active, programmed community spaces with more open flexible space. Everyday program elements are arranged nearer to community and along the northern edge of the Paseo, while a larger plaza space is revealed along the CMP side of the site for seasonal community events. Community spaces double as recessed water plazas (stormwater management) whenever possible, and the programmatic possibilities include public restrooms, a coffee kiosk, a newspaper stand, tables for dominoes, children’s play areas, market space, and an amphitheater and stage.

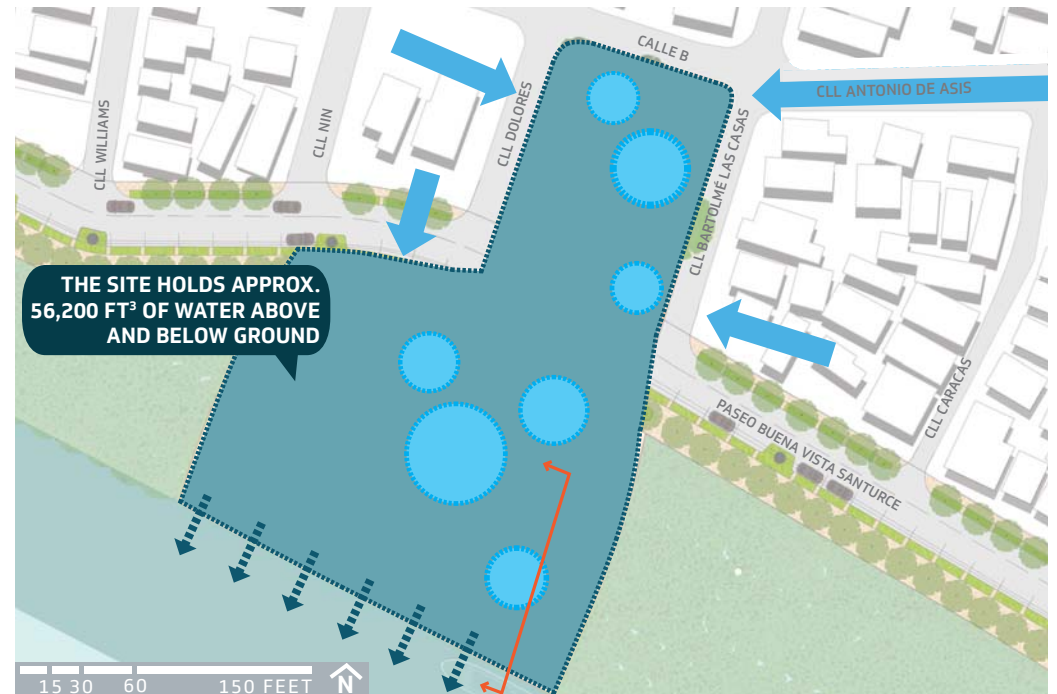
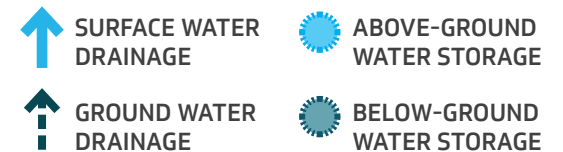


FIGURE 36 A stormwater strategy proposal for sites 3 and 4.





## WATER MANAGEMENT PRACTICES

The site utilizes several main methods to capture stormwater runoff. All paving used within the site is permeable. Additionally, stormwater pods, which consist of both rain gardens and sunken water plazas, work together to capture, clean and slow water as it passes through the site. When the sunken water plazas are dry, they become places for sports and theater.

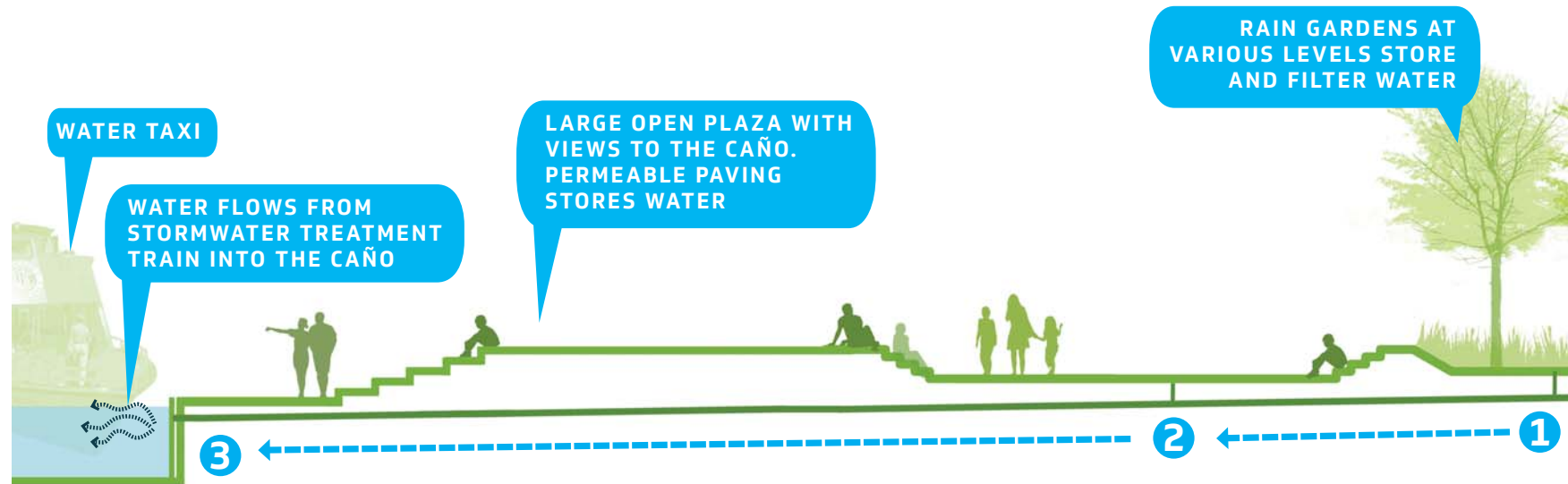
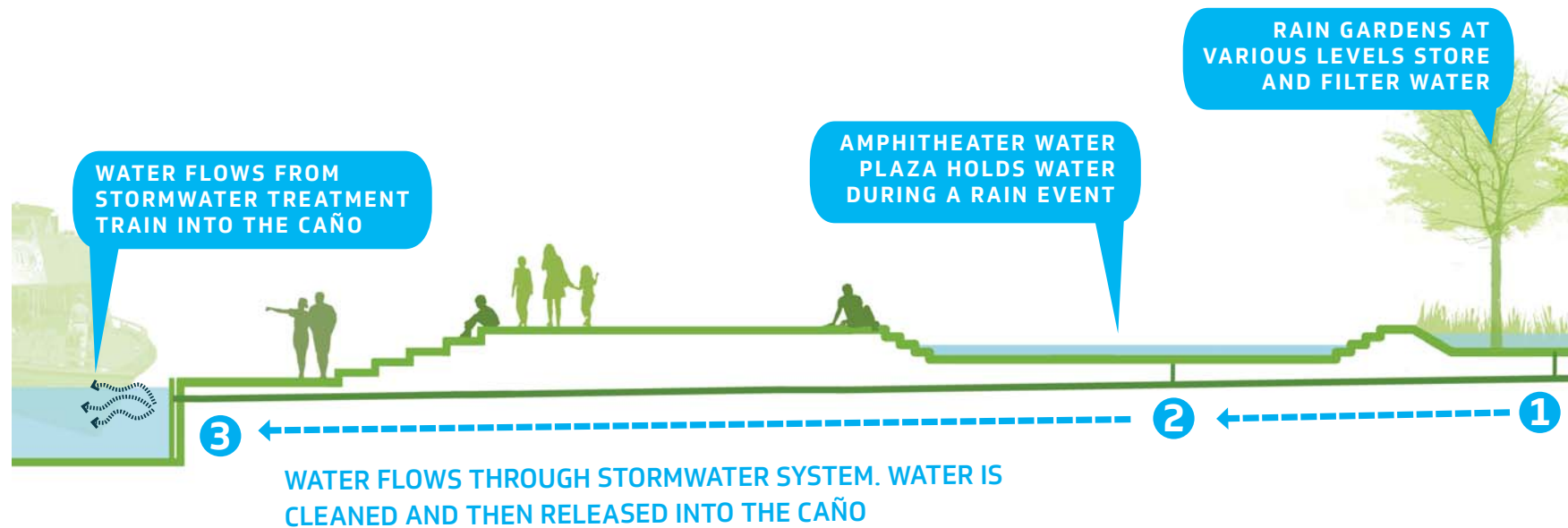


FIGURE 37 A section cut of the Caño and the water plaza.

## WATER MANAGEMENT PRACTICES CONTINUED

During a rain storm, recessed water plazas and rain gardens (1) begin to fill with water. As the sites continues to be inundated, overflow drains distribute water to additional pods (2), creating a network of stormwater management areas. Eventually, the water cleaned through the stormwater pods is slowly released into the CMP (3), protecting habitat and water quality, and the water plaza becomes accessible again for activity. The site manages approximately 56,200 cubic feet of stormwater above and below ground.



**FIGURE 38** A section cut of the Caño and the water plaza after a rain event.



**FIGURE 39** *A view of the Water Plaza towards the Caño. The community can access the Water Plaza after water has been drained from a storm event.*

## 5

SITES 3 AND 4: RESIDENTIAL URBAN PLAZA BUENA VISTA SANTURCE  
AND BUENA VISTA SANTURCE WATER PLAZA

## RELEVANT DESIGN PRECEDENTS



**FIGURE S 40-43.** *Water Square Bentheimplein, Rotterdam, NL. The plaza functions as a stormwater basin during rain events and becomes a public plaza when the water drains. This creates a place for excess stormwater runoff while also providing a place for communities to gather and enjoy.*

**PHOTO CREDIT** *Top Left: Jeroen Musch, Urbanisten.NL; Bottom Left: Ossip Van Duivenbode, Urbanisten.NL; Right: Lepamplet.com*



FIGURE 41 *Illustrating location of site 5 in relation to sites 1,2,3 and 4.*

## DESIGN OVERVIEW

The proposal for this segment of the Paseo suggests adjustments to the layout for vehicular, pedestrian, and cyclist traffic and introduces green infrastructure into the overall design. The overarching comment from the community during the design charrette was around concerns for safety. For this reason, the community selected the option that provided more separation between cyclists and pedestrians and located the zone for cyclists closer to the street edge.

## LAYOUT AND PROGRAM

The vehicular travel and parking lanes are reduced to the minimum lane width requirements, to allow for greater pedestrian space along both sides of the street. The neighborhood edge of the Paseo features a traditional sidewalk. Bioswales flank both sides of the paseo to capture surface runoff and create a vegetated buffer between vehicles and pedestrians. Additionally, bumpouts along the paseo slow traffic and help bridge to the pedestrian space on either side of the street. The CMP side of the paseo creates a more generous space for a separated bike path and a walking path along the mangrove edge. Street trees are shifted from the street edge on the south side of the Paseo to the center of the recreational path to provide separation between pedestrians and cyclists and to avoid interference with the servitude of the 115 kw power line that will run along Paseo del Caño Norte. Space along the Paseo is open for site amenities like benches and offers the possibility for street vendors or food trucks. Lastly, an iconic paving pattern along the Paseo gives a unique character and identity to the street. Overall, the design for the Paseo creates a safe space for commuter and recreational biking, walking, running, and many other activities while defining a viewing platform for the mangroves and natural habitat along the CMP.

## WATER MANAGEMENT PRACTICES

The proposal for this segment of the paseo incorporates green infrastructure in several ways:

- + Bioswales along the street edge capture surface runoff.
- + Trees within the recreational zone are planted in soil cells which increase the soil volume available to trees below the paved surface; and provide stormwater storage capacity.
- + All paving within the pedestrian/ cyclist zones will be permeable with underground gravel storage below, if the water table level in this area allows.

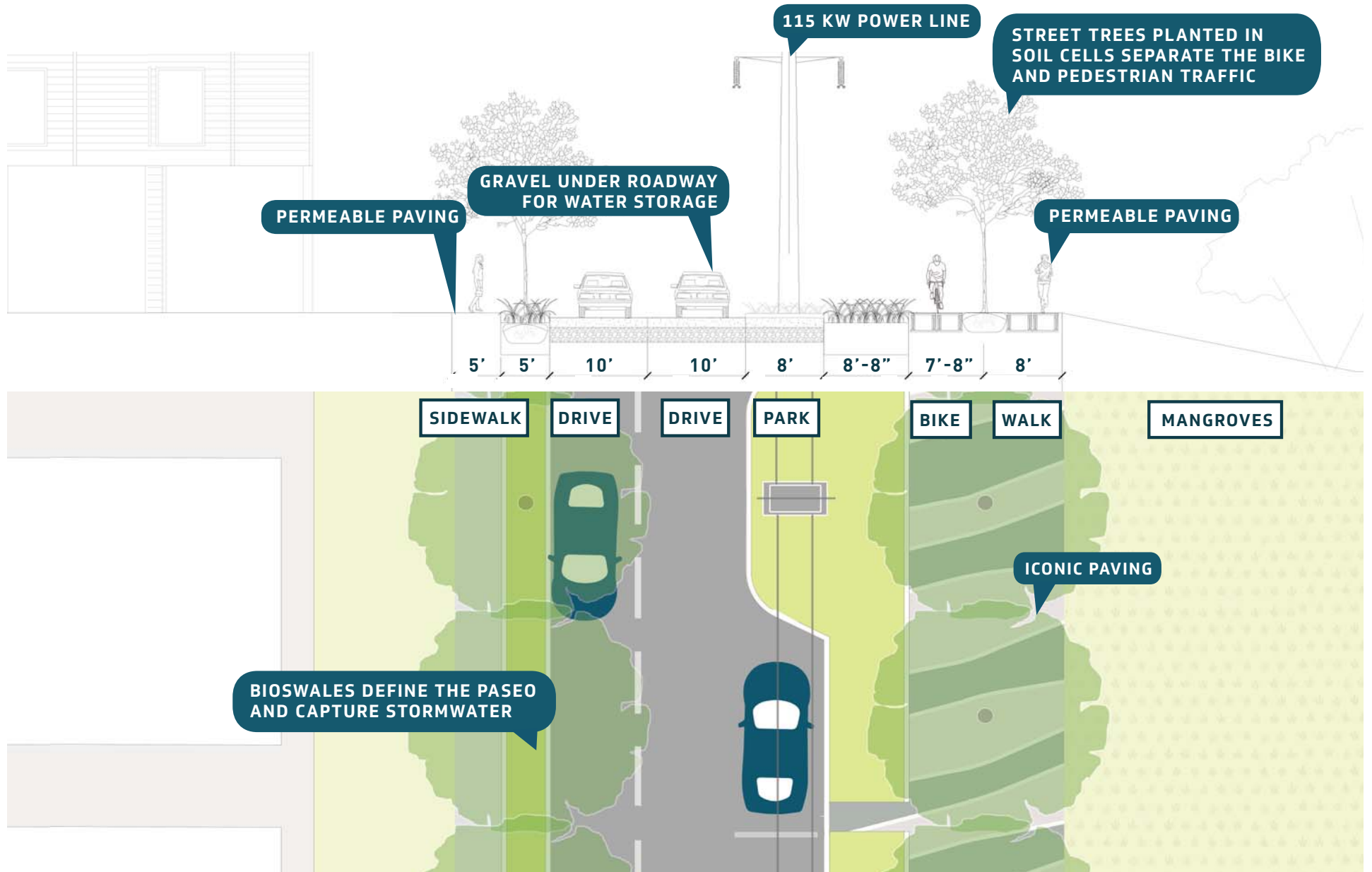


FIGURE 42 A proposed street design of site 5.



**FIGURE 43** *A view of the Paseo along the mangrove edge. The trees define the separated biking and pedestrian zones. Iconic paving creates a unique sense of place and the bioswales store rainwater while creating a buffer to the roadway.*



**FIGURE 44** *Ipanema Beach, Rio De Janeiro. The use of iconic paving pattern creates an unique sense of place and helps differentiate between pedestrian right of way and bike lanes or vehicular travel lanes.*

PHOTO CREDIT *Photos4travel.com*



**FIGURE 45** *Green streets of Portland, Oregon. The use of rain gardens along city streets acts as a buffer between vehicular and pedestrian right of way. Bioswales and permeable paving store storm water runoff and clean the water before entering the storm drainage system.*

PHOTO CREDIT *Portlandoregon.gov*



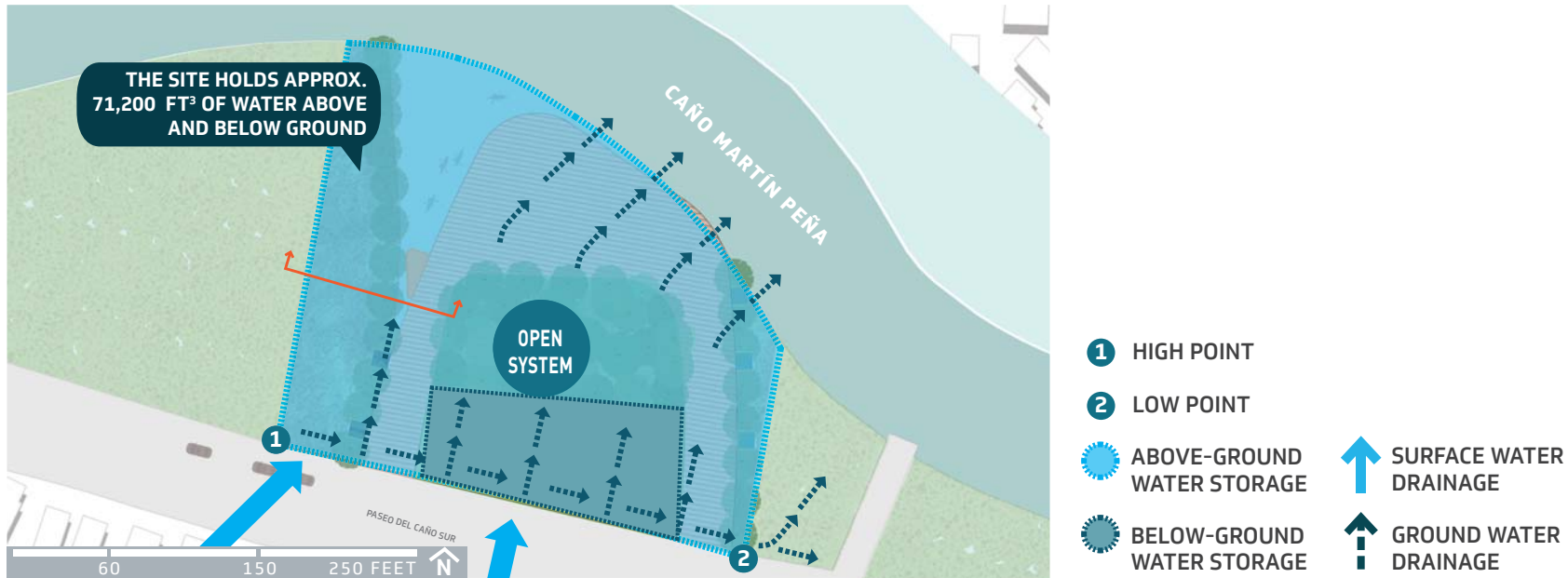


FIGURE 46 A stormwater strategy proposal for site 6.

## DESIGN OVERVIEW

This Water Plaza represents a unique typology as a “gateway” to the CMP since this is the first water plaza someone would encounter coming from the San Jose Lagoon. The design seeks to create a dynamic interaction with the CMP, while providing educational opportunities for community members, eco-tourists, and scientists, and flexible open space for large events and recreational activities. The large size of this water plaza, approximately 1.6 acres, is also a unique characteristic and allows for multiple and diverse activities. Given the site’s relationship to the CMP, the overall design acknowledges the city’s dredging project and the varying water levels within the CMP. Residents from Buena Vista Santurce were enthusiastic about the visualizations of the botanical garden proposal, however, additional input from residents of the Israel-Bitumul community is necessary.

## LAYOUT AND PROGRAM

The site interacts with the CMP in two ways: through a recreational water channel and an expansive boardwalk along the edge of the CMP. The water channel provides an opportunity for water recreational activity, featuring a kayak rental and boat launch. The boardwalk directly connects to the CMP and acts as viewing platform and community gathering space.

Community members, tourists, and scientists can study the flora and fauna of the CMP ecosystem through the central botanical garden, the cultivated mangrove areas, and various stations for bird observation and water quality monitoring located along the boardwalk. There are two flexible open spaces that can serve the community for events and activities: a large lawn and the boardwalk-plaza along the CMP edge. Both spaces are approximately 12,000 square feet and can be used for large festivals, up to approximately 1,000 people, or traditional recreational activities. The design elements of this gateway water plaza can be scaled down and applied to other water plazas along the CMP.



- ① OPEN LAWN
- ② BOTANICAL
- ③ PLAZA
- ④ MAIN BOARDWALK
- ⑤ WATER MONITORING STATION
- ⑥ KAYAK RENTALS
- ⑦ CULTIVATED MANGROVES
- ⑧ MANGROVE BUFFER ZONE
- ⑨ BIRD OBSERVATION DECK
- Ⓥ PERSPECTIVE VIEW

FIGURE 47 A design proposal for site 6.

## WATER MANAGEMENT PRACTICES

This water plaza applies a slightly different approach for managing stormwater. Overall, the site functions as an “open system,” allowing tidal fluctuations from the CMP to flow through and penetrate the interior of the plaza. In addition, the site captures surface runoff from the Paseo del Caño Sur and stores and filters it through underground detention cells in the lawn and then through the botanical garden before it reaches the CMP. The site will manage approximately 71,200 cubic feet of stormwater above and below ground.

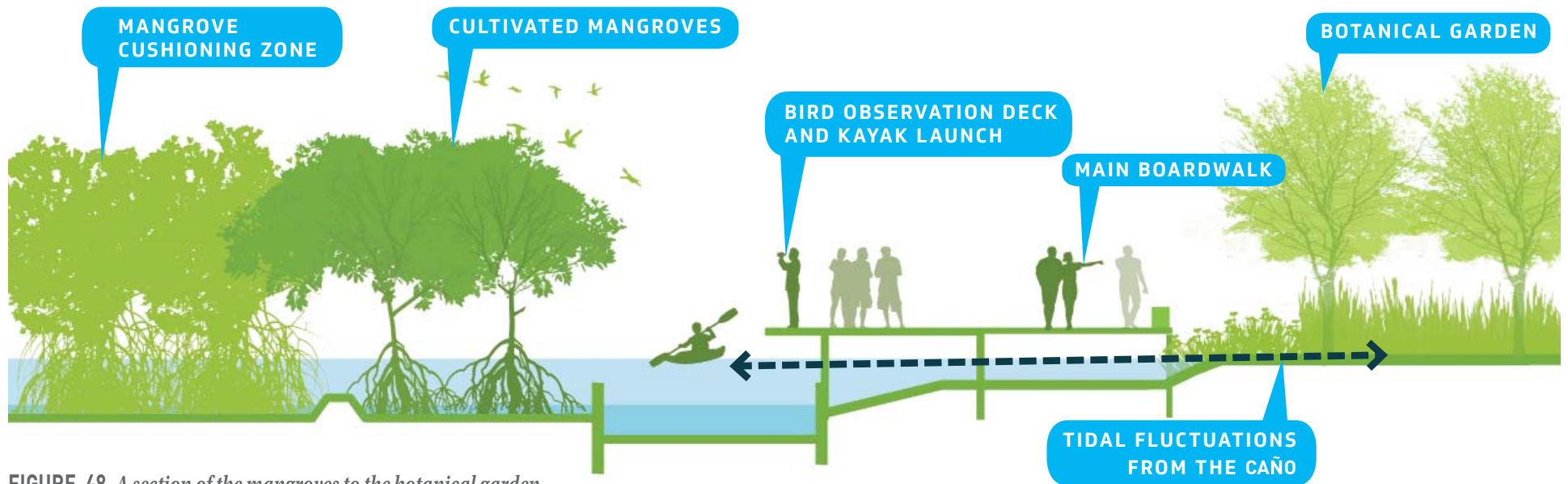


FIGURE 48 A section of the mangroves to the botanical garden.



**FIGURE 49** *A view from the boardwalk to the Caño. The expansive boardwalk and plaza along the caño allow for adequate space for everyday activities and community events.*

5 SITE 6: ISRAEL-BITUMUL GATEWAY WATER PLAZA  
RELEVANT DESIGN PRECEDENTS



*An iconic waterfront creates a place for communities to gather and opportunities to host local events. It also creates unique views and access to the water, providing a scenic thoroughfare.*

**FIGURE 50** A waterfront space, El Malecón in Naguabo, Puerto Rico  
PHOTO CREDIT <http://www.primerahora.com>



**FIGURE 51** A waterfront space, Malecón de Arroyo in Puerto Rico  
PHOTO CREDIT <http://www.primerahora.com>

# 6 NEXT STEPS

In May 2016, after a planning process of more than six years, the Secretary of the Army for Civil Works approved the Feasibility Study and the Environmental Impact Statement of the CMP-ERP. The approval of the Feasibility Study and the Environmental Impact Statement allowed the allocation of federal funds for the project, whose estimated costs are \$215 million, of which the federal government will provide 65% and ENLACE must contribute 35% as part of the local cost share. In June 2016, ENLACE and the USACE signed the Design Agreement for the CMP-ERP, thus initiating the pre-construction, engineering and design (PED) phase of the project. As part of the PED phase, geotechnical investigations have been conducted, hydrographic and topographic data has been collected, and the horizontal/vertical controls of the CMP-ERP have been established, among other activities. ENLACE and USACE will complete the design for the landscape and recreational components of the CMP-ERP, some of which have been conceptually developed as part of this SGIA project.

The consultation and citizen participation process celebrated during the development of the CMP District Plan has made it possible to reach consensus on the priorities of each community, including programmatic needs, public space character and identity, connectivity strategies, and opportunities for community economic development, among others. During the engagement process for this SGIA project, the community also identified concerns regarding the procurement of financing sources, maintenance and sustainability of green infrastructure applications, security in public space, and the necessary coordination of all of the various projects to be developed within the CMP District. This last concern is crucial, since to ensure the cost-benefit optimization of the investments of the individual projects, work must be done through a comprehensive systems approach, where the green infrastructure, the sanitary and gray stormwater infrastructure systems, and the dredging project are coordinated. This is an even greater challenge because it depends on each entity, such as the Municipality of San Juan, Puerto Rico Aqueduct and Sewer Authority (PRASA) and ENLACE, concurrently obtaining financing for their respective projects.

On the other hand, the work developed will serve ENLACE as a tool to determine priorities of specific areas included in this project, but also

presents a variety of adaptable scenarios applicable to public spaces in other communities within the CMP District Plan. In addition, the participation process allowed for the establishment of collaboration with government agencies, organizations, and the Municipality of San Juan to proactively work for the integration of the various projects. Organizations such as, the San Juan Bay Estuary Program (SJBEP) proved to be particularly interested in the proposed green infrastructure projects and is envisaged as a collaborator in the gathering of scientific information and monitoring of systems; and in promoting the educational aspects of green infrastructure to the community in general. All the approaches explored in this project are transferable to other areas of the city, and elsewhere in Puerto Rico, experiencing similar flooding issues to make urban infrastructure more resilient to extreme storm events.

## POTENTIAL FINANCING SOURCES

TIGER's Discretionary Funds (Transportation Investment Generating Economic Recovery) offered by the Department of Transportation, seek innovative proposals with multimodal projects that generate economic development opportunities and promote the complete streets vision, providing safe and affordable transportation to urban and rural communities. The Paseo del Caño Norte project could potentially benefit from these competitive funds. For more information: <https://www.transportation.gov/tiger>

The Department of Housing and Urban Development (HUD) provides funding through the Community Development Block Grants (CDBG) program. The city of San Juan already benefits from these funds through the Municipal Entitlement Area, and Puerto Rico in general through the Insular Area. The funds are directed primarily to low-income communities for the development of viable urban communities; decent housing and adequate livable environments; and providing opportunities for economic development. The funds provide for relocation of families and demolition of structures; construction and improvement of public facilities; development of activities related to energy conservation; and programs to create or retain economic development. Under these parameters, all the proposals included in this project qualify, in addition to the infrastructure

improvements necessary for the full development of the communities. The Albert Einstein High School site and San Antonio Asís Plaza site, particularly seek to improve the services of the facilities of the neighboring schools for the benefit of communities and for the conservation of resources. For more information: [https://portal.hud.gov/hudportal/HUD?src=/program\\_offices/comm\\_planning/communitydevelopment/programs](https://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs)

The U.S. Environmental Protection Agency (EPA) provides the Clean Water State Revolving Fund (CWSRF), for which Puerto Rico qualifies. The fund emerges from the Clean Water Act as a financial assistance program for a range of water infrastructure projects, including green infrastructure projects. The fund is managed in Puerto Rico by the PR Environmental Quality Board; and its aim is to capitalize on other infrastructure developments. It requires a state pairing of 20% and also provides low or zero-interest loans and grants to states, municipalities, and nonprofit organizations. For more information: <https://www.epa.gov/cwsrf>

In addition to this resource, the new Water Infrastructure and Resiliency Finance Center's Water Finance Clearinghouse may also be used to search for funding sources available to US territories for stormwater infrastructure projects. For more information visit: <https://ofmpub.epa.gov/apex/wfc/f?p=165:1:1787613072094::NO::>

Lastly, there are several online green infrastructure cost estimation tools that can be utilized for planning and advancing these design proposals. For the EPA's National Stormwater Calculator visit: <https://www.epa.gov/water-research/national-stormwater-calculator> And for the Water Environment & Reuse Foundation's BMP and LID Whole Life Cost Tools visit: [http://www.werf.org/c/KnowledgeAreas/Stormwater/ProductsToolsnonWERF/BMP\\_and\\_LID\\_Whole\\_Li.aspx](http://www.werf.org/c/KnowledgeAreas/Stormwater/ProductsToolsnonWERF/BMP_and_LID_Whole_Li.aspx)

Potential funding sources from local government agencies is somewhat uncertain at this time. Puerto Rico is experiencing financial problems that are creating difficulties in delivering even essential services. Given this, government agencies and municipalities have been forced to postpone

the development of capital improvement projects. In the meantime, it is essential to continue to encourage infrastructure agencies such as PRASA, the Highway and Transportation Authority, the Department of Transportation and Public Works, and the Municipality of San Juan to work together and to embed green infrastructure practices as an essential element in the development of the built environment; that provides social, environmental, and economic benefits, and above all, protects water quality.

Strategic existing alliances with related entities such as the San Juan Bay Estuary Program (SJBEP) must continue to advance the projects and environmental restoration initiatives of the CMP; being an integral part of protecting and maintaining the estuary. The SJBEP is leading water quality restoration projects and monitoring pilot projects, and has developed an environmental database that could nurture the design development of the proposals included in this project. Their water quality monitoring database includes dissolved oxygen, pH, and turbidity data; and can be viewed here: <http://www.estuario.org/index.php/agua/monitoreo> . Likewise, the program has access to funds that could complement the proposed work.

