

Maintaining Your Levee

North Kansas City Levee
District Case Study

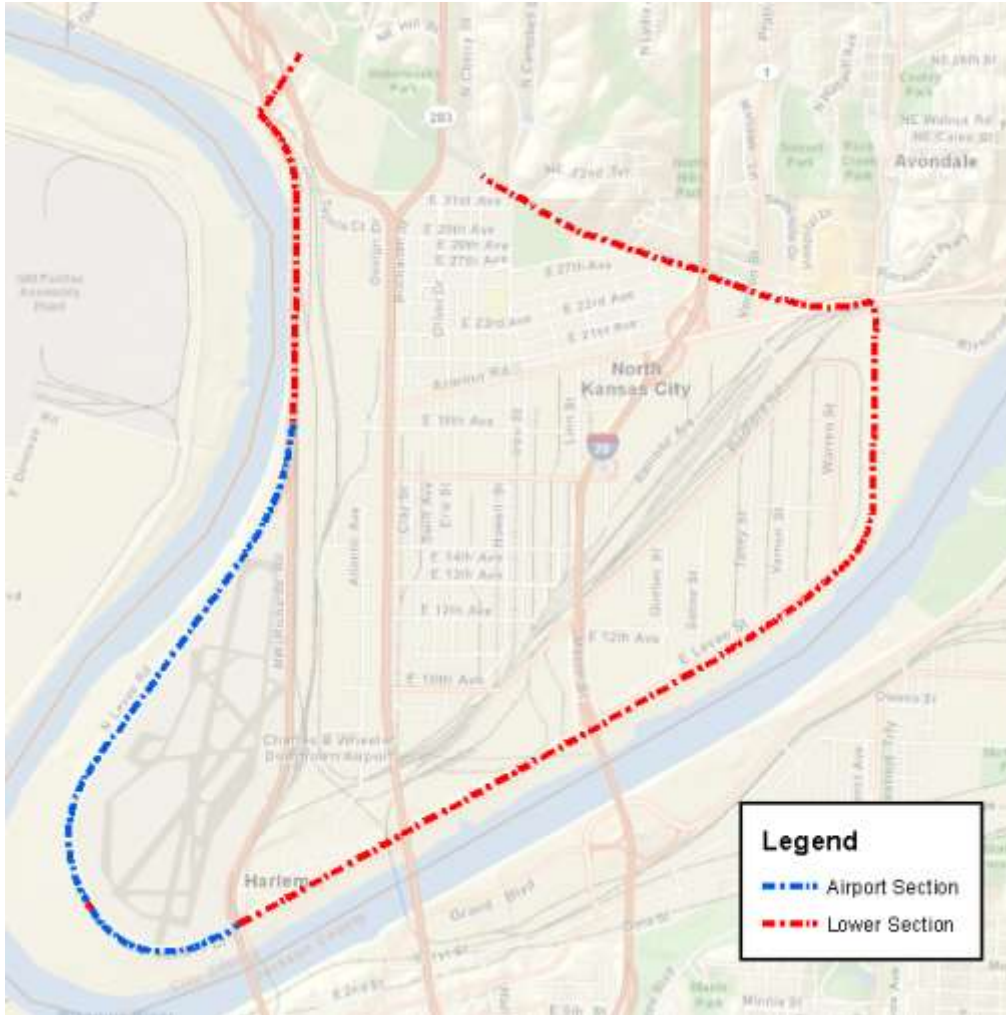
Leon J. Staab, P.E.

KC Urban Stormwater Conference

January 23, 2016

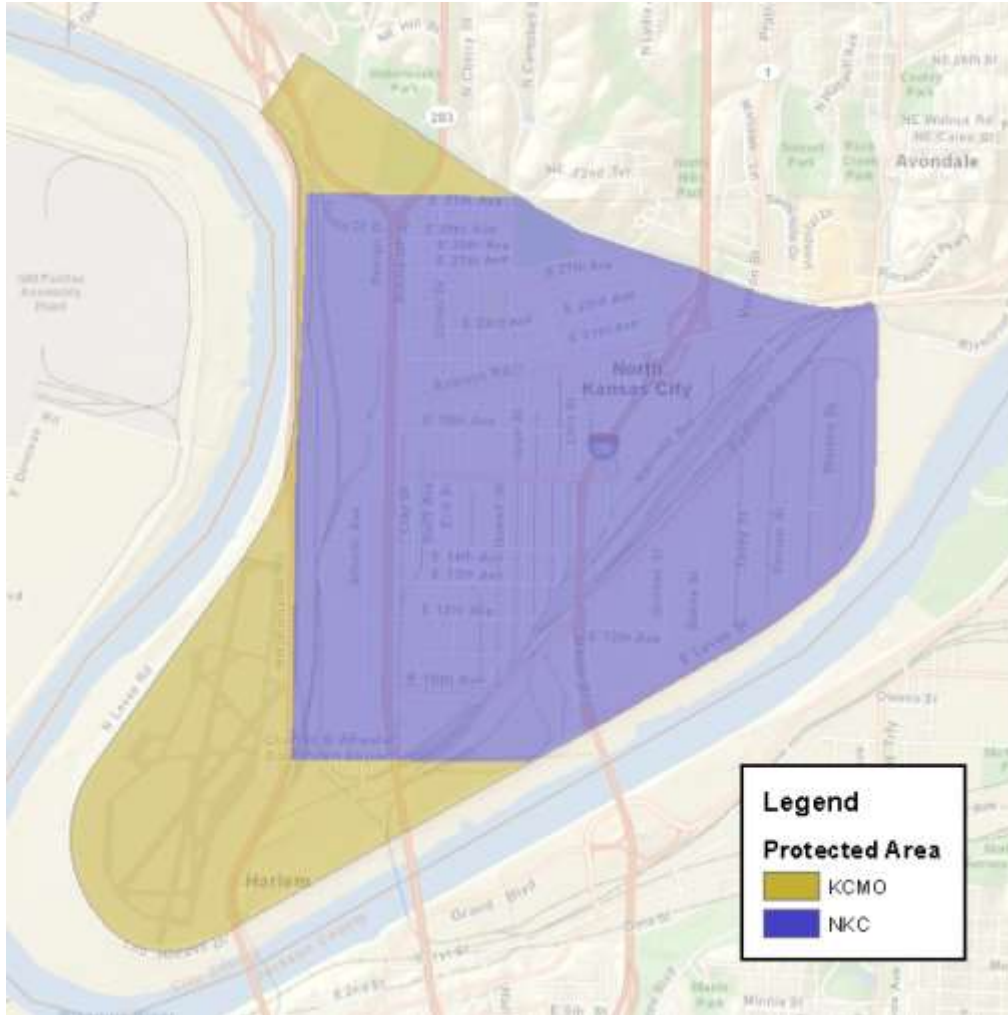
Introduction

North Kansas City Levee Unit



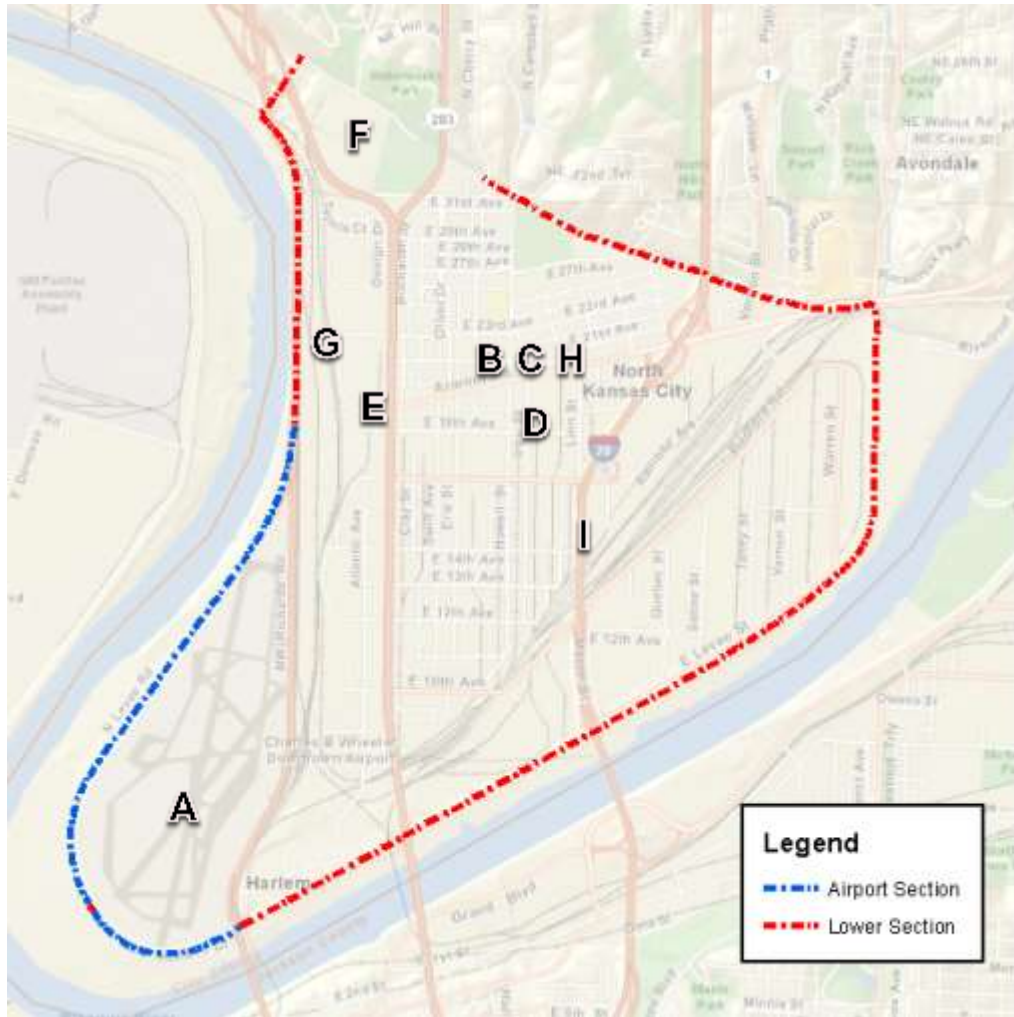
- ▶ Constructed in 1949
- ▶ USACE Made \$3 million if improvements in 1951
- ▶ Owned by 2 Local Sponsors
 - Lower Section - North Kansas City Levee District
 - Airport Section - City of Kansas City, MO
- ▶ Total Length is 8.87 miles
 - NKCLD maintains 6.21 miles
 - KCMO maintain 2.66 miles

Protected Area



- ▶ Total area protected is 2,930 acres
 - 73% is in North Kansas City
 - 27% is in Kansas City, MO
- ▶ Protects 1800 properties
- ▶ Protects 840 homes
- ▶ Value of assets protected is approximately \$4 billion

Critical Infrastructure



- ▶ (A) Charles B. Wheeler Downtown Airport
- ▶ (B) NKC City Hall
- ▶ (C) NKC Police Department
- ▶ (D) NKC Fire Department
- ▶ (E) NKC Water Treatment Plant
- ▶ (F) KCMO Water Treatment Plant
- ▶ (G) BNSF Murray Yard
- ▶ (H) NKC Community Center
- ▶ (I) Interstate 35

North Kansas City Levee District

▶ Board of Supervisors

- Richard Lanning, President
- Bear Kistler
- David Zimmer
- Ed Brown
- Tobin Zerfas

NT Realty
City of North Kansas City
Zimmer Realty
Cullum and Brown
BNSF Railroad

▶ Secretary to the Board

- Jerome Brant

Withers, Brant, Igoe &
Mullennix, P.C.

▶ District Engineer

- Leon Staab, P.E.

Burns & McDonnell

▶ Levee Security Officer

- Bill Hudson

Inspections

33 CFR Ch. II

PART 208—FLOOD CONTROL REGULATIONS

- No unusual settlement, sloughing, or material loss of grade
- No caving has occurred which might affect the stability
- No seepage, saturated areas, or sand boils are occurring
- Toe drainage systems and pressure relief wells are in good working condition
- Drains through the levees are in good working condition
- No revetment work or riprap has been displaced, washed out, or removed
- No action is being taken which will retard or destroy the growth of sod
- Access roads are being properly maintained
- Cattle guards and gates are in good condition
- Crown of levee is well shaped and maintained
- There is no unauthorized grazing or vehicular traffic
- No encroachments which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

Importance of Compliance

- Reduction in system reliability
- Higher risk of unsatisfactory performance
- Loss of eligibility under Public Law 84-99, Flood Control and Coastal Emergencies
- Requirement for levee accreditation for FEMA Flood Insurance Program



Scheduled Maintenance Inspections

- ▶ January
- ▶ March / April (Special Inspection)
- ▶ June / July
- ▶ Early September (pre-USACE inspection)
- ▶ October (USACE Annual Inspection)

- ▶ Before a Known Flood Event
- ▶ After a Flood Event



Safety First

- Have a written safety plan
- Conduct a tailgate safety meeting
- Wear proper safety clothing & equipment
- Use proper confined space entry procedures
- Know location of hospitals, emergency clinics & emergency responders
- Conduct inspections with two or more people

- Always step over rails
- Always get an escort from the railroad
- Stay out of the foreshore area
- Stay clear when the police are using the shooting range
- Let police interact with homeless



Levee

- Condition of Turf
- Condition of Riprap
- Evidence of Burrowing Animals
- Condition of Access Roads
- Condition of Fencing
- Ponding Along Levee Toe
- Unauthorized Access
- Sinkholes
- Sloughing



Closure Structures

- Structural Damage
- Obstructions that Would Prevent Closure
- All Equipment & Materials Needed are on Hand.



Pump Stations

- Operate All Pumps
- Operate All Sluice Gates
- Check Lubrication of Sluice Gates
- Check Oil in Pumps
- Check Pump Lubrication
- Check Lighting
- Check HVAC
- Operate Cranes
- Check Pump Controls (floats)
- Photograph Wet Well
- Check Condition of the Building



Underseepage Control Systems

- Open All Well Structures
- Take Photo with the Structure Number
- Photograph Well Point
- Photograph Upstream Pipe
- Photograph Downstream Pipe



Flap & Sluice Gates

- Manually Release Flap Gates
- Operate through Full Range
- Lubricate the Hinges
- Check Structural Integrity of Headwalls
- Look for Presence of Debris
- Check Seating of Flap Gate
- Check for Scour Near Headwall
- Check Wells for Accumulation of Debris



Drainage Channels

- Debris Accumulation
- Channel Meandering
- Fallen Trees & Woody Growth
- Sedimentation in Bridges & Culverts



Planned, Routine Maintenance

- ▶ Mowing (once per month)
- ▶ Surface Treatment of Roads (every year)
- ▶ Clearing of Woody Growth (every winter)
- ▶ Culvert Cleaning (every two years or as needed)
- ▶ Well Testing (every 5 years)
- ▶ CCTV Pipe Inspections (every 5 years)
- ▶ Bathymetric Survey (every 5 years)
- ▶ Megger Testing of Pump Motors (every 2 years)
- ▶ Crane Load Tests (every 10 years)
- ▶ Portable Pumps

Reporting

- ▶ 33 CFR Ch. II, PART 208—FLOOD CONTROL REGULATIONS

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

Asset Management

1978 - Original Asset Management System

Example checklist provided in 1978
Operation & Maintenance Manual

2-page checklist

Hard copy only

CHECKLIST

LEVEE

Inspected by _____ Title _____ Date _____

Inspection covers: Station _____ to _____

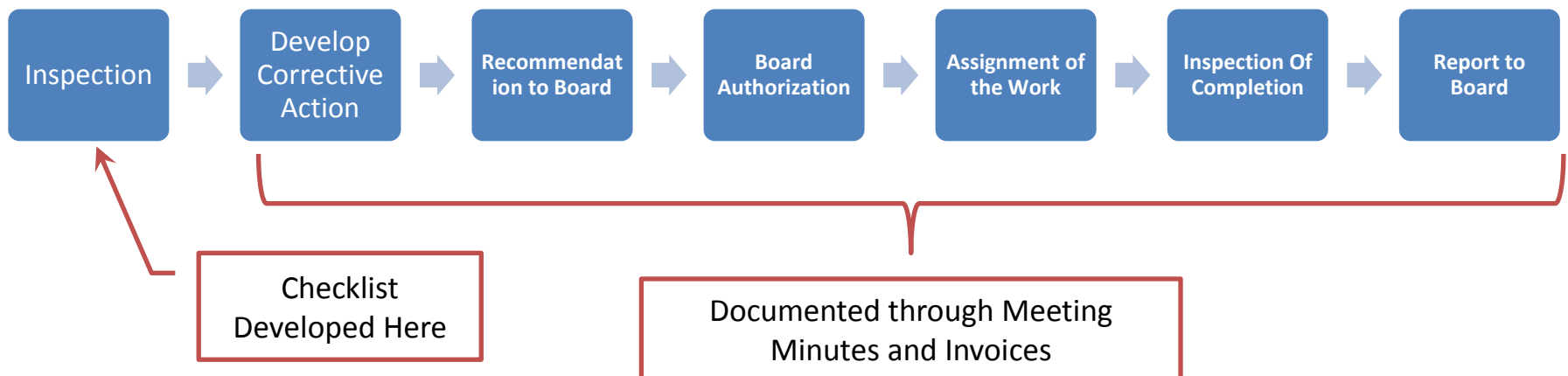
Report condition requiring maintenance in "Remarks" column or on separate sheet, attached.

<u>Item</u>	<u>Location</u> <u>Station</u>	<u>Condition</u>	<u>Remarks</u>
1. Settlement, sloughing, or loss of grade			
2. Caving (either side of levee)			
3. Seepage, saturated areas, or sand boils			
4. Riprap slope protection			
5. Sod			
6. Access roads and ramps			
7. Levee crown			
8. Freeboard gages			
9. Unauthorized traffic			
10. Unauthorized encroachment on right-of-way			
11. Accumulation of drift, trash or debris			
12. Weeds or undesirable vegetation			
13. Miscellaneous pipe crossing			
14. Unauthorized excavation and loose backfill			

Exhibit C
Sheet 1 of 2

Shortcomings of Checklists

- ▶ Only documented deficiencies.
- ▶ Did not document good or normal conditions.
- ▶ No longer matched the USACE's inspection documentation practices.
- ▶ Did not document the maintenance activities throughout the entire process.
- ▶ Things occasionally got lost in the cracks.



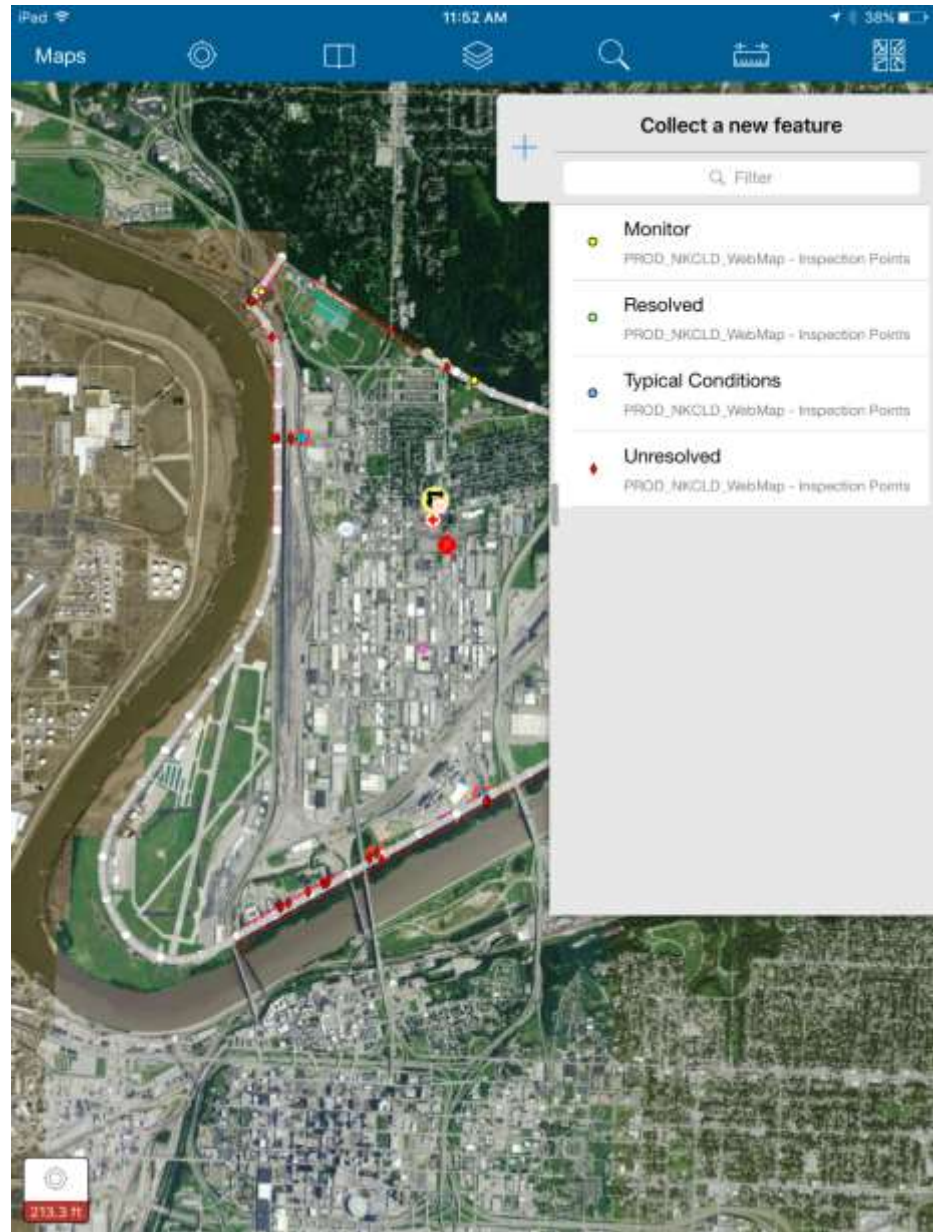
Asset Inspections Using Collector for ArcGIS

- Publish map of levee assets to online GIS – (using ArcGIS Server or ArcGIS Online)
- Configure Collector for ArcGIS inspection form based on USACE database structure
- Utilize Collector for ArcGIS on smart phones or tablets to perform inspections. (Can be integrated with high precision GPS)
- Inspection is data stored in GIS for reporting and analysis. (Can utilize ArcGIS Operations Dashboard for real-time analysis)
- Information is accessible through the following:
 - ArcMap
 - Web page
 - Mobile Application



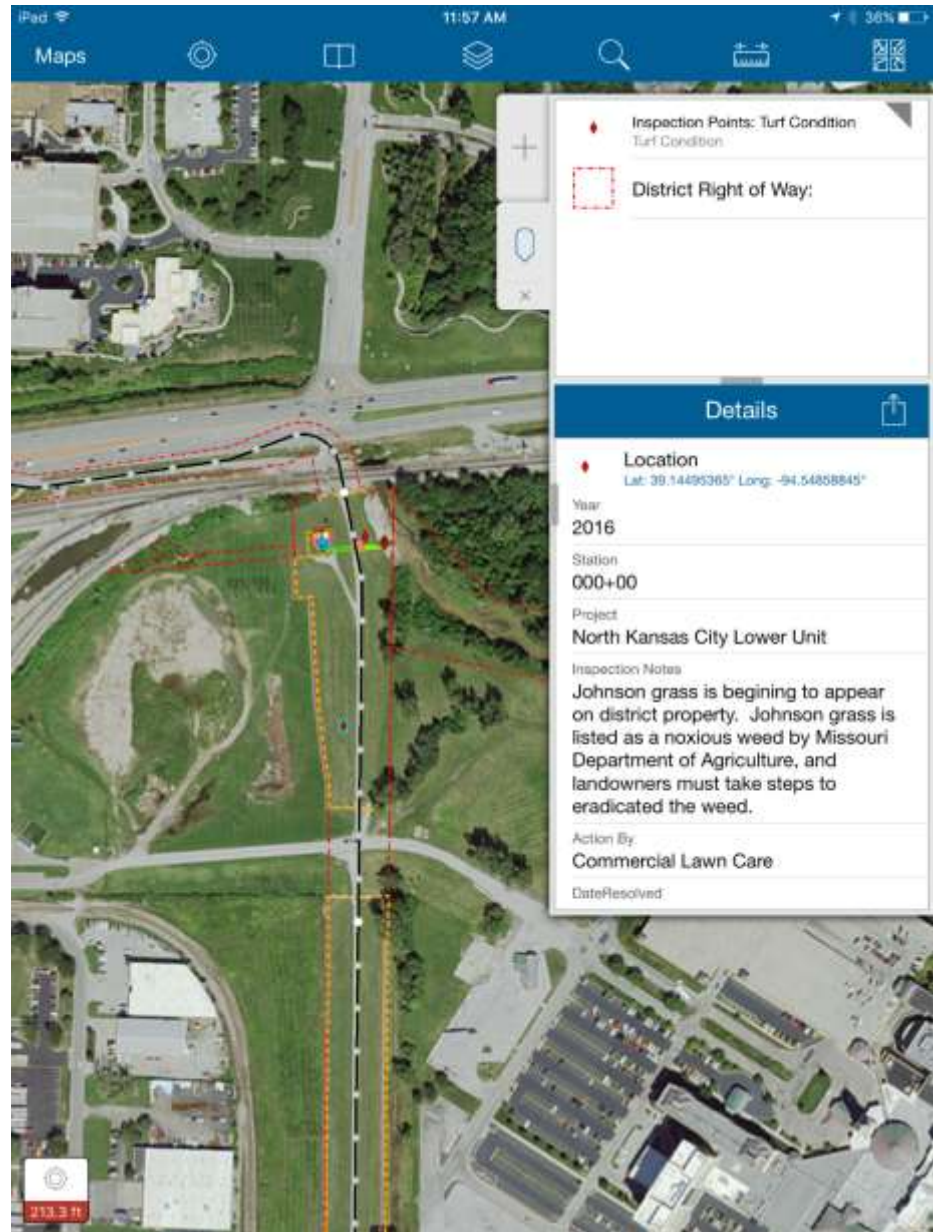
Asset Inspections Using Collector for ArcGIS

- Place points
- Located based on location of device
- User has predefined selection



Asset Inspections Using Collector for ArcGIS

- Mapping shows District's assets & property
- Inspection points and status of each
- Can take & attach photos to each point
- Database includes
 - Data
 - Location
 - Description of problem
 - Rating
 - Recommended action
 - Responsible party
 - Date resolved
- Predefined Inspection Points
- Tracked 100+ points in the first year.



Reporting

- Data driven pages in ArcGIS
- Generate a report for each point
- Includes basic information, action and status
- Includes a map showing location
- Shows photographs
- Can sort, query & filter data to generate any report desired

North Kansas City Levee District
Inspection Report



**BURNS
MCDONNELL**

Current Status

Inspection ID NKCLD_BMCD_NKCL_2016_a_088	Inspection Date 6/17/2016 6:14:24 PM	Levee Station 385+00	Date Resolved 	Status Unresolved
Feature Levee Slope Only (RIS)	Item Other (Specify in Remarks)	Rating Unacceptable	Action Required by CommLawnCare	
Remarks Harris's Tieback Levee - Foreshore Area				
Inspection Notes Turf damaged during construction project needs to be restored		Status Communication Commercial Lawn Care was notified 6/17/2016 that the damage turf needs to be repaired. ESI will place and maintain erosion control. CLC will plant grass in the Fall of 2016.		

Ball in Court



Exact Location

Legend

Inspection Points


- Monitor
- Risk Area
- Typical Conditions
- ◆ Unacceptable

Levee Section

- Lower Section
- Aligned Section
- Closed Right of Way
- Underseepage Potential
- Underseepage Pipe
- Fencing

Sample Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, GEBCO, SwireVision, and the GIS User Community

What needs to be done





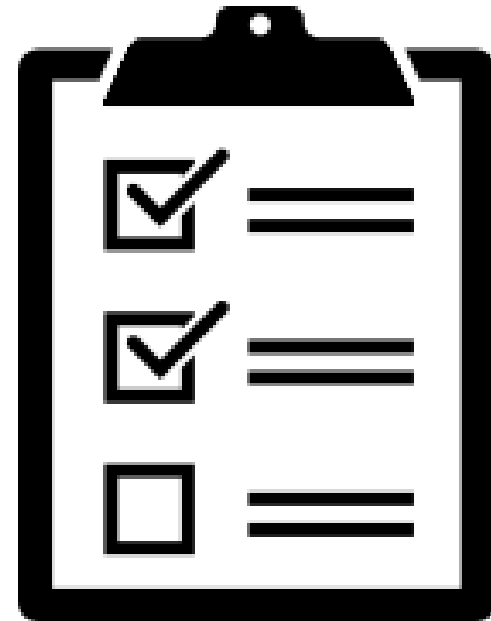
What to look for in the field

Expanded Uses for Collector

- ▶ Document & track punch list items for construction projects
- ▶ Used to document flood fight activities
 - Patrol routes
 - Location of freeboard gages and readings
 - Location and status of sand boils
 - Evacuation routes
 - Flood fight photographs
- ▶ Plan review and permitting
- ▶ Access to O&M Manual in the field
- ▶ Access to construction record drawings in the field

What's Needed to Support Inspection Workflow?

- Geodatabase of levee assets
- ArcGIS Online or Portal for ArcGIS
- Collector for ArcGIS Installed on mobile device (Apple, Android, or Windows)
- Optional, Collector for ArcGIS can integrate with a high precision GPS via Bluetooth connection.



Recommendations for Inspections

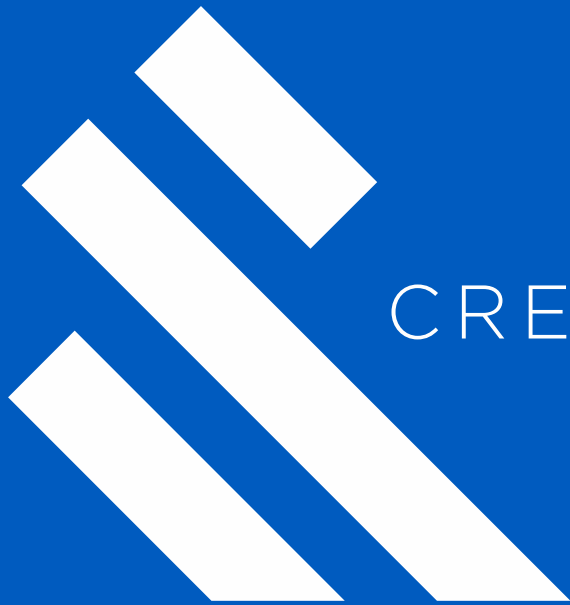
▶ Have a Plan

- Identify everything that needs to be inspected
- Schedule when inspections are to occur
- Assign inspection responsibilities
- Do the inspections as required by your O&M Manual
- Do the maintenance
- Document everything (bad and good)

▶ Write the Plan Down

▶ Report What is Done

Questions?



CREATE AMAZING.