

# Waterfront Implementation Project

## Waterfront Commission – Project Update

February 15, 2022

Terry Suehr, PE, DBIA, PMP

Department of Project Implementation, Director

Matthew Landes, PLA, CCM, ISA

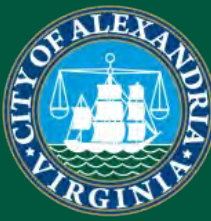
Department of Project Implementation, Division Chief / Waterfront Program Manager



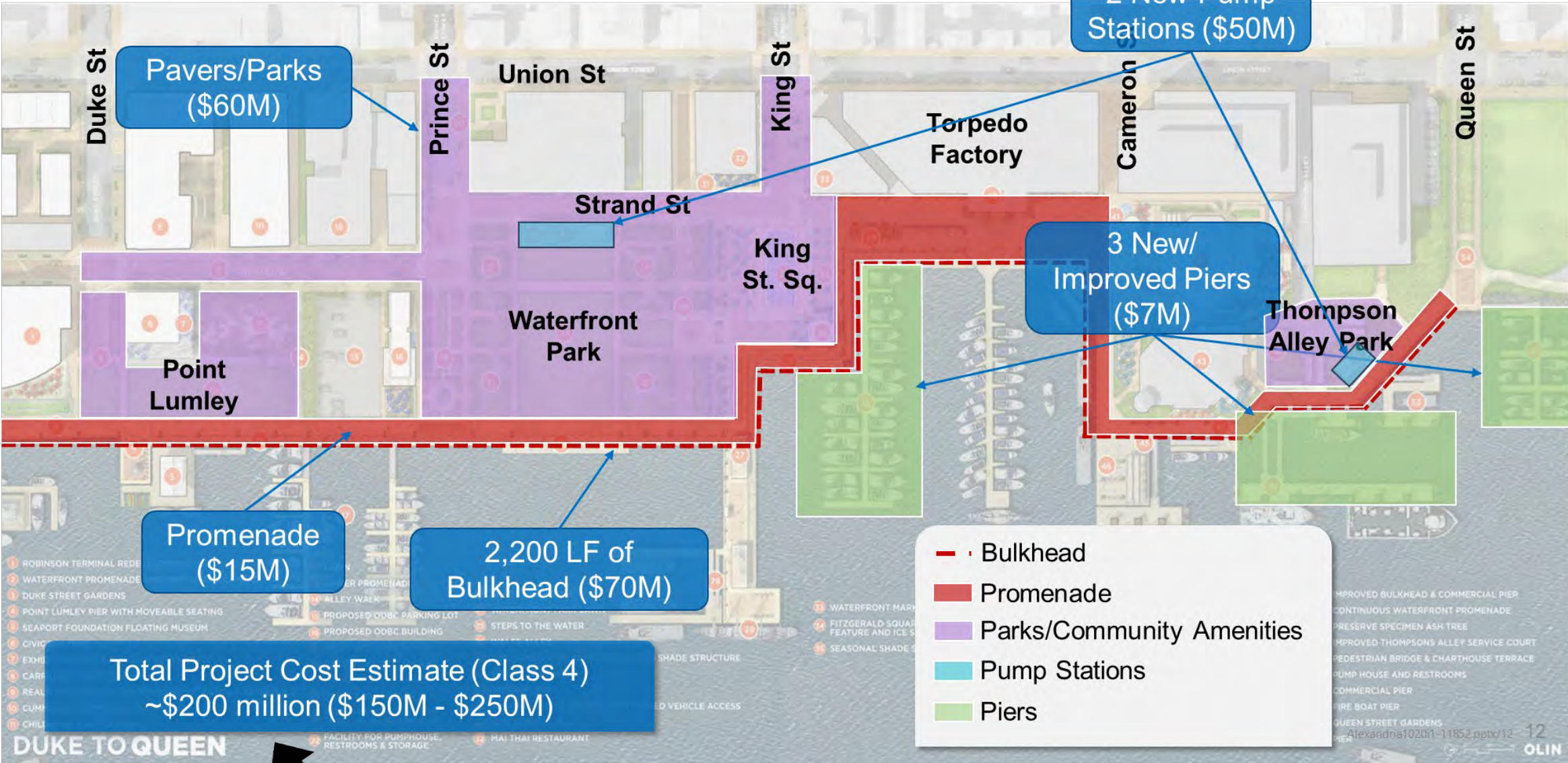
# Meeting Objectives

- ✓ **Baseline Project – Goals of Waterfront Plan**
  - ✓ Area of focus and Scope of discussion
  - ✓ Review baseline project priorities
  - ✓ Baseline Project Cost vs Current CIP Funding
- ✓ **Share alternative under consideration**
  - ✓ Based on current best practices in Resiliency Planning and Low Impact Development
  - ✓ Scoped to project budget
- ✓ **Highlight the input needed from Flood Mitigation Committee & Waterfront Commission**
  - ✓ Preferred prioritization of investment in project areas and project elements
- ✓ **Next steps and anticipated timeline**

# Schematic Design Endorsed by Waterfront Commission & Council is discussed as the original “Baseline Project”



# // Baseline Project



Current Funding in CIP  
**\$102M**

## Limitations of the Baseline Project

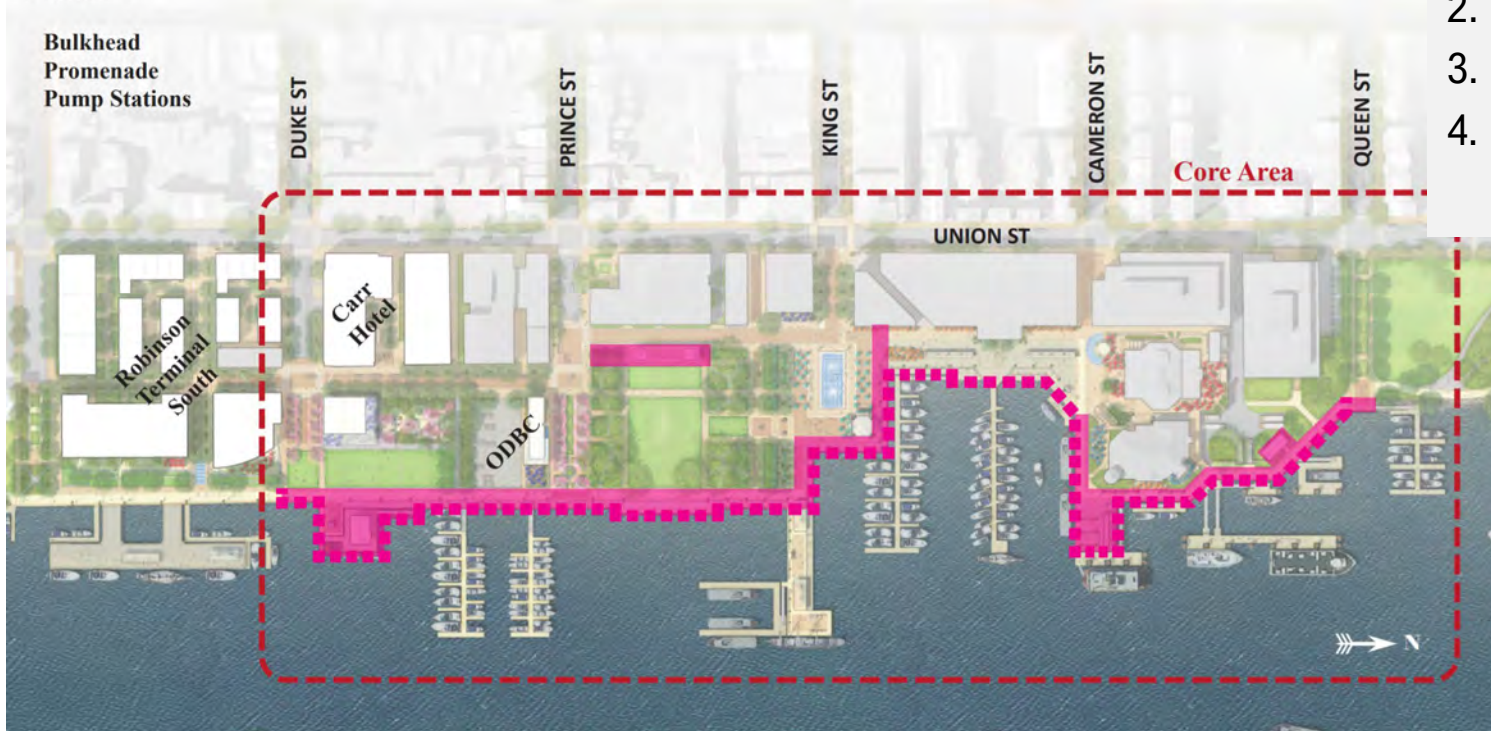
- Concepts developed a decade ago and rely 100% on “grey” infrastructure
- Best practices in resiliency have changed
  - View water as an asset rather than a liability
  - Concentrate on recovering quickly from (rather than completely preventing) extreme conditions/events
- Climate change impacts better defined
  - Storm intensity, frequency, and precipitation volume are increasing.
  - Models predict 1-2 feet of sea level rise in the Chesapeake Bay by 2050.<sup>1</sup>
- **Approach is costly and exceeds current City funding**



<sup>1</sup> Chesapeake Stormwater Network, *Review of Recent Research on Climate Projections for the Chesapeake Bay Watershed*, October 20, 2020.

# Phasing Plan and Budget adopted by Council (2015)

## Phase 1



### Reflects community priorities:

1. Flood mitigation
2. Riverfront promenade
3. Plaza at the foot of King Street
4. Park improvements

## Option A Flood Mitigation & Promenade Priority

# Flood Mitigation – Opportunity to consider

- Changing realities of storm intensity and frequency
- Dynamic regulatory environment
  - Approach to permitting
  - Approach to mitigation and related cost-escalation
- Many communities re-evaluating their approach to shoreline management and flood mitigation
- Consider philosophy of flood resilience
- **Cost reduction strategies**
- **Scoping to budget-**
  - **Requesting feedback on prioritization of project areas and project elements**



# Alternatives Development



# Goals and Objectives

- Mitigate stormwater flooding:
  - New civil infrastructure (inlets, pipes, storage, pumps, etc.):
    - Size based on a conservative baseline storm
    - Reasonably account for climate change projections through 2100
    - Eliminate capacity issues
- Eliminate backflow of Potomac River into streets
- Address most frequent overtopping of bulkhead/shoreline
- Policy and Regulatory Compliance
- Deliver on goals of Waterfront Small Area Plan
- Replace aging/failed bulkhead/shoreline (where feasible and affordable)

Recommended approach for optimizing the Baseline Project included three parallel tracks.

## PROJECT PHASING



**Could the Baseline Project be implemented over a longer time-period, and restrict the first phase to <\$102M?**

## VALUE ENGINEERING



**How might we value engineer the “big ticket” items (bulkhead, pump stations, and parks)?**

## ALTERNATIVE/ GREEN SOLUTIONS



**How might green infrastructure offset the need for a new bulkhead and pump stations?**

# Flood Characterization along the Waterfront

## **OVERTOPPING** of Bulkhead



**Address through:**  
Repair and raising of bulkhead  
or other physical flood  
barrier(s).

## **BACKFLOW** of River Outfalls



**Address through:**  
Backflow prevention on  
underground storm sewer  
system.

## **INUNDATION** of Storm Sewers



**Address through:**  
Larger storm sewer pipes,  
underground storage, and  
pumping.

# Flood Resilience

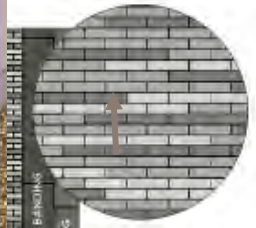
- New way of thinking about flood disaster mitigation.
- Embracing the philosophy that we should learn to live with floods and to manage flood risk and not seek to avoid it.
- Resilient flood risk strategies aim at reducing flood risk through:
  - Protection
  - Prevention
  - Preparedness / Quick Recovery

# Flood Barriers

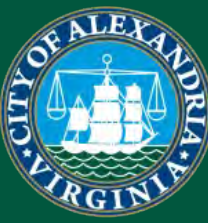
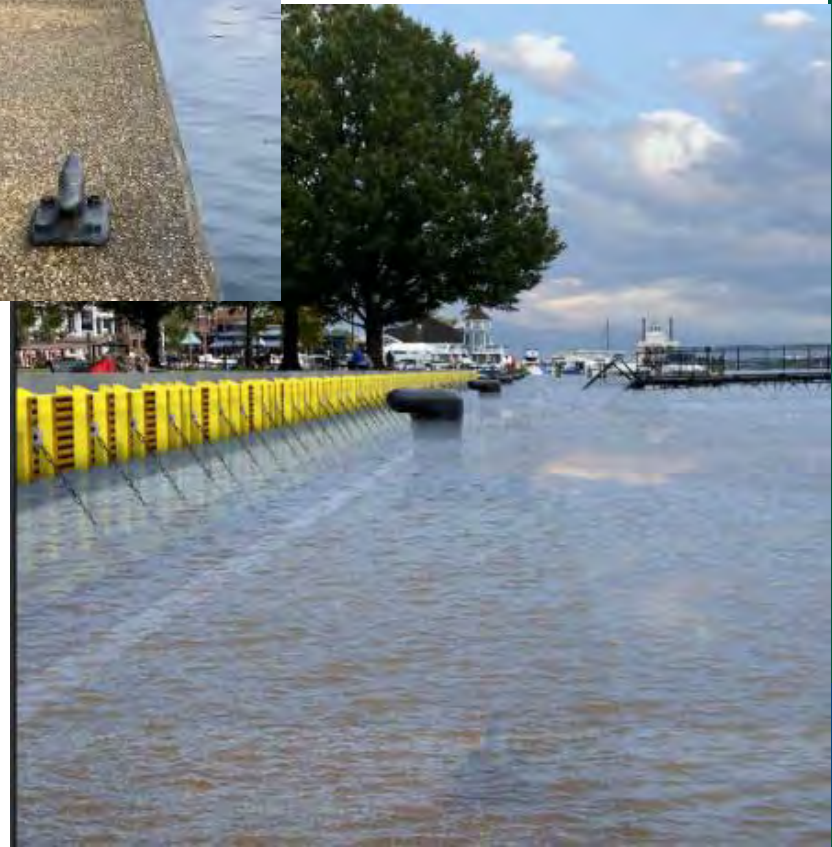


Landscape-Based Flood Protection:

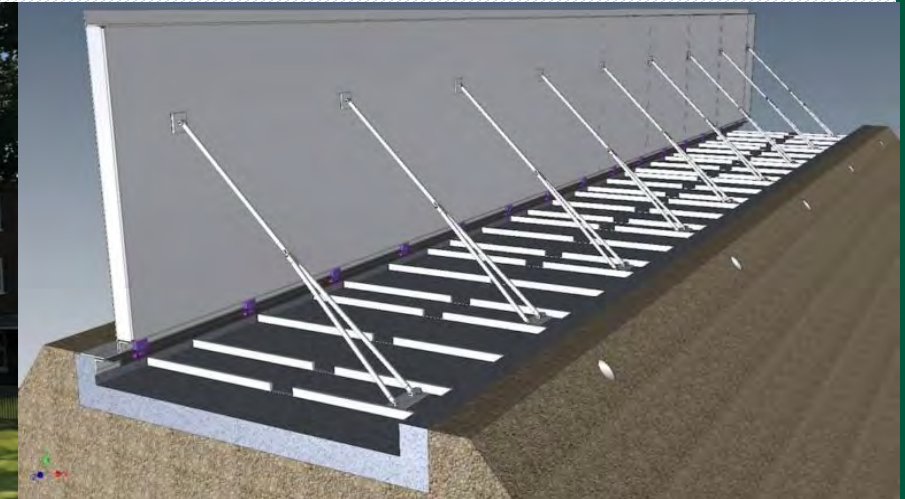
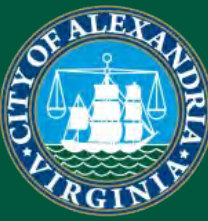
- integrated into landscape as public amenity



- Hinged barriers
- Self-deploying Barrier
- Embed in promenade



# Flood Gates



**To install product along the entire bulkhead, material cost is \$5M with a 3.5-ft self-deploying wall.**

# Flood Barriers – Building Floodproofing



Concealed Deployable Options



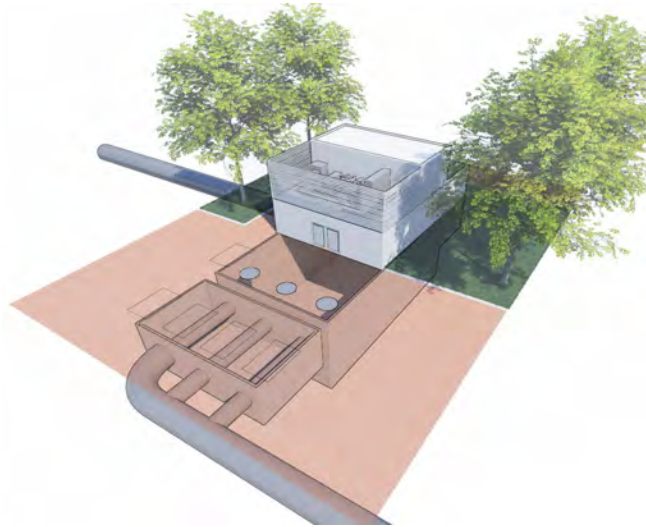
# Current Project Alternatives



# // Project Elements to address:

**BACKFLOW**  
of River Outfalls

**INUNDATION**  
of Storm Sewers



## 2x PUMP STATIONS

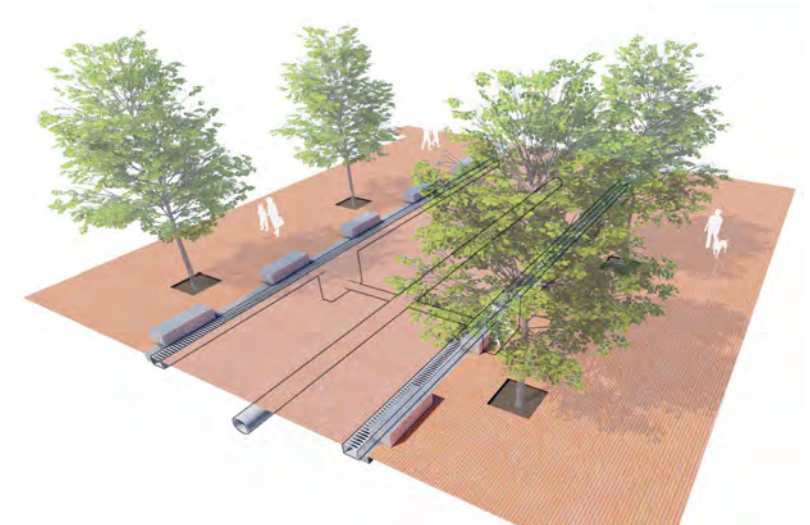
- Utilitarian structure housing stormwater pumps and associated mechanical and electrical equipment
- No city storage or amenity space
- Thompsons Alley PS capacity reduced by 95%



## UNDERGROUND DETENTION

Stormwater storage chambers sited under existing park spaces

Receiving community opposition



## STREETSCAPE AND STORMWATER INFRASTRUCTURE IMPROVEMENTS

- New and upsized stormwater inlets and conveyance pipes
- Common elements paving for streets and promenade de-prioritized by community

# // Project Elements to address: **OVERTOPPING** of Bulkhead



## LANDSCAPE-BASED FLOOD PROTECTION

- Stabilized bulkhead
- Landscape seat walls as flood barriers
- Alternative paving and finish materials likely required based on escalating costs



## DEPLOYABLE BARRIERS CAN BE ADDED IN FUTURE, AS FUNDING IS AVAILABLE

- Hidden when not needed
- Maintains experience and connection to water
- Prevents visual disruption when not needed



# // Phase 1 – Scope to \$100M Budget

## Hybrid Bulkhead & Landscape Based Flood Protection

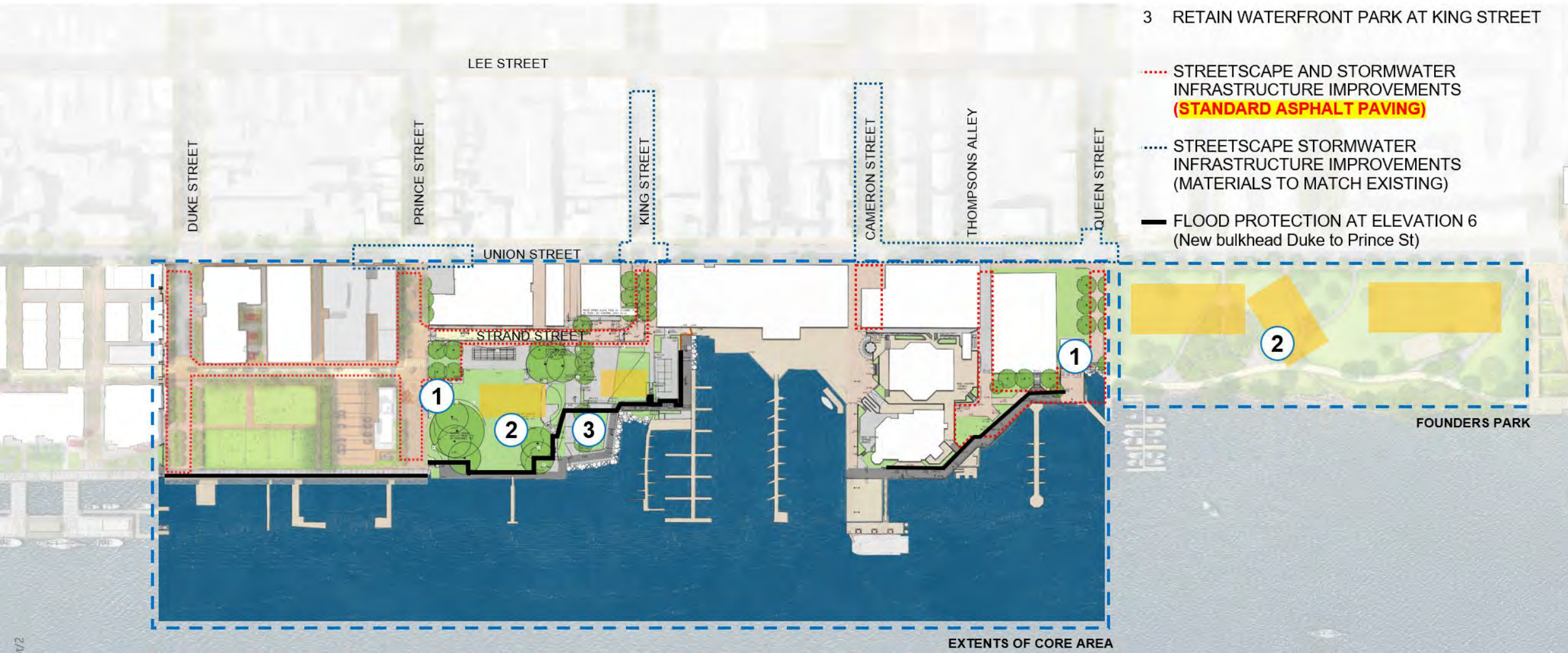
### LEGEND

- 1 PUMP STATION
- 2 UNDERGROUND STORMWATER DETENTION CHAMBERS
- 3 RETAIN WATERFRONT PARK AT KING STREET

..... STREETScape AND STORMWATER INFRASTRUCTURE IMPROVEMENTS  
**(STANDARD ASPHALT PAVING)**

..... STREETScape STORMWATER INFRASTRUCTURE IMPROVEMENTS  
 (MATERIALS TO MATCH EXISTING)

— FLOOD PROTECTION AT ELEVATION 6  
 (New bulkhead Duke to Prince St)



SLIDE CORRECTED FROM FEB PRESENTATION - TO DEPICT POTENTIAL UNDERGROUND STORAGE IN WATERFRONT PARK, CONSISTENT WITH PRIOR PRESENTATIONS (APRIL, JUNE, SEPT.) AND AS PROPOSED FOR FURTHER EVALUATION WITH DESIGN BUILD TEAM.

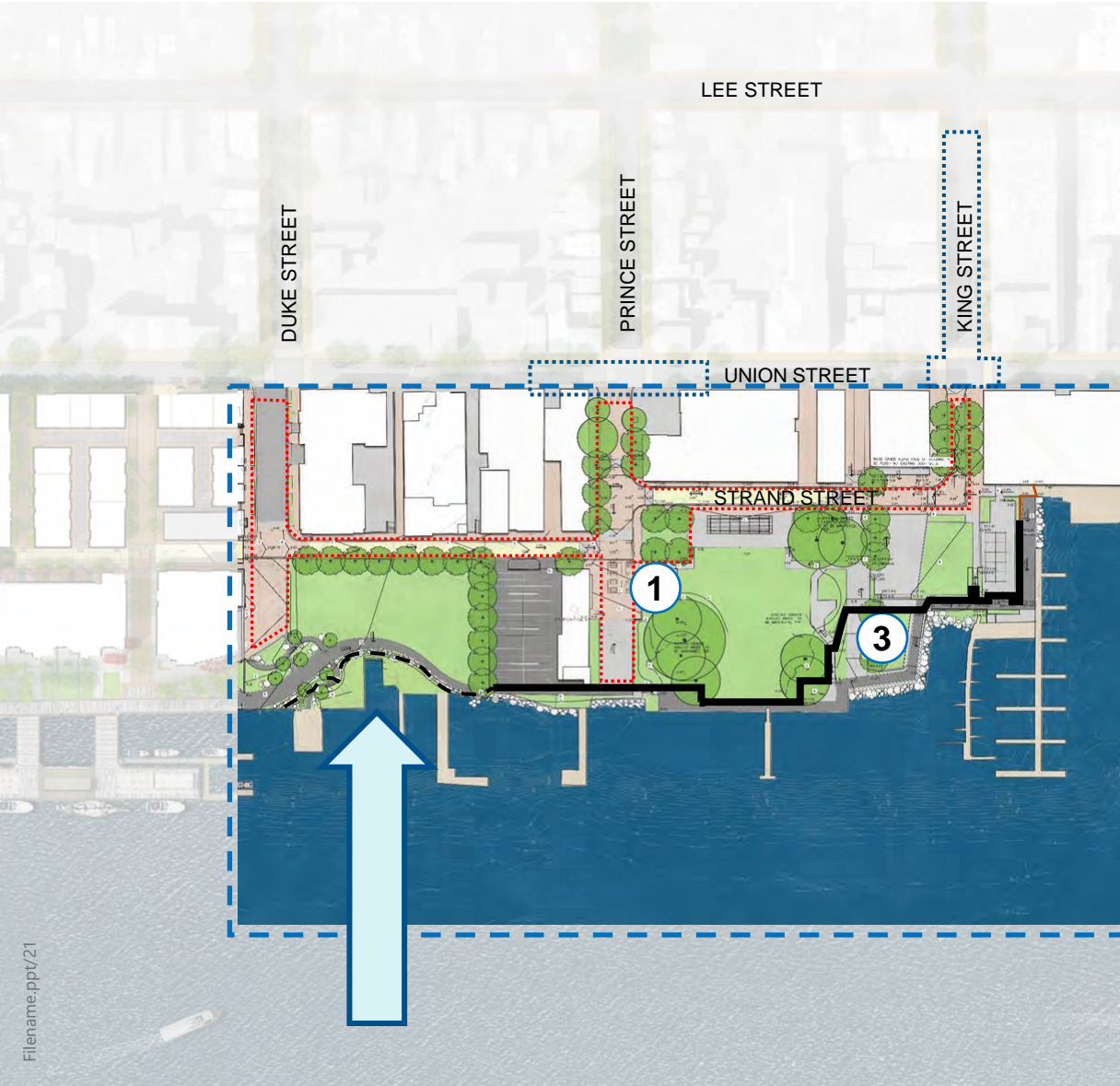
# Phase 1 – Cost Breakdown of included elements:

Community Priorities	Estimated Total Cost	Project Elements
Flood Mitigation <ul style="list-style-type: none"> <li>Storm Sewer Upgrades</li> <li>Pump Stations</li> <li>Riverine Protection</li> </ul>	\$20M <b>\$55M</b> \$18M	<ul style="list-style-type: none"> <li>Interim tide gate at King and Prince Street</li> <li>New and upsized inlets and stormwater piping</li> <li>Two stormwater pumping stations</li> <li><b>Underground stormwater detention chambers</b></li> <li>New bulkhead from Duke to Prince; ha-ha wall in Waterfront Park + King St Square and Cameron to Queen St; no upgrades to Torpedo Factory</li> </ul>
Riverfront Promenade	\$2M	<ul style="list-style-type: none"> <li>10-20ft wide <b>promenade from Duke to Queen St with a lower-cost finished material (asphalt, or crushed stone)</b></li> </ul>
Plaza at the foot of King Street	\$2M	<ul style="list-style-type: none"> <li>Material upgrades to make permanent park</li> <li>Actual improvements worth ~\$600K</li> </ul>
Park Improvements	<\$1M \$2M	<ul style="list-style-type: none"> <li>Restore all streets with asphalt pavement</li> <li>Waterfront Park and Founders Park restoration</li> </ul>
<b>Total Estimated Project Cost</b>	<b>\$100M</b>	<b>AACE Cost 4 - Low: \$80M - High: \$120M</b>

Notes:

- Subsurface conditions under parks are unknown and ongoing field investigations will inform the Class 3 Cost Estimate at the next iteration.
- Evaluation, review, and cost estimating for the riverine protection option is contingent upon ongoing field investigations.

# // Phase 1 – Point Lumley Shoreline Alternate Hybrid Shoreline & Landscape Based Flood Protection



## LEGEND

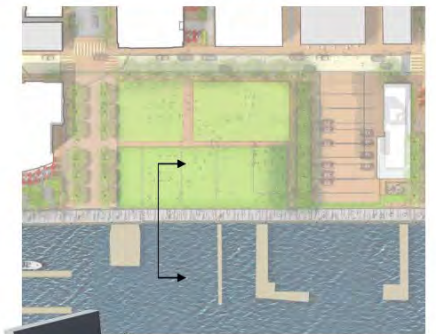
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- ..... STREETScape STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)
- FLOOD PROTECTION AT ELEVATION 6 (Stabilized Shoreline-no bulkhead Duke to Prince St)

## Duke to Prince Strategies – Point Lumley

### LANDSCAPE \$7M



### BULKHEAD \$28M



- Included but not shown:**
- Hardscape + landscape allowances
  - Baseline Plan furnishings

# Resiliency and Green Building Approach

- **Hybrid/resiliency elements are critical elements for grant competitiveness**
- Consider water management differently: **prioritize delay and store strategies.**
- **Provide water quality benefits and compliance with local policy on site**
- City recommends evaluation of cost-benefit and alternatives with Design-Build team
- **Less reliance on pumping** at peak of storm
- Pumping at lower rate for a longer duration **reduces peak energy demand**
- Stormwater chambers are **more sustainable and resilient measures for reducing risk and increasing reliability**

**Based on some concerns shared by community about impacts to the parks – Design team will continue to evaluate underground storage and other alternative approaches to meeting intent and requirements of the Green Building Policy and goals for resiliency.**

# Funding Opportunities

# Funding Update

- **\$102M in CIP (City Funding)**
  - For design and construction
  - **No additional funding anticipated within 10-year CIP**
- **Virginia Community Flood Preparedness Fund (DCR Grant)**
  - **\$3.24 million awarded December 27, 2021!**
- **BRIC Grant (FEMA)**
  - Grant application submitted for \$50 Million
  - Award notification is expected July 2022
- **USACE Coastal Storm Risk Management Feasibility Study**
  - Potential for 65% Federal – 35% Local funding cost share –
  - May demonstrate eligibility for other small USACE funding opportunities - TBD
- **Rosenbaum Family Bequest**
  - To cover unfunded improvements to Point Lumley
  - Anticipated to be a subsequent phase of design and construction



# Project Element Prioritization

# Scoping to Budget

<b>ITEMS ESTIMATED TO BE WITHIN BUDGET:</b>	<b>\$</b>		<b>ITEMS ESTIMATED TO BE WITHIN BUDGET:</b>	<b>\$</b>
UTILITIES - PUMP STATION #1	\$\$\$\$\$		UTILITIES - PUMP STATION #1	\$\$\$\$
UTILITIES - PUMP STATION #2	\$\$\$\$\$		UTILITIES - PUMP STATION #2	\$\$\$\$
UTILITIES - STORM SEWER	\$\$\$\$		UTILITIES - STORM SEWER	\$\$\$
UTILITIES - DRY	\$\$\$		UTILITIES - DRY	\$\$\$
UTILITIES - WET	\$\$		UTILITIES - WET	\$\$
RESTORATION OF PARKS	\$\$\$		RESTORATION OF PARKS	\$\$\$
RESTORATION OF ROW	\$\$		RESTORATION OF ROW	\$\$
			STRUCTURAL BULKHEAD	\$\$\$
			PROMENADE	\$\$
			KING STREET SQUARE IMPROVEMENTS	\$\$\$
TOTAL DIRECT COSTS	\$\$\$\$\$\$\$			
<b>PRIORITIZED ITEMS NOT CURRENTLY WITHIN BUDGET:</b>	<b>\$</b>			
STRUCTURAL BULKHEAD	\$\$\$\$\$		TOTAL DIRECT COSTS	\$\$\$\$\$\$\$
PROMENADE	\$\$\$			
KING STREET SQUARE IMPROVEMENTS	\$\$\$		<b>PRIORITIZED ITEMS NOT CURRENTLY WITHIN BUDGET:</b>	<b>\$</b>
WATERFRONT PARK IMPROVEMENTS	\$\$		WATERFRONT PARK IMPROVEMENTS	\$\$
MARINA IMPROVEMENTS	\$\$\$		MARINA IMPROVEMENTS	\$\$\$
POINT LUMLEY IMPROVEMENTS	\$\$		POINT LUMLEY IMPROVEMENTS	\$\$
KING STREET PIER	\$\$\$		KING STREET PIER	\$\$\$
ADDITIONAL PIERS	\$\$\$		ADDITIONAL PIERS	\$\$\$
TOTAL ADDITIONAL COST	\$\$\$\$\$\$\$		TOTAL ADDITIONAL COST	\$\$\$\$\$\$\$

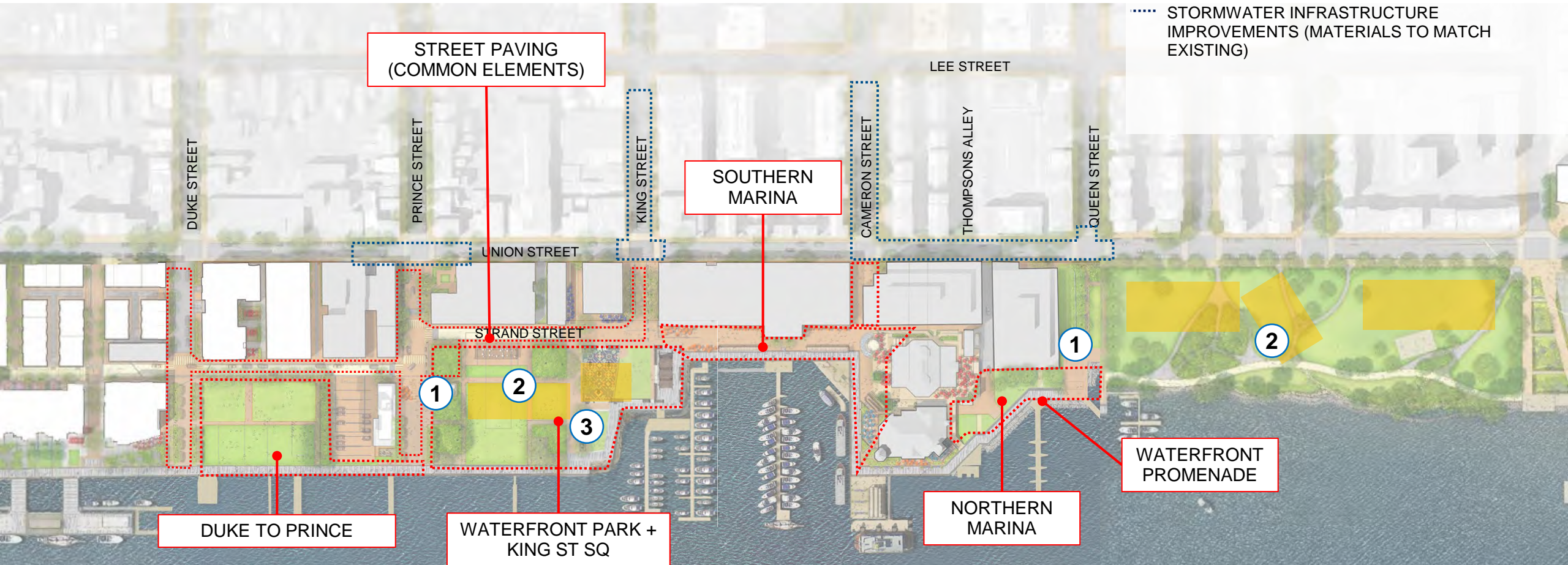
If additional CIP/external funding becomes available or if through Design-Builder innovation, value engineering, cost reduction more scope could be delivered (or cost savings could be realized by taxpayers)

# // Project areas for Prioritization

## LEGEND

- 1 PUMP STATION
- 2 UNDERGROUND STORMWATER DETENTION CHAMBERS
- 3 RETAIN WATERFRONT PARK AT KING STREET

..... STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)



# // Phase 1

## Hybrid Bulkhead & Landscape Based Flood Protection

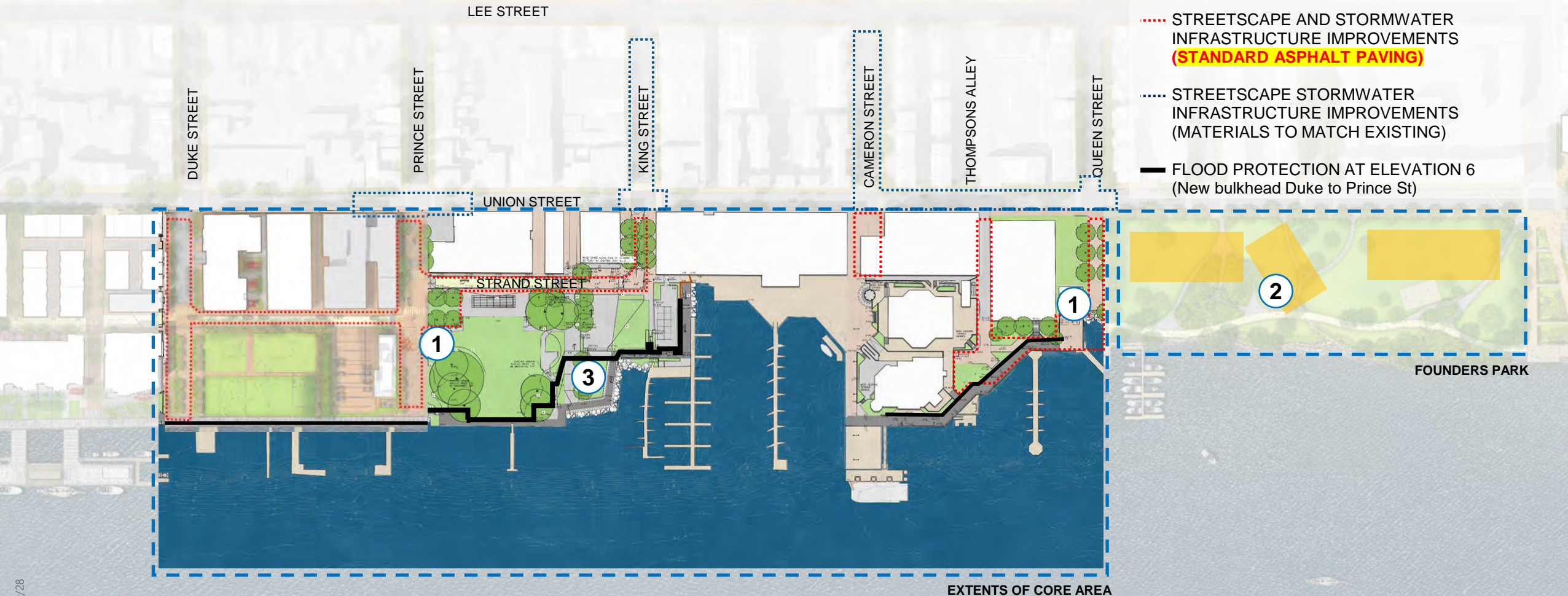
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..... STREETScape STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)

— FLOOD PROTECTION AT ELEVATION 6 (New bulkhead Duke to Prince St)



EXTENTS OF CORE AREA

# Requested Committee input on prioritization of project elements (if or when additional funding becomes available – no guarantee of additional funds)

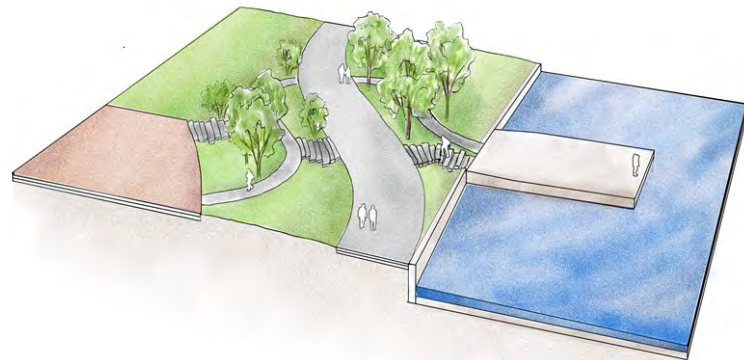
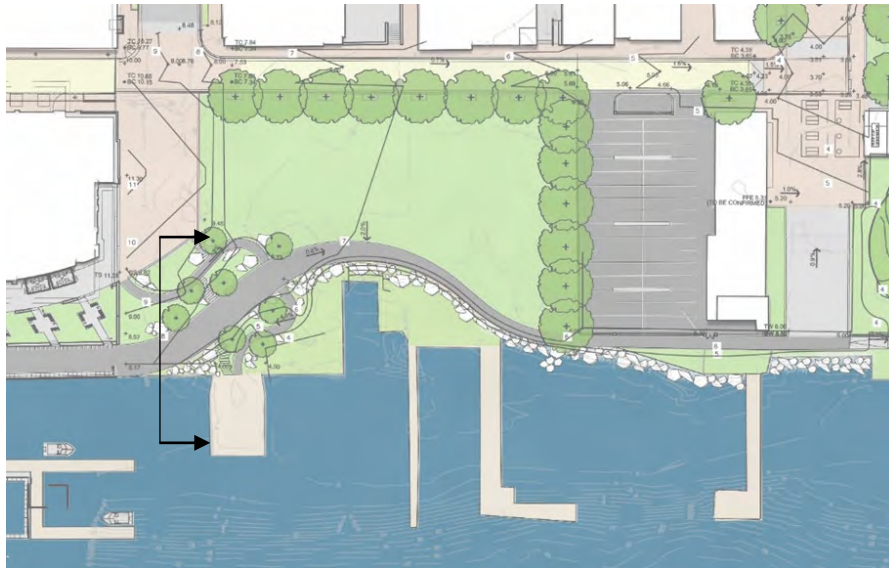
Priority	Area	Elements	Total Estimated Cost
	King St Sq + Waterfront Park	<ul style="list-style-type: none"> <li>• <b>Restore</b> King St Sq and Waterfront Park</li> <li>• Promenade (alt. material)</li> <li>• Ha-Ha Wall + SS</li> </ul>	\$6M
		<ul style="list-style-type: none"> <li>• <b>Improve</b> King St Sq</li> <li>• <b>Improve</b> Waterfront Park</li> <li>• Promenade</li> <li>• Ha-Ha Wall + SS</li> </ul>	\$17M
	Duke to Prince St	<ul style="list-style-type: none"> <li>• Improve Point Lumley</li> <li>• Promenade (<b>adjusted/inland, alt. material</b>)</li> <li>• <b>Ha-Ha Wall + SS</b></li> </ul>	\$7M
		<ul style="list-style-type: none"> <li>• Improve Point Lumley</li> <li>• Promenade (<b>alignment per Baseline</b>)</li> <li>• <b>New Bulkhead</b></li> </ul>	\$28M
	Northern Marina	<ul style="list-style-type: none"> <li>• Promenade</li> <li>• Ha- Ha Wall (no new bulkhead)</li> <li>• Thompsons Alley Park</li> </ul>	\$5M
	Southern Marina (Torpedo Factory Frontage)	<ul style="list-style-type: none"> <li>• Improve Torpedo Factory</li> <li>• Promenade</li> <li>• New Bulkhead</li> </ul>	\$20M
	Strand St + Street Ends	<ul style="list-style-type: none"> <li>• Street Pavers per Common Elements</li> </ul>	\$18M
	Waterfront	Promenade Paving per Common Elements	
		- King Street Sq + Waterfront Park	\$4M
		- Duke to Prince St	\$3M
		- Northern Marina	\$3M
		- Southern Marina	\$3M

**Notes:**

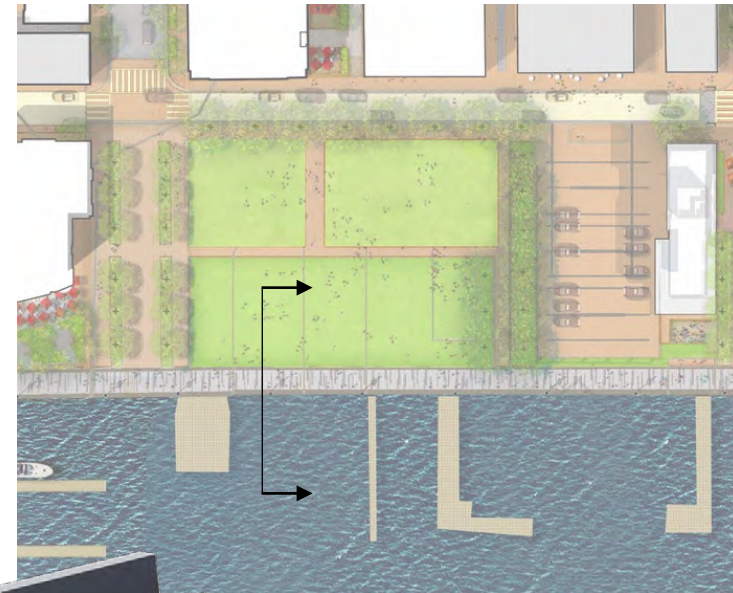
1. Evaluation, review, and cost estimating for two riverine protection options are contingent upon ongoing field investigations.
2. King St Square Improvements are per the Baseline Project except for a splash pad.
3. All costs assume that existing King St Sq shoreline is maintained and stabilized.

# Duke to Prince Strategies – Point Lumley

LANDSCAPE  
\$7M



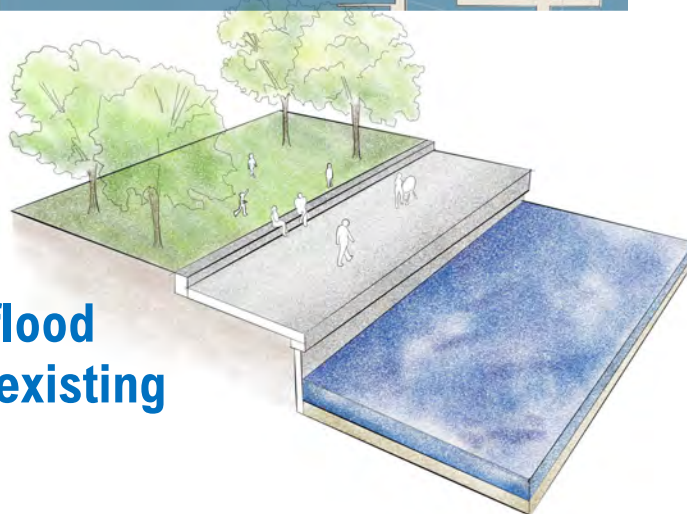
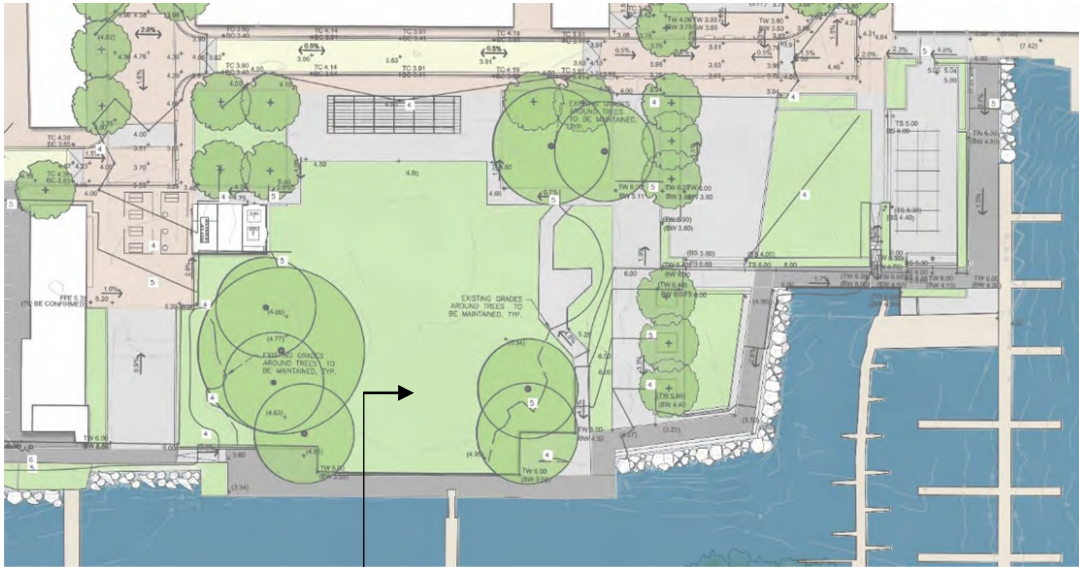
BULKHEAD  
\$28M



- Included but not shown:**
- Hardscape + landscape allowances
  - Baseline Plan furnishings

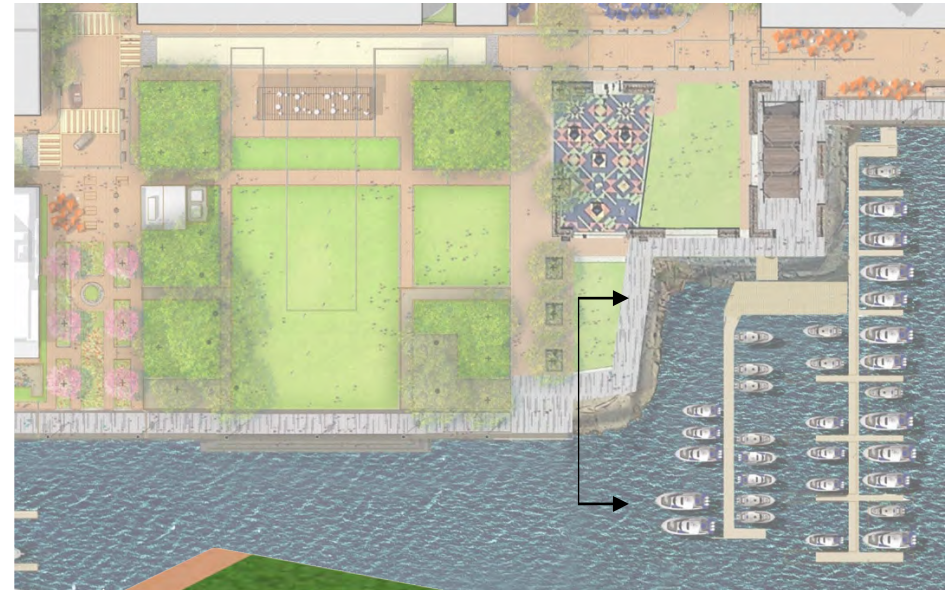
# Prince to King - Waterfront Park & King St Square Strategies

**RESTORE**  
**\$6M**



**Landscape-based flood protection (re-use existing bulkhead)**

**IMPROVE**  
**\$17M**



**Included but not shown:**

- Hardscape + landscape allowances
- Baseline Plan furnishings

RIP RAP STABILIZATION OF PROMENADE EDGE

# Next Steps

- **Field investigations**
  - Survey work completed
  - Geotechnical testing and structural analysis
  - Environmental Site Assess. Ph2 – Field work complete – labs due by March 2022
  - Will inform Refinement of costs, Risk assessments, Contractual requirements, Site and Cost constraints, Prioritization of project elements
- **Focus on Project Prioritization**
  - Community feedback
  - Field investigation data reports and engineering design recommendations
- **External funding opportunities**
  - FEMA – VDEM Building Resilient Infrastructure and Communities (BRIC) Program – Submitted on November 10<sup>th</sup>
  - DCR - Virginia Community Flood Preparedness Fund – Submitted on November 5<sup>th</sup>
- **Next Sub-Committee Meeting – TBD**
- **Council Engagement – February 2022 – May 2022 (budget development / adoption)**
- **Commence development of procurement document package**
- **Advertise Design Build Contract in late Summer 2022**
- **Award contract and start design in late 2023**
- **Design complete late 2024 (could be impacted by regulatory and grantor reviews)**
- **Construction late 2024/early 2025 – likely after City’s annual birthday celebration**



# Flood Mitigation Committee: Next Steps

# Cost Estimate Accuracy (AAEC Classification System)

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic			
	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

- Class 4 Level Estimate by Owner-Advisor Team
- Determine priorities



- Class 3, 2, & 1 Estimates by Engineer of Record / D/B Team
- Will determine costs of priorities & affordability



# Recap Project Alternatives

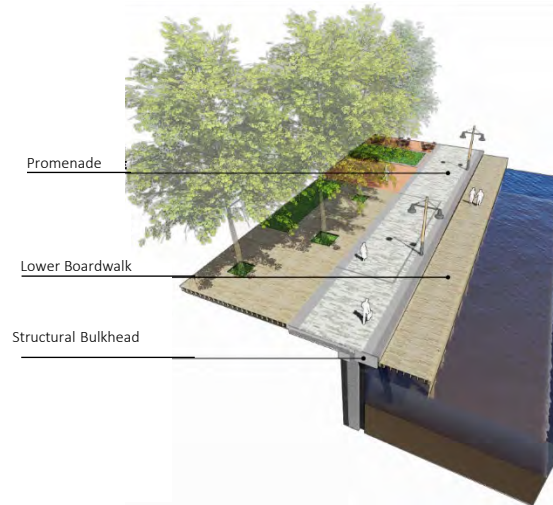
# Requires an Integrated Solution to Mitigate Flooding

## BACKFLOW of River Outfalls



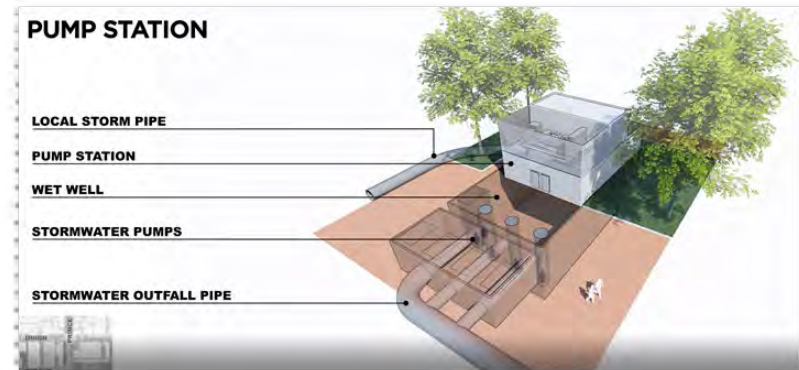
Requires backflow prevention on outfalls.

## OVERTOPPING of Bulkhead



Requires a higher-level protecting storm surge barrier.

## INUNDATION of Storm Sewers

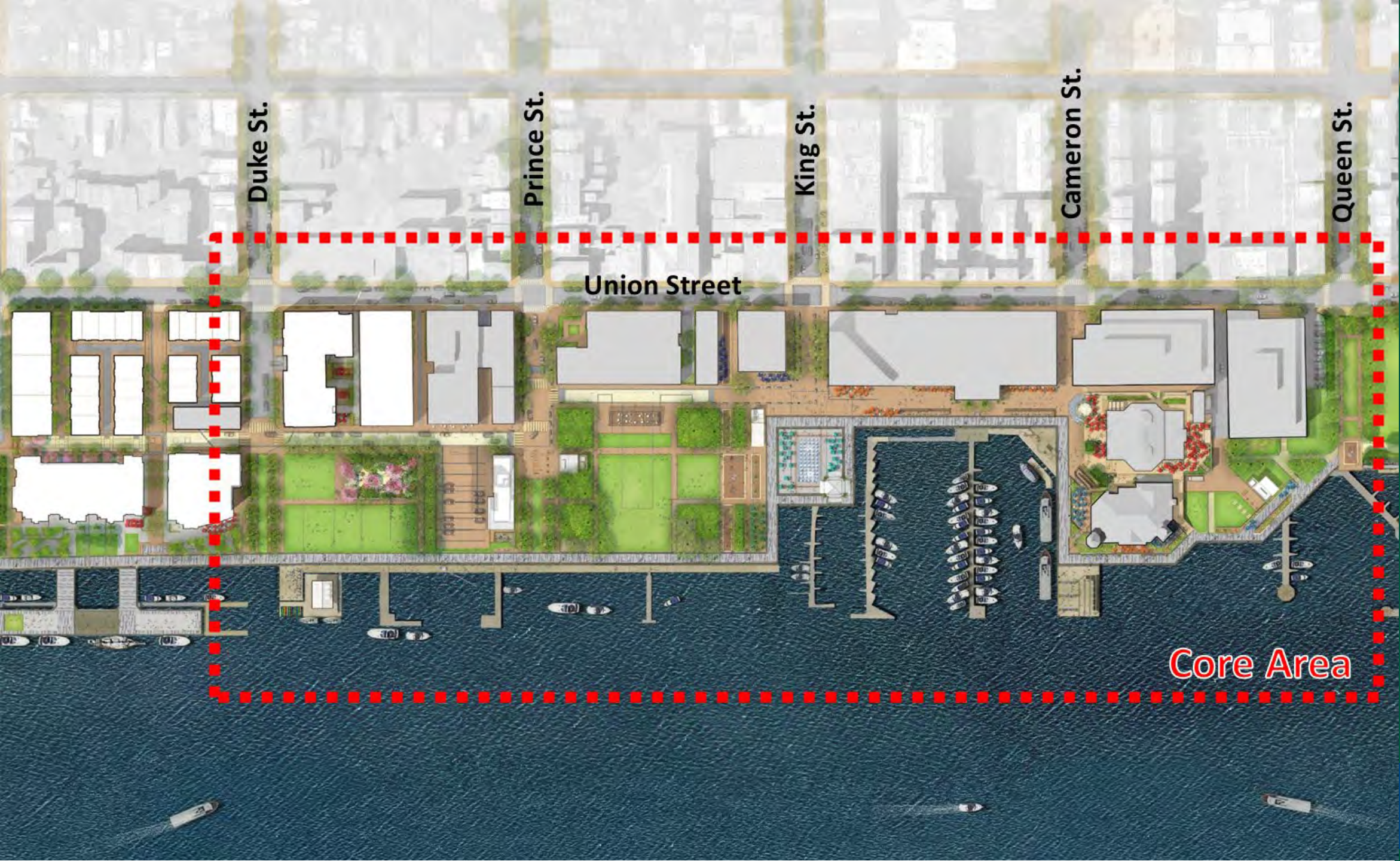


Requires new/larger inlet structures, new/larger storm sewer pipes, and pumping.

1. Backflow: Backflow prevention can be considered an interim, immediate solution as well as a permanent solution part of the larger WFI Project. Images provided by Red Valve.

2. Overtopping: Storm surge protection can be provided (in part) by a bulkhead. The existing bulkhead can be rehabilitated and raised to the protected height and/or replaced and reconstruction to protected height. Storm surge protection can also be provided by other physical flood barriers. Image from March 19, 2019. White Paper Graphics (Olin).

3. Inundation: Image from April 15, 2019. Alexandria Waterfront Pump House / Pavilion Development (Olin)



Duke St.

Prince St.

King St.

Cameron St.

Queen St.

Union Street

Core Area

# // Cost Based Option – 1- \$100m Budget

Mitigates Rainfall Flooding;

**Deferred River flooding, Shoreline, and most Park Improvements**

Discussion from last meeting suggested to defer Street Improvements to prioritize shoreline and other park improvements

## LEGEND

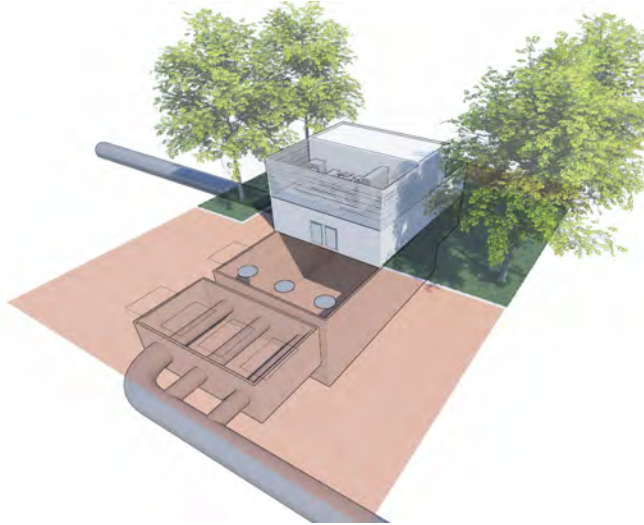
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..... STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)



# // Project Elements



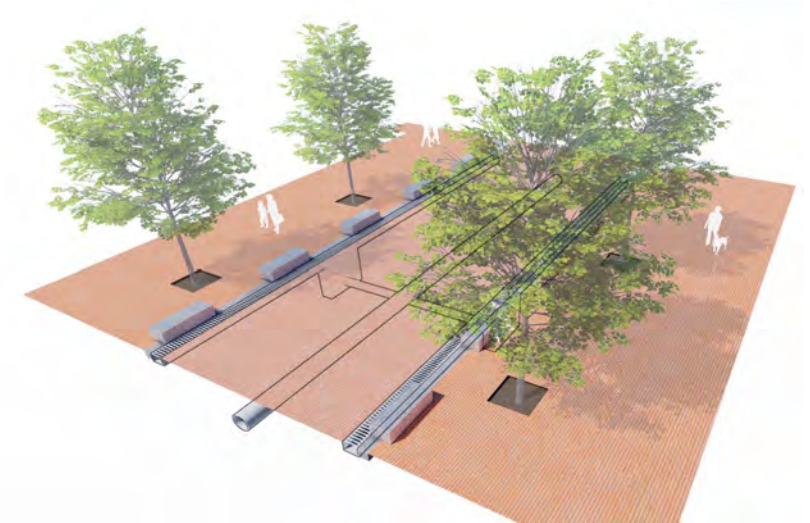
## PUMP STATIONS

- Utilitarian structure housing stormwater pumps and associated mechanical and electrical equipment
- No city storage or amenity space
- Thompsons Alley PS capacity reduced by 95%



## UNDERGROUND DETENTION

Stormwater storage chambers sited under existing parkspaces



## STREETSCAPE AND STORMWATER INFRASTRUCTURE IMPROVEMENTS

- New and upsized stormwater inlets and conveyance pipes
- Common elements paving proposed for streets within the core area only. All others to match existing materials

# // Cost Based Option – 1 – (as funds available)

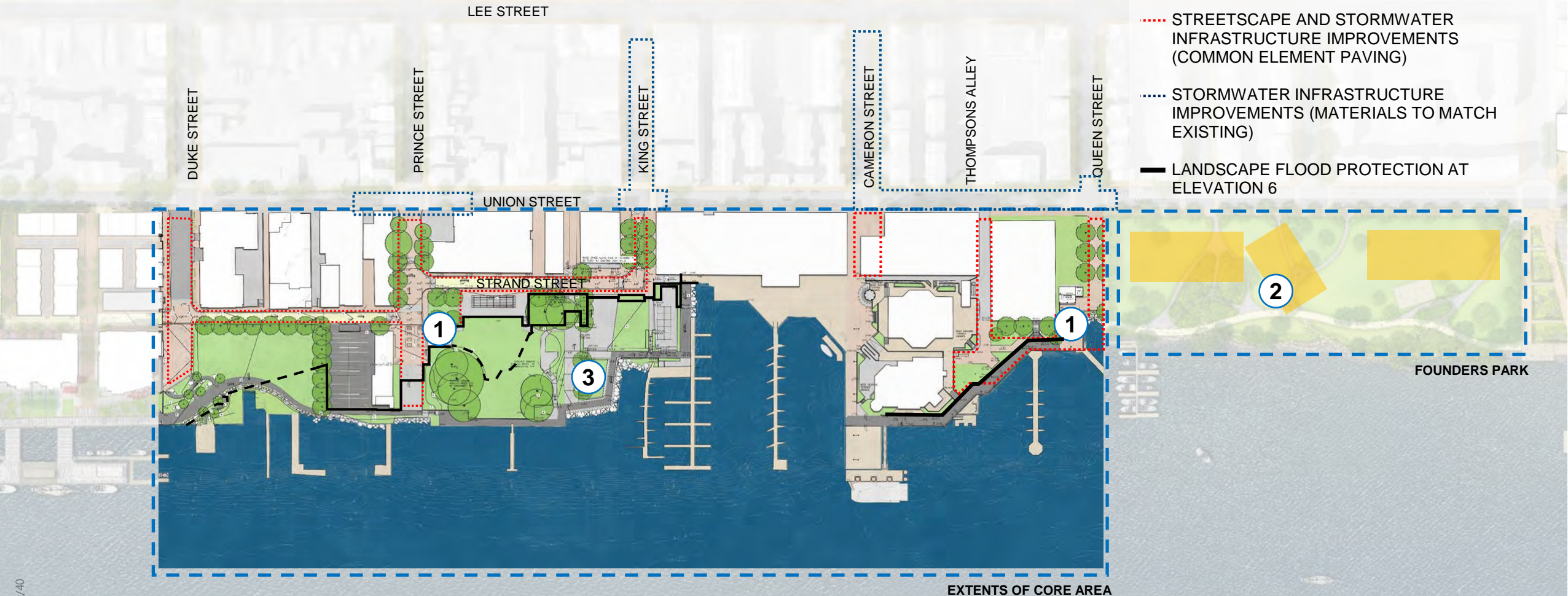
## Add-On A: Landscape Based Flood Protection (Strand)

Positive reception to alternative shoreline at Point Lumley

### LEGEND

- 1 PUMP STATION
- 2 UNDERGROUND STORMWATER DETENTION CHAMBERS
- 3 RETAIN WATERFRONT PARK AT KING STREET

- ..... STREETScape AND STORMWATER INFRASTRUCTURE IMPROVEMENTS (COMMON ELEMENT PAVING)
- ..... STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)
- LANDSCAPE FLOOD PROTECTION AT ELEVATION 6





# // Cost Based Option - 1 – (as funds available)

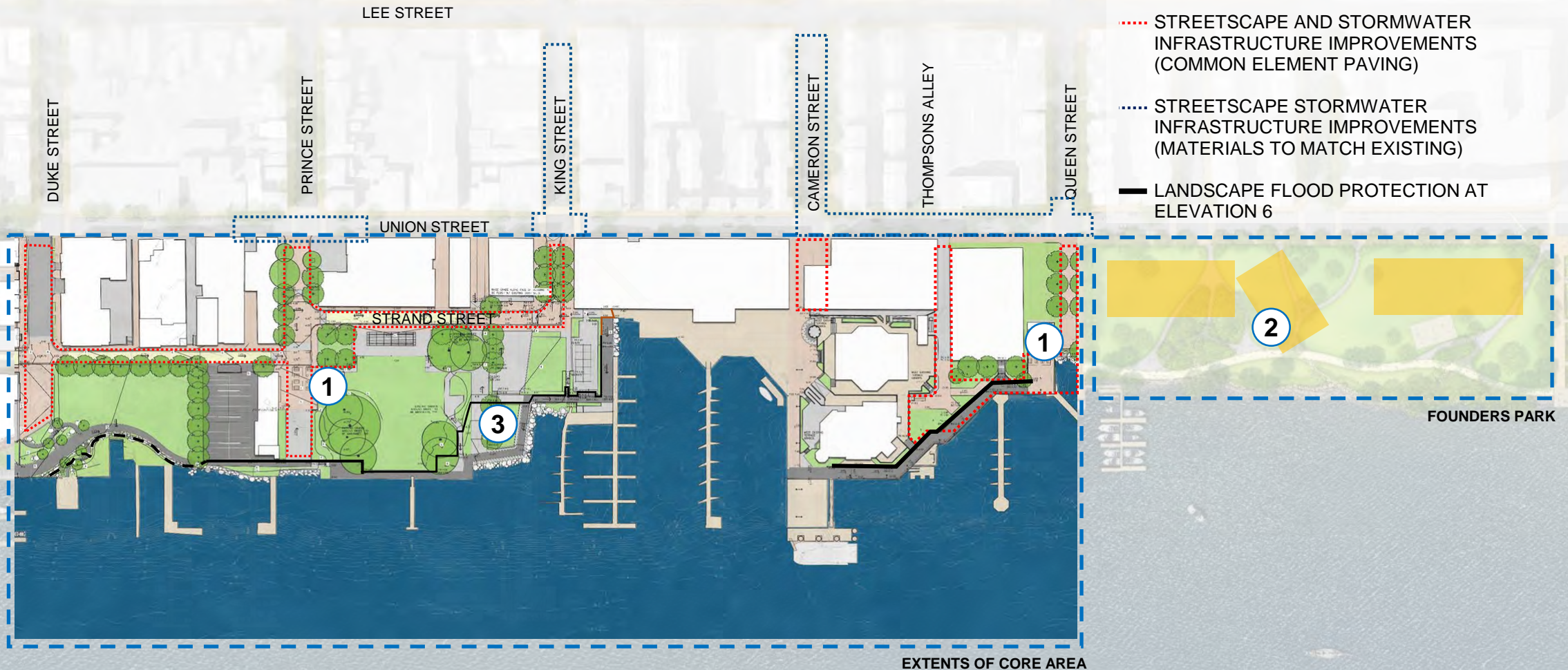
## Add-On B: Landscape Based Flood Protection (River)

LANDSCAPE ELEMENTS PROVIDE 6' ELEVATION FLOOD PROTECTION

### LEGEND

- 1 PUMP STATION
- 2 UNDERGROUND STORMWATER DETENTION CHAMBERS
- 3 RETAIN WATERFRONT PARK AT KING STREET

- ..... STREETScape AND STORMWATER INFRASTRUCTURE IMPROVEMENTS (COMMON ELEMENT PAVING)
- ..... STREETScape STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)
- LANDSCAPE FLOOD PROTECTION AT ELEVATION 6



**Positive reception of promenade alignment and alternative shoreline protection at Point Lumley**

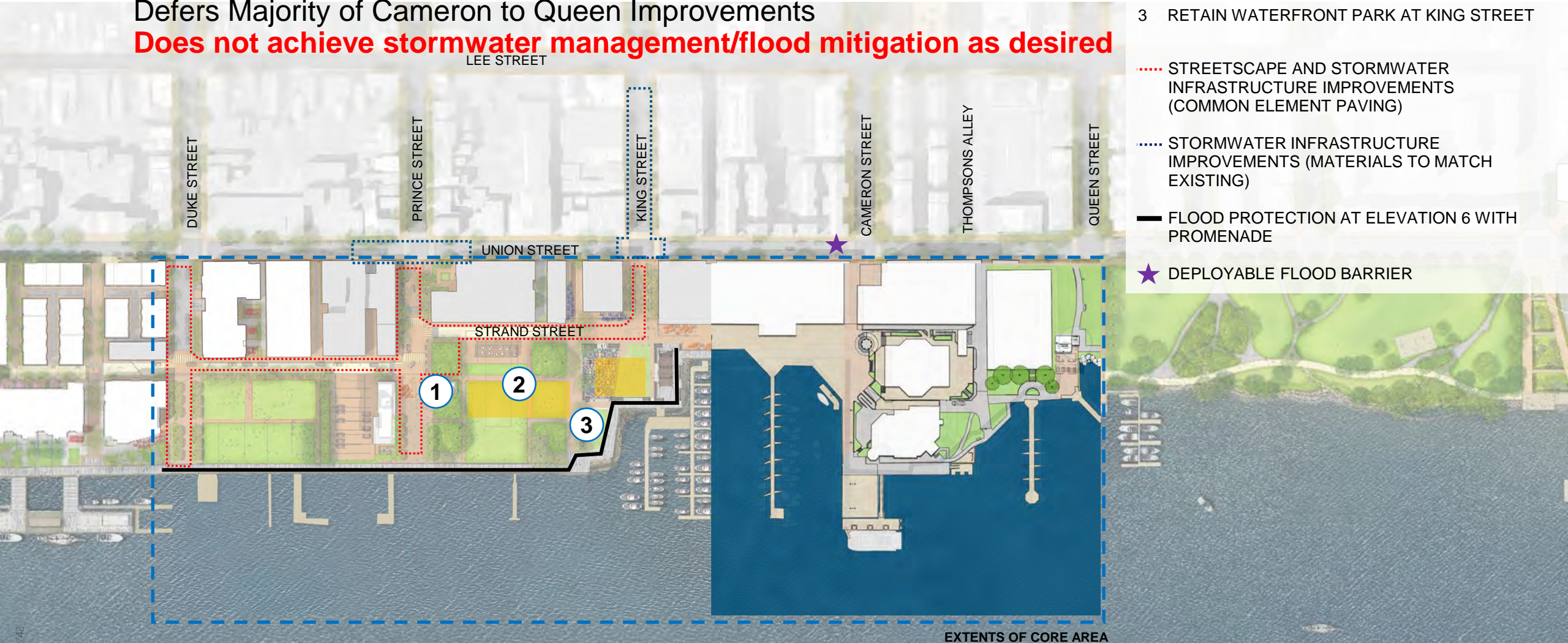
# // Cost Based Option – 2

Prioritizes Southern Project Area Improvements;  
Defers Majority of Cameron to Queen Improvements

**Does not achieve stormwater management/flood mitigation as desired**

## LEGEND

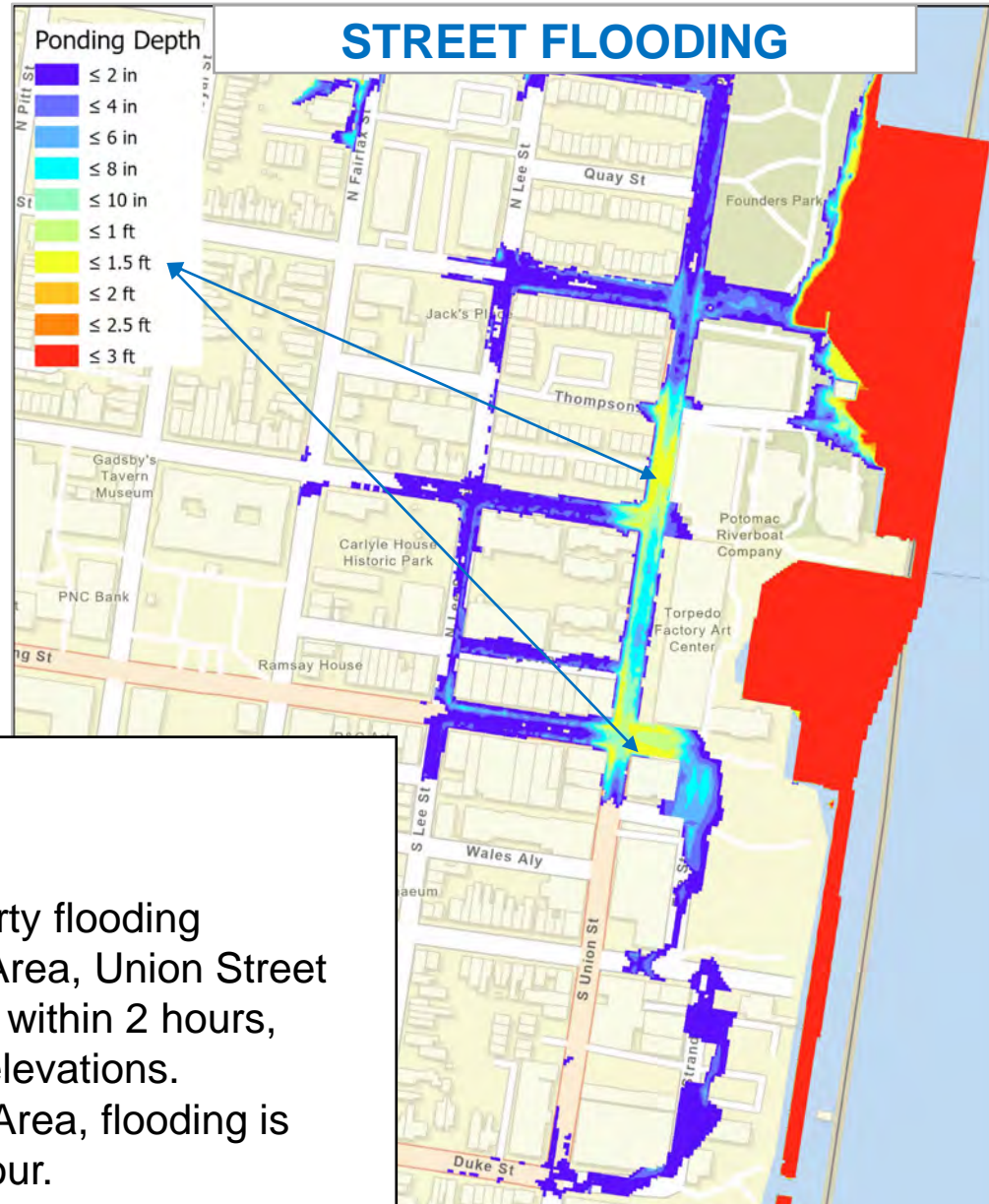
- 1 PUMP STATION
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- 3 RETAIN WATERFRONT PARK AT KING STREET
- ..... STREETScape AND STORMWATER INFRASTRUCTURE IMPROVEMENTS (COMMON ELEMENT PAVING)
- ..... STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)
- FLOOD PROTECTION AT ELEVATION 6 WITH PROMENADE
- ★ DEPLOYABLE FLOOD BARRIER



EXTENTS OF CORE AREA

# Challenges with Cost Based Option 2

# Design Storm Resultant Flooding with Southern Improvements Only



## Key Results

- Roadway and property flooding
- In Northern Project Area, Union Street flooding is managed within 2 hours, depending on river elevations.
- In Southern Project Area, flooding is managed within 1 hour.

# King and Union: *Maximum Ponding Depth*



## Legend

July 2018 Storm\*   
*Flooding recedes in < 2 hours*

Design Storm   
*Flooding recedes in < 4 hours*

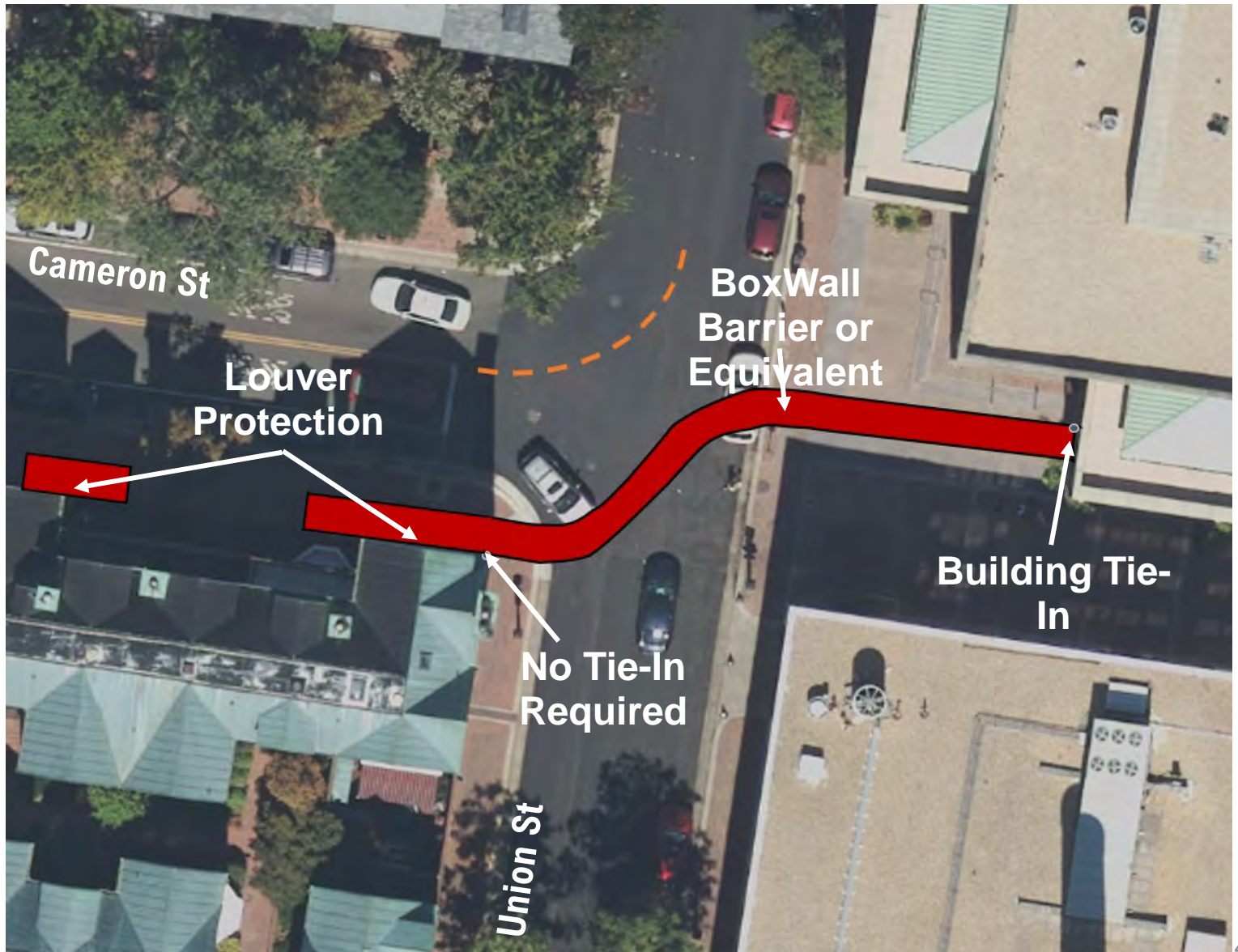
1-L Soda Bottle is  
1-foot tall



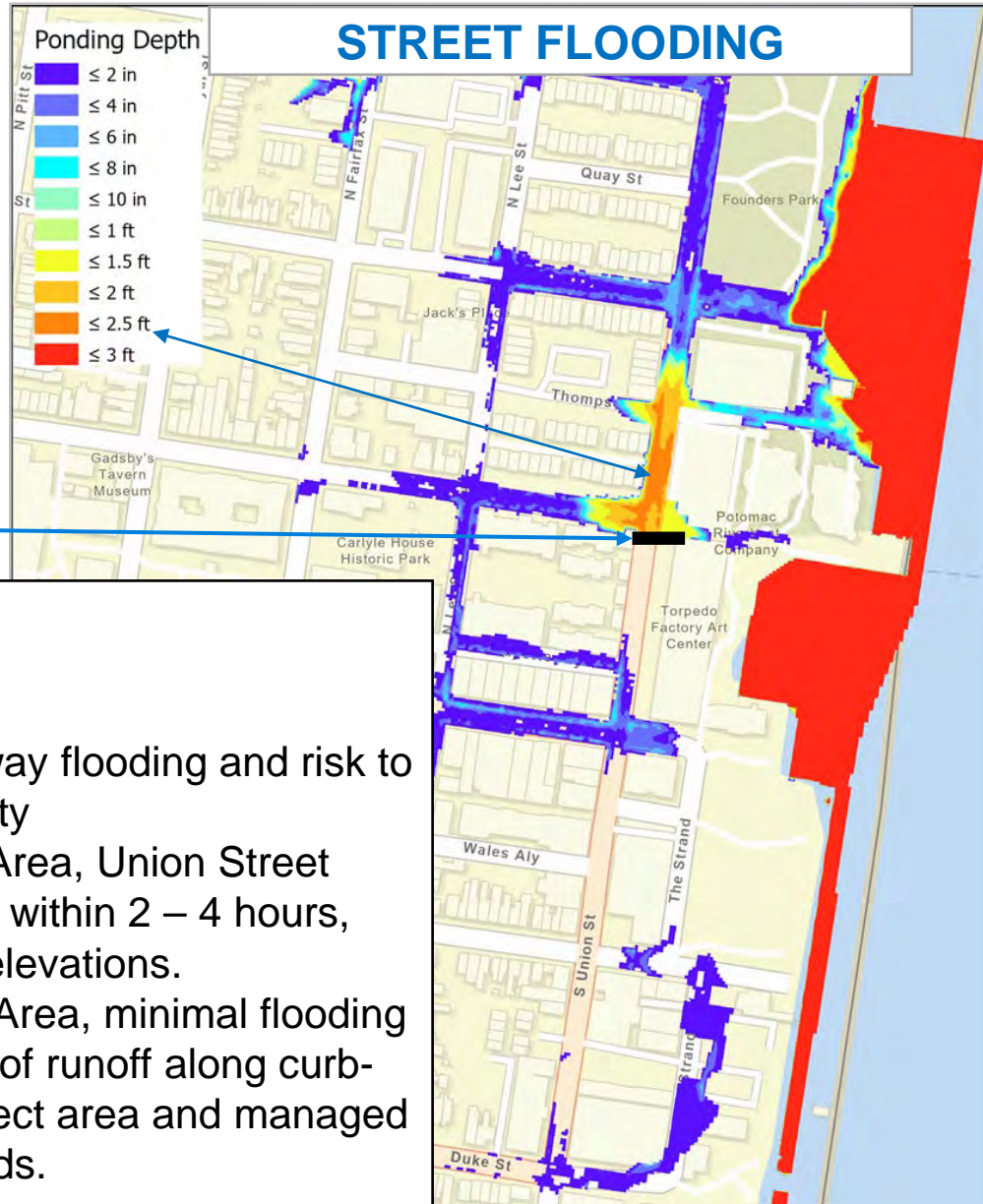
# Union/Cameron St Deployable Barrier

Intended to prevent “spillover” to King/Union and Strand St

- Vertical protection is 39"
- Footing extends 5' from wall base
- Preserve emergency vehicle access to Marina; block pedestrian access to Marina from Cameron St



# Design Storm Resultant Flooding with Cameron / Union Deployable



## Key Results

- Unacceptable roadway flooding and risk to personal/real property
- In Northern Project Area, Union Street flooding is managed within 2 – 4 hours, depending on river elevations.
- In Southern Project Area, minimal flooding impact with up to 4" of runoff along curb-line in southern project area and managed < 1hr after storm ends.

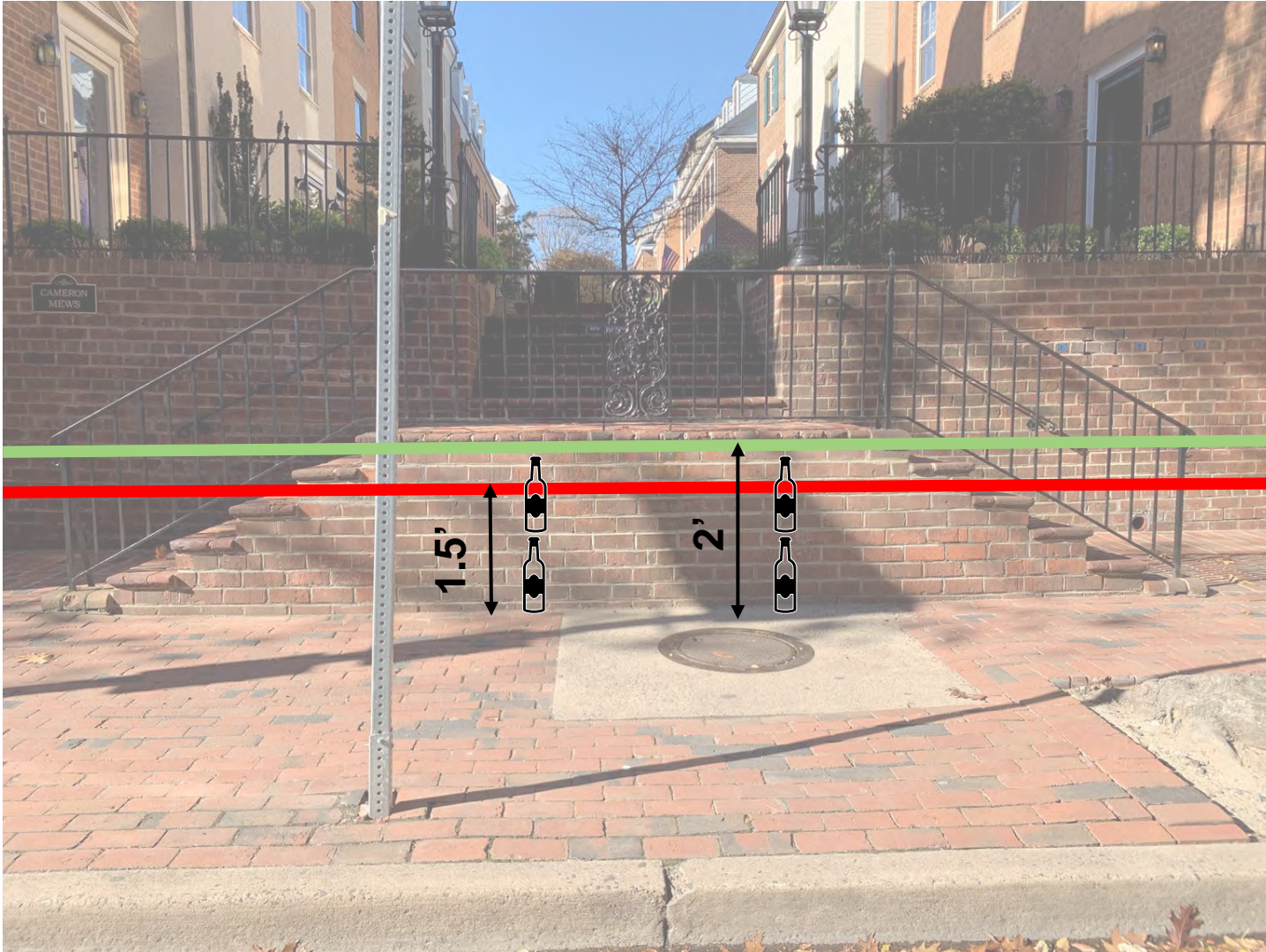
# Union Street Facing North: *Maximum Ponding Depth*

Legend	
Design Storm	<span style="display: inline-block; width: 20px; height: 10px; background-color: #90EE90; border: 1px solid black;"></span>
July 2018 Storm	<span style="display: inline-block; width: 20px; height: 10px; background-color: #FF0000; border: 1px solid black;"></span>





# Cameron Mews Residences: *Maximum Ponding Depth*



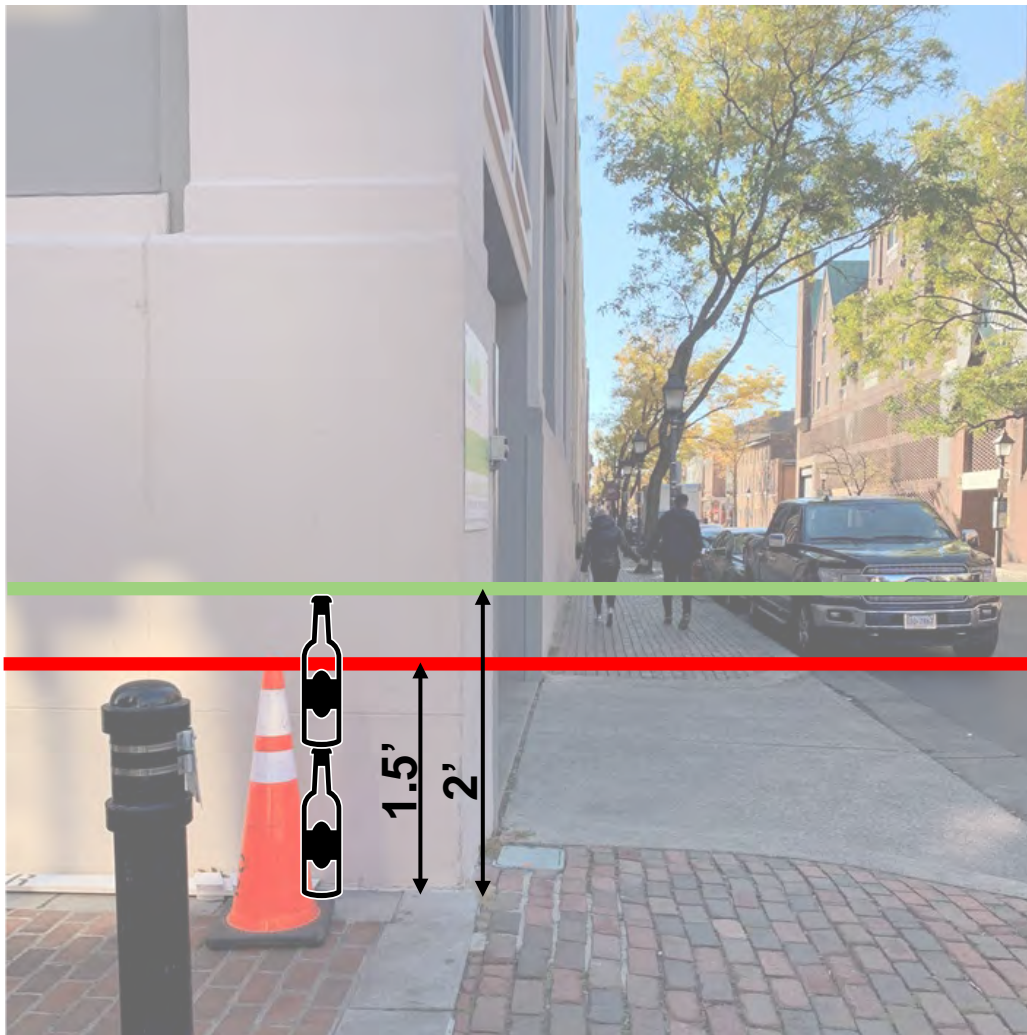
## Legend

July 2018 Storm\*   
Flooding recedes in < 2 hours

Design Storm   
Flooding recedes in < 4 hours

1-L Soda Bottle is   
1-foot tall

# Torpedo Factory Loading Dock: *Maximum Ponding Depth*



## Legend

July 2018 Storm\*    
Flooding recedes in < 2 hours

Design Storm    
Flooding recedes in < 4 hours

1-L Soda Bottle is    
1-foot tall

# Union/Cameron St Deployable: *NOAQ Boxwall*

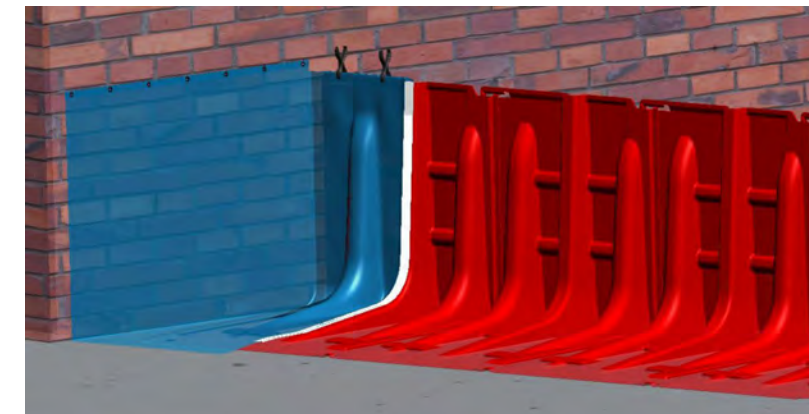
Freestanding deployable flood barrier to protect up to 40"

Uses water weight to withstand flood load

Stored offsite in a 7' x 5' area. Use a forklift to move and install piece by piece in advance of a flood event

Base extends 5' into roadway

Optional use of sandbags to control leakage



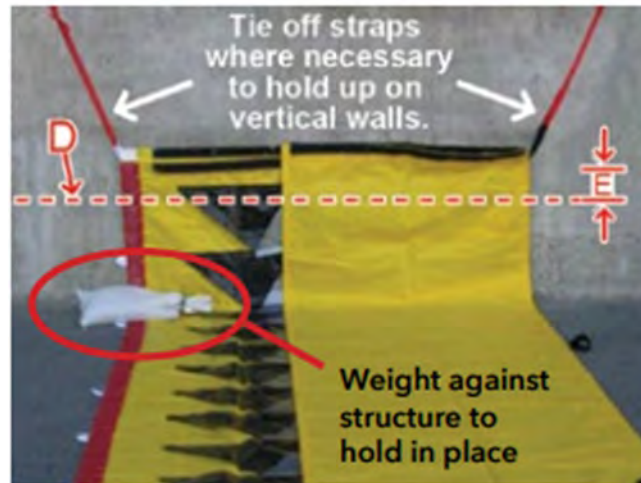
# Union/Cameron St Deployable: *Quick Dam Water-Gate*

Flexible, self-rising roll out dam

Rising flood water fills the dam and uses water weight to withstand flood load

Stored offsite in a 4' x 4' area. Use a forklift to deploy and roll into place in advance of a flood event

Emergency access vehicle can drive over barrier



# Union/Cameron St Deployable: *Quick Dam Water-Gate*

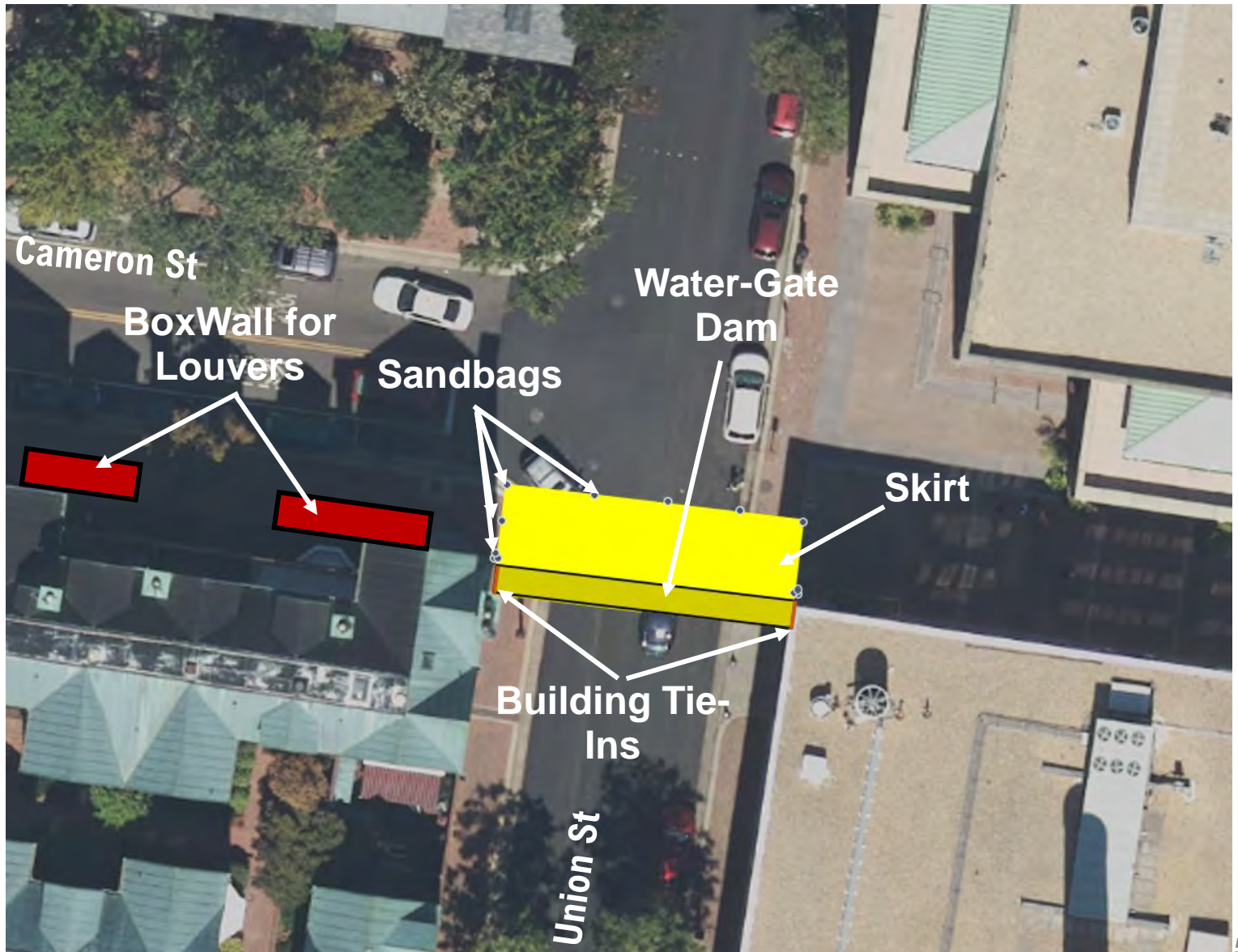
Vertical protection is 39"

Skirt extends 13' from base

Vehicle traffic between south of Cameron to King affected; preserves through traffic on Cameron St.

Preserves emergency vehicle access to Marina; minor impacts to pedestrian access to Marina from Cameron St and at Union/Cameron intersection

Emergency vehicles can drive over barrier



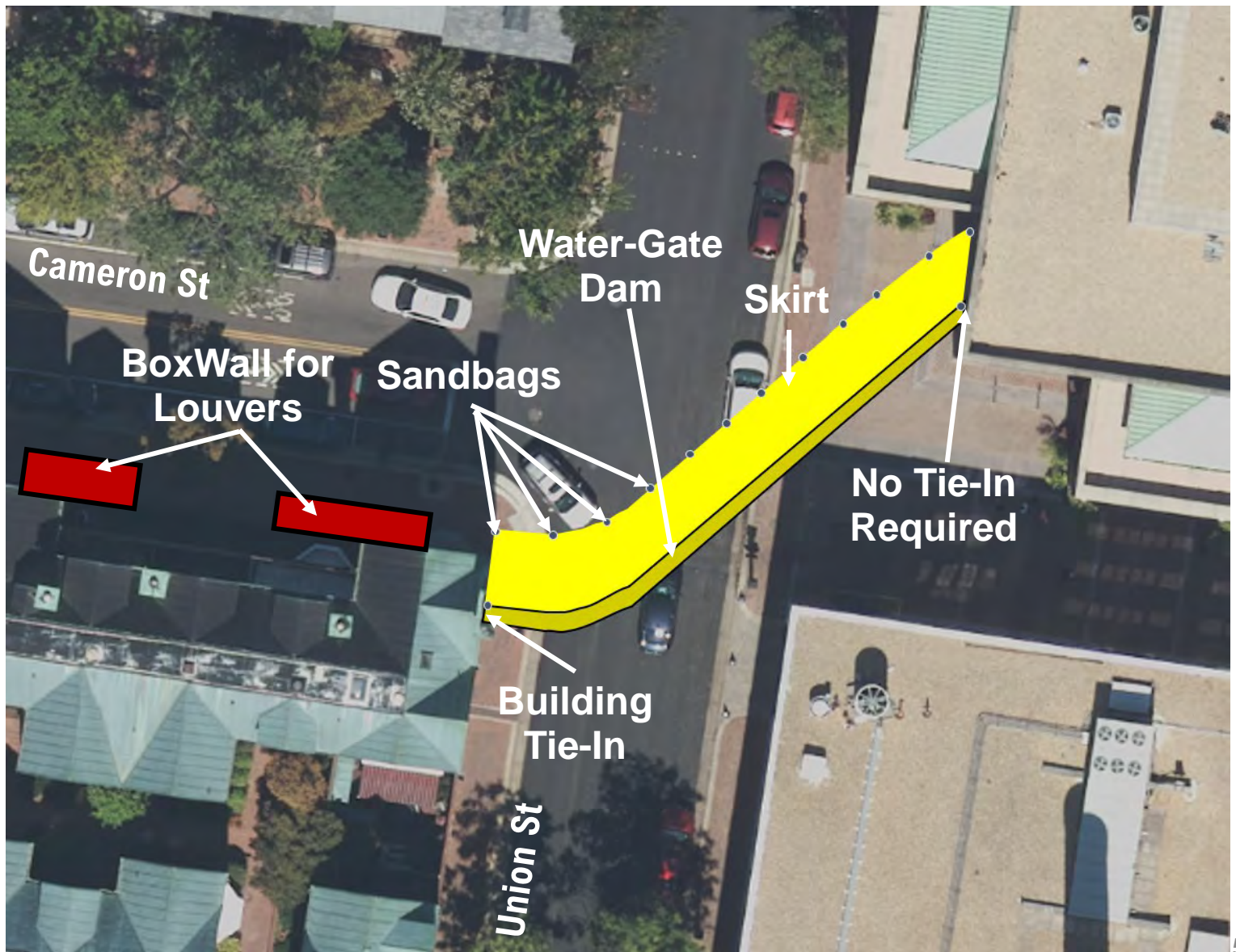
# Union/Cameron St Deployable: *Quick Dam Water-Gate*

Vertical protection is 39"

Skirt extends 13' from dam base

Preserves emergency vehicle access to Marina; block pedestrian access to Marina from Cameron St

Minimize chance of emergency vehicle driving over barrier



# Union/Cameron St Deployable: *Muscle Wall*

Freestanding deployable flood barrier to protect up to 36"

Stored offsite in bundles of 4 units. Bundle dimensions are 6' x 2' x 6' (L x W x H) and can be moved with hand truck. Would need 3 or 4 bundles

Wall sections are installed and then filled with water prior to flood event

Internal water weight withstands the flood load

Optional use of sandbags to control leakage



# Union/Cameron St Deployable: *ILC Dover Flex Wall*

High-strength fabric flood barrier stored onsite to protect up to 36"

Pulled across the flood pathway from storage container to receiver anchored on the opposite side

Both containers would have to be permanently anchored to building faces; structural investigation recommended for design phase

Storage and receiving boxes are 1.5' wide and would impact sidewalk widths

Cannot jump the sidewalk curb; would require re-grading around each curb

RECEIVER

CONTAINER



STOWED

CONTAINER  
OPEN

FLEXIBLE  
WALL

WEIGHTED  
SKIRT



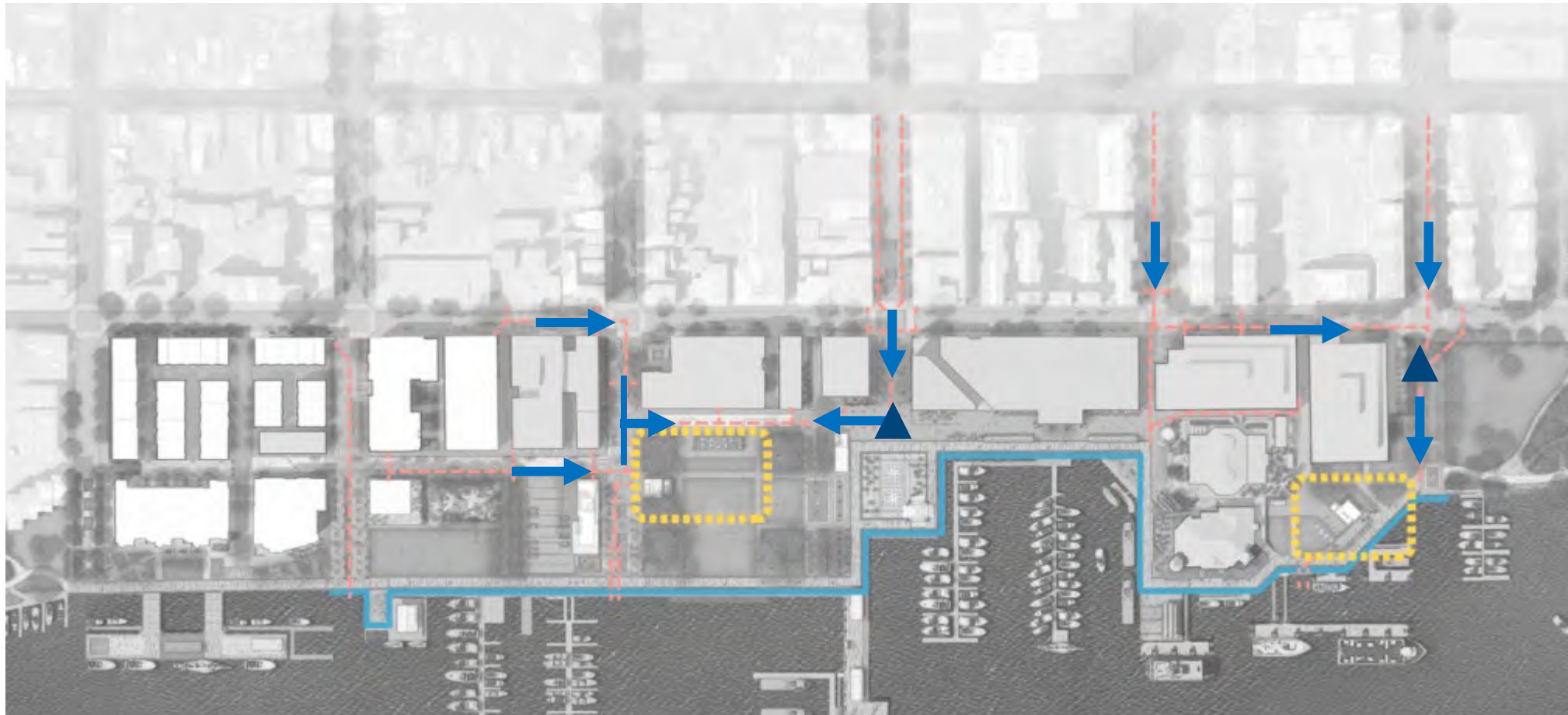
DEPLOYED



# Understanding the improvements with a more sustainably-focused and resilient project

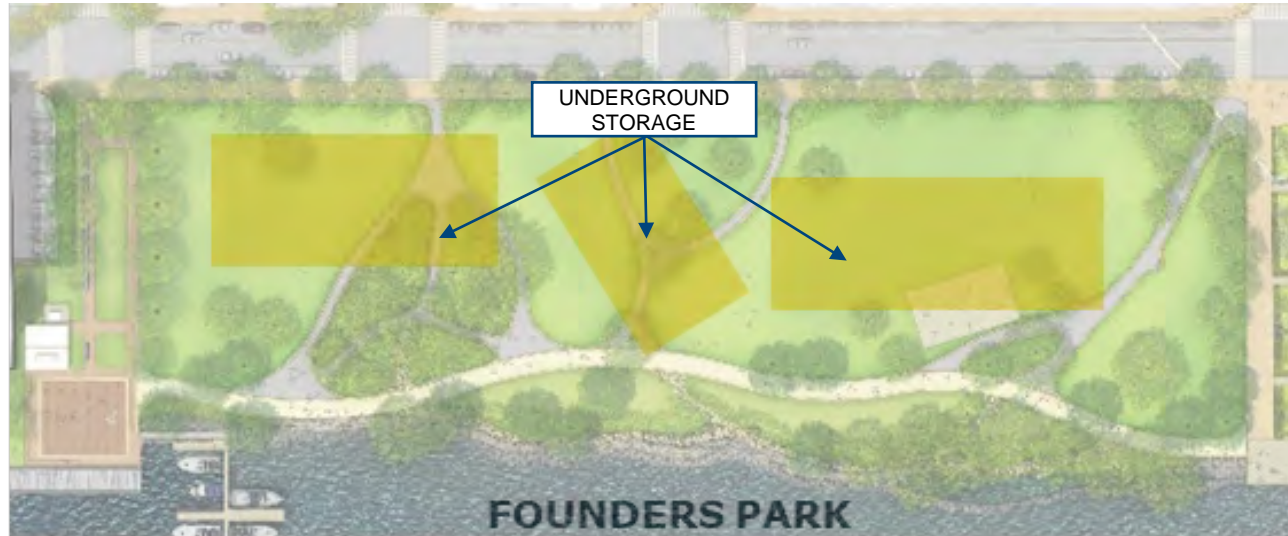
Criteria	Baseline	Added Sustainability/Resiliency
Flood Mitigation	Effectively eliminate “nuisance” flooding and mitigate all historical storms on record	
Climate Change	Considers increased peak rainfall intensity and sea level rise through project lifecycle	
Cost	Exceeds the City’s current CIP budget	
Resilient	Relies on grey infrastructure for immediate flooding response	Reduced reliance on grey infrastructure and incorporates passive, attenuation solutions for immediate flooding response
Water Quality Improvements	None	Solutions provide proven water quality benefits in accordance with VDEQ and to meet regulatory requirements

# Park spaces are an opportunity to manage water differently through delay and store strategies



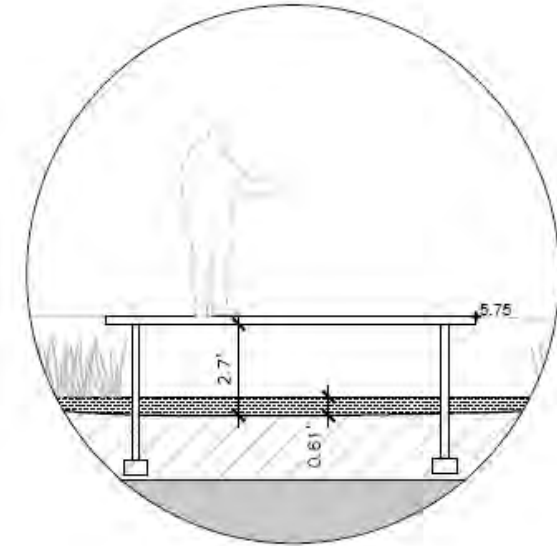
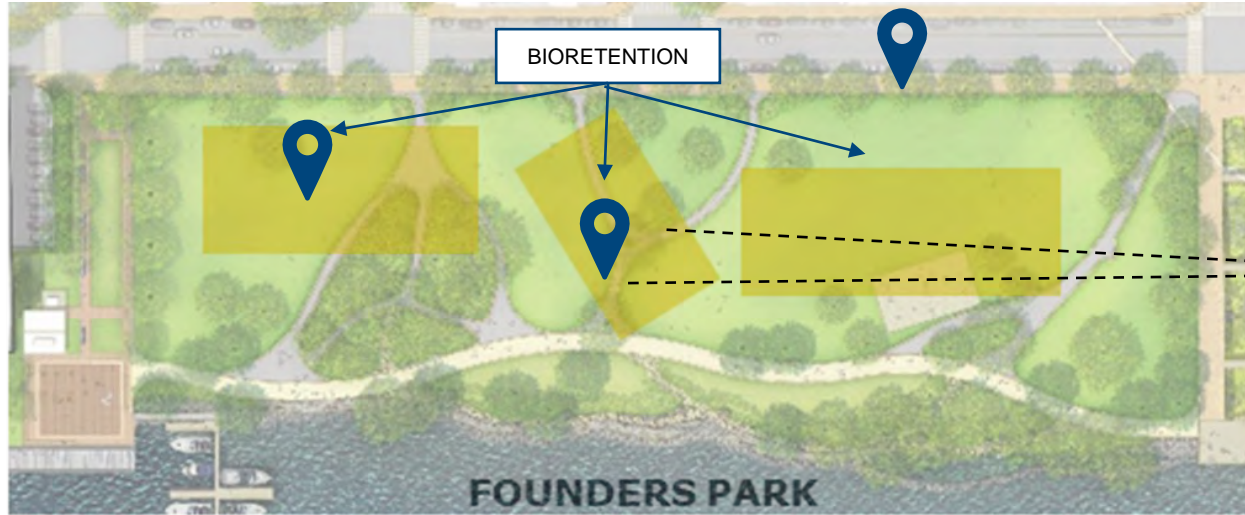
- Local Stormwater Systems
- Riverfront Alignment
- Direction of flow to PS
- Point of interception
- Pumping Stations

# Underground stormwater chambers offer an opportunity to attenuate stormwater and restore park to existing condition

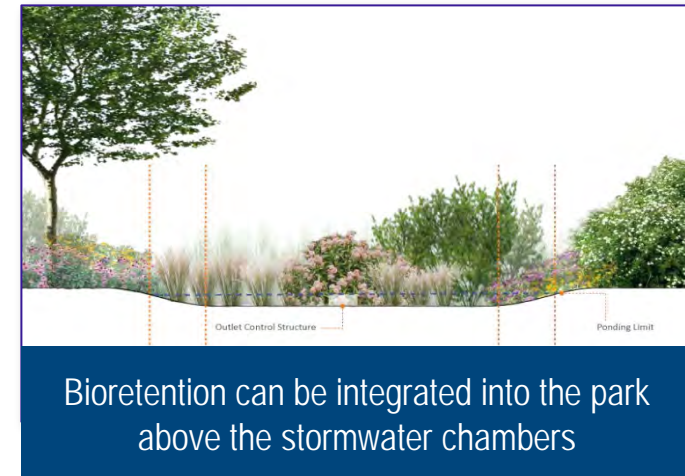


Sources:  
<https://www.youtube.com/watch?v=-PZ9P2NyD44>  
<https://www.triumphgeo.com/product/3-stormtech-treatment-systems/>

# Bioretention can attenuate stormwater, offer educational programming, and provide water quality benefits



ELEVATED BOARDWALK AT BIORETENTION



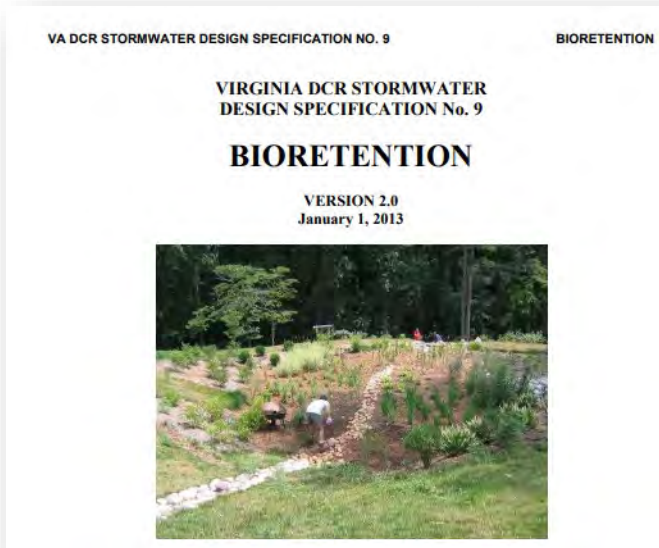
Bioretention can be integrated into the park above the stormwater chambers

# New solutions in park spaces support: Eco-City Alexandria, Green Building Policy, Environmental Action Plan 2040, and VDEQ Regulatory Compliance

## Water Resources

Reduce stormwater phosphorus concentrations

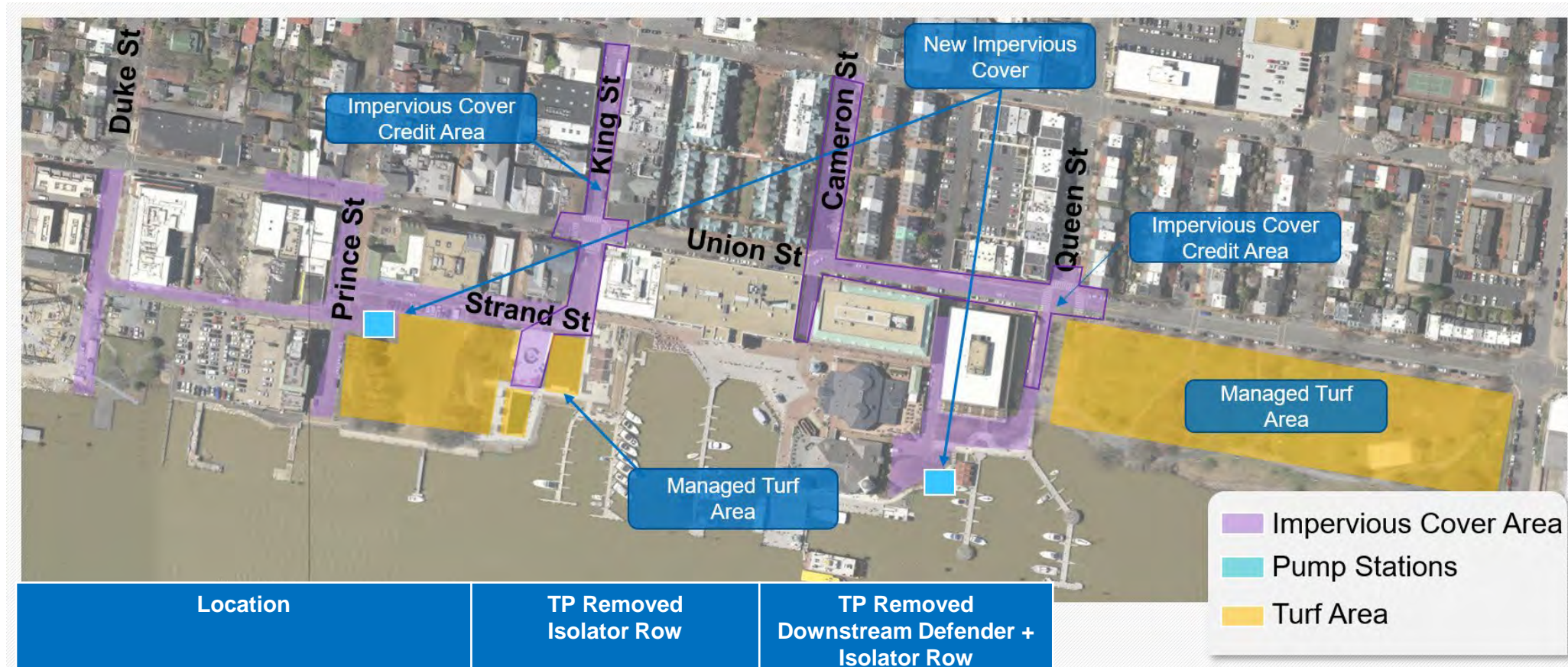
- Chambers with an Isolator Row are proven to **remove total phosphorus by 40%**
- Opportunity to comply with water quality regulatory requirements without the purchase of credits



VA DEQ has approved these solutions for stormwater pollutant removal and water quality improvements

1. Bioretention
2. Downstream Defender, a hydrodynamic separator
3. Isolator Row, a pretreatment for the StormTech Stormwater Chambers

# Preliminary calculations suggest that supporting technologies for chambers can help us meet and **exceed** water quality goals



Location	TP Removed Isolator Row	TP Removed Downstream Defender + Isolator Row
King St Drainage (PS1)	0.8 lb/yr	1.1
Queen St Drainage (PS2)	1.9 lb/yr	2.5
Total TP Removed	2.7 lb/yr	3.6 lb/yr
Regulatory Requirement	3.3 lb/yr	

WQ = water quality  
 TP = total phosphorus  
 lb/yr = pounds per year

# Cost Based Option - 1

*Addresses flooding due to rainfall runoff with improved streetscape and stormwater infrastructure and pump stations within the City's CIP budget of \$100M.*

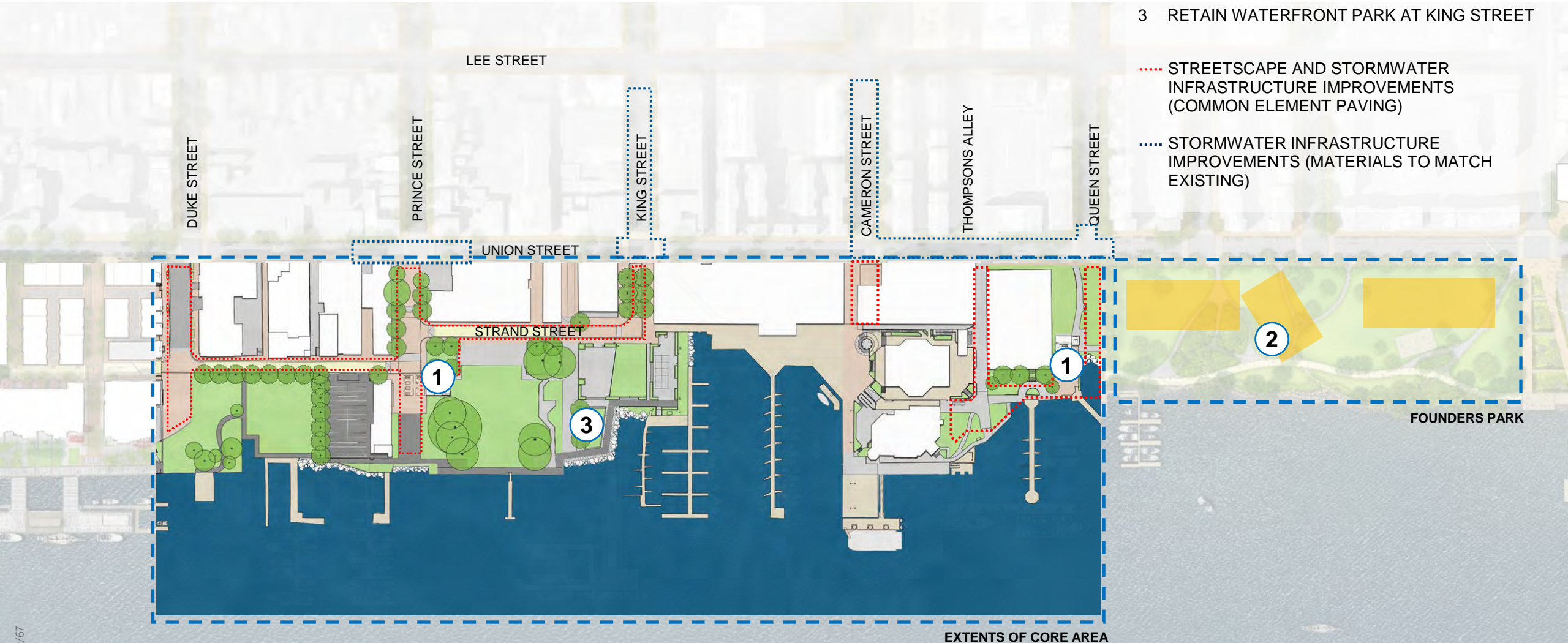
# // Cost Based Option – 1

Mitigates Rainfall Flooding; Defers Shoreline and Park Improvements

## LEGEND

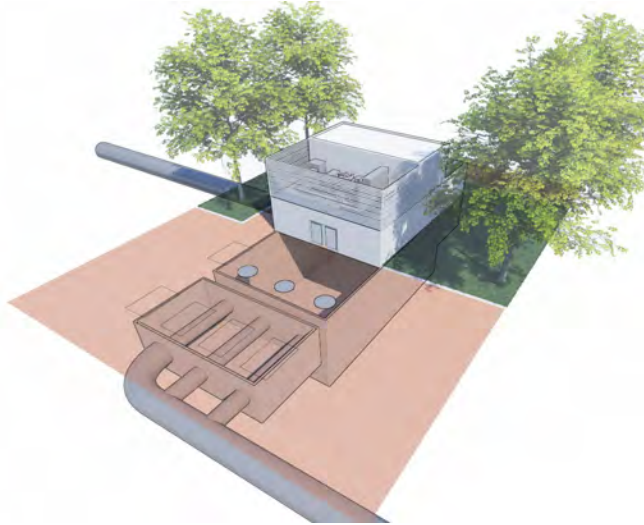
- 1 PUMP STATION
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- ..... STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)





# // Project Elements



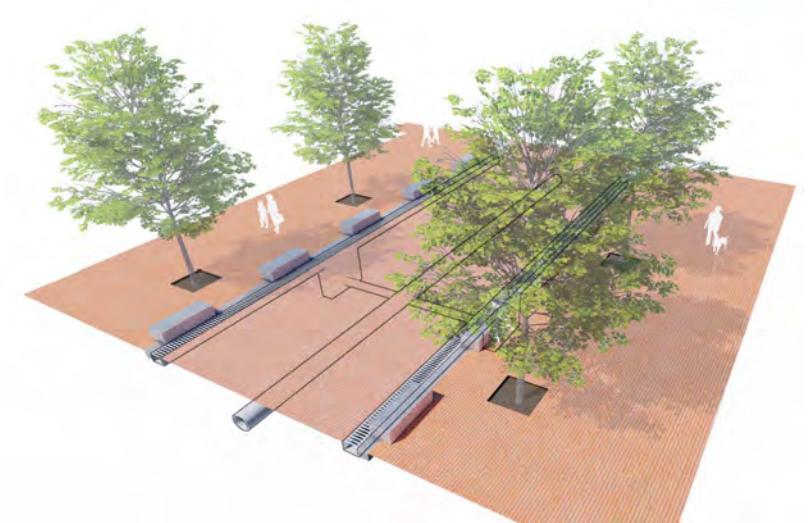
## PUMP STATIONS

- Utilitarian structure housing stormwater pumps and associated mechanical and electrical equipment
- No city storage or amenity space
- Thompsons Alley PS capacity reduced by 95%



## UNDERGROUND DETENTION

Stormwater storage chambers sited under existing parkspaces



## STREETSCAPE AND STORMWATER INFRASTRUCTURE IMPROVEMENTS

- New and upsized stormwater inlets and conveyance pipes
- Common elements paving proposed for streets within the core area only. All others to match existing materials

# // Green Infrastructure approach in Alignment with Regulation and Local Policy

## Green Building Policy (Adopted 2019)

- Requires that public development “will treat 100% of the required stormwater treatment through green infrastructure.”
- Water quality requirements for nutrient reductions shall be addressed by on-site management of stormwater via green infrastructure.
- The City must use practices approved by Virginia Department of Environmental Quality in order to comply (such as the underground storage chambers with isolator row and/or hydrodynamic separators).

## Environmental Action Plan 2040 (Adopted 2019)

- “Green Infrastructure Program Plan to prioritize projects, increase green infrastructure projects on public and private property, and promote green infrastructure as the leading approach for stormwater management in the City.”

## Eco-City Charter (2008)

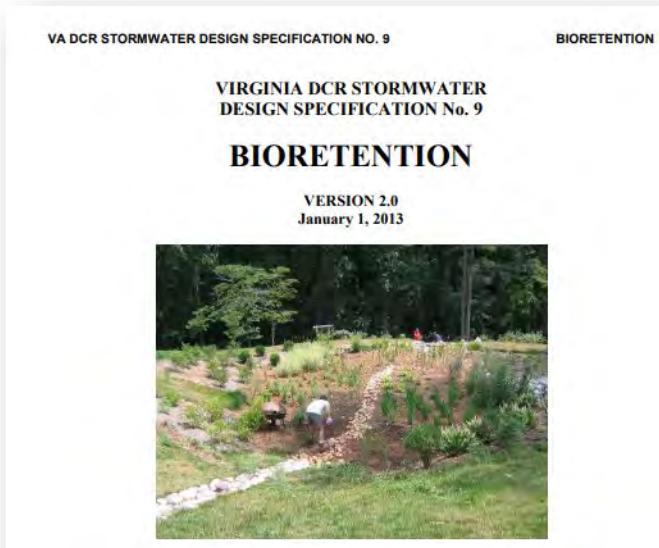
- Laid out initial vision and framework to create a more sustainable future and City approach to infrastructure

# New solutions in park spaces support: Eco-City Alexandria, Green Building Policy, and VDEQ Regulatory Compliance

## Water Resources

Reduce stormwater phosphorus concentrations

- Chambers with an Isolator Row are proven to **remove total phosphorus by 40%**
- Opportunity to comply with water quality regulatory requirements without the purchase of credits



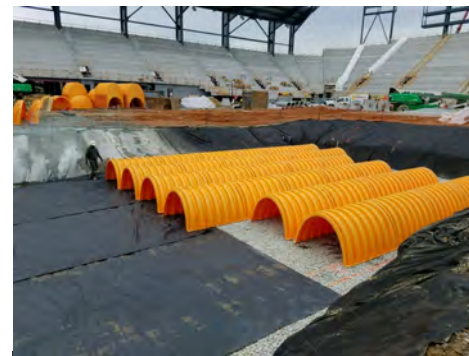
- VA DEQ has approved these solutions for stormwater pollutant removal and water quality improvements
1. Bioretention
  2. Downstream Defender, a hydrodynamic separator
  3. Isolator Row, a pretreatment for the StormTech Stormwater Chambers

# Underground stormwater chambers have successfully been installed in other green & park spaces

- Stadiums



Football field in Canton, OH



DC United Soccer Stadium

- Fairfax County Schools

- South Run Park in Fairfax County installed over 8 years ago



# // Project Expectations

- Address the highest flooding priorities and goals within existing CIP funding



- Maintaining existing shoreline infrastructure and elevations
- No new promenade or major park upgrades; material improvements to retain Waterfront Park at King St Square and establish permanent park space
- Underground detention chambers add water quality benefits

## // Project Cost Range

- Class 4 Level Estimate: -30% to +50%
  - Total Estimated Total Project Cost: \$90M
  - Total Estimated Project Cost Range: \$63M - \$136M
- Emphasizes the need to understand community priorities

# Cost Estimate Accuracy (AAEC Classification System)

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic			
	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

- Class 4 Level Estimate by Owner-Advisor Team
- Determine priorities



- Class 3, 2, & 1 Estimates by Engineer of Record / D/B Team
- Will determine costs of priorities & affordability



# Scoping to Budget

<b>ITEMS ESTIMATED TO BE WITHIN BUDGET:</b>	<b>\$</b>		<b>ITEMS ESTIMATED TO BE WITHIN BUDGET:</b>	<b>\$</b>
UTILITIES - PUMP STATION #1	\$\$\$\$\$		UTILITIES - PUMP STATION #1	\$\$\$\$
UTILITIES - PUMP STATION #2	\$\$\$\$\$		UTILITIES - PUMP STATION #2	\$\$\$\$
UTILITIES - STORM SEWER	\$\$\$\$		UTILITIES - STORM SEWER	\$\$\$
UTILITIES - DRY	\$\$\$		UTILITIES - DRY	\$\$\$
UTILITIES - WET	\$\$		UTILITIES - WET	\$\$
RESTORATION OF PARKS	\$\$\$		RESTORATION OF PARKS	\$\$\$
RESTORATION OF ROW	\$\$		RESTORATION OF ROW	\$\$
			STRUCTURAL BULKHEAD	\$\$\$
			PROMENADE	\$\$
			KING STREET SQUARE IMPROVEMENTS	\$\$\$
TOTAL DIRECT COSTS	\$\$\$\$\$\$			
<b>PRIORITIZED ITEMS NOT CURRENTLY WITHIN BUDGET:</b>	<b>\$</b>			
STRUCTURAL BULKHEAD	\$\$\$\$\$			
PROMENADE	\$\$\$			
KING STREET SQUARE IMPROVEMENTS	\$\$\$			
WATERFRONT PARK IMPROVEMENTS	\$\$			
MARINA IMPROVEMENTS	\$\$\$			
POINT LUMLEY IMPROVEMENTS	\$\$			
KING STREET PIER	\$\$\$			
ADDITIONAL PIERS	\$\$\$			
TOTAL ADDITIONAL COST	\$\$\$\$\$\$			
			<b>PRIORITIZED ITEMS NOT CURRENTLY WITHIN BUDGET:</b>	<b>\$</b>
			WATERFRONT PARK IMPROVEMENTS	\$\$
			MARINA IMPROVEMENTS	\$\$\$
			POINT LUMLEY IMPROVEMENTS	\$\$
			KING STREET PIER	\$\$\$
			ADDITIONAL PIERS	\$\$\$
			TOTAL ADDITIONAL COST	\$\$\$\$\$\$





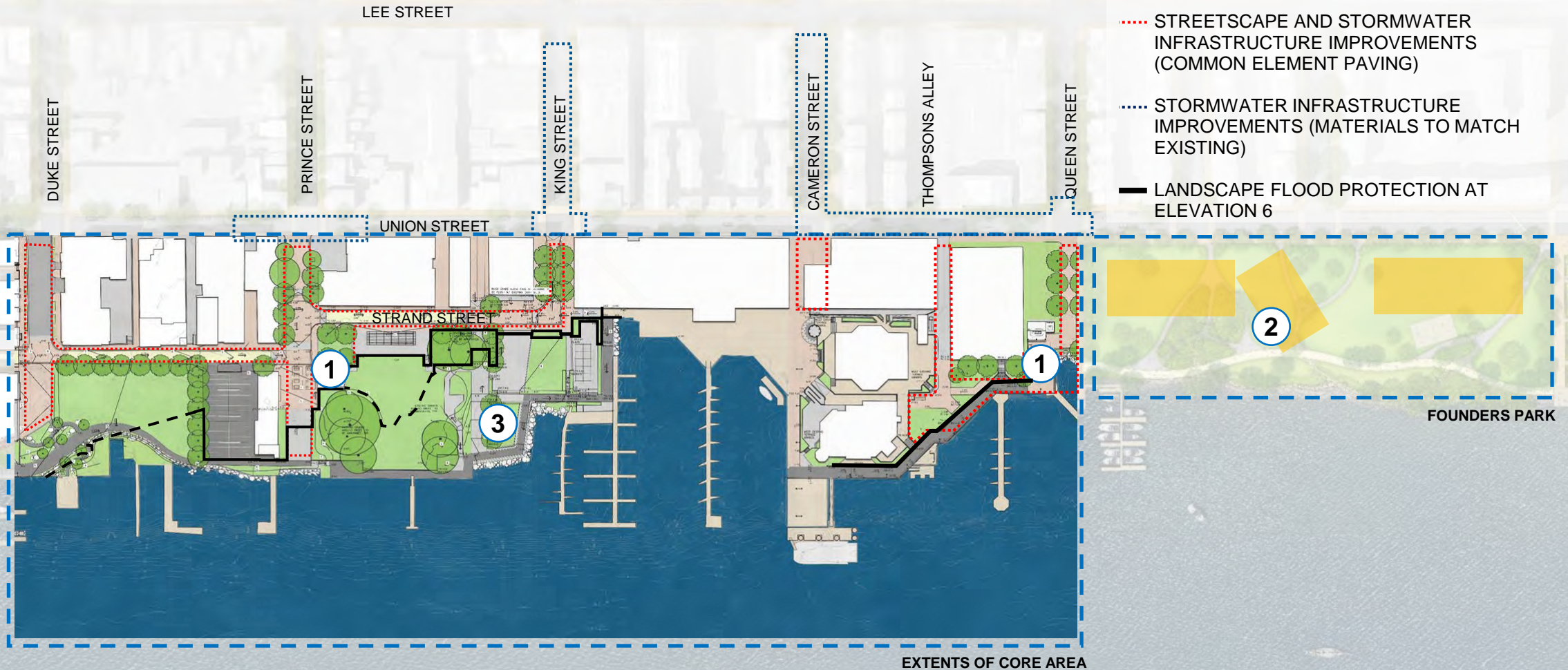
# // Cost Based Option - 1

## Add-On A: Landscape Based Flood Protection (Strand)

### LEGEND

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- LANDSCAPE FLOOD PROTECTION AT ELEVATION 6



# // Cost Based Option - 1

## Add-On B: Landscape Based Flood Protection (River)

LANDSCAPE ELEMENTS PROVIDE 6' ELEVATION FLOOD PROTECTION

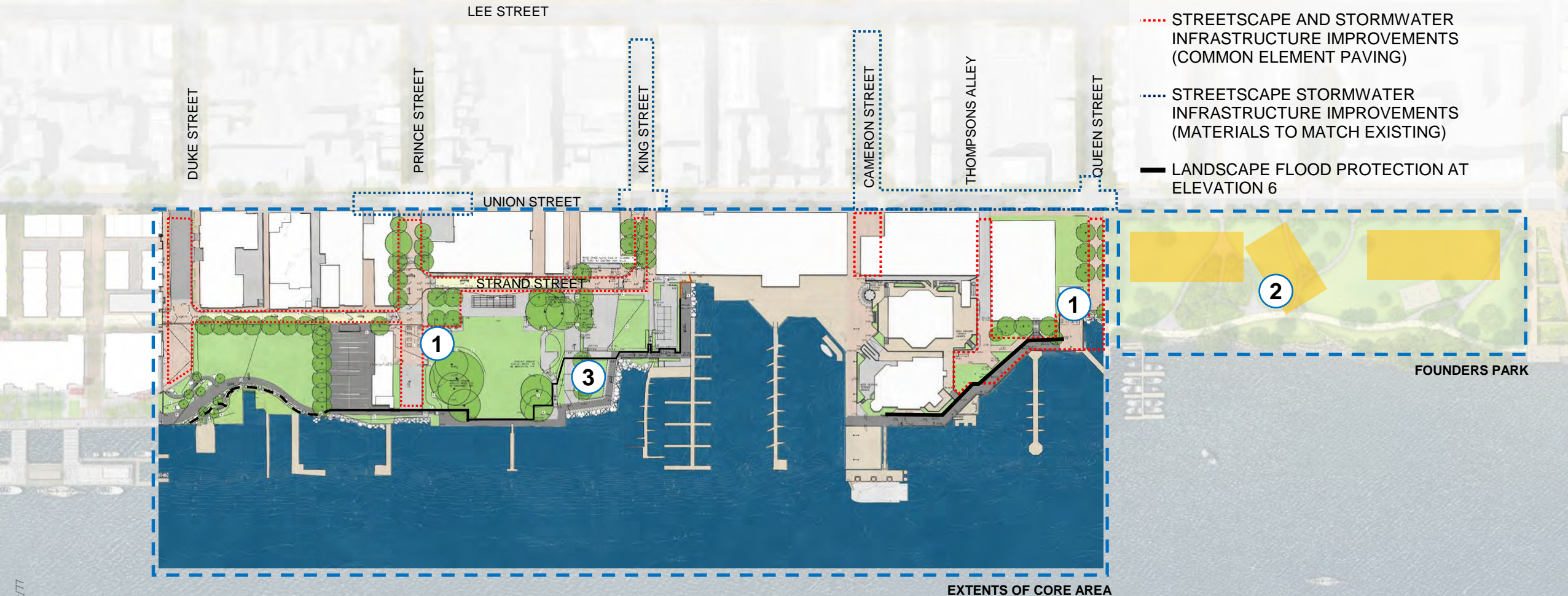
### LEGEND

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..... STREETScape STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)

— LANDSCAPE FLOOD PROTECTION AT ELEVATION 6



FOUNDERS PARK

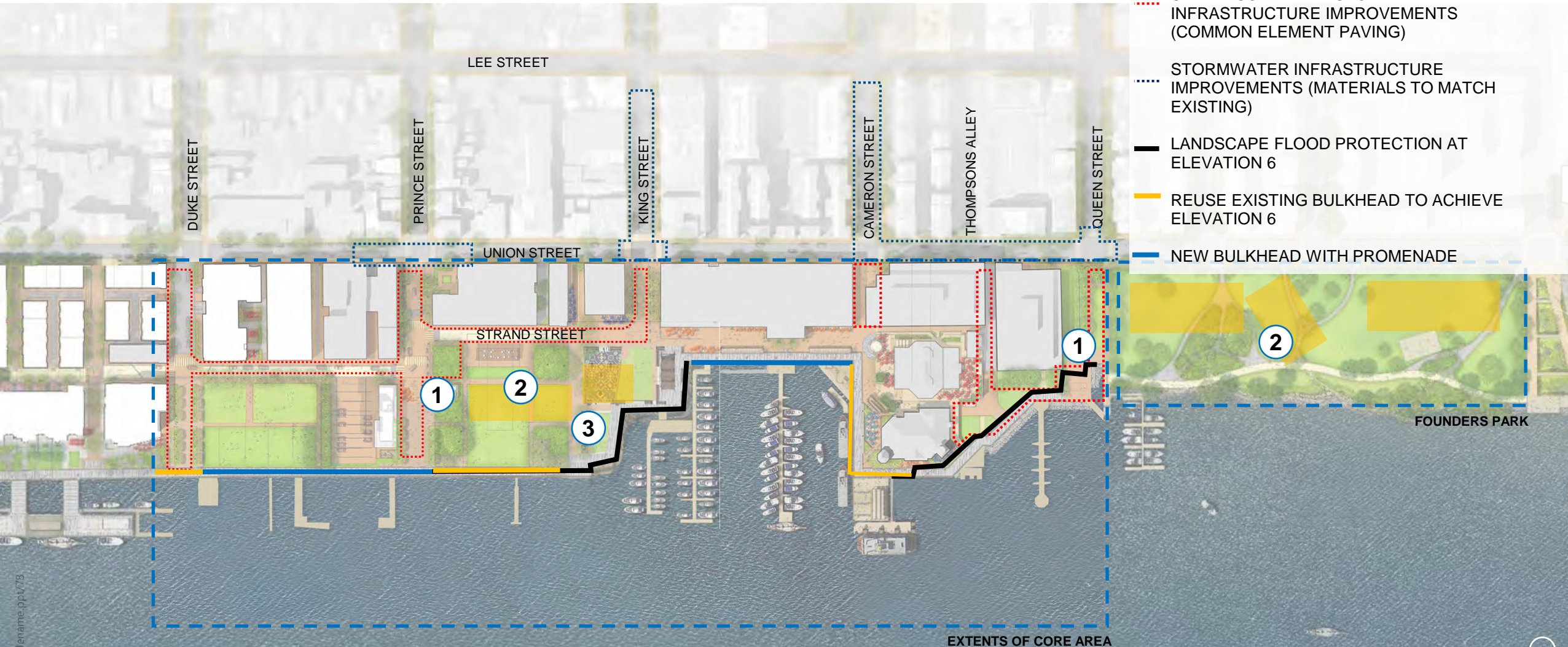
EXTENTS OF CORE AREA



# // Performance Alternative A

## LEGEND

- 1 PUMP STATION
- 2 UNDERGROUND STORMWATER DETENTION CHAMBERS
- 3 RETAIN WATERFRONT PARK AT KING STREET
- ..... STREETScape AND STORMWATER INFRASTRUCTURE IMPROVEMENTS (COMMON ELEMENT PAVING)
- ..... STORMWATER INFRASTRUCTURE IMPROVEMENTS (MATERIALS TO MATCH EXISTING)
- LANDSCAPE FLOOD PROTECTION AT ELEVATION 6
- REUSE EXISTING BULKHEAD TO ACHIEVE ELEVATION 6
- NEW BULKHEAD WITH PROMENADE



EXTENTS OF CORE AREA

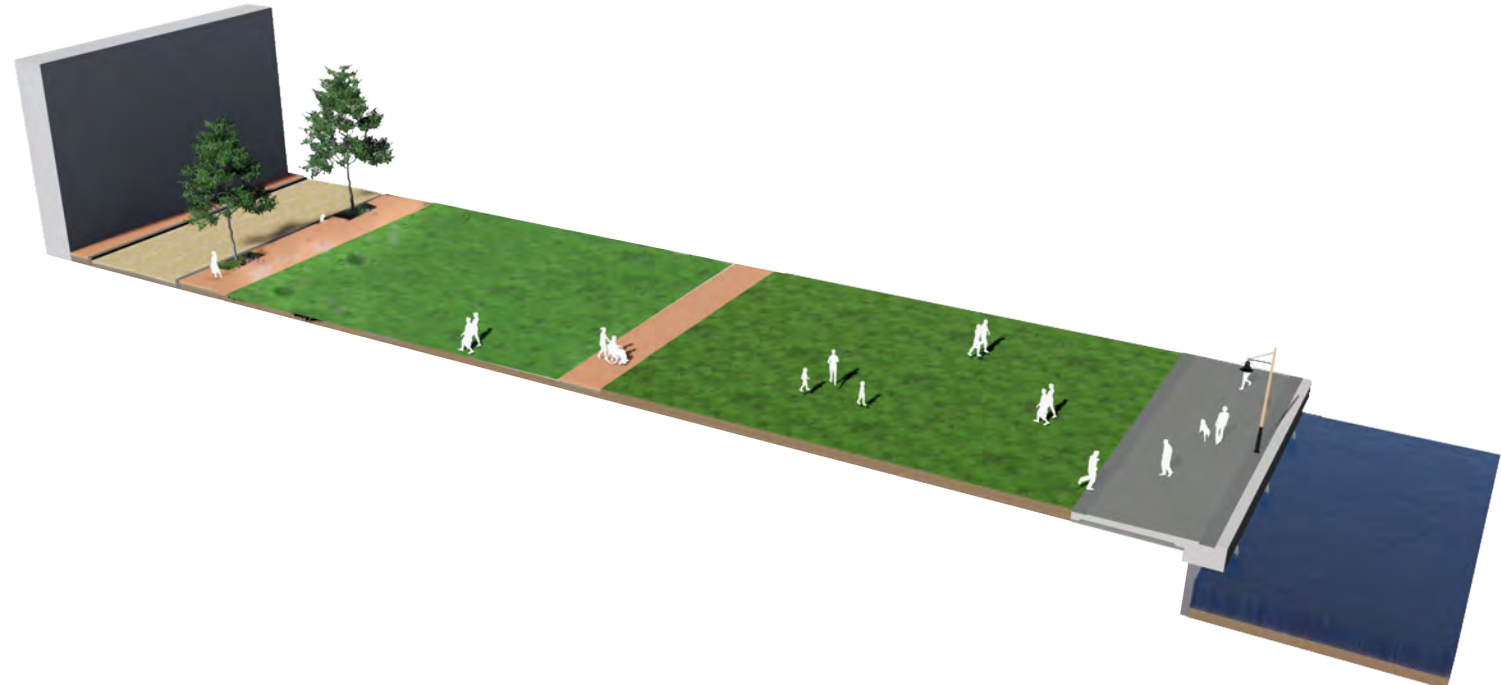
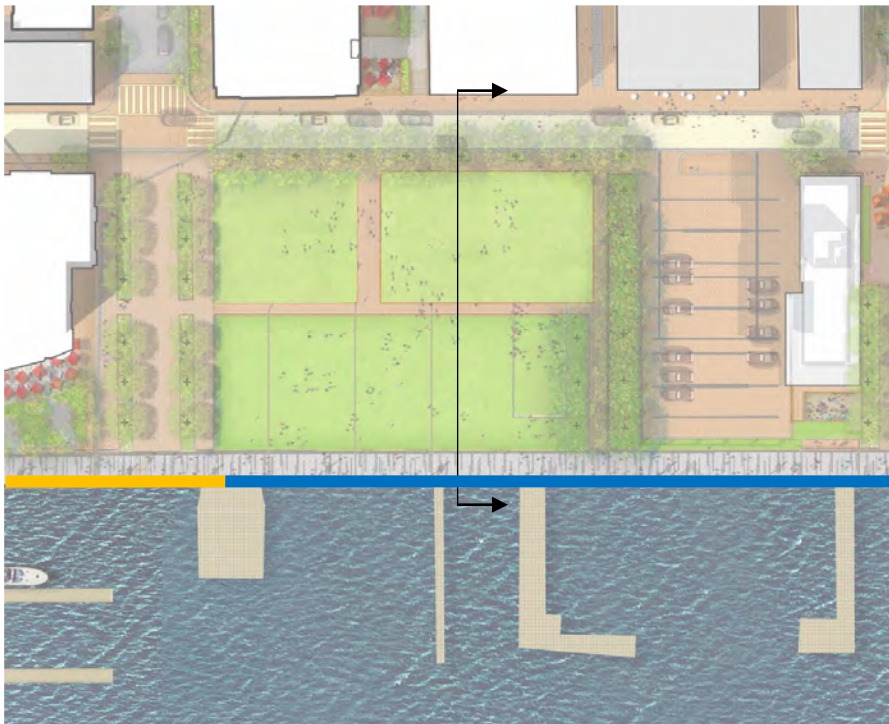
# // Performance Alternative A

## Point Lumley Park Improvements

- Extension of greenspace with new hardscape and landscape improvements
- New bulkhead and 20-ft wide promenade with pavers
- Connection to Robinson Terminal South and rest of waterfront new development



KEY PLAN



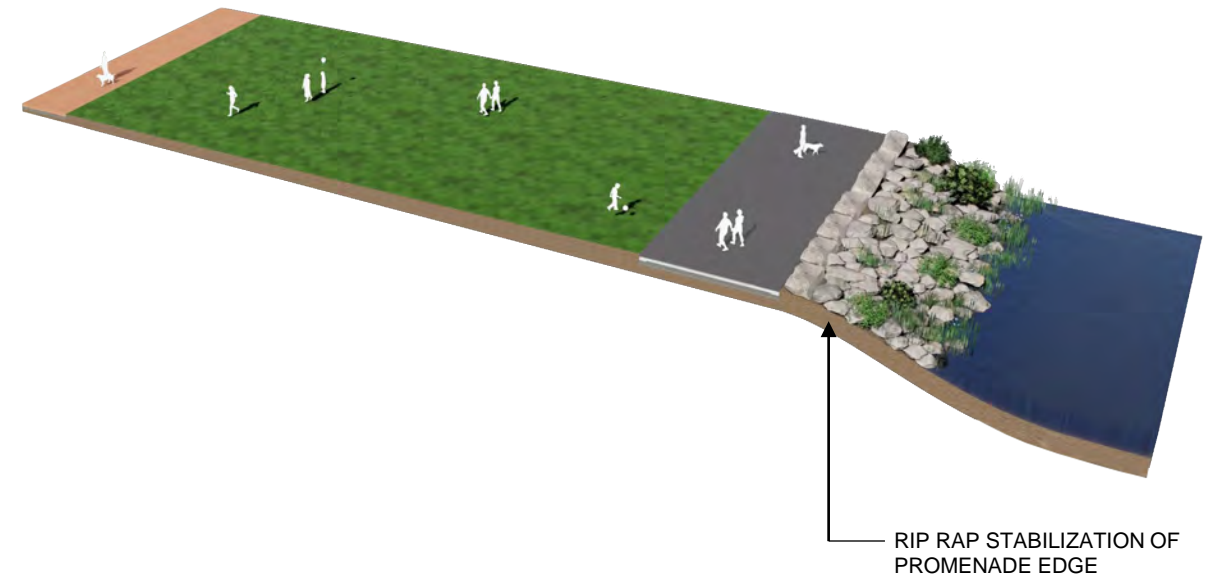
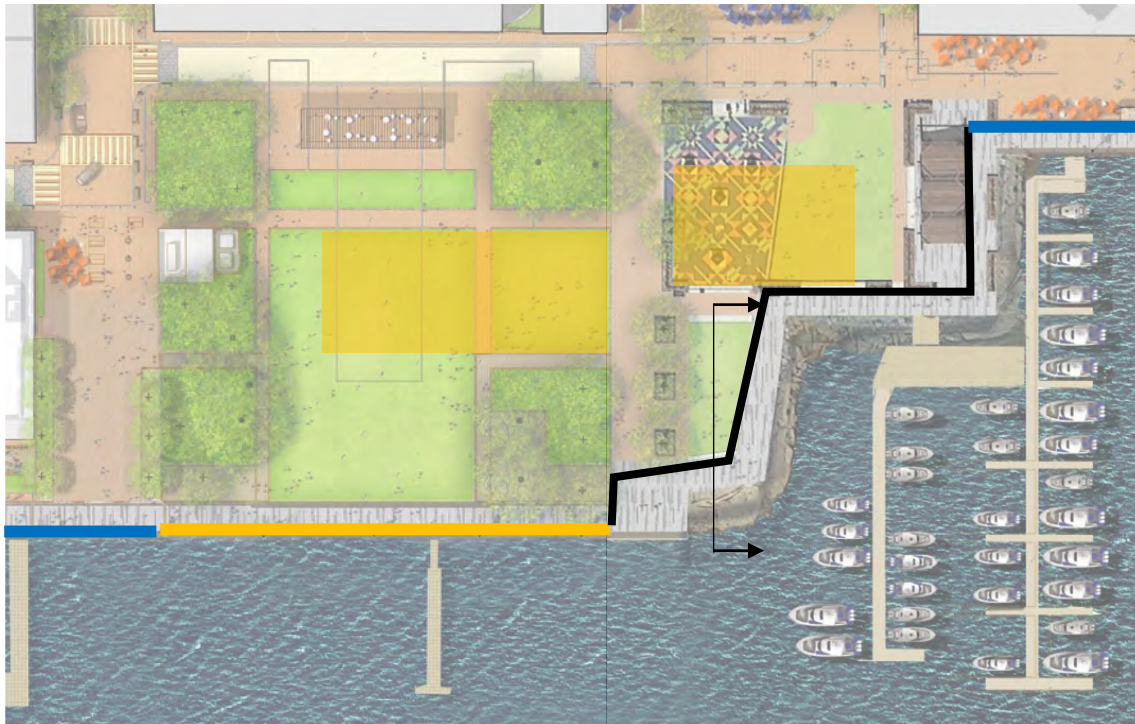
# // Performance Alternative A

## Waterfront Park and King St Square Improvements

- Pump Station at 60% capacity reduction
- New 20-ft wide promenade with pavers
- Riprap promenade edge at King St Square
- Concealed stormwater chambers



KEY PLAN

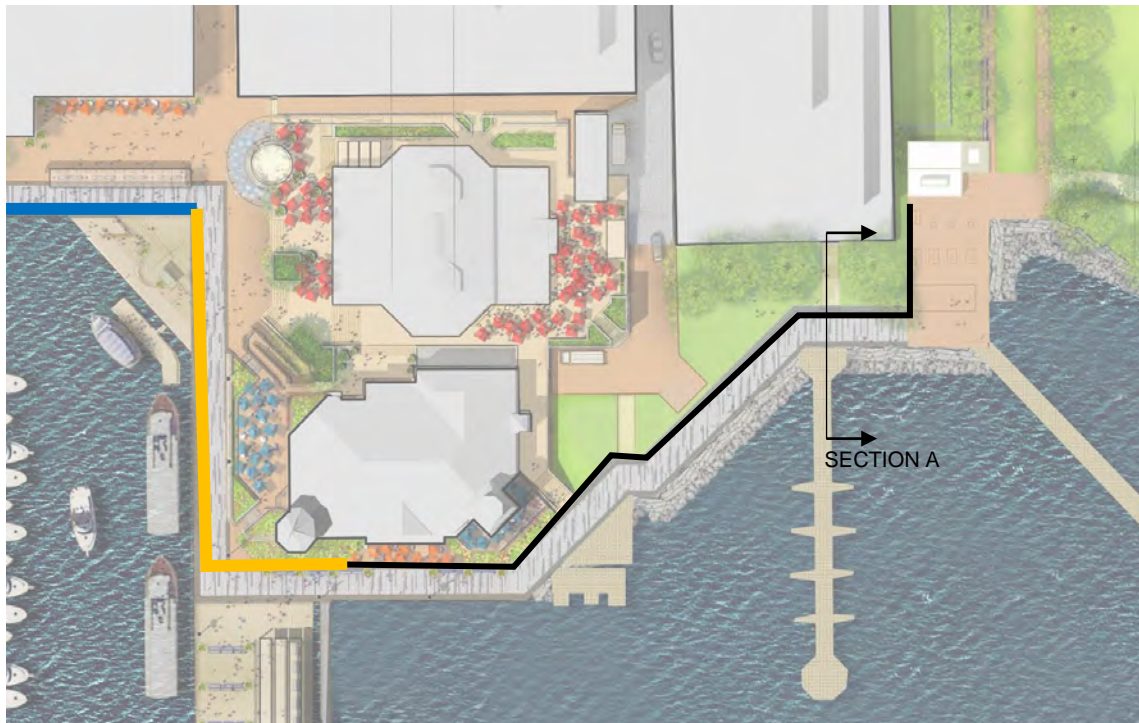


RIP RAP STABILIZATION OF PROMENADE EDGE

# // Performance Alternative A

## Thompsons Alley Improvements

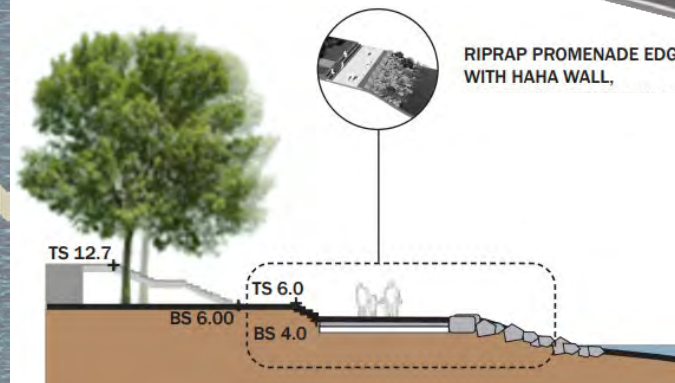
- Ha-ha wall to new 20-ft wide promenade with pavers
- Pump Station at 95% capacity reduction and at least a 15% footprint reduction



KEY PLAN



RIPRAP PROMENADE EDGE WITH HAHAWALL



SECTION A

# // Project Expectations

- Adapts value engineering and innovation solutions to satisfy flood mitigations goals while reducing the capacity of both pumping stations



- Maximize bulkhead reuse and landscape-based solutions for overtopping protection
- Provides new promenade with changes in shoreline only from Duke to Prince St
- Scales back community amenities, e.g., maintaining Interim Waterfront Park


## // Project Cost Range

- Class 4 Level Estimate: -30% to +50%
  - Total Estimated Project Cost: \$170M
  - Total Estimated Project Cost Range: \$120M - \$255M

**There is an opportunity for cost savings by minimizing new bulkhead construction and using landscape-based solutions for flood protection while still providing a new promenade.**



# Recap of Last Meetings



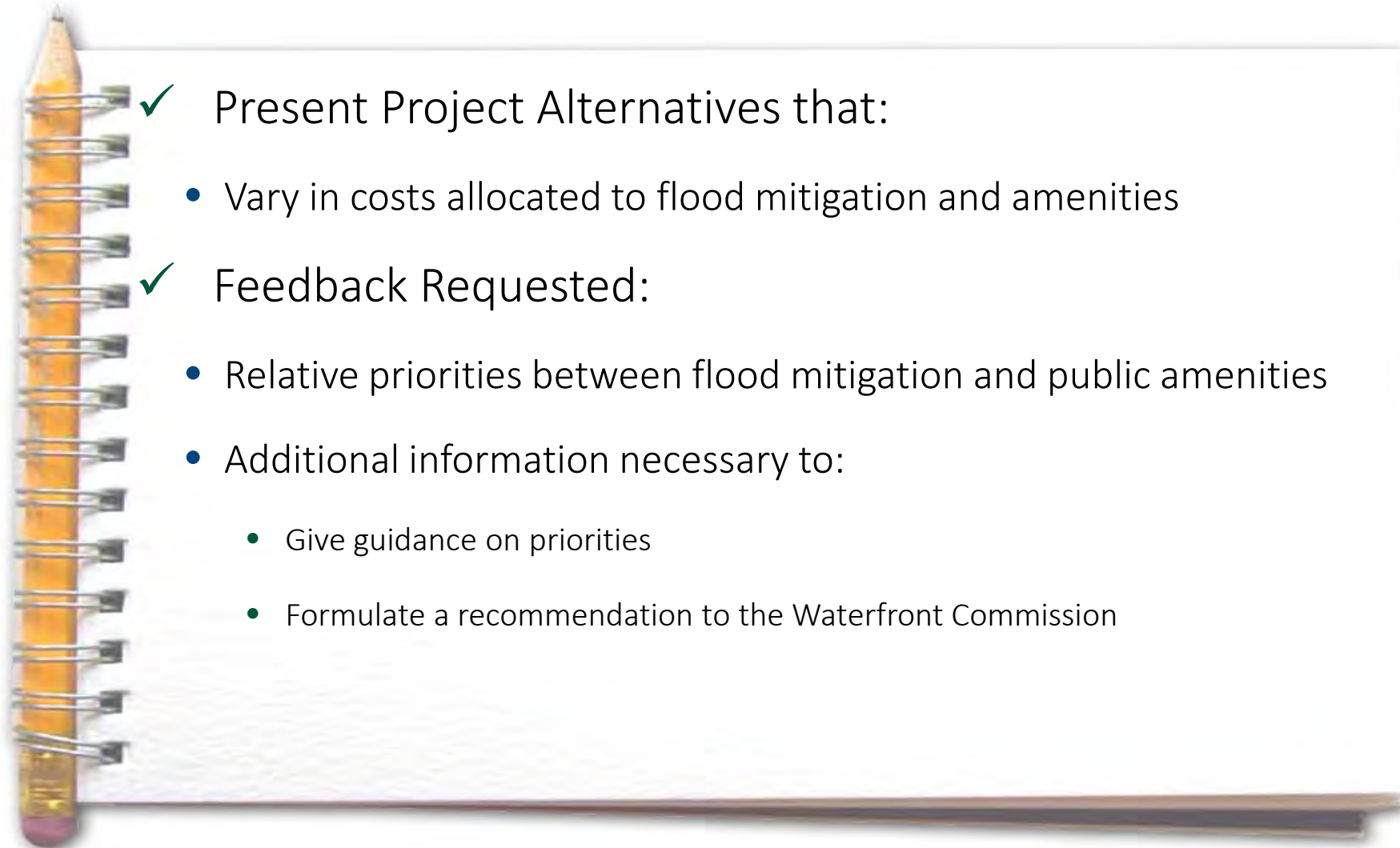
## Flood Mitigation Sub-Committee

- ✓ Flooding is complex and a comprehensive flooding solution will have many components
- ✓ The Baseline Project exceeds the current City's funding
- ✓ Presented Project Alternatives that either (1) maintained or exceeded Baseline Project flooding performance; or (2) scoped to meet the City's funding constraints

## Parks and Recreation Commission

- ✓ Supportive of bioretention and stormwater attenuation in parks
- ✓ Endorsed aligning project with Green Building Policy and Environmental Action Plan 2040

# Meeting Objectives



✓ Present Project Alternatives that:

- Vary in costs allocated to flood mitigation and amenities

✓ Feedback Requested:

- Relative priorities between flood mitigation and public amenities
- Additional information necessary to:
  - Give guidance on priorities
  - Formulate a recommendation to the Waterfront Commission