Permeable Friction Course (PFC) Asphalt Overlay and Advanced Rainwater Harvesting System
Design, Construction & Function

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Presentation Outline

- Project Objective
- Site Locations
- Design: Technology Descriptions
  - Permeable Friction Course (PFC)
  - Advanced Harvesting Systems
- Construction: Spring/Summer 2011
- Function: Opti-RTC
Project Objective

- Design and install permeable friction course (PFC) permeable paving and a rainwater harvest reuse system with advanced harvest controllers along with long term monitoring equipment to measure effectiveness.
- Develop designs that are transferable to other similar locations in the District.
D.C. Firehouse Engine #3
D.C. Firehouse Engine #3
D.C. Firehouse Engine #25
D.C. Firehouse Engine #25
Permeable Friction Course (PFC)

- PFC - Permeable (or Porous) Friction Course
- OGFC - Open Graded Friction Course
- Voids in pavement allow rainfall to *drain through* pavement instead of running off.
- Historically (since the 1970’s) used to make roadways quieter and safer.

Sample Cross-Section of Permeable Friction Course Overlay (with vegetated shoulder)
Barrett (2006) study conducted over a 21-month period showed:

- TSS: 91% decrease
- Total P: 35% decrease
- Total Copper: 49% decrease
- Total Lead: 90% decrease
- Total Zinc: 76% decrease

Through:

- Reduced pollutant generation.
- Filter and capture through the PFC.
Advanced Rainwater Harvesting

- Simplest Definition of Advanced Rainwater Harvesting: Drain storage in advance of predicted rainfall or other trigger
- Optimized storage use and site stormwater discharge control
- Wireless and online monitoring and control
- Modular above ground “Green Harvesting Cube”
- Deploy-ability, aesthetics and functionality critical
- At-grade precast concrete tank with irrigated green wall exterior and top
Engine House #3: Design
Engine House #3: Design
Inverted Siphon Downspout Design
(Note: location of cistern is shown close to building for illustrative purposes only)

- Proposed Flow Splitter Box Installed on Existing Downspout
- Proposed Inverted Siphon Downspout Pipe (Extends 8'-10' Above Ground Level)
- Flow During Emergency Bypass
- Flow During Typical Use
- Existing Downspout Connection to Combined Sewer
- 4” Automatic Drain Valve Open During Automated Cleaning Cycle and When Cistern is Full
- Proposed Connection to Combined Sewer
- Flow During Cleaning Cycle or When Cistern Full
Engine House #3: Design
Engine House #3: Construction
Engine House #3: Construction
Engine House #3: Construction
Engine House #3: Construction
Engine House #25: Design
Engine House #25: Construction
Engine House #25: Construction
RTC Solution

Internet Based Weather Forecast or other data sources (METSTAT or other Web service API)

Azure Tables/Blobs

OptiRTC Data Aggregator and Decision Space

OptiRTC User Interface Web Services and User Dashboards

Data Logging and Telemetry Solutions

Field Monitoring and Control (Sensors, Gauges, and Actuators)

Email Tweet SMS Voice Autodial
Real-Time Control System Overview

- Interfaces with in-the-field measurement devices and internet data feeds
- Logs data to cloud solution
- Runs models on logged data – producing “Decision Space” data
  - With measured data, decision-space data, and conditional logic...
    - Actuates devices in the field
    - Sends internet-based communications
- Client-specific data visualization/ control dashboards and mobile applications
The User Experience:
Dashboard Example - NCSU
The User Experience:
Dashboard Example - NCSU
The User Experience:

Dashboard Example – NCSU – 9/27/11
Key Design Features 1

- Treats environmental data as simply another enterprise data stream
  - leverages readily available enterprise data management solutions and new developments as they occur.
    - Database solutions
    - Open source visualization, statistical analysis, reporting tools...
    - Mobile platforms
  - supported by a large and competent developer base (i.e., Microsoft Azure, Silverlight, HTML 5, etc...)

- Definition: Enterprise Data Stream
  - Precisely defined, easily integrated and effectively retrieved data for both internal applications and external communication.
  - Data in well run modern corporations are enterprise data streams. (e.g., Geosyntec’s accounting data)
Key Design Features 2

- “Controllers” are just standard web services
  - ANY internet-accessible structured dataset can be collected (e.g., weather feeds) and integrated into decision-space.
  - Can be done in near real-time.
Key Design Features 3

- Built out of proven technologies.
  
  Operating each component will only become less expensive as it is scaled, and as the component technologies continue to improve.
Key Design Features 4

- Cloud-based data processing and storage
  - No physical server hardware
  - Bandwidth availability (i.e., internet facing external connectivity of 99.95%)
  - Forward compatibility
  - Massively redundant data storage
  - Scalability
  - 99.95% application uptime
Timing of release relative to forecast (blue line) allows for dramatic reduction in wet-weather discharge without giving up harvesting performance. Note no discharge during baseline event.

Water remains in system for potential onsite use while providing improved CSO flow control. Drains only right before events.

Detention tank empty except during rainfall.
Technology Application - CSO Control

- DDOE Modeling Summary
  - Baseline runoff volume:
    - 12,680 cf/yr
  - Passive detention wet-weather runoff volume:
    - 11,326 cf/yr
    - 11% reduction
  - OptiRTC controlled wet-weather runoff volume:
    - 3,899 cf/yr
    - 69% reduction in wet-weather flow volume
    - Note no harvesting factored in, assumes accurate forecasts
Example Performance During Large Event - NYC
5/18/1988

Runoff Hydrograph
High Performance Green Infrastructure: Test Site Opportunities

The Water Environment Research Foundation (WERF) invites new test sites for the research project Transforming our Cities: High Performance Green Infrastructure.

Recent advances in information technology infrastructure as well as hardware systems and software solutions are providing the foundation for a future of ubiquitous, digitally-connected, green infrastructure. Intelligent management of such infrastructure will change the way we understand and control our urban environments and impact natural systems. The availability of a new breed of robust, extremely low cost, highly functional, internet accessible, programmable logic controller systems coupled with the ease of wired and wireless communications are making onsite real-time and dynamic controls viable options for both new construction as well as retrofits with green infrastructure based stormwater systems.
Thank you... Questions?

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