Bacteria Source Tracking: in Kittery, Maine
and Seacoast New Hampshire

March 23, 2012
New Hampshire Waters Conference

Forrest Bell, Principal
Emily DiFranco, Water Quality Scientist
FB Environmental Associates
Presentation in Brief...

- Spruce Creek, Kittery, ME
  - 2009 Stormwater Outfall sampling
  - 2011 Bracket Sampling at Admiralty Village
  - 2011 Stormwater Outfall sampling
- Little River, North Hampton, NH
  - 2011 Bracket Sampling
- Questions?
# 2009 Stormwater Outfall Sampling

## Spruce Creek Association ~ Kittery, ME
### 2009 End-of-Pipe Sampling Project

**Bacteria Concentrations**

<table>
<thead>
<tr>
<th>Site</th>
<th>5/12 (dry)</th>
<th>5/29 (wet)</th>
<th>6/10 (wet)</th>
<th>6/15 (wet)</th>
<th>6/18 (dry)</th>
<th>7/17 (dry)</th>
<th>Geo. Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV2</td>
<td>2419.6</td>
<td>2419.6</td>
<td>816.4</td>
<td>2419.6</td>
<td>2419.6</td>
<td>2419.6</td>
<td>2019</td>
</tr>
<tr>
<td>MS1</td>
<td>8.6</td>
<td>2419.6</td>
<td>1986.3</td>
<td>816.4</td>
<td>816.4</td>
<td>517.2</td>
<td>492</td>
</tr>
<tr>
<td>CB1</td>
<td>161.6</td>
<td>1314.6</td>
<td>48.9</td>
<td>35.9</td>
<td>48.7</td>
<td>51.2</td>
<td>99</td>
</tr>
<tr>
<td>HC1</td>
<td>52.0</td>
<td>461.1</td>
<td>151.5</td>
<td>122.3</td>
<td>48.0</td>
<td>36.8</td>
<td>96</td>
</tr>
<tr>
<td>SHC2</td>
<td>12.2</td>
<td>39.7</td>
<td>1299.7</td>
<td>547.5</td>
<td>25.6</td>
<td>5.2</td>
<td>60</td>
</tr>
<tr>
<td>R1NW</td>
<td>1.0</td>
<td>96.0</td>
<td>18.9</td>
<td>26.9</td>
<td>21.6</td>
<td>73.8</td>
<td>21</td>
</tr>
<tr>
<td>SHC1</td>
<td>4.1</td>
<td>133.3</td>
<td>1.0</td>
<td>23.1</td>
<td>20.3</td>
<td>1.0</td>
<td>8</td>
</tr>
</tbody>
</table>

**Geometric Mean Results**

- **<64 col/100 mL**
- **64 - 235 col/100 mL**
- **236 - 1000 col/100 mL**
- **>1000 col/100 mL**

*Maine Class B freshwater standards
Geometric mean: 64 col/100 mL
Instantaneous: 236 col/100 mL*

**2009 Precipitation for Pease Infl. Tradeport - Portsmouth, NH**

![Precipitation Graph](chart.png)

*Data Sources: Maine Office of GIS; Spruce Creek Association; FBE Coordinate System: NAD83, UTM Zone 19, Meters
Date: 7/29/09 by F. Dillon for FB Environmental*
2011 Bracket Sampling at Admiralty Village
Outfall AV2 Flowing into Spruce Creek
Philbrick Avenue in Admiralty Village
Sampled all Catch Basins, Inflow Pipes, and Outfalls
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
<td>FC</td>
<td>E. coli</td>
</tr>
<tr>
<td>AV-2</td>
<td>CB2 Outfall</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>1440</td>
<td>520</td>
</tr>
<tr>
<td>CB2</td>
<td>Catch Basin 2</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>1520</td>
<td>1000</td>
</tr>
<tr>
<td>2-3</td>
<td>Inflow from CB3</td>
<td>300</td>
<td>100</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>1560</td>
</tr>
<tr>
<td>CB3</td>
<td>Catch Basin 3</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>3760</td>
<td>3280</td>
</tr>
<tr>
<td>3-Lower</td>
<td>Inflow from unknown pipe</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>3680</td>
</tr>
<tr>
<td>3-NH</td>
<td>Inflow pipe from Navy Housing</td>
<td>100</td>
<td>80</td>
<td>1320</td>
<td>1320</td>
<td>960</td>
</tr>
<tr>
<td>CB4</td>
<td>Catch Basin 4</td>
<td>300</td>
<td>140</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>CB5</td>
<td>Catch Basin 5</td>
<td>100</td>
<td>60</td>
<td>520</td>
<td>440</td>
<td>200</td>
</tr>
<tr>
<td>CB6</td>
<td>Catch Basin 6</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>&gt; 4000</td>
<td>920</td>
</tr>
<tr>
<td>CB7</td>
<td>Catch Basin 7</td>
<td>210</td>
<td>70</td>
<td>600</td>
<td>520</td>
<td>240</td>
</tr>
<tr>
<td>CB8</td>
<td>Catch Basin 8</td>
<td>880</td>
<td>300</td>
<td>960</td>
<td>880</td>
<td>440</td>
</tr>
<tr>
<td>AV-3</td>
<td>CB8 Outfall</td>
<td>380</td>
<td>40</td>
<td>--</td>
<td>--</td>
<td>120</td>
</tr>
</tbody>
</table>
What Do These Results Mean?

- High concentrations of bacteria in dry weather may indicate the presence of leaking sewer pipes or illicit connections to storm drains.
- Highest concentrations follow path from AV2 to 3-Lower (inflow pipe had Geomean = 3557 colonies/100 mL).
- 3-NH also had continuous flow (Geomean = 519 colonies/100 mL).
3-Lower

- Do not know the origin of 3-Lower

- Pipe appears to run parallel to a sewer line
What Do We Do Next?

- Closer look at high count areas
  - Identify source of mystery outfalls/pipes (ongoing)
  - Camera pipeline inspection of the pipe (completed)
  - Dye/smoke test or DNA testing of outflow (2012)
  - Canine Scent Tracking (2012)
2012 – Canine Scent Tracking

- FBE working with Kittery to bring Sable the Sniffer to Maine and NH in August 2012
- Illicit Discharge Detection (IDDE) – human fecal matter and surfactants (detergents)
- Working across USA since 2007
- High success rate; affordable; canine tracking in Region 5 Beach Program QAPP
2011 Stormwater Outfall Sampling
## Wet and Dry Weather Results

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sample Location</th>
<th>FC Geo Mean Total</th>
<th>FC Geo Mean Wet</th>
<th>FC Geo Mean Dry</th>
<th>E. coli Geo Mean Total</th>
<th>E. coli Geo Mean Wet</th>
<th>E. coli Geo Mean Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picott</td>
<td>Culvert on Picott Road</td>
<td>1058</td>
<td>1464</td>
<td>764</td>
<td>1133</td>
<td>1347</td>
<td>952</td>
</tr>
<tr>
<td>I95</td>
<td>Storm drain off of I95 behind KTP</td>
<td>353</td>
<td>249</td>
<td>500</td>
<td>190</td>
<td>234</td>
<td>139</td>
</tr>
<tr>
<td>GW95</td>
<td>GW seep near I95 behind KTP</td>
<td>83</td>
<td>98</td>
<td>70</td>
<td>53</td>
<td>83</td>
<td>34</td>
</tr>
<tr>
<td>MOC1</td>
<td>Concrete pipe behind MOC parking lot</td>
<td>224</td>
<td>224</td>
<td>--</td>
<td>219</td>
<td>219</td>
<td>--</td>
</tr>
<tr>
<td>MOC2</td>
<td>Concrete pipe behind the Burger King</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>MOC3</td>
<td>GW seep behind MOC parking lot</td>
<td>51</td>
<td>77</td>
<td>34</td>
<td>36</td>
<td>71</td>
<td>13</td>
</tr>
<tr>
<td>Orvis</td>
<td>Small stream behind Orvis outlet</td>
<td>411</td>
<td>1131</td>
<td>210</td>
<td>282</td>
<td>1020</td>
<td>120</td>
</tr>
<tr>
<td>Trafton</td>
<td>Culvert at Haley and Trafton</td>
<td>844</td>
<td>449</td>
<td>1585</td>
<td>559</td>
<td>423</td>
<td>740</td>
</tr>
<tr>
<td>Norton</td>
<td>Storm drain off of Haley and Norton</td>
<td>253</td>
<td>253</td>
<td>--</td>
<td>126</td>
<td>126</td>
<td>--</td>
</tr>
<tr>
<td>Coleman</td>
<td>Storm drain at the end of Coleman</td>
<td>289</td>
<td>98</td>
<td>596</td>
<td>177</td>
<td>76</td>
<td>312</td>
</tr>
<tr>
<td>Wyman</td>
<td>Seep off of Wyman in Admiralty Village</td>
<td>181</td>
<td>221</td>
<td>148</td>
<td>100</td>
<td>106</td>
<td>94</td>
</tr>
<tr>
<td>Cole</td>
<td>Concrete pipe Admiralty Vil., Cole Rd.</td>
<td>1265</td>
<td>1265</td>
<td>--</td>
<td>1265</td>
<td>1265</td>
<td>--</td>
</tr>
<tr>
<td>Howard</td>
<td>Concrete pipe in Admiralty Village off of Howard</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>AV3</td>
<td>Concrete pipe in Admiralty Village from CB8</td>
<td>677</td>
<td>1876</td>
<td>407</td>
<td>286</td>
<td>1386</td>
<td>130</td>
</tr>
</tbody>
</table>
Closer Look at Wet/Dry Impairments

- **Wet Weather Impairments**
  - Picott, Orvis, Cole, and AV3 (Geomean > 10 times WQS)
  - Trafton (Geomean between 5 and 10 times WQS)

- **Dry Weather Impairments**
  - Picott and Trafton (Geomean > 10 times WQS)
  - Coleman (Geomean almost 5 times WQS)
What Do We Do Next?

- Upstream land use investigation of sites with highest bacteria (Picott, Cole, and Trafton)
- Map drainage area to each high bacteria outfall (Picott, Cole, Trafton, and Orvis)
- Investigate site specific locations to install stormwater BMPs in areas of high wet weather bacteria (Picott, Cole, AV2, and Orvis)
- Conduct a camera inspection of outfalls with high dry weather bacteria concentrations (Coleman)
Begin Phase III of Outfall Sampling

Outfalls within 250 feet of Spruce Creek:
Previously Sampled and Not Sampled

Legend
- Sampled Outfalls
- Outfalls Not Sampled within 250'

Data Sources: Maine Office of GIS, Spruce Creek Association, FBE
Coordinate System: NAD83, UTM Zone 19, Meters
Created by: FBE Environmental 10/2011

M A I N E
Study Area
Little River, North Hampton, NH

- Coastal beach watershed
- Large salt marsh
- Mostly residential
- Commercial on Rte 1
Little River,
North Hampton, NH

- Watershed Based Plan 2010
- Town not interested in pursuing 319 funds in 2010.
- Generally high water quality
- 2 beach advisories in 2011
Conservation Commission is Funding Bracket Testing
Concerns: Development at River’s Edge
Concerns: Route 1 Large Septics

Trailer Park, Supermarket, Gas Station, Etc.
Concerns: Impact of Mill Pond
Town Hopes to Find “Smoking Guns”
Initial Bacteria Results, Wet vs. Dry

North Hampton Enterococci Bacteri Results - October 2011

Enterococci (counts / 100mL)

Site

NOHA1  NOHA2  NOHA3  NOHA4  NOHA5  NOHA6  MP-IN  MP-OUT  BCH17  BCH23

Geometric Mean  Average Wet  Average Dry
North Hampton Bacteria Bracket Testing
Schematic of Upper Watershed Enterococci Levels – October 2011

North Rd. / Highlander Rd. / W. side of Rte 1

NOHA1
Dry: 81
Wet: 503
Geomean: 177

NOHA2
Dry: 139
Wet: 1671
Geomean: 361

NOHA3
Dry: 235
Wet: 545
Geomean: 292

NOHA4
Dry: 154
Wet: 517
Geomean: 236

NOHA5
Dry: 110
Wet: 1422
Geomean: 363

NOHA6
Dry: 105
Wet: 1053
Geomean: 275

BCH23
Dry: 144
Wet: 1682
Geomean: 466

BCH17
Dry: 195
Wet: 244
Geomean: 159

MP-IN
Dry: 103
Wet: 1576
Geomean: 386

MP-OUT
Dry: 51
Wet: 1910
Geomean: 214

Glendale / Kimberly Rte 111 / Rte 1 Area

Southerly flow

Pine Rd.

Northerly flow

Pine / Mill Rd

RR tracks

Mobile Homes

Wetland

North Rd just before it becomes South Rd

Wetland

Wetland

Wetland

Mill Pond

Downstream

Northern Rte 1 area (Ford - Hyundai & other businesses)
Little River, North Hampton, NH

- Bacteria diffuse thru watershed
- Wet weather very high
- Dry weather a bit high
- More testing is ongoing
Little River, North Hampton, NH

- Front page of local paper
- Health Officer found failing septic system, now slated for repair
- "They've been problems for 10 or 20 years, and nobody's done anything about it," Consv. Com.
- Town considering funding
- Perception that only state enforces
Observations: Thick Algae in Estuary
Observations: Farm Road Washout
Take Home Messages

- Bacteria often diffuse (see also Wells, Cape Nedick, Rye NH), but successes are indeed possible
- Pin-pointing sources via sampling is iterative
- Small, cumulative efforts seem to work well for municipal budgets and staff
- Local knowledge with technical support at municipal level is finding and fixing bacteria sources
Questions?