NEW YORK STATE OF OPPORTUNITY. Department of Transportation

"Boots on the Ground" Are Already Going Green:

Stream Restoration Best Management Practices from Maintenance Programs

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- New York State has experienced several major floods during the late 1900's to the early 2000's due to intense rainfalls.
  - Examples include:
    - October 1955: Schoharie Creek – 16 to 18 inches of rainfall
    - September 1975 – Susquehanna River/Catskills – Hurricane Eloise
    - March 1980 – Schoharie, Catskill & Esopus Creeks – 10 inches of rain. "Great Catskill Toilet Flush"
    - April 4-5, 1987 – Mohawk River & Catskills, record flooding causing the sudden collapse of NYS Thruway bridge over Schoharie Creek resulting in 10 deaths
    - January 19-20, 1996 – Rapid snowmelt and 2-4 inches of rain caused severe flooding throughout Region 9. Record flooding on Schoharie Creek.
    - September 1999 – Tropical Storm Floyd – 3 to 12 inches of rainfall.
    - September 17-18, 2004 – Hurricane Ivan – up to 6 inches of rainfall.

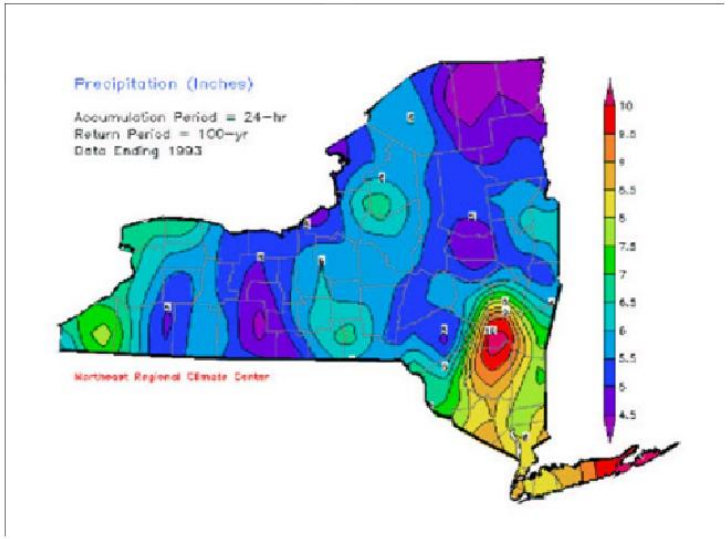
- More examples….
  - June 2006 – Flood of Record for most of NYSDOT Region 9. Up to 12 inches of rain. Several deaths occurred as a result.
  - April 2007 – Catskill Region – 6 to 8 inches of rainfall.
  - June 2007 – T/O Colchester, Delaware County, NY – flash flooding resulting in 4 deaths.
  - July 2008 – T/O Colchester, Delaware County, NY – flash flooding – same locations as June 2007
  - August 28, 2011 – Tropical Storm Irene – Widespread flooding
  - September 5-8, 2011 – Tropical Storm Lee – Widespread flooding
  - October 2012 – Hurricane Sandy
  - June 2013 – Flash Flooding – Widespread throughout NYS.
  - Localized events - 2014, 2015 & 2016.

Catskill Region Climate

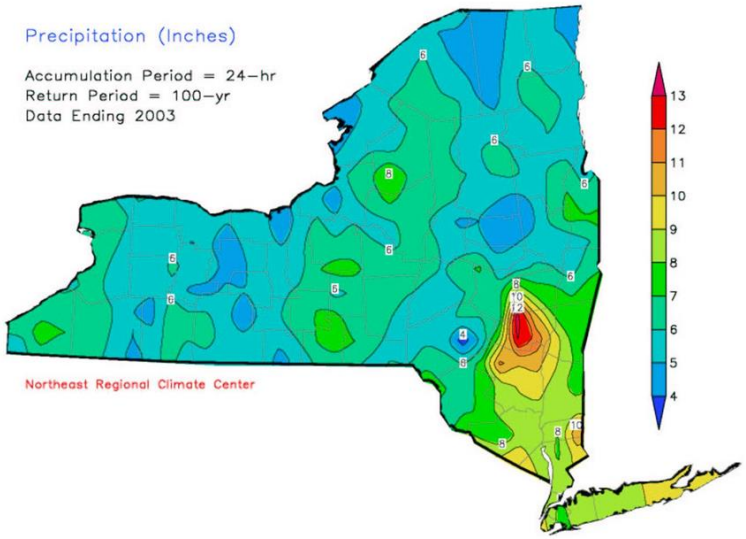
- High rainfall compared to rest of state
- Climate change causes increasing precipitation levels and variability (more extremes)
  - Streams are adjusting to increase flows
- Difficult to predict local severity of forecasted rain event

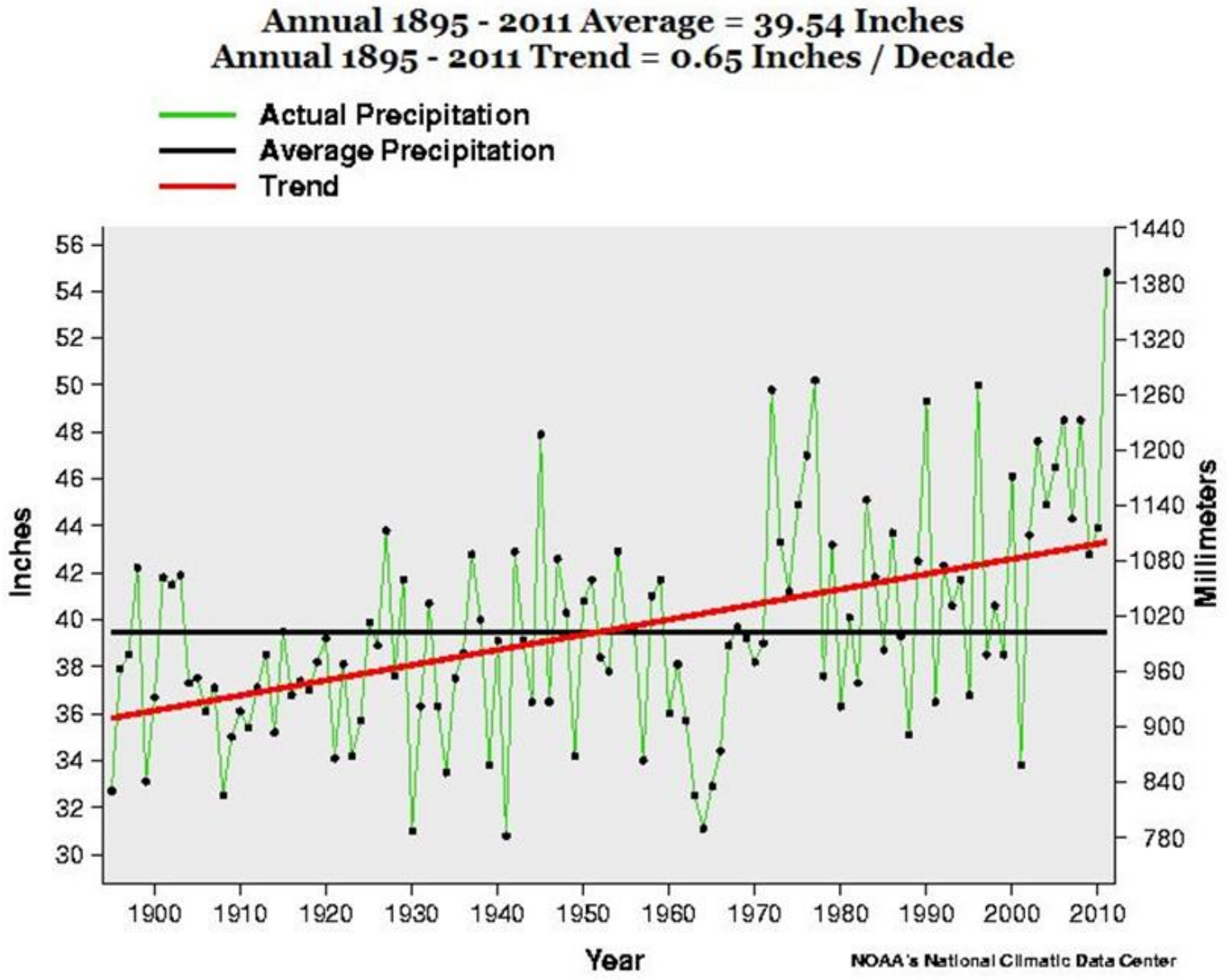
Comparison of 100 year storms

Data ending 1993



Data ending 2003




Annual 1895 - 2011 Average = 39.54 Inches
Annual 1895 - 2011 Trend = 0.65 Inches / Decade
Actual Precipitation
Average Precipitation
Trend
Inches
Millimeters
Year
NOAA's National Climatic Data Center


Tropical Storm Irene
Satellite photo courtesy of:
August 28, 2011

Background Information

- As a result of increased flooding and infrastructure damage, ***State Maintenance Forces*** are often called upon to respond to an emergency or to reduce the potential for future damage.
- In an emergency situation, there is much pressure to “do something”
  - “Something” generally translates to “Equipment & Operator”
  - Employees should have a basic knowledge of stream mechanics to be able to intervene in an emergency and then restore the conditions.

Stream Restoration defined…

- Restoring stream to original dimensions, pattern and profile to allow it to contain a bankfull discharge flow at which channel maintenance is most effective.
- Bankfull flow: *"The bankfull stage corresponds to the discharge at which the channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing the work that results in the average morphologic characteristics of the channel."* - *Dunne and Leopold, 1978*
- Bankfull flows generally occur on the 1.5 year interval in NY's Catskill Region.
- Stream restoration also reconnects the stream and floodplain, which can mitigate future flood damage.

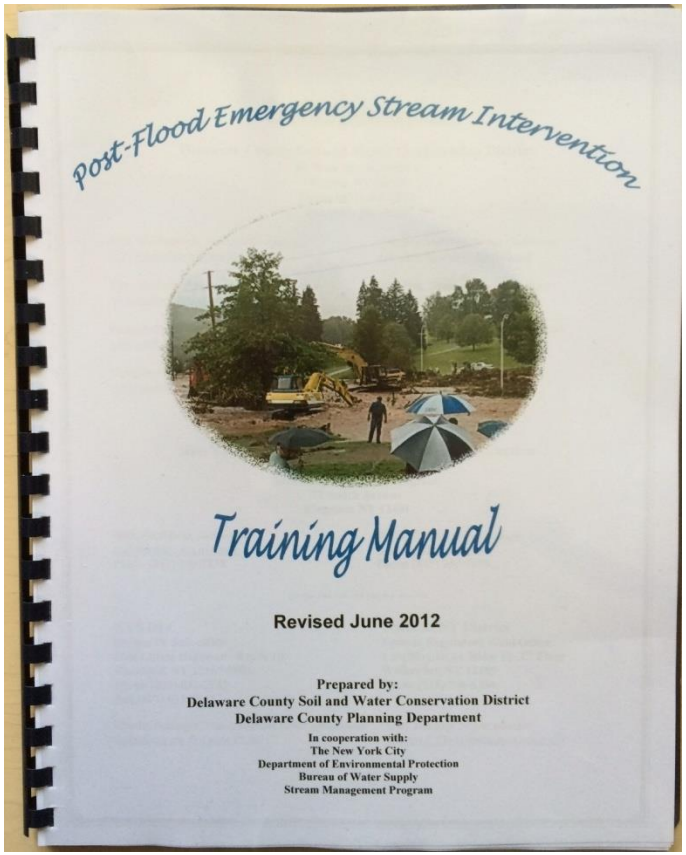
Stream work with Maintenance Personnel

- Train Employees
- Assemble a “Team”
  - Networking
  - Partnerships
- Restore the stream
  - Identify the problem
  - Develop solutions
  - Develop schedules
  - Obtain permits
  - Undertake work
  - Re-vegetate site
  - Evaluate post-construction

Training of Employees

- All NYSDOT Region 9 Highway Maintenance Supervisors (HMS 1 & 2) and Operators (HMW2) have attended “Post Flood Emergency Stream Intervention Training as developed by the Delaware County Soil and Water Conservation District.
  - Several operators and supervisors attended a Pilot Training session of this class that included a field session.
- Field experience for operators and supervisor is critical for success.
  - It is equally important for employees to witness streams under all flow conditions (low flows, bankfull flows, and flood stages).

Training Topics



- Precipitation
- Stream Mechanics
- Stream Types
- Flood plains
- Stream Instability
- Impaired Floodplains
- Unstable Channels
- Avulsion
- Flood Response
- Channel Sizing
- Examples – Field Experience
- Work Methods
- De-Watering Methods
- Permitting
- Types of Equipment

The “Team”

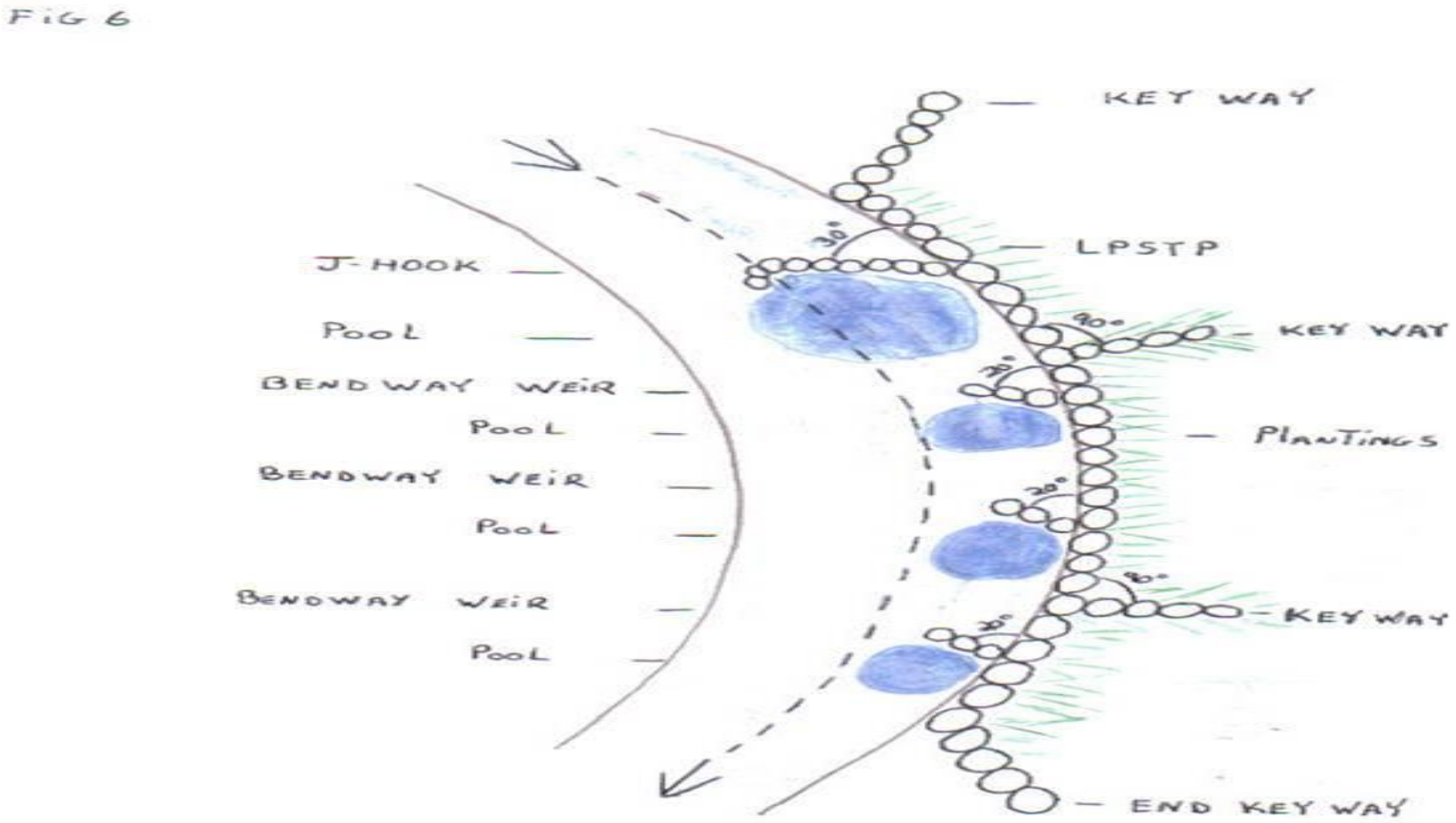
- Other groups within Department may have expertise that can be utilized.
- Outside agencies / organizations may have the necessary information to improve planning and design
  - Soil and Water Districts, Regulatory Agencies, etc
- May need to “Shared Services” for equipment and materials.
- Coordinated work:
  - Other local governments
  - Others who are working upstream/downstream.
  - NYSDOT work is limited to on Right-of-way, in most instances.

Stream Restoration Process

- Identify problem
- Develop solutions
- Develop schedules
- Obtain permits
- Undertake work
- Re-vegetate site
- Post construction evaluation

Identify the Problem

Develop Solutions



Develop Schedules

- Prioritize work locations
- Availability of specialized equipment, if needed
- Site limitations
  - Runoff season?
  - Severe weather forecasted?
  - Stream flow conditions
- Regulatory limitations
  - Protect fisheries
  - Protect endangered species, if applicable.
    - Protect bats if tree cutting needed

Obtain Permits

- State and/or federal permits may be required
- Documentation is critical, even under emergency conditions!
  - Length and width and dimension of fills
  - Before and after photos
- If possible, coordinate with regulatory agencies before undertaking work
- Level of detail in permit documentation required may be different depending on the regulatory agency.

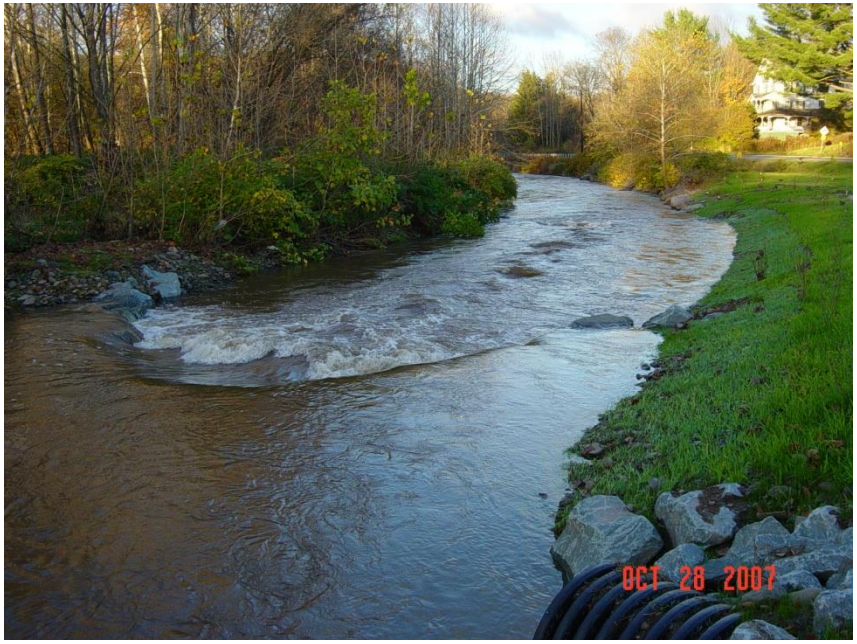
Undertake Work

Re-vegetate Site

Post-construction evaluation

09/20/2007

10/28/2007



Post-construction evaluation

09/20/2007

10/28/2007

Case Study: Cadosia Creek – Kerryville Brook

NYSDOT Region 9 – Delaware County

NYS Route 268

Kerryville Brook

Both streams are tributaries to the Delaware River and are trout spawning streams.


NYS Route 268 over
Kerryville Brook culvert
NYS Route 268 over
Cadosia Creek bridge
Image USDA Farm Service Agency
Google ear

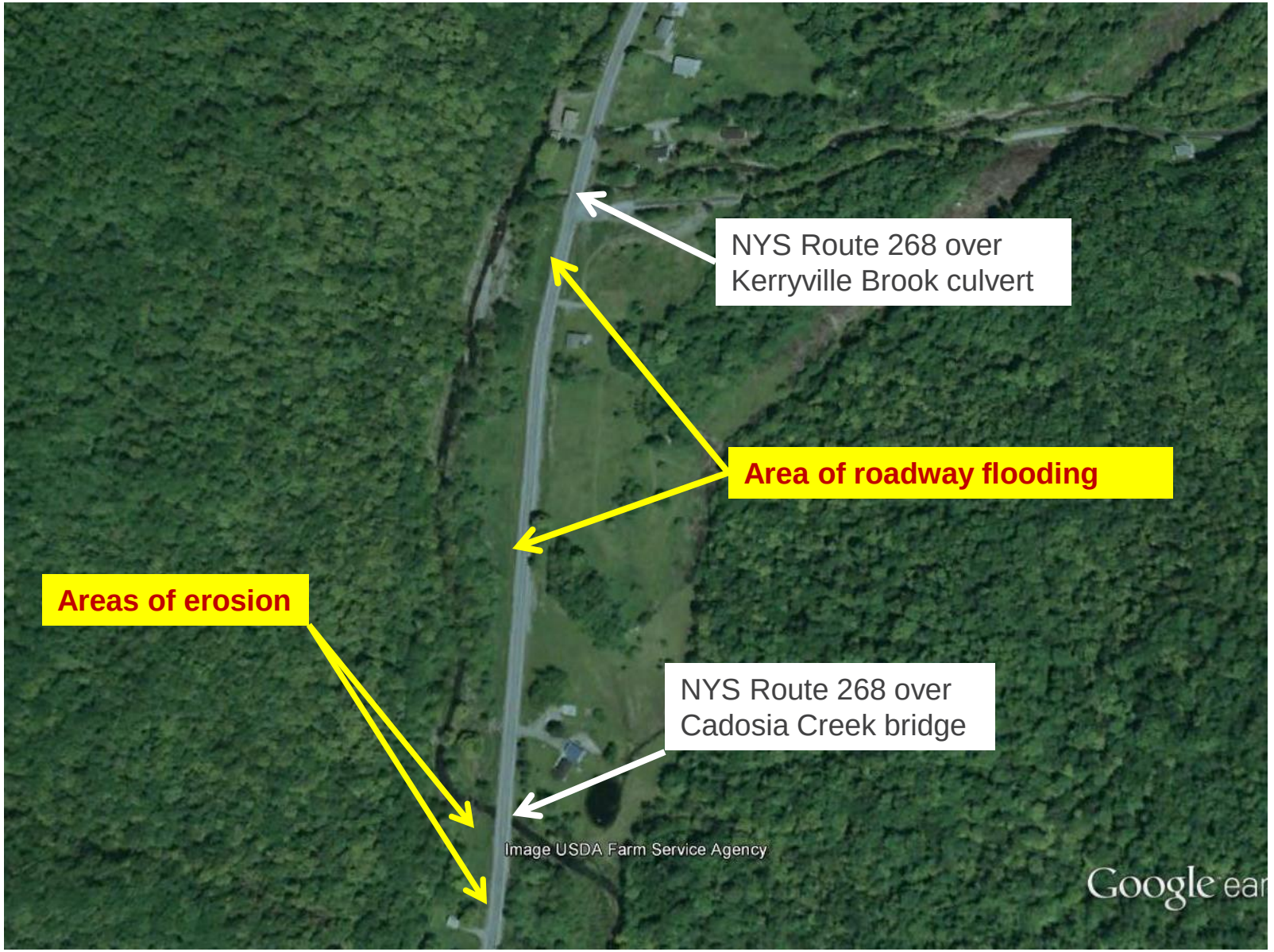
Identify Problem

Kerryville Brook

- High sediment load in the Kerryville Brook due to eroding banks and slides.
- The majority of this sediment deposits at the mouth of Kerryville Brook.
- The culvert that carries Route 268 over the Kerryville Brook would continually have a reduced hydraulic capacity due to sediment deposits and aggradation.

Cadosia Creek

- Cadosia Creek's bed elevation was almost even with the adjacent floodplain.
- Cadosia Creek would usually overflow and a flood channel would form at the toe of the Route 268 embankment
- Erosion at the approach to the NYS Route 268 over Cadosia Creek bridge would cause water to bypass inlet and erode Route 268.


NYS Route 268 over
Kerryville Brook culvert
Area of roadway flooding
Areas of erosion
NYS Route 268 over
Cadosia Creek bridge
Image USDA Farm Service Agency
Google ear

Proposed Solutions

Kerryville Brook

- Remove sediment from under culvert structure.
- Protect bank downstream
- Install cross-vanes upstream and downstream of bridge structure
- Install straight vane at confluence with Cadosia Creek
- Vegetate with willow cuttings.

Cadosia Creek

- Create flood plain bench
- Utilize root wads for bank protection, where applicable.
- Install cross vanes
- Install straight vanes
- Place heavy stone rip rap as bank protection, where needed.
- Vegetate with willow cuttings.

Kerryville Brook

- 2 Cross vanes were installed upstream of the NYS Route 268 culvert structure.

Kerryville Brook

- Accumulated sediments were removed from under culvertstructure using a walk-behind tracked loader.
- 1 Cross vane was installed downstream of NYS Route 268 culvert structure.
- Heavy stone protection was added at the toe of slope.

Cadosia Creek

- Cross vanes were installed in Cadosia Creek between the confluence with Kerryville Brook and the NYS Route 268 over Cadosia Creek bridge structure.

Cadosia Creek

- Removed an average of 2.0 feet of accumulated sediments from active channel to establish a single channel.
- Established a flood plain bench below abandoned O & W Railroad Line.
- Used root wads, where available, as bank protection.

Cadosia Creek

- Installed 2 straight vanes within channel immediately upstream of NYS Route 268 over Cadosia Creek bridge structure.

Cadosia Creek

- Installed 2 straight vanes within channel immediately upstream of NYS Route 268 over Cadosia Creek bridge structure.
- Installed stacked heavy stone as bank protection upstream of inlet to NYS Route 268 over Cadosia Creek bridge structure.

Cadosia Creek – Kerryville Brook Sites

Over 1500 Hybrid Willow (Salix spp.) were installed in the fall of 2011.

Vegetation – 2 years later

Case Study: Panther Rock Brook

NYSDOT Region 9 – Sullivan County

- Panther Rock Brook, a tributary of Callicoon Creek, has a large, but low clearance culvert in the middle of a hamlet (Youngsville, NY)
  - Hydraulic openings:
    - 35.0 ft. span by 3.4 ft. high
    - Bridge has a concrete bottom slab.
- Culvert has issues clogging with debris and sediments, which causing localized flooding with extensive damage.

Panther Rock Creek: 2006 Flood

Panther Rock Creek: 2006 Flood

Identify Problem – Panther Rock Creek

- "Floods of Record" occurred on June 26, 2006 and June 28, 2006.
  - Caused many trees to fall into the stream.
  - Widespread bank erosion.
- In response to these floods, local officials hired contractors to "*Clean the streams*".
  - Resulted in widespread destabilization of the banks.
    - Increased sediment loading and aggradation of the stream channel near the bridge.

Proposed Solutions - Panther Rock Creek

- 1st: Recommend to town/locals to vegetate banks to prevent further erosion and mobilization of sediments.
- 2nd: Remove sediments from under bridge with Micro Track excavator
  - This was a non-sustainable approach.
- 3rd: Maintenance forces partnered with SWCD and installed rock vanes upstream of culvert to better manage sediment deposition and control flows through bridge structure.
  - Work partners included Sullivan County Soil and Water District and the Youngsville Fire Department.

Panther Rock Creek: 2009

Panther Rock Creek: 2010

Panther Rock Creek: 2010

Panther Rock Creek – 2010

October 2010 – 1 month post construction

Panther Rock Creek: Next Steps

- Cross vanes facilitated the stream's ability to carry sediments through the structure for approximately 3 years without any maintenance required.
- This watershed had microburst (15 inches rainfall) on July 4, 2014.
  - Another "500 year flood" resulted.
  - Sediments needed to be removed from cross-vanes.
- Next step: A bridge replacement project is scheduled for 2017 to replace bridge with a larger structure to accommodate debris/sediment transport.
  - Involves the purchasing of private property and building removal.

Stream Restoration with Maintenance Forces: Opportunities

- Materials simple and relatively inexpensive
- Maintenance forces understand the problems
  - They're closest to the problem when it rains!
- Workers/supervisors like restoration work
  - Work is interesting and a change
  - They like leaving it "Better than before".
- Allows partnerships, yields multiple benefits: protects assets and natural resources

Stream Restoration with Maintenance Forces: Challenges

- Permits are generally required.
- Required de-watering
  - Added costs
  - Site may not make it feasible
- Equipment (gradalls, excavators) may be limited.
- Need additional training:
  - Constructing rock structures
- Maintenance may not have enough staff and equipment.
- Other work may be of a higher priority.

Stream Restoration with Maintenance Forces: Issues

- Some watersheds may have so many upstream/downstream problems that simple, site specific solutions may not possible.
  - Work may be larger in scope than can be completed by Maintenance forces.
- How to plan for future weather that is more extreme?

Acknowledgements

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Thank You!