TOP 6 NONSTRUCTURAL MEASURES AND NEW ERA PLANNING FOR LEVEES

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USACE – Kansas City District
Member, USACE National Nonstructural Committee

September 5, 2018
OBJECTIVES

- Study information for levee projects
  - Florence, KS
  - Manhattan, KS
- Identifying flood risks in leveed areas
- Flood risk assessment for communities with levees
- Flood risk management measures
  - Nonstructural measures
  - Critical facilities
- Recommended risk management options
- Suggested risk management options
FLOODING IN A LEVEED AREA

1. Breach prior to overtopping
2. Overtopping with breach
3. Malfunction or improper operation
4. Levee overtopping without breach
Many Measures
THE MEASURES – HOW YOU GET THERE

The Menu of Measures may be put in two sets. Many of these items are activities, while some are features that can be built.

<table>
<thead>
<tr>
<th>FLOODPLAINS</th>
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<tbody>
<tr>
<td>Nonstructural flood proofing measures include</td>
</tr>
<tr>
<td>• Elevation</td>
</tr>
<tr>
<td>• Relocation</td>
</tr>
<tr>
<td>• Buyout / Acquisition</td>
</tr>
<tr>
<td>• Dry Flood Proofing</td>
</tr>
<tr>
<td>• Wet Flood Proofing</td>
</tr>
<tr>
<td>Nonphysical nonstructural measures include:</td>
</tr>
<tr>
<td>• Flood Warning Systems</td>
</tr>
<tr>
<td>• Flood Insurance</td>
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<tr>
<td>• Floodplain Mapping</td>
</tr>
<tr>
<td>• Flood Emergency Preparedness Plans</td>
</tr>
<tr>
<td>• Land Use Regulation</td>
</tr>
<tr>
<td>• Zoning</td>
</tr>
<tr>
<td>• Evacuation Plans</td>
</tr>
<tr>
<td>• Risk Communication</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FLOODWATERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical or structural measures include constructible features such as</td>
</tr>
<tr>
<td>• Detention Basins</td>
</tr>
<tr>
<td>• Dams</td>
</tr>
<tr>
<td>• Floodwalls</td>
</tr>
<tr>
<td>• Levees and Berms</td>
</tr>
<tr>
<td>• Channel</td>
</tr>
<tr>
<td>• Straightening</td>
</tr>
<tr>
<td>• Widening</td>
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<tr>
<td>• Deepening</td>
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<tr>
<td>• Diversions</td>
</tr>
<tr>
<td>• Bridge Enlargements</td>
</tr>
<tr>
<td>• Conveyance Modifications</td>
</tr>
<tr>
<td>And these activities</td>
</tr>
<tr>
<td>• Clearing and Snagging Debris</td>
</tr>
<tr>
<td>• Pumping</td>
</tr>
<tr>
<td>• Land Treatment And Infiltration</td>
</tr>
</tbody>
</table>
To achieve the highest level of resilience requires collaboration. We’re better together. That’s how you achieve lower risk and a resilient state.
Levees in communities in the FEMA National Flood Insurance Program will eventually need to be accredited by a professional engineer to remove the leveed area from the special flood hazard area.
LEVEED AREA IN MANHATTAN, KS

- Levee centerline
- Water Well Field
  - Lose power supply 1008.0
- Water Treatment Plant
  - Lose generator 1018.0
- Westar Energy
  - Levee Substation
    - Initial inundation 1010.0
- Westar Energy
  - East Manhattan Substation
    - Initial inundation 1003.0
- Wastewater Treatment Plant
  - Lose main power 1012.0
  - Lose generator 1016.0
RISK IDENTIFICATION AND ASSESSMENT
FLOOD RISKS DEFINED

Flood hazards that need to be discussed in your floodplain management plan:

- Inundation and Depth
- Velocity
- Proximity of the Population / Consequences
- Rate of Rise

Consider amount of warning time.

Know where **critical structures** are and what your critical infrastructure is.
FLOOD RISK USING INUNDATION – DEPTH
(MANHATTAN, KS)

4 hours after breach

Water Well Field
Inundation Depth=0.0 ft

Levee Sub-Station
Inundation Depth=2.0 ft

East Manhattan Sub-Station
No Power due to Initial Inundation
FLOOD RISK USING INUNDATION

TIMING OF OVERTOPPING 2D MODEL

(LEVEES IN BUCHANAN COUNTY, MO)

MRLS 448-443 L Inundation Progression due to Overtopping and Breach
This flood level is for the base flood elevation without the levee. This is the “natural valley” method, where de-accredited levees do not provide a protected area for flood insurance purposes. This uses the 1.0% annual chance exceedance (100-year) without the levee. For a home mortgage period of 30 years, the owner may expect this flood 26% in a given year, if living there for that whole time, and the levee is not certified.
This flood level describes one of the events that will overtop the levee at the 0.2% annual chance exceedance (500-year). For a home mortgage period of 30 years, the owner may expect this flood 6% in a given year, if living there for that whole time.
LAND SURVEY POINT WITH OLD FLOOD MAP
RISK MANAGEMENT OPTIONS - RECOMMENDATIONS

Florence, KS
The project team recognized the following geographic conditions at each property and screened most of the items above to narrow the list. Conditions included the building foundation as one of the following.

- Slab on grade
- Crawl space
- Basement

And possible type of building’s construction material is below.

- Concrete or masonry
- Metal
- Wood
RISK MANAGEMENT OPTIONS

• No action
• Wet flood proofing
  – Elevate utilities
  – Anchor storage tanks
  – Anchor mobile homes
• Flood openings
• Fill basement
• Dry flood proofing
• Elevation on foundation walls
• Elevation on piers

• Elevation on fill
• Relocation
• Buyout / acquisition
## Example Tier 2 Recommendations

<table>
<thead>
<tr>
<th>ID#</th>
<th>Address</th>
<th>4th Nonstructural Measure</th>
<th>5th Nonstructural Measure</th>
<th>6th Nonstructural Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>410 BARKER</td>
<td>Helical Ground Anchoring</td>
<td>Elevation on Piers</td>
<td>Relocation</td>
</tr>
<tr>
<td>86</td>
<td>224 E 5TH</td>
<td>Wet Flood Proofing</td>
<td>Elevation on Foundation Walls</td>
<td>Relocation</td>
</tr>
<tr>
<td>87</td>
<td>503 MAIN</td>
<td>Wet Flood Proofing</td>
<td>Elevation on Foundation Walls</td>
<td>Relocation</td>
</tr>
<tr>
<td>88</td>
<td>502 MAIN</td>
<td>Wet Flood Proofing</td>
<td>Elevation on Foundation Walls</td>
<td>Relocation</td>
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<tr>
<td>89</td>
<td>229 W 5TH</td>
<td>Wet Flood Proofing</td>
<td>Elevation on Foundation Walls</td>
<td>Relocation</td>
</tr>
</tbody>
</table>
FLOOD OPENINGS
STRUCTURE IS MANUFACTURED HOME OR TRAILER
Building Section of Existing Condition
 Manufactured Home

- Existing grade
- Lowest adjacent grade
- Base flood elevation
- Finished floor
- Existing structure
- Existing grade
Building Section of Proposed Mitigation
Elevating Manufactured Home

- Elevating utility
- Secure to built-in frame anchors
- Elevated structure
- Elevate utility
- Concrete footers with steel reinforced concrete columns
- Install helical ground anchors
- Base flood elevation
- Frame strap
- Existing structure
- Finish floor
- Lowest adjacent grade
- Existing grade
RELOCATION AND BUYOUTS
STRUCTURE WITH BASEMENT

Residential
(and limited Commercial where a business is located in a structure that used to be a family house)
Building Section of Existing Condition Structure with Basement

- Existing structure
- Base flood elevation
- Lowest adjacent grade
- Finished floor
- Basement
- Foundation
- Existing grade
Building Section of Proposed Mitigation Elevation on Foundation Walls

- Break up floor
- Basement
- Elevate utilities & storage
- Elevate structure
- Extend foundation walls
- Add flood openings
- Fill crawl space or basement
- Basement
- Break up floor

- Existing structure
- Base flood elevation
- Lowest adjacent grade
- Finished floor
- Existing grade
- Elevate utilities & storage
- Elevate structure
- Extend foundation walls
- Add flood openings
Elevated Air Conditioner (and Foundation Stem Walls may be Elevated Structure)
This proposed mitigation is mainly for commercial structures.

Flood insurance still required for residential structures.
STRUCTURE WITH BASEMENT

Commercial
Building Section of Existing Condition Structure with Basement

- Existing structure
- Lowest adjacent grade
- Base flood elevation
- Finished floor
- Existing grade
- Basement
- Foundation
Building Section of Proposed Mitigation

Dry Flood Proofing

Businesses get a flood insurance premium rated for the Dry Flood Proofing measure.

- Break up floor
- Existing grade
- Basement
- Elevate utilities & storage
- Install dry flood proofing & opening barriers
- Fill crawl space or basement
- Existing grade
- Add flood openings
- Basement
- Finished floor
- Base flood elevation
- Lowest adjacent grade
STRUCTURE WITH CRAWL SPACE
Building Section of Existing Condition Structure with Crawl Space

- **Existing structure**
- **Base flood elevation**
- **Lowest adjacent grade**
- **Finished Floor**
- **Existing grade**
- **Foundation**
- **Crawl space**
Building Section of Proposed Mitigation
Wet Flood Proofing

- Elevate utilities & storage
- Add flood openings
- Elevate inside utilities
- Retrofit structure walls (and floors if needed) with waterproof rated building materials
- Existing grade
- Base flood elevation
- Lowest adjacent grade
- Finished floor
- Foundation
- Crawl space

Existing structure

Lowest adjacent grade

Base flood elevation

Existing grade

Finished floor

Foundation

Crawl space
STRUCTURE WITH SLAB ON GRADE
Building Section of Existing Condition Structure with Slab on Grade

- Existing structure
- Base flood elevation
- Lowest adjacent grade
- Finished floor
- Existing grade
- Slab on grade concrete foundation
- Slab on grade concrete foundation
Building Section of Proposed Mitigation
Elevation on Fill

- Proposed grade
- Elevated utilities & storage (add house addition if feasible)
- Elevated structure
- Proposed slab on grade
- Proposed grade
- Slab on grade concrete foundation
- Finished floor
- Base flood elevation
- Lowest adjacent grade
- Existing structure
Building Section of Proposed Mitigation

Dry Flood Proofing

Existing grade

Elevate outside utilities

Install dry flood proofing & opening barriers

Flood insurance still required for residential structures.

Existing structure

Lowest adjacent grade

Base flood elevation

Finished floor

Slab on grade concrete foundation

Existing grade
Building Section of Proposed Mitigation

Wet Flood Proofing

- Elevate outside utilities
- Elevate inside utilities or build an addition
- Retrofit structure walls (and floors if needed) with waterproof rated building materials

Flood insurance still required for residential structures after this measure.
Building Section of Proposed Mitigation

Wet Flood Proofing

Flood insurance still required for residential structure, after this measure.

- **Existing grade**
  - Elevate outside utilities
  - Slab on grade concrete foundation

- **Finished floor**
  - Existing structure

- **Lowest adjacent grade**
  - Base flood elevation

- **Proposed structure**
  - Elevate inside utilities or build an addition
  - Retrofit structure walls (and floors if needed) with water proof rated building materials
## TOP MEASURES, 4TH, 5TH, AND 6TH

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<thead>
<tr>
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<td>Dry flood proofing</td>
<td>9</td>
</tr>
<tr>
<td>Elevation on foundation walls</td>
<td>132</td>
</tr>
<tr>
<td>Elevation on piers</td>
<td>13</td>
</tr>
<tr>
<td>Elevation on fill</td>
<td>0</td>
</tr>
<tr>
<td>Relocation</td>
<td>44</td>
</tr>
<tr>
<td>Buyout / acquisition</td>
<td>43</td>
</tr>
<tr>
<td>Anchoring</td>
<td>14</td>
</tr>
</tbody>
</table>
RISK MANAGEMENT OPTIONS

**HAZARDS**
- Reservoir Operations
- Channel Conveyance Modifications
- Bridge Enlargement
- Clearing Snagging & Debris
- Interior Drainage Features

**PERFORMANCE**
- Improve O&M
- Monitor Levee Performance
- Erosion Protection
- Overtopping Resilience

**CONSEQUENCE**
- Elevating Structures
- Relocation
- Buyout/Aquisition
- Flood Proofing
- Flood Warning System
- Flood Insurance
- Emergency Preparedness Plans
- Land Use Regulation
- Evacuation Plans/Drills
- Zoning
- Communication for Awareness

*The Sponsor’s Guide To the USACE Levee Safety Program (EP 1105-1-1, June 2018)*
<table>
<thead>
<tr>
<th>High Priority Measures</th>
<th>Flood Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td></td>
</tr>
</tbody>
</table>
ALERT! A Flash Flood Warning and Flood Warning are in effect for portions of the area.

View all valid statements/warnings or choose a specific point or river to get the details for that location.
Flood Forecast Inundation Map, Big Blue River (from past Silver Jackets project)
https://water.weather.gov/ahps2/inundation/index.php?gage=mntk1

- Forecast point and gage site
- Levee (orange) overtopping location
- Current stage
PUBLIC UNDERSTANDING

NWS flood category color scheming is a consistent tool extended to describe the level of flooding.

<table>
<thead>
<tr>
<th>Flood Stage</th>
<th>30</th>
<th>27</th>
<th>19</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Flood Stage:</td>
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<tr>
<td>Moderate Flood Stage:</td>
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<tr>
<td>Flood Stage:</td>
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<tr>
<td>Action Flood Stage:</td>
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</tbody>
</table>

Flood Impacts

37  Levee along the Big Blue River is overtopped.
30  Structures along and north of Prospect Street and along Messenger Road flood.
27  Structures along Harwood Road flood.
19  Minor low land flooding begins along the river.

Extensive inundation of structures and roads. Significant evacuations of people and property.
Some inundation of structures and roads near stream —some evacuations of people and property.
Minimal or no property damage, but possibly some public threat.
River or stream level approaching flood stage.
River or stream level below flood stage.
Appendix A. Flood Risk Management Glossary

A Flood is a specific location on a stream or river that has a 1-percent probability of being inundated or exceeded in any given year. The flood is typically defined as the 100-year flood, which means that the public believes that 100 years pass between flood events. Each flood is a 100-year flood, but the same flood will occur again every 100 years.

Back (also Bank) is the area of land that drains runoff from places higher or upstream, as if under a levee or along a stream or river.

Berm (also levee) is a feature made of soil that acts as a barrier along a watercourse and provides flood control. Berm levees are limited in size and protect a small flood area from a small flood event. Berm levees are easily constructed on the floodplain.

Beneficial Use of Floodplain is a method to go beyond managing flood risks, encouraging a more diverse natural environment, and adding recreational spaces in what is thought of as a flood plain. Communities also find this adds value to their residents, which help the community thrive.


defined to relieve flood hazards and those helping to reduce flood hazards.

Activity is defined to be associated with being a feature. An activity could be one-time, periodic, or continuous. Local, state, and federal agencies may classify activities to manage the use of floodplains to address floods and to flood management.

A municipality or city is a physical means of managing flood risks by addressing consequences to the floodplain, with the purchase and elimination of flood-resistant buildings, allowing for rehabilitation to relocate to locations away from flood hazards.

A Floodplain is a large area of any, which is subject to flooding caused by a move to or elevation to affect dry areas of the U.S., such as can occur during a Flooded Flood because the water level rises and falls rapidly as flood waters rise.

A Floodplain is the area of land that drains runoff from places higher or upstream, as if under a levee or along a stream or river.

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Beneficial Use of Floodplain is a method to go beyond managing flood risks, encouraging a more diverse natural environment, and adding recreational spaces in what is thought of as a flood plain. Communities also find this adds value to their residents, which help the community thrive.
MARION HISTORIC FLOODING

Marion was founded in 1861 along the Cottonwood River and has endured 15 floods between 1865 and 1971. The 1903 and 1951 floods were the most devastating. The 1903 flood (shown) reached the greatest depth recorded in municipal buildings: 4.5 feet on Main Street. The Courthouse flooded to 5.3 feet in 1951 with public damages at $750,000. The bottom of this sign represents the water level in the 1951 flood. In 1970, the Corps of Engineers built a levee. This sign is in the levee area. Learn about your levee’s flood risk at http://mil.usace.army.mil. Learn more about Marion’s flood history and how measures like flood insurance can lower your flood risk at the Kansas web link, below.

Driving into floodwaters is the number one cause of flood-related deaths in Kansas. Do not drive into flooded areas!

Photo courtesy Kansas Historical Society

HISTORICAL MARKER

Silver Jubilee brings together federal, state, and local agencies to design and install a communication program to encourage people to prepare for disasters.

To learn more about Kansas flood history visit https://agriculture.ks.gov/disasters/

FEMA, the Federal Emergency Management Agency, is the primary federal agency for coordinating domestic incidents.

Living with Levees
Know Your Flood Risk
Be Prepared
Flood Risk Notice 2016
FREE TEMPLATE OF ANNUAL MAILER FOR LEVEED AREA

Dear Property Owner:

The State has many different terrains and climates, and given the right conditions, flooding can happen anytime and anywhere—even during one of the most severe droughts in the region’s history. Your property is located near a levee or a river. According to our records, your property located at INSERT ADDRESS may be affected by potential flood risk from the LEVEE NAME. Your property may also be at risk for flooding from other sources, not only from rain in the region, such as creeks and local storm drains. Visit the USACE National Levee Database web page (http://www.usace.army.mil) and look for your property address to find the areas subject to flooding if the project should fail and to get information about how to further reduce your risk, such as the warning notice and evacuation planning.

NAME OF FLOOD RISK NOTIFICATION PROGRAM ADDRESS

US Army Corps of Engineers.

Know your FLOOD RISK

Flood Risk Notice 2018

Consider these facts:

• Levees may reduce, but do not eliminate, flood risks.
• Even if a levee meets the FEMA standard of the base flood, a 2% or in 4 chance of a larger flood occurring within any 30-year home owner’s mortgage is possible.
• Flood damage is not covered by most standard insurance policies for homeowners, renters, or businesses.
• The state recommends that you obtain flood insurance for your property. Contact your insurance agent or call the National Flood Insurance Program at 1-888-435-6337. Or visit the state NFIP web page.

Remember this simple 3-step plan

PREVENT
Keep storm drains, gutters, and ditches clear.
Check with your local flood risk management agency to see if a permit is required if you plan to build on, fill, regrade or re-grade your property.
Never excavate, landscape, modify, or build anything on any levee or flood easement without permits from the appropriate local, state, and federal agencies.

PROTECT
Never drive through flooded streets or roads; more people are trapped and die in their vehicles than anywhere else during floods.
Never try to escape rising floodwater by going into the attic unless you have roof access or other safe options.
Consider buying flood insurance, which is a very wise investment and is not part of home owner insurance.

Get a list of your local emergency agency contacts and more local, state, and federal information at STATE WEB PAGE

EMAIL ADDRESS PHONE NUMBERS
Please share this important information with your tenants. Have it translated if necessary.
INSERT A QUICK RESPONSE CODE

ESTA NOTIFICACION CONTIENE INFORMACION IMPORANTE.
Por favor compárala con sus inquilinos. Traduzcalo si es necesario. Para preguntas llame al: PHONE NUMBER TO TRANSLATE o visite: STATE WEB PAGE.
#2

<table>
<thead>
<tr>
<th>High Priority Measures</th>
<th>Emergency Action Planning</th>
<th>Flood Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TIER 1 RECOMMENDATIONS</strong></td>
<td><strong>Emergency Management Planning</strong></td>
<td><strong>Evacuation Planning</strong></td>
</tr>
</tbody>
</table>
TIPS FOR GETTING PUBLIC AWARENESS

Prepared By

Dennis S. Mileti, Ph.D.
Professor Emeritus
University of Colorado, Boulder

John H. Sorensen, Ph.D.
Distinguished Researcher Emeritus
Oak Ridge National Laboratory

for the

U.S. Army Corps Of Engineers
Risk Management Center

June 5, 2015

Search the title

“A Guide To Public Alerts and Warnings for Dam and Levee Emergencies”
Ultimately, the community may take some action, such as closing a low water crossing, or for communities like Parkville, setting up a temporary flood barrier (that's certified).

These actions take time, resources, and sometimes several people. That's why EAPs help, because they identify these constraints in advance.

USACE St. Paul District has a useful guide for setting up a flood emergency action plan.
PRESS RELEASES

The following messages can be announced via radio, television, and web site based on various zones identified in the evacuation plan. The City’s automatic calling system will also distribute the messages.
PRESS RELEASES
Each zone will have a target threshold that emergency managers are watching. Target thresholds will be tied to events and estimated timing per the 2D-inundation model.
CRITICAL FACILITY FLOODS

- Existing levee
- Floodwater level
- River and floodplain
BUILDING SECTION OF PROPOSED MITIGATION CRITICAL FACILITY FLOODING, WATER TREATMENT BUILDING

- Existing grade
- Elevate outside utilities
- Install dry flood proofing & opening barriers
- Slab on grade concrete foundation
- Finished floor
- Existing structure
- Base flood elevation
- Lowest adjacent grade
- 0.2% annual chance exceedance
TOPOGRAPHIC MAP
## TIER 1 RECOMMENDATIONS

### #1

<table>
<thead>
<tr>
<th>High Priority Measures</th>
<th>Flood Insurance</th>
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<th>Flood Warning</th>
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<tbody>
<tr>
<td><strong>Flood Insurance</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Building Inspection &amp; Codes</strong></td>
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</tr>
<tr>
<td><strong>Regulations &amp; Mapping</strong></td>
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</tr>
<tr>
<td>Community Name</td>
<td>Policies In-force</td>
<td>Insurance In-force whole $</td>
<td>Written Premium In-force</td>
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<tr>
<td>----------------------</td>
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<td>--------------------------</td>
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<tr>
<td>GOESSEL, CITY OF</td>
<td>1</td>
<td>28,000</td>
<td>188</td>
</tr>
<tr>
<td>HILLSBORO, CITY OF</td>
<td>2</td>
<td>107,600</td>
<td>936</td>
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<tr>
<td>PEABODY, CITY OF</td>
<td>8</td>
<td>687,8008</td>
<td>11,326</td>
</tr>
<tr>
<td>MARION COUNTY *</td>
<td>15</td>
<td>1,461,600</td>
<td>16,136</td>
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</table>
## SUMMARY OF TIER 2, PROPERTY LEVEL RISK MANAGEMENT OPTIONS

<table>
<thead>
<tr>
<th>Measure</th>
<th>Number of Feasible Structures</th>
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<tr>
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<td>43</td>
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</table>
EFFECTED PREMIUMS WHEN ELEVATING BUILDING

Elevation Reduces Flood Insurance Premiums and Risk

- **First Floor 1 Foot Below BFE**: $4,786/year
- **First Floor at BFE**: $2,136/year
- **First Floor 3 Feet Above BFE**: $591/year

Illustration assumes AE Flood Zone, amount of coverage $200k Building/$80k Contents
Rates are as of April 2016
Many Measures
FOR MORE INFORMATION

Manhattan, Kansas flood risk communication web page
- https://cityofmhk.com/2199/Know-Your-Flood-Risk

USACE, Kansas Silver Jackets
- http://silverjackets.nfrmp.us/State-Teams/Kansas

A Guide To Public Alerts and Warnings for Dam and Levee Emergencies

USACE St. Paul District has a useful guide for setting up a flood emergency action plan

NOAA National Weather Service, Advanced Hydrologic Prediction Service

USACE, National Nonstructural Committee, Training Modules, FMPs
FOR MORE INFORMATION

USACE, Kansas and Missouri Silver Jackets
- [http://silverjackets.nfrmp.us/State-Teams/Kansas](http://silverjackets.nfrmp.us/State-Teams/Kansas)
- [http://silverjackets.nfrmp.us/State-Teams/Missouri](http://silverjackets.nfrmp.us/State-Teams/Missouri)

USACE, National Nonstructural Committee, Training Modules, FMPs