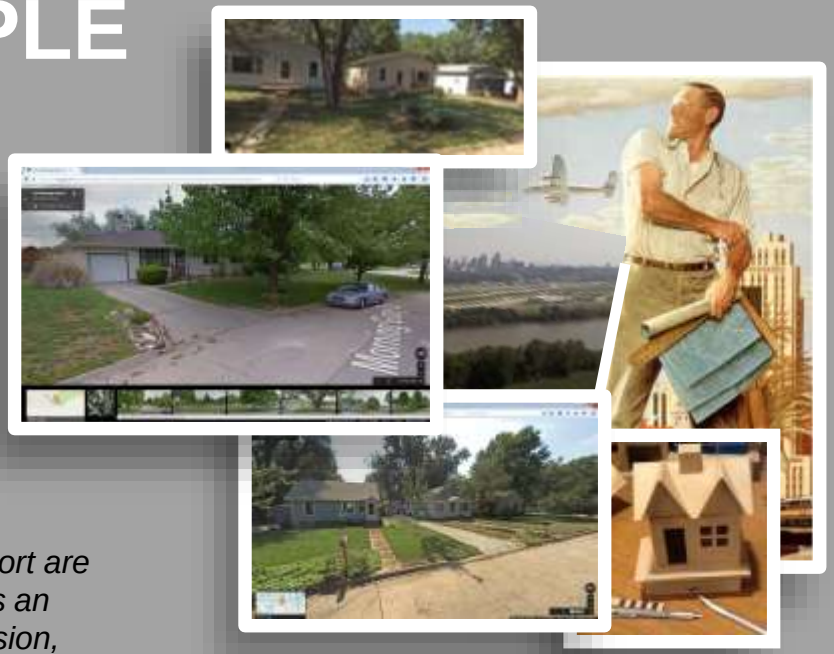
A PRESENTATION FOR THE 2017 ASFPM ANNUAL CONFERENCE IN KANSAS CITY, MO, MANAGING FLOOD RISK IN THE HEARTLAND

NONSTRUCTURAL ASSESSMENT IN THE LITTLE APPLE



Brian Rast, PE, CFM, PMP
Senior Risk
Management Specialist
Institute for Water Resources

May 2, 2017

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

US Army Corps of Engineers
Nonstructural - Flood Proofing
National Nonstructural / Flood Proofing Committee

US Army Corps of Engineers

U.S.ARMY

OBJECTIVES

Tools for Nonstructural Assessments

- Structure Attribute Data Table
- Nonstructural FRM Matrix
- nServo cost estimating software
- USACE National Nonstructural Flood Proofing Committee Website

Little Apple Nonstructural Assessment

- Study Location and Authority
- Study Background
- Steps in Conducting the Nonstructural Assessment
- Plan Formulation
- Study Results
- Next Steps

Find this presentation and a recording on the web (as “Evaluating the Feasibility of Adopting Nonstructural Measures as Applied in Manhattan, Kansas”) at

http://silverjackets.nfrmp.us/Get-Involved/More-Information/Webinars-Presentations

US Army Corps of Engineers.

U.S.ARMY

TOOLS FOR NONSTRUCTURAL ASSESSMENTS

US Army Corps of Engineers.

PROJECT MANAGEMENT & PLANNING - STEPS FOR CONDUCTING NONSTRUCTURAL ASSESSMENTS

- Develop Hydrology (rainfall runoff)
- Develop Hydraulics (flow, depth and velocity of water)
- Conduct Structure Inventory (what gets flooded)
  - Structure Attribute Data Table
- Identify Potential Flood Risk Adaptive Measure (FRAM)
  - Nonstructural Flood Risk Management Matrix
  - Field Assessment
- Perform Economic Analyses (costs and benefits)
  - Identify least cost technique
  - Identify financial assistance (federal / state / private)
  - Compare mitigation to long-term insurance

US Army Corps of Engineers.

U.S.ARMY

STRUCTURE ATTRIBUTE DATA TABLE

Shaded cell information is most important to collect

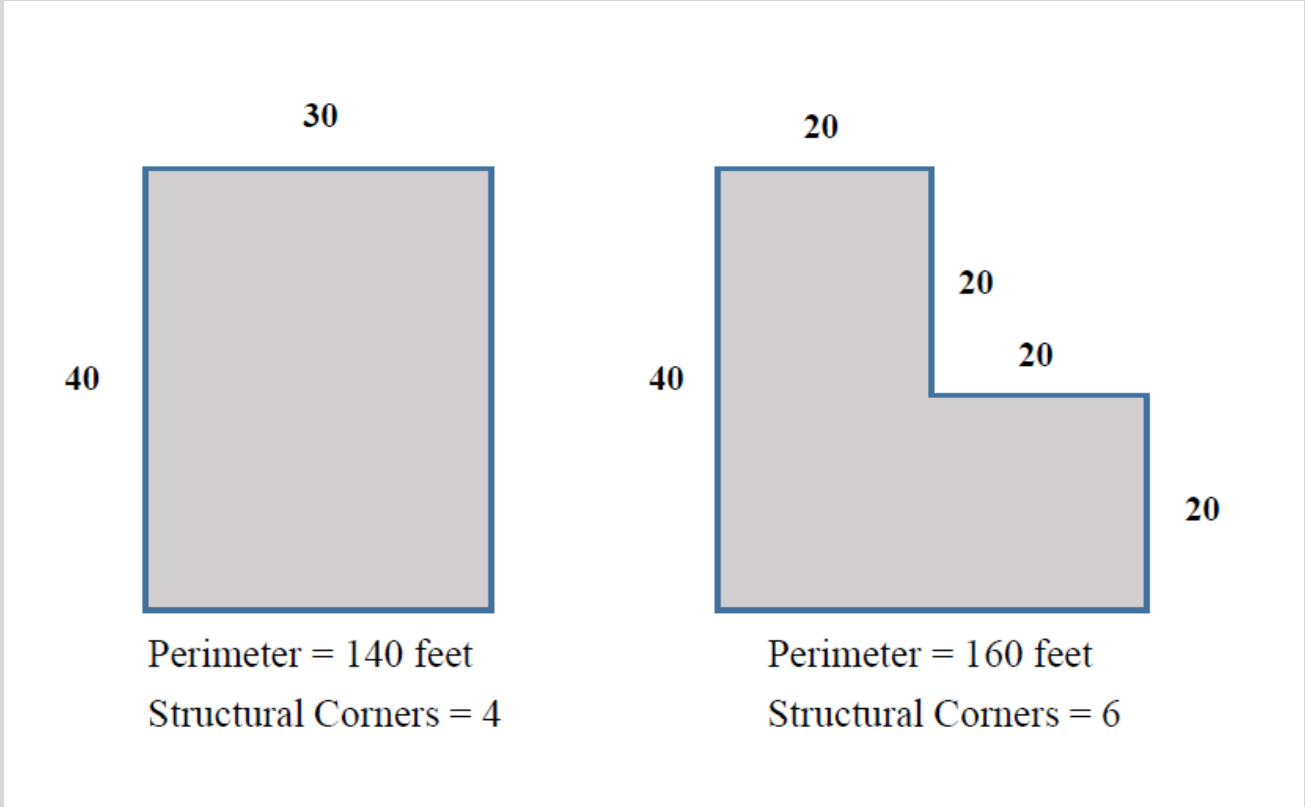
Data may be available from existing databases (Tax Assessor)

Structure Data	Data Definition
Building Identification Number	**Specific to Structure (geo referenced, coordinates, etc.)**
Structure Address	**Specific Postal Location of Structure**
Critical Facility	**Yes / No**
Lowest Adjacent Ground Elevation	**Elevation of Lowest Ground at Structure**
First Floor Elevation	**Elevation of Finished First Floor**
Structure Category	**Residential, Commercial, Industrial, Public**
Structure Use	What is the Specific Use of Structure
Total Stories	Total Number of Floors Above Grade
Structure Footprint	**Total Square Foot Area of At-Grade Floor**
Number of Structural Corners	**Total Number of Corners in Perimeter**
Structure Foundation Type	**Slab, Reinforced Slab, CMU, Piers, Columns, Posts, Stone**
Structure Perimeter Distance	**Total Length of All Exterior Sides of Structure**
Exterior Wall Construction	**Wood, Masonry, Brick, Metal, Stone, Concrete, Other**
Structure Visual Condition	**Good / Fair / Poor**
Garage	**Attached, Detached, None**
Doorways	**Number of Pedestrian Doorways**
Basement	**Full Basement, Half, Crawl Space, None**
Structure Photos	**Photograph of Four Sides of Structure**
Utilities Location	**Electrical, Gas, Water, Sewer, Oil, Propane, Coal, Other**
Structure Value	**Assessed Value of Structure**
Fireplace	Yes / No
Structure Owner	Who Owns the Structure
Year Structure Built	Year Structure was Constructed (Any Historic Significance)
Water Surface Elevation	Elevation or Depth of Water at Structure (H&H activity)
Water Velocity	Erosive Potential of Flood Waters (H&H activity)

DATA NEEDS FOR NONSTRUCTURAL ASSESSMENTS

1. A nonstructural assessment is different than a structural assessment in that the resulting product is an individually modified structure employing specified techniques to reduce the structure's vulnerability to flood risk.
2. Since the product of the nonstructural assessment is to determine potentially feasible techniques for reducing flood risk, the data which is specific to each structure is required to be collected.

1,200 Square-Foot Structure



NONSTRUCTURAL FLOOD DAMAGE REDUCTION MATRIX

Considering Physical Nonstructural Measures

- Elevation
- Relocation
- Acquisition
- Dry flood Proofing
- Wet Flood Proofing

Measurable Characteristics

- Flooding Characteristics
  - depth
  - velocity
  - flashiness, Ice, and Debris
- Site Characteristics
  - location (coastal or riverine)
  - soils (permeable or impermeable)
- Building Characteristics
  - foundation type
  - construction type
  - condition

US Army Corps of Engineers.

NONSTRUCTURAL FLOOD RISK MANAGEMENT MATRIX

March 2016		FLOOD DAMAGE REDUCTION MEASURES												
		NONSTRUCTURAL MITIGATION MEASURES												
												NFIP		
FLOOD DAMAGE REDUCTION MATRIX		Elevation on Foundation Walls	Elevation on Piers	Elevation on Posts or Columns	Elevation on Piles	Elevation on Fill	Relocation	Buyout/ Acquisition	Dry Flood Proofing	Wet Flood Proofing	Flood Warning Preparedness	Flood Plain Regulation	Flood Insurance	Flood Mitigation 1
Flooding Characteristics	**Flood Depth**													
	Shallow (<3 ft)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Moderate (3 to 6 ft)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
	Deep (greater than 6 ft)	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
	Flood Velocity													
	Slow (less than 3 fps)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Moderate (3 to 5 fps)	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y
	Fast (greater than 5 fps)	N	N	N	Y	N	Y	Y	N	N	Y	Y	Y	Y
	Flash Flooding													
	Yes (less than 1 hour)	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y
	No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Ice and Debris Flow													
	Yes	N	N	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y
	No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Site Characteristics	**Site Location**													
	Coastal Flood Plain													
	Beach Front	N	N	N	Y	N	Y	Y	N	N	Y	Y	Y	Y
	Interior (Low Velocity)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Riverine Flood Plain	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Soil Type													
	Permeable	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
	Impermeable	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Building Characteristics	**Structure Foundation**													
	Slab on Grade	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Crawl Space	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
	Basement	Y	N	N	N	N	Y	Y	N	Y	Y	y	Y	Y
	Structure Construction													
	Concrete or Masonry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Metal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Wood	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Structure Condition													
	Excellent to Good	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Fair to Poor	N	N	N	N	N	N	Y	N	N	Y	Y	Y	2

USACE NATIONAL NONSTRUCTURAL FLOOD PROOFING COMMITTEE

Chartered: 1985

NFPC Members and Advisors

Randall Behm, Chair, Omaha

Kim Gavigan, Secretary, Los Angeles

Steve O'Leary, Huntington

Keven Lovetro, New Orleans

Lea Adams, Davis, CA

Mary Weidel, Detroit

Bob Finch, Hawaii

Brian Rast, Kansas City

Technical Resources

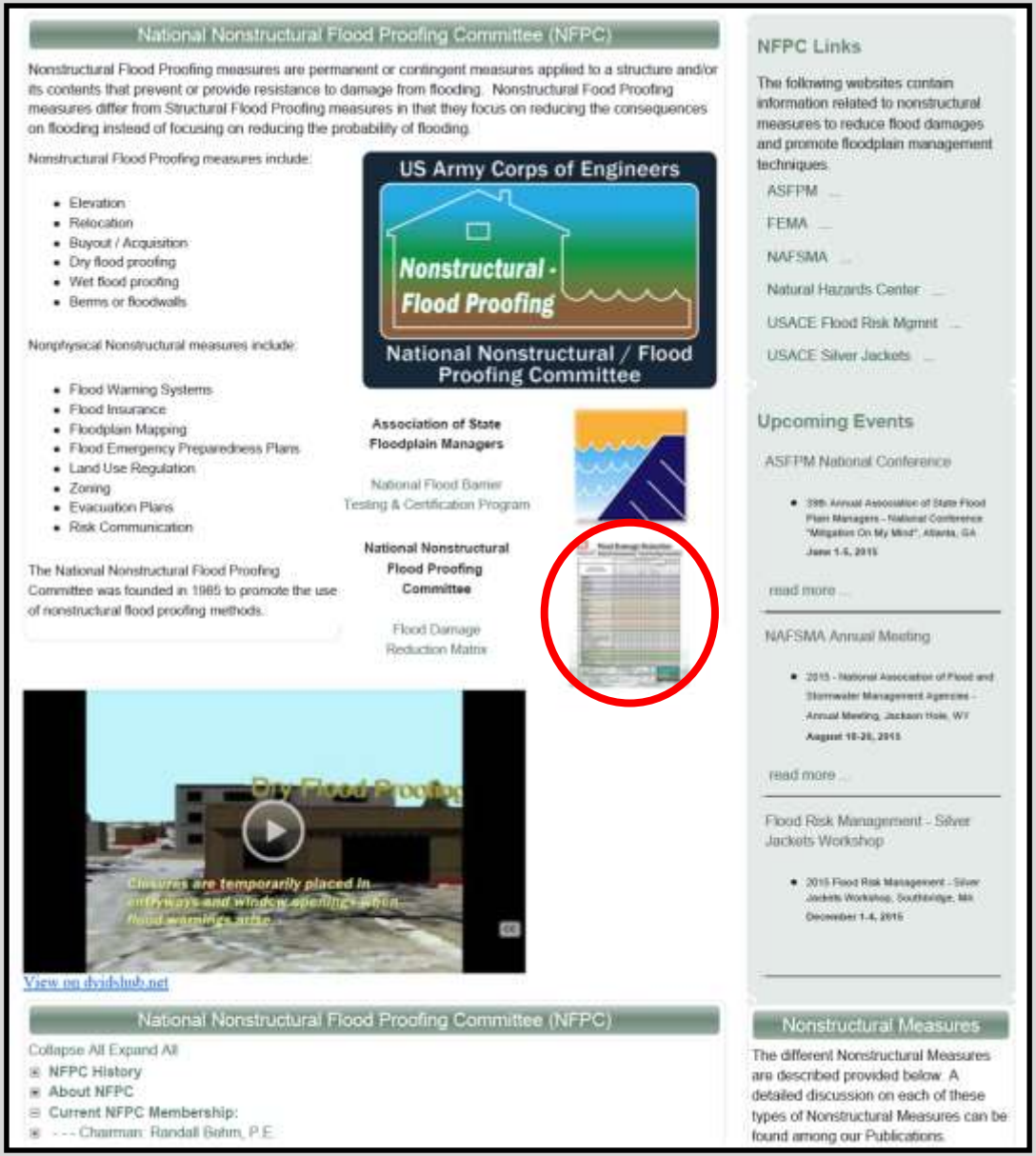
Nonstructural Techniques

Publications

Assessment Tools

National Flood Barrier Testing & Certification Program

Google: NFPC



web site: http://www.usace.army.mil/Missions/CivilWorks/ProjectPlanning/nfpc.aspx

LITTLE APPLE NONSTRUCTURAL ASSESSMENT

US Army Corps of Engineers.

U.S.ARMY

LITTLE APPLE NONSTRUCTURAL ASSESSMENT

- Project Description
- Planning and Project Management
- Analysis
- Results
- Next Steps
- Take-Aways

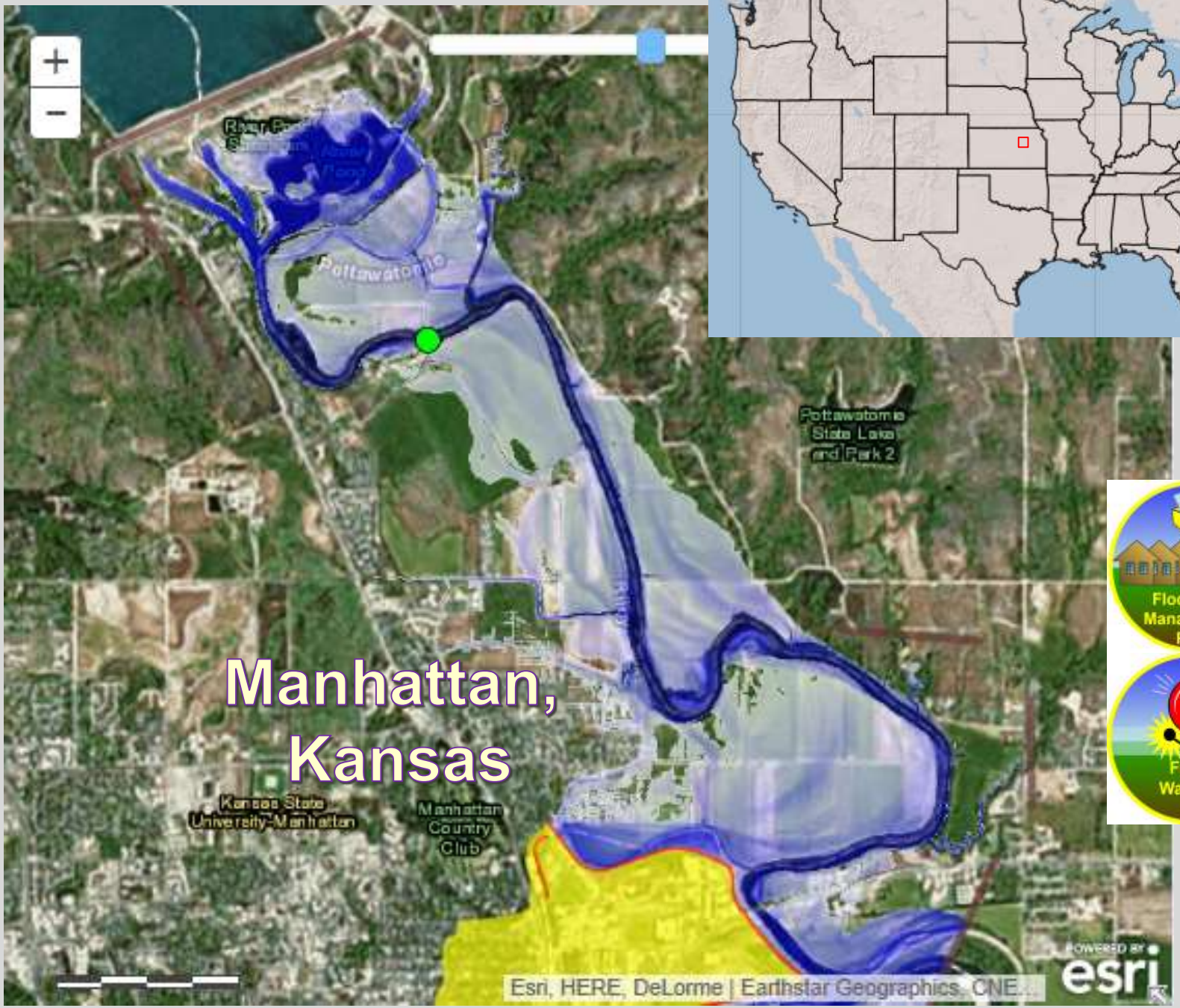
US Army Corps of Engineers.

Winter flood, Missouri, 2016.
Photo from Governor's Office, MO.

1000-year "rain bombs" in Louisiana, 2016. Photo from Civil Air Patrol.

Oklahoma flooding, 2015.
Photo from Floodlists.com

Millennium Flood Event, South Carolina, 2015.
Photo from Sean Rayford.



Manhattan, Kansas

PROJECT DESCRIPTION

Project Objectives

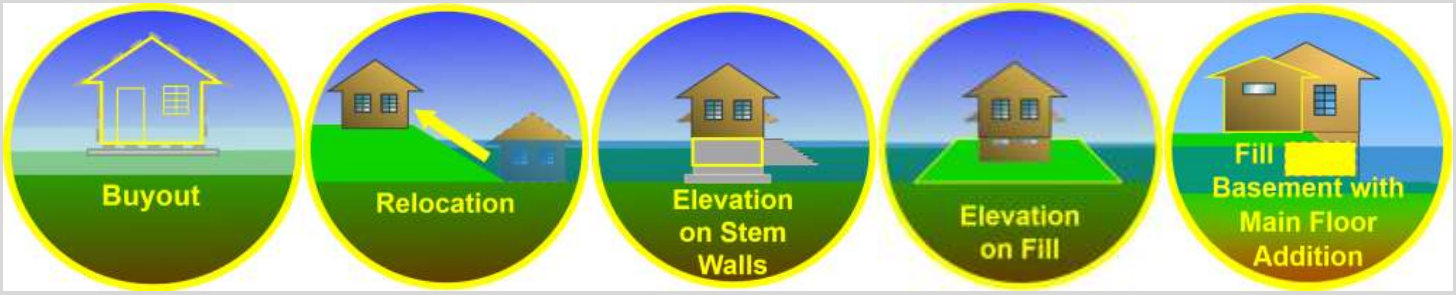
- Evaluate structures needing nonstructural / flood proofing measures
- Provide plan formulation for a first look at structures at risk
- Support the state and the city in mitigation grants
- Address a diversity of issues for a low budget
- Raise District's familiarity with conducting a nonstructural assessment
- Apply the tools from the USACE Nonstructural / Flood Proofing Committee

US Army Corps of Engineers.

PROJECT DESCRIPTION

Project Outcomes

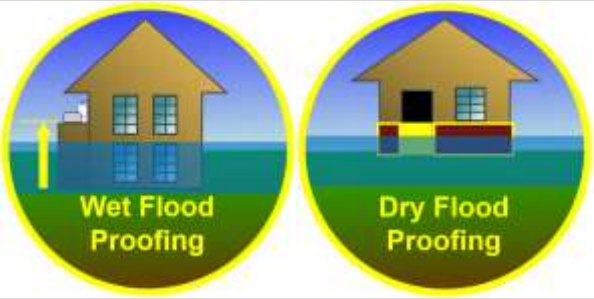
1. Produced cost engineering estimates.
2. Conducted economic analysis (including a benefit-cost).
3. Evaluated four **types** (eight specific) flood risk adaptive measures to supplement the city's floodplain management planning.
   - **Buyout** (with and without Green Space)
   - **Relocation** (with and without Green Space)
   - **Elevation** (1, 2, and 4-feet above BFE)
   - **Basement Fill**
4. Presented results in a way that develops
   - property owner buy-in
   - Implementation of the flood risk adaptive measures.



PROJECT DESCRIPTION

The project does **NOT** include

- Costs
  - A bottom line contingency
  - Project management needed in design phase or implementation (like grant management)
  - 2010 baseline, should be escalated
- Assessment for these flood risk adaptive measures
  - Dry flood proofing
  - Wet flood proofing
  - Hybrids, or combinations of various measures

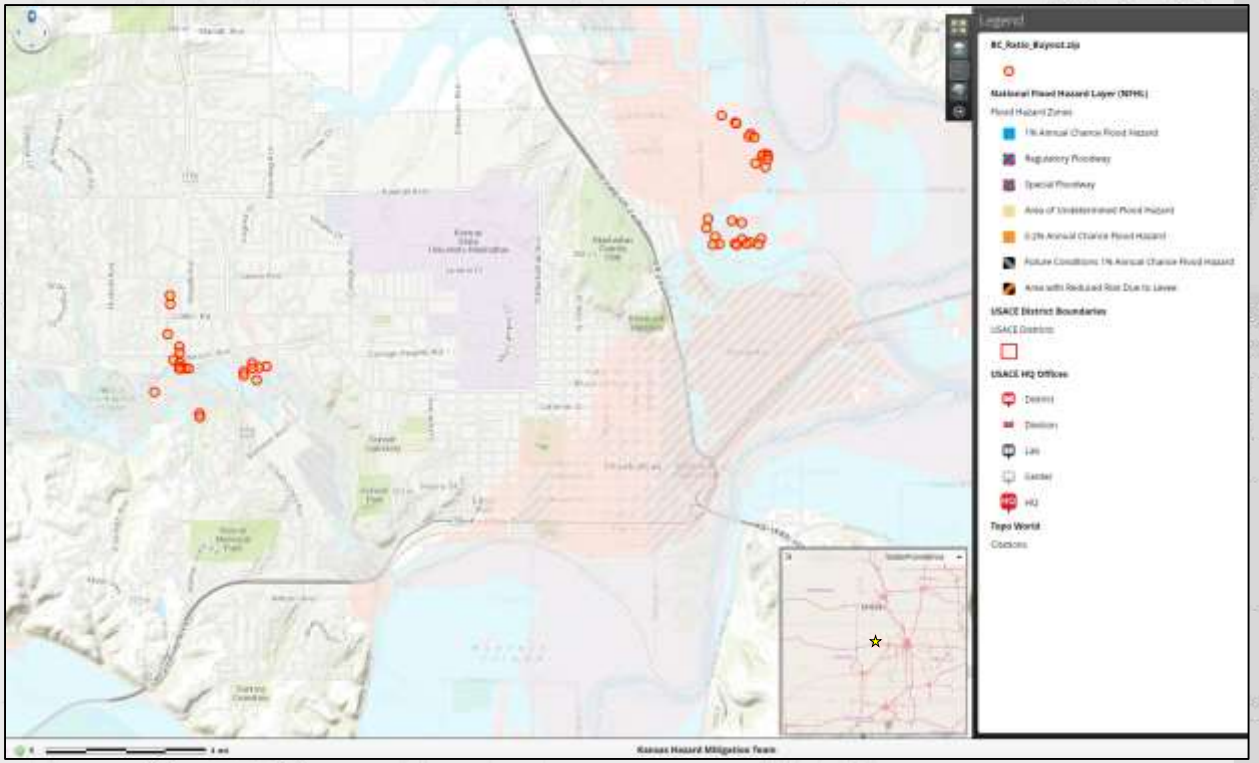


PLANNING AND PROJECT MANAGEMENT

<u>Sampling Approach</u>

Plan formulation strategy for structures

- Flood hazard
- Structure types
- Demographics
- Geography
- Cultural

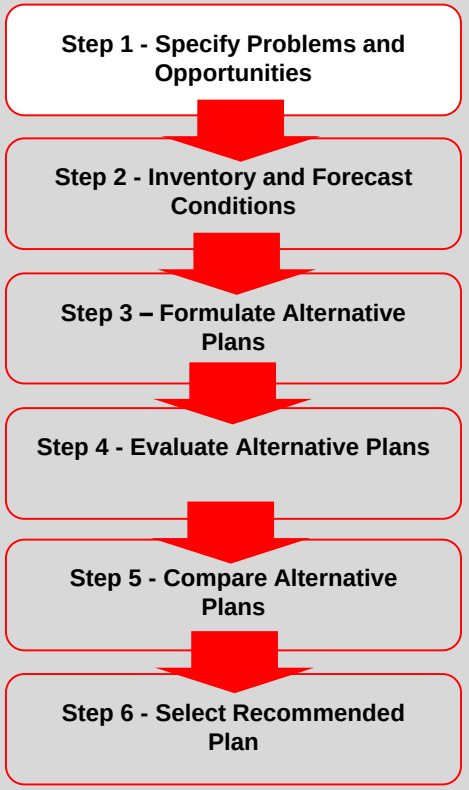


US Army Corps of Engineers.

PLANNING AND PROJECT MANAGEMENT

Step 1 - Identifying Problems and Opportunities

- Develop hydrology for the existing and most-likely future without project conditions
- Develop water surface profiles and velocities for an array of discharges
- Identify the 1% and 0.2% annual exceedance flood boundaries and floodway
- Identify short flood warning time and areas of high depth and/or high velocities
- Identify constraints and opportunities for:
    - o environment
    - o recreation
    - o cultural / societal / historically significant resources



PLANNING AND PROJECT MANAGEMENT

Step 2 - Inventorying and Forecasting Conditions

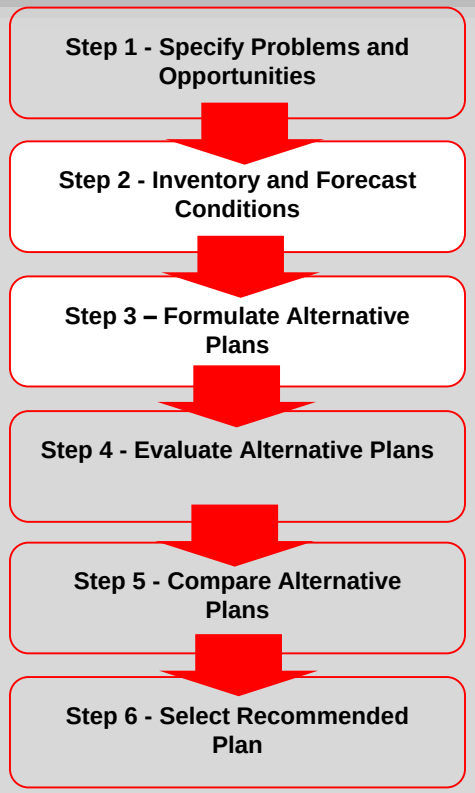
- Develop inventory of structures for residential, commercial, public, industrial, and critical facility buildings on a structure by structure basis
- See Structure Inventory Attachment for pertinent inventory requirements

Step 3 - Formulating Alternative Plans

- Determine geographical, political, or cultural subdivisions
- Determine all applicable FRAM measures (note inherent constraints for some measures)
- Formulate plans utilizing the most appropriate and/or least cost FRAM measures (elevation, flood proofing, relocation, acquisition, basement removal) or combination of FRAM measures

Formulate on like levels of risk reduction (i.e. plans based upon frequency of flooding)

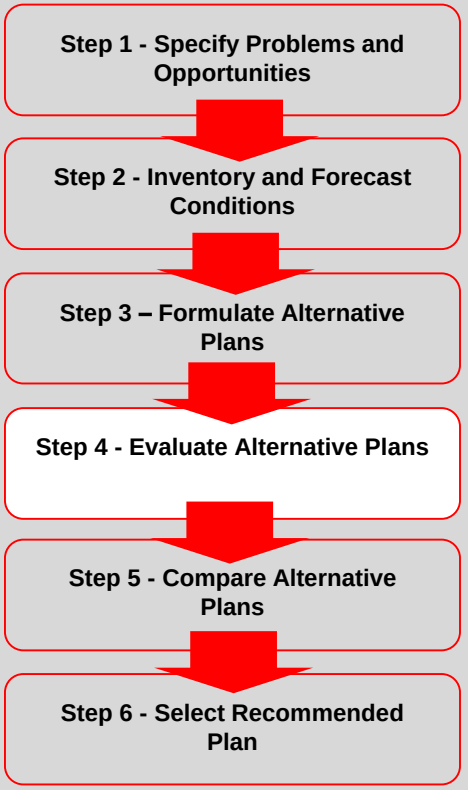
- Plans must be compliant with existing statutes, regulations, and common law



PLANNING AND PROJECT MANAGEMENT

Step 4 – Evaluating Alternative Plans

- Alternative plans must meet requirements of EO 11988, Flood Plain Management
- Federal investment in the regulatory floodway requires relocation or acquisition
- For each plan, compare the difference between with- and without-project conditions with respect to benefits and costs
- Consider the four national accounts (NED, EQ, RED, and OSE)



ANALYSIS, HYDROLOGY AND HYDRAULICS

- Leverage recently revised FEMA NFIP maps
- Hydraulic profiles
- Depth grids

US Army Corps of Engineers.

ANALYSIS, COST ESTIMATING

The parametric unit cost approach for the first look assumed

1) Buyouts
   - County assessor's data base, combing two items = structure appraised values + parcel land value +
   - + $5,000 for structure demolition (no foundation removal)
   - + $5,000 for moving expenses

2) Relocation
   - Per diem costs
   - Storage, rental
   - $50 / sq ft
   - Hotel 60 days (applied to all, not voluntary vs involuntary)
   - Moving and storage costs
   - New lot $30,000
   - Utilities $2,000
   - New site's landscaping $2,000
   - Other $5,000

ANALYSIS, COST ESTIMATING

3) Elevating to
   - Base flood elevation (BFE) plus one foot, or BFE+1
     - Unit cost for Elevating $70 per square-foot
     - Hotel for 60 days $4,005
     - Moving and storage $1,150
   - BFE+2, add $2,000 to BFE+1 assumptions
   - BFE+4, add $6,000 to BFE+1 assumptions
   - Then plus minus per height (various alternatives)

4) Fill Basement
   - The concrete floor must be made permeable (break-up concrete)
   - Move utilities, ie. gaslines, electrical box, sewer, HVAC, appliances
   - $40,000 per 1,200 sq ft
   - Plus the reduced value of the home for lost area (small lots had no room for an addition to offset the lost sq ft)

ANALYSIS, COST ESTIMATING

- Cost estimator can use a parametric unit cost approach for a first look a basic measures and enhance the cost estimating in future plan iterations.
- nServo software
  - has been improved as a direct result of this project.
  - is continuing improvements, including efforts to enable the tool for external partners.

ANALYSIS, ECONOMICS

The risk analysis software is a model of the community's building structures and rivers or streams.

- Interest rate of 3.125%
- Period of analysis of 50 years
- Plan formulation
  - Planners and economists can group individual structures
  - Setting up the model in the software properly from the start can make a big difference in the team's ability to evaluate various measures

ANALYSIS, ECONOMICS

Sensitivity analysis for green space

The Corps cannot do ecosystem services currently

FEMA's "Hazard Mitigation Assistance Guidance" puts the value of green space at $7,853. Each structure removed is assumed to be 1/4 of an acre.

Table 4: Green Open Space and Riparian Benefits

Land Use	Total Estimated Benefits (per acre per year)	Total Estimated Benefits[1] (per square foot)
Green Open Space	$7,853	$2.57
Riparian	$37,493	$12.29

[1] Projected for 100 years with 7 percent discount rate

INCLUSION OF ENVIRONMENTAL BENEFITS INTO THE BCA TOOLKIT

Green open space and riparian benefits have been identified and quantified for acquisition projects. The BCR for an acquisition project must be at least 0.75 before the environmental benefit can be incorporated.

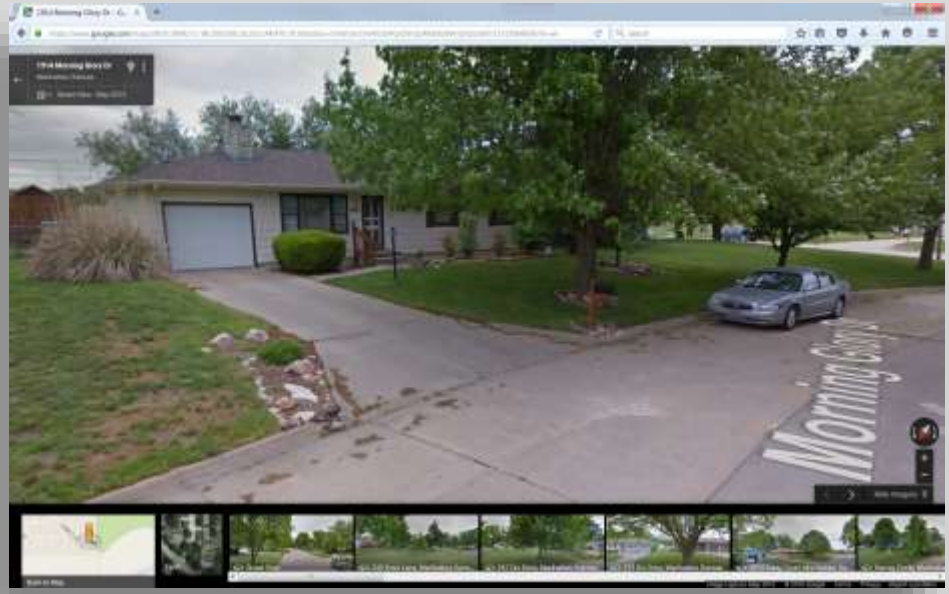
ANALYSIS, PLAN FORMULATION

Inventory of Structure Data (table from NFPC)

- Most data collected virtually
  - GoogleEarth and GoogleStreetView
  - County database
  - City data
  - Limited field visits to some structures by either City or USACE team
- Adjacent grade is from LiDAR near front door
- Water surface elevations come from recent FEMA models

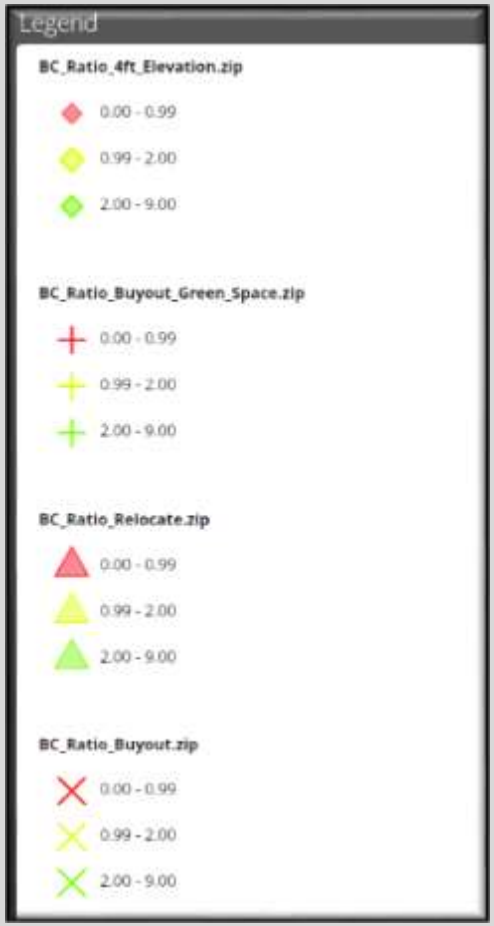
Inventory of Structure Data

Structure Data (Description)	Structure Data	Data Definition	Comments
Building Identification Number	1035	Specific to Structure (geo referenced, coordinates, etc.)	
Structure Address	3205 STATE ST, Manhattan, KS 66503	Specific Postal Location of Structure	
Critical Facility	No	Yes / No	
Lowest Adjacent Ground Elevation	1046.7	Elevation of Lowest Ground at Structure	
At Grade Front Door Elevation	1047.1		
Estimated vertical distance to First Floor Elevation	1.3		Field verified, 2 steps.
First Floor Elevation	1048.5	Elevation of Finished First Floor	
Structure Category	Residential	Residential, Commercial, Industrial, Public	
Structure Use	Single Family Residence	What is the Specific Use of Structure	
Total Stories	One Story	Total Number of Floors Above Grade	
Structure Footprint (sq ft)	1449	Total Square Foot Area of At-Grade Floor	
Number of Structural Corners	4	Total Number of Corners in Perimeter	
Structure Foundation Type	Crawl Space	Slab, Reinforced Slab, CMU, Piers, Columns, Posts, Stone	



ANALYSIS, PLAN FORMULATION

- Evaluate individual structures first
- Map the benefit-cost ratios, then look at grouping in later iterations (future project)
- Plan formulation moves more quickly with a map describing measures in
  - Class breaks for benefit-cost ratio (BCR)
    - RED, BCR < 1.0
    - LIGHT GREEN, 1.0 <= BCR <= 2.0
    - DARK GREEN, BCR > 2.0
  - Specific point formats for each flood risk adaptive measure evaluated
    - ELEVATION, diamond
    - BUYOUTS, an “x” (BUYOUT GREEN SPACE, a cross)
    - RELOCATION, pyramid (similar to up arrow)



Inventory of Structure Data

Structure Data (Description)	Structure Data	Data Definition	Comments
Building Identification Number	1047	Specific to Structure (geo referenced, coordinates, etc.)	
Structure Address	3213 ANDERSON AVE, Manhattan, KS 66503	Specific Postal Location of Structure	
Critical Facility	No	Yes / No	
Lowest Adjacent Ground Elevation	1044.6	Elevation of Lowest Ground at Structure	
At Grade Front Door Elevation	1046.3		
Estimated vertical distance to First Floor Elevation	0.0		
First Floor Elevation	1046.3	Elevation of Finished First Floor	
Structure Category	Residential	Residential, Commercial, Industrial, Public	
Structure Use	Single Family Residence	What is the Specific Use of Structure	
Total Stories	One Story	Total Number of Floors Above Grade	
Structure Footprint (sq ft)	2893	Total Square Foot Area of At-Grade Floor	
Number of Structural Corners	8	Total Number of Corners in Perimeter	
Structure Foundation Type	Slab	Slab, Reinforced Slab, CMU, Piers, Columns, Posts, Stone	
Structure Perimeter Distance (ft)	233	Total Length of All Exterior Sides of Structure	
Exterior Wall Construction	Wood	Wood, Masonry, Brick, Metal, Stone, Concrete, Other	Some brick veneer on some structures
Structure Visual Condition	Excellent to Good	Good / Fair / Poor	
Garage	None	Attached, Detached, None	See columns for Attached Garages.
Doorways	2	Number of Pedestrian Doorways	Assumed 2; update this in future analysis iterations; $
Basement	Slab	Full Basement, Half, Crawl Space, None	Check cell text matching definition
Structure Photos		Photograph of Four Sides of Structure	Complete in future revisions of nonst.asmt.
Utilities Location		Electrical, Gas, Water, Sewer, Oil, Propane, Coal, Other	
Structure Value	$34,300	Assessed Value of Structure	
Fireplace	Yes	Yes / No	Assumed 1; update this in future analysis iterations; $
Structure Owner	[redacted]	Who Owns the Structure	
Year Structure Built	1957	Year Structure was Constructed (Any Historic Significance)	
Water Surface Elevation (1% ACE)	1050.0	Elevation or Depth of Water at Structure (H&H activity)	
Water Surface Elevation (50% ACE)	1049.8	Elevation or Depth of Water at Structure (H&H activity)	
Water Velocity (1% ACE)	0.9	Erosive Potential of Flood Waters (H&H activity)	
Water Velocity (50% ACE)	0.8	Erosive Potential of Flood Waters (H&H activity)	
1st Floor-BFE=	-3.6		

ANALYSIS, PLAN FORMULATION

Nonstructural Flood Risk Management Matrix

The nonstructural / flood proofing measures appear in the column headers on the next page. Evaluative criteria are in the colorized rows.

US Army Corps of Engineers.

ANALYSIS, PLAN FORMULATION

NFPC Matrix

ID #	Elevation on Foundation Walls	Elevation on Piers	Elevation on Posts or Columns	Elevation on Piles	Elevation on Fill	Relocation	Buyout/Acquisition	Dry Flood Proofing	Wet Flood Proofing	Flood Warning Preparedness
1000	9	6	7	7	7	8	8	5	8	8
1001	9	7	7	7	7	8	8	6	8	8
1002	9	7	7	7	7	8	8	6	8	8
1003	9	7	7	7	7	8	8	5	8	8
1004	9	8	8	8	8	8	8	6	8	8
1005	9	7	7	7	7	8	8	6	8	8
1006	8	6	6	6	6	7	7	4	7	7
1007	9	7	7	7	7	8	8	4	7	8
1008	9	7	7	7	7	8	8	6	8	8

US Army Corps of Engineers.

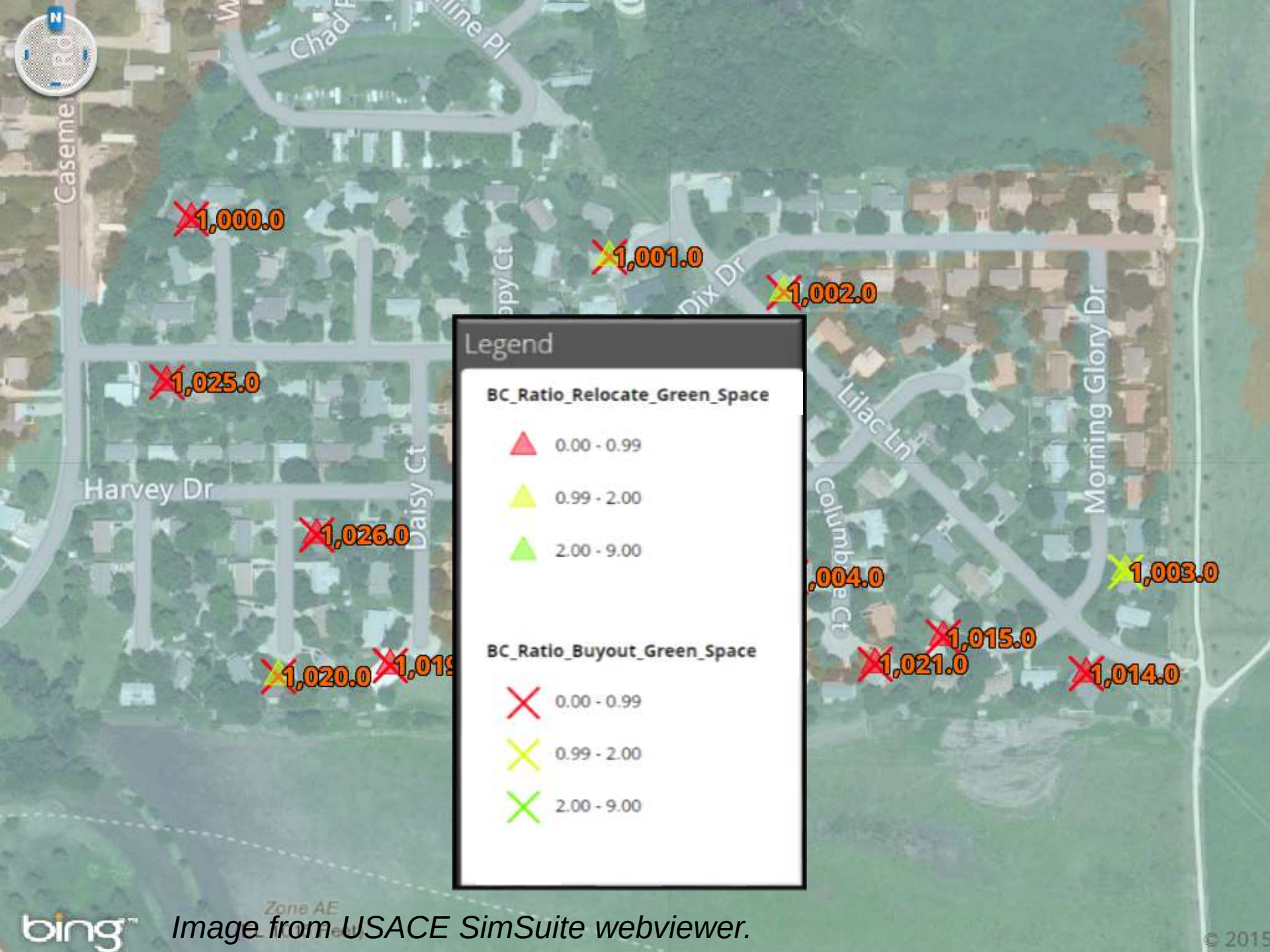


Image from USACE SimSuite webviewer.

RESULTS

Image from USACE SimSuite webviewer.

NONSTRUCTURAL ASSESSMENT FOR KANSAS' LITTLE APPLE

This map presents **benefit-cost ratios** for multiple frequencies at select points. Cost engineers and architects use the USACE "nServo" cost tool, specifically enabled by the National Flood Proofing Committee for elevating structures. This first iteration evaluates 50 structures. The next iteration of plan formulation will do the remaining 250 at risk structures.

THE NONSTRUCTURAL PLAN FORMULATION MAP

This approach is great during outreach and engages the public in the decision making process!

Structure number 1,047.0 is not feasible to elevate.

Green Is Good. Three **colors** are used with classes ranges of benefit-cost ratios to improve visibility during plan formulation.

Planners can engage property owners could find economies of scale in banding together on one measure.

Next iteration will evaluate remaining structures.

Structure 1,035.0 is not feasible for a buyout, but could be elevated.

Credit for Green Space. FEMA grants allow credit for open space associated with buyouts. Corps must account for this under recreation or ecosystem restoration.

Going Up. The team formulated several **Elevate** scenarios (only one shown here). Each is tied to vertical height in relation to the new Base Flood Elevation (BFE). The new Federal Flood Risk Management Standard (Executive Order 13690) may require grant agencies to not invest below a certain level above the BFE. Therefore, though a **1 foot** raise was only evaluated, for federal grants, such as HUD's National Disaster Resiliency Competition, this may require federal dollars to be only for the **2 and 4 feet** raises.

11 200 ft Kansas Hazard Mitigation Team

Benefit-cost ratios

Buyouts, Green Credit
- 0.00 - 0.99
- 0.99 - 2.00
- 2.00 - 9.00

Buyouts
- 0.00 - 0.99
- 0.99 - 2.00
- 2.00 - 9.00

Basement Fill
- 0.00 - 0.99
- 0.99 - 2.00
- 2.00 - 9.00

Elevate 4-feet
- 0.00 - 0.99
- 0.99 - 2.00
- 2.00 - 9.00

National Flood Hazard Layer (NFHL)
Flood Hazard Zones
- 1% Annual Chance Flood Hazard

What's What? The **symbols** tied to each structure vary, depending on which flood risk management measure and allows the map users to more quickly make decisions on next steps, and getting property owners on board with measures that have more strength in numbers.

A Map For First Looks. The menu of flood risk management measures displayed serves as the **first iteration in plan formulation**. A subset of structures can be done in the first benefit-cost analysis. Results for plans can be overlaid (**three** on this map) to build capacity with stakeholders for follow-up formulation. The map can be used with the public to improve how they understand opportunities, including the possibility of getting funding aid from partnering agencies.

Image from USACE SimSuite webviewer.

RESULTS

Out of the 49 structures evaluated…

- 9 structures are feasible for a buyout with green space
- 4 structures are feasible for a buyout without green space
- 23 structures are feasible for a relocation with green space
- 17 structures are feasible for a relocation without green space
- 35 structures are feasible for basement fill
- 13 structures are feasible for being elevated four feet (also evaluated one foot and two feet)

Other measures for future planning iterations

Wet flood proofing

Dry flood proofing

US Army Corps of Engineers.

U.S.ARMY

NEXT STEPS

- Public meeting (in this scope)
- Collect more elevation data (by others) and get Elevation Certificates wherever possible
- Enhance plan formulation (not limited to USACE)

QUESTIONS

Let’s go mitigate!

US Army Corps of Engineers.

TAKE-AWAYS

- Several tools from NFPC that simplify the nonstructural / flood proofing analysis
- Project management plans (PMP) should be set up to analyze the full menu of FRM measures, and this can reinforce, for example, that
  - HEC-FDA is applied correctly at beginning and setup in a way to address individual structures and groupings
  - Groups of structures may be justified as feasible, similar to past studies for structural plans like levees
- Success is only possible with proper understanding and budgeting the plan formulation of nonstructural and flood proofing assessments in the beginning with the PMP
- The map acts as a guide to the next plan formulation iterations
  - colorized points for measures
  - class breaks for final benefit-cost ratios

USEFUL LINKS

USACE, National Nonstructural/Flood Proofing Committee

- http://www.usace.army.mil/Missions/CivilWorks/ProjectPlanning/nfpc.aspx
- Nonstructural Flood Risk Reduction Matrix
- Inventory of Structure Data spreadsheet

USACE, Silver Jackets Program Webinars

- http://silverjackets.nfrmp.us/Get-Involved/More-Information/Webinars-Presentations

USACE, Silver Jackets Kansas webpage

- http://silverjackets.nfrmp.us/State-Teams/Kansas

Little Apple Nonstructural Assessment project poster

- http://silverjackets.nfrmp.us/Portals/0/KS_LilAppleNonstrAsmt_11-12-15.pdf?ver=2015-11-16-165501-537

US Army Corps of Engineers.

U.S.ARMY

ADDITIONAL MAPS

US Army Corps of Engineers.

COMPARING MEASURES, INDIVIDUAL STRUCTURE'S BENEFIT-COST RATIO

Image from USACE SimSuite webviewer.

NONSTRUCTURAL ASSESSMENT FOR KANSAS' LITTLE APPLE

This map presents **benefit-cost ratios** for multiple frequencies at select points. Cost engineers and architects use the USACE "nServo" cost tool, specifically enabled by the National Flood Proofing Committee for elevating structures. This first iteration evaluates 50 structures. The next iteration of plan formulation will do the remaining 250 at risk structures.

THE NONSTRUCTURAL PLAN FORMULATION MAP

This approach is great during outreach and engages the public in the decision making process!

TAKING STOCK. Structure identification number (ie. 1,026.0) are a first step in doing inventory and are one of many attributes displayed geospatially.

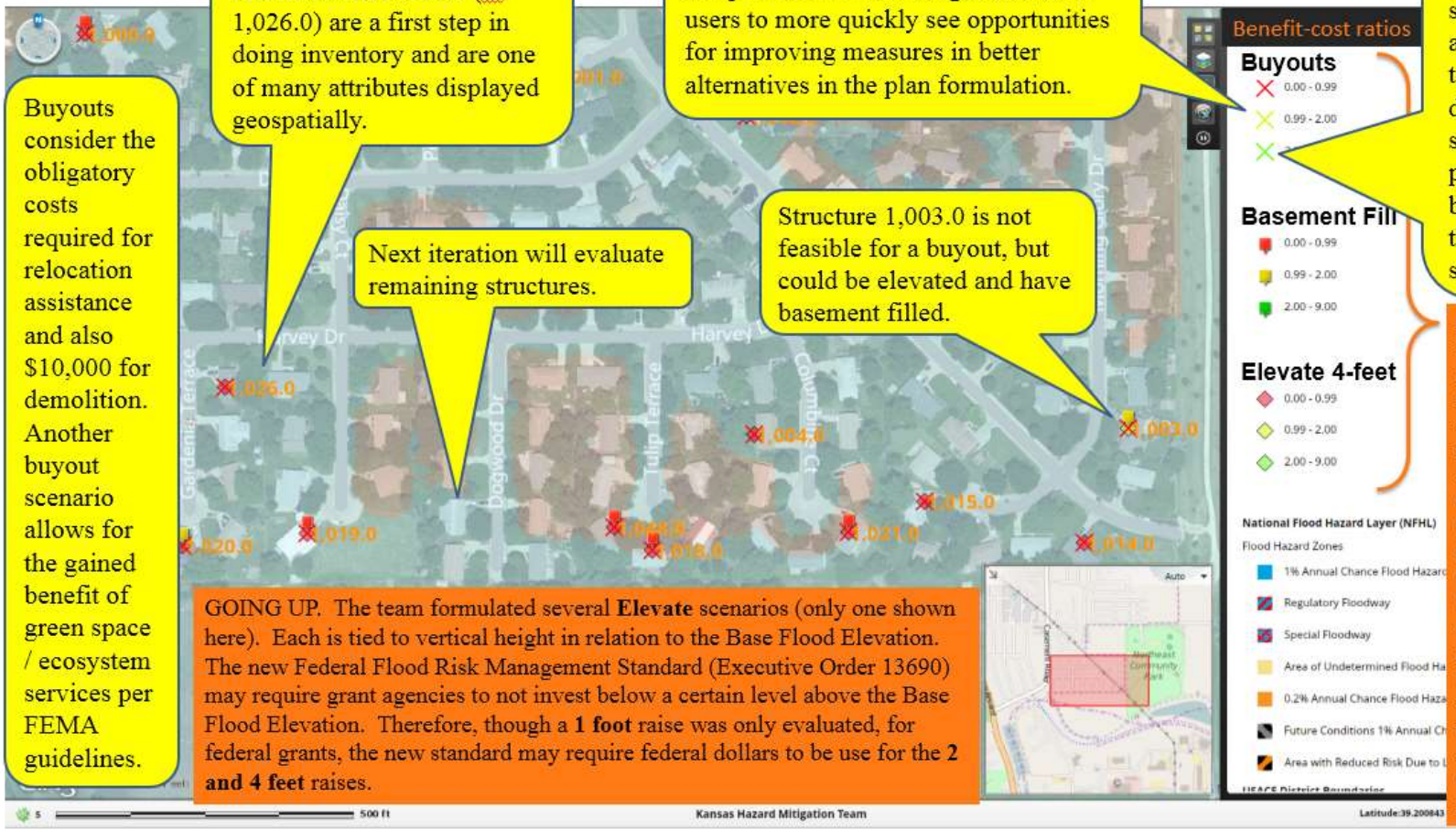
GREEN IS GOOD. The **colors** are setup in classes with ranges that allow users to more quickly see opportunities for improving measures in better alternatives in the plan formulation.

WHAT'S WHAT? The **symbols** vary, using Xs, Diamonds, or Callout Squares to show the results and allows the map users to more quickly make decisions on next steps, and getting property owners on board with measures that have more strength in numbers.

Buyouts consider the obligatory costs required for relocation assistance and also $10,000 for demolition. Another buyout scenario allows for the gained benefit of green space / ecosystem services per FEMA guidelines.

Next iteration will evaluate remaining structures.

Structure 1,003.0 is not feasible for a buyout, but could be elevated and have basement filled.



GOING UP. The team formulated several **Elevate** scenarios (only one shown here). Each is tied to vertical height in relation to the Base Flood Elevation. The new Federal Flood Risk Management Standard (Executive Order 13690) may require grant agencies to not invest below a certain level above the Base Flood Elevation. Therefore, though a **1 foot** raise was only evaluated, for federal grants, the new standard may require federal dollars to be use for the **2 and 4 feet** raises.

A MAP FOR FIRST LOOKS. The menu of flood risk management measures displayed serves as the **first iteration in plan formulation**. A subset of structures can be done in the first benefit-cost analysis. Results for plans can be overlaid (**three** on this map) to build capacity with stakeholders for follow-up formulation. The map can be used with the public to improve how they understand opportunities, including the possibility of getting funding aid from partnering agencies.

Image from USACE SimSuite webviewer.

COMPARING MEASURES, INDIVIDUAL STRUCTURE'S BENEFIT-COST RATIO

Image from USACE SimSuite webviewer.

RESULTS

The recommendations

1. Buyouts
2. Relocations
3. Elevate the structure
4. Flood warning
5. Wet flood proofing *(not in first look iteration, but team should survey structures and evaluate in next round)*