City of Parkville, Missouri Flood Protection Study

December2013

US Army Corps of Engineers

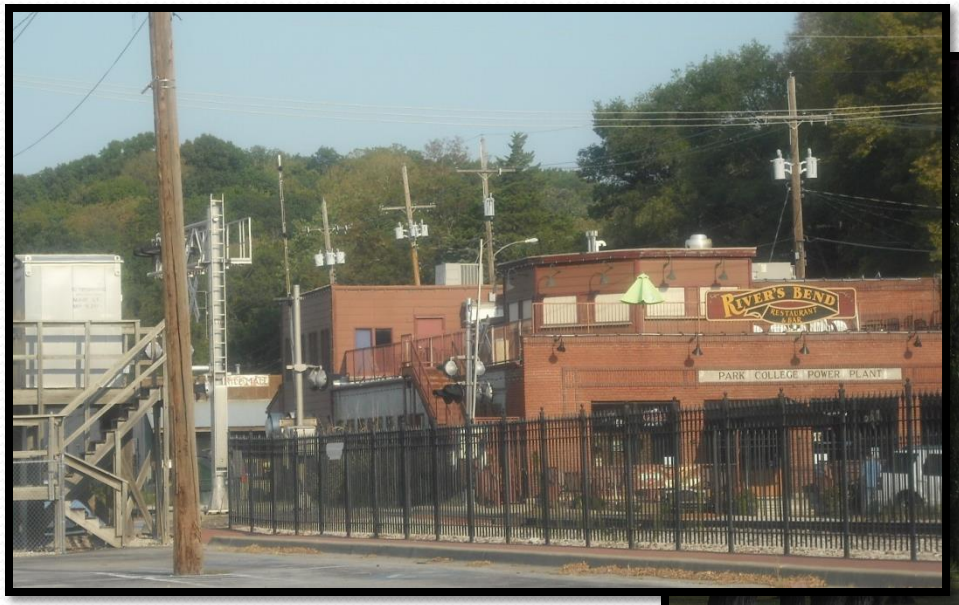
CDM Smith

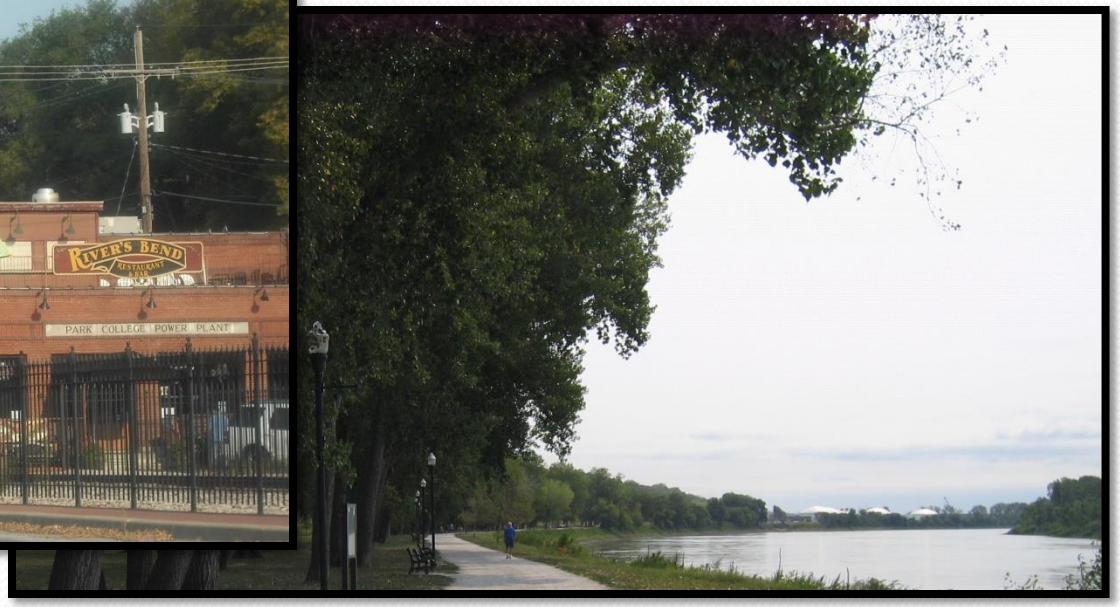
Study Authority: Planning Assistance to States (PAS) Program, Section 22 of the Water Resources Development Act (WRDA) of 1974

- Planning program for water resources planning – can address diversity of water related issues including flood risk
- Cost sharing 50% Federal, 50% Local Sponsor:
  This study: $50,000 total cost; $25,000 City, $25,000 Corps
- For comparison of potential solutions and preparation of plans, not for construction assistance
- This study focused on addressing flood threat to Parkville's Historic Downtown and English Landing Park

Objectives of the Study:

- Evaluate alternatives for ***integrated***, ***cost efficient***, and ***effective*** flood protection for
  - Historic Downtown Business District
  - English Landing Park





Tasks To Achieve the Objectives:

- Evaluation of traditional and innovative / temporary flood protection systems available & applicable
- Evaluated flood protection systems for use in the Historic Downtown Business District
- Evaluated flood protection options for English Landing Park lower cost, less risk, but more frequently flooded, less warning time

Evaluation Criteria for Alternatives

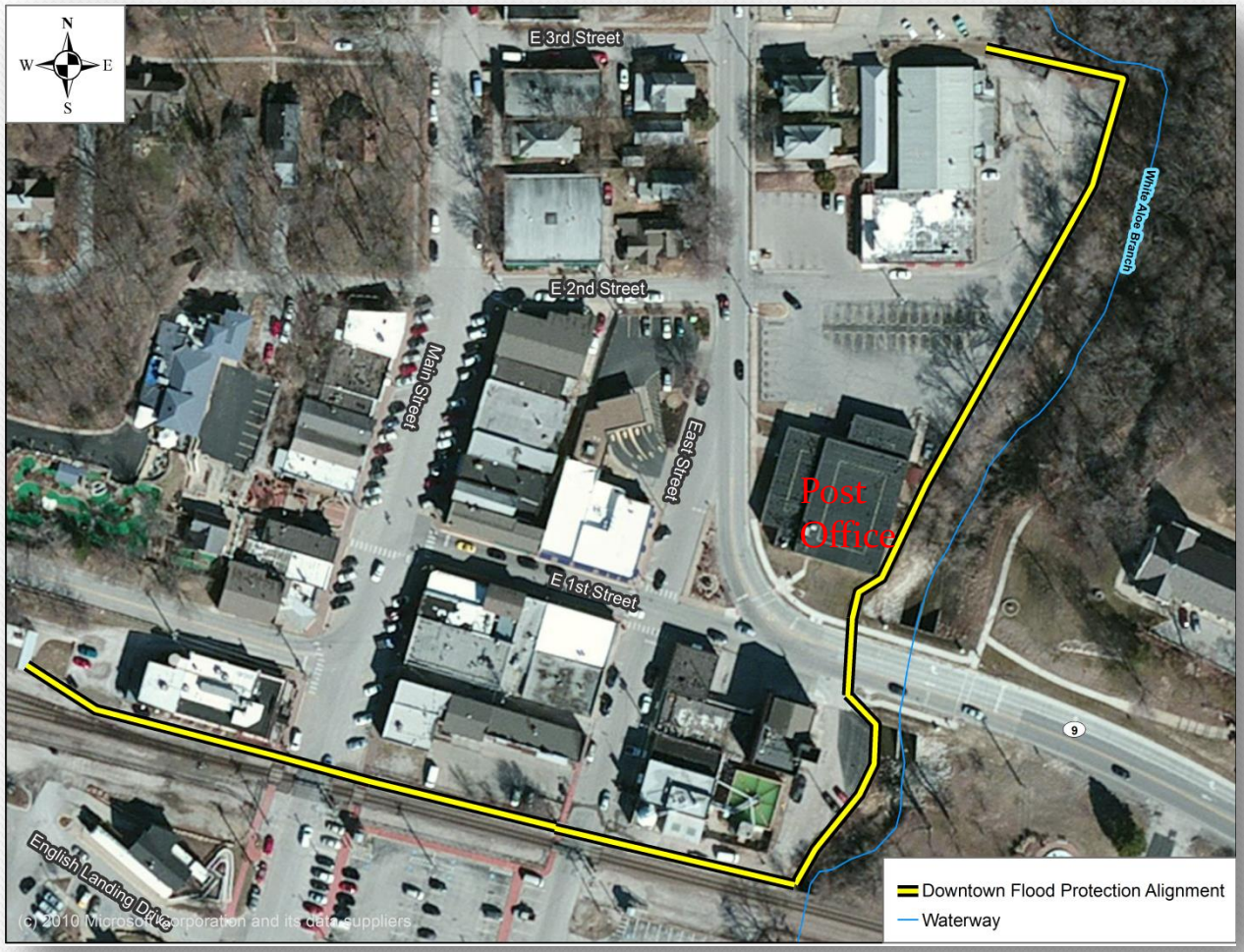
- Effectiveness
  - Response time: time to set up the system (how much warning time is needed)
  - Function of the system during extended flood events (durability)
- Constructability
  - Labor requirements for installation (ease of constructability)
  - Special equipment requirements for installation
- Affordability
  - Cost of system per linear foot of alignment
  - Initial and recurring costs
- Alignment Constraints
  - Foundation requirements
  - Available area for installation (width and height)
  - Existing utility impacts
- Maintenance and storage
  - Inspection and maintenance requirements during extended flood conditions
  - Maintenance requirements during non- and post flood conditions
- Review of Federal Design Standards

Flood Protection for Historic Downtown

Preliminary Planning Criteria:

- Desired horizontal alignment based on 2011 Flood Port-a-Dam construction
- Desired vertical level of protection
  - 1% Chance or 100 Year Flood Event = Elevation 760 feet
  - Plus Required Freeboard: 3-4 feet
  - Approximate Height Above Existing Ground: 7.5 to 10 feet
  - 1993 Flood = 764.5 feet, a protection level not evaluated - much more costly & less technically feasible
- Limited clearance available in places (8 feet at the Post Office)

Flood Protection Alignment for Downtown



Evaluation of Flood Protection Systems

Concrete Floodwall

Fabric Membrane Dam Flood Protection (Photo Source: Port-a-dam)

Water-Inflated Tubes at Testing Grounds (Photo Source: US Flood Control Corporation)

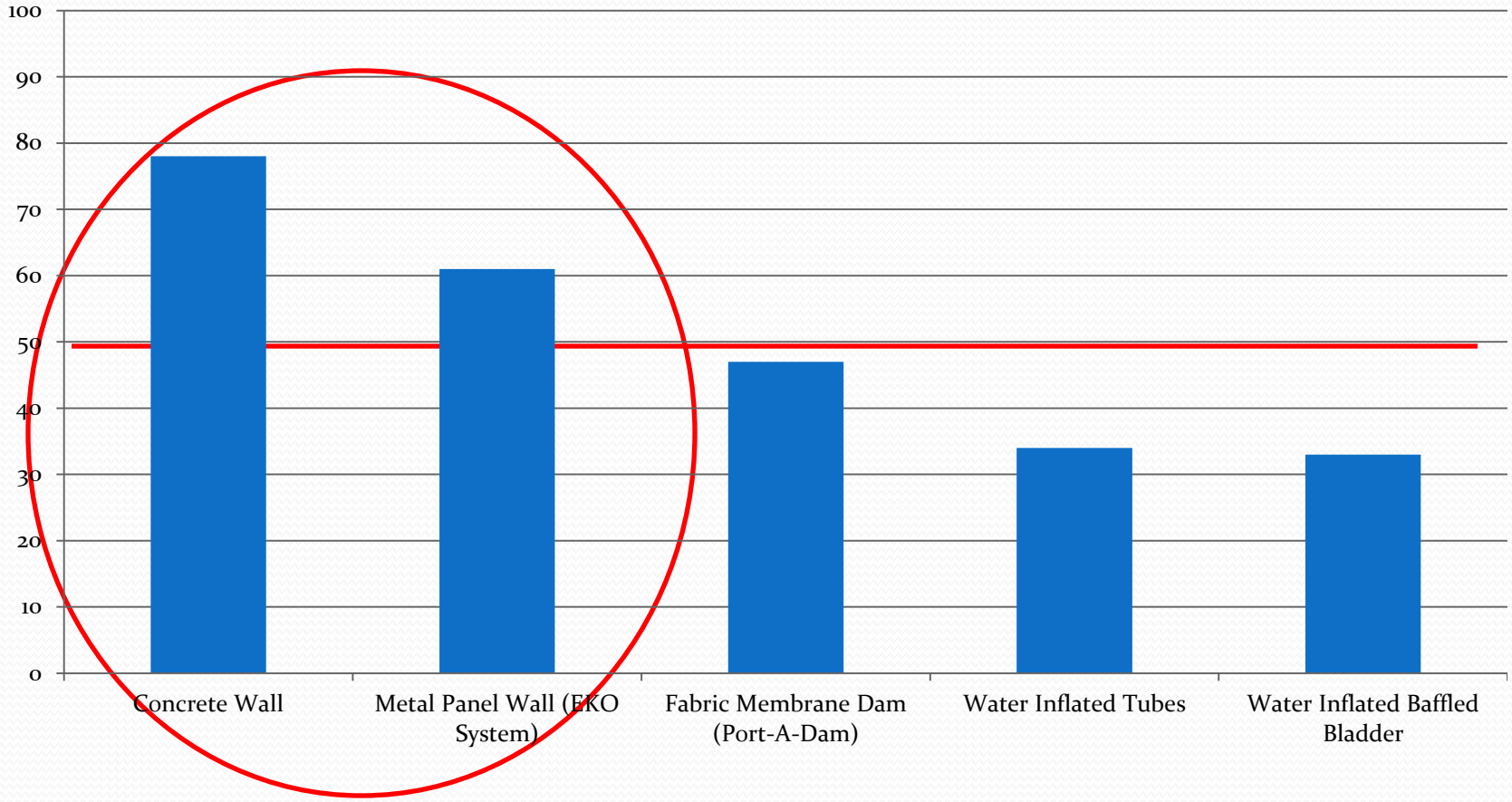
Metal Panel Flood Protection (Photo Source: EKO Flood Systems USA, LLC)

Water-Inflated Baffled Bladder (Photo Source: Hydrological Solutions, Inc.)

Evaluation of Flood Protection for Downtown Parkville

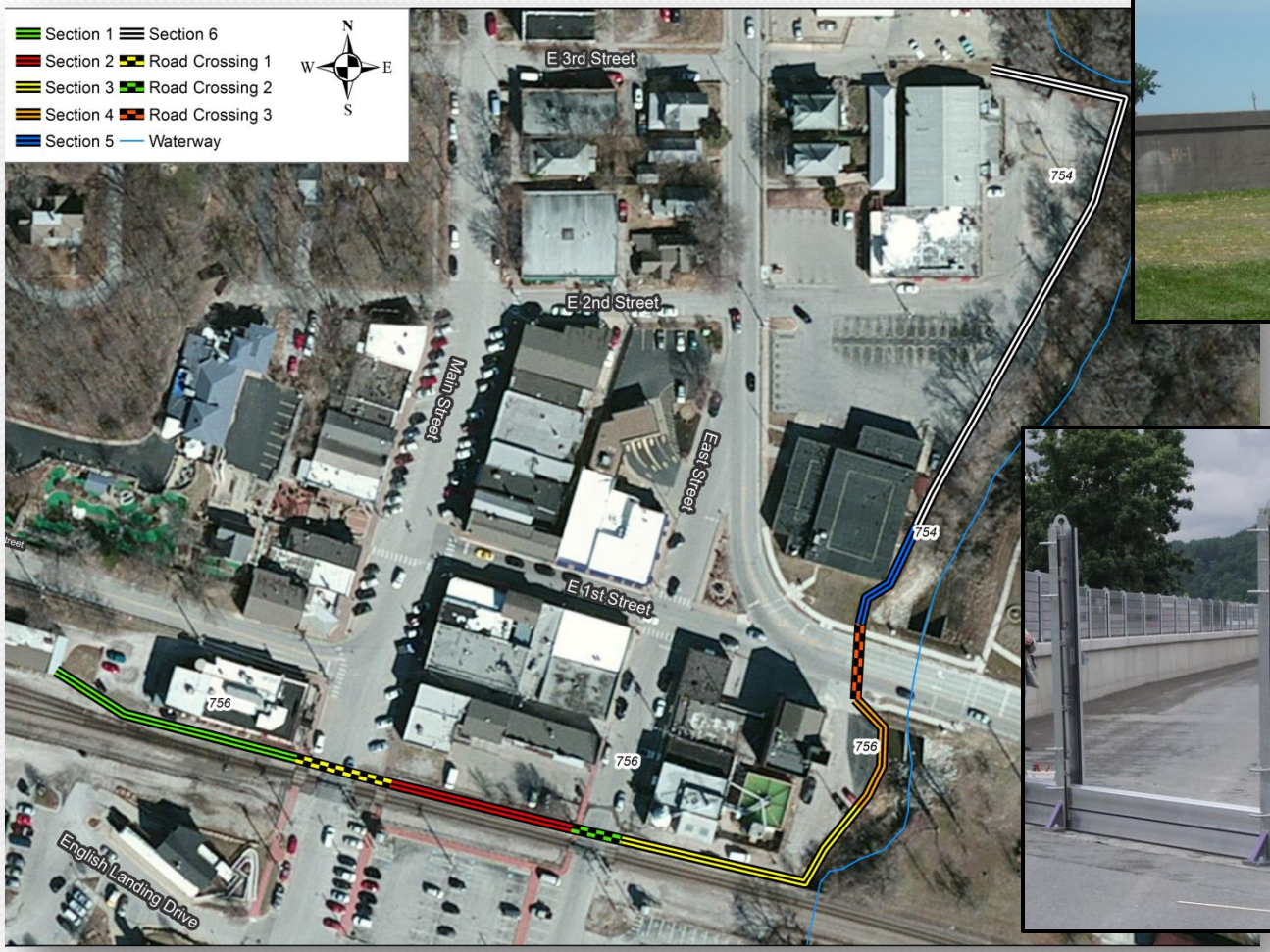
Evaluation Criteria	Concrete Wall	Metal Panel Wall (EKO System)	Fabric Membrane Dam (Port-A-Dam)	Water Inflated Tubes	Water Inflated Baffled Bladder
Response Time	None	Low	Med	High	High
Durability	Very High	High	Med	Low	Low
Constructability Issues During Flood Response	Low	Low	High	High	High
Special Equipment for Installation	None	Med	Med	High	High
Foundation Requirements	Yes	Yes	No	No	No
Width Requirements	Min	Min	Min	Cannot achieve min width	Cannot achieve min width
Maintenance requirements	Med	Med	High	High	High
Storage requirements	None	Yes	Yes	Yes	Yes
Affordability - cost per linear feet @ 8 feet	$800	$770	$720	$600	NA (Can't achieve 8 feet)

Flood Protection for Historic Downtown



Most effective flood protection is concrete wall and metal panel wall

Recommendation – Concrete Wall with Metal Panel Closures



(Photo Source: EKO Flood Systems USA, LLC)

Recommendation for Historic Downtown Flood Protection – Concrete Wall w/ Metal Panel Barrier At Road Crossings

What could this look like?

PARKING
TO
FF

PARKING
TO
FF

Cost Estimate for Recommend Option – Concrete Wall with Metal Panel Closures

Description	Estimated Cost
Permanent Flood Protection (Concrete Floodwall)	$1,091,000
Gate/Road Crossings (Metal Panels w/footer)	$197,000
Subtotal Wall Construction	***$1,288,000***
Easement and Acquisition (5% of Construction Cost)	$65,000
Utility Modifications/Relocations (16% of Construction Cost)	$206,000
Local/State/Federal Permitting (5% of Construction Cost)	$65,000
Engineering Design, Borings, Surveys (25% of Construction Cost)	$321,000
Contingency (35% of Construction Cost)	$460,000
Subtotal Other Costs	***$1,117,000***
Total	**$2,405,000**

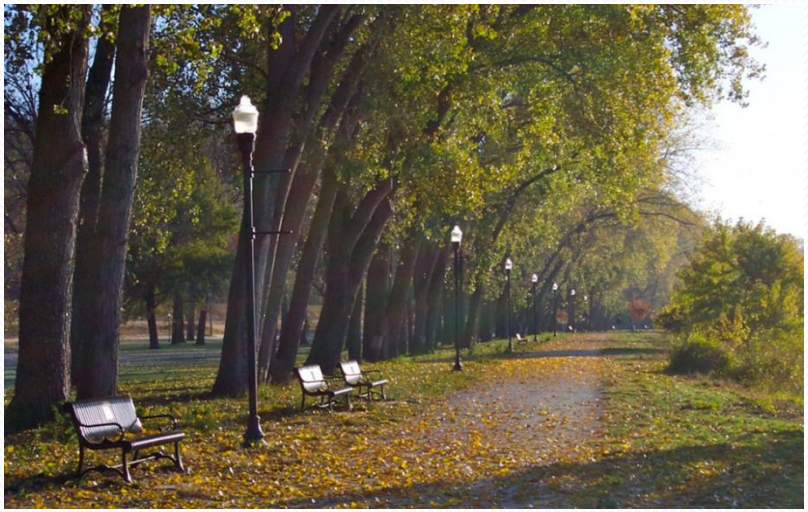
Note: *Conceptual level cost estimate. Actual cost could vary based on subsurface investigations, utilities, esthetics for concrete wall, & economy / bidding climate.* ***Does not include cost escalation to a future point of construction.***

Benefits of this Recommendation for Historic Downtown

- Limited annual maintenance
  - Annual inspections of concrete wall
  - Metal panels can be stacked and stored at existing facilities
- Installation
  - One-time construction for concrete wall & panel foundation
  - Limited time & staff needed for installation of metal panels prior to flooding
- Regulatory
  - Precedence to remove protected area from FEMA Floodplain
- Aesthetics
  - Could be made compatible with architectural historic features

English Landing Park Alternatives

- City's Goals for Study:
  - Provide better flood protection to the Park from frequent flooding and improve the trail
  - Retain existing mature trees where possible
  - Retain current trail alignment
  - Trail top width of 12 feet
  - Retain the Park's connection with the Missouri River (aesthetic view)
  - Evaluate a range of alternatives
  - Complete screening level analysis
  - Develop concept plan for improved trail and flood protection in Park



English Landing Park – Protected Area

Trail Raise / Flood Protection Alignment

Trail Raise / Flood Protection Alternatives

- **Raise Trail**
  - **Elevation 749 Feet** (Approx 3 foot ave. raise on most of trail)
  - **Elevation 752 Feet** (Approx 6 foot ave. raise on most of trail)

- **Temporary Protection: Water Filled Tubes**
  - **El. 749 Feet** (3 foot raise ave.)
  - **El. 752 Feet** (6 foot raise ave.)

- **No Action – Budget for Flood Clean-up Cost –** used average cost per year from City cost data - period 2007-11

Estimated Costs for Trail Raise Alternatives

Alternative	Description	Initial Cost	Annual Cost
No Action	Budget for Park Clean Up	$0	$230,000
Six-Foot Berm	Raise Trail Elevation to 752 feet	$1,820,000	$280,000
Temporary Flood Protection	~~3-foot High Water Filled Tubes~~	~~$270,000~~	~~$250,000~~
	~~6-foot High Water Filled Tubes~~	~~$520,000~~	~~$260,000~~
Three-Foot Berm	Raise Trail Elevation to 749 feet Contract Construction	$670,000	$260,000
	Raise Trail Elevation to 749 feet City Self Perform Construction	$510,000	$230,000

Conclusions:

- **No Action –** budget for park clean-up – used average cost per year with cost data from City for flooding in period 2007 - 2011
- **Raise to 752 Feet** - significant impact to river view, higher annual costs than No Action alternative, and safety concerns for trail users
- **Water Filled Tubes** – considered infeasible due to lack of water to park, potential for compromise by Missouri River flows
- **Raise to 749 Feet** – competitive with No Action alternative

(Assumed City cost 75% of contract for raise to 749 Feet, a 25% savings.)

Construction Segments for English Landing Park

White Aloe Berm Segment – El. 749

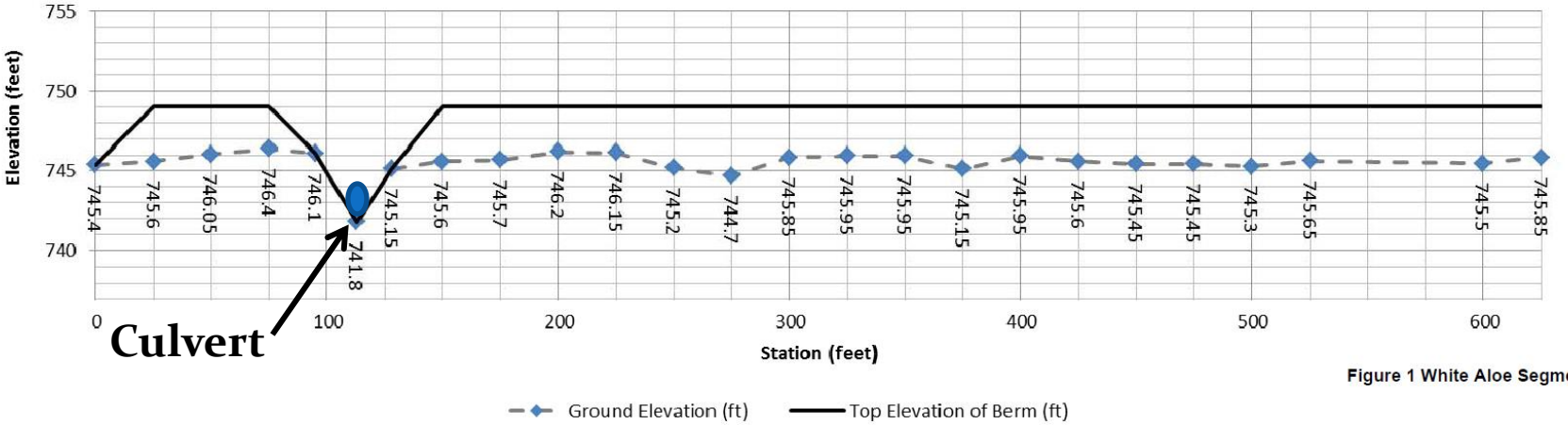


Figure 1 White Aloe Segment

Construction Considerations for White Aloe Segment El. 749

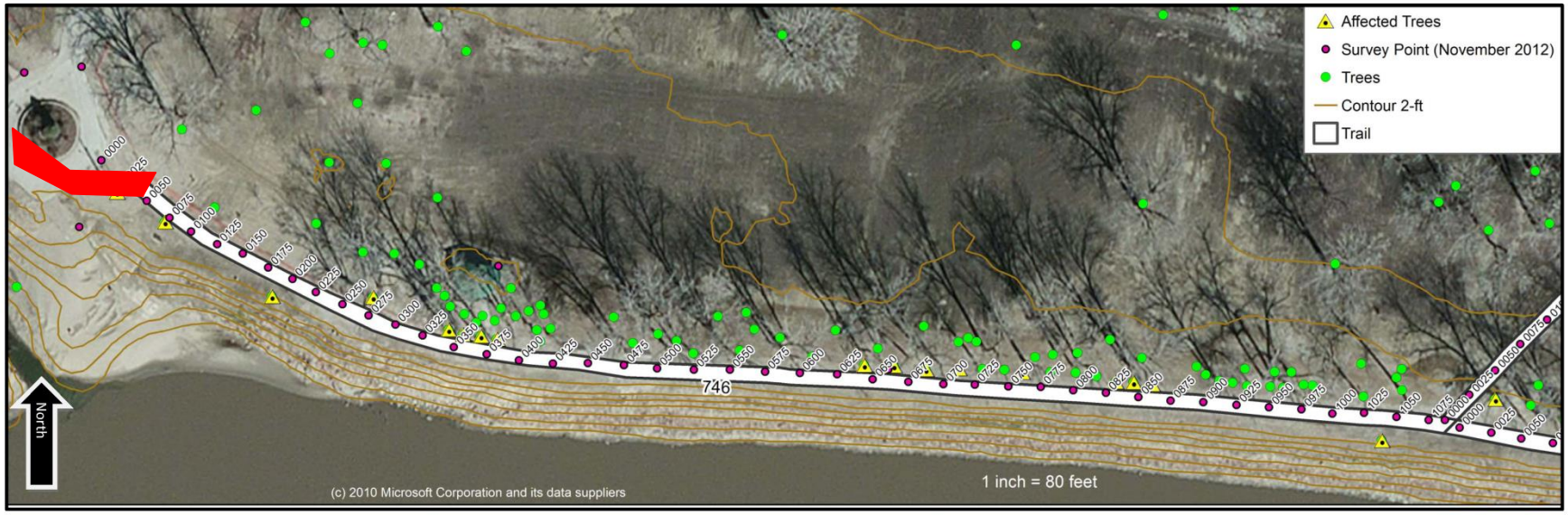
Construct a berm embankment adjacent to White Aloe with top elevation at 749 feet and top width of 10 feet,

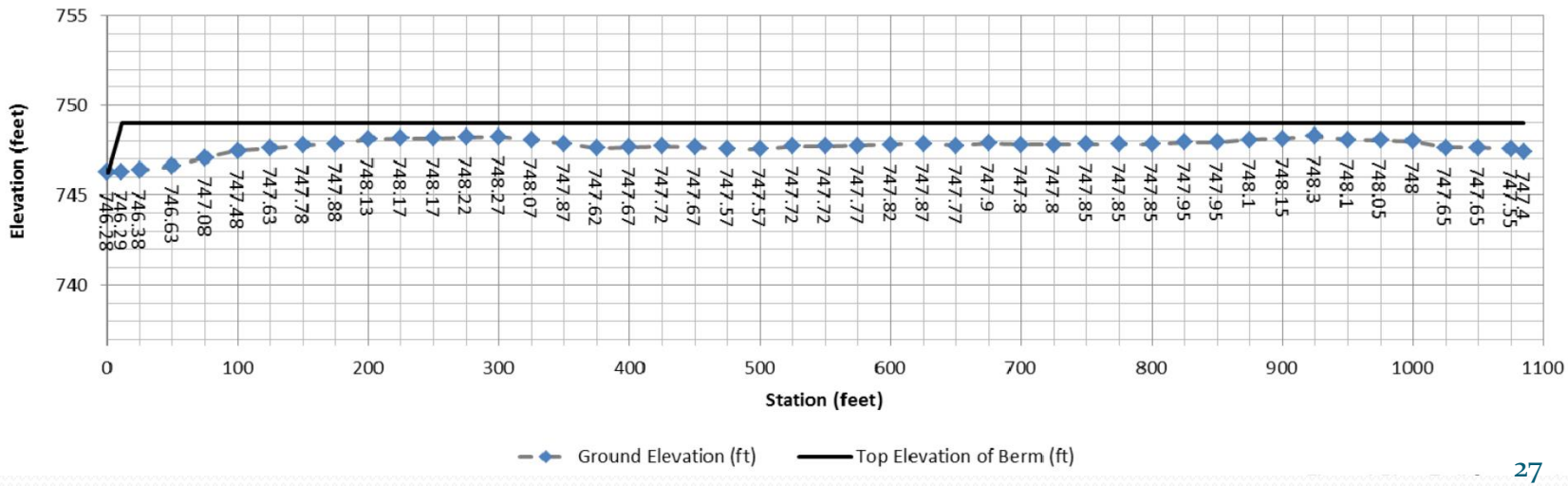
Considerations:

- Fill compacted to meet Corps' "Semi-compacted" Standards
- Vegetate to maintain stability
- Consult an arborist to determine fill allowable near trees and/or design requirements for tree protection
- Existing drainage must be maintained through the berm
- Park road lower than top of berm – **sandbag closure**

  & tie-in to high ground at Low Water Crossing / Public Restroom
- Inspect berm semi-annually for burrowing animals, sunken areas, and voluntary trees
- During high water monitor status during event

Trail Segment 1 – El. 749

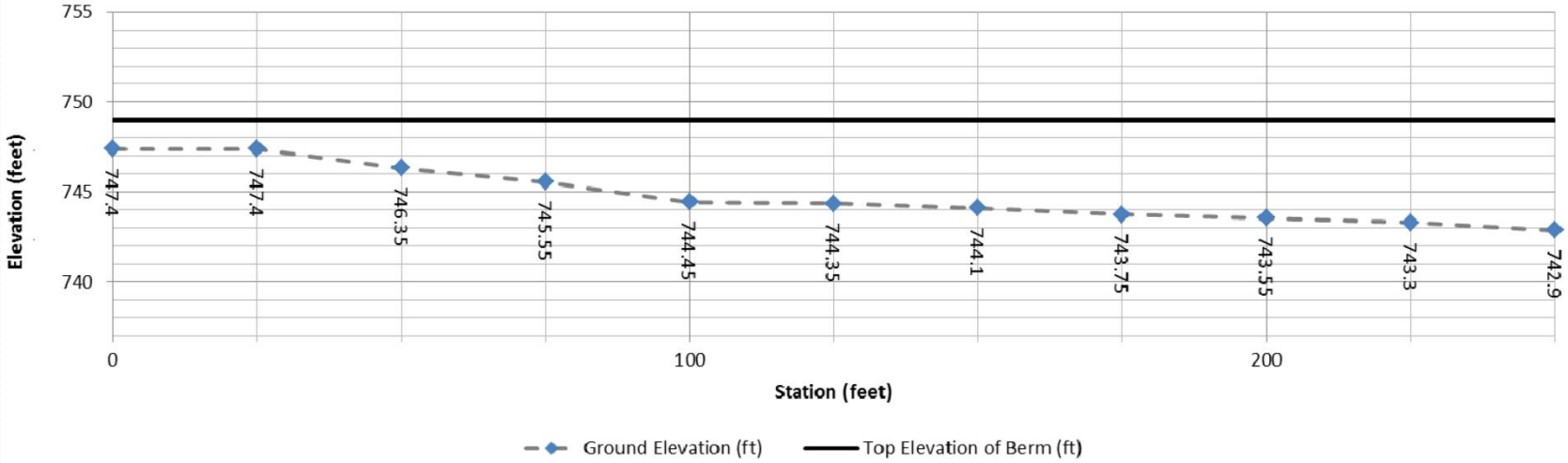




Trail Construction - Flood Protection El. 749

Assumed 12-foot wide trail + 2-foot shoulder dry side + 5-foot shoulder on wet side of berm - could modify these dimensions

Trail Segment 2A – El. 749



Trail Segment 2B – El. 749

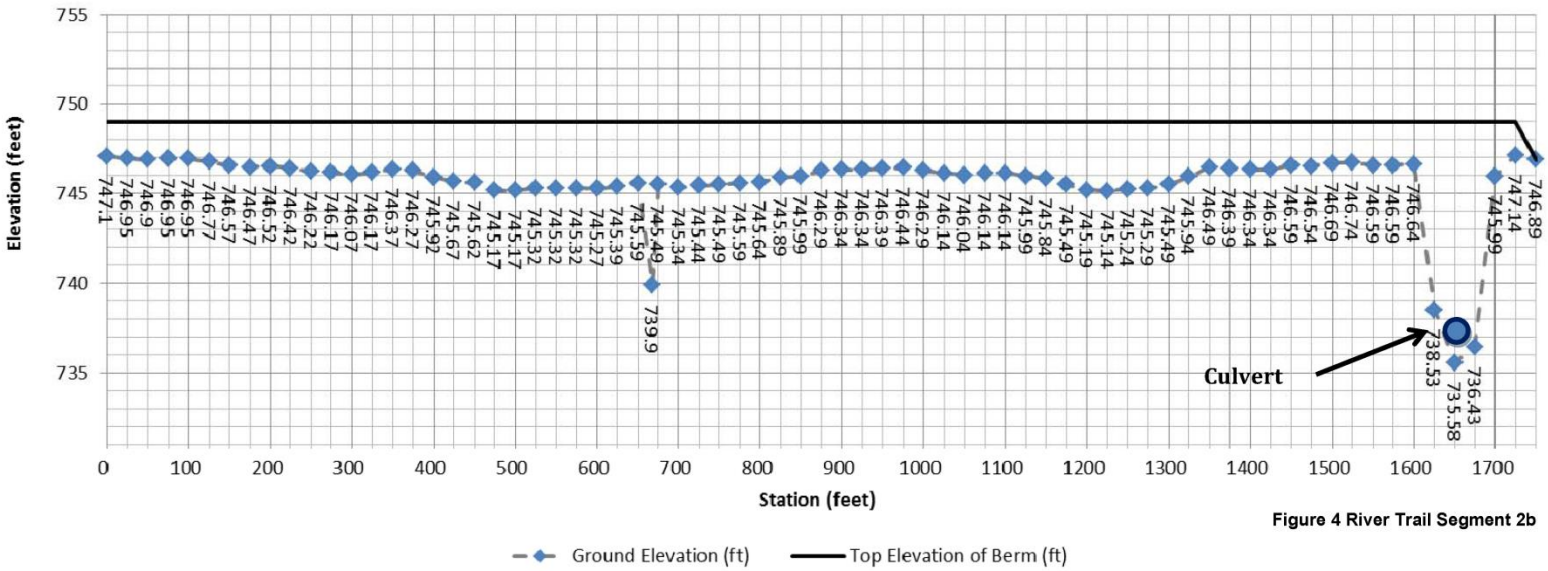


Figure 4 River Trail Segment 2b

Construction Considerations – Trail Segment 1, 2A & 2B

Raise existing trail to El. 749, maintain existing top width of 12 feet

Considerations:

- Fill compacted to meet Corps' "Semi-compacted" Standards
- Quality fill material, placed in 6 to 10-inch lifts
- **Optional:** Implement raises incrementally - more gradually as part of an annual trail maintenance program
- Consult an arborist to determine amount of fill allowable near trees and/or design for necessary tree protection
- Existing drainages will need to be maintained – culverts or pipes
- Existing boat ramp area & park road cul-de-sac lower than top of trail, **sandbag closure required during high water**
- **Segment 2A -** Highest at tie in to RR tracks embankment approx. 6 feet, permission from BNSF *may* be required
- During high water stages monitor status
- Post Flood Drainage – could be more difficult if trail overtops flooding the park

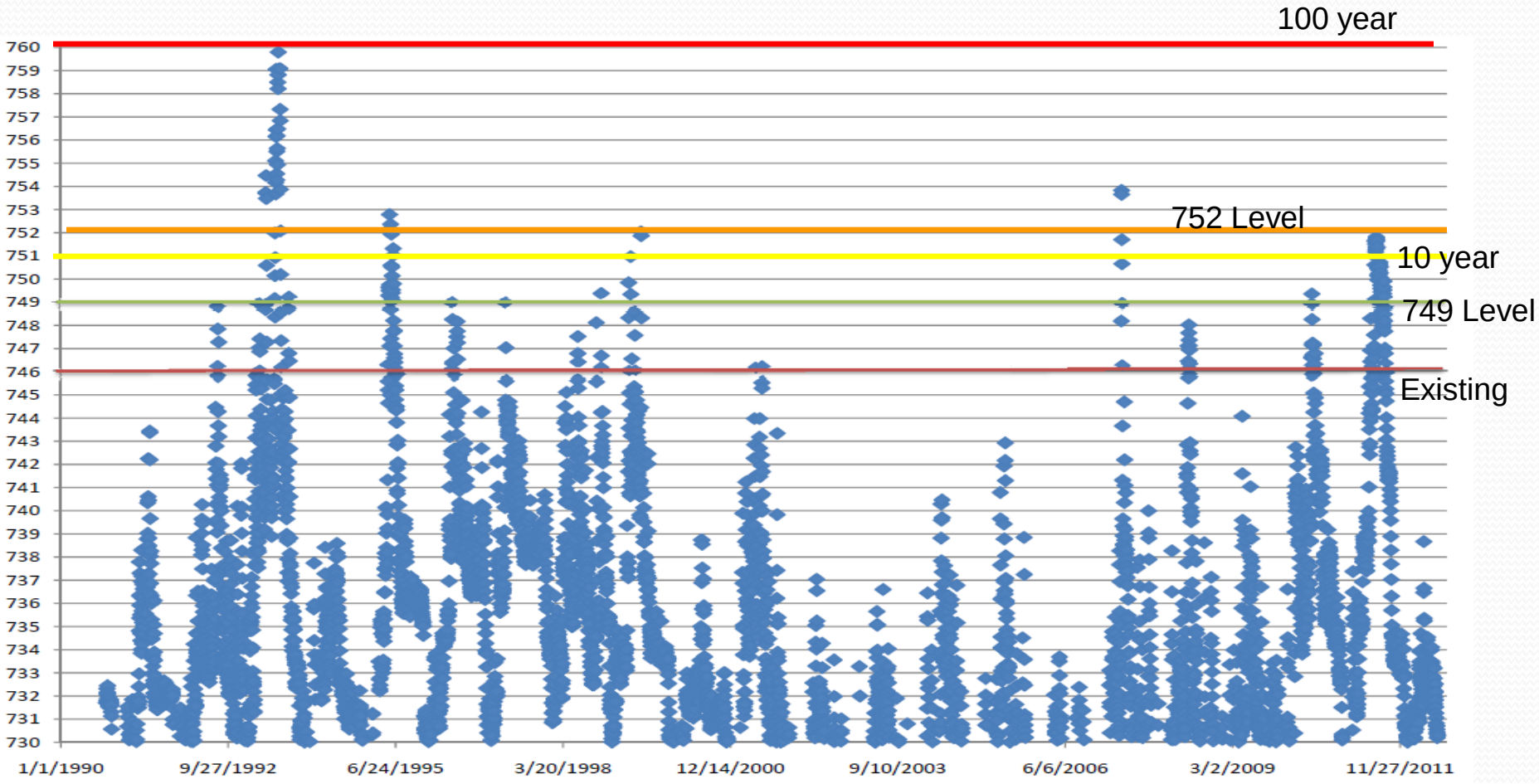
Material Quantities for El. 749 Protection - How Much Soil is Needed for the Raise?

Segment	Total Cubic Feet	Total Cubic Yards
White Aloe Segment	35,000	1,300
Trail Segment 1	22,000	815
Trail Segment 2A	29,000	1,075
Trail Segment 2B	152,000	5,630
Total with 2A	**86,000**	**3,185**
Total with 2B	**209,000**	**7,740**

This is estimated to require approximately 1,000 truckloads + or -

Historical Missouri River Water Levels

- 1993: 764.5 feet



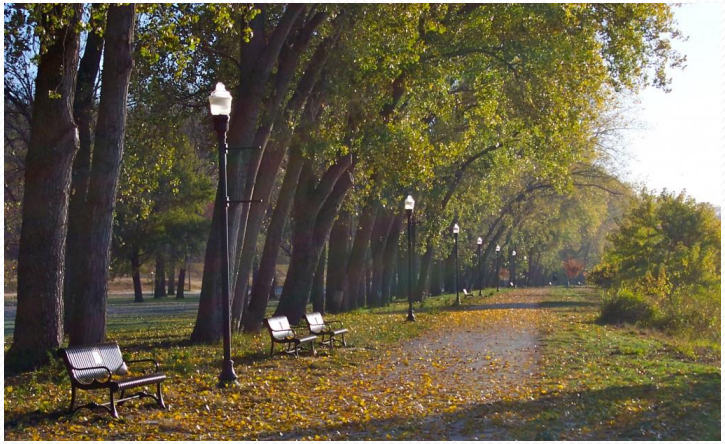
Flood Protection for English Landing Park

Implementation Considerations:

- Entirety of Park is within the FEMA regulated *floodway of the Missouri River* – requires City floodplain permit
- Potentially impacted trees - need to be field evaluated by arborist for detailed assessment of conflicts & necessary design features
- Where possible, trail improvements should meet the "Shared Use Path Design Criteria" per AASHTO for trail design
- Local drainage improvements needed to maintain park drainage
- Modification to light poles and accommodation for benches will be required

Flood Fighting Considerations

- Sandbag closures required at:
  - Low water crossing / public restroom
  - Boat ramp
  - Adjacent to railroad embankment
- Flood protection planning
  - Close the park prior to flood
  - 1-2 day lead notice
- Monitoring during flood event
  - Berm, sandbag closures, & dewatering
  - Limited access to dry side of berm
- Post flood event
  - Remove sandbags
  - Inspect berm
  - Repair wet side damage



Questions ?