The average annual precipitation total over the past 10 years, however, through implementation of ASM measures (specifically the elevated Scrub-Shrub Wetland)

Bridgertown Rental and Oil Services (BROS) Superfund Site is located in Southern New Jersey. Following a hurricane in the summer of 1972, a waste-oil lagoon located on the property breached and flowed into the adjacent forested wetland. Environmental remediation included removal of contaminated sediment, placement of a surficial layer, and clean fill backfilling which temporarily disturbed 15.3 acres of wetland, including 7.4 acres of forest/scrub-shrub. Remediation was completed in 2010, after which restoration activities were initiated.

Due to changing/variable hydrologic conditions in the wetland areas, the restoration plan consists of an integrated approach that includes Adaptive Site Management (ASM) measures. The ASM approach promotes restoration of a self-sustaining wetland, given hydrologic conditions/variation following remediation and restoration/mitigation goals provided in the State permit equivalency (i.e., re-vegetation in-kind: forested wetland with some open water and emergent marsh).

### HYDROLOGIC CONDITIONS & ADAPTIVE SITE MANAGEMENT

**Increased Intensity/Duration of Flood Events**

- Analysis of local precipitation patterns and data (Marcus Hook, PA weather station), over the past 30 years indicates a 300% increase in the number of storms with >5 inches of rain within the past 15 years (presented below).

<table>
<thead>
<tr>
<th>Number of Rain Events</th>
<th>1984-1998</th>
<th>1999-2013</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;5 Inches</td>
<td>2</td>
<td>9</td>
<td>350.00%</td>
</tr>
<tr>
<td>&gt;6 Inches</td>
<td>7</td>
<td>14</td>
<td>100.00%</td>
</tr>
<tr>
<td>&gt;7 Inches</td>
<td>26</td>
<td>37</td>
<td>42.51%</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>60</td>
<td>71.43%</td>
</tr>
</tbody>
</table>

**Tidal influence has increased over the past 5 years as the Delaware tides**

- Tidal influence was minimal prior to remediation and was controlled by a tide gate
- High tides and storm surge associated with tidal influence prevents

### Current Precipitation Trends

- The average annual precipitation total over the past 5 years (2009-2014) is 8.4 inches greater than the 30-year average used for restoration design (Figure 1)
- The average annual precipitation total over the past 5 years (2009-2014) is 8.4 inches greater than the 30-year average used for restoration design (Figure 1)
- The 30 and 10 year precipitation amounts are steadily increasing (Figure 2)
- Higher than normal precipitation amounts and prolonged inundation of areas targeted for forest/scrub-shrub plantings (Figure 3) limited the ability to plant areas per the restoration plan:
  - Used live stakes and revised containerized species to those more tolerant of hydrologic variability and inundation.
- Created elevated mounds/areas of topsoil addition (12-24 inches above ground surface) to provide elevations suitable for forest/scrub-shrub species plantings.

### RESTORATION OBJECTIVES

- "Restoration objective is to replace red maple forested wetland that existed at the time of lagoon release, and where technically feasible reforest with Atlantic White Cedar, or a more diverse indigenous hardwood species"
- Permit Equivalency (INDEP)
  - "return the regulated areas (wetlands, wetland transition areas, and riparian zones) impacted by the remediation activities to self-sustaining wetland and upland habitats employing an Adaptive Site Management technique that will be implemented and modified as necessary"
  - Pre-restoration cover type mapping identified 7.8 acres of forest/scrub-shrub wetland in the excavation area (Table 1)
  - Restoration design, including elevations and plant species, was developed concurrently with the permit equivalency in 2009
  - Implementing an ASM approach allowed for natural succession and recruitment of desirable species and the identification of supplemental restoration activities based on changing/variable hydrologic conditions, facilitating progression toward restoration of self-sustaining wetland cover types disturbed during remediation activities.

### RESTORATION STATUS & FUTURE PROJECTIONS

- Percent cover of forested/scrub-shrub wetland has increased over the past 3 years (Table 1) due to the implemented ASM measures.
- The adjacent forested wetland is naturally transitioning to a scrub-shrub wetland as water levels increase and trees die
- Continued water level increases and prolonged inundation of the restored forested/scrub-shrub wetland will affect the long-term survival of the currently established forest/scrub-shrub cover types, as exhibited in the adjacent wetland areas.
- However, through implementation of ASM measures (specifically the elevated mounds/planting areas) the restored wetland area has an opportunity to adapt to a diverse wetland that includes forest/scrub-shrub areas and that over time, when/if the water level stops increasing or declines, will become self-sustaining.