BOWER ELEMENTARY SCHOOL
LEVEE DESIGN AND CERTIFICATION
DUPAGE COUNTY, IL

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Special Thanks To Project Partners:
PRESENTATION OUTLINE

- General Overview
- Bower School Levee
- Levee Certification
- River Road Levee
- Questions
Project Location

West Branch DuPage River Watershed

- 128 square miles
- 17 Tributaries
- 14 Communities & Unincorporated DuPage
DuPage County experienced six to ten inches of rain.
2008 Flooding in Warrenville
2008 Flooding in Warrenville

Bower Elementary School
West Branch Watershed Plan Addendum

County’s Response to September 2008 Storm

Study Limits: Roosevelt Road to Upstream of Fawell Dam

Total Reach Length: 7.0 Miles

Preferred Alternatives Included:

- Bower Berm Berm
- Raising River Road
- 2nd Street Corridor Restoration
- Williams Road Bridge Replacement
- Warrenville Rd Bridge Replacement
- Flood Control Berms N. of Williams Road

Approved by Stormwater Management Committee & DuPage County Board - 2010
BOWER SCHOOL – EXISTING CONDITIONS
Bower School Berm and Levee Certification

- **Stakeholders**
  - Bower Elementary School
  - DuPage County
  - City of Warrenville
  - EPA

- **Objective:** Protect School

- **Overlapping Projects**
  - Berm and Superfund cleanup

- **Coordination**
  - Cost Share (County, School, City)
  - FEMA
  - EPA Superfund Cleanup
  - Permits
  - Intergovernmental Agreements
OVERLAPPING PROJECTS – BERM AND SUPERFUND CLEANUP
Current Regulatory Floodplain
Bower Elementary Flood Control Improvements
West Branch Watershed Plan Addendum

FPE = 2’ ABOVE 100-YR BASE FLOOD
2008 Peak Water Levels at Bower School

2008 WSE = ±693
Historical WSE = 693.4
What Should be the Flood Protection Elevation?

County’s commitment is to protect to 2’ above BFE i.e. top of berm at 694’?

Possibility to raise berm to meet FEMA levee certification criteria is discussed.

Berm would need to be raised to a minimum of 695’ to meet freeboard requirements for levee certification.
Freeboard Requirements for Levee Certification

Min. 3’ above the 100-yr BFE

An additional 1’ above the minimum is required within 100 feet in either side of structures

An additional 0.5’ foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.
BOWER BERM

School Opt for Certified Levee

FPE of 695.5 is chosen

County/School Cost Participation. Need an Intergovernmental Agreement

Would the levee need to meet freeboard requirements on all sides?

Can a School Own/Operate a Levee? Apply for Levee Certification?

Early coordination with FEMA completed
Seepage Analysis - Existing Conditions

Steady Seepage from Full Flood Stage
Station 202+75

Soil Parameters

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<tr>
<th>Soil ID</th>
<th>Soil Type</th>
<th>Unit Weight</th>
<th>Drained Parameter</th>
<th>Coefficient of Permeability, K</th>
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<td>3.10⁻¹ / 10⁻⁵</td>
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<td>3.10⁻¹ / 10⁻⁵</td>
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<tr>
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<td>Hard LEAN CLAY</td>
<td>125</td>
<td>300</td>
<td>3.10⁻¹ / 10⁻⁵</td>
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</table>
BOWER LEVEE – TYPICAL SECTIONS
Levee Certification
Example Embankment Specifications

The material shall consist of approved materials that are free of organic matter and debris. The soil shall be of classification CL in accordance with the Unified Soil Classification System obtained from glacial till deposits. The soil shall have a liquid limit greater than 30 and less than 50, a plasticity index of greater than 15 and less than 30, the fines content (percent passing sieve #200) greater than 30% and a hydraulic conductivity of less than $1 \times 10^{-6}$ cm/sec or less.

The Owner will employ the professional services of a qualified geotechnical firm at Owner’s expense to provide material sampling, material testing, quality assurance and field quality control. Material used for embankment fill including embankment soil compaction shall be per the direction of the Owners geotechnical engineer.
Embankment Soils Compaction: Embankment compaction shall be done in accordance with the applicable portions of Article 205.06 of the Standard Specifications. Density and moisture content shall be as specified below: Field density test frequency shall be at least one test per each 10 cubic yards placed within areas adjacent to structures, a minimum of two tests shall be performed for each structure located within the embankment. Field density test frequency shall be at least one test per 100 cubic yards in open areas of the embankment. A minimum of three tests shall be completed for any lift of fill. Locations of field density tests shall be subject to approval by the Owner’s geotechnical engineer. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.

Moisture Content: The clay fill shall be brought to a moisture content between +2% and +4% greater than the optimum moisture content and compacted to a minimum 95% of the maximum dry unit weight according to ASTM D 698 Method A. After compacting each lift, the surface should be scarified for bonding between successive lifts. Contractor must maintain moisture content until acceptance by Owner. If the hydraulic conductivity is not met, Contractor shall re-compact or replace at the Contractor expense.
BERM CONSTRUCTION COORDINATION

TEMPORARY BERM NOTE:
- APPROXIMATE LIMITS OF TEMPOARY BERM (BY OTHERS) TO PROVIDE FLOOD PROTECTION TO ELEV. 692.52. CONTRACTOR TO MAINTAIN TEMP. BERM AT ALL TIMES.
- WHILE MAINTAINING POSITIVE DRAINAGE TO TEMPOARY PIPE (BY OTHERS). TEMP. BERM SHALL BE REMOVED AND UTILIZED AS FILL MATERIAL FOR THE FINAL BERM ONCE THE AREA BETWEEN STA. 204+00 TO STA. 208+00 IS FLOOD PROTECTED TO ELEV. 692.5 PER FINAL GRADING PLANS.

HOPE UNDERDRAIN WITH TEE TRENCH FOR SEEPAGE CONTROL

临时缓冲区注意:
- 临时缓冲区（由他人）的近似位置以提供洪水保护至标高692.52。承包商应保持临时缓冲区在任何时候。
- 在保持正的排水到临时管道（由他人）的情况下。临时缓冲区应被移除并作为最终缓冲区的填料。一旦标高204+00至208+00的区域被洪水保护，标高692.5的最终平整计划。

BOWER SCHOOL PROPERTY

TOP BERM
- MAINTENANCE ACCESS (ALONG BERM)
- PROPOSED CHAIN LINK 6"X8" DOUBLE SWING GATE
- PROP. 6" CHAIN LINK FENCE

EXIST. CENTERLINE OF EXIST. BERM
- PROP. BASE REFERENCE LINE APPROX. 692.00 ELEV.

EXIST. WETLAND BOUNDARY (TYP.)
- EXIST. WATERS EDGE AT TIME OF SURVEY (TYP.)

PROP. TEMPORARY RIP RAP (BY OTHERS) TO BE REMOVED AT FINAL BERM CONSTRUCTION AND PRIOR TO FINAL SITE RESTORATION

CENTERLINE ALIGNMENT OF DUPAGE RIVER PER AEA

WEST BRANCH DUPAGE RIVER
Bower School
Now that the levee passed the test in April 2013!
Levee Certification

DESIGN, OPERATION AND MAINTENANCE PLAN REQUIREMENTS
PER 44 CFR SECTION 65.10:

DESIGN CRITERIA
- FREEBOARD DESIGN REQUIREMENTS
- CLOSURE
- EMBANKMENT PROTECTION
- EMBANKMENT AND FOUNDATION STABILITY ANALYSES
- SETTLEMENT ANALYSES
- INTERIOR DRAINAGE

OPERATION PLAN
- FLOOD WARNING SYSTEM
- PLAN OF OPERATION
- PERIODIC OPERATION OF CLOSURES
- INTERIOR DRAINAGE

MAINTENANCE PLAN
Levee Certification Report
Table of Contents

TABLE OF CONTENTS

I. MT-2 Form 1
II. MT-2 Form 3
III. COVER PAGE AND CERTIFICATION
IV. LEVEE CERTIFICATION CRITERIA
V. FREEBOARD ASSESSMENT
VI. CLOSURE ASSESSMENT
VII. EMBANKMENT PROTECTION ASSESSMENT
VIII. GEOTECHNICAL- EMBANKMENT AND FOUNDATION STABILITY
IX. GEOTECHNICAL- SETTLEMENT
X. INTERIOR DRAINAGE
XI. OPERATIONS AND MAINTENANCE
XII. SUPPLEMENTAL INFORMATION
   - AS-BUILT PLANS
   - PRE AND POST FLOODPLAIN MAPS
Levee Certificate
Engineer’s Certificate

HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10(b) Tab

For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists is provided here forth in this submission.

Note: According to 44 CFR 65.2, "(b) For the purpose of this part, a certification by a registered professional engineer or other party does not constitute a warranty or guarantee of performance, expressed or implied. Certification of data is a statement that the data is accurate to the best of the certifier’s knowledge. Certification of analyses is a statement that the analyses have been performed correctly and in accordance with sound engineering practices. Certification of structural works is a statement that the works are designed in accordance with sound engineering practices to provide protection from the base flood. Certification of “as built” conditions is a statement that the structure(s) has been built according to the plans being certified, is in place, and is fully functioning.
(c) For the purposes of this part, “reasonably safe from flooding” means base flood waters will not inundate the land or damage structures to be removed from the SFHA and that any subsurface waters related to the base flood will not damage existing or proposed buildings.”

Signature: ___________________________ 06/12/2014

Name: Michael J. Ryan, P.E.

License Number and State: 062.040894 Expires 11/30/2015
44 CFR 65.10(b) (1) (i) Tab

(1) Freeboard. (i) Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.

P.E. Signature: Michael J. Ryan  
June 12, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015
HR Green, Inc.
Project No.: 86120243

Levee Certification Report
Bower School Berm
DuPage County, IL

44 CFR 65.10 (b) (2) Tab

(2) Closures. All openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.

P.E. Signature: [Signature]

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015
HR Green, Inc.  
Project No.: 86120243

Levee Certification Report  
Bower School Berm  
DuPage County, IL

44 CFR 65.10 (b) (3) Tab

(3) Embankment protection. Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability. The factors to be addressed in such analyses include, but are not limited to: Expected flow velocities (especially in constricted areas); expected wind and wave action; ice loading; impact of debris; slope protection techniques; duration of flooding at various stages and velocities; embankment and foundation materials; levee alignment, bends, and transitions; and levee side slopes.

P.E. Signature: Michael J. Ryan  
June 13, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015
44 CFR 65.10 (b) (4) Tab

(4) Embankment and foundation stability. Engineering analyses that evaluate levee
embankment stability must be submitted. The analyses provided shall evaluate expected
seepage during loading conditions associated with the base flood and shall demonstrate
that seepage into or through the levee foundation and embankment will not jeopardize
embankment or foundation stability. An alternative analysis demonstrating that the levee is
designed and constructed for stability against loading conditions for Case IV as defined in
the U.S. Army Corps of Engineers (COE) manual, “Design and Construction of Levees”
(EM 1110–2–1913, Chapter 6, Section II), may be used. The factors that shall be
addressed in the analyses include: Depth of flooding, duration of flooding, embankment
geometry and length of seepage path at critical locations, embankment and foundation
materials, embankment compaction, penetrations, other design factors affecting seepage
(such as drainage layers), and other design factors affecting embankment and foundation
stability (such as berms).

P.E. Signature: [Signature]

P.E. Name: Mickey Snider

P.E. License Number and State: No. 062-058045 ILLINOIS
Levee Accreditation
Embarkment and Foundation Stability Analyses

Drained Analysis for Berm Slope River Side, Ref Borings BB-6 and BB-7

<table>
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<th>Description</th>
<th>Unit Weight (pcf)</th>
<th>Drained Cohesion (psf)</th>
<th>Drained Friction Angle (degrees)</th>
<th>Hydraulic Conductivity (cm/sec)</th>
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Levee Accreditation
Embarkment and Foundation Stability Analyses

Drained Analysis for Berm Slope Protected Side, Ref Borings BB-6 and BB-7

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<th>Drained Cohesion (psi)</th>
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<td>30</td>
<td>1x10^-3</td>
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</table>
HR Green, Inc.  
Project No.: 86120243

Levee Certification Report  
Bower School Berm  
DuPage County, IL

44 CFR 65.10 (b) (6) Tab

(6) Interior drainage. An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.

P.E. Signature:  

Michael J. Ryan  
June 12, 2014

P.E. Name: Michael J. Ryan

P.E. License Number and State: No. 062.040694, State of Illinois, Expires 11/30/2015
INTERIOR DRAINAGE WORKED AS DESIGNED IN APRIL 2013 FLOOD
INTERIOR DRAINAGE WORKED AS DESIGNED IN APRIL 2013 FLOOD
In-River Enhancements/ Restoration

- Riffle Enhancement Area
- Vegetated Rock Toe
- Native Vegetation
Closing

• **What to take away from this**
  • Review and first obtain concurrence with all parties on flood protection elevation.
  • If the levee is to be certified, ensure all requirements for certification can be addressed.
  • Find a good geotechnical consultant who can take it from design through certification.
  • Coordinate early with FEMA

• **Multiple Alternatives/ Designs**
  • Required to satisfy all stakeholders

• **Costs**
  • Conscientious of all stakeholders needs while keeping budget on track
  • Cost Sharing contributes to successful completion and satisfied stakeholders

• **Keep big picture / goals in mind**
Questions/ Discussion

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BOWER LEVEE
BOWER LEVEE LIFT STATION = 2 - 500 GPM PUMPS CAPACITY
BOWER LEVEE - CLOSURE GATE

1. GATE STRUCTURE B (STORM TAG 6)
2. GATE STRUCTURE C (STORM TAG 18)

Final for Construction

BOWER SCHOOL BERM RESTORATION PROJECT
CITY OF WARRENVILLE
DUPAGE COUNTY, IL

GATE VALUE
SLICE GATE AND GUIDE ASSEMBLY, 3' X 3' FOR GATE STR. B AND C

GV102
River Road

- **Stakeholders**
  - Residents
  - City of Warrenville
  - DuDOT
  - DuPage County

- **Objective:** Protect Business/Residents from Flooding

- **Coordination**
  - Cost Share (County, City)
  - Business and Residents for Property Impacts
  - DuDOT for Jurisdictional Transfer
  - County Consultant (ERA) for River Restoration One bid package (2 consultants!)
Temporary River Crossing

Curb & Gutter

Compensatory Storage

Some of the construction pictures. Shows the construction of the berm, lime being mixed to the excavated and stockpiled contaminated material to dry it out before hauling.