

Appendix C

Project Meetings

Agenda for September 5, 2013 Project Kick-Off Meeting

Suggested West Windsor Kick-Off Meeting Agenda Items

1. Discuss Primary Points of Contact for Project
 - Consultant Team Project Manager
 - Township Project Manager

2. Review Key Dates for Project Schedule (Goals 1 and 2)
 - Confirmation of the 9/16 Initial Public Presentation date (Goal 1)
 - Coordinate Public Presentation dates with Township Meeting Schedule (Goals 1 and 2)

3. Goal #1 – Little Bear Brook Flood Hazard Assessment
 - Obtain Township Contact Information Including DPW, OEM, Police, Fire, Planner
 - Identify Available Township Data Including Township Facilities in Flood Zone and Reports Noted in RFP
 - Identify Flood Survey Area and Residences
 - Identify Structures and Facilities for Elevation Survey
 - Discuss Questions and Response Method for Flood Survey
 - Review Uncertain Scope Items:
 - Goal 1-5-b-i - Preventative Activities (e.g., planning and zoning, stormwater regulations)
 - Goal 1-5-c - Emergency Services (Warnings and evacuations for residents and critical facilities protection)

4. Goal #2 – West Windsor Redevelopment Area Regional Stormwater Management Analysis
 - Additional Data needs:
 - Roadway shapefile for Township roads with reference data (minor collector, major collector, etc.)
 - Municipal tax parcel shapefile (only table was provided by email)
 - Existing stormwater buildout analysis for the Township (if available)
 - Title surveys for properties (paper copies) – OPRA Request?
 - Review Uncertain Scope Items:
 - Goal 2-7 - "Full construction of all intermodal transportation infrastructure"

PowerPoint for September 16, 2013 Township Council Meeting

Little Bear Brook Flood Hazard Assessment and Redevelopment Area Regional Stormwater Management Analysis

**West Windsor Township Council Meeting
September 16, 2013**

Princeton Hydro, LLC and SWM Consulting, LLC

Project Team

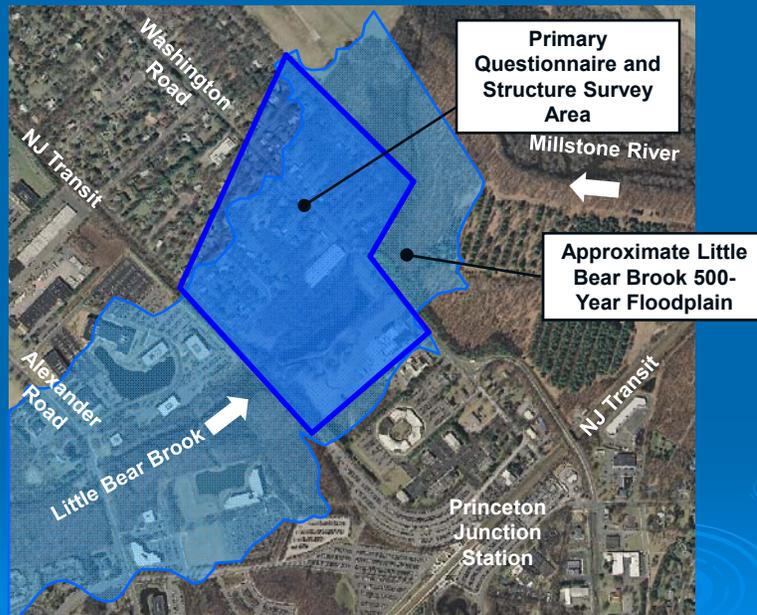
- **West Windsor Township**
 - M. Patricia Ward, Community Development Director
 - Francis Guzik, PE – Township Engineer
- **Princeton Hydro, LLC**
 - Geoffrey M. Goll, PE – Principal
 - Mary Paist-Goldman, PE – Project Manager
- **Storm Water Management Consulting, LLC**
 - Joseph J. Skupien, PE, PP – Principal

Princeton Hydro and SWM Consulting

Project Goals & Scope of Work

- **Goal 1: Little Bear Brook Flood Hazard Assessment**
 - Public Meetings and Outreach
 - Compile and Review Existing Data
 - Flood Hazard Assessment
 - Analysis of Flood Mitigation Strategies
 - Action Plan
 - Final Report and Presentation

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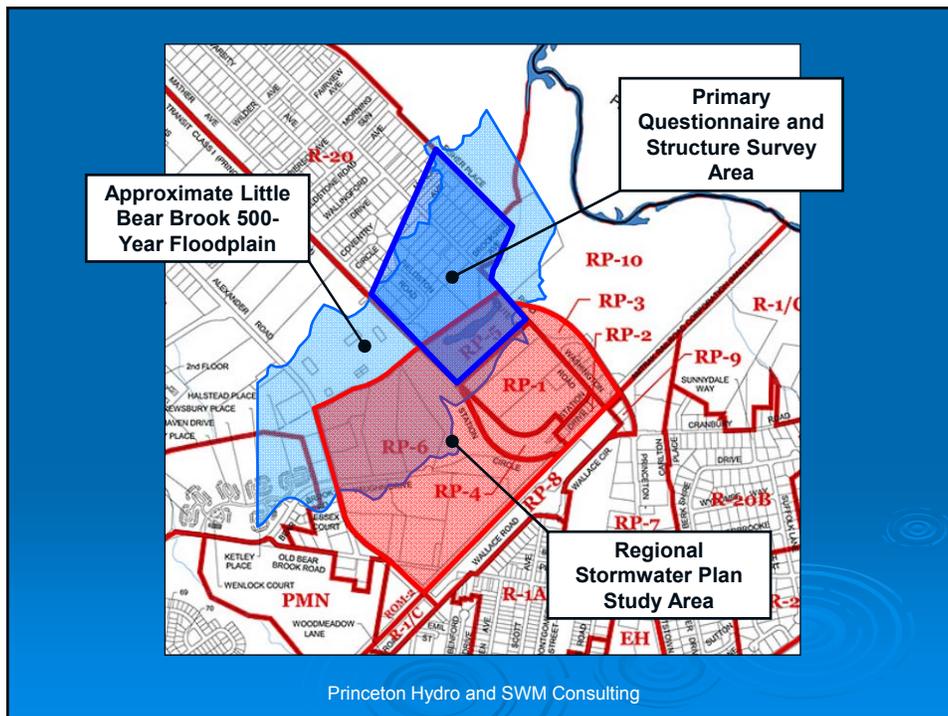


Princeton Hydro and SWM Consulting

Project Goals & Scope of Work

- **Goal 2: Redevelopment Area Regional Stormwater Management Plan**
 - Public Meetings
 - Aerial Topographic Mapping
 - Maps and Overlays
 - Regional Stormwater Analysis
 - Conceptual Basin Locations and Designs
 - Potential Little Bear Brook Flood Relief
 - Final Report and Presentation

Princeton Hydro and SWM Consulting



Princeton Hydro and SWM Consulting

Next Project Steps

- **Compile and Review Existing Data**
- **Prepare Topographic Maps of Both Study Areas**
- **Prepare and Distribute Little Bear Brook Flood Questionnaire**
- **Perform Little Bear Brook Structure Elevation Surveys**

Princeton Hydro and SWM Consulting

Next Township Meeting

- **Present Existing Flood Hazard Risk in Little Bear Brook Study Area**
 - **Existing Flood Risk or Probability**
 - **Contributing Factors and Conditions**
- **Begin Selection of Alternative Flood Mitigation Measures for Analysis**
 - **Flood Mitigation Effectiveness**
 - **Physical, Fiscal, and Regulatory Feasibility**

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Princeton Hydro and SWM Consulting

PowerPoint for June 30, 2014 Public Meeting

Little Bear Brook Flood Hazard Assessment and Redevelopment Area Regional Stormwater Management Analysis

Progress Meeting

June 30, 2014

Princeton Hydro, LLC and SWM Consulting, LLC

Project Team

- **West Windsor Township**
 - M. Patricia Ward, Community Development Director
 - Francis Guzik, PE – Township Engineer
 - Township Departments
- **Princeton Hydro, LLC**
 - Geoffrey M. Goll, PE – Principal
 - Mary Paist-Goldman, PE – Project Manager
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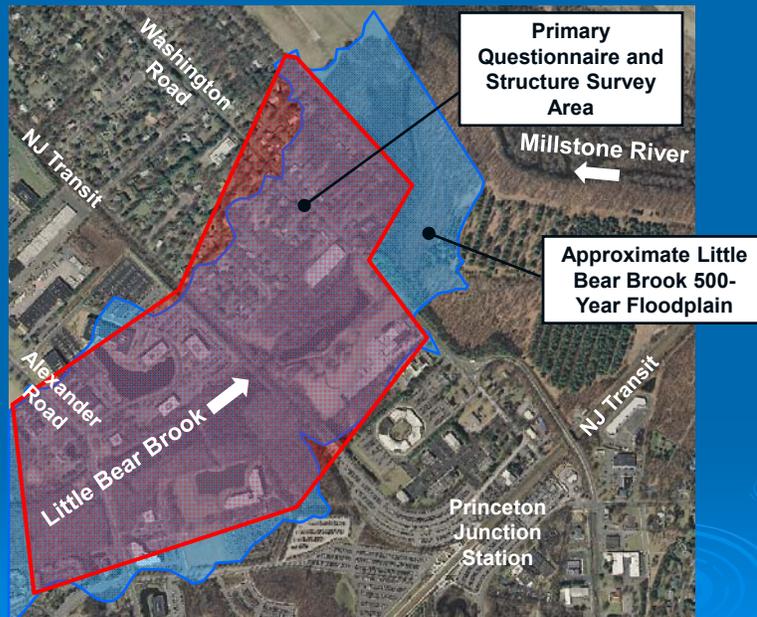
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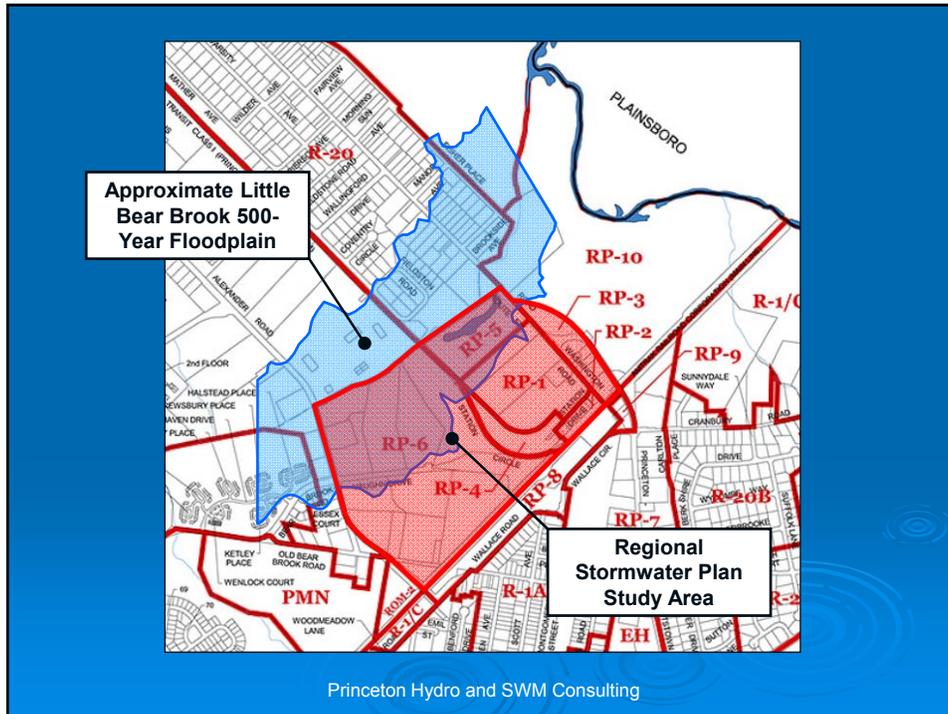
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Little Bear Brook Flood Hazard Assessment Update

Princeton Hydro and SWM Consulting



Princeton Hydro and SWM Consulting



LBB - Completed Project Steps

- Attended Township Council Meeting
- Compiled and Reviewed Existing Data
- Prepared Topographic Maps
- Prepared and Distributed 82 Little Bear Brook Flood Questionnaire
- Analyzed 58 Questionnaire Responses
- Performed and Analyzed 40 Little Bear Brook Structure Elevation Surveys

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LBB - Completed Project Steps

- **Performed Flood Hazard Assessment**
- **Began Analysis of Flood Mitigation Strategies**

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Some Flood Fundamentals

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Albert Einstein

“For every complex problem, there exists an answer that is simple, concise, and totally wrong.”

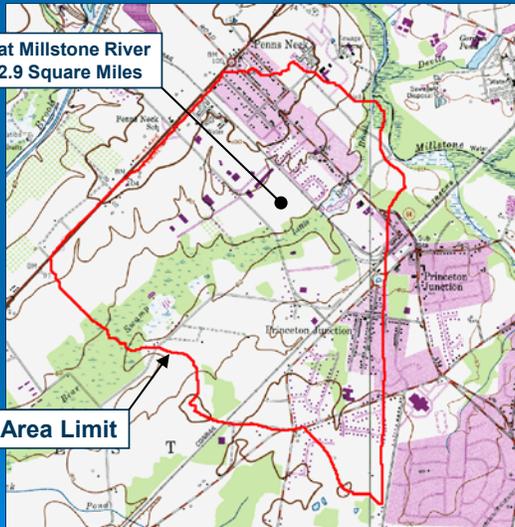
“The most incomprehensible thing about the universe is that it is comprehensible.”

Stormwater Management for Engineers

Watershed or Drainage Area

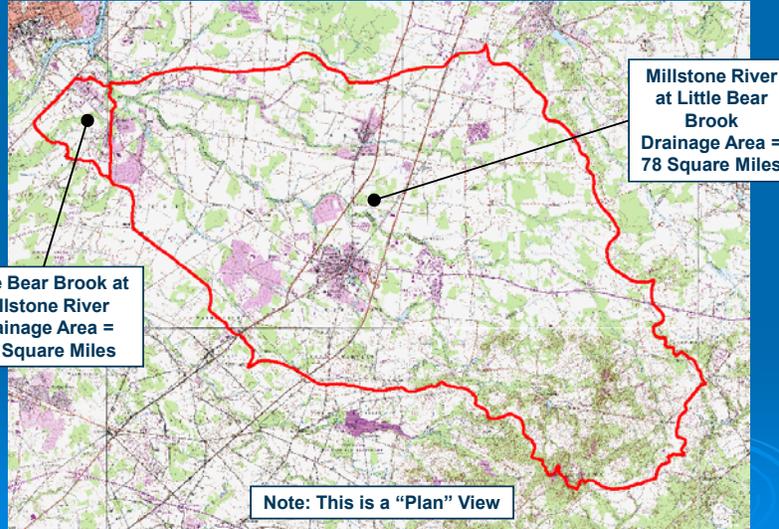
Little Bear Brook at Millstone River
Drainage Area = 2.9 Square Miles

Drainage Area Limit



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Watershed or Drainage Area



Princeton Hydro and SWM Consulting

USGS Peak Discharge Equations

$$\begin{aligned} Q_2 &= 25.6 A^{0.89} S^{0.25} S_l^{-0.56} I^{0.25} \\ Q_5 &= 39.7 A^{0.88} S^{0.26} S_l^{-0.54} I^{0.22} \\ Q_{10} &= 54.0 A^{0.88} S^{0.27} S_l^{-0.53} I^{0.20} \\ Q_{25} &= 78.2 A^{0.86} S^{0.27} S_l^{-0.52} I^{0.18} \\ Q_{50} &= 104 A^{0.85} S^{0.26} S_l^{-0.51} I^{0.16} \\ Q_{100} &= 136 A^{0.84} S^{0.26} S_l^{-0.51} I^{0.14} \end{aligned}$$

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Flood Frequency and Probability

Flood 'Frequency' Typically Expressed in Years

$$\text{Annual Flood Probability (\%)} = \frac{100}{\text{Flood Frequency (Years)}}$$

100-Year Flood Annual Probability = $100 / 100 = 1\%$

25-Year Flood Annual Probability = $100 / 25 = 4\%$

10-Year Flood Annual Probability = $100 / 10 = 10\%$

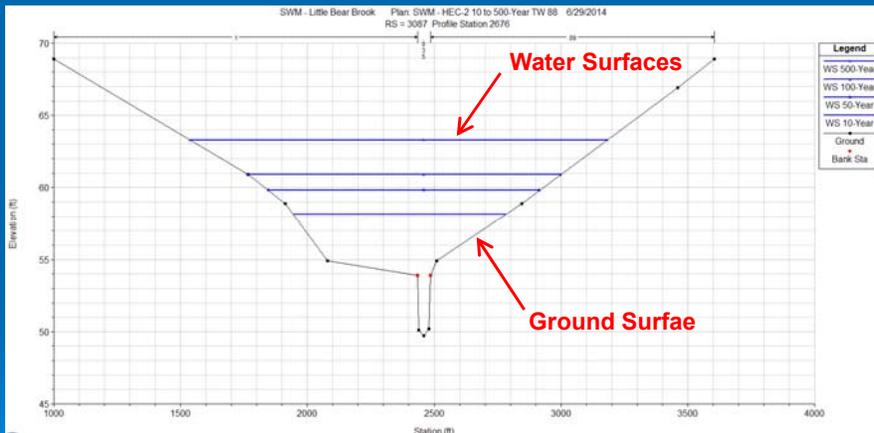
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Another Plan View



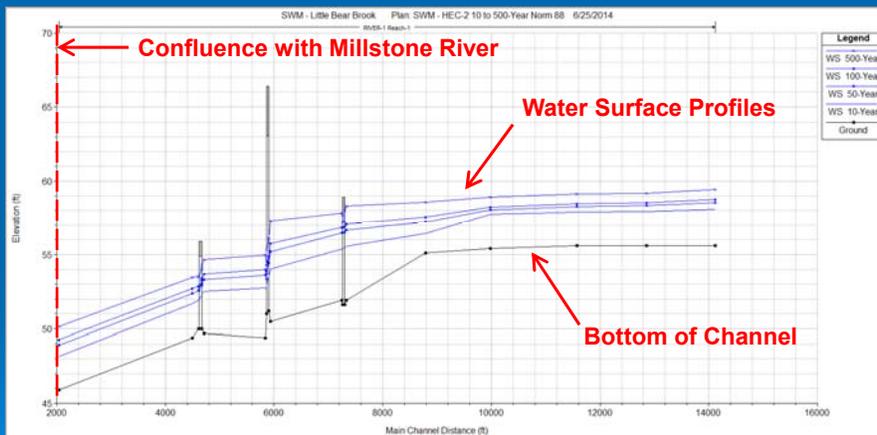
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Cross Section View (Looking Upstream or Downstream)



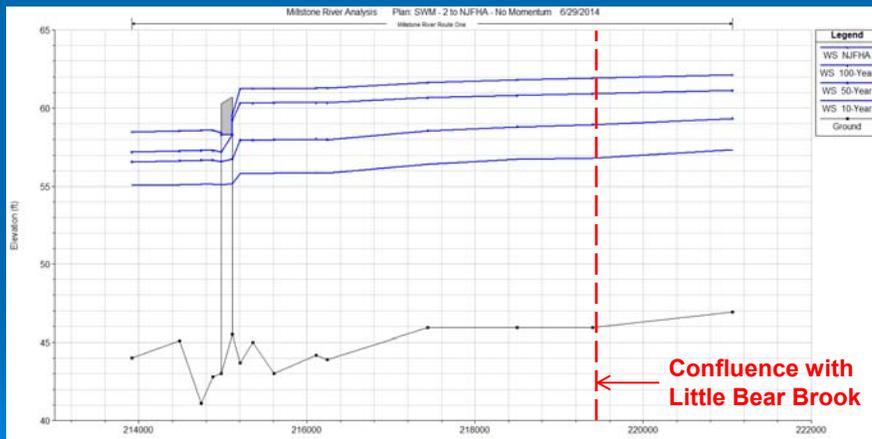
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Profile View (Looking Sideways)



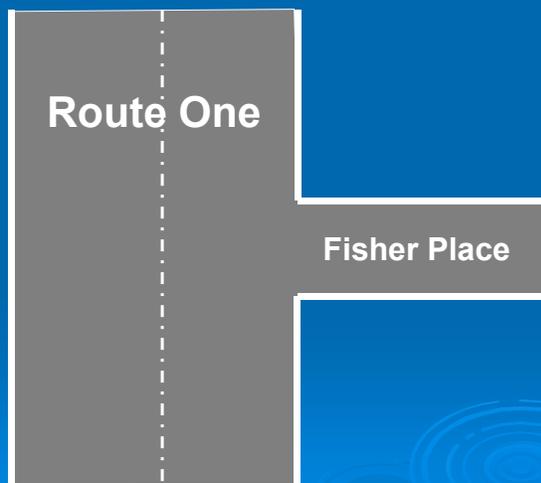
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Millstone River FIS Profiles



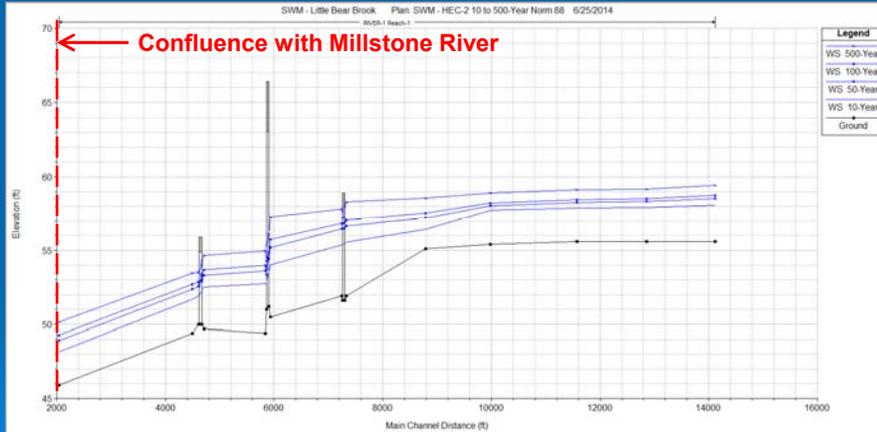
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Confluence



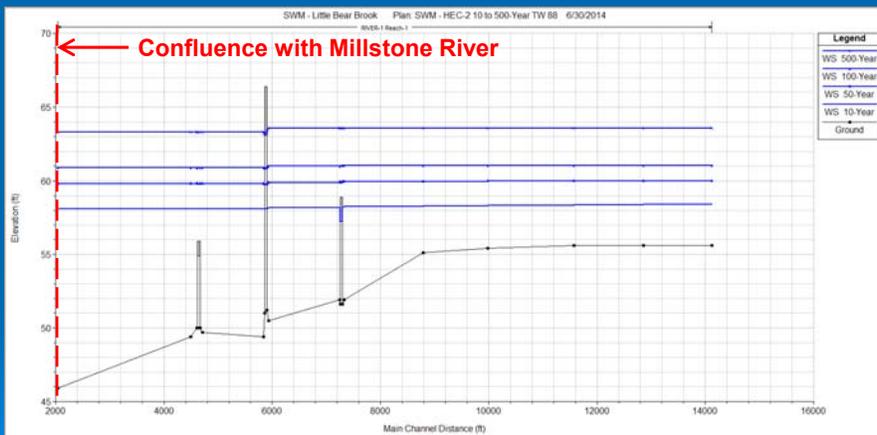
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Little Bear Brook FIS Profiles Without Millstone River



Princeton Hydro and SWM Consulting

Little Bear Brook FIS Profiles



Princeton Hydro and SWM Consulting

Questionnaire Results

- 58 Responses from 82 Questionnaires
- Worst Flooding in 2011 from Tropical Storm Irene
- Second Worst in 1999 from Tropical Storm Floyd
- Flooding Above First Floor Reported at Six Structures
- Road and Yard Flooding Reported Most Frequently

Princeton Hydro and SWM Consulting

Flood Hazard Assessment

- Assessment Results Based Upon:
 - Questionnaire Results
 - Interviews with Township Personnel
 - FEMA Flood Insurance Study
 - NJDEP Floodplain Delineation
 - Computer Model Data and Simulations
 - May 1, 2014 Storm and Flood Event

Princeton Hydro and SWM Consulting

Flood Hazard Assessment

- Estimated Road Flood Thresholds:
 - Fisher Place – 4-Year Flood
 - Washington Road – 4-Year Flood
 - Alexander Park – 2-Year Flood
 - Alexander Road – 5-Year Flood
 - Similar Yard and Parking Lot Flood Thresholds

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Flood Hazard Assessment

- Estimated Structure Flood Thresholds:
 - Fisher Place – 10-Year Flood
 - Washington Road – 5-Year Flood
 - Alexander Park – >100-Year Flood
 - Alexander Road – 15-Year Flood
- Comments or Information?

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May 1, 2014 Flood Event

- Total Rainfall Approximately 5.3 Inches in 36 Hours
- Approximately 4 Inches in 24 Hours
- Approximately 3 Inches in 12 Hours
- Approximately 5 to 10-Year (20% to 10% Chance) Storm Event

Princeton Hydro and SWM Consulting

May 1, 2014 Flood Event

- Field Surveyed High Water Elevations:
- Fisher Place = 58.5 NAVD88
- Washington Road = 58.7 NAVD88
- Fieldston Road = 58.5 NAVD88
- Alexander Road = 58.8 NAVD88
- Approximately 10-Year Flood Event

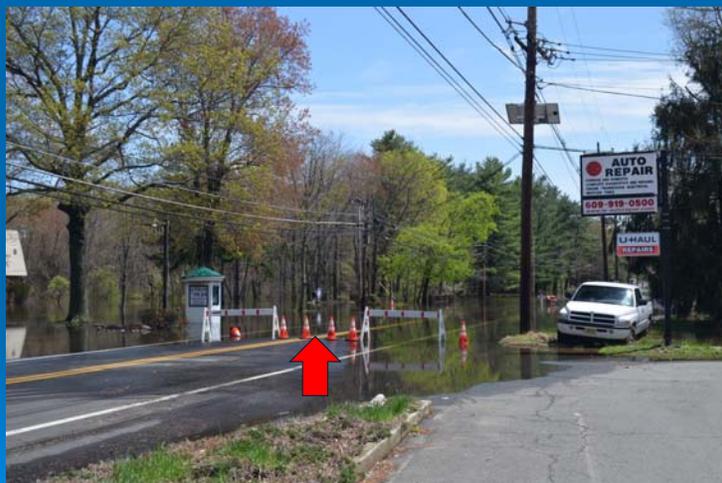
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Surveyed HW Elevations



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Surveyed HW Elevations



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Surveyed HW Elevations



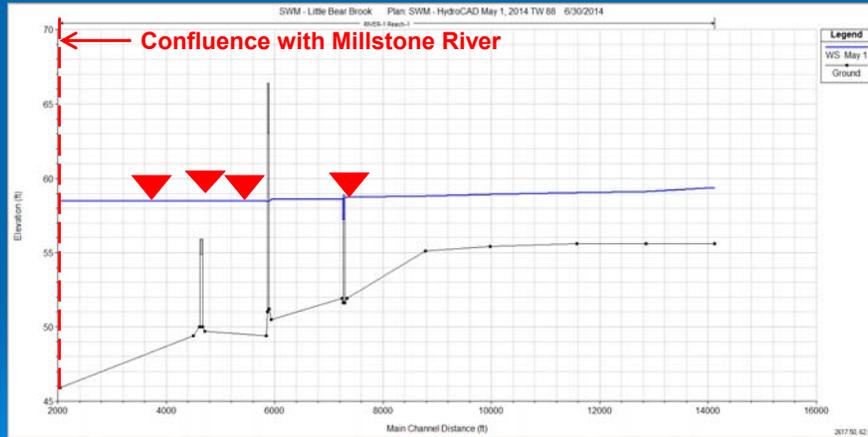
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Surveyed HW Elevations



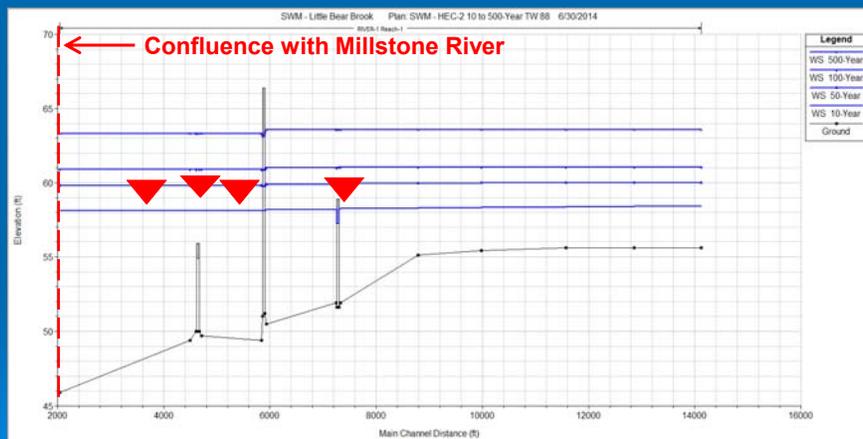
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Little Bear Brook HWMs and Computed WS Profile – May 1, 2014



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Little Bear Brook FIS Profiles



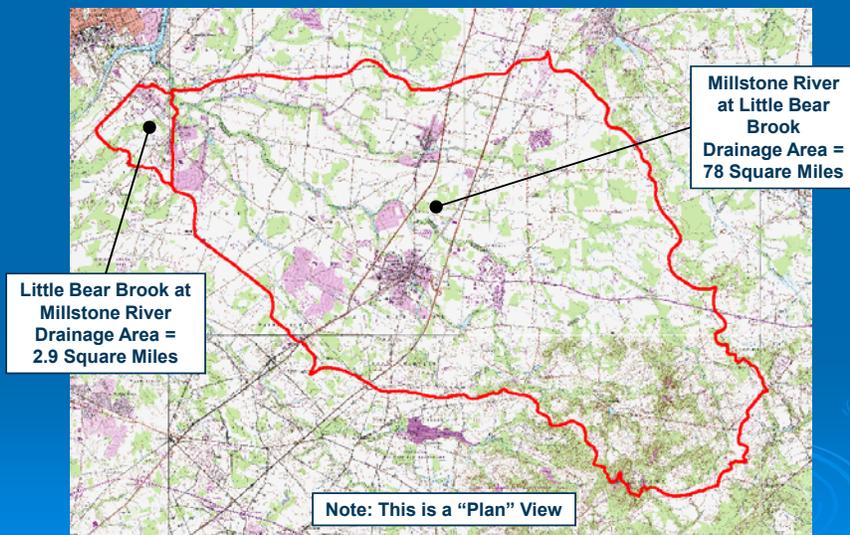
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Flood Mitigation Strategies

- What is the Primary Source of the Flooding?
 - Little Bear Brook?
 - Millstone River?
 - Inadequate Bridges and Culverts?
 - Downstream Structures?

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Watershed or Drainage Area



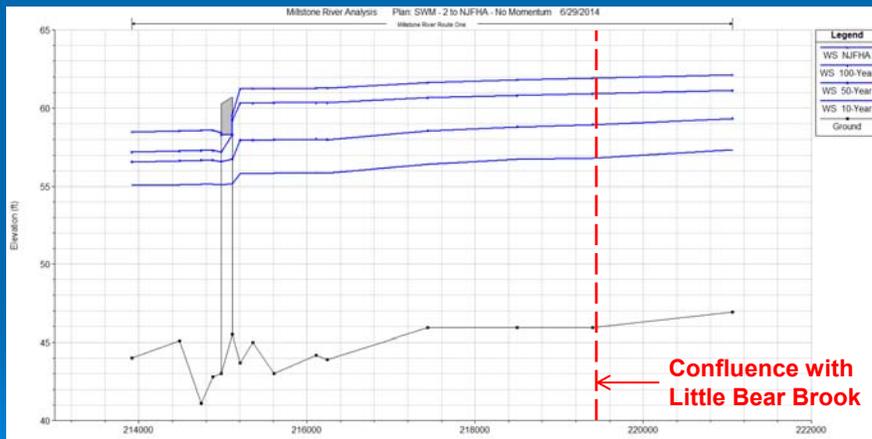
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USGS Watershed Data

Characteristic	Little Bear Brook	Millstone River
Drainage Area (SM)	2.9	78
Flow Length (Miles)	2.8	23
% Forest Cover	8	12
% Urban Land Cover	62	36
% Wetlands	18	25
Peak 10-Year Flow	472	2910
Peak 100- Year Flow	821	5090

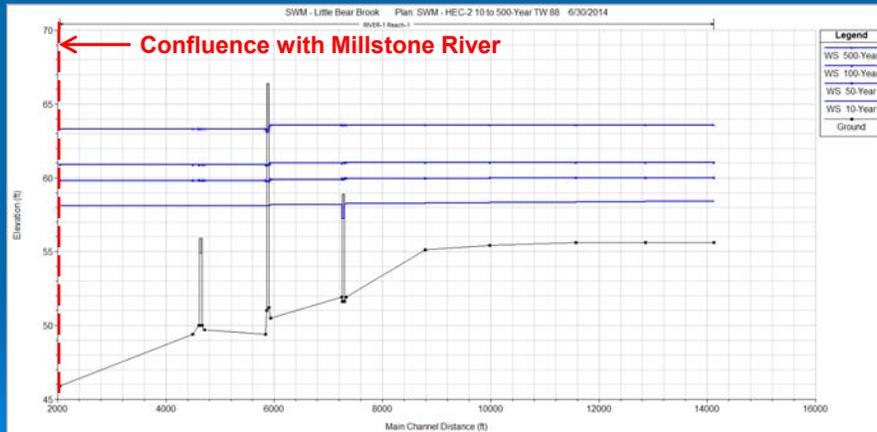
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Millstone River FIS Profiles



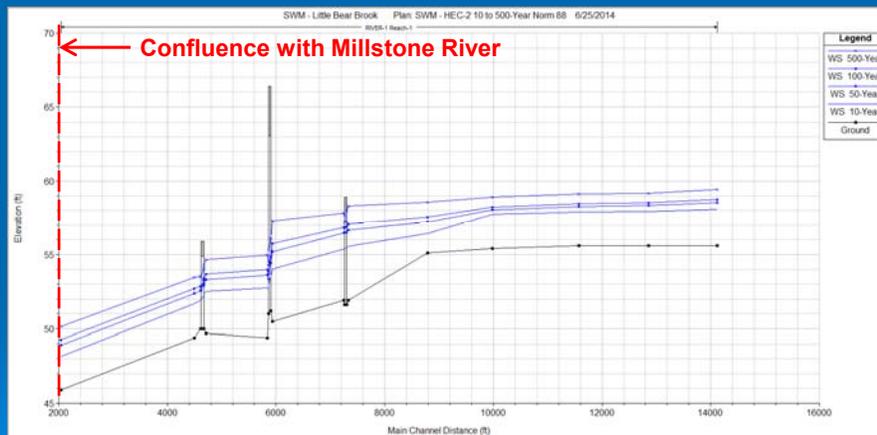
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Little Bear Brook FIS Profile



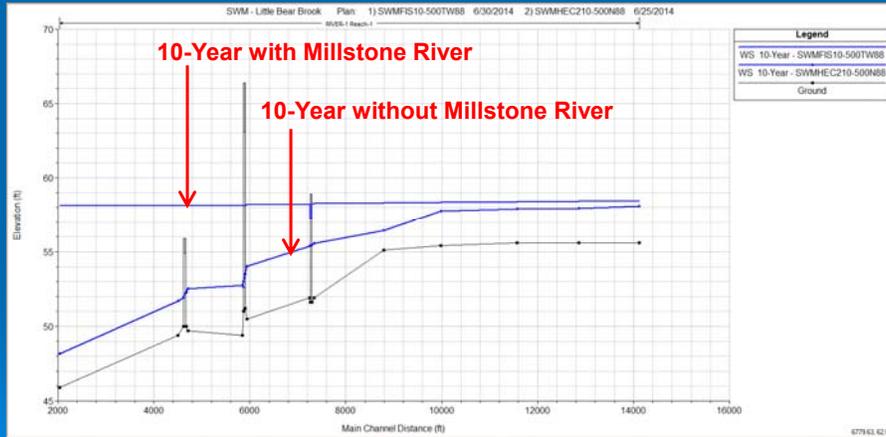
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Little Bear Brook FIS Profiles Without Millstone River



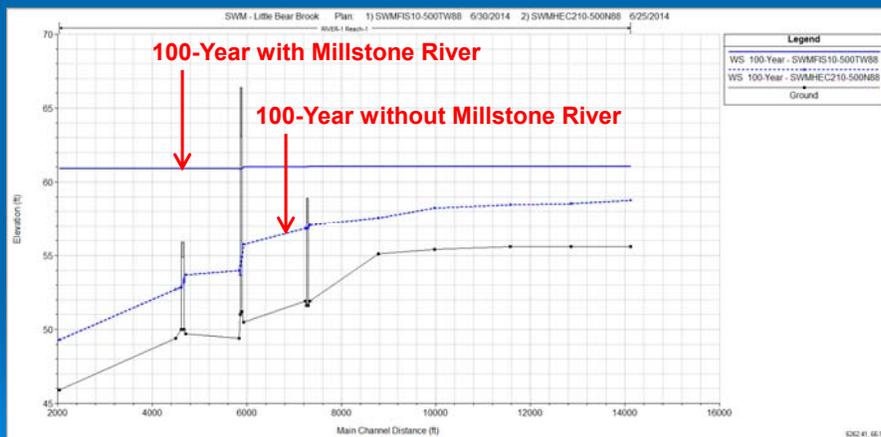
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Little Bear Brook FIS Profiles Without and With Millstone



Princeton Hydro and SWM Consulting

Little Bear Brook FIS Profiles Without and With Millstone



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Why the Millstone River?

- Much Larger Drainage Area and Flows at Same Ground Elevation
- Downstream Influences?
 - Carnegie Lake Dam?
 - Delaware & Raritan Canal Culvert?
 - Route One Bridge?

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Carnegie Lake Dam – April 31st



Princeton Hydro and SWM Consulting

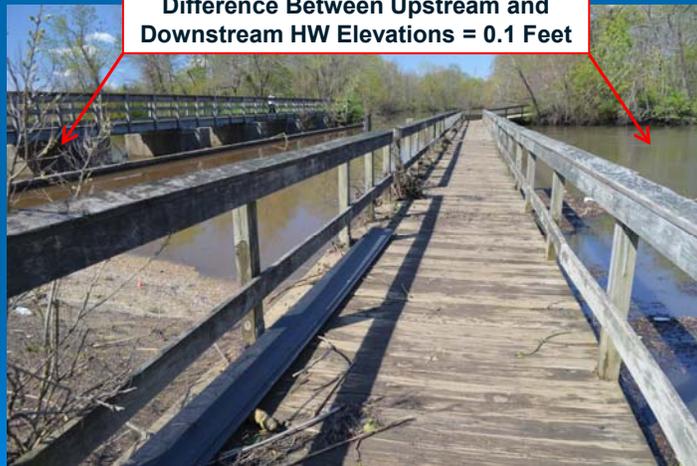
Carnegie Lake Dam – May 1st



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D & R Canal Culvert

Difference Between Upstream and
Downstream HW Elevations = 0.1 Feet



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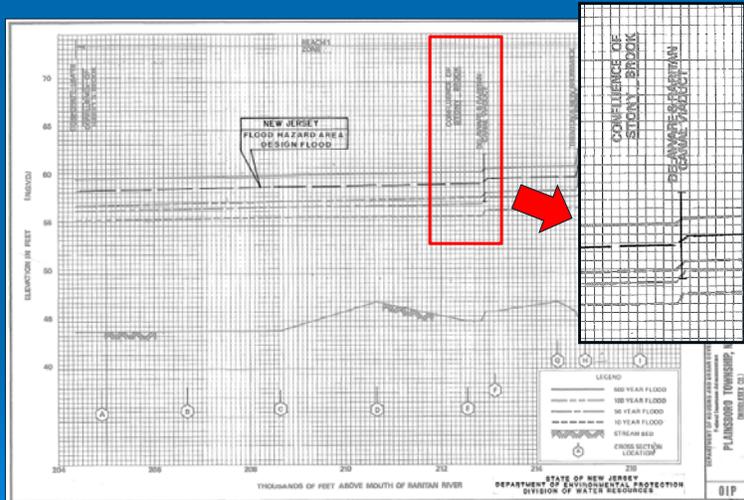
D & R Canal Culvert

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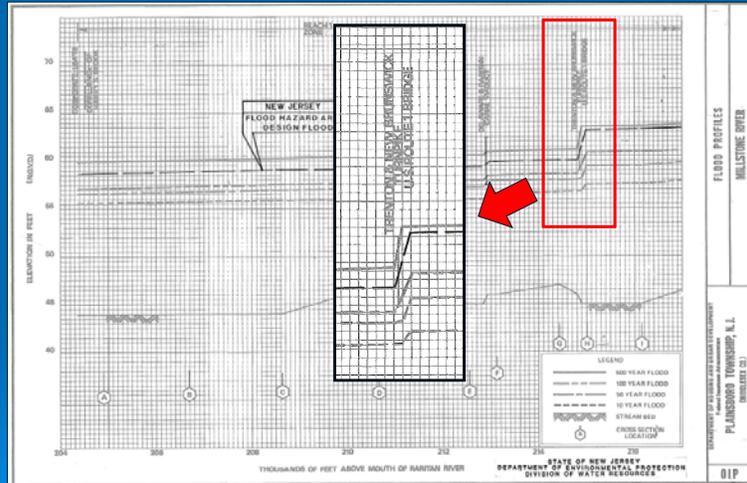
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D & R Canal Culvert



Princeton Hydro and SWM Consulting

D & R Canal Culvert



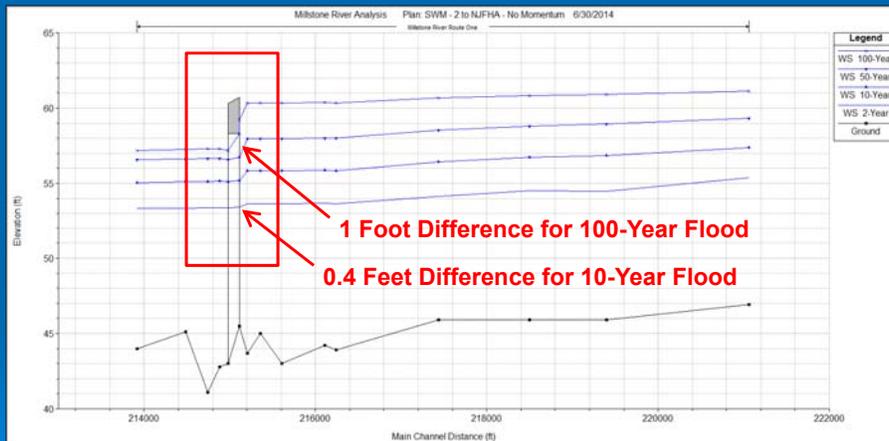
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Millstone River HEC-RAS Computer Model at Route One

- Based Upon NJDOT HEC-RAS Computer Model of 2009 Replacement Bridge
- Some Bridge Parameters Modified to Better Match Bridge Type
- Results Checked with May 1, 2014 High Water Elevations

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Millstone River HEC-RAS Model



Princeton Hydro and SWM Consulting

Millstone River at Route One



Princeton Hydro and SWM Consulting

Potential Mitigation Strategies

- Investigation to Estimate Strategy's Potential to Reduce Flood Risk
- Investigation to be Based Upon Existing Available Study Data
- Objectives of Investigation are to Both Identify Strategies That:
 - Have Potential to Reduce Flood Risk
 - Do Not Have Potential to Reduce Risk

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Potential Mitigation Strategies

- Potential Strategies to be Investigated Include:
 - Reduce Millstone Flows via Upstream Storage
 - Lower Downstream Starting WS Elevations
 - Increase Route One Bridge Capacity
 - Levees, Floodwalls, and Road Raisings
 - Enhanced Flood Warning System
 - Wet and Dry Structure Floodproofing

Princeton Hydro and SWM Consulting

Little Bear Brook Summary

- **Flood Assessment Study Based Upon:**
 - New Topographic Mapping
 - Property Owner Questionnaires
 - Interviews with Township Officials
 - Structure Elevation Surveys
 - FEMA and NJDEP Waterway and Flood Plain Data and Models
 - Rainfall and High Water Data for May 1, 2014 Rainfall and Flood Event

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Little Bear Brook Summary

- **Findings to Date Include:**
 - Road, Yard, and Parking Lot Flooding Most Chronic (2 to 5-Year+ Frequency)
 - Structure Flooding Occurs During Larger, Less Frequent Events (10 to 25-Year+ Frequency)
 - Millstone River is Primary Flooding Source
 - Little Bear Brook may Worsen Problem During Extreme Events (50 to 100-Year+ Frequency)

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Little Bear Brook Summary

- **Potential Strategies to be Investigated Include:**
 - **Reduce Millstone Flows via Upstream Storage**
 - **Lower Downstream Starting WS Elevations**
 - **Increase Route One Bridge Capacity**
 - **Levees, Floodwalls, and Road Raisings**
 - **Enhanced Flood Warning System**
 - **Wet and Dry Structure Floodproofing**

Princeton Hydro and SWM Consulting

Little Bear Brook Summary

- **Objectives of Investigation are to Both Identify Strategies That:**
 - **Have Potential to Reduce Flood Risk**
 - **Do Not Have Potential to Reduce Risk**

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Redevelopment Area Regional Stormwater Management Plan Update

Princeton Hydro and SWM Consulting

Project Goals & Scope of Work

- Goal 2: Redevelopment Area Regional Stormwater Management Plan
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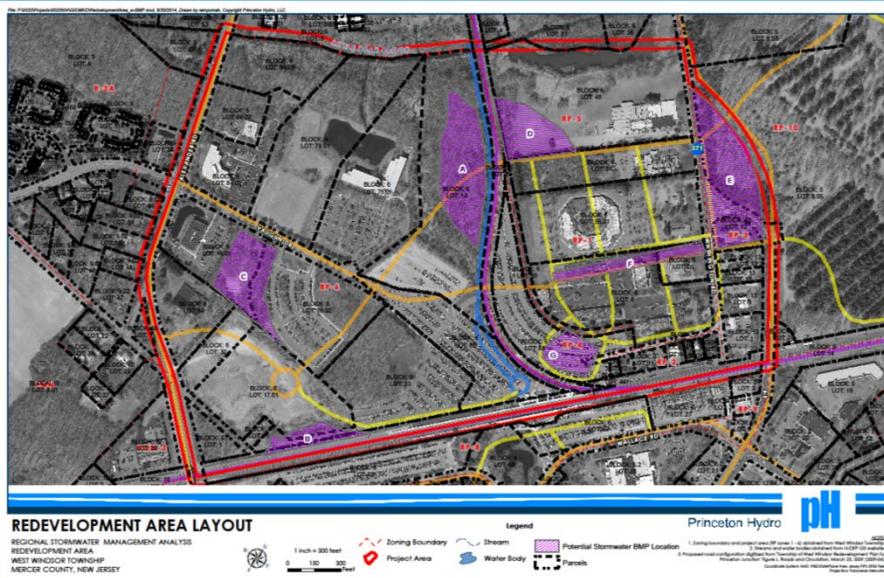
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Build-out Analysis

- Analyzed runoff in HydroCAD for existing conditions and full-buildout of the redevelopment area
- Regional Stormwater BMP
 - ~7 acres, 3 foot depth
 - ~4 acres, 6 foot depth
- Included environmental constraints
 - T&E Habitat
 - Soils (including depth to SHWT)
 - Geology
 - Wetlands and Transition Areas
 - Floodplain

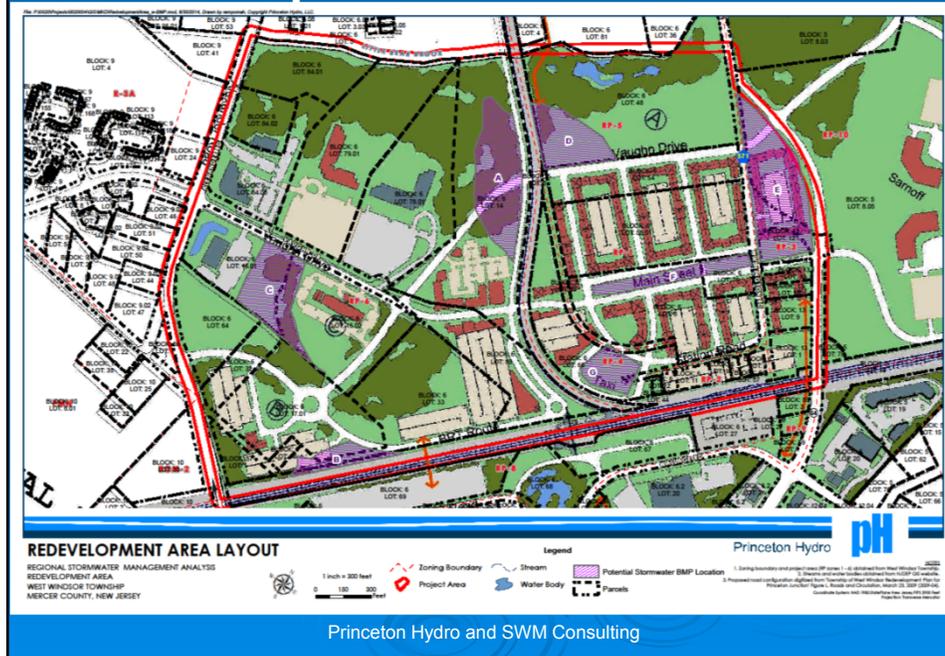
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Conceptual Basin Locations



Princeton Hydro and SWM Consulting

Conceptual Basin Locations



Review of Next Steps to Progress Conceptual Designs

- Finalize Conceptual Basin Locations
- Complete field investigation
- Prepare preliminary engineering design plans
- Final report

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