23 OCTOBER 2019
DOWNTOWN DEVELOPMENT DISTRICT

DDD Stormwater Infrastructure Plan: Phase 1

Waggonner & Ball Architecture/Environment
GAEA Engineering Consultants
Sherwood Design Engineers

WAGGONNER & BALL

I Problem Definition

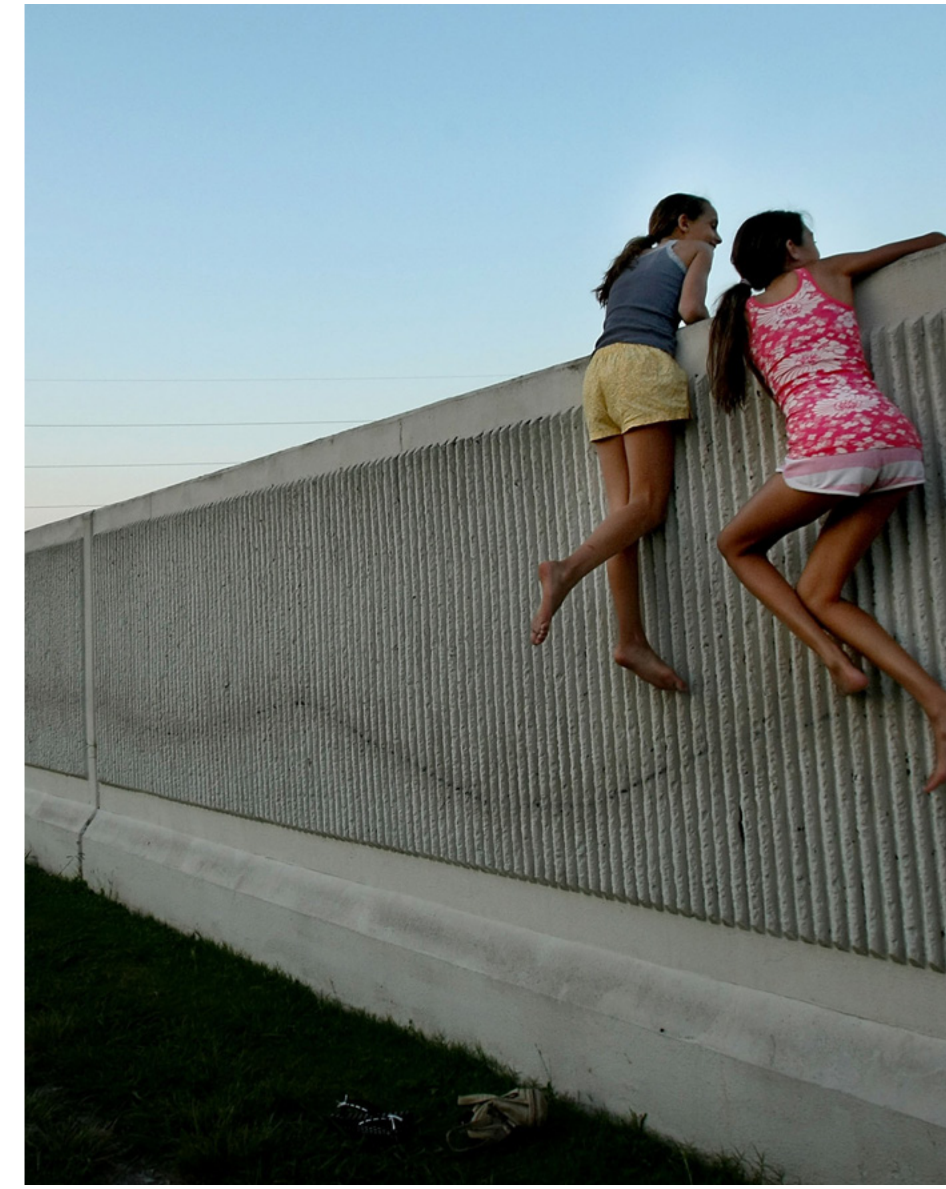
II Analysis Maps

III Engineering Analysis

IV Interventions

1 **Drainage systems are regularly overwhelmed by too much runoff, causing flooding.**

2 **Excessive pumping causes the land to sink by lowering groundwater levels.**



3 **Critical water assets are wasted, hidden behind walls, buried underground, or pumped out of sight.**

Design Storm Events

Rainfall Intensity and Volume

2-Year 50% Chance	5-Year 20% Chance	10-Year 10% Chance	25-Year 4% Chance	100-Year 1% Chance
2.3 inches in 1 hour	2.9 inches in 1 hour	3.3 inches in 1 hour	4.1 inches in 1 hour	5.4 inches in 1 hour
5.4 inches in 24 hours	6.9 inches in 24 hours	8.3 inches in 24 hours	10.5 inches in 24 hours	12.4 inches in 24 hours

W &B

Why is Louisiana seeing more 'showers on steroids,' intense downpours these days?

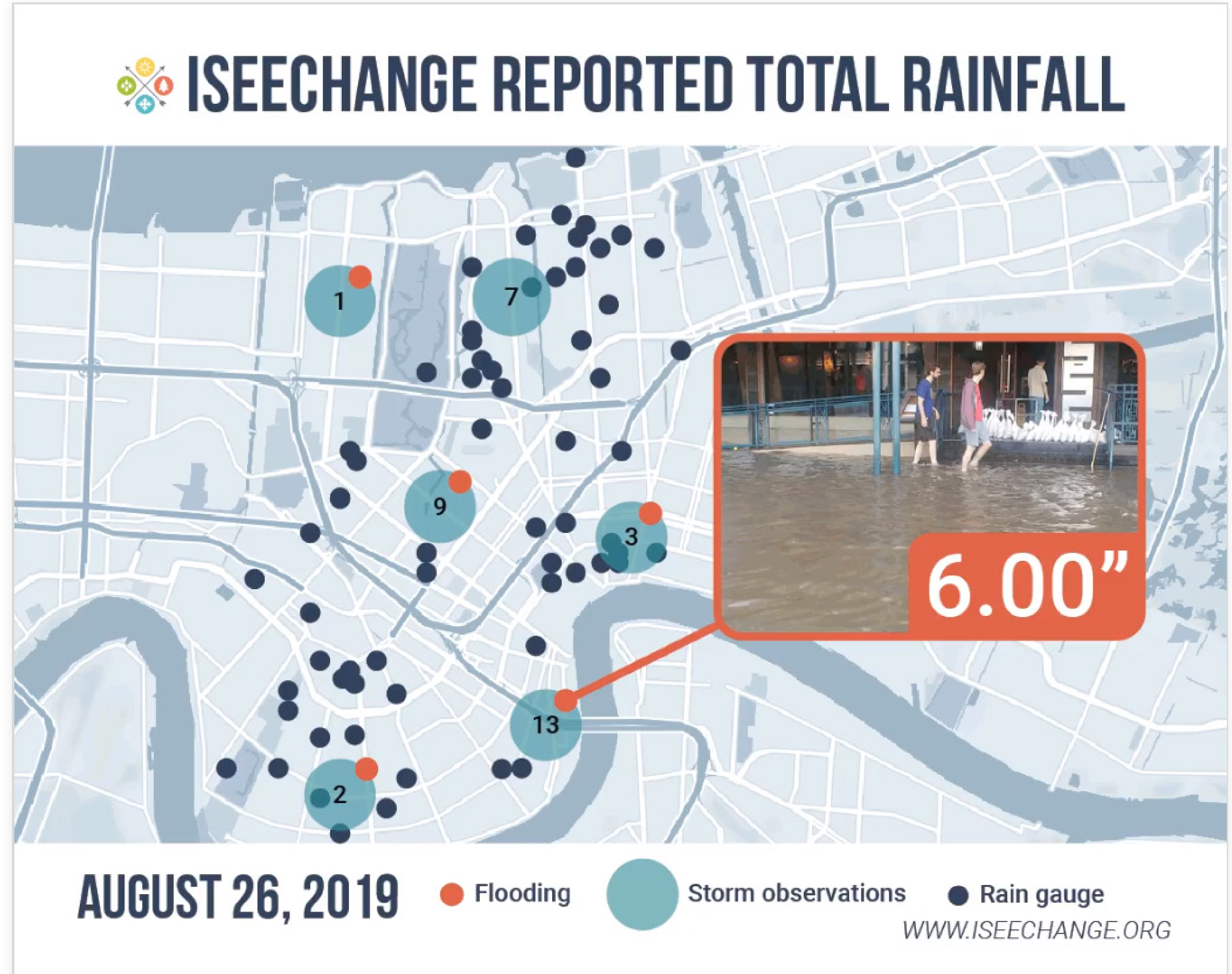
BY CHARLES LUSSIER | STAFF WRITER AUG 11, 2019 - 5:32 PM

If it seems like rainfalls in south Louisiana are becoming more intense and flash flooding more frequent, it's not your imagination.

A new research study led by a team from LSU closely examined rainfall amounts in Louisiana over a period of decades and found that today's showers, on average, are more intense and deposit their rain loads more quickly than they did in the early 60s.

The result is flash flooding that surprises and sometimes strands motorists and leaves streets and yards underwater before the rains soon move on.

Credit: nola.com



Drainage canals in New Orleans CBD found to be mostly clear. So why the flooding? TBD.

BY JEFF ADELSON | STAFF WRITER SEP 11, 2019 - 11:18 AM

Sewerage & Water Board officials have now examined most of the major underground canals in and around downtown New Orleans, hoping the investigation would offer an explanation for recent flooding after heavy rains in the area.

It hasn't.

"We haven't had anything that jumps out at us as saying, 'This is the reason we're seeing flooding,' " S&WB General Superintendent Bob Turner told a City Council committee on Wednesday.

Crews are now delving deeper for answers by looking in the smaller pipes that crisscross the area, Turner said, trying to determine whether they're blocked or possibly just too small to carry the huge amounts of water that have fallen on the Central Business District in recent storms.

Credit: nola.com

Council hoping porous paving in parking lots will help flooding

Requirements set for new commercial surfaces in N.O.

BY JESSICA WILLIAMS
Staff writer

New Orleans is a city often inundated by water and, just as often, a city frustrated in its attempts to deal with it.

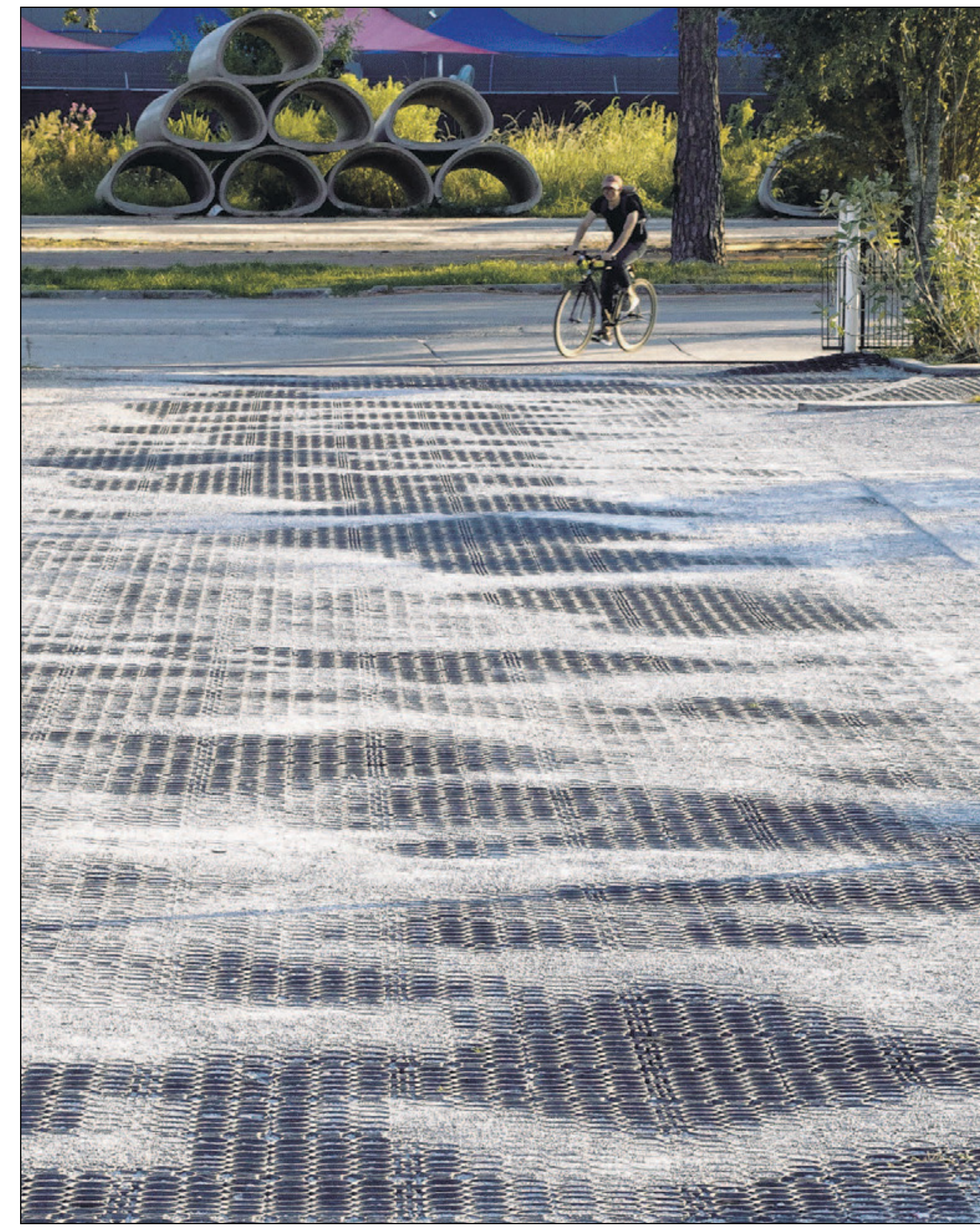
Now, joining a movement that supporters say will help mitigate flooding and soil subsidence, the City Council has decided that all new commercial parking surfaces in New Orleans must be porous.

The rules unanimously approved by the council last week require businesses to use pervious paving — which lets rainwater flow through it, to be absorbed by the soil beneath it — for any new projects. The rules do not require businesses to replace existing concrete lots and do not affect residential construction.

Parking spaces must be porous under the new rules, but "driving lanes" in parking lots do not need to be. That's because heavily traveled parts of parking lots tend to need the heavy-duty support that impervious materials provide.

Porous parking surfaces obviously won't solve the problem of street flooding in New Orleans or clear the canals and pipelines that drain the city. But they will lighten the burden placed on the city's drainage system during heavy rainfalls and curb stormwater runoff to Lake Pontchartrain, council members said.

"Simply put ... water cannot simply be absorbed through traditional pavement and concrete," said Councilman Jason Williams, who co-sponsored the ordinance. "Permeable solutions ... allow water to be absorbed into the ground, reduce runoff vol-



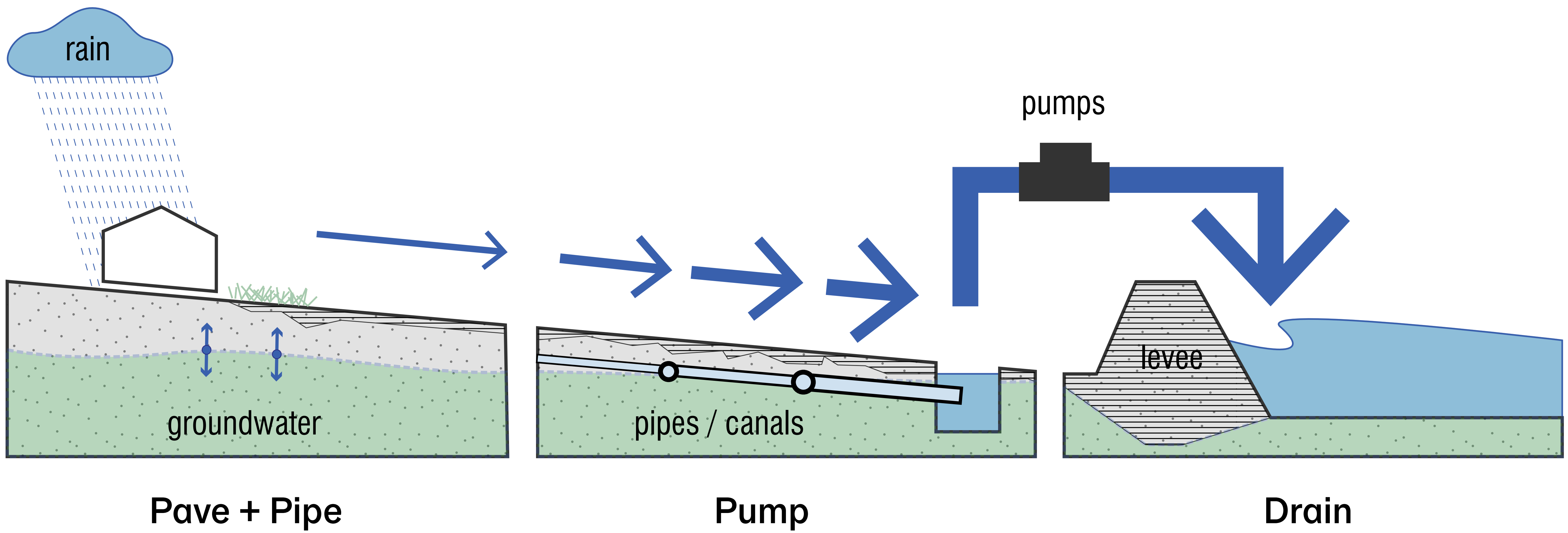
STAFF PHOTO BY DAVID GRUNFELD

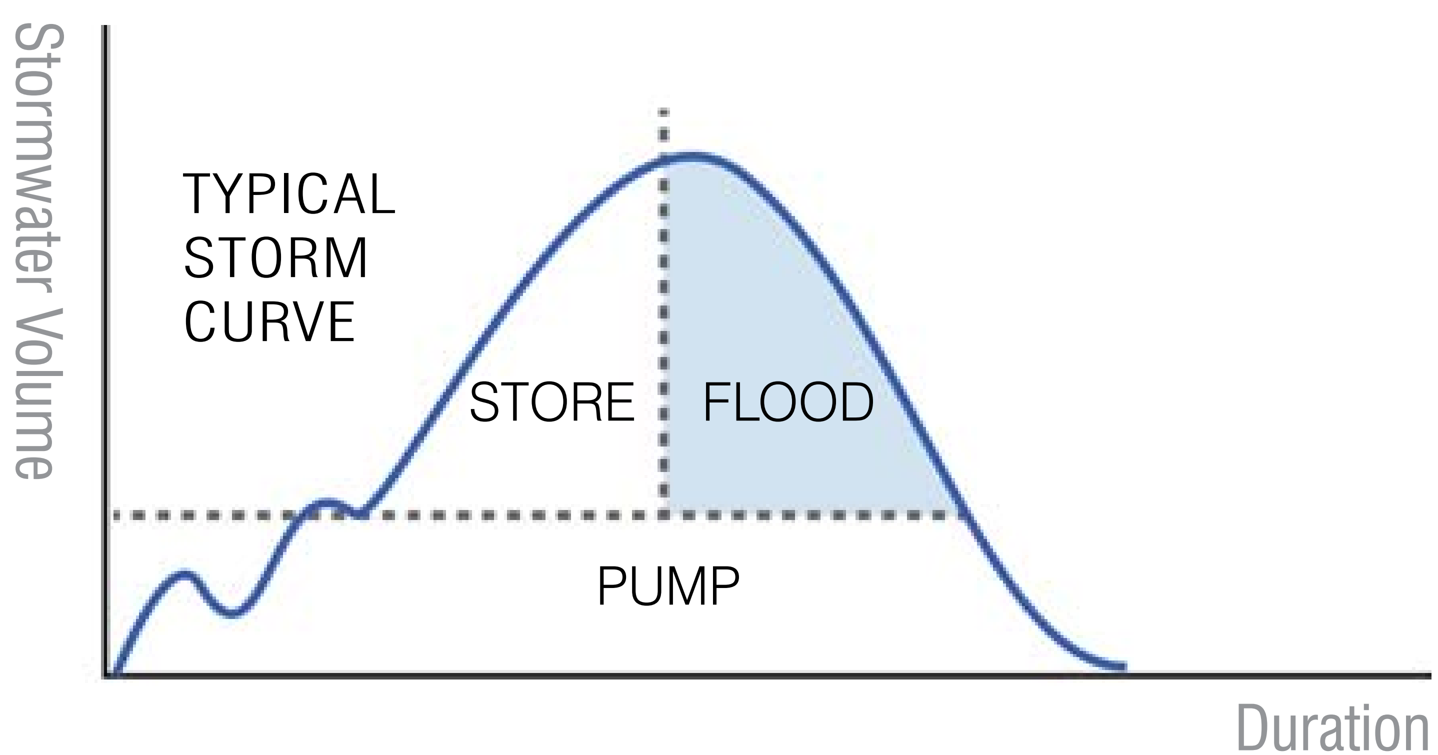
Parkway Bakery & Tavern in New Orleans has a permeable parking lot.

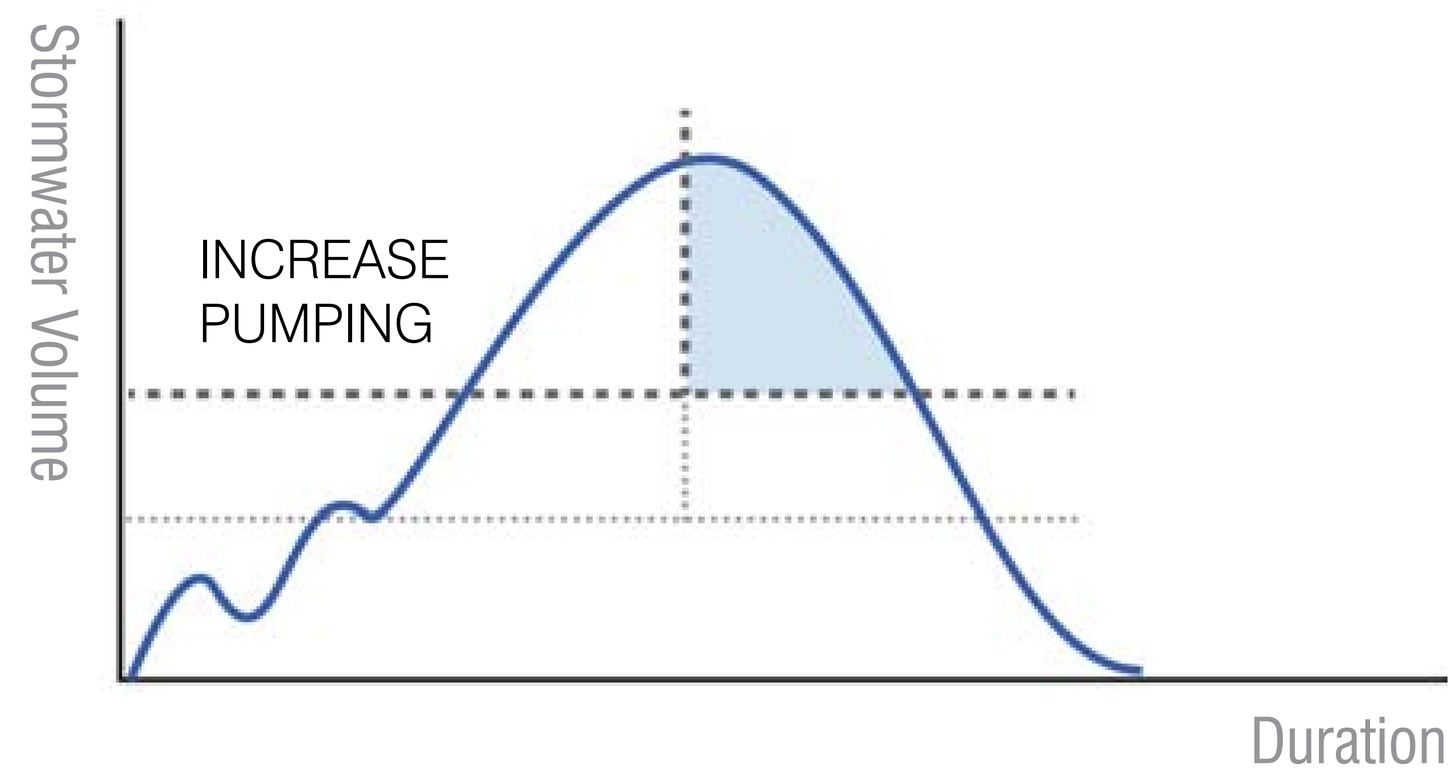
Credit: nola.com

Historic Drainage Strategy

System Reliant on Pipe and Pump Capacity

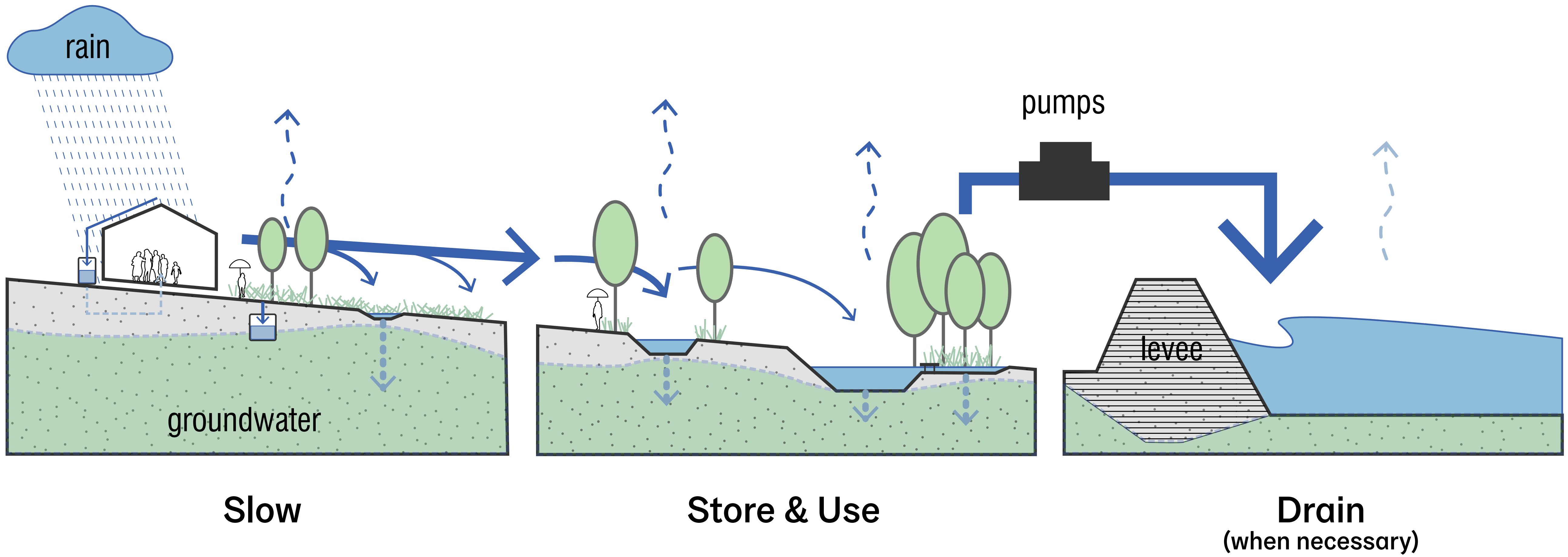


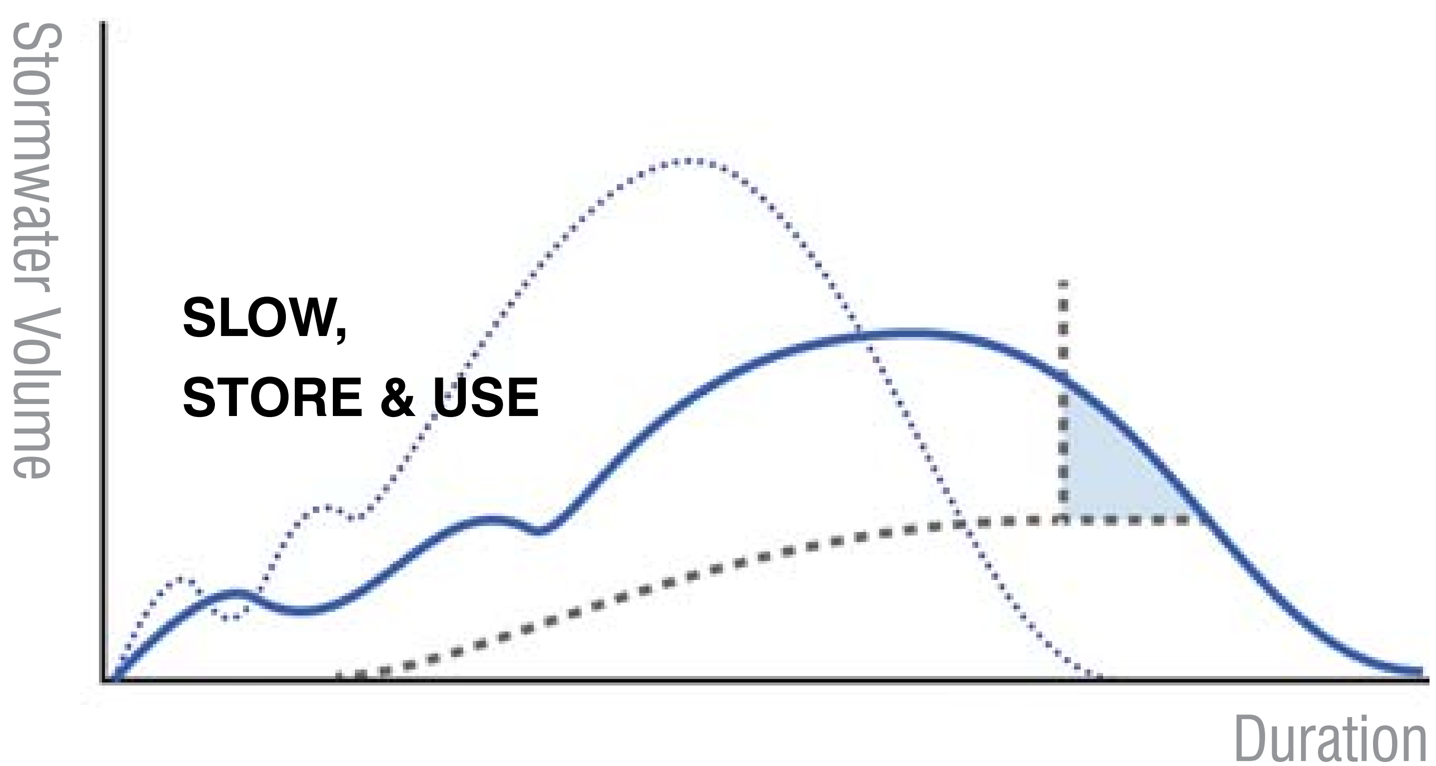




Paradigm Shift

Living With Water® Approach

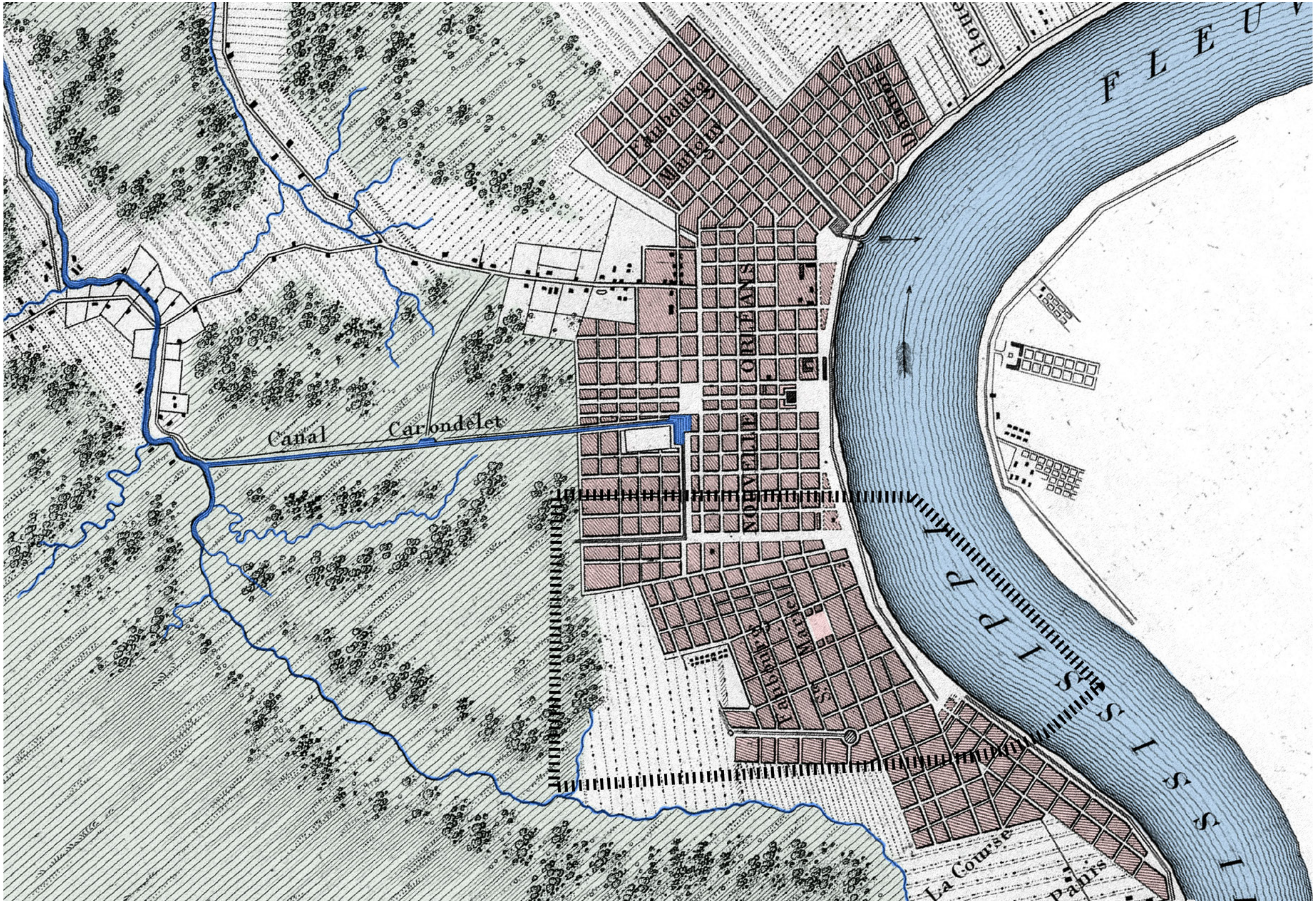




1828 Survey Map

Development Pattern on High Ground, Along Bayous

New Orleans was settled on the high ground along the Mississippi River and along Bayou St. John, which provided access to the Gulf of Mexico. Drainage followed topography. Stormwater runoff flowed across the landscape from the higher ground down to the low lying swamps at the “back of town.”



LEGEND

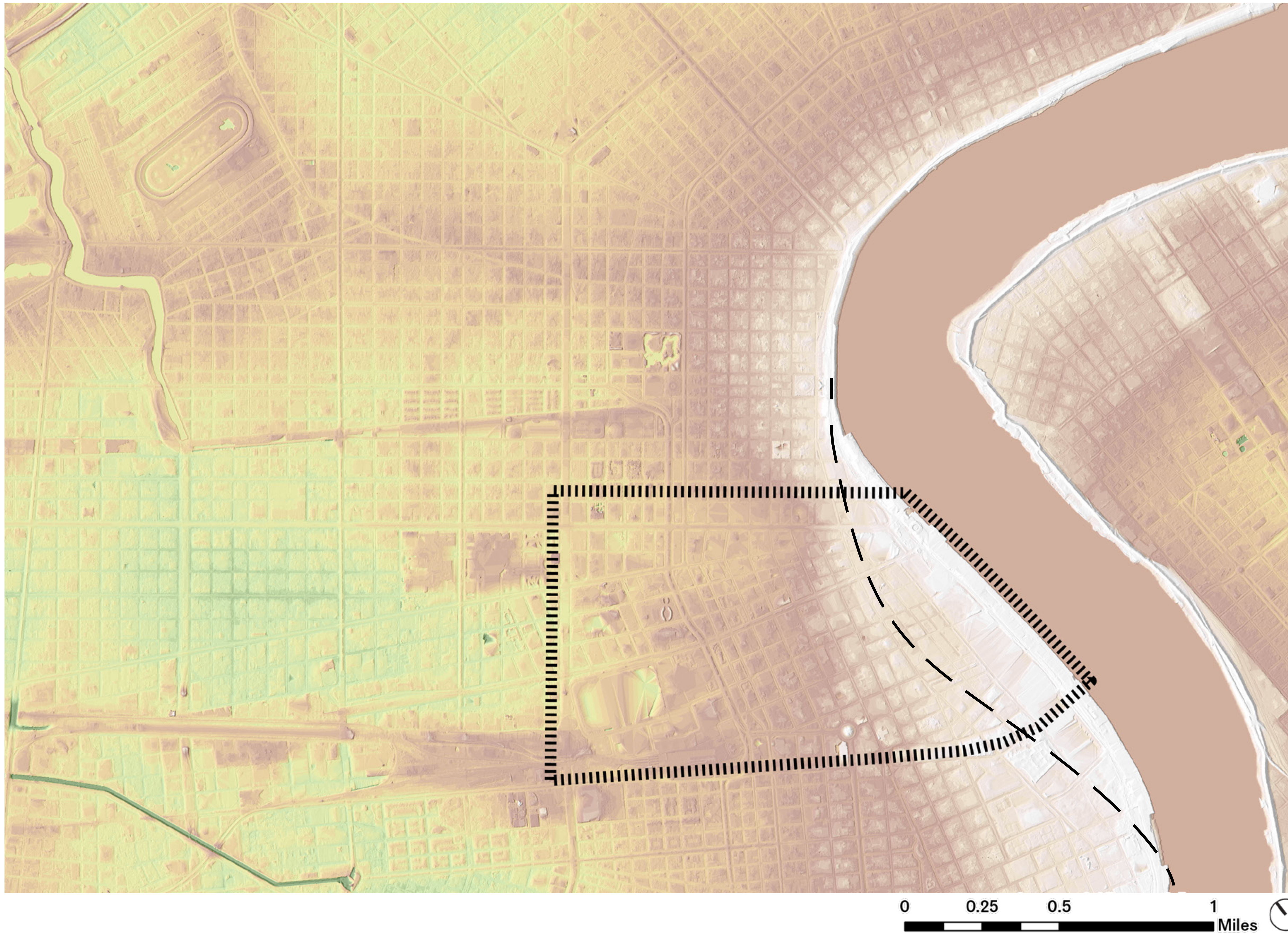
DDD Boundary

0 0.25 0.5 1 Miles

Surface Elevation

Shallow Slope, Ridges and Depressions

The land surface of the city slopes very gradually from the high ground along the river to the former swampland at the bottom of the bowl. The land is very flat - when minor ridges and depressions trap runoff, localized flooding results. The drainage system helps to move the water away from these low points to the pump stations.



LEGEND

DDD Boundary

Surface Elevation

- ≤-8
- ≤-7
- ≤-6
- ≤-5
- ≤-4
- ≤-3
- ≤-2
- ≤-1
- ≤0
- ≤1
- ≤2
- ≤3
- ≤4
- ≤5
- ≤6
- ≤7
- ≤8
- ≤9
- ≤10
- ≤11
- ≤12

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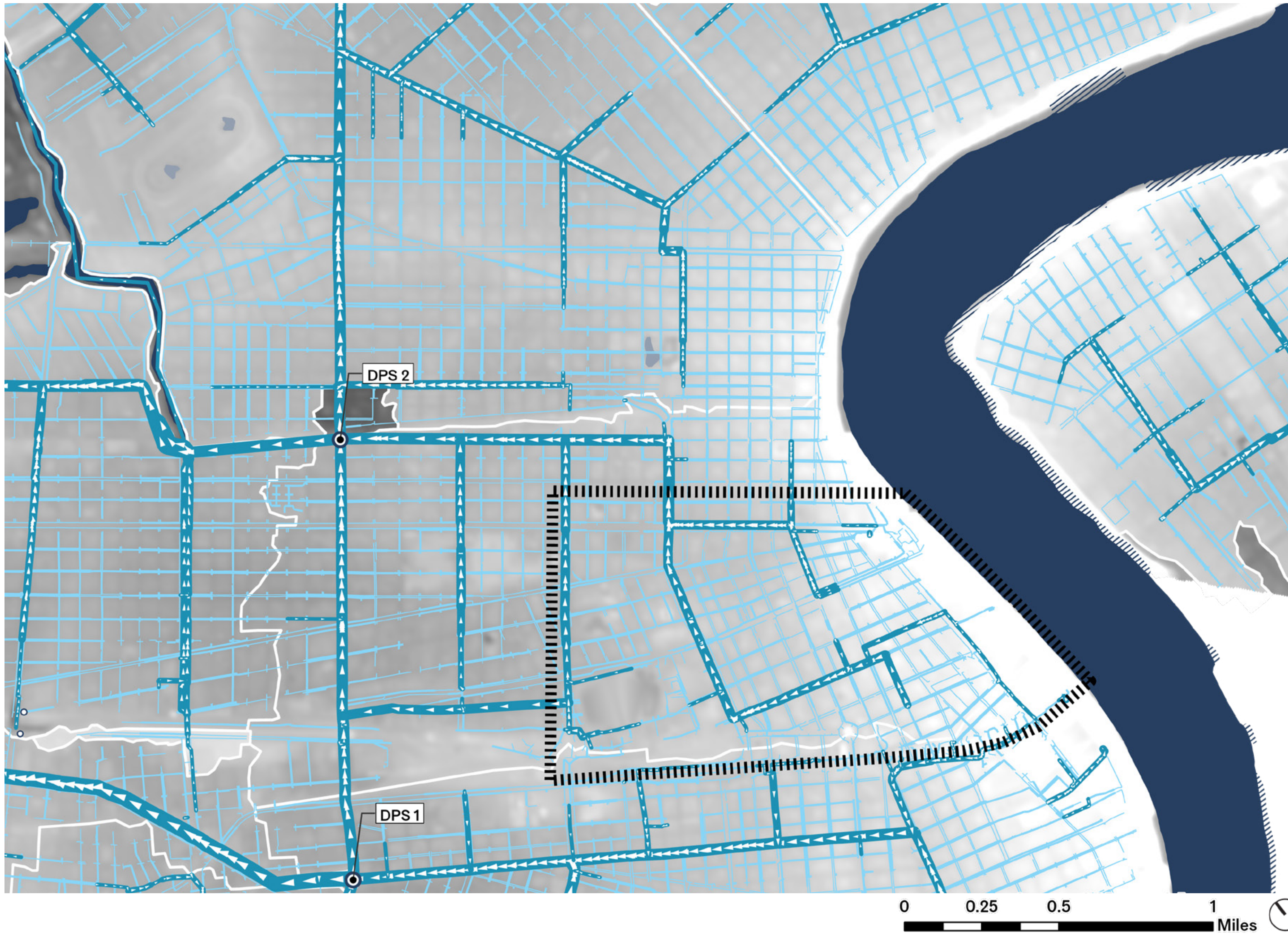
Drainage System

Pipes to Canals to Pumps

The New Orleans drainage system collects surface runoff in catch basins, which connect to pipes and then canals, where it flows by gravity to pump stations, which lift the stormwater into outfall canals. The Sewerage and Water Board manages the pump stations and the canals and pipes larger than 36” in diameter. The Department of Public Works manages the smaller lateral pipes and catch basins in the streets.



LEGEND

DDD Boundary

DPW Drainage System

≤1.23 ft

≤7.07 ft

SWB Drainage System

≤12.57 ft

≤28.27 ft

≤50.27 ft

≤113.10 ft

≤452.39 ft

≤100000.00 ft

Elevation

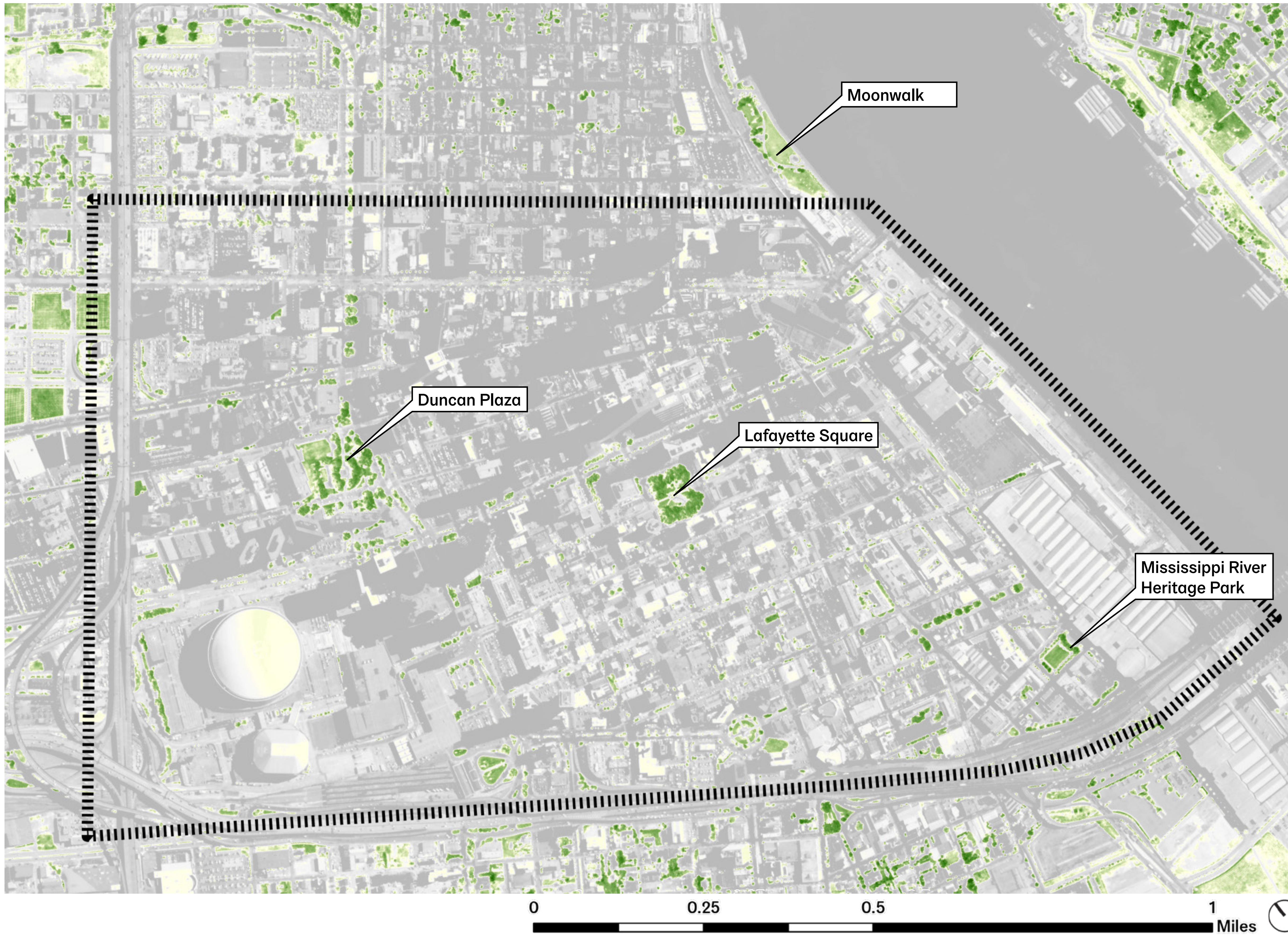
10'

-10'

Tree Canopy + Vegetation

Impervious Surfaces Increase Flooding and Heat Island Effect

Infrared aerial imagery illustrates vegetation and tree canopy. The DDD and Drainage Pump Station (DPS) 2 watershed have the highest impervious surface ratios in New Orleans. This results in large stormwater runoff volumes and high urban heat island effect.



LEGEND

- DDD Boundary
- Trees and Vegetation

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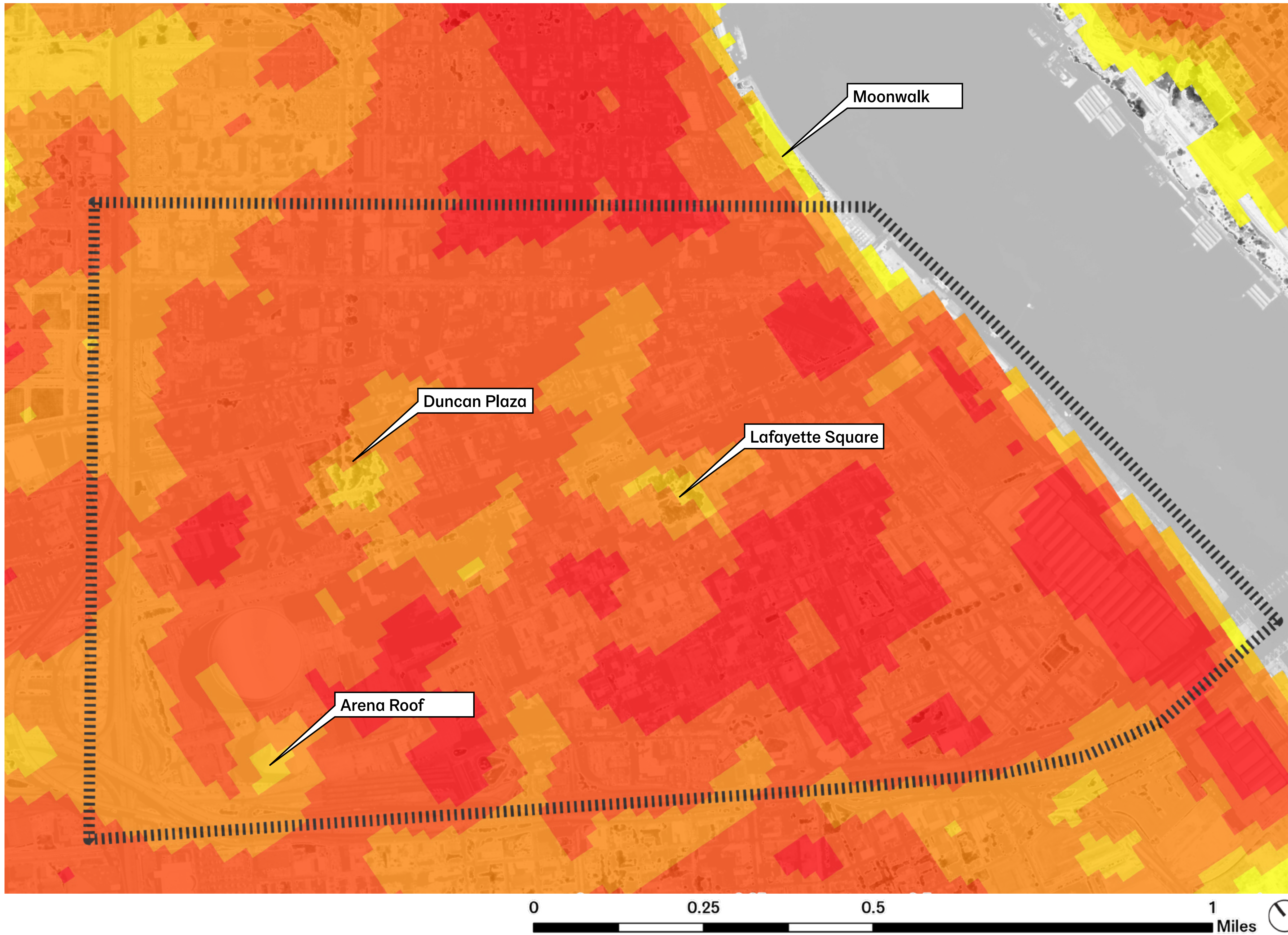
Heat Island Effect

Urban Development, Increased Heat Hazard

Remote sensing data of heat radiated from surfaces. Parking lots, roofs, and roads absorb and radiate heat. Trees, vegetation, water, and insulated cool roofs reflect heat, reducing the heat island effect.



LEGEND

- DDD Boundary
- Extreme Heat
- Severe Heat
- High Heat
- Above Average Heat

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Drainage System

SWB and DPW Networks

Major SWB canals within the DDD are located on Claiborne Ave, Loyola Ave, Julia St, Canal St, and Chartres St. They collect flow into the St. Louis Canal, which leads to DPS 2 on Broad St. Sub-catchment areas are illustrated here, color coded with impervious surface percentages. DPW drainage pipes are light blue.

LEGEND

- DDD Boundary
- Parks

DPW Drainage System

- DPW Pipes
- SWB Canals

DPS 2 Subcatchments Impervious Surfaces

- +60%
- +65%
- +70%
- +75%
- +80%
- +85%
- +90%
- +95%

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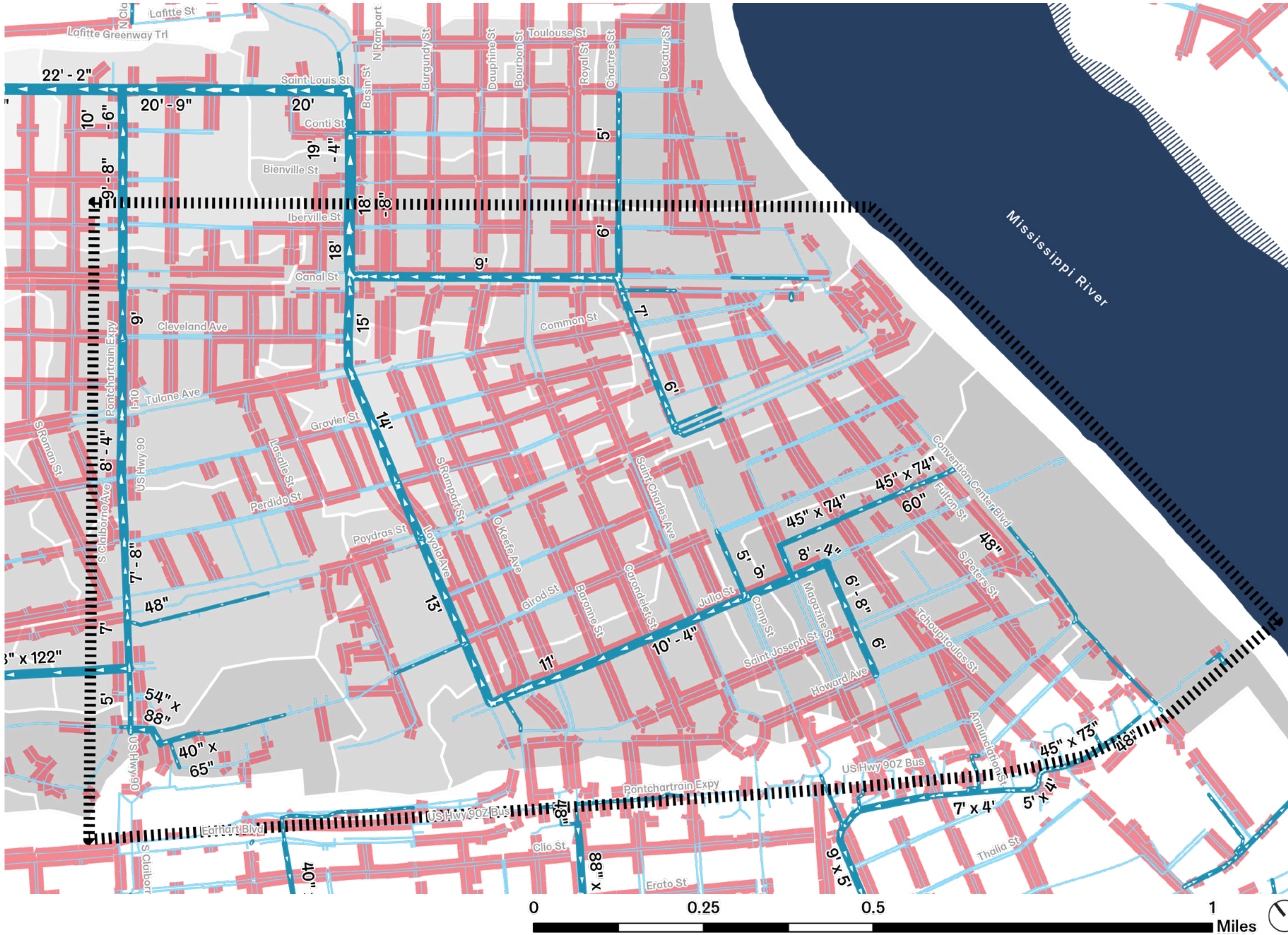
Substandard DPW Pipes

Pipes Less than 15” in Diameter

An estimated total of 126,173 linear feet of pipe are undersized, per DPW minumum standards. This is a major contributor to street flooding during heavy rains.



LEGEND

DDD Boundary

DPW Undersized Pipes

≤15"

Flooding: 10 Year Storm Model

Repetitive Flood Loss

The 10 year statistical storm model rendering at right was created in 2011 by CDM Smith. Overlaid on the drainage system, it indicates areas where the system may be overwhelmed. Pre-Katrina FEMA repetitive loss claim data is overlaid, with dot size relative to total paid for losses. Updated modeling and repetitive loss data should be acquired in a larger study.

LEGEND

- DDD Boundary
- Parks

2011 Modeled 10 Year Storm

- 2 to 10
- 1.5 to 2
- 1 to 1.5
- 0.5 to 1
- 0 to 0.5

2005 FEMA Repetitive Loss Total Paid

- ≤$25,000
- ≤$50,000
- ≤$100,000
- ≤$250,000
- ≤$500,000

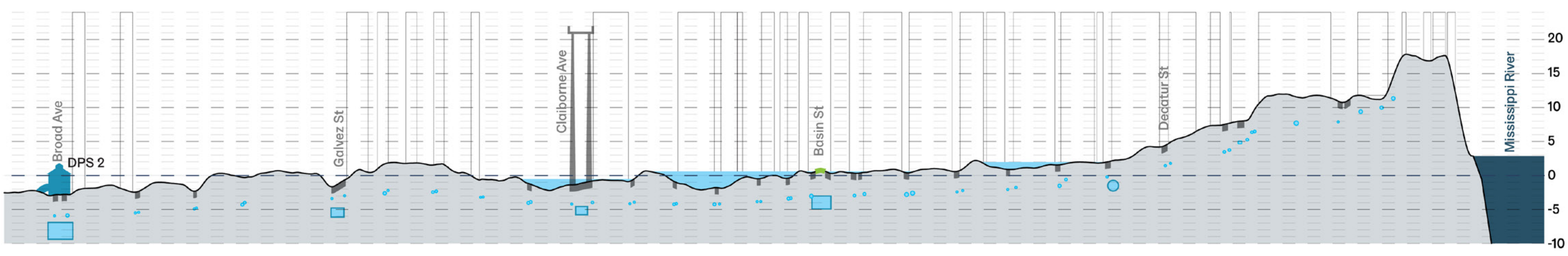
Section Profile at Canal Street

100x Vertical Exaggeration

An exaggerated section profile through areas that experience some of the worst flooding shows how shallow depressions and ridges trap runoff. Between Decatur St/Magazine St and the river, the slope is notably steeper than the nearly flat land area that extends to the pump station at Broad St. Note the large depression between Claiborne Ave and Basin St, and the artificially higher land at the new University Medical Center at Galvez St.

LEGEND

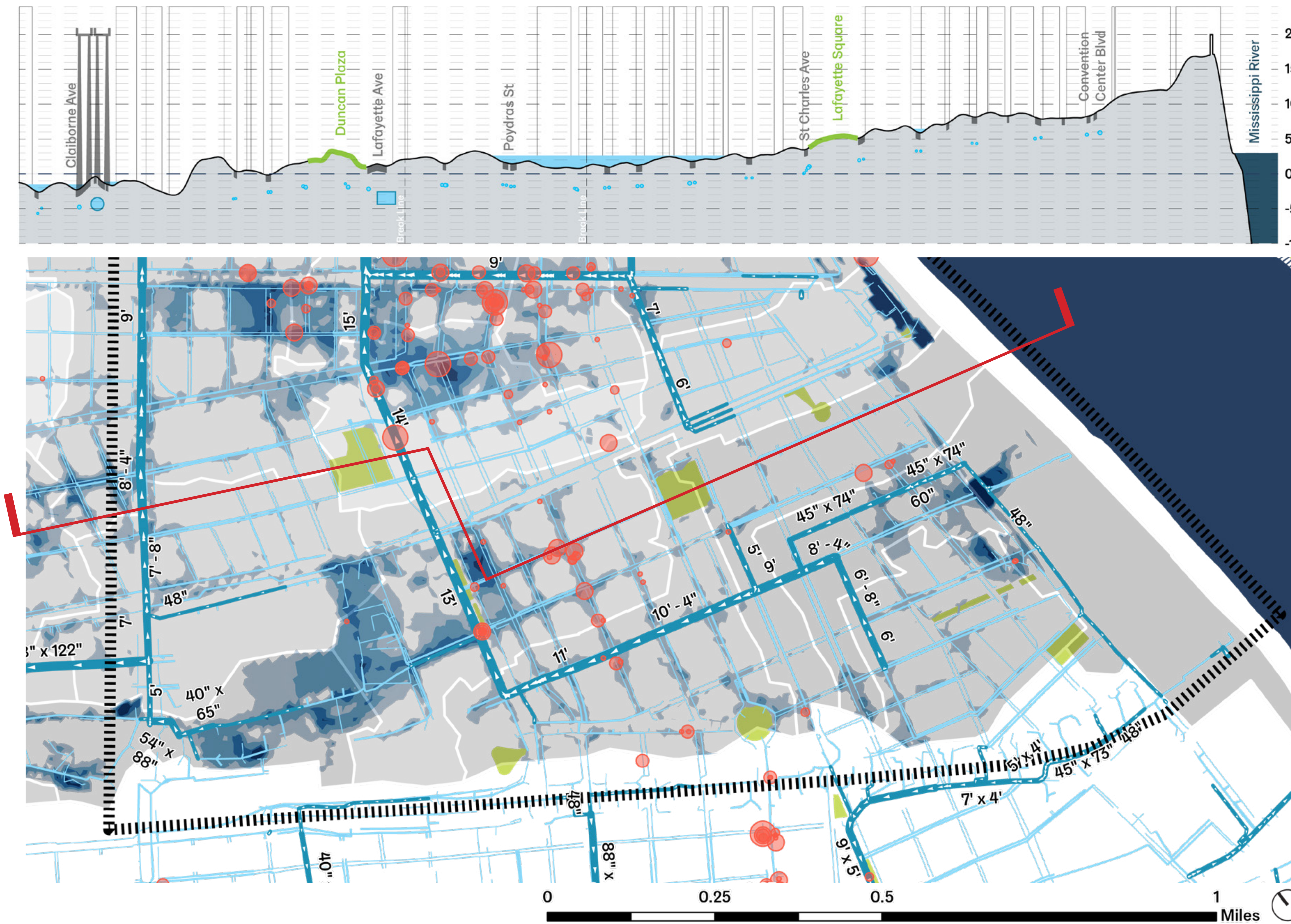
- 1in = 1/8mi Horizontal Scale
- 50x Vertical Exaggeration
- 100x Drainage Sectional Exaggeration
- DPW
- SWB
- Flooding
- Building Footprint
- Pavement
- Parks



Section Profile at Duncan Plaza

100x Vertical Exaggeration

An exaggerated section profile through areas that experience some of the worst flooding shows how shallow depressions and ridges trap runoff. Both Duncan Plaza and Lafayette Square are ideally located on relatively higher ground to store intercepted stormwater.

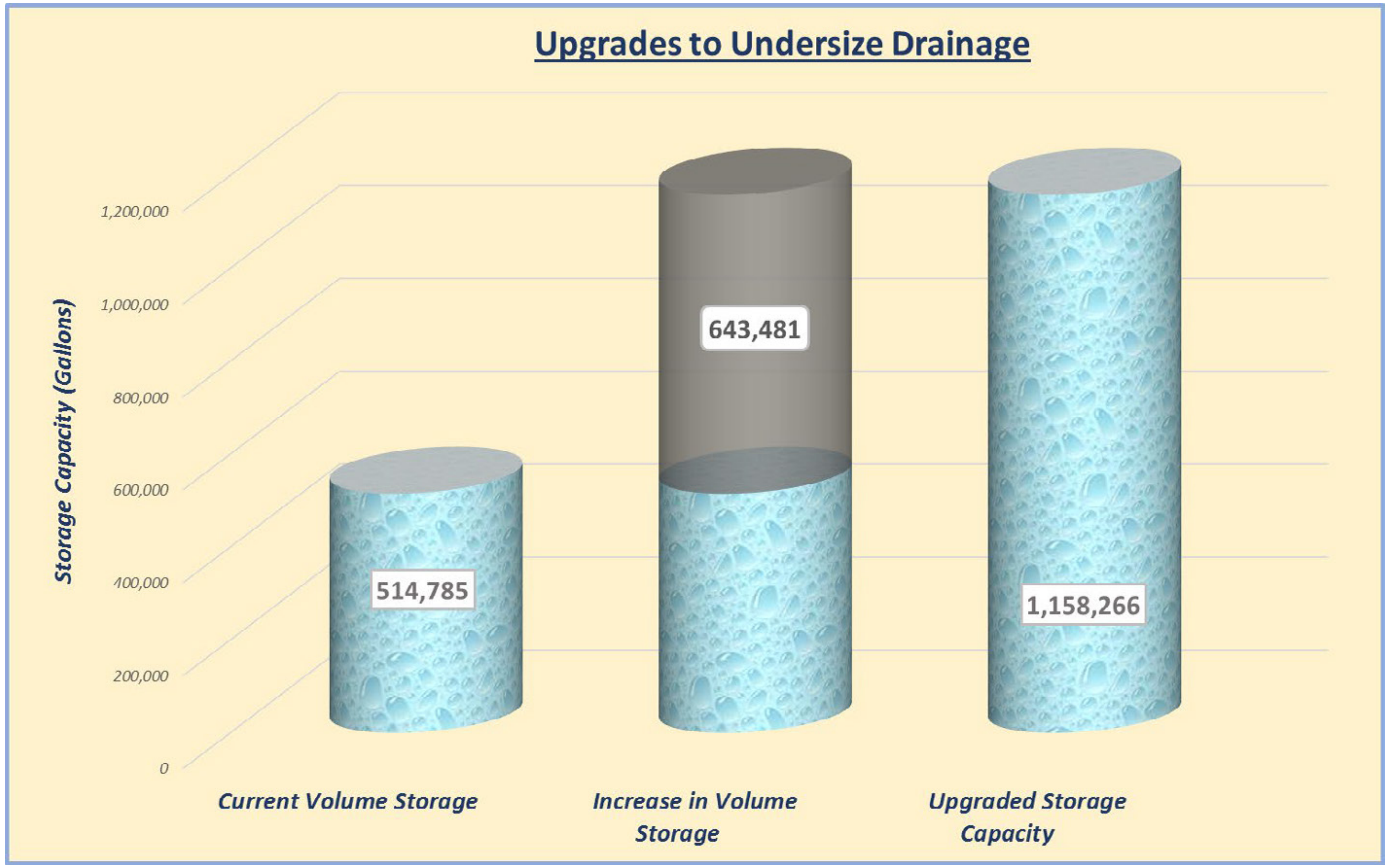


LEGEND

1in = 1/8mi	Horizontal Scale
50x	Vertical Exaggeration
100x	Drainage Sectional Exaggeration
	DPW
	SWB
	Flooding
	Building Footprint
	Pavement
	Parks

Grey Infrastructure Improvements

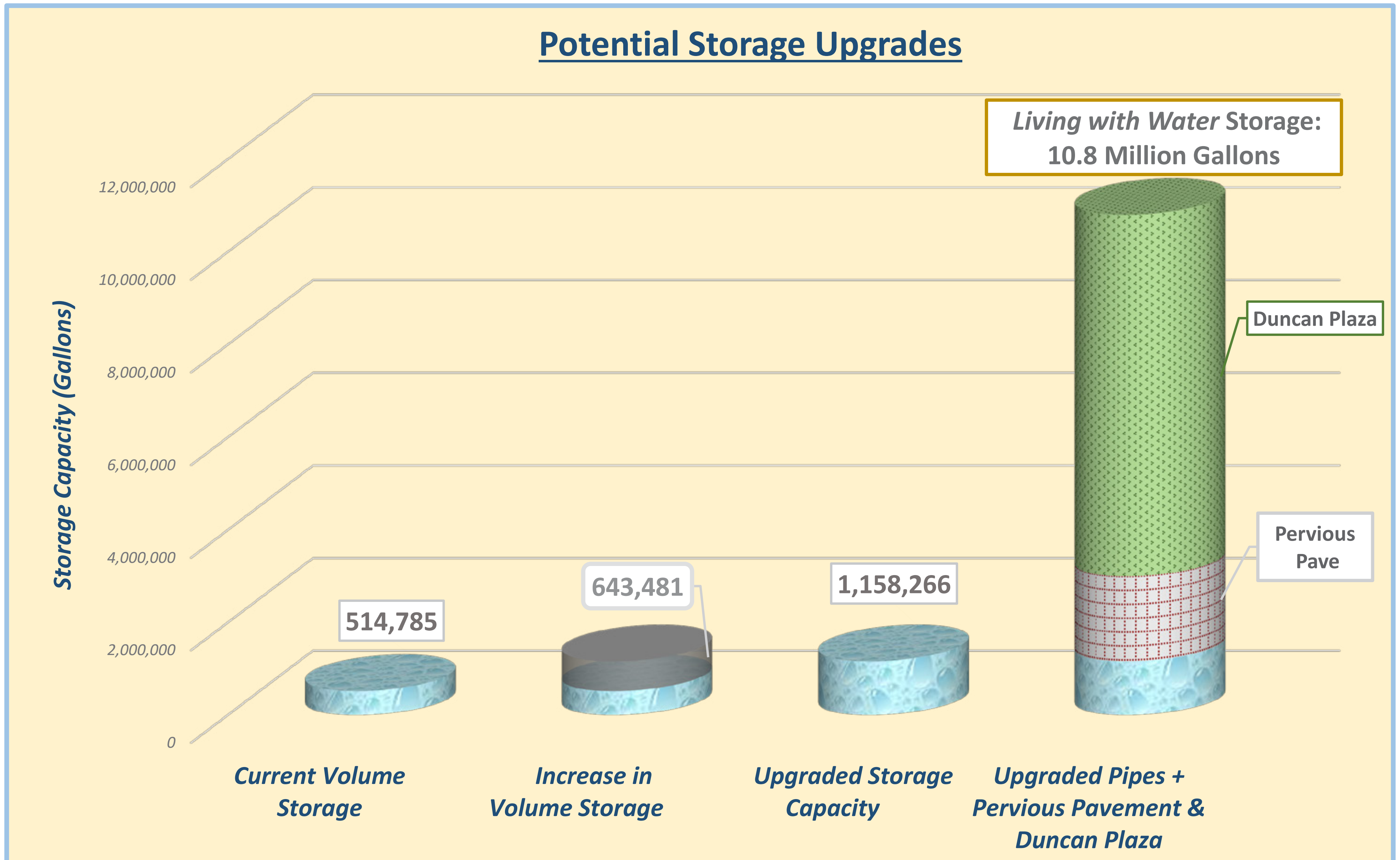
Addressing Undersized Drainage in the Current System



- **126, 173 linear feet of drainage infrastructure is of diameter smaller than 15"**
- **Upsizing these pipes to 15" in diameter meets Department of Public Works Standards and increases stormwater volume storage capacity of the system by *643,481 Gallons***
- **Storage Capacity of the improved grey infrastructure more than doubles current capacity of the undersize "main line" drainage pipes**
- **Upgrades to pipe storage increase total storage capacity to *1,158,266 Gallons***

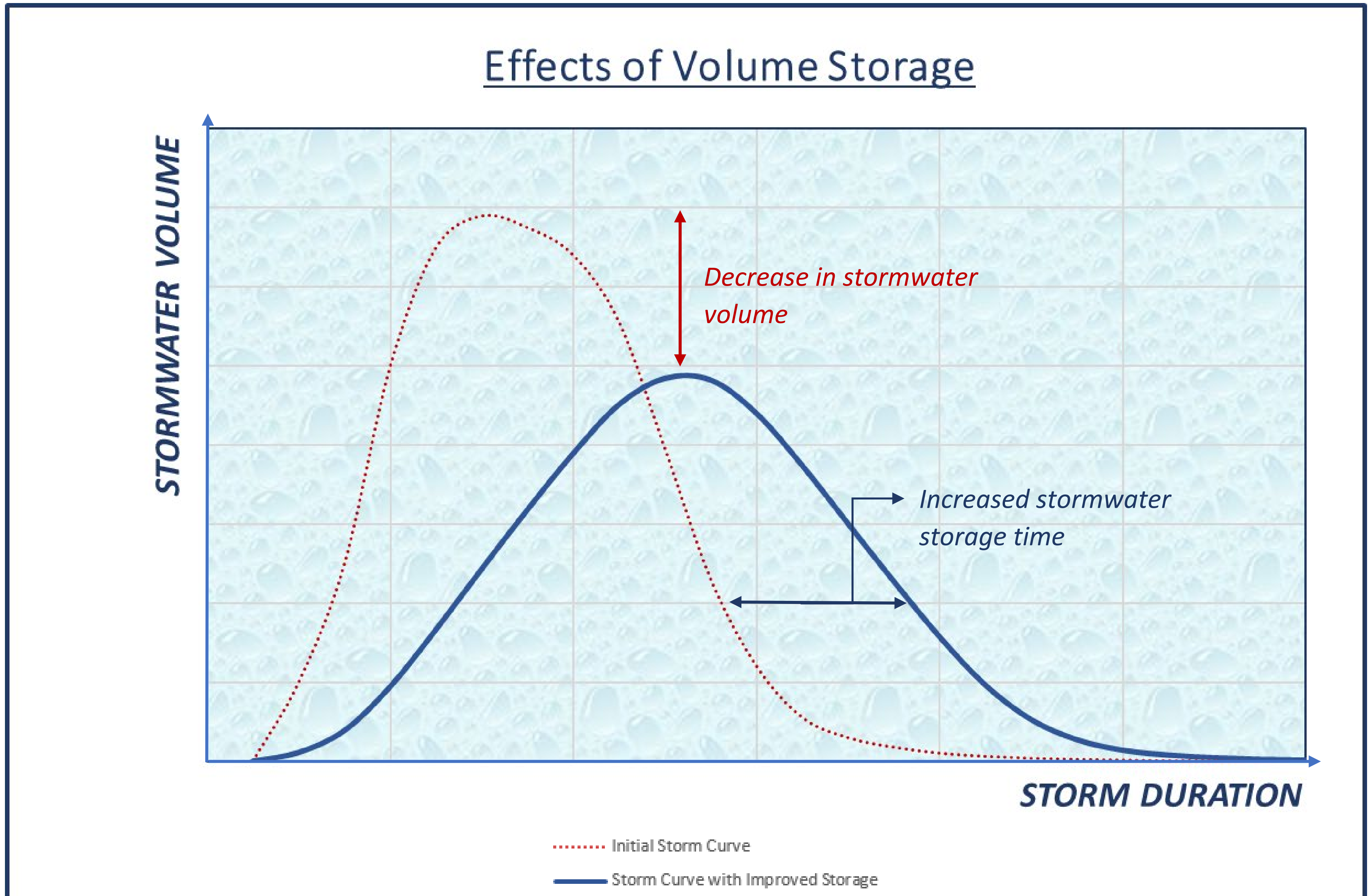
Grey + Green Infrastructure Improvements

Large Scale Storage in Streets and Open Spaces



- **Upgrades to pipe storage increase total storage capacity to *1.15 Million Gallons***
- **Pervious pavement parking lanes on 45 blocks provide a capacity of approximately *1.85 Million Gallons***
- **With the 7.8 Million Gallons of underground storage at Duncan Plaza the total potential storage volume will be *10.8 Million Gallons***

Stormwater Storage Benefits



- **Increased storage decreases initial stormwater volume surplus**
- **Increased storage in the system allows more capacity for traditional grey infrastructure to manage stormwater**
- **Surplus stormwater is managed by the traditional system over more time**
- **Utilizing and maximizing available storage is essential to break the cycle of <u>initial inundation</u> + <u>recovery</u>, and creates a steady system of stormwater management**

Proposed Stormwater Interventions

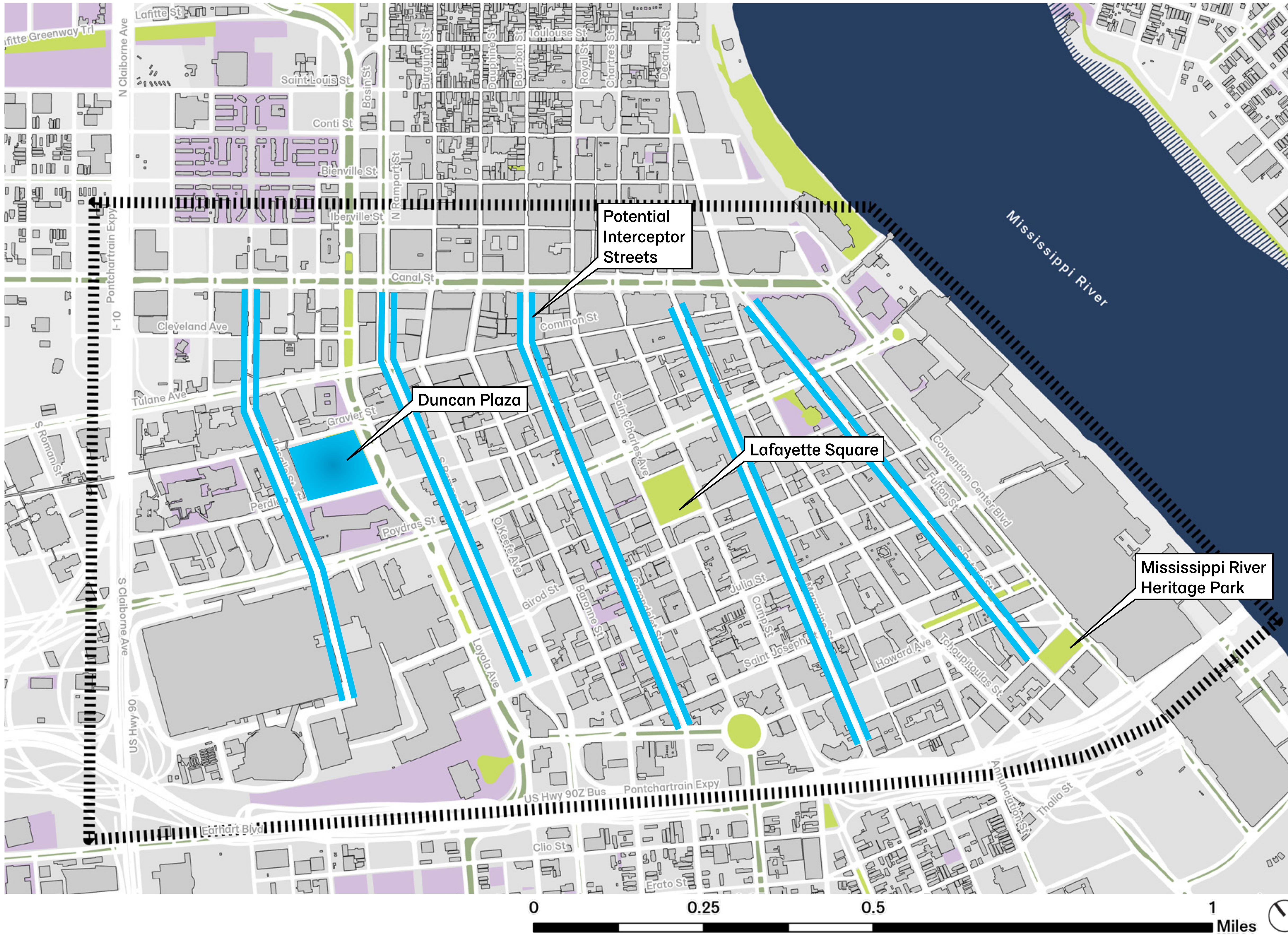
Pervious Paving and Large Subsurface Storage

Intensive stormwater interventions have been proposed. Pervious parking lanes with gravel subsurface storage has been proposed for 45 blocks, combined with large subsurface detention in Duncan Plaza. The arrangement of the pervious street interventions has yet to be designed, but this graphic shows an option where cross slope streets would intercept runoff.

Publicly owned parcels, parks, and neutral grounds are additional opportunities for large scale water storage.

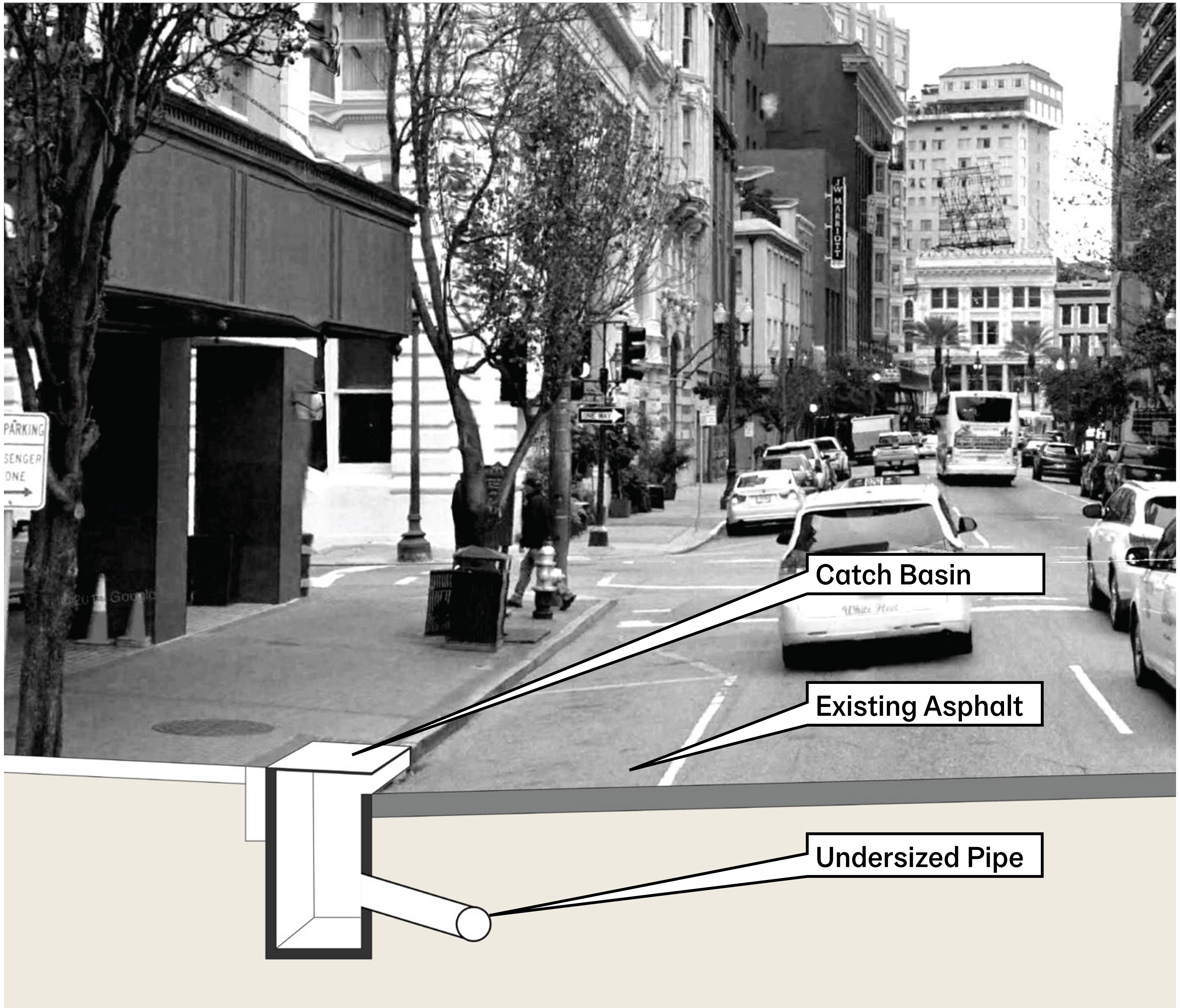
LEGEND

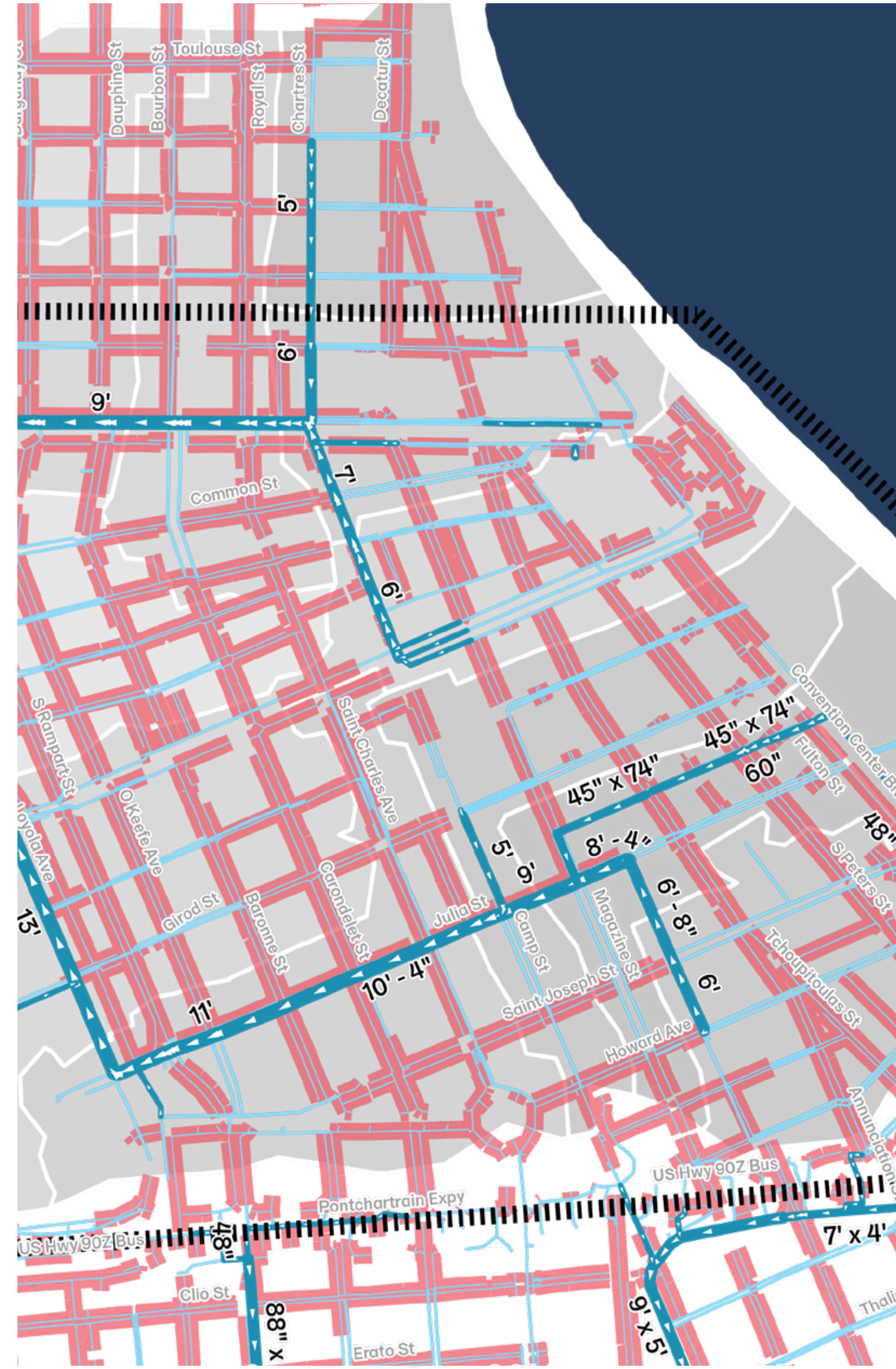
- DDD Boundary
- Parks
- Medians
- Public Parcels
- Potential Interceptor Streets
- Water Plaza



Existing Street Condition

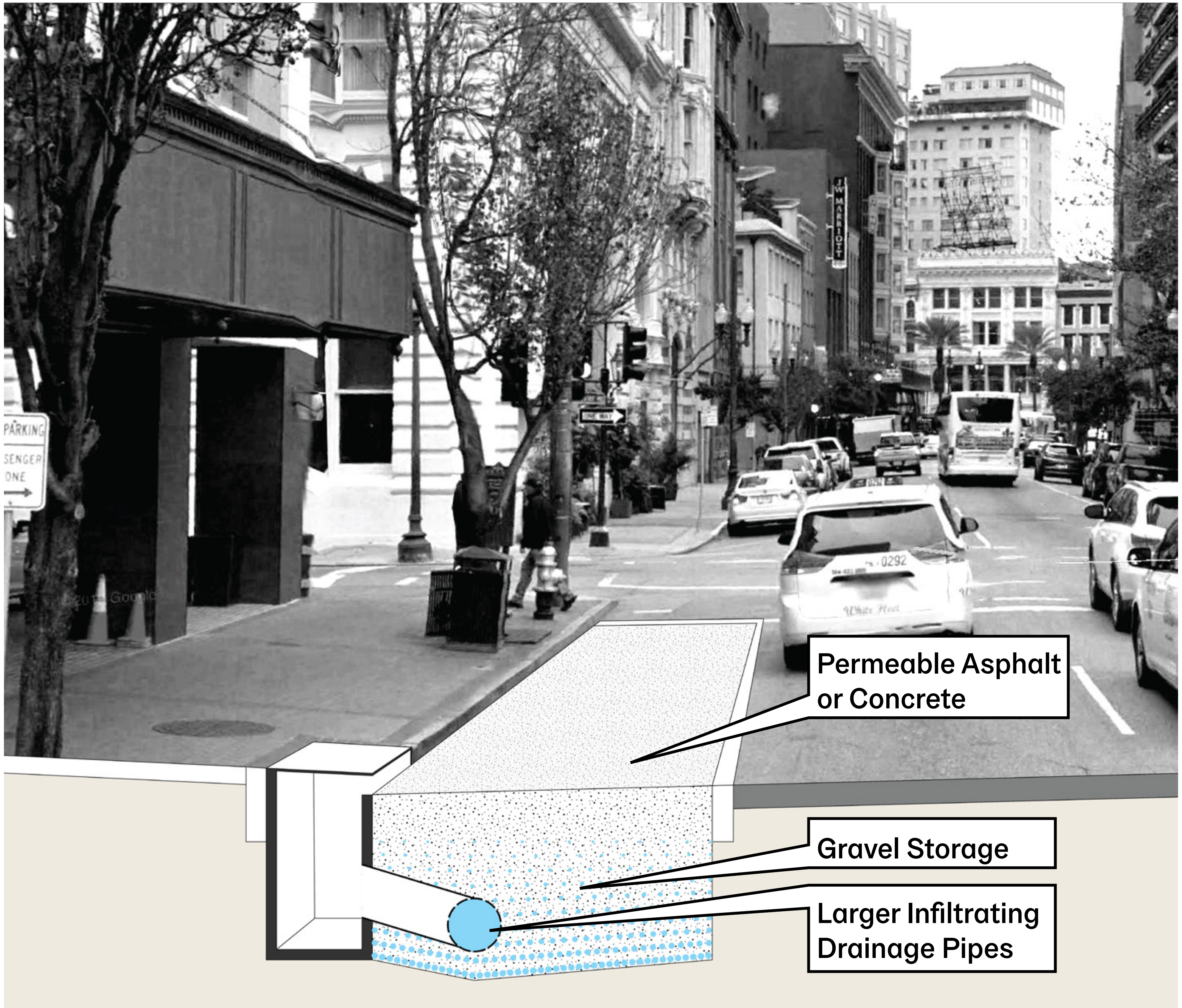
Undersized Pipes, Impermeable Surfaces, and Frequent Flooding





Proposed Interceptor Street

Improved Drainage, Permeable Parking Lane, Subsurface Storage

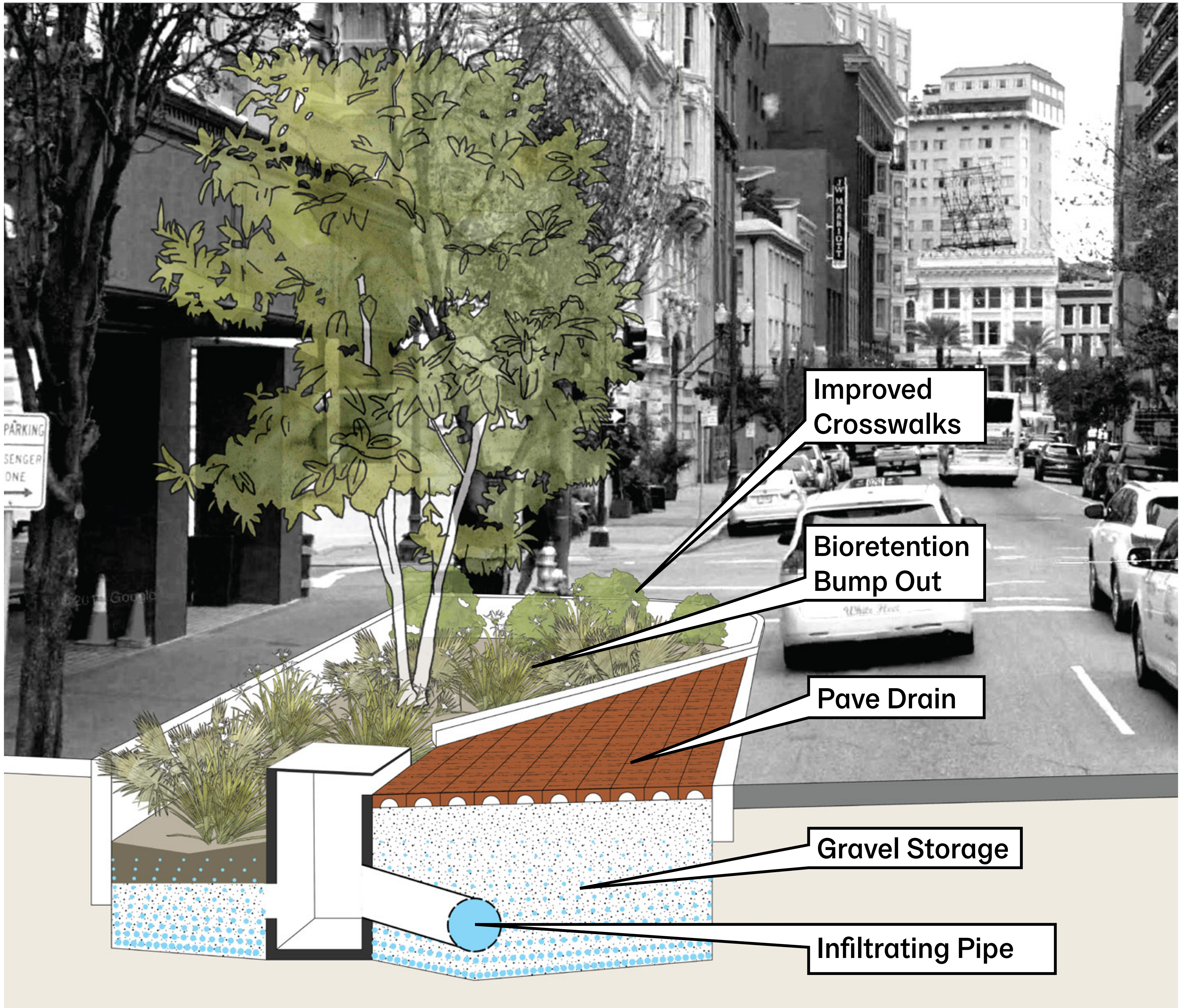


Permeable Concrete Parking Lane at S. Galvez

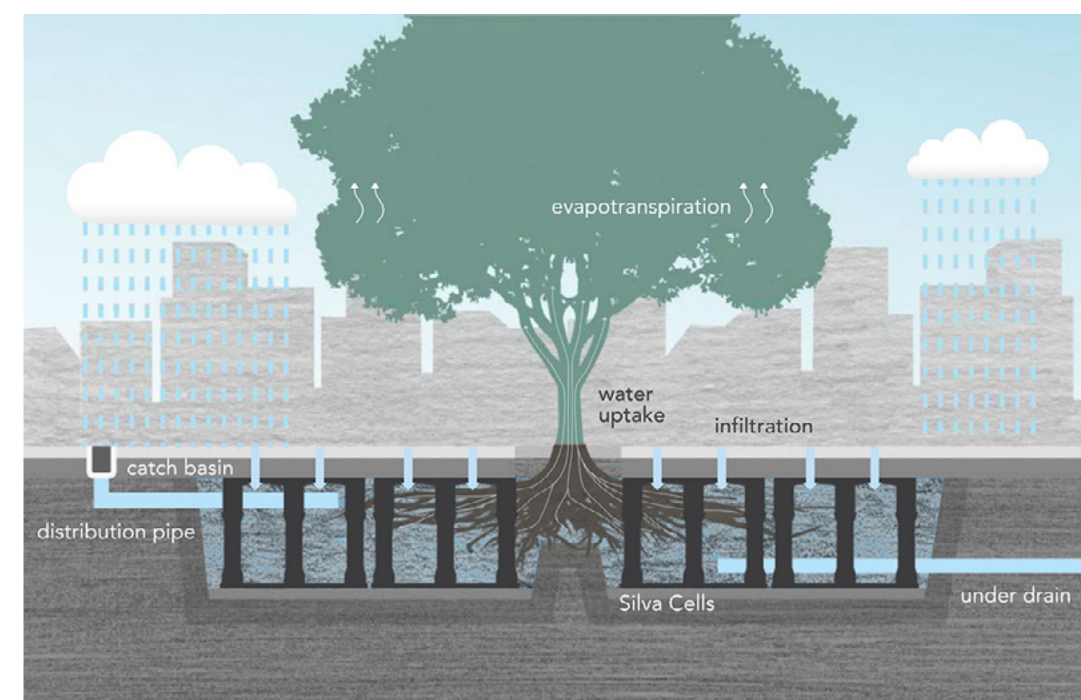
Alternate: Pave Drain Modular Permeable Pavers

Living With Water® Alternative

Improved Storage, Ecological, and Spatial Quality



Bioretention Plantings, Seattle



Structural Sidewalks Provide Space for Tree Roots and Water Storage

Right of Way Green Infrastructure

Green Infrastructure Precedents

Green Street Program
Portland

Green Streets
Program
Rego Park
New York

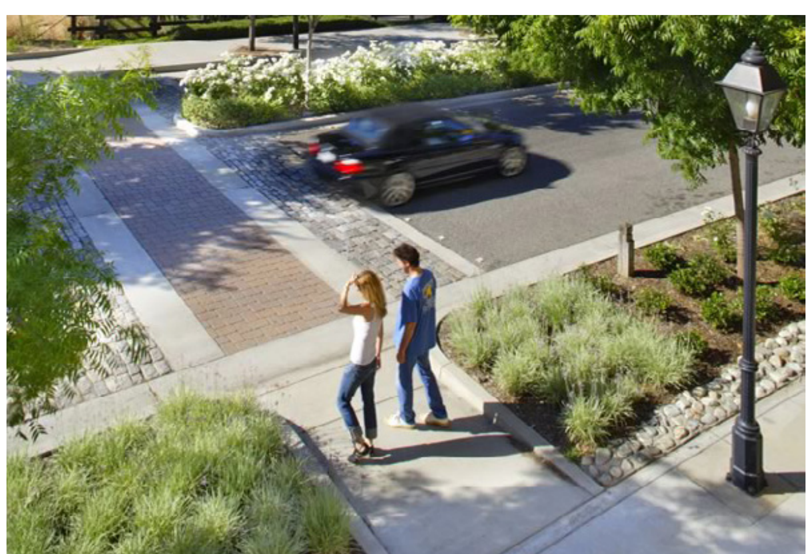
Calabasas
California
RRM Design Group

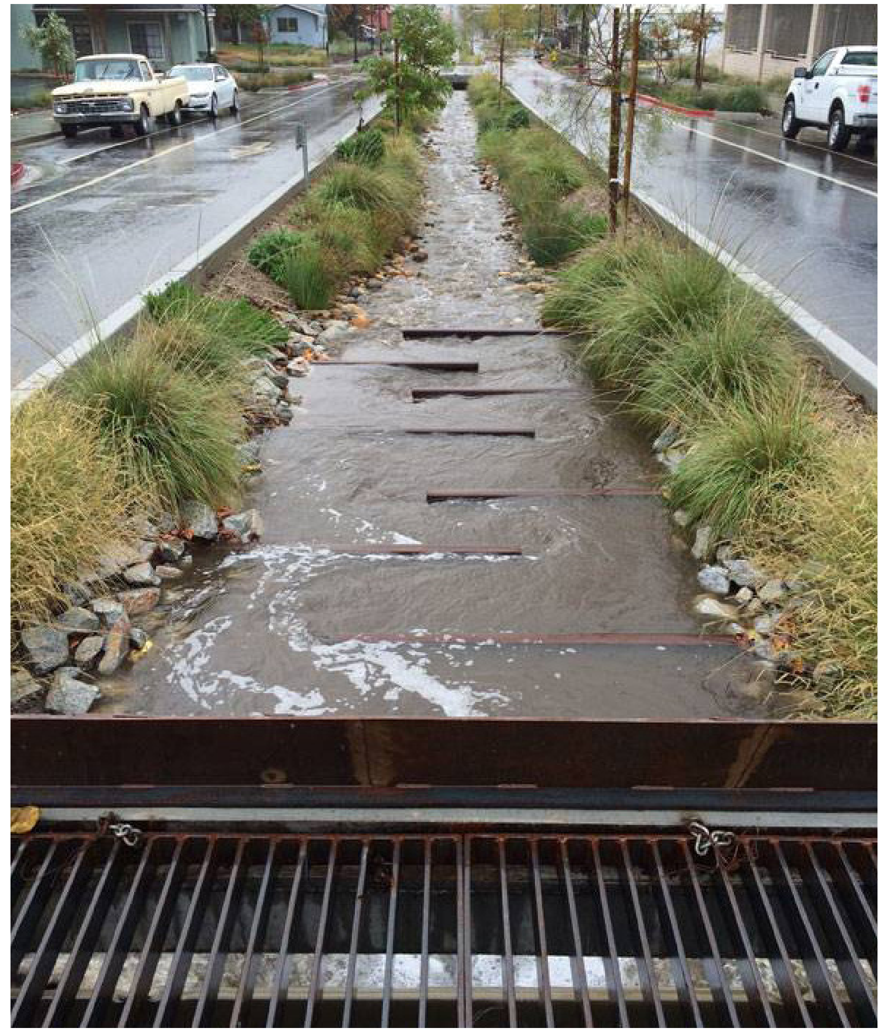
Paso Robles
California
SvR

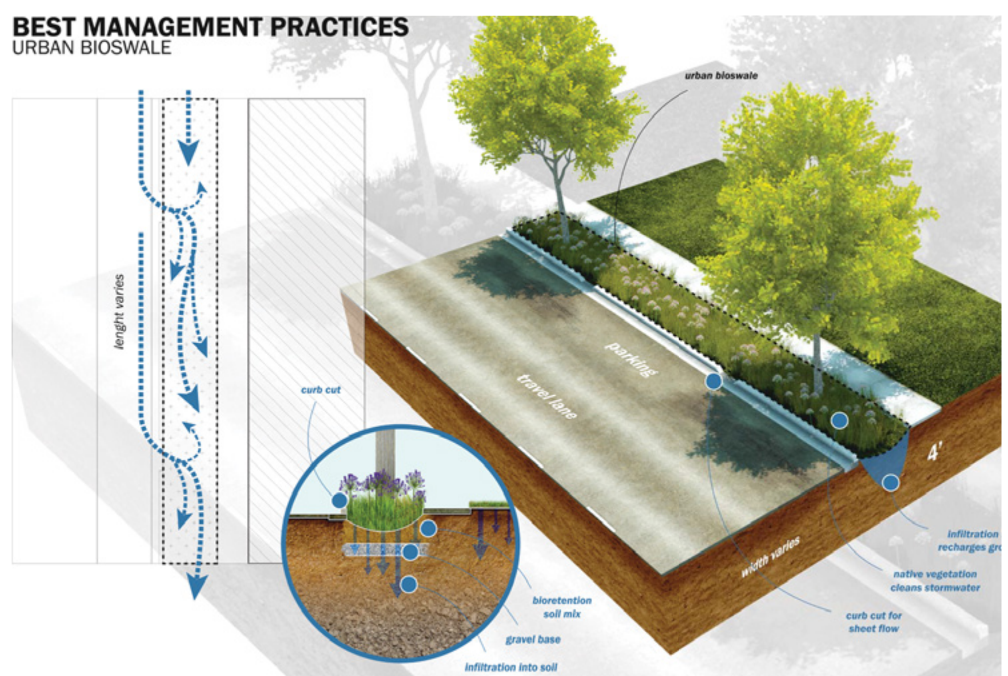
Sustainable Urban
Drainage System Llanelli
Wales

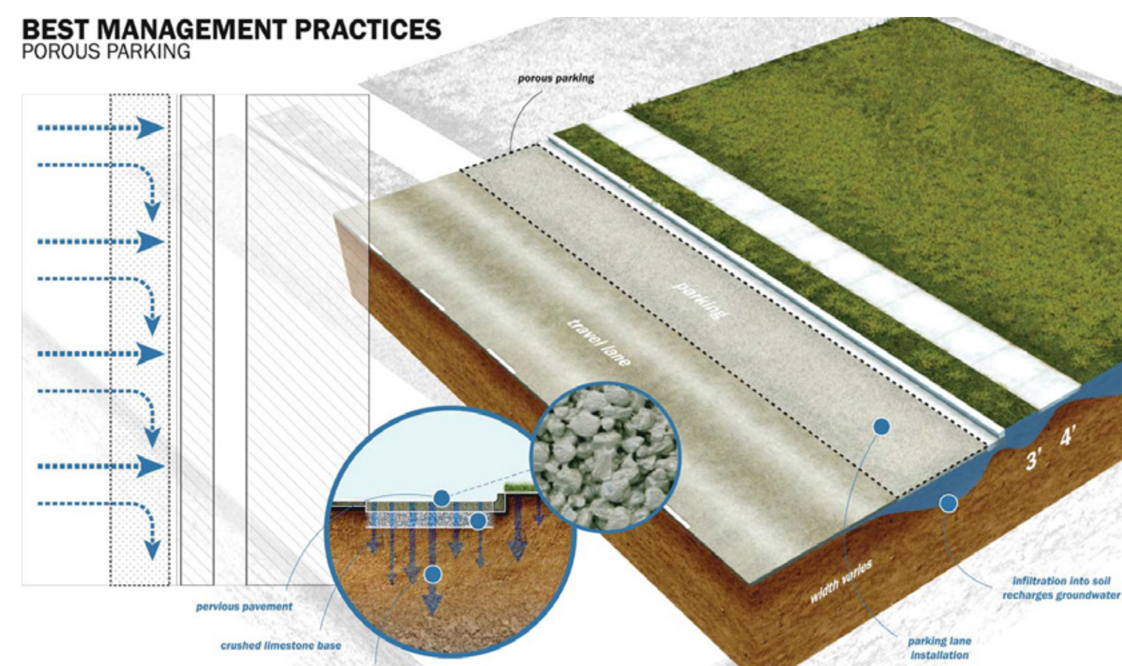
Best Practices
Urban Bioswale

Best Practices
Porous Parking









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Duncan Plaza

Subsurface Storage Capacity

The proposed subsurface storage at Duncan Plaza has an ambitious capacity 7.8 million gallons. This translates to about 24 acre/feet, or about 24 football fields, 1 foot deep. The Mirabeau Water Garden HMGP project is designed to hold at least 25 acre/feet.

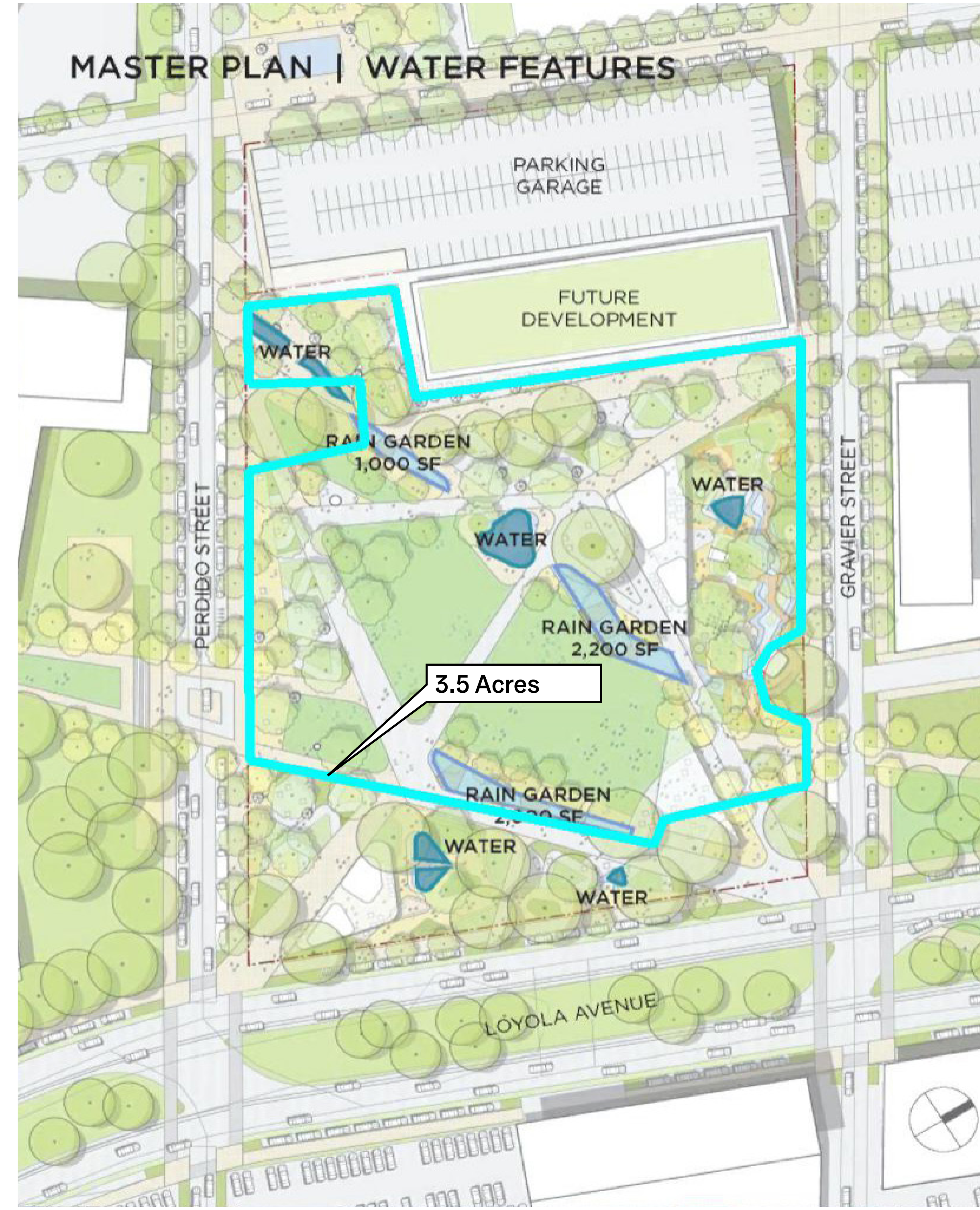
With a 6 foot storage depth, more than 4 acres of surface area is required (with 75-95% void space).

The figures at right highlight areas for potential storage zones, assuming space to preserve existing oaks along Loyola Ave and working with the current landscape design. The area highlighted is only 3.5 acres.

More intensive subsurface storage would be required to achieve the stated storage target, or possibly a different design approach that uses a combination of above and below ground storage. Distributing storage around the DDD would be a beneficial approach.

Water Plazas both manage stormwater and celebrate water as an amenity. Berms, depressions, rain gardens and water features create above grade capacity.

Existing Site



OJB Proposal

Subsurface Water Detention

Typical → Intensive

Modular Storage Units

Park Above Cisterns Kasukabe, Japan

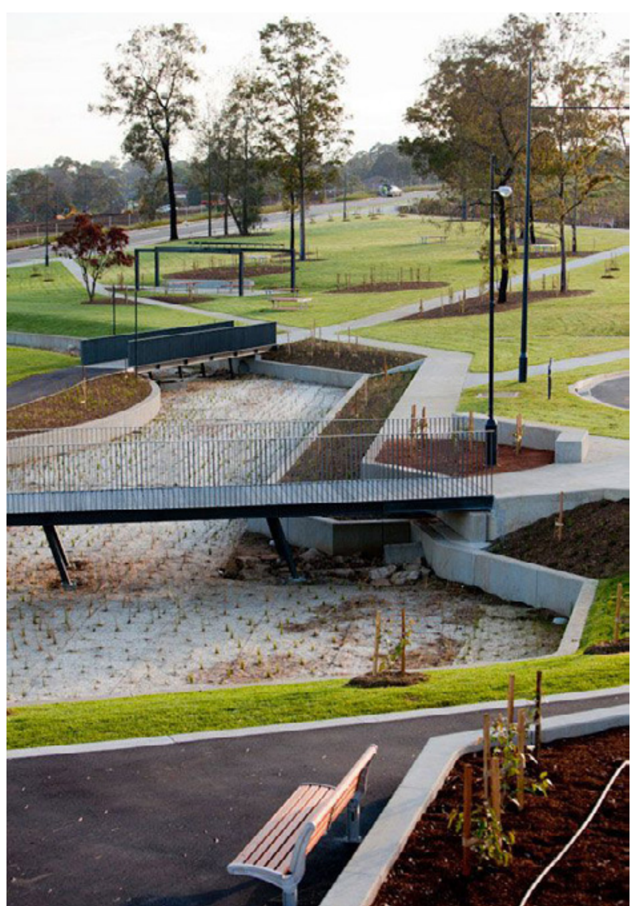
Precast Storage Vaults

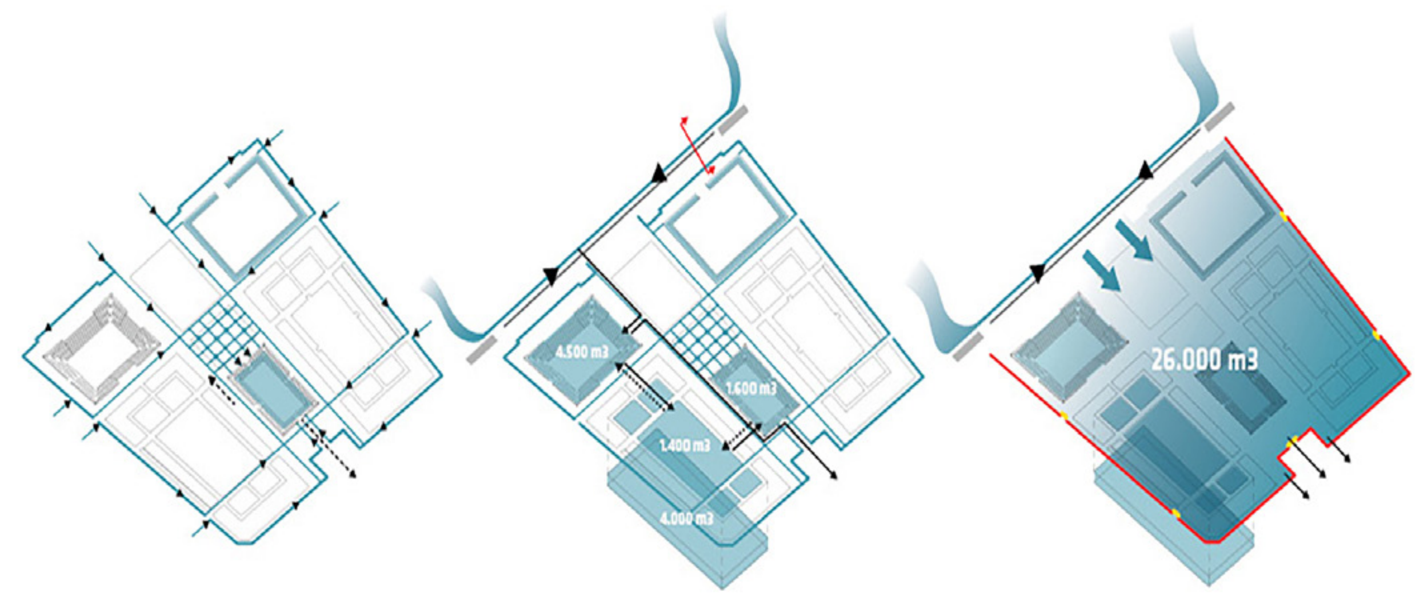
Plastic Storage Vaults

Large, Underground Concrete Cisterns Kasukabe, Japan

Water Plazas

Safety + Amenity





Tanner Springs Park Portland CMS	Tanner Springs Park Portland CMS
Redfern Park Sydney, Australia	Engehave Park, Copenhagen Tredje Natur

DPW Scope

Proposed work will have positive impacts on flooding in DDD and downstream areas
Hydrologic & Hydraulic modeling is needed to validate impacts

SLOW + STORE + DRAIN approach reduces flooding, starting at top of watershed

- SLOW: Permeable paving slows and intercepts runoff
- STORE: Subsurface storage detains water before it enters drainage system
- DRAIN: Increased pipe sizes increases conveyance capacity

Duncan Plaza has large storage potential. Underground and surface water storage should accommodate trees, plantings and community uses

Living With Water® Opportunities

Provide multiple benefits: Safety, Ecology, Spatial Quality

- Bioretention increases storage and water quality, provides streetscape improvements
- Tree plantings provide shade and water uptake, reduces heat island effect
- Intersection improvements provide stormwater and Complete Streets benefits

Public parcels, right of ways, and parks are good opportunities for resilience interventions

- Lafayette Square, Champions Square, Lee Circle, VA Site, Neutral Grounds, etc.

Incentives for developers, property owners, and businesses to maximize stormwater detention

- Green/Blue Roofs, Cisterns, Bioretention, Permeable Parking Lots, etc.