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Flood Protection Resiliency and Sustainability through an Asset Management Lens

Case study illustrating an Asset Management approach for attaining certification of the Grand River flood protection system by the Federal Emergency Management Agency (FEMA) in its efforts to modernization the National Flood Insurance Program (NFIP).

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President

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Presentation Contents

- Asset Information
  - Knowing what you have.
- Decision-Making related to:
  - Operational activities, inspections & routine maintenance interventions
  - Post-flood protocols throughout the asset's life-cycle process.
- Contingency Planning
  - Prepare, Respond, Recover
  - Building resiliency
- Strategy and Planning
  - Integrating Flood Protection with the Grand River as a corridor for future activation
  - Business objectives
- Technical Standards & Legislation
- Management Systems
  - Integration between Management Systems

Grand Rapids & Grand River Fun Facts

- Grand Rapids is the second largest city in Michigan with a population around 200,000; 1.06M metro area.
- Grand Rapids is home to ArtPrize.
- Furniture City

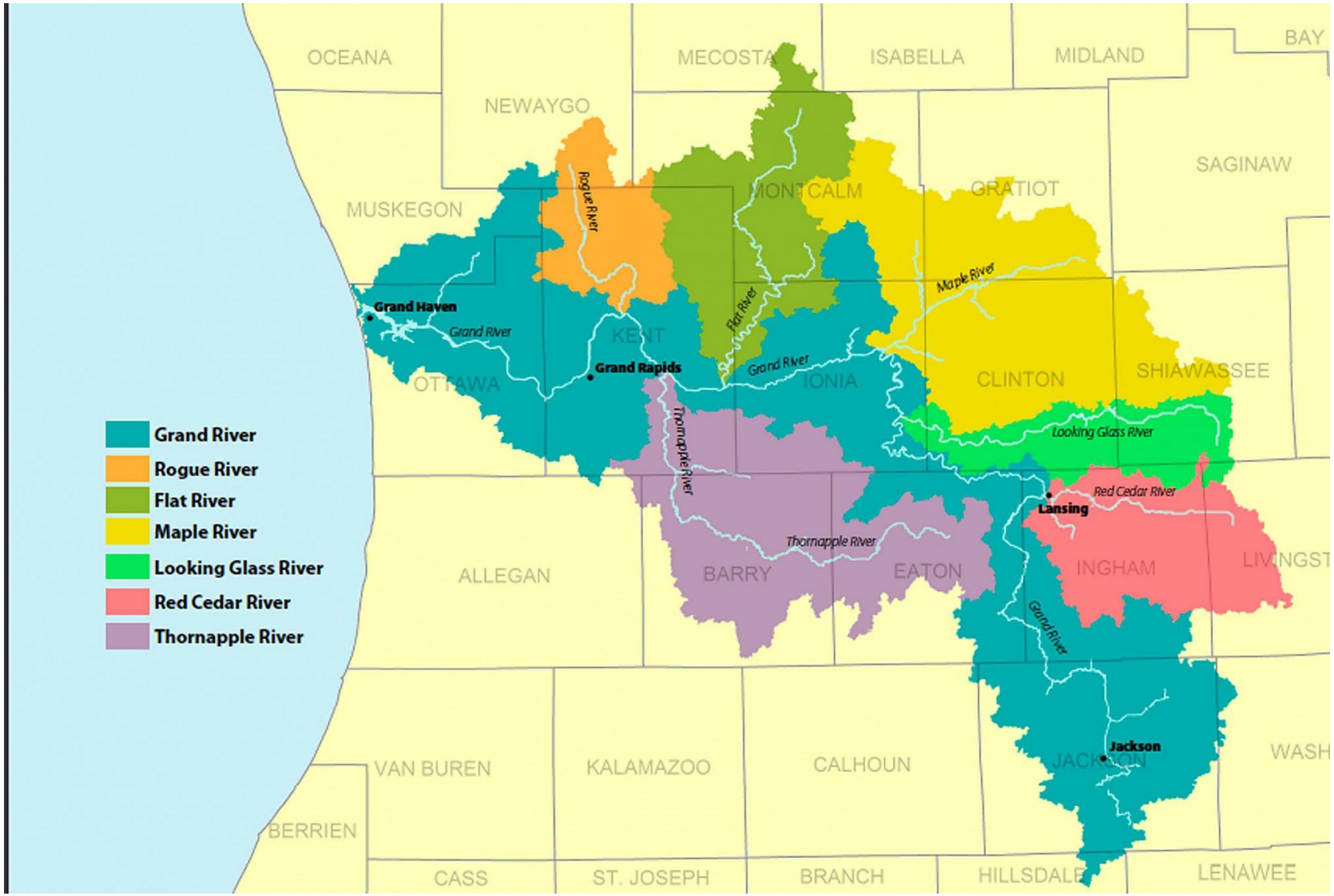
- The Grand River begins near the Michigan International Speedway in Hillsdale County
- The Grand River extends 252 miles and empties into Lake Michigan at Grand Haven (about 45 miles due west of GR).
- A two-mile stretch flows through the heart of downtown.

The City and Grand River

Grand River during the 2013 Flood Event

CSX Railroad over the Grand River

Grand River Watershed



Background & Context

- FEMA's mission was to update the National Flood Insurance Program throughout the United States
- Congress intervention
- Levee Analysis & Mapping Procedure (LAMP)
- Around 7,000 private properties affected

LAMP Enables Options

Certified Flood Protection

- Freeboard Deficient but meets 100-yr Base Flood Elevation
- Zero to limited freeboard
- Enables full river activation potential

Fully Accredited Flood Protection

- 100-yr Base flood elevation *plus* 3 feet Freeboard
- Basically “walling off” the City from its river
- None to limited river activation potential

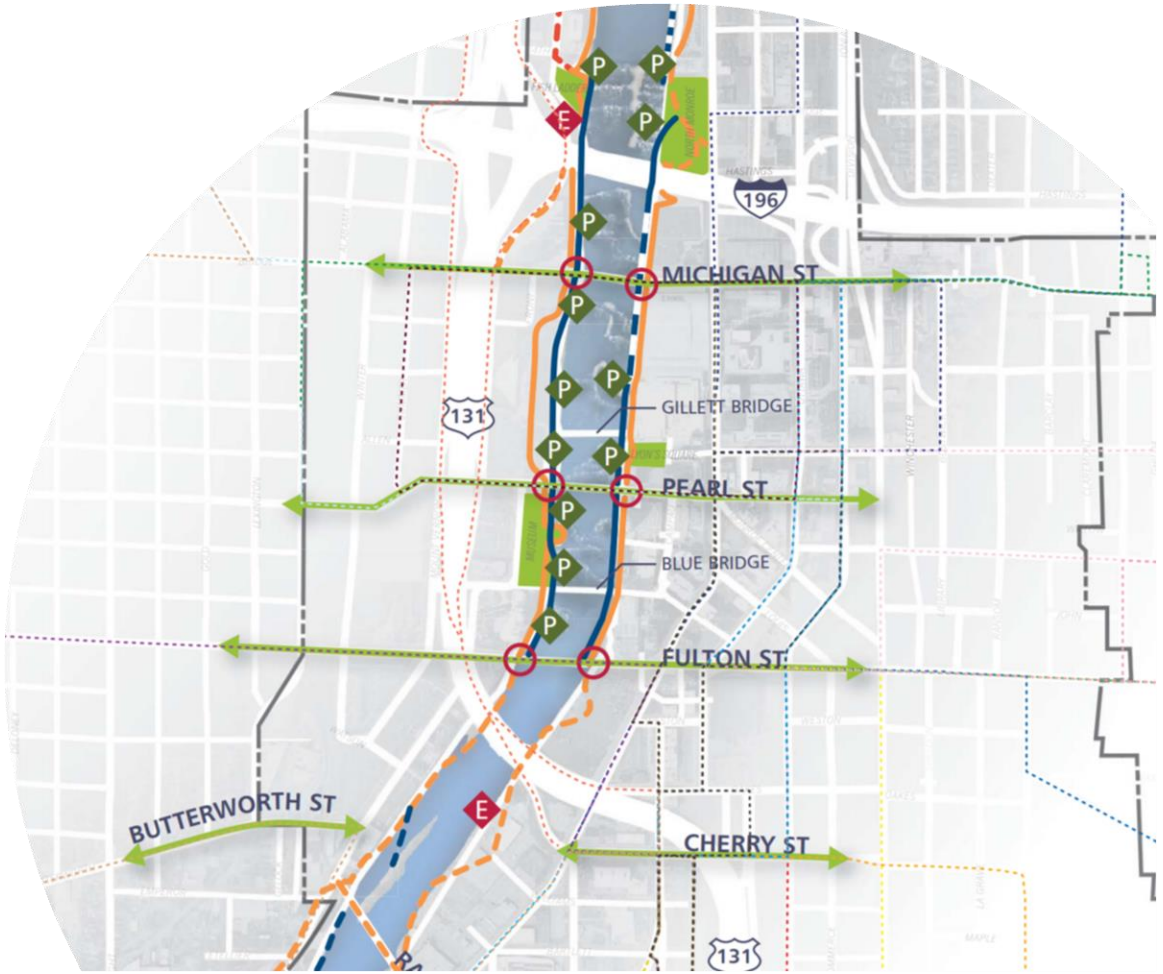
Certified Flood Protection enables Grand Rapids to achieve Fully Accredited status through river activation projects based on future funding availability; but not mandatory in the post-LAMP era.

Systems Engineering Approach to a mixed bag of complex infrastructure

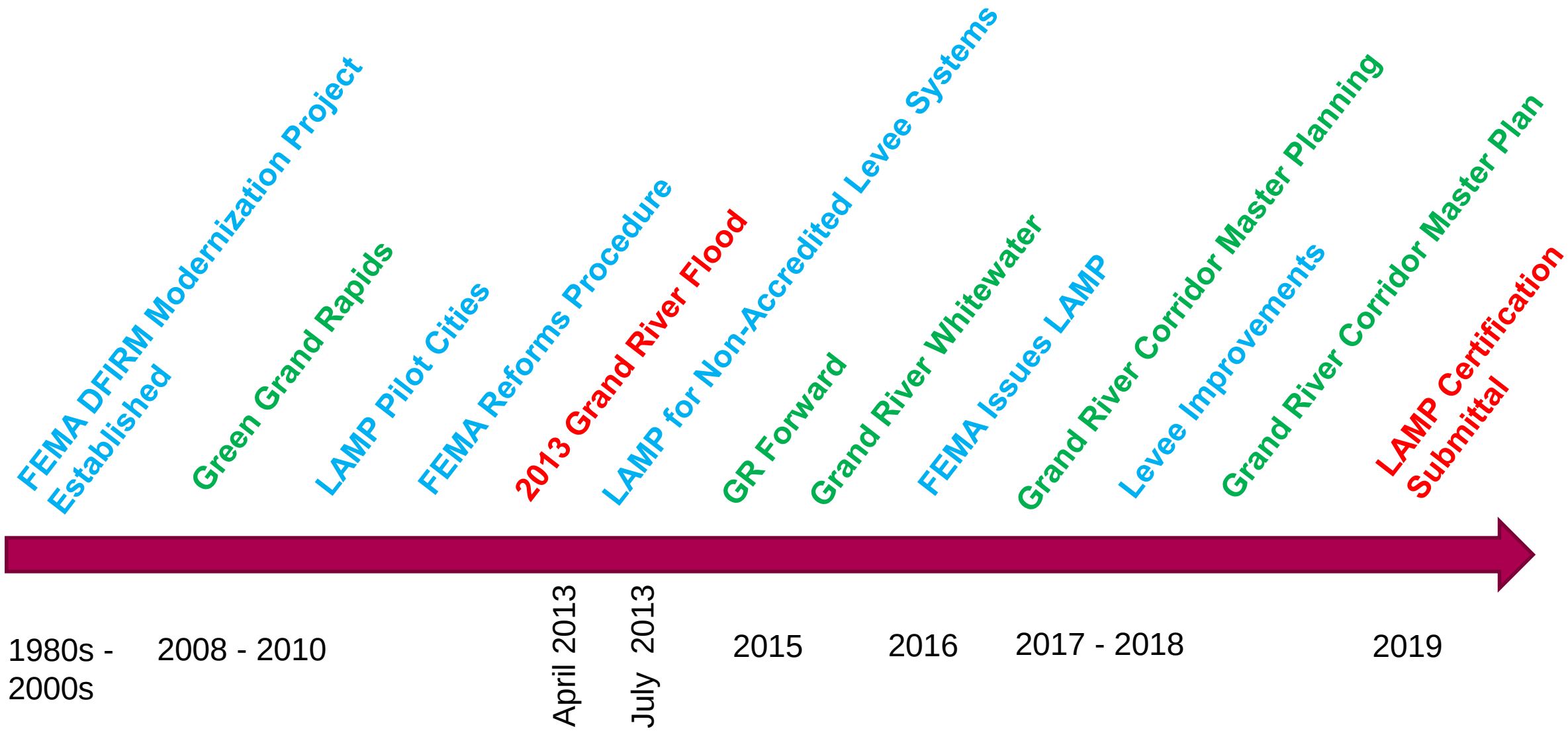
- Flood Protection System
- Stormwater Conveyance System
- Flood Conveyance
- Floodplain Drainage
- Riverfront Walkway & Green Spaces

Problem Defined

- Certify the flood protection system under FEMA to issue updated flood insurance maps per the new 100-yr BFE without walling off the river.
- Clearly articulate Operations, Inspection, Routine Maintenance.
- Prepare, Respond, Recover
- Strategy & Planning
- Much needed Alignment of AMP's, Contingency Planning, Decision-Making and Long-term Strategy & Planning efforts.



Timeline

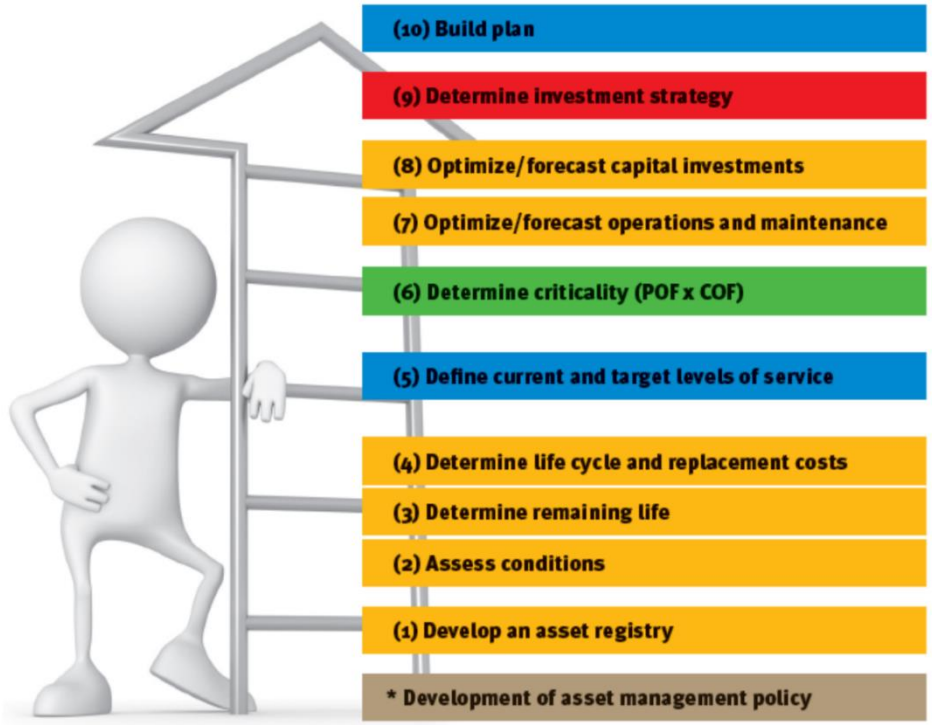


By The Numbers

- 85,000 Lineal feet of flood protection system consisting of:
  - Concrete walls
  - Soil embankments
  - Downtown building basement walls that were constructed with river rock
  - Bridge abutments
  - Geologically deposited Gypsum & ensuing voids
- 25% of flood protection system required raising up to 30 inches
- 100-Year Base Flood Elevation is around 25.5 feet at approx. 50,000cfs river flow rate
- 2013 Flood Event flow was approx. 38,000cfs
- Normal flow rate is <10,000cfs

How did we Solve the Problem?

Build Asset Management Plan



Identify Risks and How Big

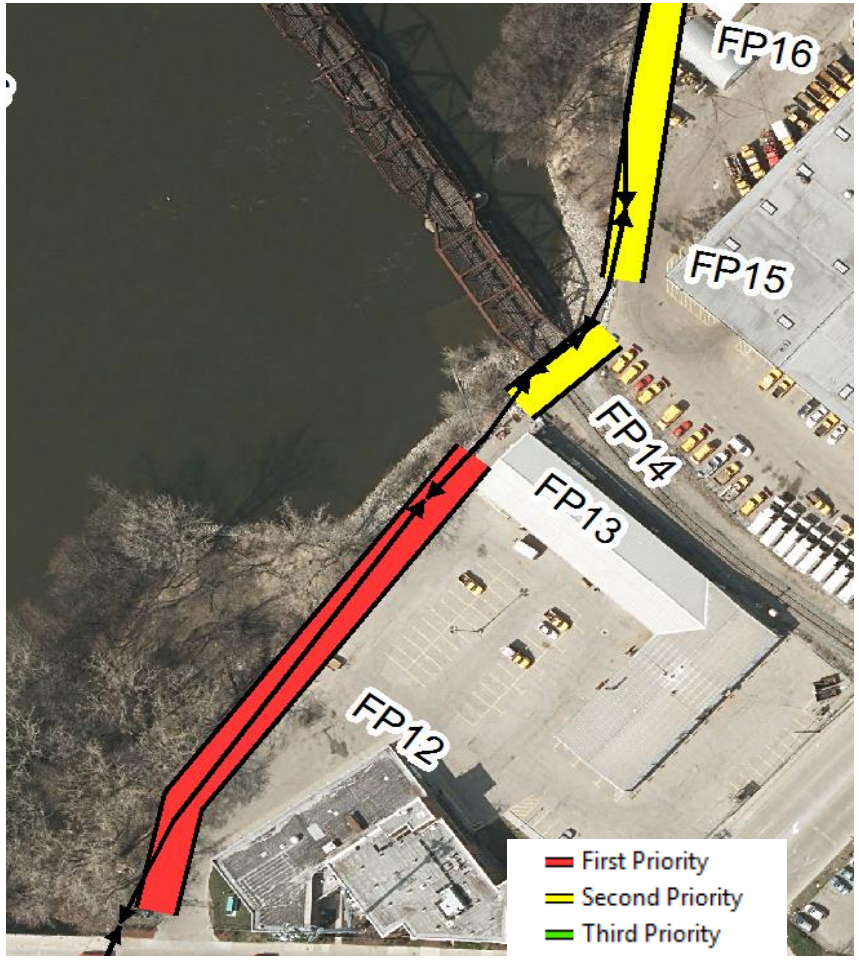
Exposure (BRE)

cality of each asset; it is calculated by multiplying t
Consequence of Failure.

Critical Elements	Weighting Factor	1 Very Low		2 Low		3 Moderate	
FLOODED AREA (acres)	0.70	<25		25 - 100		100 - 500	x
FLOOD DAMAGES	0.90	$100,000		$500,000	x	$1,000,000	
ENVIRONMENTAL IMPACT	0.85	No contamination		Minor water contamination from residential properties		Moderate water contamination from commercial and residential properties	x
DISRUPTION TO LIFELINE INFRASTRUCTURE	1.00	No disruption		Few flooded streets, all bridges open, no damage to pump stations, minor rerouting of emergency vehicles necessary		Low depth flooding of several neighborhoods, one or more pump stations require temporary flood protection measures, rerouting of emergency vehicles needed for several neighborhoods and medical facilities, minor power outages	

Inventory Flood Protection System

GIS interactive mapping application



Identify from: All Actions Items

All Actions Items
Traffic Safety - Wealthy to RR Bridge

Location: 12,771,662.176 533,628.419 Feet

Field	Value
Name	Traffic Safety - Wealthy to RR Bridge
Side of River	Eastside
Location	509 Wealthy St
FacilityID	Q
Priority	First Priority
Condition	Inadequate Freeboard
Action Elevation-River Stage (FT)	23
100-Year Flood-River Stage (FT)	25.46
Unprotected Height (FT)	0 to 2.5
Temporary Protection Height (FT)	3
Unprotected Length (LF)	300
Number of Sandbags Per LF	45
Number of Sandbags Total	13500
Length of 6 Ft Trapbags (LF)	0
Total Sand (CYD)	125
Action	Construct 300' of sandbag berm (0 to 3' high).
Link Code	Sandbag Levee Detail.pdf

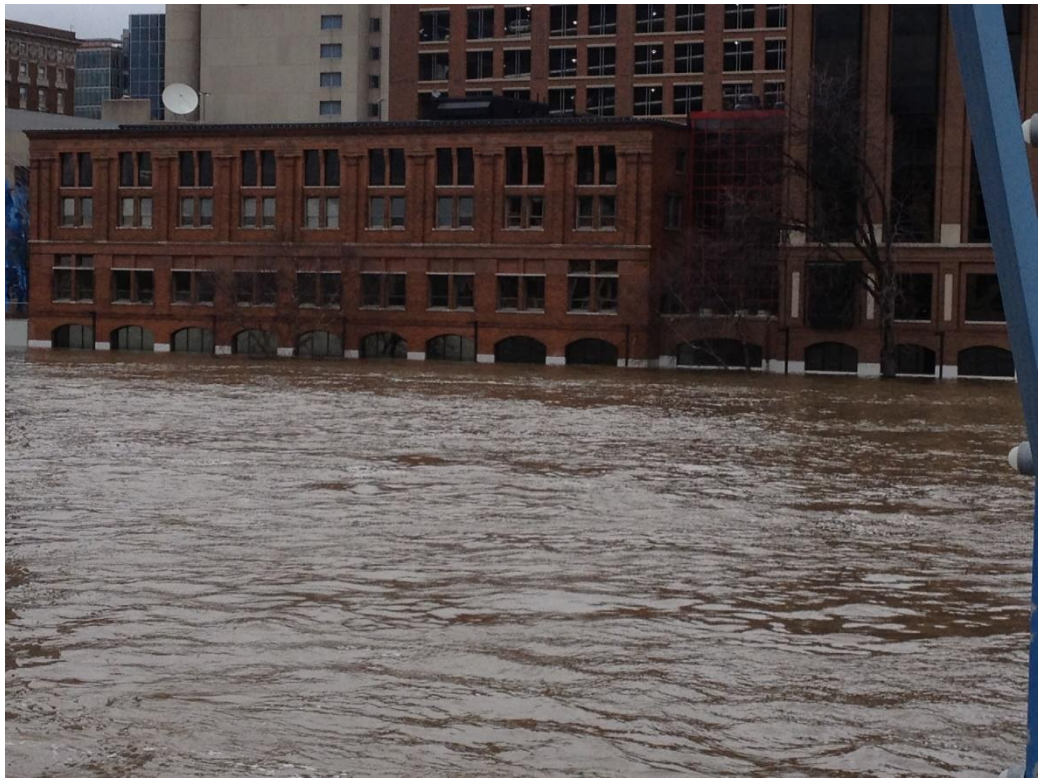
Flood Protection Asset Inventory

Embankments

Concrete Retaining Walls

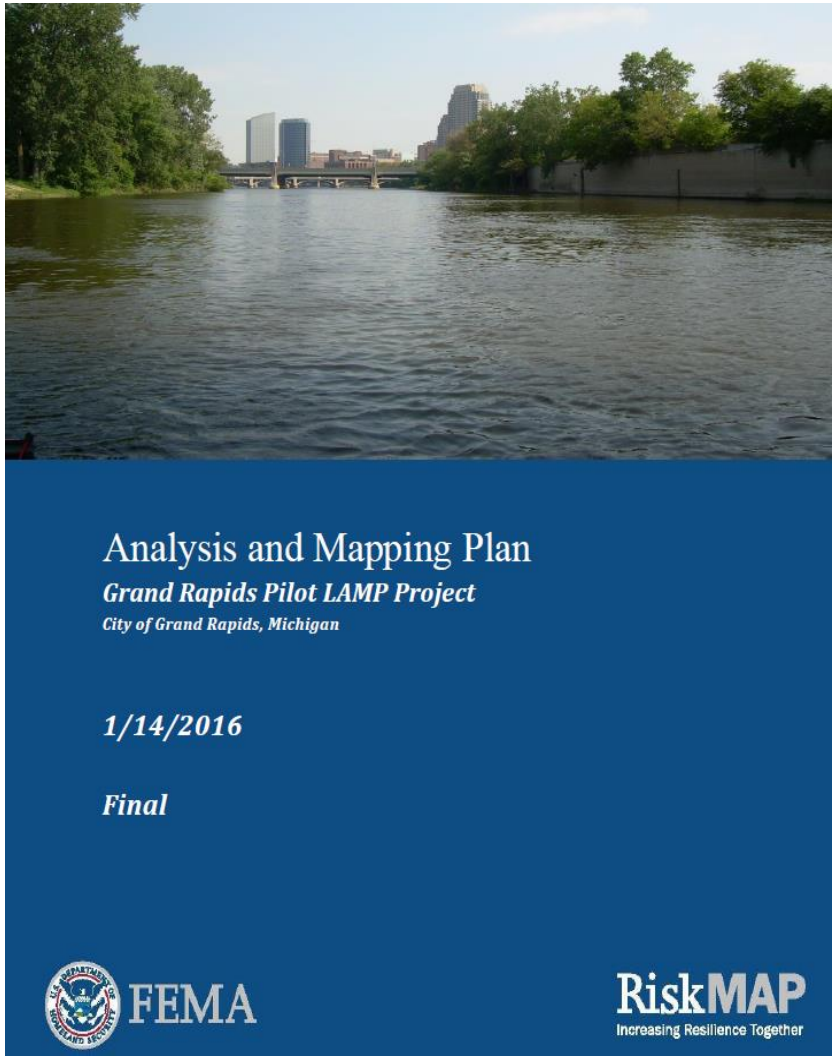
Flood Protection Asset Inventory

Private Building Basement Walls



Inside Looking Out

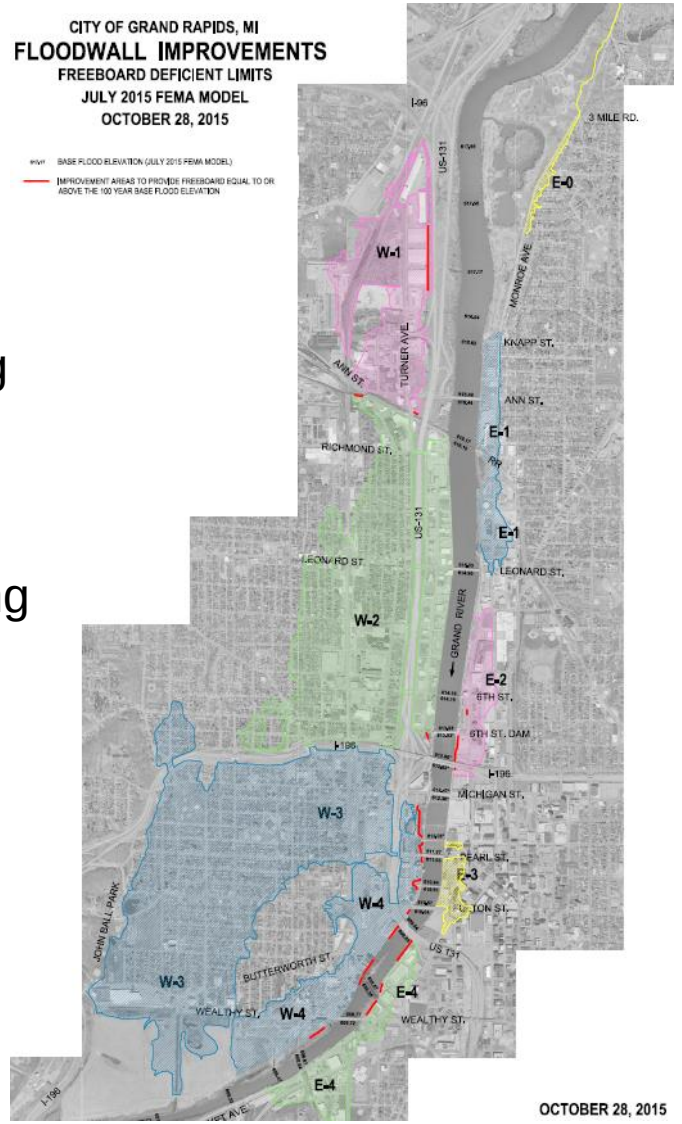
FEMA Flood Protection Improvements



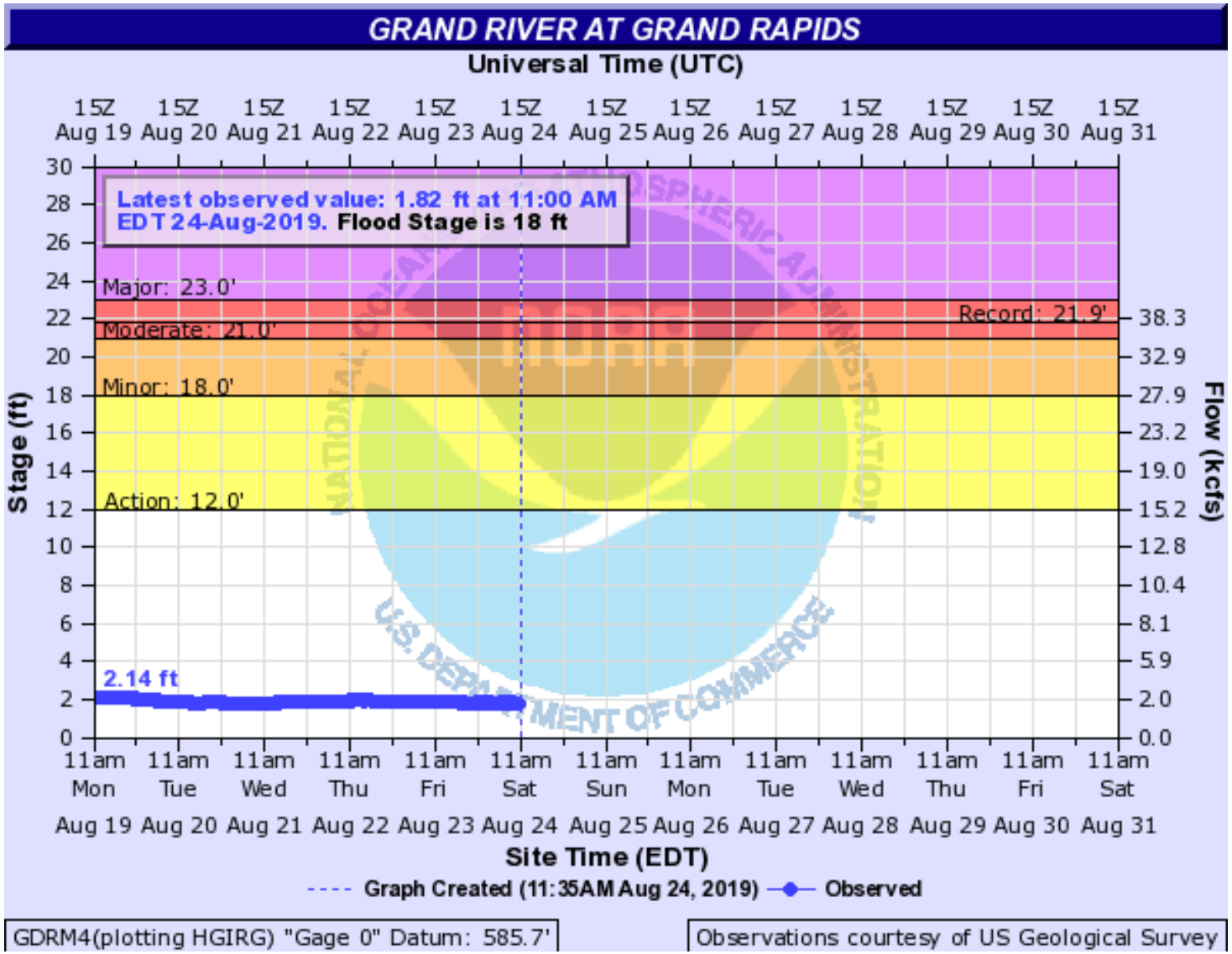
Standards & Legislation

- CFR 65.10
- Interior Drainage Modeling
- Storm Water Model
- Embankment Seepage
- USACE Standard Details
- Emergency Action Planning

$11 Million Capital Investment for Improvements



Operations & Maintenance Decision – Making



Data electronically collected with access to GIS or City Works via Work Orders and FEMA standard forms.

EOC activated, use NIMS system, Internal & External resources up to river crest & drawdown.

External Consultant inspect & report to City Engineer, EOC activated on watch alert.

City Engineer's Office accompany Environmental Services staff.

Normal Asset Operations – Annual Inspections by Staff, External Consultant every 5 yrs, Condition Assessment every 10 yrs

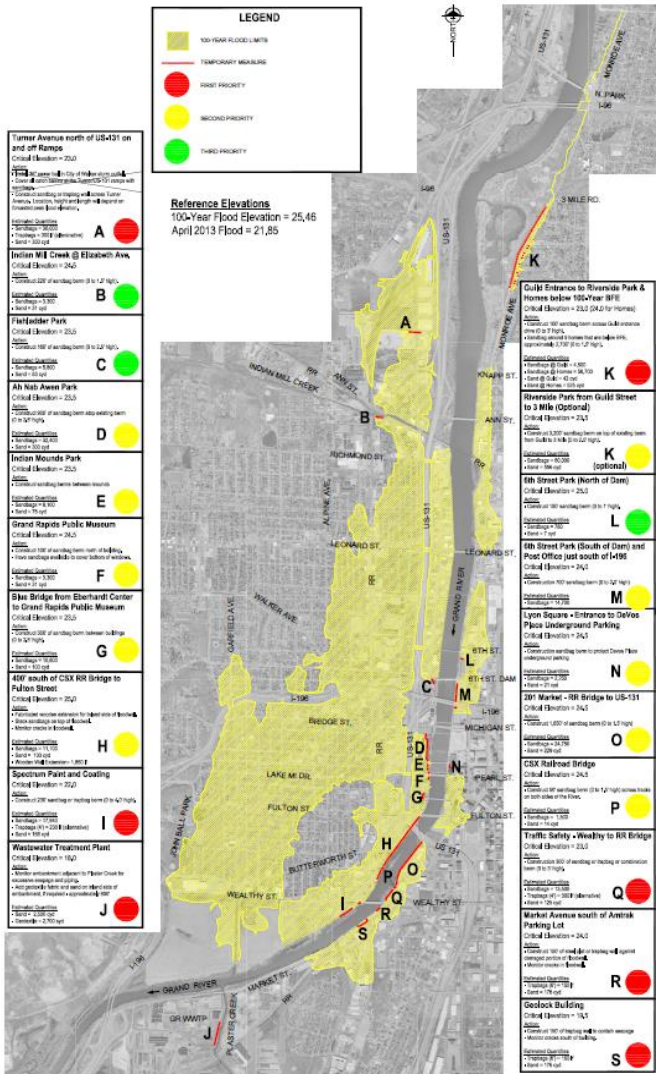
Emergency Action Plan

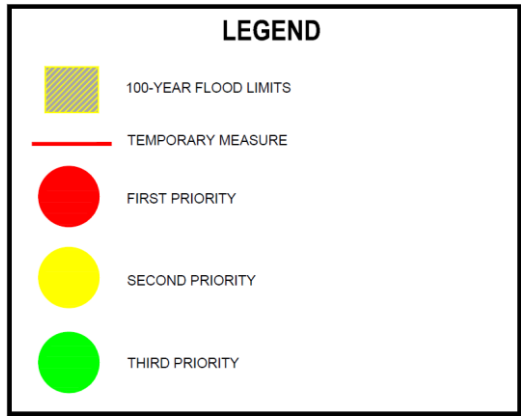
Table 4
Grand Rapids Flood Protection System
Emergency Action by Flood Stage

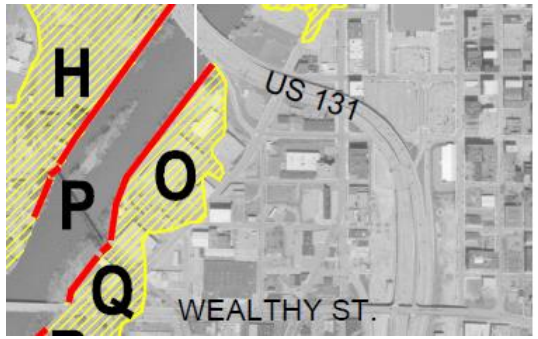
USGS Gage Height (feet)	Water Surface Elevation at Gage (feet, NAVD88)	Action
-2.31	582.94	• East Side: Check groundwater level around empty or partially filled tanks at WWTP. Fill tanks as necessary per WWTP O&M Manual.
3.84	589.09	• East Side: Check that Market Avenue Pumping Station sluice gates are fully closed. Two sluice gates keep the east side trunk sewer from overflowing into the river. • West Side: Check to see that the Garfield Avenue combined trunk sewer sluice gate is fully closed at the head of the West Side Ditch at Garfield Avenue.
4.44	589.69	• East Side: Fill primary effluent retention basin at WWTP to same elevation as Grand River level to keep the basin from floating.
6.90	592.15	• East Side: Close storm water and sanitary sewer valves in manholes in earth dike at WWTP to prevent surcharging caused by storm water from CSX property.
8.45	593.70	• East Side: Close Comstock Riverside Park to automobiles due to flooding of drive 400' south of Guild Street.

Contingency Planning
Prepare – Respond – Recover

Contingency Planning







Traffic Safety - Wealthy to RR Bridge

Critical Elevation = 23.0

Action:

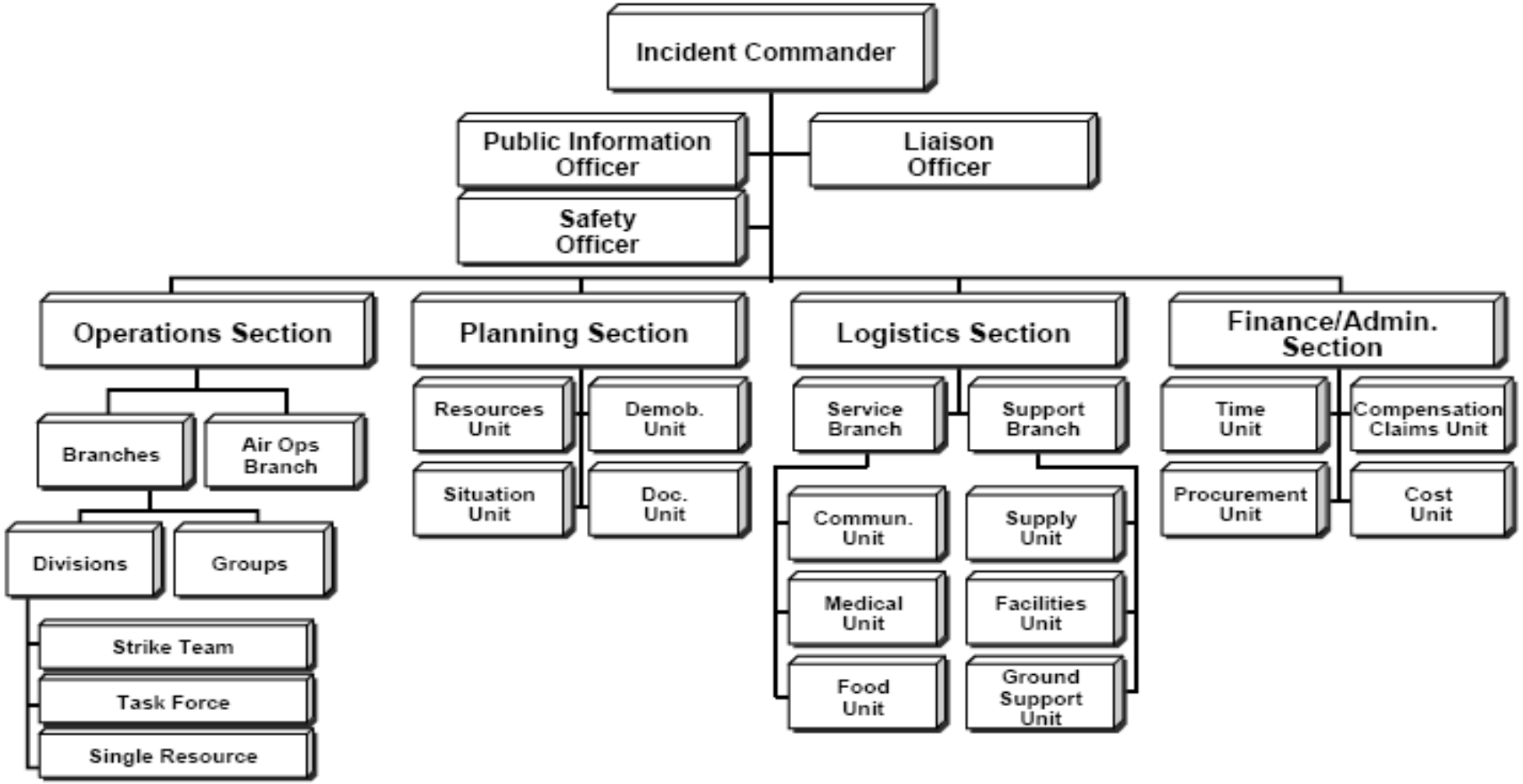
- Construction 300' of sandbag or trapbag or combination berm (0 to 3' high).

Estimated Quantities

- Sandbags = 13,500
- Trapbags (4') = 300 lf (alternative)
- Sand = 125 cyd

Q

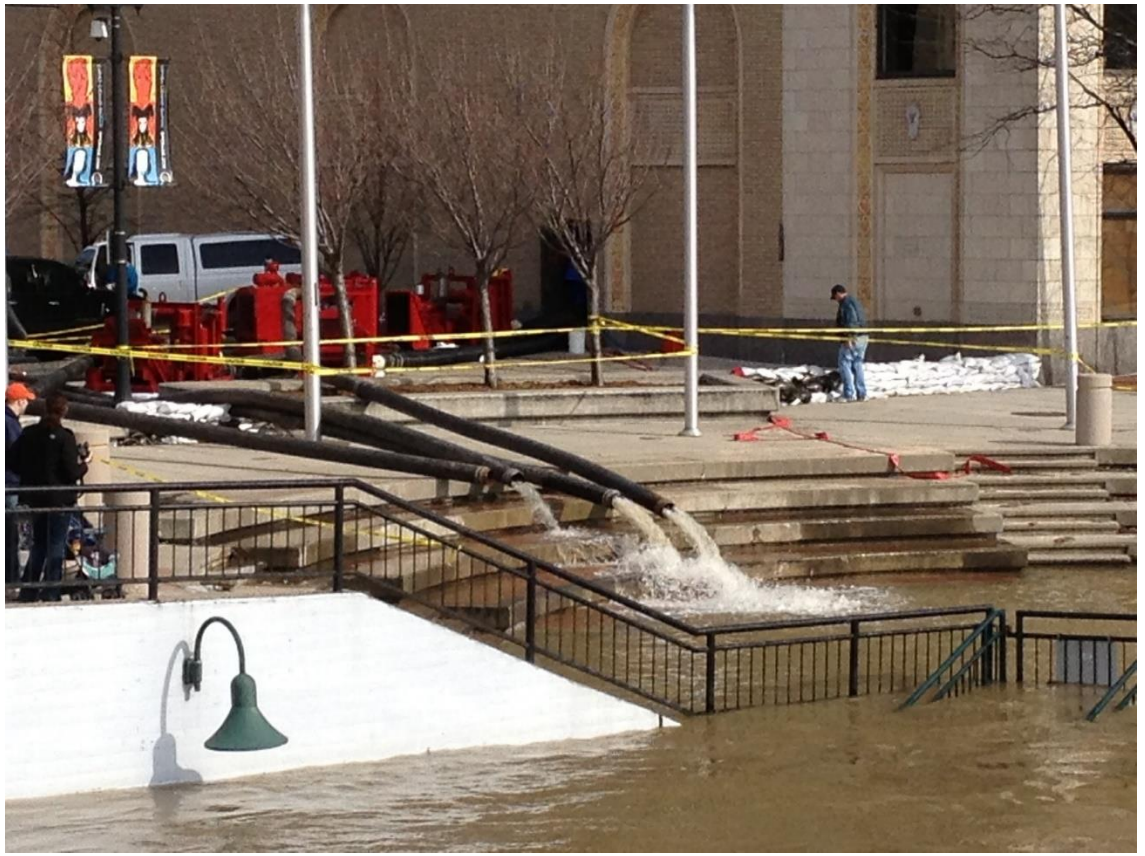
Asset Management integrated with National Incident Management System



Equipment & Contractor Inventory

Excavators & Material

Pumps & Hoses



All Hands On Deck!

Grand River Corridor as an Asset
Long-term Planning & Strategy

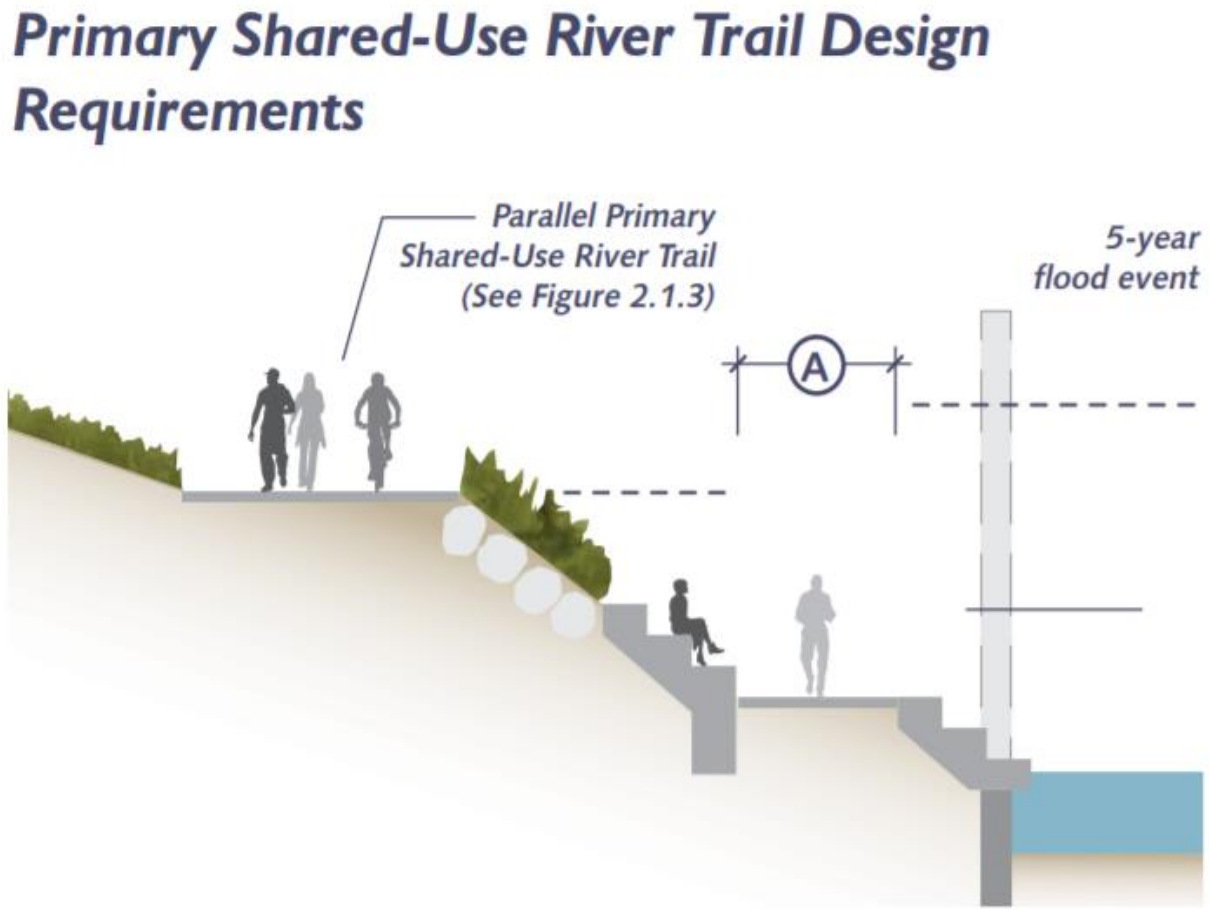
Activate the Riverbanks

Restore the Rapids to the Grand River

Long-term Planning & Strategy

Organizational and Various Master Plans

- Green Grand Rapids
- GR Forward
- GR Whitewater
- Grand River Corridor Master Plan
- Grand Rapids Parks & Rec Master Plan
- Vital Streets Asset Management Strategy
- Grand Rapids Bicycle Plan



Business Objectives & Forward -Thinking

- City Public Works “Island”
- Property sale for private development
- Site identified in Grand River Corridor Master Plan, GR Forward & Green Grand Rapids
- Property value based on flood protection infrastructure repairs & value
- Watercraft take-out location for GR Whitewater
- Continue river walkway
- Activation & private development must assure flood protection

Recap & Questions

- Resiliency & Sustainability
- Asset Management Planning
- Contingency Planning
- Asset Operations & Maintenance Delivery
- Operations & Maintenance Decision-Making
- Technical Standards & Legislation
- Planning & Strategy

Questions