Retrofitting 22 Impervious Acres in the Long Creek Watershed Management District

“Session 2.1 – Stormwater Retrofit Challenges”

24th Annual Nonpoint Source Pollution Conference
Sheraton Hotel and Conference Center, Burlington, VT

May 14 & 15, 2013
AMEC Environment & Infrastructure, Inc.
Rich Niles
Case Study Outline

- Long Creek Watershed Characteristics
- Long Creek Watershed Management District
  - Formation & Funding Approach
- Watershed Management Plan – Priority Catchments
- Catchment C-08: Texas Instruments & Fairchild Semiconductor
- Stormwater Improvement Feasibility Study
- Stormwater BMP Retrofit Design
- Alternative Design Considerations (storm design criteria & hydrology)
- Challenges & Lessons Learned
Long Creek Watershed Characteristics

- 2,242 acres
- 630 acres IC
- 28% IC overall
- 7 Catchments:
  - 10.6-61.8% IC
- Impairment Causes:
  - Decreased DO
  - Altered flow regime
  - Lack of large, woody material
  - Increased temp.
  - Chlorides
- Flows to Clark’s Pond to Fore River to Casco Bay

Source: Long Creek Watershed Management Plan, July 2009
Long Creek Watershed Management District (LCWMD)

- **Quasi-Governmental Agency:** Governing Board & Cumberland County Soil & Water Conservation District

- **LCWMD History:**
  - Long Creek Restoration Project – collaborative initiative by the City of South Portland and a Steering Committee comprised of stakeholders
  - July 2009 Long Creek Watershed Management Plan
  - Preliminary order from EPA to regulate stormwater discharges from properties with >1 acre impervious area
  - Coordinated Program versus Individual Permit Approach
  - 2 year process of negotiating a Coordinated Program - no small feat!
  - LCWMD Formed & 97% land owner participation!

- **64 Participating Landowners, ~120 parcels originally designated**
- **$3,000/IA/year Fee**
- **$1.5M Budget: Planning, Operation/Maintenance & Capital Projects**
- **~$800K for capital projects**
Long Creek Watershed Management Plan
Overview

- **3 Tier Approach:**
  - 1 - Retrofit opportunities with *very good* cost-benefit ratios
  - 2 - Opportunities with *average* cost-benefit ratios
  - 3 - Remaining IA that is not managed under Tier 1 or 2

- **Restoration Projects Completed:**
  - 7 retrofit & stream restoration projects under Tier 1 & 2
  - Underdrained soil filter, porous pavement, water quality units (proprietary), plantings for stream restoration
  - ~$3.5M construction

- **Near Future Retrofit Projects:**
  - Catchment C-08 (Summer 2013 construction)
  - Gorham & Maine Mall Roads (designer selection underway)

- **Total Plan Implementation = $14M over 10 years**
Watershed Management Plan – Priority Catchments

- 9 Catchments
- 222 Acres total
- 175 Acres IC
- 67-93% IC

Source: Long Creek Watershed Management Plan, July 2009
Catchment C-08: Texas Instruments & Fairchild Semiconductor

Catchment Characteristics
- DEP ID: C-08
- Size: 40 acres
- Impervious Cover Breakdown:
  - Roof: 33% (10 acres)
  - Parking: 66% (20 acres)
  - Roadway: 1% (0.4 acres)
- Existing Stormwater Management System: Yes
- Stormwater Infrastructure Ownership: Private

Opportunity Overview
- Tier 1: Implement water quality retrofit within existing dry detention basin on Fairchild Semiconductor property.
- Tier 2: Implement additional water quality retrofits within other existing dry detention basins on National Semiconductor property.
- Tier 3: Implement additional water quality retrofits for impervious cover within catchment.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Retrofit ID#</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPO_018</td>
<td>$130,000</td>
</tr>
<tr>
<td>2</td>
<td>SPO_019</td>
<td>$35,000</td>
</tr>
<tr>
<td>3</td>
<td>Additional IC WQ enhancements</td>
<td>$1,813,000</td>
</tr>
</tbody>
</table>

Considerations
- Tier 1 retrofit will require a bypass for other stormwater drainage from National Semiconductor property through dry detention basin. Limited hydraulic head may complicate Tier 2 retrofit on National Semiconductor property.

Source: Long Creek Watershed Management Plan, July 2009
Catchment C-08: Texas Instruments & Fairchild Semiconductor

- 39.6 total acres
- 30.5 acres IC (76.9%)
- Fairchild Semiconductor Corp.
  - ~14.6 acres IC
  - $38,882 annual fee
- Texas Instruments, Inc.
  - ~23.5 acres IC
  - ~7.6 acres IC outside C-08
  - $58,850 annual fee
Stormwater Improvement Feasibility Study

Existing Conditions:
Primarily “Peak Flow Attenuation”

Detention Pond

Bioretention Cell

Detention Pond

Detention Pond
Stormwater Improvement Feasibility Study

Disconnect T1 and Fairchild flows and construct bypass Appendix H

Remove Impervious Cover Appendix A

Underdrained Filter Swale Appendix B

BMP 1

BMP 2

BMP 3

BMP 4

BMP 5

BMP 6

BMP 7

Detention Pond #1

Detention Pond #4

Mulch Top Bioretention Cells with Trees Appendix D

Bioretention Cell Property Divider Appendix D

Porous Pavement Appendix D

Retrofit Detention Pond #3 Appendix C

Retrofit Detention Pond #4 and connect to Detention Pond #1 Appendix F

Retrofit Detention Pond #1 to become a WSTS Appendix E

Remove Impervious Cover Appendix A

Bioswales Appendices E & G
# Stormwater Improvement Feasibility Study

<table>
<thead>
<tr>
<th>BMP Option</th>
<th>Technical Feasibility/Comments</th>
<th>Retained for Further Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vegetated Buffers</strong></td>
<td>Can be implemented and maintained at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Underdrained Soil Filters</strong></td>
<td>Can be implemented and maintained at several locations at the site assuming extensive excavation is not required.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Infiltration</strong></td>
<td>Site has some existing soil contamination and soils with high clay content.</td>
<td>Limited</td>
</tr>
<tr>
<td><strong>Wet Ponds</strong></td>
<td>Can be implemented and maintained at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Subsurface Gravel Wetlands</strong></td>
<td>Can be implemented and maintained at several locations at the site assuming extensive excavation is not required.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Proprietary Systems</strong></td>
<td>Too much existing infrastructure on site to be feasible/cost-effective.</td>
<td>No</td>
</tr>
<tr>
<td><strong>Wet Vegetated Treatment Systems (WVTS)</strong></td>
<td>Can be implemented and maintained at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Bioretention Cells</strong></td>
<td>Can be implemented and maintained at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Bioswales</strong></td>
<td>Can be implemented and maintained at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Tree Box Filters</strong></td>
<td>Rely too heavily on infiltration and are cost prohibitive.</td>
<td>No</td>
</tr>
</tbody>
</table>
## Stormwater Improvement Feasibility Study

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<th>Retained for Further Consideration</th>
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</thead>
<tbody>
<tr>
<td>Green Roofs</td>
<td>Requires in depth building/facility assessment and are cost prohibitive.</td>
<td>Feasible, but not cost-effective</td>
</tr>
<tr>
<td>Permeable Paving</td>
<td>Can be implemented and maintained at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td>Rain Harvesting/Irrigation</td>
<td>Can be implemented and maintained at several locations at the site. Cheaper to purchase water than collect and filter.</td>
<td>Feasible, but may not be cost-effective</td>
</tr>
<tr>
<td>Pavement Reduction/Removal</td>
<td>Can be implemented at several locations at the site.</td>
<td>Yes</td>
</tr>
<tr>
<td>Porous Asphalt Top Coat</td>
<td>Existing paved surfaces are &lt;4-5% and roadways do not have a significant crown. If re-grading is needed, then a full-depth porous asphalt and drainage layer should be constructed instead.</td>
<td>No</td>
</tr>
</tbody>
</table>
Stormwater Improvement Feasibility Study

BMP 1: Reduce/Remove Impervious Cover

Remove Impervious Cover

Remove Impervious Cover

TI Building 1(10)
Stormwater Improvement Feasibility Study

BMP 1: Reduce/Remove Impervious cover

Remove Impervious Cover

TI Building 1(10)
The Underdrained Filter Swale would intercept runoff from the adjacent road and roof leaders. Any overflow would be directed into existing storm drain catch basins 46, 47, 48 and 49.
Stormwater Improvement
Feasibility Study

Convert into a Gravel Wetland or Underdrained Filter Pond. Existing outlets would be raised, plugged or disconnected. The 36-inch RCP that enters from the north could be reduced, if not disconnected, if a bypass for TTs stormwater flow is constructed. The addition of filter media and any wetland vegetation would add water quality treatment. A Gravel Wetland would provide more intensive water quality treatment whereas an Underdrained Filter Pond would likely require the use of redundant filtration BMPs (e.g. Bioretention Cells in the main parking area).
Stormwater Improvement Feasibility Study

The six (6) Mulch Top Bioretention Cells and the property divider would be built around existing catch basins. These BMPs would treat runoff as it entered the biocell and then drain to current storm drain infrastructure. The property divider would be the width of one row of parking and would be located on the FSC side of the property line. An additional biocell could be constructed near CB 10 to accept runoff from the FSC truck path. All biocells would contain a tree/s and other vegetation. A section of TI's parking lot, west of Building 4(18), would be repaved with Stormcrete.
Stormwater Improvement Feasibility Study

Convert Detention Pond #1 into a Wet Vegetated Treatment System (WVTS) or a wet pond. A WVTS would provide greater capacity to capture and contain stormwater runoff and would add a water quality treatment component to this BMP. WVTSs are between 6" and 18" deep, meaning minor excavation, and can contain plants chosen to best fit the purification needs of the site.

The Bioswale would intercept runoff from the adjacent road and the parking lot to the south. The bottom of the bioswale would be lower than outlet 4 so that runoff entering the swale would not immediately flow out of the BMP and the bioswale would have a lower northern edge to allow overflow to drain into Detention Pond #1.
Stormwater Improvement Feasibility Study

Convert Detention Pond #4 into a wet pond. An underdrained gravel filter layer would add a water quality treatment component to this BMP. It could also be advantageous to consider combining Detention Pond #1 and Detention Pond #4 to an in-series system to further increase stormwater quality treatment and to manage larger water volumes.
BMP 7: Retrofit TI Loading Dock

Remove Impervious Cover

TI Building 1(10)

Remove unnecessary impervious cover from a section of the TI loading dock and the northern edge of the adjacent road. Construct a bioswale at the northern edge of the adjacent road. The bioswale would intercept runoff from the loading dock and the road and direct it into existing stormwater infrastructure.
## Stormwater BMP Retrofit Design

<table>
<thead>
<tr>
<th>BMP</th>
<th>Impervious Removed (SF)</th>
<th>Impervious Treated (SF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel Wetland</td>
<td>N/A</td>
<td>12.23 ac</td>
</tr>
<tr>
<td>Bioretention Cell #1</td>
<td>2,491</td>
<td>4,907</td>
</tr>
<tr>
<td>Bioretention Cell #2</td>
<td>2,992</td>
<td>3,950</td>
</tr>
<tr>
<td>Bioretention Cell #3/ Loading Dock</td>
<td>4,823</td>
<td>13,467</td>
</tr>
<tr>
<td>Wet Pond</td>
<td>N/A</td>
<td>59,826</td>
</tr>
<tr>
<td>Wet Vegetated Treatment System</td>
<td>N/A</td>
<td>146,826</td>
</tr>
<tr>
<td>Vegetated Swale</td>
<td>786</td>
<td>0</td>
</tr>
<tr>
<td>Upper Parking Lot</td>
<td>28,423</td>
<td>N/A</td>
</tr>
<tr>
<td>Tree Islands</td>
<td>8,220</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43,642</strong></td>
<td><strong>17.49 ac</strong></td>
</tr>
</tbody>
</table>
Stormwater BMP Retrofit Design

Proposed BMPs for Construction

- Retrofit Detention Pond #3 into a Gravel Wetland
  - 0.52” Storm, 95% TSS Removal Rate
- Retrofit Detention Pond #1 into a Wet Vegetated Treatment System
  - 70% TSS Removal Rate
- Retrofit Detention Pond #4 into a Wet Pond
  - 1.5” Storm, 60% TSS Removal Rate
- 3 Bioretention Cells
  - 1” Storm for Cells #1 & #2
  - 0.25” Storm for Cell #3
  - 80% TSS Removal Rate for all 3
- 9 Tree Islands in Main Parking Lot
Stormwater BMP Retrofit Design
## Stormwater BMP Retrofit Design

### Existing & Post-Retrofit Conditions (cfs)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Area (ac)</th>
<th>Peak Flow 2 yr storm</th>
<th>Peak Flow 10 yr storm</th>
<th>Peak Flow 25 yr storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>34.4</td>
<td>22.89</td>
<td>35.71</td>
<td>40.33</td>
</tr>
<tr>
<td>Post-Retrofit</td>
<td>34.4</td>
<td>13.65</td>
<td>33.46</td>
<td>40.41</td>
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</tbody>
</table>
Stormwater BMP Retrofit Design

- Cost: $500K (design, permitting & construction)
  - $200K to be paid by Texas Instruments, Inc.
- $28,000 per impervious acre treated
- Texas Instruments, Inc. = credit (up to 40%) & reduction in fee
- Fairchild Semiconductor = slight reduction in fee
Alternative Design Considerations

- Gravel Wetland Alternative Design:
  - Capture the first 0.5” of runoff
  - Bypass flows >0.5” to avoid “flushing of BMP”
  - Resulting flow increase = 50% for 25-year storm (from current conditions)
  - Timing of release to the North Branch of Long Creek
  - “Maximize the use of the floodplain during bankfull conditions”
  - Potential downstream impacts
- Not feasible due to legal and permit constraints
Challenges & Lessons Learned

**Challenges:**
- Low hydraulic grades, poor soils and shallow depth to groundwater
- Potential contaminated soil on-site
- Considerations for MEPDES Multi-Sector General Permit (segregating flows)
- Ownership of receiving culvert (restricted any flow increase)
- Design & construction with 2 funding sources: TI & LCWMD

**Lessons Learned:**
- Existing infrastructure & public/private partnerships = big bang for the $
- Property owners want to do the “right thing” and improve conditions
- Consider a variety of BMPs – you’ll be surprised what property owners are interested/willing to do (e.g., pavement removal)
- Property issues and “flow rights” can restrict a more holistic watershed management approach to address hydrology
- Develop a better understanding of hydrology and hydraulics to support stream restoration objectives (underway by LCWMD)