Stormwater Basin Retrofitting

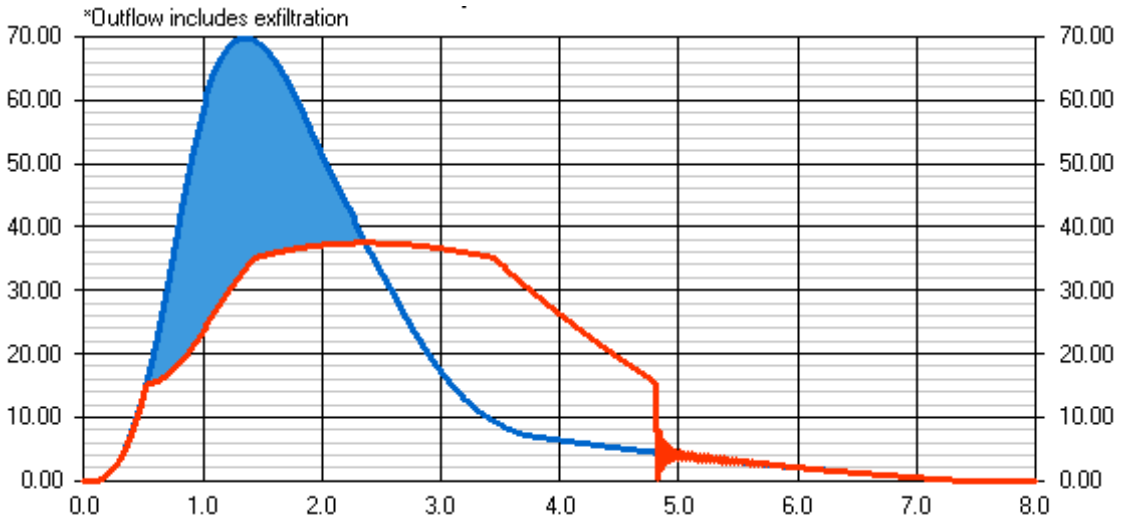
March 2013

Definition of retrofitting

- The act of installing, fitting, or adapting for use with something older.

Benefits of Stormwater Detention

- **Reduces peak flows downstream of developments**

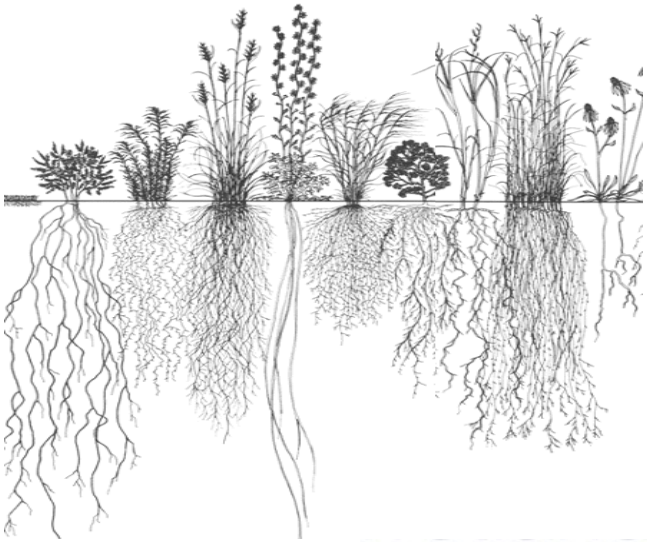


Benefits of Stormwater Detention

- **Creates open space**
  - Recreation opportunity
  - Wildlife habitat

Benefits of Stormwater Detention

- **Water quality**
  - Promotes sedimentation
  - Groundwater infiltration
  - Vegetation absorption of nutrients
  - Filtration of oil, grease and other pollutants from urban runoff



Reasons for Retrofitting

Reasons for Retrofitting

- Flooding
  - Structure flooding
  - Roadway impassible
  - Reduces emergency service weather delays
- Tributary Changes
  - Urbanization
  - Diversions
  - Other stormwater basins
- Old Basin Design
  - Outdated engineering practices
  - Basin overtopping
  - Steep Slopes without safety shelf

Reasons for Retrofitting

- Scour
  - Wall scour
  - Outlet scour
  - Shoreline erosion
- Improve Water Quality / MS4 Permit
  - Retention
  - Wet bottom detention
  - Riparian vegetation
- Maintenance Issues
  - Overgrown
  - Difficult to access
  - Sediment deposit
  - Trash

Reasons for Retrofitting:

Flooding

Flooding

Problems you are likely seeing:

- Flooding homes and streets in developed areas

- Resident complains

- Emergency Vehicles are not able to pass flooding

Flooding

Why should the problem be corrected:

- Ensure resident safety
- Reduce Municipal liability
- Reduce Public Works time and cost

Flooding

Solutions:

- Increase conveyance to stormwater basin
  - Increase size of storm sewer
  - Overland flood routing

- Increase the volume of the stormwater basin
  - Adjacent On-site ($50,000/ac-ft)
  - Lower Invert On-site ($65,000/ac-ft)
  - Upstream ($75,000/ac-ft)
  - Underground ($250,000/ac-ft)

Flooding

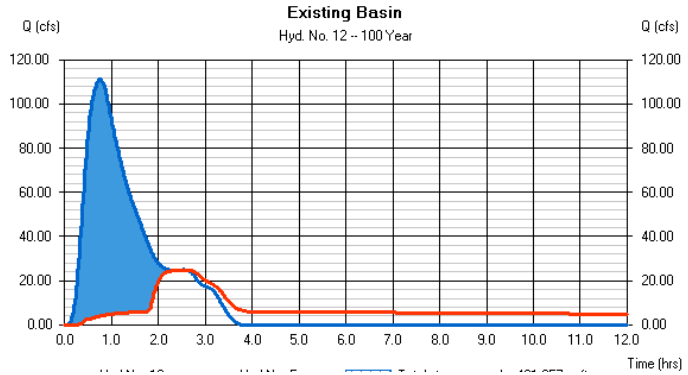
Solutions:

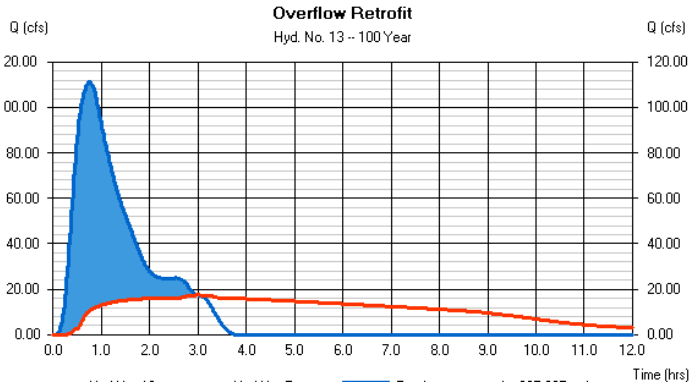
- Multi-stage outlets
  - Two (2) or more outlet pipes to control the flow of stormwater
  - Establish Goals
    1. Reduce flood overflows from undersized basins
    2. Increase effectiveness of basin for more frequent storm events (10-year)

Flooding

Solutions:

- Multi-stage Outlets – Reduce Flood Overflows
  - Excellent for basins that open channel outlets
    - Maintain low-flow outlet
    - Additional conduits
    - Improve outlet as needed
    - Eliminate overflow
  - Existing 40 acre development
    - 12” pipe outlet, Overflow weir
    - Max Outflow 10-year = 4.8 cfs
    - Max Outflow 100-year = 24.8 cfs
  - Proposed Multi-stage retrofit
    - 12” pipe outlet, Overflow weir
    - 15” pipe outlet (new)
    - Max Outflow 10-year = 11.6 cfs (>100% increase)
    - Max Outflow 100-year = 17.4 cfs (30% decrease)

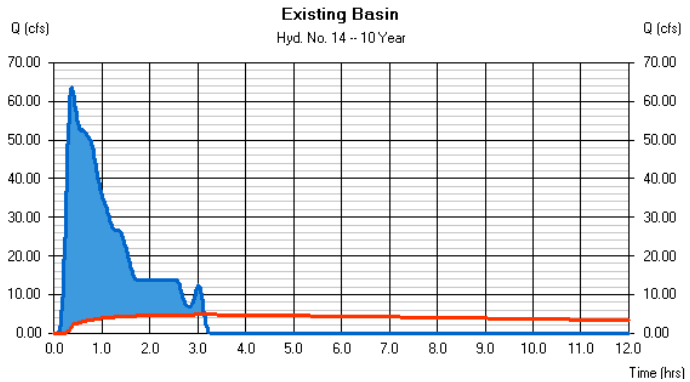


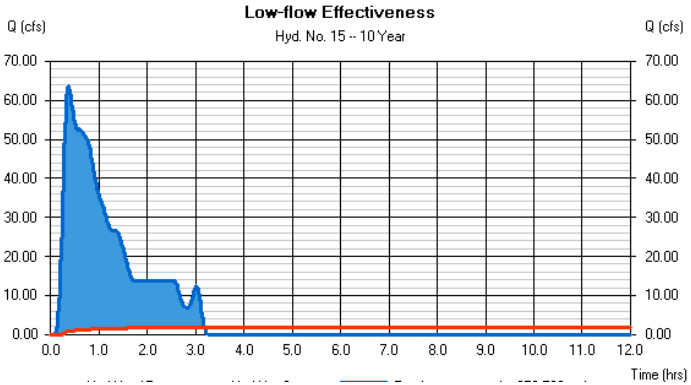


Flooding

Solutions:

- Multi-stage Outlets – Effectiveness for Frequent Storms





  - Excellent for basins that utilize sensitive downstream sewers
    - Reduce low-flow outlet size
    - Additional conduits
    - Maximize Storage
  - Existing 40 acre development
    - 12” pipe outlet, Overflow weir
    - Max Outflow 10-year = 4.9 cfs
    - Max Outflow 100-year = 6.5 cfs
  - Proposed Multi-stage retrofit
    - 8” pipe outlet (new), Overflow weir
    - 12” pipe outlet (new)
    - Max Outflow 10-year = 1.9 cfs (61% decrease)
    - Max Outflow 100-yer = 7.1 cfs (10% increase)

Flooding

Solutions:

- Multi-stage outlets considerations
  - What kind of flooding is occurring downstream?
  - Should the multi-stage outlet system concentrate on 100-year flood event or more frequent storms (10-year)
  - How is the drainage system downstream functioning?
    - Limited downstream sewer system
    - Open channel / stream

Reasons for Retrofitting:

Tributary Changes

Tributary Changes

Problems you are likely seeing:

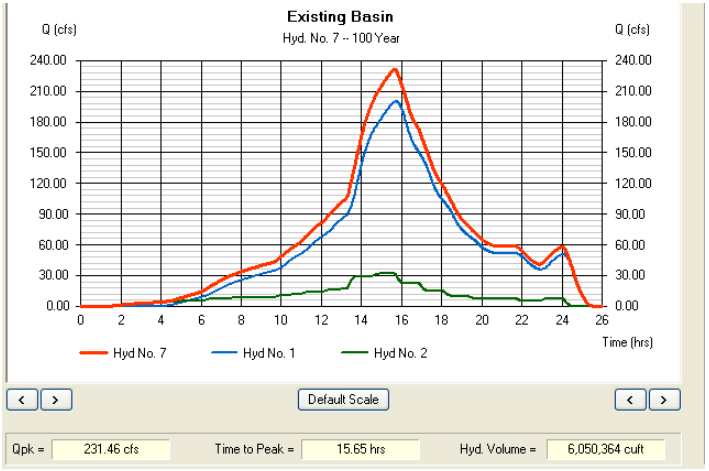
- Stormwater no longer fills the stormwater basin during major flooding event

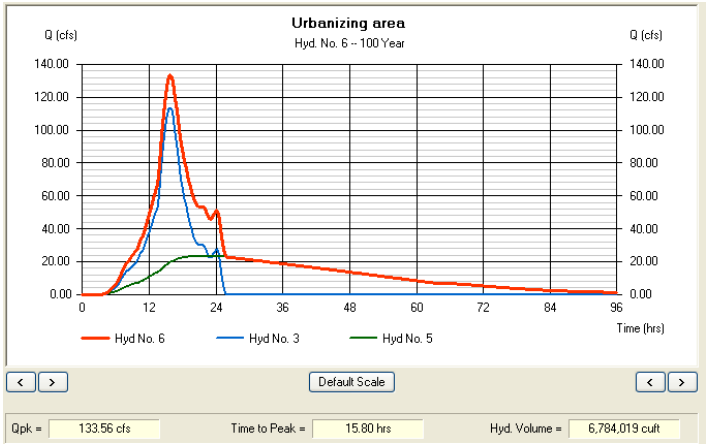
- Dry bottom stormwater basins stay wet most of the year

Tributary Changes

Tributary Changes

Inflow



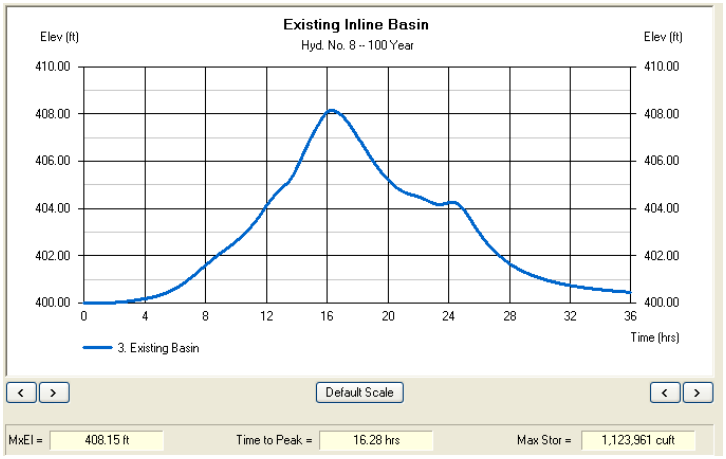


Inflow from 350 acres tributary area

- Existing Conditions (100yr,24hr)
  - 310 acres of natural area
  - 40 acres of urban area with inline storage
  - Peak 230 cfs
  - Runoff Volume = 140 ac-ft
  - Flow ends at 25 hours
- Urbanized Conditions
  - 175 acres of natural area
  - 40 acres of urban area with inline storage
  - Newly created 135 acres of urbanized area with stormwater detention
  - Peak 135 cfs
  - Runoff Volume = 160 ac-ft
  - Flow ends at > 5 days

Tributary Changes

Inflow



Basin Function

- Existing Conditions
  - Max Storage = 26 ac-ft
- Urbanized Conditions
  - Max Storage = 18 ac-ft
  - Storage Reduces = 8 ac-ft

Tributary Changes

Why should the problem be corrected:

- Reduce flooding in problematic areas downstream
- Maintain stormwater basins for athletic fields
- Increased pollutant loads from urbanized areas

Tributary Changes

Solutions:

- Modify stormwater basin outlet
  - Reduce outlet pipe
  - Increase storage volume
  - Increase benefits for major storm events
- Infiltration
  - Install underdrain system
  - Reduce nuisance flows
  - Reinstate dry athletic fields

Tributary Changes

Solutions:

- Two level basin
  - Wet Area
    - Naturalized area with native plants to help in infiltration and evapotranspiration
  - Dry Area
    - Athletic fields

Reasons for Retrofitting:

Old Basin Design

Old Basin Design

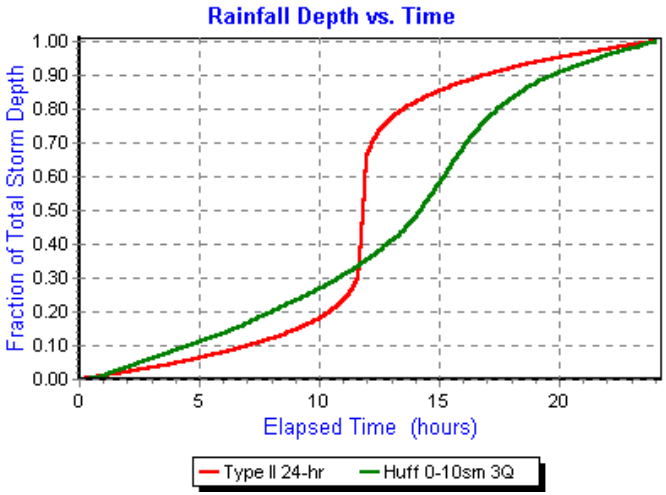
Problems you are likely seeing:

- Basin design includes steeps slopes and no safety shelf
- Stormwater is overtopping the basin
- Lack of overland flood route
- Stormwater standing in neighborhood

Old Basin Design

Reason for the problem:

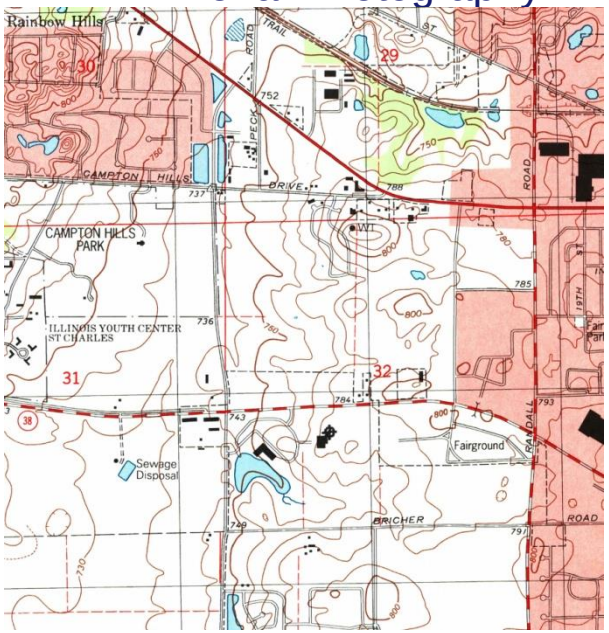
- Change in engineering rainfall data
  - Technical Paper 40 (1961) – 100-year event = 5.8” precipitation
  - Bulletin 70 (1989) – 100-year event = 7.58” precipitation
  - 30% increase in precipitation
- Change in storm distributions
  - SCS Method, Type II – conservative results
  - Huff Distribution – represent the typical rainfall distribution

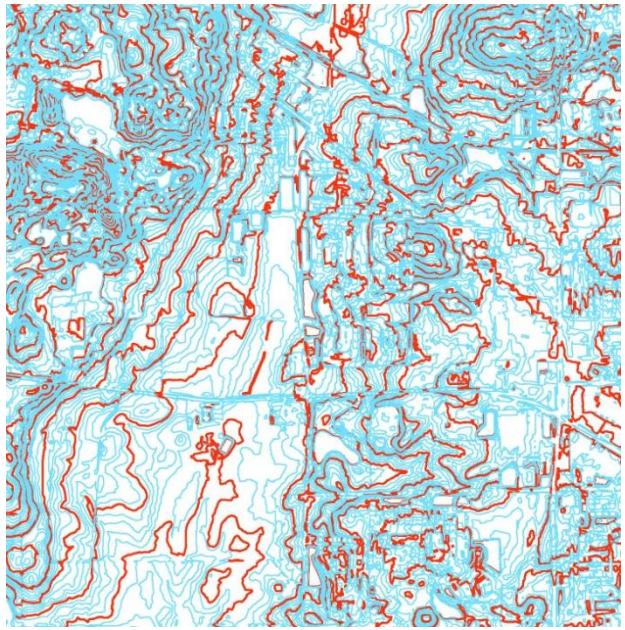


Old Basin Design

Reason for the problem:

- Available Data
  - Contour Maps
    - OLD – USGS Quadrangle Map / Hydrologic Atlases
    - NEW – 2’ GIS Contours
  - Aerial Photography





Old Basin Design

Reason for the problem:

- County / Municipal Ordinances
  - DuPage County
    - Original Ordinance – 1991
    - Latest Update – 2012
  - Kane County
    - Original Ordinance – 1998
    - Latest Update – 2009
  - Lake County
    - Original Ordinance – 1992
    - Latest Update – 2012
  - McHenry County
    - Original Ordinance – 2004
    - Latest Update – 2011
  - Will County
    - Original Ordinance – 1998
    - Latest Update – 2010
  - Cook County
    - Full implementation coming soon

Old Basin Design

Reason for the problem:

- Other revelations
  - Overland flow routes are necessary for all developments

Old Basin Design

Why should the problem be corrected:

- Overtopping leading to flooding downstream
- Flooding upstream of the basin due to undersized storm sewers
- Overland flood routes area undersized and depressional areas are flooding
- Include safety measures

Old Basin Design

Solutions:

- Increase the volume of the basin
  - Added volume upstream, on-site, or underground to new engineering standards
- Multi-stage outlet
  - Improve the performance with additional control
- Increase conveyance to stormwater basin
  - Upsize the storm sewer and inlet structures

Reasons for Retrofitting:

Scour and Erosion

Scour and Erosion

Problems you are likely seeing:

- Erosion along the side of basin
- Scour at the inflow pipes

Scour and Erosion

Why should the problem be corrected:

- Sedimentation from erosion and scour can limit the conveyance of downstream sewer and culverts
- Infrastructure replacement due to scour
- Breach if an above-ground impoundment

Scour and Erosion

Solutions:

- Inflow protection
  - Rock rip-rap at the basin inlet
  - Plunge pool

Scour and Erosion

Solutions:

- Erosion protection
  - Collect the stormwater along the ridge of the basin and drop into basin with catch basin and sewers
  - Use deep rooted native plants to stabilize side and shoreline of basin

Reasons for Retrofitting:

Water Quality

Water Quality

Problems you are likely seeing:

- Stormwater is cloudy
- Odor
- Oil Sheen

Water Quality

Why should the problem be corrected:

- NPDES / MS4 Regulations
- Protection of State / County / Municipal natural areas
- Protection of wildlife

Water Quality

Solutions:

- Sedimentation Areas
  - Located near inflow to basin
  - Use rock check damn to promote sedimentation
  - Maintain as needed

- Increase detainment time
  - Use stormwater “run around” to maximize travel distance
  - Use perforated riser

Water Quality

Solutions:

- Naturalize Basin
  - Install wetland, emergent and prairie plants to help remove pollutants

Reasons for Retrofitting:

Difficult to Maintain

Difficult to Maintain

Problems you are likely seeing:

- Cannot access stormwater basin
- Dense invasive species
- Trash
- Cannot locate points of inflow and outflow from basin

Difficult to Maintain

Why should the problem be corrected:

- No easement to access basin
- Stormwater does not move through the basin effectively
- Significant head needed to create flow
- Unable to check or maintain control structures
- Vegetation can plug outlet structures and overtopping can occur.
- Unsightly

Difficult to Maintain

Solutions:

- Obtain easements
  - Actively look for opportunities to obtain easement from property owners

- Natural area maintenance
  - Prescribed burn
  - Overseeding and plugs of low-profile vegetation
  - Maintenance plan and schedule

Questions and Contact Information

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