Lockport Pool Major Rehab

Stage III Canal Wall Collapse & Response

2012 Lock Maintenance Workshop

Paducah, KY

28 February 2012

Andrew G. Barnes, P.E.


Chicago Sanitary & Ship Canal
Chicago Lock
Lake Michigan
Des Plaines River
Chicago Sanitary & Ship Canal
Chicago
Calumet Sag Channel
T.J. O'Brien L&D
Lockport L&D
Lockport Pool
Joliet
Brandon Road L&D
Des Plaines River

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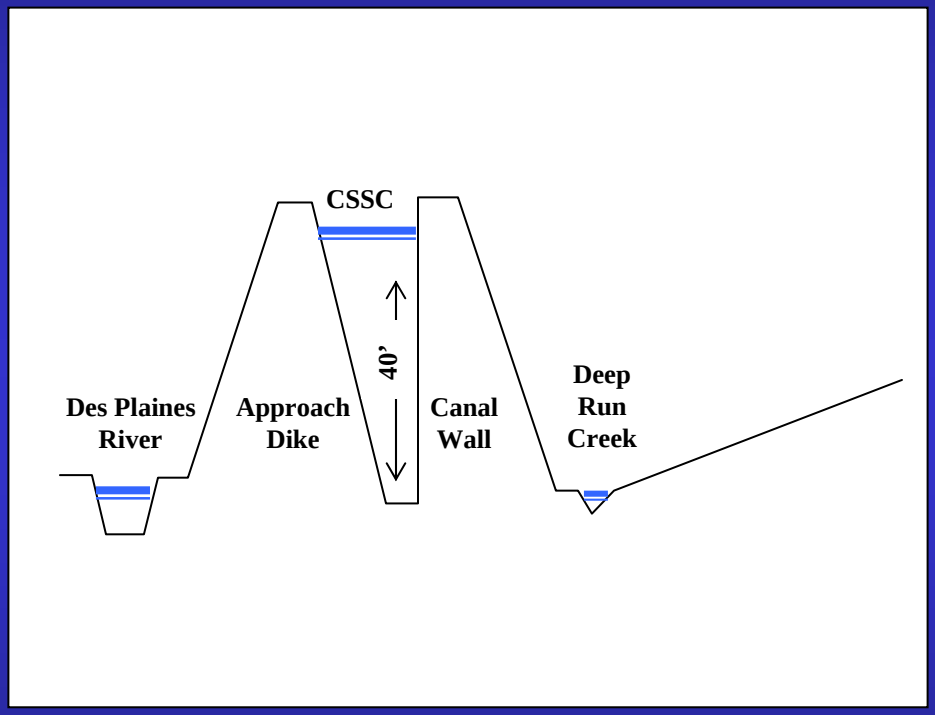
Chicago Sanitary & Ship Canal (CSSC) on the Illinois Waterway



Section of the "Perched" CSSC Canal

Lockport Pool @ Downstream End Of the CSSC

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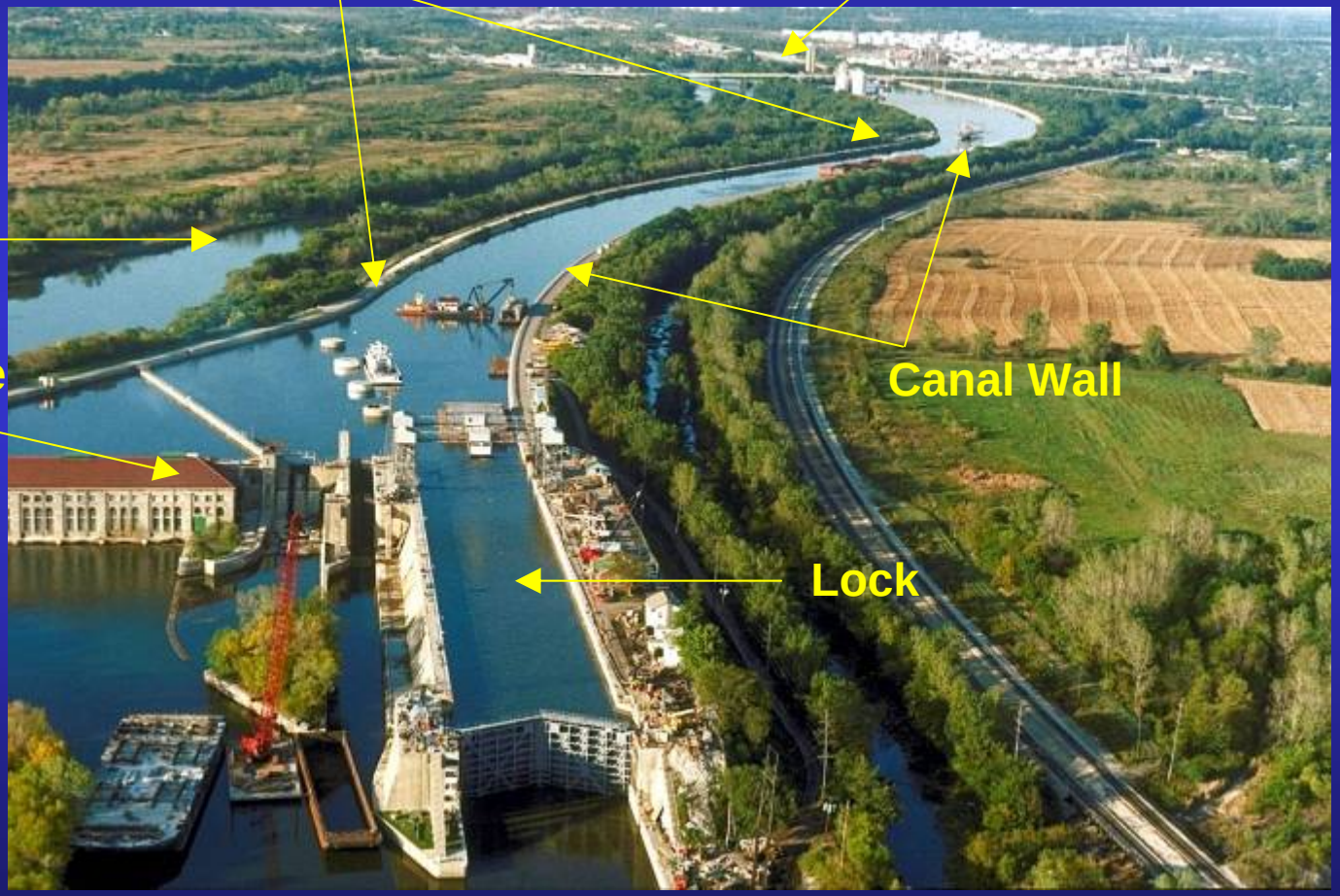
Lockport Pool Reach



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Chicago Sanitary & Shipping Canal

- Constructed in 1890's by what is now the Metropolitan Water Reclamation District of Greater Chicago (MWRD)
- Reversed flow of Chicago River which previously flowed into Lake Michigan
- Allowed discharge of sewage to Illinois and Mississippi Rivers rather than to the lake
- Responsibility for pool-retaining structures transferred to USACE via MOA in 1980's

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Chicago Sanitary & Ship Canal

- Provides stormwater management function for the Chicago metropolitan area
- Provides navigation link between the Illinois & Mississippi Rivers and Great Lakes
- Supports significant industry due to availability of water and commercial navigation
- Hydroelectric power generation (MWRD)

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What if the canal breached?

- In the 2004 RER **economic consequences for catastrophic failure of the canal wall total $50,370,800**, which includes $3,692,800 in wall repair costs, $45,850,000 in navigation impacts, and $828,000 in hydropower losses.
- It should be noted that a breach in this reach would likely result in major upstream impacts that were not quantified in the RER. The Chicago Sanitary and Ship Canal (CSSC) extends over 35 miles upstream from Lockport through downtown Chicago to the Chicago Lock at Lake Michigan and a similar distance up the CSSC to the Calumet-Sag Channel to T.J. O'Brien L&D. **A breach at Lockport could result in draining the entire CSSC to both locks.**
- **It is unknown how all of the canal wall would react to loss of pool through the heavily populated and urbanized Chicago metro and downtown areas.**

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Concrete Canal Wall

(Left Descending Bank)

- Lockport Pool reach has 399 monoliths, 60 with barge check posts.
- Acts as a high-head dam with maximum 40-foot head.
- Serious concerns of structural stability and integrity.

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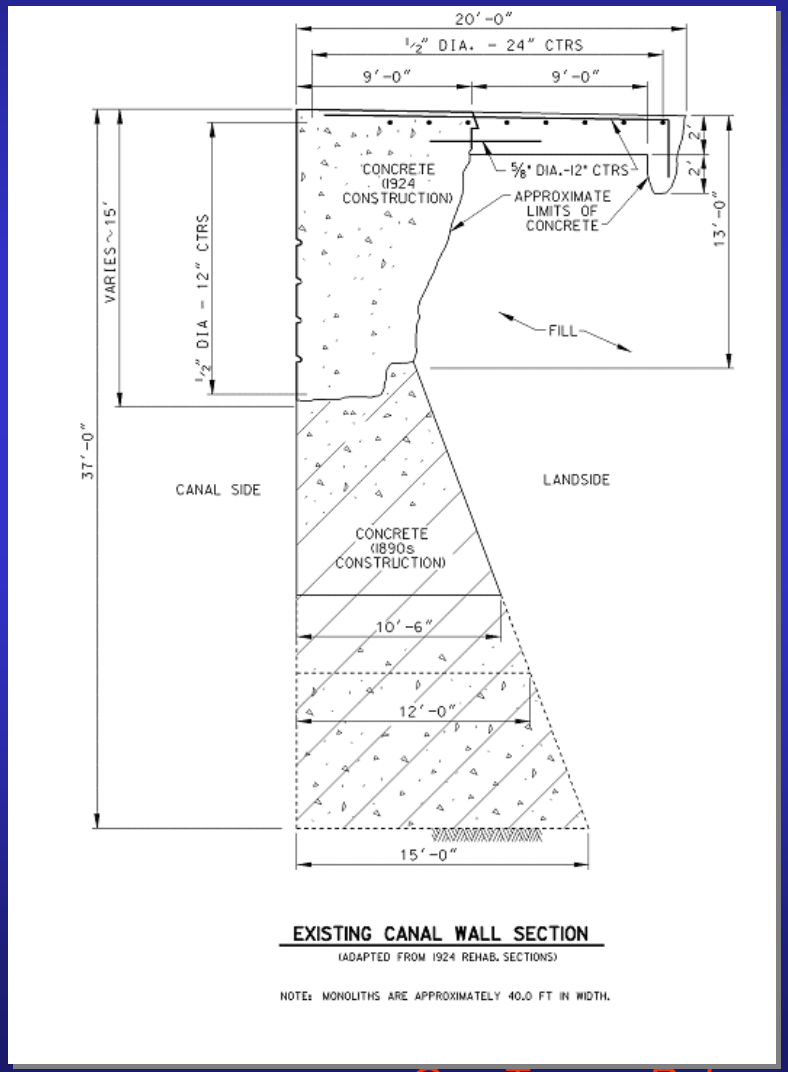
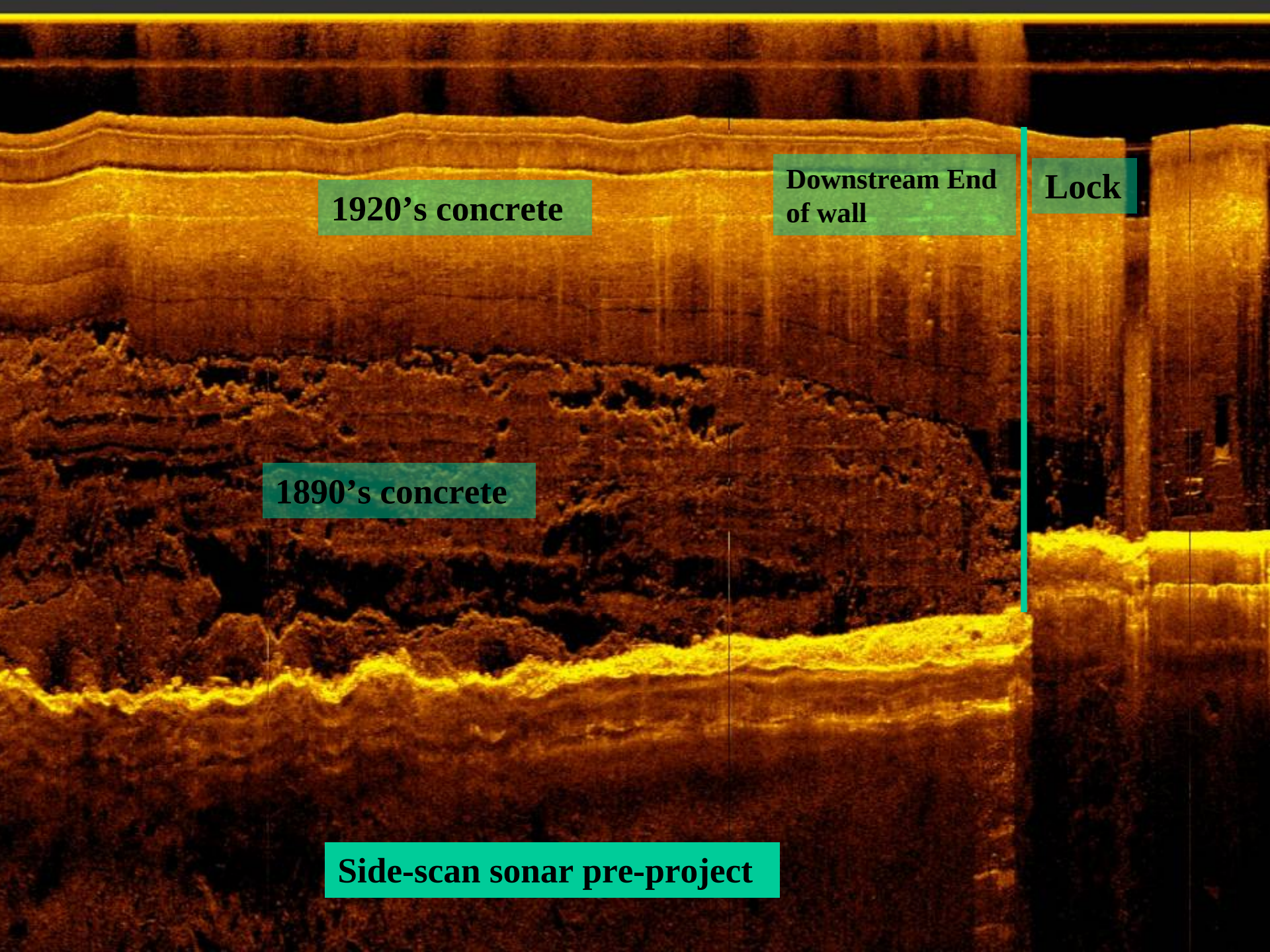


Concrete Guide Wall


1920’s concrete
Downstream End of wall
Lock
1890’s concrete
Side-scan sonar pre-project

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Stage III Contract

- Project entails replacement of approximately 2 miles of 40-ft high canal wall
- Awarded contract to Walsh Construction in September 2009 for approx. $63M
- Construction project funded with Regular and ARRA Construction funds
- Favorable bid allowed return of $31M of ARRA Construction funds to HQ for central management of contingency funds

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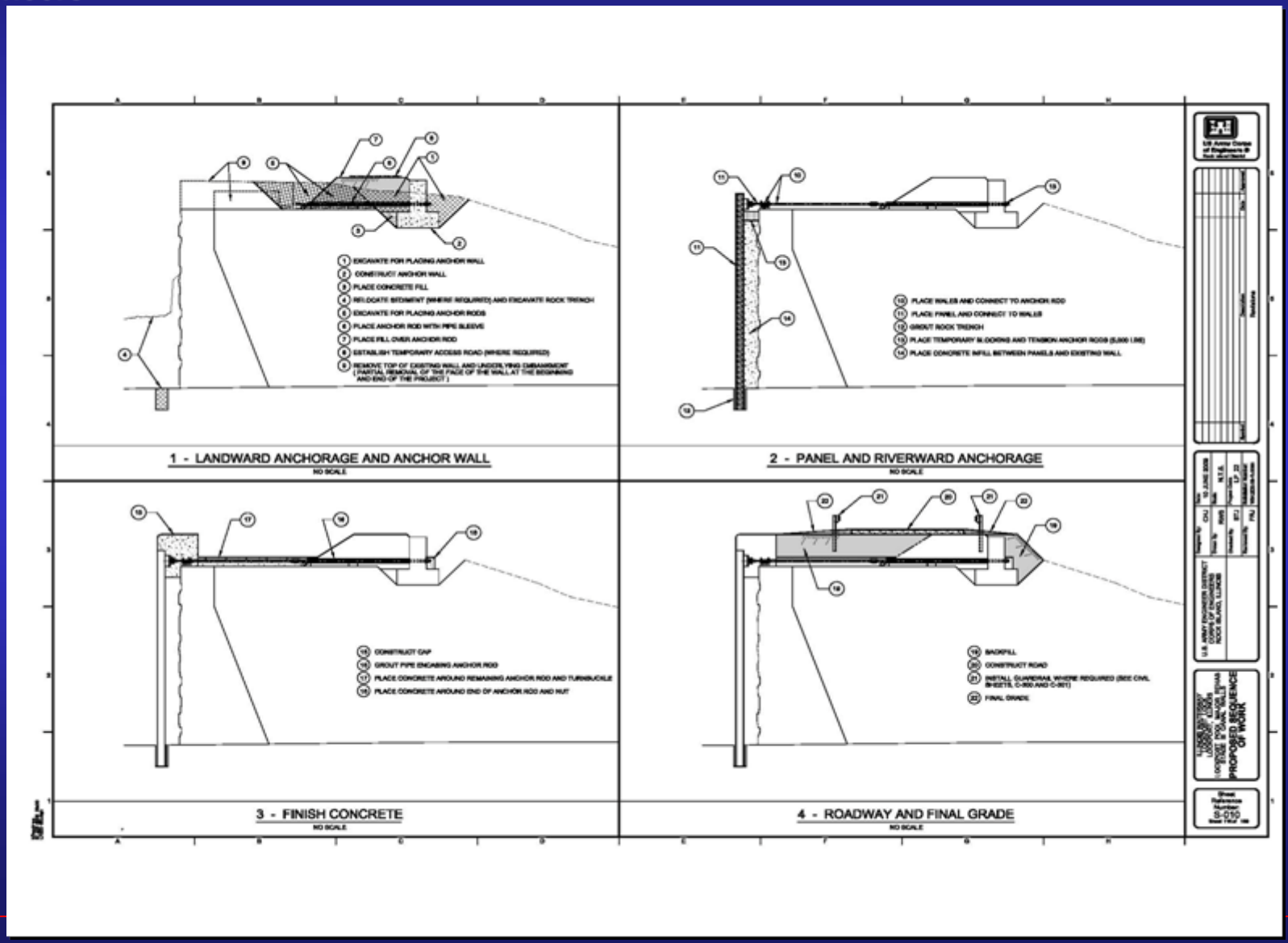
Construction Sequencing



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Anchor Wall Construction

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Trenching Operation

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Placing Precast Panels

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Placing Precast Panels

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Placing Wall Cap

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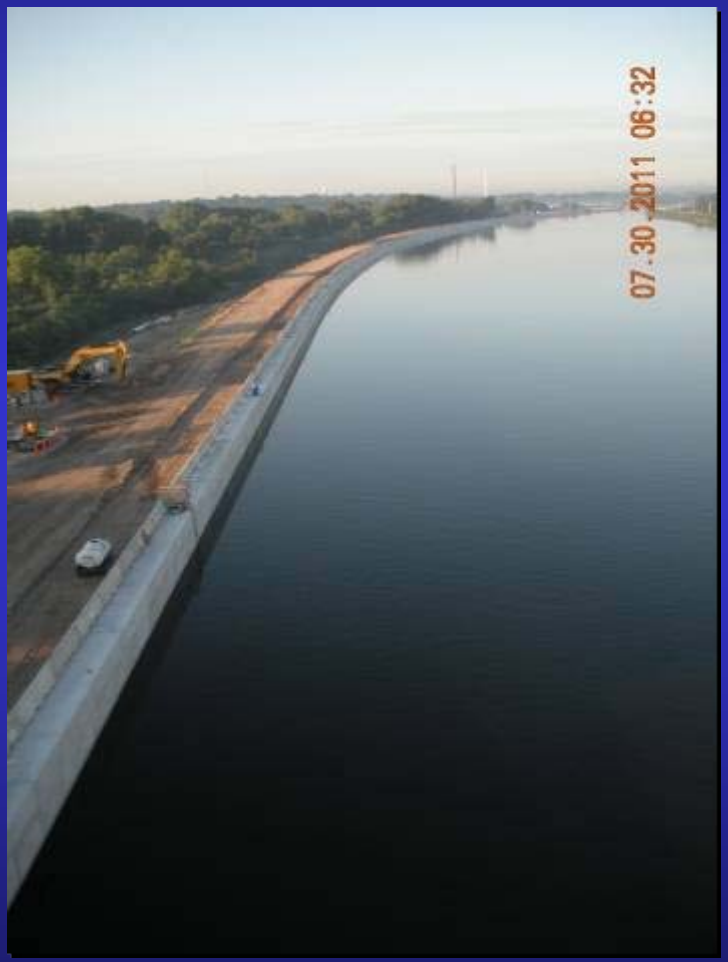
Completed Wall



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Construction Progress

- Through October 2011, over 75% of the new wall was completed without incident
- All work in the canal was on schedule to complete in January 2012
- Site work including earthwork and paving was on schedule to complete by May 2012
- On October 7, 2011, a 280-foot section of existing canal wall collapsed and fell into the canal

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Wall Collapse (Oct 7 2011)

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Trenching Operation

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Collapse Impacts

- The Good News:
  - Nobody Injured
  - Canal did not breach
- The Bad News:
  - Too much to list
  - Re-evaluate method
  - Schedule & cost impacts
  - “Fully funded contract”

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Collapse Impacts

- Declaration of Condition B Dam Safety Emergency
- Total shutdown of work site activity
- Gather new survey information
- Analysis of remaining wall & embankment section

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Collapse Impacts

- Completion of original contract work will cost more and take longer
- Wall collapse displaced adjacent lock monolith
  - Tie-in point for new wall cannot be used
  - Landwall lock monoliths must be stable and straight to support normal operations
  - Cost to repair damaged lock monolith now part of construction project
- Funding needs exceed remaining funds

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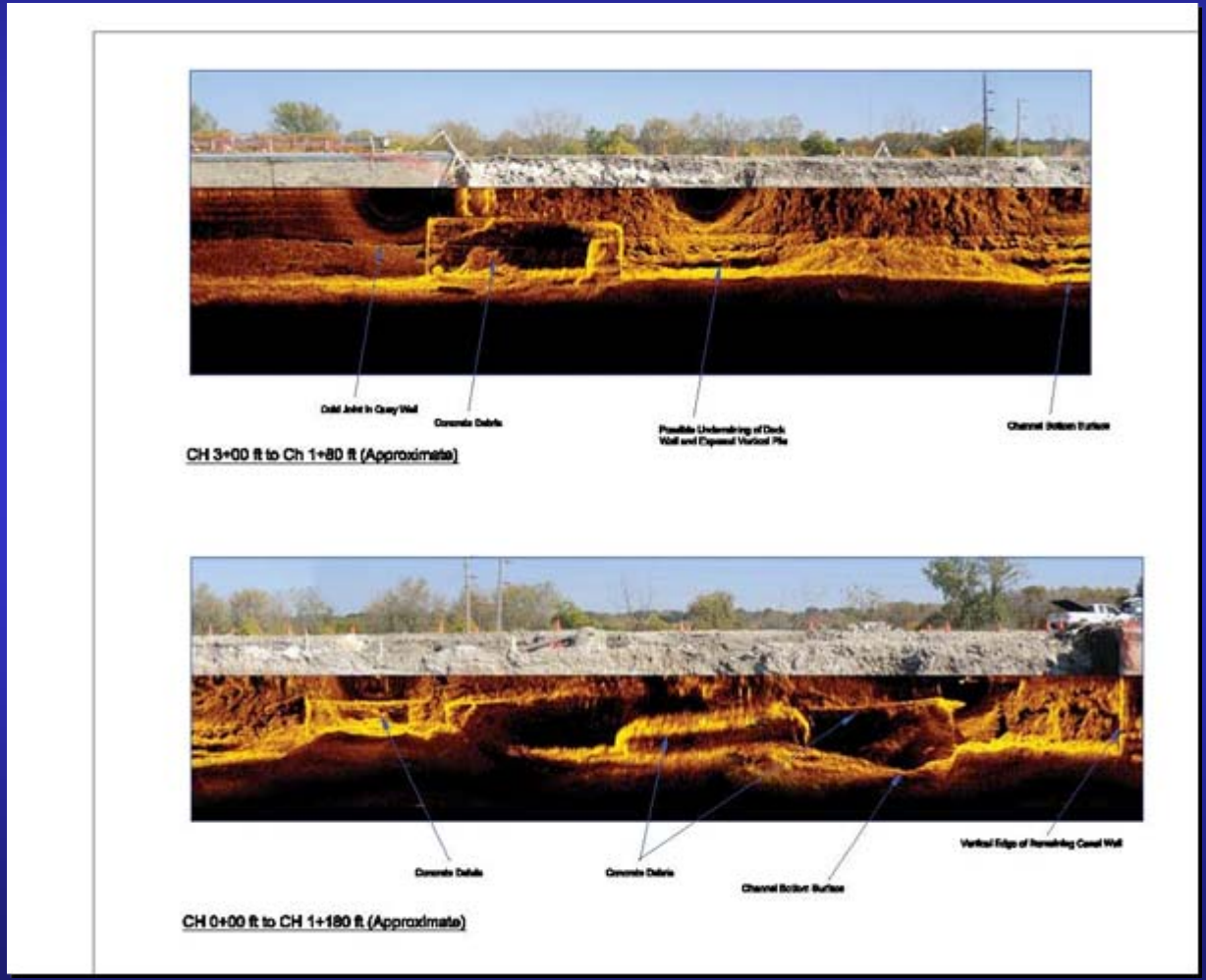
Side scan sonar Post Collapse



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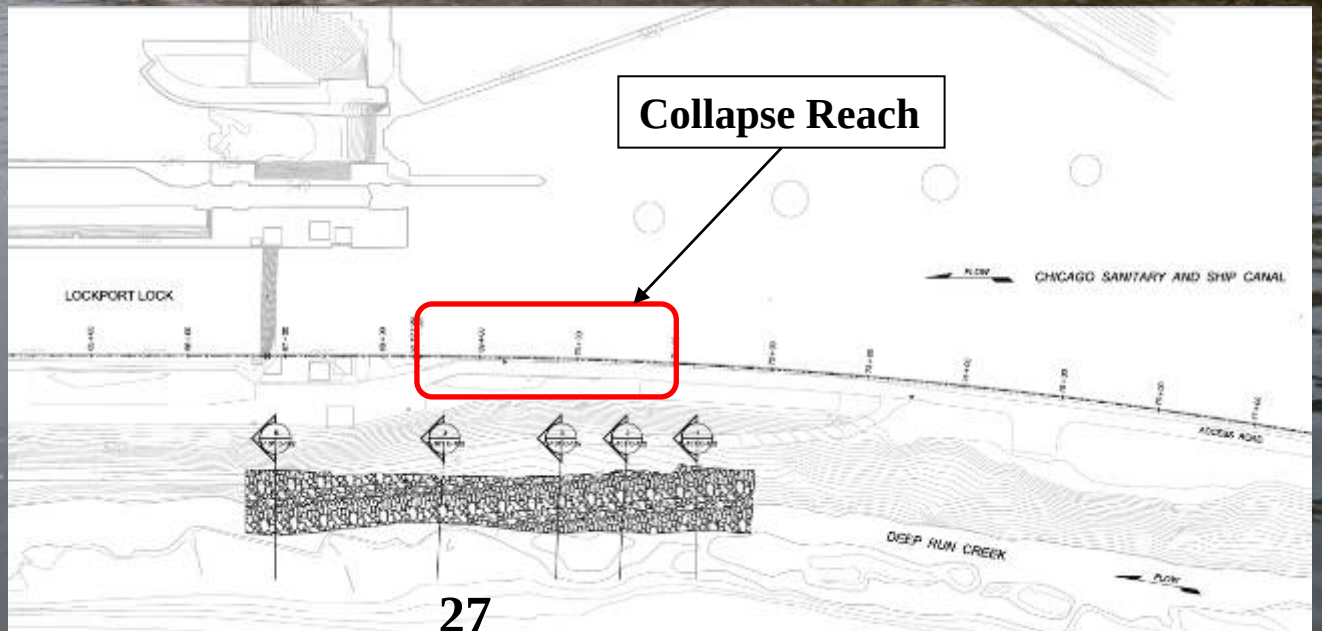
Contract Modifications

- Stability Berm – to prevent canal breach
- Work Platform – to complete wall in collapse area
- Helper Boat – to safely pass navigation traffic and protect work in progress
- Lock Repair – to return lock structure to pre-wall collapse condition
- Debris Removal – to ensure no navigation obstructions in channel

Stability Berm



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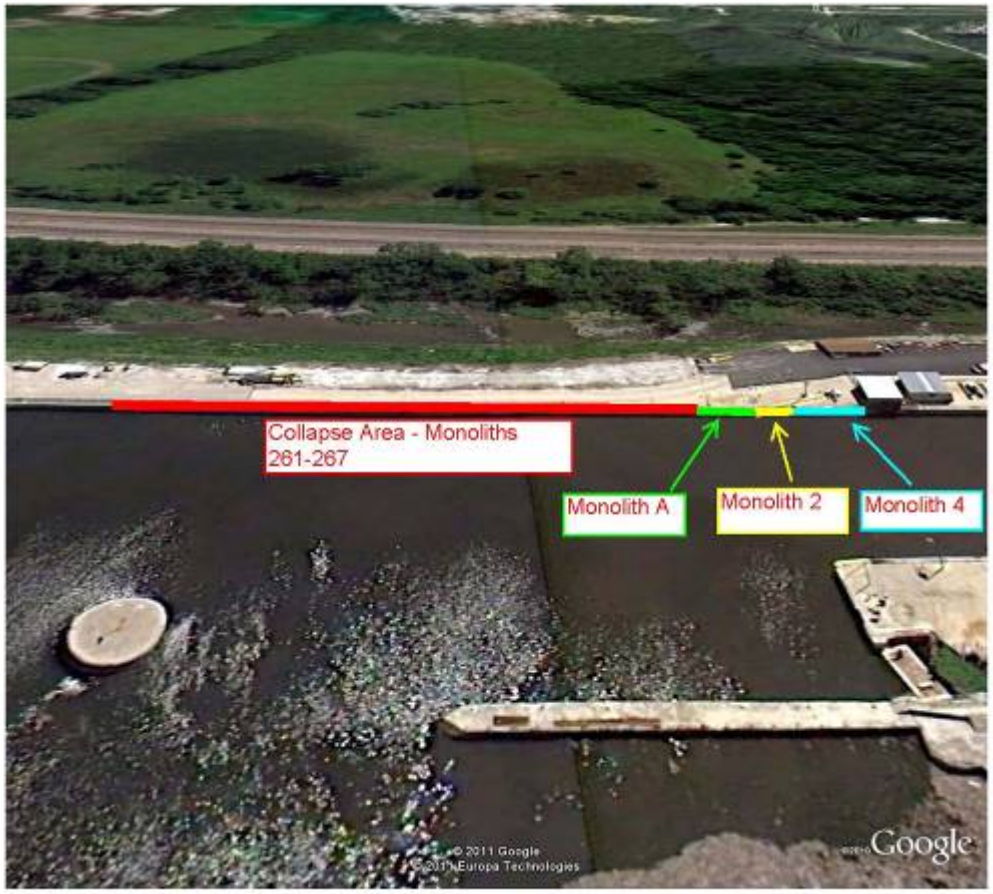
Lock Monolith Repair

Lockport Stage III – Canal Wall Rehabilitation



Ongoing Construction

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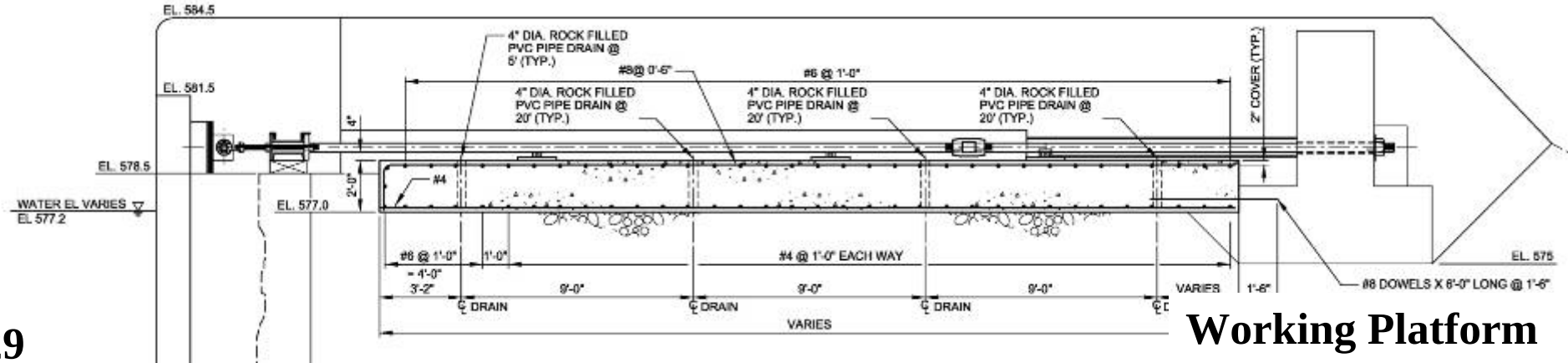
Lock Wall

Anchor Wall

26 JAN 2012



Working Platform

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What's next

- Expect completion of original contract work in canal in early April 2012
- Repair of Monolith A expected to be completed by end of April 2012
- If all goes well:
  - Navigation restrictions lifted
  - Termination of Condition B Dam Safety Emergency Classification
  - Only paving and punchlist items will remain
  - Construction physical completion June/July 2012

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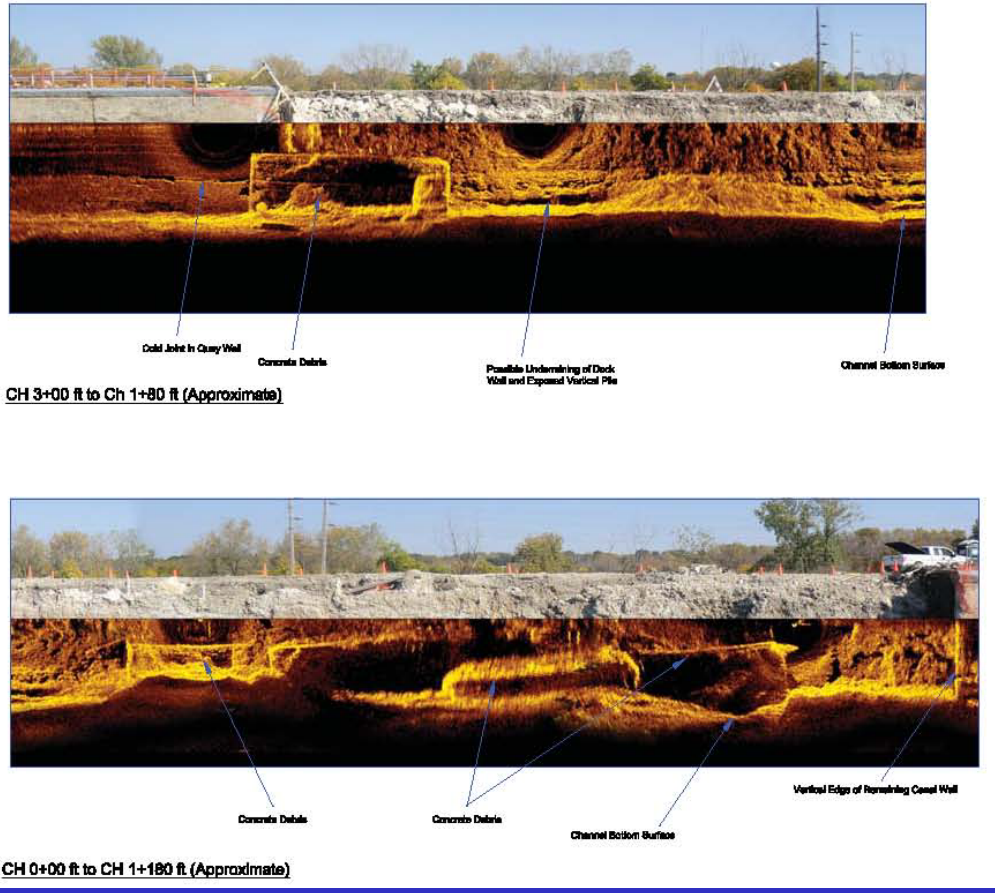
Why did it happen?

- Currently investigating
- Case History Report currently being developed (next slide)
- Several potential causes related to grouting behind the wall.

AAR

- MVR has underway a comprehensive AAR led by an experienced engineer without prior project involvement
- Facts:
  - The wall collapse area coincides with the grouting limits
  - It appears that the wall collapse originated at the interface of the 1890 and 1920's concrete
- Possible Contributing Factors:
  - Grouting hydro-fractured the wall
  - The grout curtain equalized water pressure on both sides of the wall reducing the net hydrostatic force
  - Extensive deterioration; greater than other reaches of wall as indicated in preconstruction survey



- Construction methods including demolition and excavation in combination with the condition and age of the wall in this reach
- The collapse area is upstream of the lock and is subject to more barge impacts than other area of the wall. The wall has experienced barge impacts during construction while the backfill was removed behind the wall. One instance was within 24 hours of the collapse event.
- The contractor encountered large concrete footings located behind the wall. These footing were removed with large impact breakers subjecting the wall to vibration. Vibration could weaken the interface between the 1890s and 1920s concrete.

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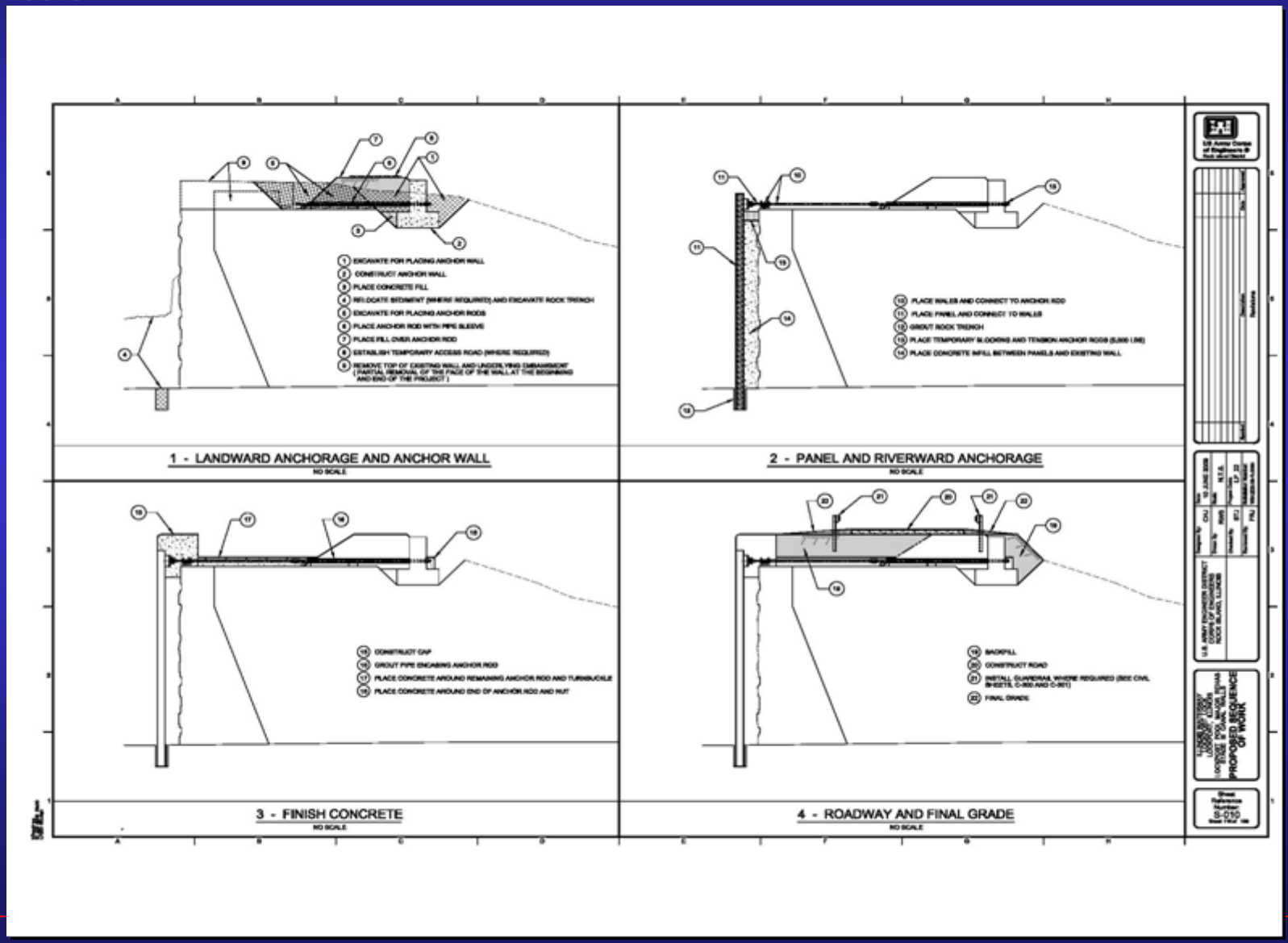
Construction Sequencing



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Summary

- Response will total about 25 separate contract actions
- Final cost impact estimated between $3M and $5M (hopefully)
- Estimated completion delay of 2-3 months

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Questions?