Plum Creek / Hart Ditch Flooding Watershed Study

March 11, 2009

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Plum Creek / Hart Ditch Watershed

- Will and Cook County Illinois
- Lake County Indiana

36 mi² at State Line (Plum Creek)
71 mi² at Little Calumet River (Hart Ditch)
Study Purpose

- Plum Creek / Hart Ditch Overtopped Banks (August 2007)

- Significant Damages
  - Crete Township
  - Dyer, Indiana
    - Saint Margaret Mercy Healthcare Center
    - Several Subdivisions
Study Purpose

- Plum Creek / Hart Ditch overtopped its banks (August 2007)
  - Property damage (12”-18” in 1st Floor)
  - Roadway closures (confluence area)
  - Isolated from emergency services 30+hrs
Study Objective

- Determine the cause of the August 23rd and 24th, 2007 Flooding

- Identify damage areas and structures in the Plum Creek / Hart Ditch Watershed

- Develop Hydrologic and Hydraulic Models
  - Calibrate August 2007 storm event
  - FIS Flow rates compared to calibrated model
Study Partners

• Crete Township

• Lake County Surveyors Office, Lake County Indiana

• Saint Margaret Mercy Healthcare Centers, Dyer Campus

• Town of Dyer, Indiana
Crete Township Flooding

- Confluence Area
  - 30 mi$^2$ at confluence of Klemme and Plum Creek
FIS Differences IL to IN

• Regulatory Models
  – Illinois and Indiana discrepancies
    • Illinois - HEC 1
      – Three subbasin model
      – FIS flowrate at state line = 2,689 cfs
    • Indiana - Coordinated Discharge Curve
      – FIS flowrate at state line = 1,860 cfs

• 0.5 foot difference in 100-year elevations at State Line
Study Approach
(Hydrologic Gage Data)

Hydrologic Modeling
– Precipitation Gages
  • USGS – Crete and 213th St.
  • CoCoRaHS (Community Collaborative Rain, Hail & Snow Network
    – Community-based network of volunteers
    – Located in Will County
Study Approach
(Hydraulic Gage Data)

- Hydraulic Modeling
  - Stage Gages
    - USGS – Hart Ditch at 213th Street
    - USGS – Hart Ditch at Munster
    - Local High Water Marks
      - Observed; Crete and Dyer
August 2007 Storm Event

- Bulletin 70
  - 100-year, 5-day = 10.9 inches
- Measured
  - 10.2 inches in 5-days
Sunny in Dyer

- August 24, 2007
  - 0.97 inches in Dyer (downstream)
    - Storms moved through area and giving way to sunshine in Dyer
  - 4.94 inches in Crete Township (upstream)

- Flooding came by surprise
August 2007 Storm Event

USGS Gage – 213th Street in Dyer
Regulatory 100-year flow rate, 1910 cfs at 213th St.

Max Stage = 15.66 feet
Max Flow = 2,650 cfs
Calibrated Hydrologic Study

- A detailed hydrologic model was developed using the precipitation and other gage data in the watershed
  - HEC-HMS with 15 subbasins
  - Calibrated to August 2007 storm
  - Gage data from USGS precipitation gages
  - Match flow rate at 213\textsuperscript{th} Street in Dyer
Hydrologic Results at 213th Street

• Measured data
  – Measured vs. Simulated
    • 2,649 cfs vs. 2,645 cfs

• Design data
  – Bulletin 70
  – 100-year critical duration flow rate is more than double the measured flowrate
Hydrologic Calibration

• Determine the 100-year design flowrate at 213th St.
  – Continuous rainfall over a 6-day period
    • Saturated watershed condition
  – 4.94 inches in Crete Township on August 24, 2007
    • No infiltration, large runoff volume

• Initial CNs are assumed to be AMC III
  • Convert AMC values for III condition to II
  • Execute HMS for August 2007 storm event
  • Compare hydrographs at 213th Street
  • 100-year design flowrate = 3,282 cfs
Hydraulic Calibration

• Known water surface elevations
  – Observed during August 2007 event
    • SMMHC
    • Hart Street
    • Subdivisions throughout Dyer

• Calibrate HEC-RAS to match elevations observed and measured
  • Manning’s N values
Expanded Study Purpose

- **September 14th 2008**
  - Flooding Occurred again in the region

- Expand study to identify possible locations for floodwater storage facilities

- Determine flood reduction benefits throughout the watershed
September 13th and 14th 2008

Source: The Times, Munster IN
September 13th and 14th 2008

Source: Lake County Surveyors Office
September 13th and 14th 2008

Source: The Times, Munster IN
September 13th and 14th 2008

Source: Lake County Surveyors Office
## September 2008 Storm Event

### Precipitation Gages
- **USGS**
- **CoCoRaHS (Community Collaborative Rain, Hail & Snow Network)**

### Bulletin 70
- 100-year, 10-day = 12.26”

### Nearly 8 inches in 2-days

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September 2008 Storm Event

USGS Gage – 213th Street in Dyer
Regulatory 100-year flow rate, 1910 cfs at 213th St.

Max Stage = 16.76 feet
Max Flow = 3,110 cfs
Modeling Verification

• Execute hydrologic model using the September 2008 precipitation data
  – Match flowrate measured at 213\textsuperscript{th} Street
    • Measured flow = 3,110 cfs
    • Simulated flow = 3,151 cfs
• Enter flowrates into HEC-RAS hydraulic model to verify measured stage at 213\textsuperscript{th} St. gage
Potential Flood Control Reservoir

• Flood storage upstream of flooding areas
  – Identified two locations in Illinois
    • One for the benefit of Crete Township
    • One for the benefit of Indiana

• Utilize flood storage by “cutting off” the peak of the hydrograph
Regional Flood Control Reservoir

Inflow - Outflow Hydrograph at Potential Flood Control Reservoir

Determine reservoir size by diverting volume off the peak
Flood Reduction Benefits

• Determine flowrate reduction utilizing flood storage
• Determine decrease in water surface elevations through damage areas
• Benefits with flood reservoirs
  – Reduction of 1.5 feet in Crete Township
  – Reduction from 2 feet to 0.5 feet in Indiana all the way to the Little Calumet River
Conclusions

• Early Warning system in Crete Township through cooperation with USGS
  – Currently working on forecast of downstream gage heights
  – Time to prepare, utilize an emergency action plan
Challenges

• Regional Flood Control Reservoir
  – Multiple Location(s)
    • Crete Township and Lake Co, IN
    • Upstream of flooding
    • Provide storage in Illinois for Indiana
    • Land Acquisition, public or private
  – Funding
  – Permitting
  – Mapping