

# Manhattan Levee Section 216 Feasibility Study

Public Workshop

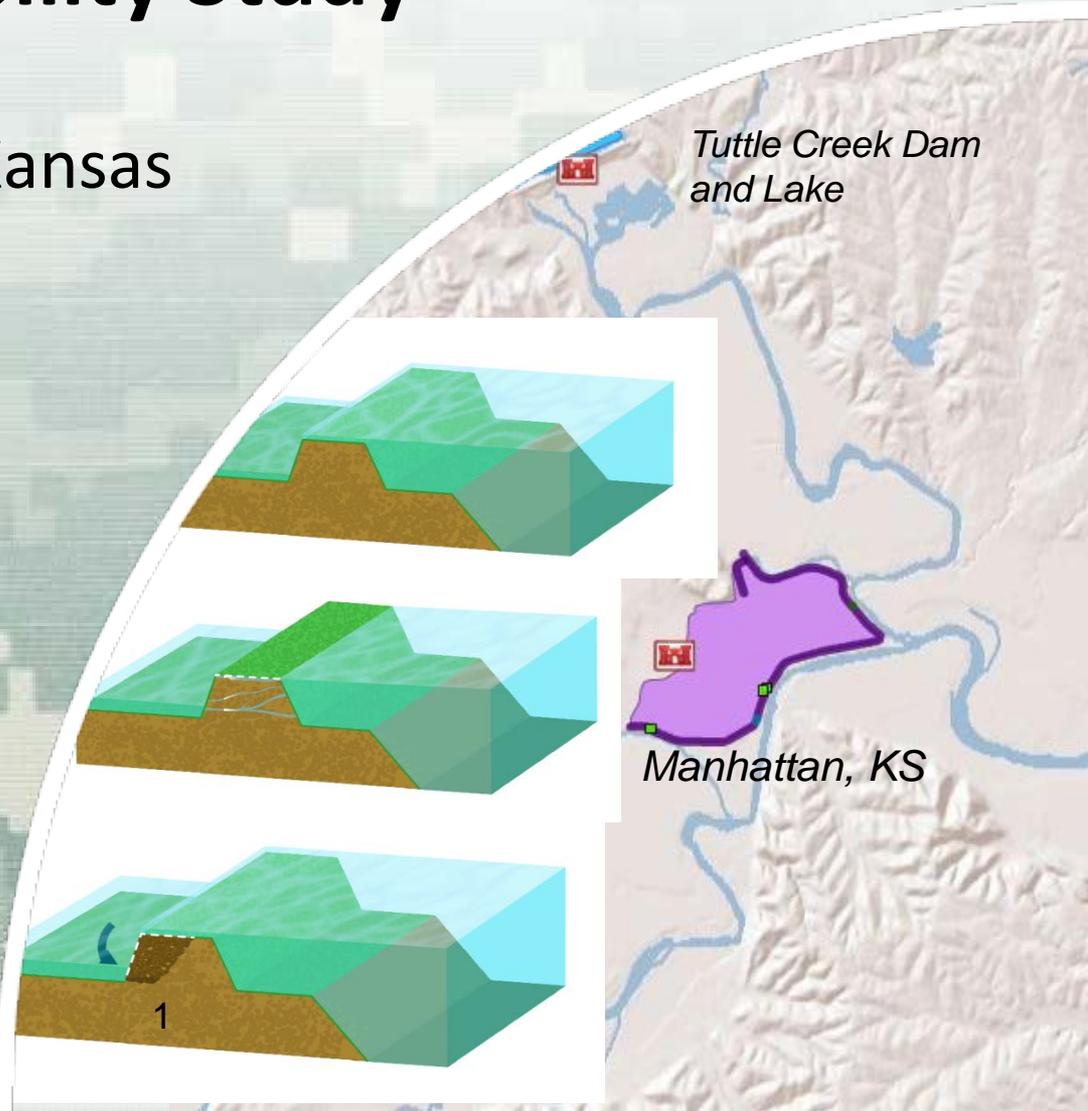
17Apr13 – Manhattan Kansas

Kansas City District

Project Development Team



US Army Corps of Engineers  
BUILDING STRONG®



# Location and Study Context





**Tuttle  
Creek Dam  
and Lake**

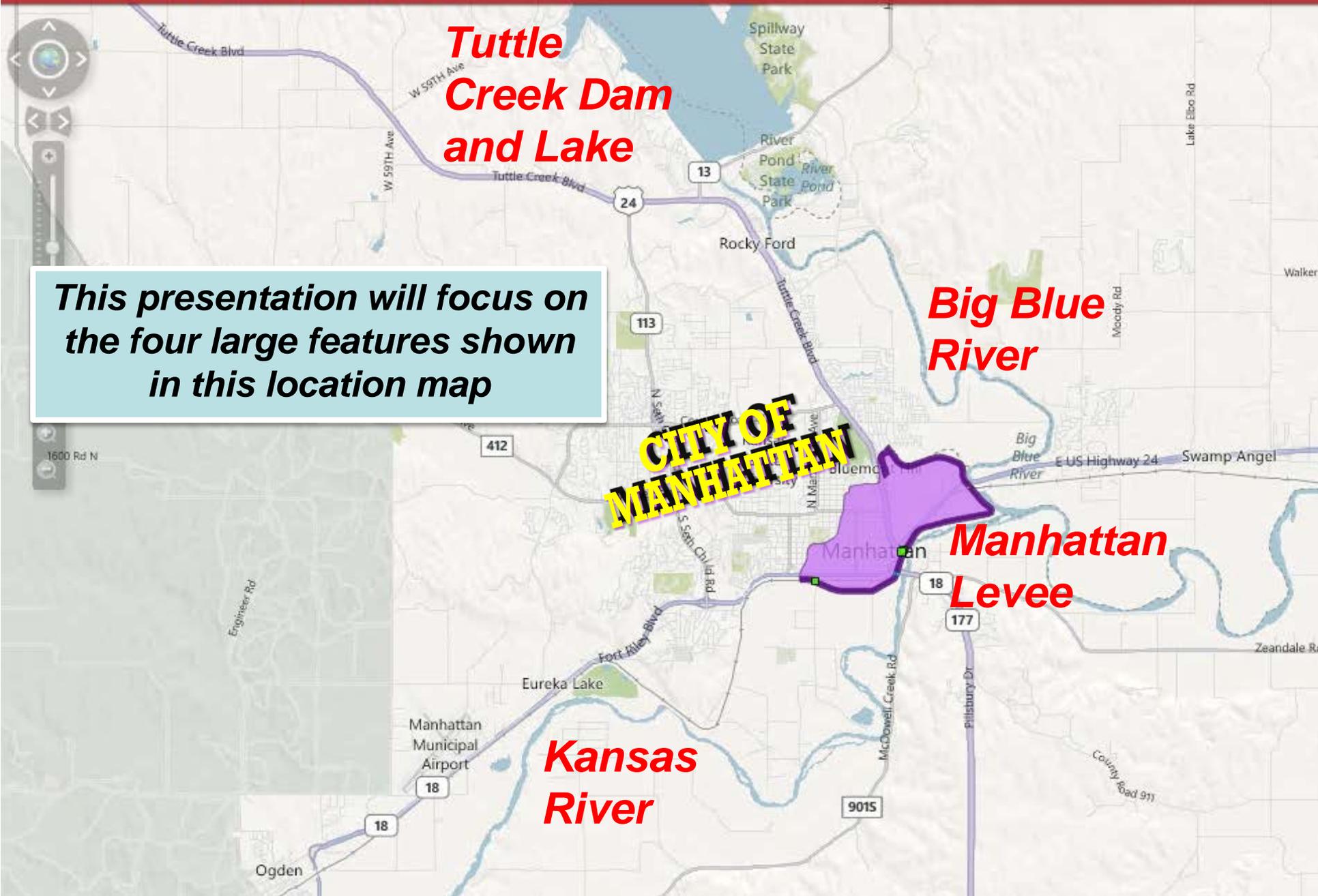
**Big Blue  
River**

**Manhattan  
Levee**

**Kansas  
River**

*This presentation will focus on  
the four large features shown  
in this location map*

**CITY OF  
MANHATTAN**





# Manhattan Levee Summary

- 5 mile long levee in a growing urban area of the City of Manhattan, and Potawatomie and Riley Counties.
- Provides protection from flooding up to the 1 percent chance exceedance flood (nominal 100-yr) event
- Releases from Tuttle Creek Lake play a role
- Approx. 1,600 acres and about \$1 Billion in commercial, residential, and public investment protected by the levee
- Serves the economic vitality of the City and the surrounding regional area.



# Manhattan Levee Summary

- The Manhattan Levee Unit is comprised of two major segments:
  1. Big Blue segment extends along the right bank of the Big Blue River from near Casement Rd down to the KS River confluence.
  2. Kansas River segment extends along the left bank of the Kansas River near Wildcat Creek to the Big Blue River
- Federal project, designed in the 1950's, construction completed in early 1960's.
- After Corps construction, the levee was turned over to the City of Manhattan who owns, operates and maintains it.
- Primarily earthen levee (5.4 miles), various interior drainage features, pump plants, and levee underseepage control.



# Levee History

- The Flood Control Act approved 3 September 1954 (Title II, Public Law 780, 83d Cong., 2d Sess., H.R. 9859) authorized the original Manhattan, Kansas, levee system
- Construction of the levee project began on 4 May 1961 and was completed and accepted by local interests in July 1963.
- The City of Manhattan owns, operates, and maintains the levee.



**1951 flood**

SE View

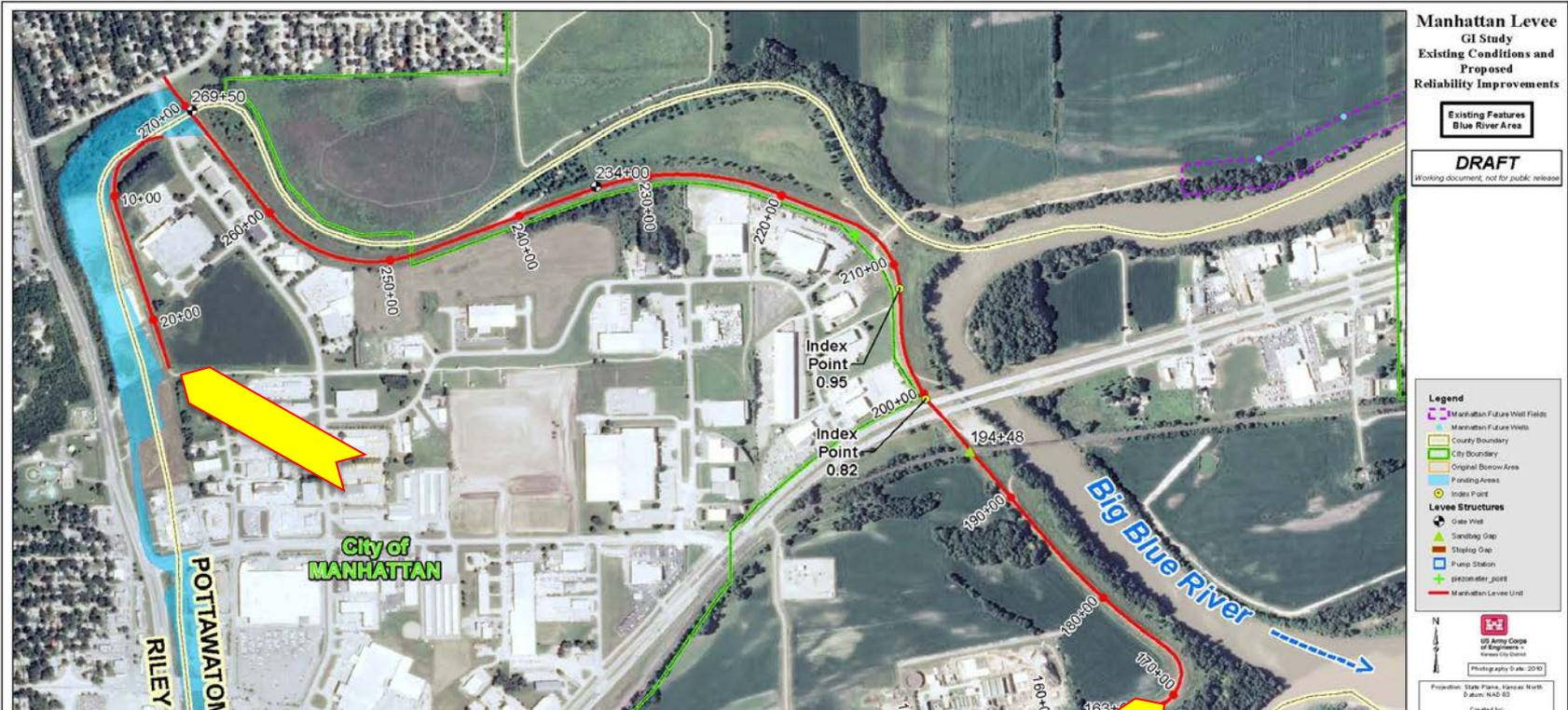
*Photo is prior to levee construction –*

Southern portions of Manhattan were inundated... most the area shown in the photo foreground.

**Griffith Stadium**

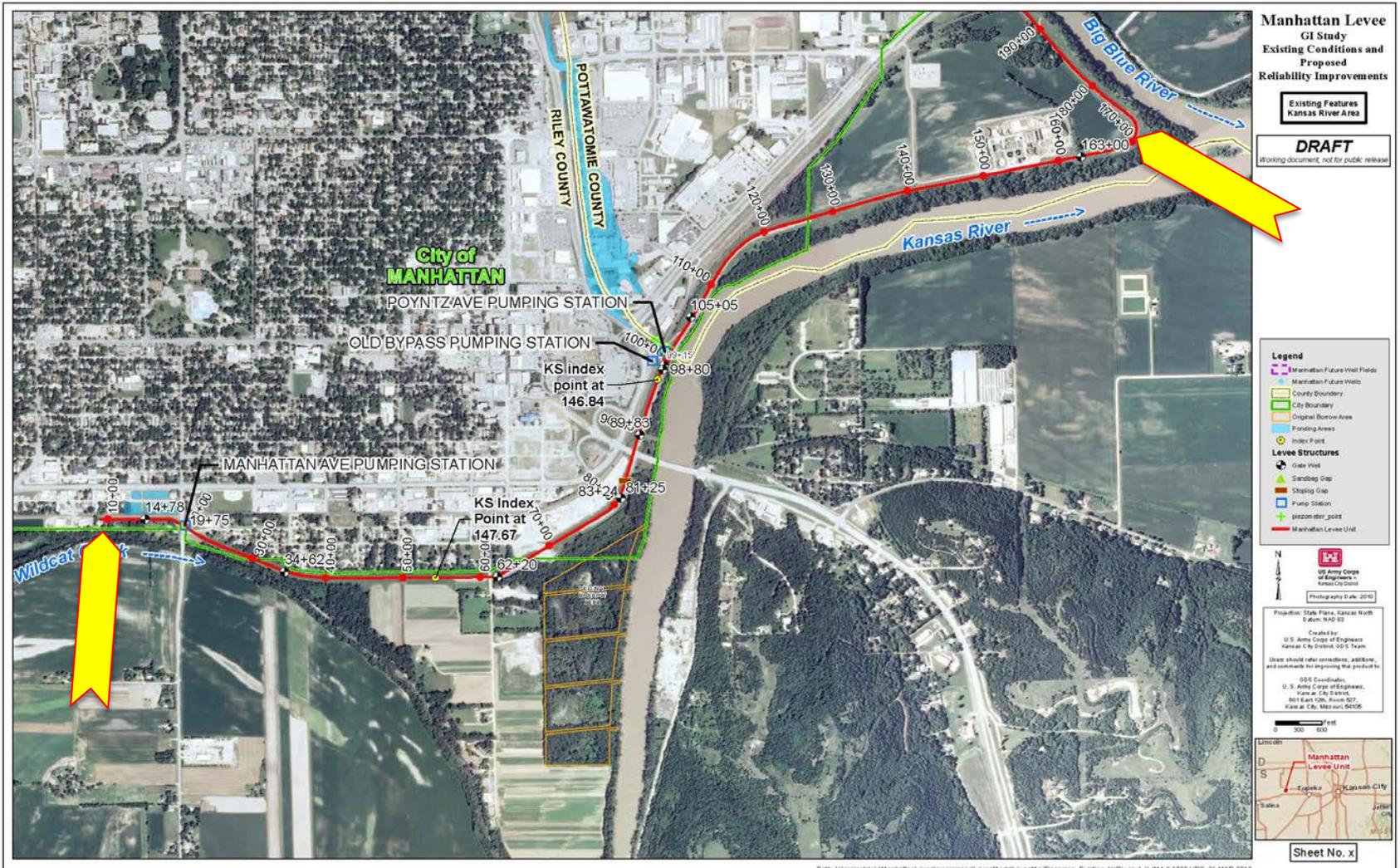
Kansas River flow

KANSAS CITY DISTRICT  
AERIAL VIEW SOUTHEAST, SHOWING INUNDATION OF THE SOUTH PORTION OF THE CITY OF MANHATTAN, KANSAS DURING THE FLOOD OF JULY 1951. THE GRIFFITH STADIUM IS SHOWN AT RIGHT OF CENTER OF PHOTOGRAPH. CONSTRUCTION OF LEVEES, FLOODWALLS, PUMPING PLANTS AND RIVER CHANNEL IMPROVEMENTS AT MANHATTAN, AND UPSTREAM RESERVOIR CONTROL, IS PROPOSED TO PREVENT FLOODS OF THIS TYPE.



# Manhattan Levee – Big Blue Segment

# Manhattan Levee – Kansas River Segment



INCLUDES PRELIMINARY INFORMATION  
17Apr13

# Why is the Corps Reviewing the Manhattan Levee ?

- Long history of Corps involvement in/around study area. The Corps' Tuttle Creek Lake is just 8 mi. upstream on Big Blue River.
- The existing levee withstood the 1993 Flood (**60,000 cfs** on Big Blue R and peak flows of 100,000 cfs on the Kansas R.)... BUT releases from Tuttle Creek Dam caused overtopping threat on Big Blue River
- **The 1993 event raised concerns that the levee does not provide the design level of performance**
  - ▶ **The levee was originally designed for a 110,000 cfs release from Tuttle Creek Reservoir plus 2 feet of freeboard, w/ 220,000 on the KS River + freeboard**
- This situation led to a request from the City of Manhattan for Corps assistance - to study the problem and prepare a report.



# Brief Study Background

- **Section 216 of the 1970 Flood Control Act** authorizes the Corps of Engineers to review previously completed Civil Works projects for beneficial improvements.
- Reconnaissance study was completed in 2004, and this feasibility study was initiated in 2005.
- Ongoing feasibility study effort includes the preliminary engineering efforts, plan formulation of project alternatives, economic evaluations, real estate studies and an environmental assessments of any proposed action
- The study is protracted due to incremental annual funding
- The City is a 50-50 cost sharing partner in the study



# Results of Feasibility Analysis

- **The levee held in 1993 BUT...**
  - **Serious concerns remained about early overtopping on the Big Blue segment at less than original design flow. Study results verify these early overtopping concerns.**
- **We examined existing geotechnical and structural reliability under various simulated flood conditions → some levee features need strengthening**
- Density of protected area development has increased substantially since 1993 and continues to increase. Thus higher consequence and damages if the levee were to fail or overtop today as compared to when originally constructed.



# Study Objectives

1. Adequately evaluate the current reliability and performance of the existing Manhattan levee unit,
2. Provide planning support and assist the City of Manhattan in effectively managing flood risk to include development of nonstructural and structural risk management measures and associated plans,
3. Formulate plans for increasing the existing Manhattan levee unit reliability & capacity through an appropriate combination of engineering measures... *And if such plans are deemed feasible and in the Federal Interest, then evaluate & select an appropriate plan, and*
4. Develop the decision documents necessary to seek project authorization from Congress & implementation funding.



# Manhattan Levee Station 160+00 *(typical existing segment)*



**Kansas River** view from Hwy 177 into downtown in 1993 Flood... Note that the Kansas River was not very high on the levee and was not in imminent danger of overtopping.



**1993 flood**

**Kansas River 100,000cfs**



# Big Blue River Flooding into Dix Subdivision -- located in unprotected northern part of City during 1993 flood.

**1993 flood**

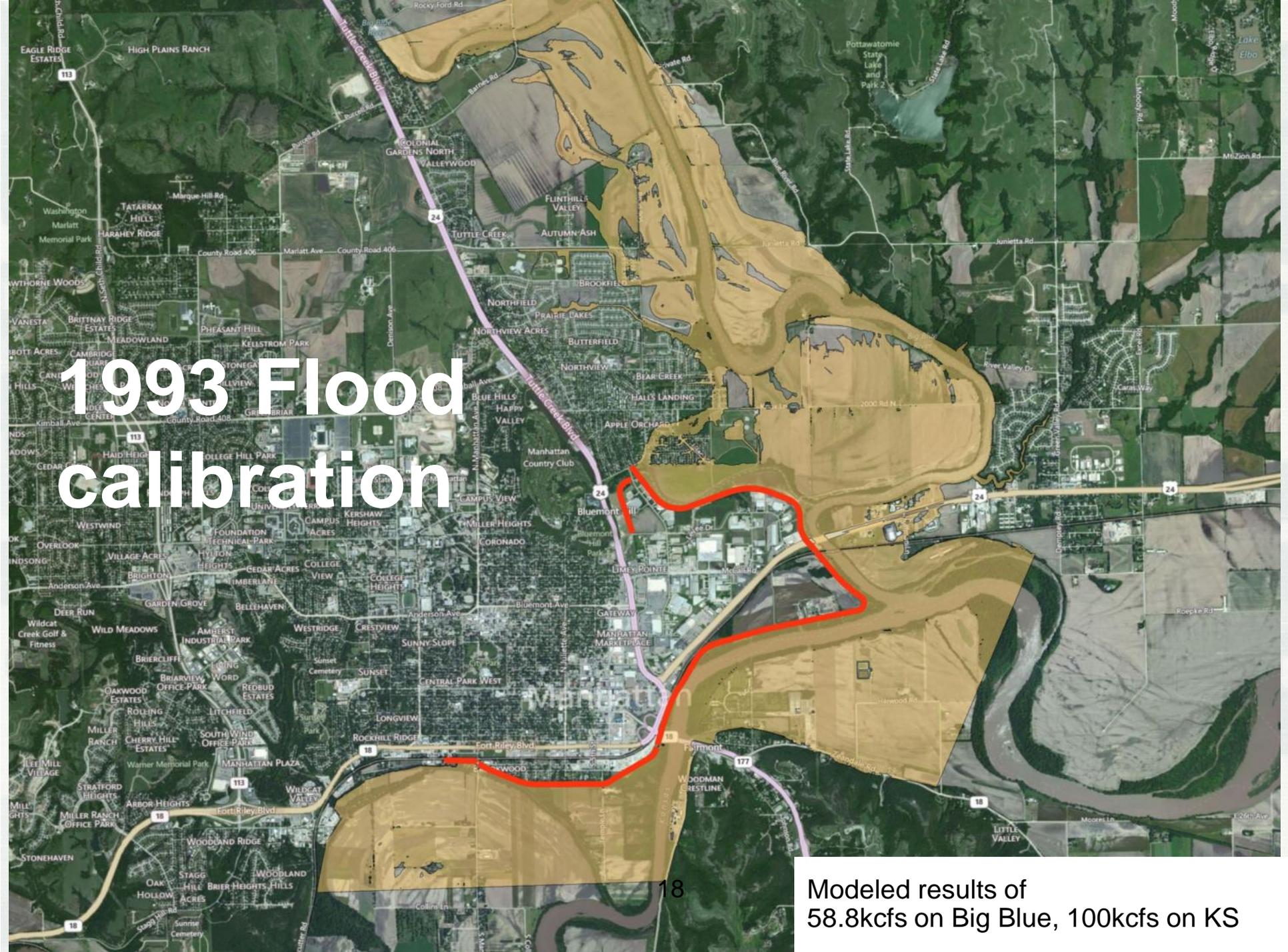


*The levee is just out of view to the left of foreground.*

**Big Blue 60,000cfs**



# 1993 Flood calibration



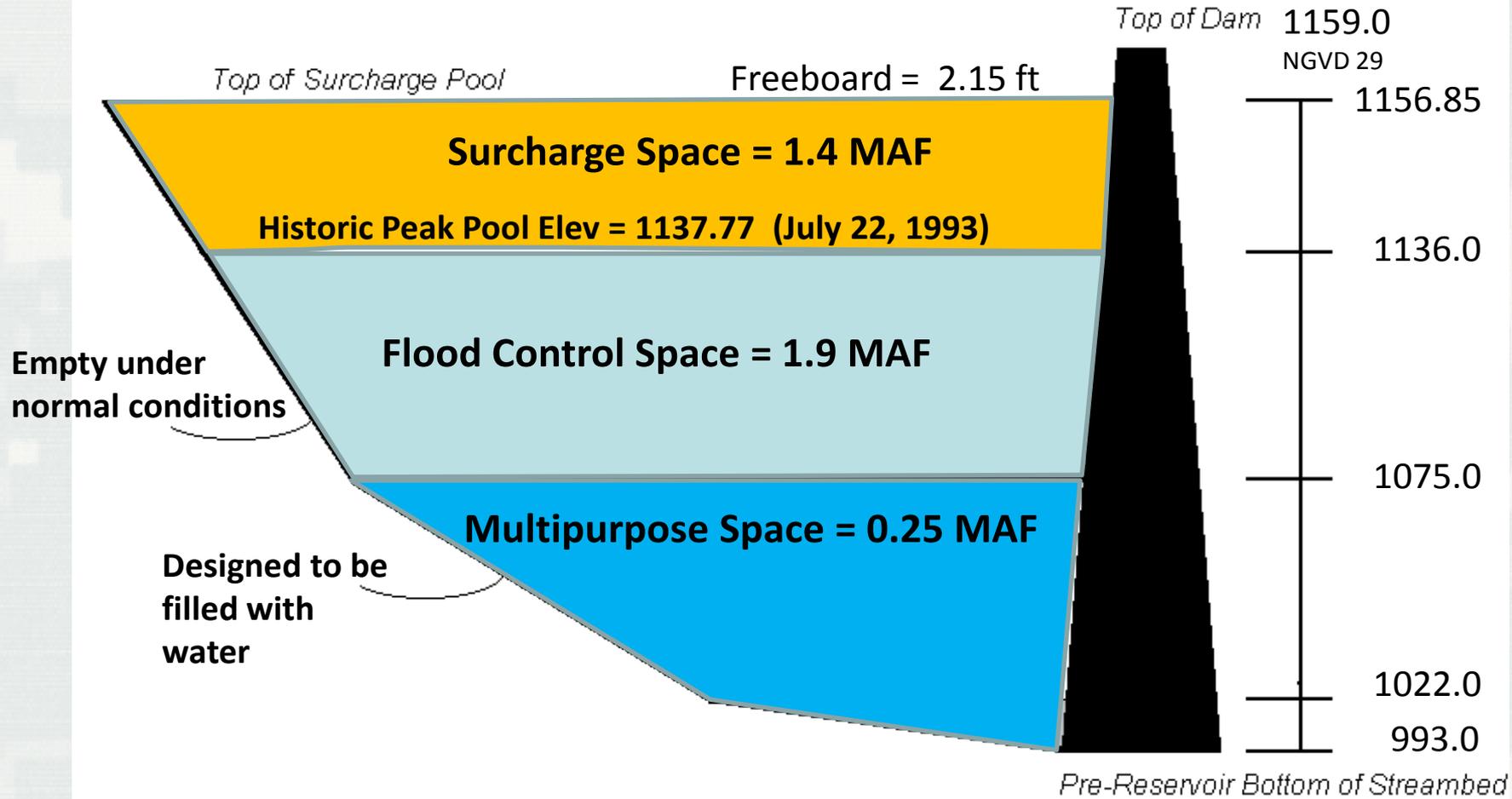
Modeled results of 58.8kcfcs on Big Blue, 100kcfcs on KS

# **Tuttle Creek Lake & Water Management**

## **(Brian McNulty)**



# Tuttle Creek Lake Pool Allocations



# How is Tuttle Creek Operated?

*Part of the Missouri River flood control system*

- **Flood Control Operations (up to 1136.0 feet msl)**
  - ▶ Tuttle Creek releases are administered by the Corps.
  - ▶ Release based on flow targets on the Kansas and Missouri Rivers, current pool elevation, and amount of water entering reservoir, space available in receiving stream
  - ▶ Corps evaluates these factors, determines release rate, and operates gates to release water
  - ▶ As long as there is space available in the lake and flooding is occurring downstream, lake stores flood water

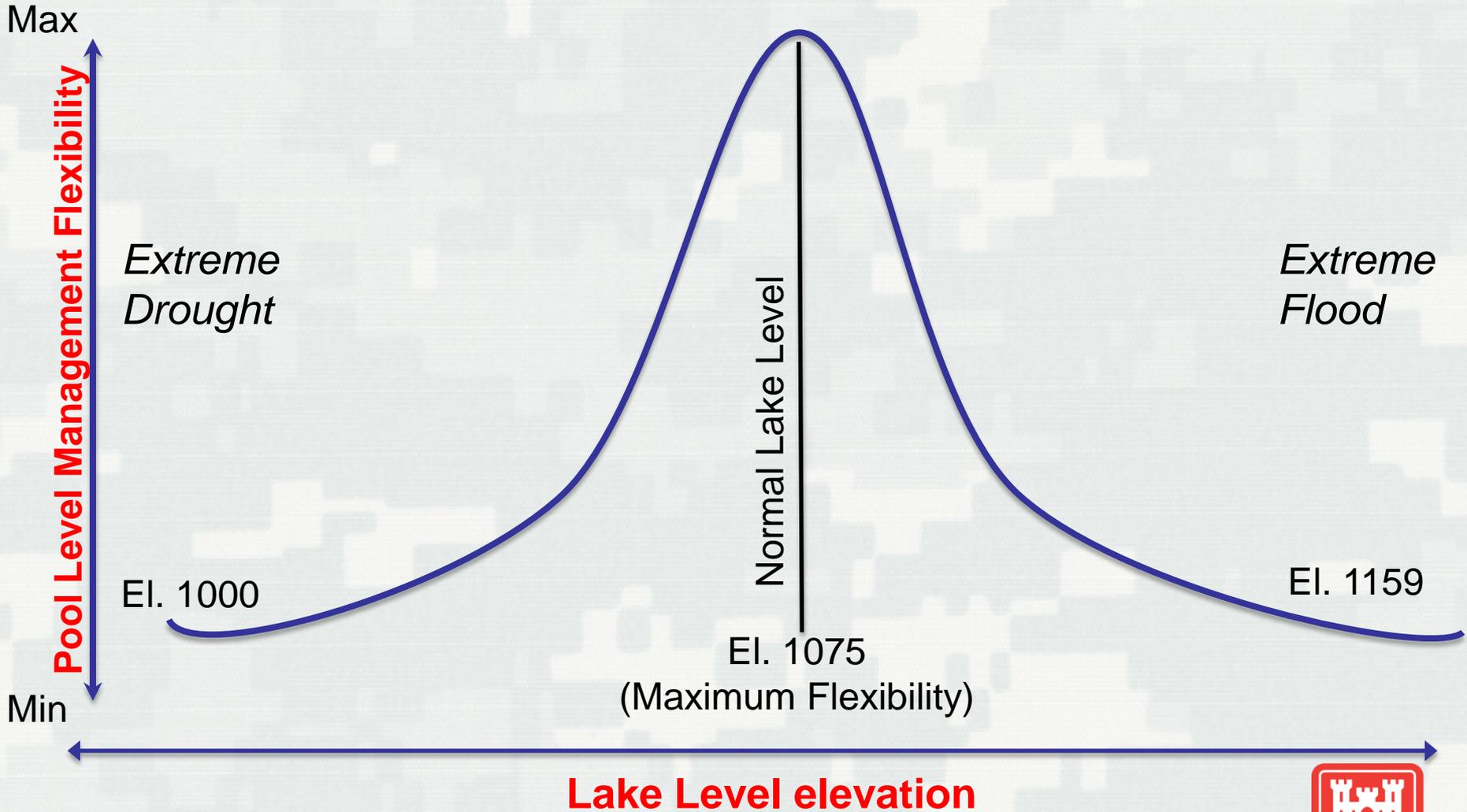


# How is Tuttle Creek Operated?

- **Surcharge Operation** (>1136.0 feet msl)
  - ▶ Flood control balances upstream and downstream flood risk
  - ▶ **Emphasizes preservation of structure**
  - ▶ Releases are determined by current pool elevation, and amount of water entering reservoir; **downstream channel condition is irrelevant**
  - ▶ **Surcharge** = to fill or load to excess... temporary abnormal lake condition intended to buffer the amount of water going to the spillway



# Tuttle Creek Lake Water Release Flexibility



# Plan Formulation



# Evaluation of Alternative Measures

- *In the case of Manhattan Levee, levee raises look like cost effective measures to improve reliability, safety and the level of flood protection*
- *Other measures considered necessary are foundation, structural and improved underseepage control*
- *Continued public outreach and flood risk awareness & preparation is needed*



# Preliminary Levee Raise Alternatives – Cost Estimate Summary

<b>N200+0 levee raise:</b>	<b>\$17 million</b>
<b>N300+0 levee raise:</b>	<b>\$18 million</b>
<b>N500+0 levee raise:</b>	<b>\$39 million</b>
<b>N300+0 + Channel Widening</b>	<b>\$30 million</b>

## Notes:

Costs are preliminary estimates at this point

Contingency costs are included in cost estimates

Costs presented in 2013 dollars



# Example Details: Alternative N300+0

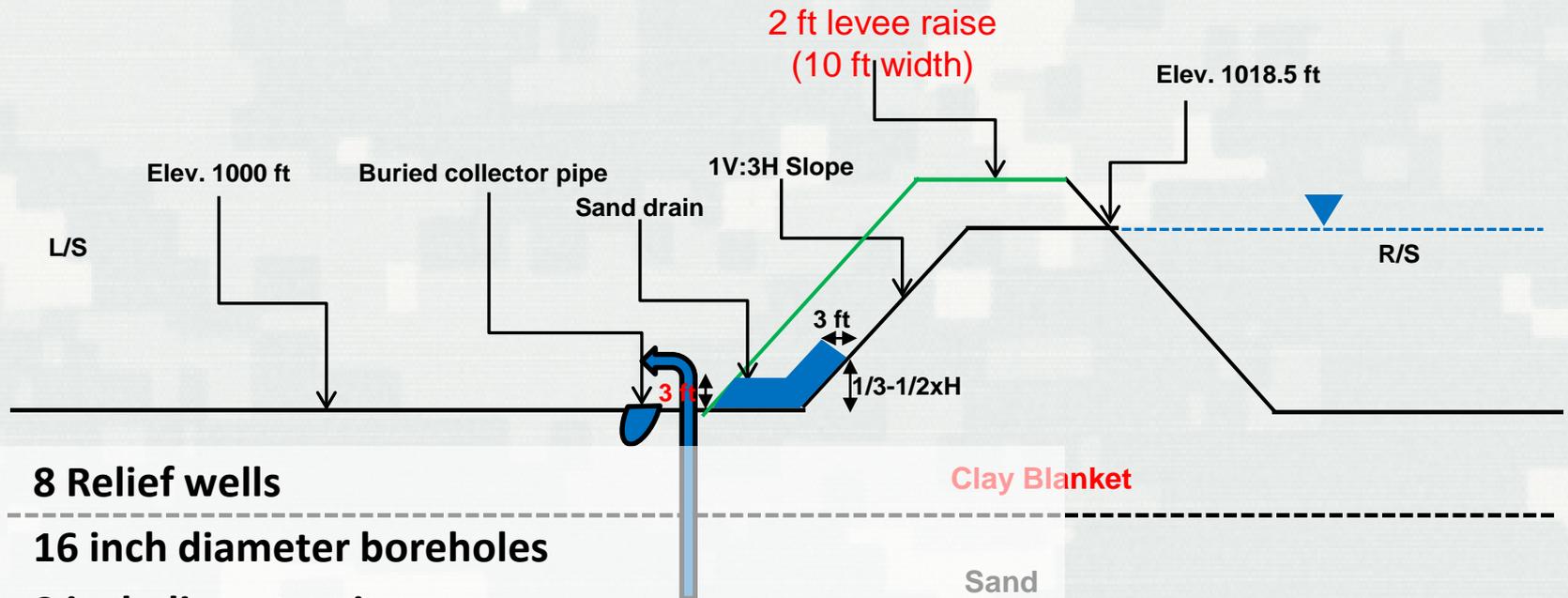
- N300+0: nominal 300 year levee raise with zero freeboard
  - ▶ **N300+0 raise averages 1.5-ft high and affects mostly the Big Blue River levee segment.**
  - ▶ Up to 3.3-ft raise in some locations
  - ▶ 440-ft Casement road raise to tie into high ground
- Geotechnical considerations: expanded footprint, slope stability & underseepage control needed
- Structural considerations: Replace gatewells at Sta. 14+78, 62+20, 89+83, 163+00, and 269+50. Temporary ring levees during construction (riverside) for each replacement
- Civil design considerations
  - ▶ Utility uplift/floatation measures & relocations
  - ▶ Borrow area locations

**CONCEPT**



# Typical levee raise and relief well measures

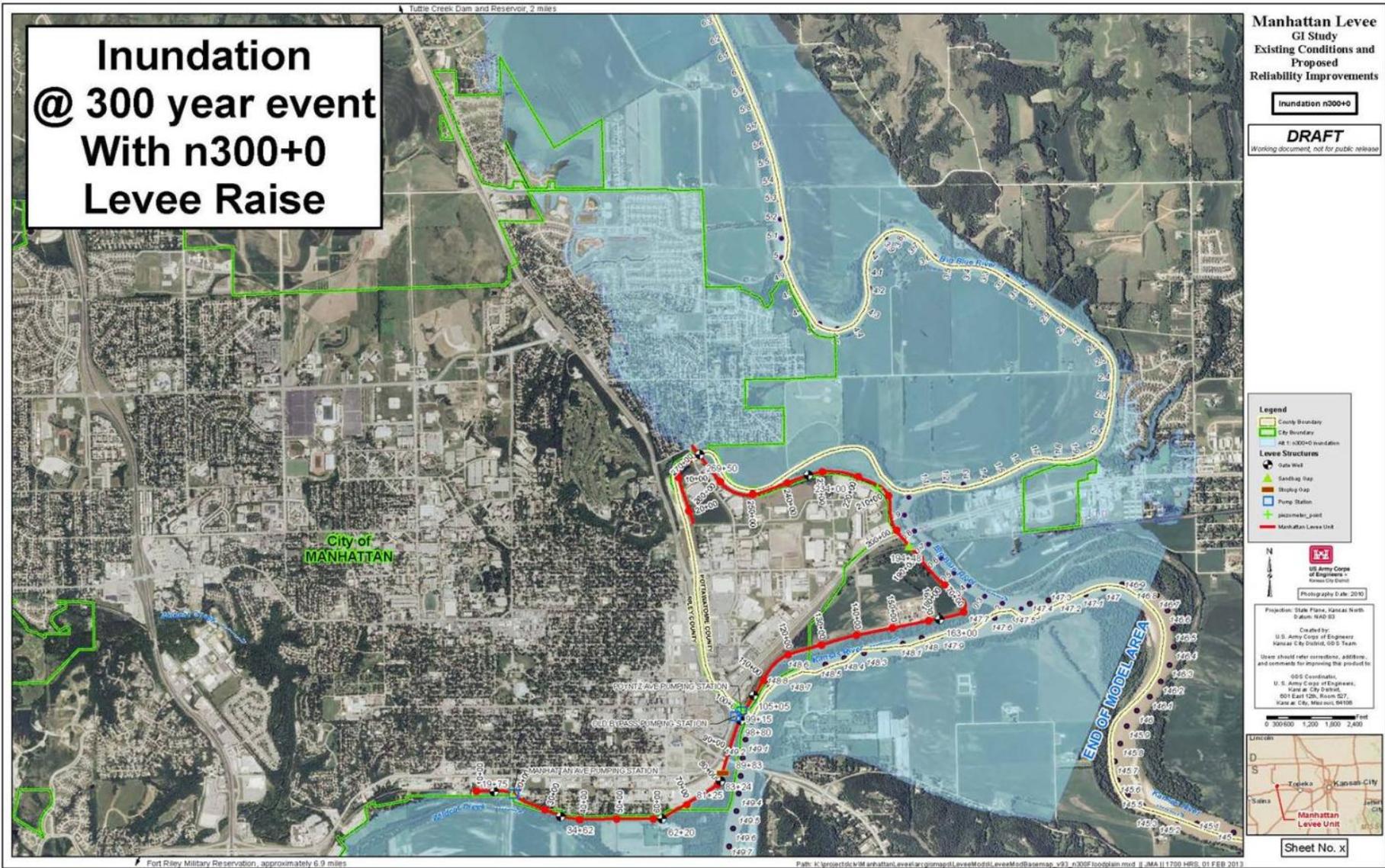
## Example N300+0 Station 265+70 to 269+50



- 8 Relief wells
- 16 inch diameter boreholes
- 8 inch diameter riser screens
- Fully penetrating approx. 60 ft
- Strip top soil
- Strip 6 inch levee crest aggregate
- Place/compact levee fill, compact 6 in crest aggregate
- Construct sand drain

**CONCEPT**

# Inundation @ 300 year event With n300+0 Levee Raise



**Manhattan Levee  
GI Study  
Existing Conditions and  
Proposed  
Reliability Improvements**

**Inundation n300+0**

**DRAFT**

*Working document, not for public release*

- Legend**
- County Boundary
  - City Boundary
  - All 1:1000+0 Inundation
- Levee Structures**
- Gate Weir
  - Sandbag Gap
  - Sloping Gap
  - Pump Station
  - jacobuslevy\_pier
  - Manhattan Levee Unit

US Army Corps of Engineers  
Kansas City District  
Photography © Jan 2010

Projection: State Plane, Kansas North  
Datum: NAD 83

Created by:  
U.S. Army Corps of Engineers  
Kansas City District, GIS Team

Users should refer corrections, additions,  
and comments for Engineering the products.

GIS Coordinator:  
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Sheet No. x

## N300+0 Cost Summary

<b>Real Estate Lands &amp; Easements</b> (Includes 29 acres temporary/permanent easements & purchasing 20 acre borrow area)	<b>\$2M</b>
<b>Levee Raise &amp; Underseepage Solutions</b> (10,000 ft of 1.5 ft avg levee raise; 2,200 ft berms; 22,200 ft sand drains; & 43 relief wells)	<b>\$7M</b>
<b>Gatewell Replacements</b> (5 total. Each includes installing/removing ring levees to maintain levee of protection during construction.)	<b>\$6M</b>
<b>Utility Relocations</b> (Includes raising 11 manholes & 30 power poles, relocating 36" water line & 8" gas line, & 440 lf Casement Road Raise)	<b>\$3M</b>
<b>TOTAL</b>	<b>\$18M</b>



# Northern (Unprotected) Neighborhood Analysis

- Northern area was not protected by the original levee and remains unprotected at this time
- Density of northern area development is increasing -- City Public Works staff are monitoring future development plans
- Corps updated northern area floodplain modeling & mapping
- Study examined possibility for extending levee protection into northern area and found it economically unfeasible per Corps guidelines for Federal Civil Works projects.
- More coordination of emergency planning as study proceeds
- A new Corps “Silver Jackets” process is proposed to increase public awareness of flood risk, planning and preparation



# Path Forward



# Environmental & Social Considerations

- Planning for an environmentally / socially acceptable project with minimal impacts that is consistent with project objectives.
- We will solicit input from the appropriate state and Federal resource agencies, local agencies and the public at large.
- Construction footprint of any proposed improvements are expected to be small, little change to the existing land uses.
- Any proposed project will have minimal increased operation and maintenance requirements compared to existing levee.
- Report includes an Environmental Assessment
- No perceptible increases in flooding on unprotected areas from a levee raise alternative



# Manhattan Levee Project Implementation Timeline



*Timeline will vary depending on Congressional Authorization and availability of Federal & Local funds*

*Cost sharing for implementation is 65% Federal, 35% local, with credits for lands and easements toward the local share*



**INCLUDES PRELIMINARY INFORMATION**

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# Open House

