Reducing CSOs Using Rain Gardens and Cisterns?
Seattle RainCatchers Pilot Project
Alice Lancaster, PE
Tracy Tackett, PE

Presentation Overview
- Context in SPU Programs
- Study Objectives
- Current Basin Conditions
- Modeling Methods
- Predicted CSO Reduction/Water Quality Impacts
- Design and Field Engineering
- Cost
- Ongoing Work

Context In SPU Programs
- Seattle’s Natural Drainage System Program
- City Right-of-Way
- Residential Neighborhood – NDS Grids
  - SEA Street
  - NW 110th Carkeek Cascade
  - Pinehurst Green Grid
- High density Neighborhood - High Point
- Commercial Area - Swale on Yale
- Private Property
- Private Parking Lots – Northgate Mall Detention
- Stormwater Code Revisions to encourage LID
- Lakewood Pilot Project
- Private Incentives – RainWise Program

Study Objectives
- Effectiveness of BMPs to help mitigate CSOs
- Water quality impacts of routing rooftop runoff to receiving water body
- Willingness of residents to participate
- Feasibility of urban retrofit

Pilot Drainage Basin
- Lakewood Neighborhood
- 75 acres
- ~390 SFR parcels
- Partially Separated Basin
  - Roadway runoff to separate storm drain (discharges to Lake Washington)
  - Roof runoff to combined stormwater/sewer system (routed to WWTP)
- CSOs to Lake Washington

Decentralized Stormwater BMPs
- Disconnect rooftops and route to Storm Drain via:
  - direct connection (tightline)
  - lined vegetated swale
- Disconnect rooftops and route to rain garden with overflows to storm drain
- Detain rooftop runoff to combined sewer with cistern
Modeling
- Infoworks CS
- Updated Base Model
  - Basin area and land use information
  - Assumed one third rooftops disconnected
- Calibrated Model
  - 3 months in sewer flow record
  - I&I ~ 80%
- Validated Model
  - 5-year CSO record
- CSO Simulation

Disconnection
- Route rooftop runoff to storm drain via tightline or lined vegetated swale
- Completely remove flow from combined sewer
- Model method: rooftop area eliminated from basin area modeled

Disconnection (Tightline or Swale)

Disconnection (Tightline or Swale)
### Rain Garden

- Route rooftop runoff to Rain Garden with Overflow to Storm Drain
- Reduces flow to combined sewer (detsains and allows infiltration)
- Modeled method: the disconnected roof area represented as pervious area

### Cisterns

- Route rooftop runoff to Cistern
- ~500 gallon tanks w/ low flow orifice and overflows to sewer
- Detains and desynchronizes storm flows
- Modeling to be completed
Water Quality Impacts

- Reduce CSOs to Lake
  - Reduce pollutant loading associated with CSOs (FC, TP)
- Increase rooftop runoff to Lake
  - Could increase loading of pollutants associated with rooftop runoff (Zn, PAHs)

Applicability of BMPs in Basin

- Connected to sewer
- Gradient
- Outside of infiltration restriction zone for rain gardens
- Cisterns to sewer where rain gardens cannot be applied

Design Variations

- Space (lot sizes/set backs)
- Basements
- Rockeries
- Thrown streets
- Storm drain capacity

Design Components

- Downspout Zone
  - Downspout extension/splash block
  - Tightline
- Conveyance Zone
  - Tightline
  - Unlined or lined conveyance furrow
- Rain Garden Zone
- Overflow Zone
  - Weep holes through curb
  - Gravel level spreader
Rain Garden Design

- Sized to infiltrate 91% runoff
- Must drain within 24 hours
- Average native infiltration rate of 0.9 in/hr
- Assuming manages runoff from 50% of a typical SFR roof (conveyance limitations)

Field Engineering

Design Decision Flow Chart

Cost to Meet Regulatory Goal

- Project Cost (Million Dollars)
- Percent Rooftop Area to Rain Gardens

Ongoing Work

- Evaluate Cistern Benefits
- Recalibrate Model Using More Reliable In-sewer Flow Data
- Complete Design
- Public Outreach/Customer Agreements
- Coordinate with Other Agencies
- Construction / Field Engineering
- Operations and Maintenance
- Monitor Performance

Rain Gardens

- Are low, wet areas typically fed by storm water.
- Act like and can look like mini wetlands.
- Like wetlands, provide some bioretention.
- Allow storm water from roofs and paving to percolate into soils.
- Help recharge springs.
- Can be designed, planted and maintained as natural garden features.