From Asphalt to Bioretention –
Lessons Learned from Two Parking Lot Retrofits

NAKANO ASSOCIATES LANDSCAPE ARCHITECTS

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Why retrofit an existing parking lot?

- Owner-driven (Case #1 – Peninsula College Parking Lot Retrofit)
  - To Provide a Sustainable Design that is environmentally-friendly (i.e. treats the stormwater runoff and reduces the flow off-site)
  - Welcome People (i.e. curb appeal)
  - Amenity Space
- Helps with compliance for Industrial National Pollutant Discharge Elimination System (NPDES) (Case #2 – Duwamish Manufacturing Company Parking Lot Retrofit)

How is stormwater being treated and controlled?

- Bioretention –flow control and treatment of stormwater
  - Engineered facility sized for specific water quality treatment and flow control objectives that includes designed soil mixes and perhaps under-drains and control structures (LID Manual for Puget Sound, WSU Extension)
  - Note: Rain Garden is similar to bioretention, but is described as a non-engineered landscaped depression to capture stormwater from adjacent areas.
- Biofiltration –is a Best Management Practice (BMP) that uses vegetation (typically grass) to provide basic treatment of stormwater only

Who reviews bioretention/biofiltration plans?

- Complying with local, state and federal regulations
- Case #1 – 2005 Stormwater Management Manual for Western Washington (91% water quality event)
  - City of Port Angeles
- Case #2 – 2009 Stormwater Management Manual for Western Washington (91% water quality event)
  - Department of Ecology
  - Washington Department of Fish and Wildlife (located near waterway)
  - City of Seattle

Site Study 1:
Peninsula College Parking lot retrofit

- Size of project area: 225,142 sf (5.1 acres)
- Number of parking stalls before: 620

  after: 504 (confirmed by campus requirements)
- Area landscaped before : 6 % (lawn)

  after: 14 % (mixed vegetation)
- % of water treated 91% of the water quality storm event

Site Study 2: Duwamish Manufacturing Company Parking lot retrofit

- Size of project area in 1,207,560 sf (~27acres)
- Number of parking stalls before: 364

  after: 351
- % of area landscaped before: 22%

  after: 29%
- 91 % of water treated per water quality event (per 2005 SWMMWW)

What Makes a Parking Lot a Good Candidate to be Retrofitted?

- 90 degree parking
- Wide turning areas and aisles (> 24-feet)
- Excess Parking
- Adjacency to Right-of-Way (with extra green space to be shared with ROW)
- Gravity discharge location
- Slope is less than or equal to 5%.

Retrofit, Recycle, and Reuse

- Retrofit parking lot by cutting out asphalt areas and replacing with bioretention/biofiltration swales.
- Recycle asphalt and reuse in overlay.
- Reuse rocks and wheel stops. Place rocks in landscape islands where “curbing” occurs. Make flow spreader by countersinking rocks.

Bioretention/Biofiltration – To be media or not be media

- Intercept flow by placing bioretention planters perpendicular to the flow path
- Flow-through treatment
  - Grass-lined swales
  - Bioretention/Rain Gardens (Case #1 – Peninsula College)
    - Lots of Mixes:
      - LID Manual (p. 181 – p. 182)
      - SPU Bioretention Mix Specification
  - Compost Amended Vegetated Filter Strip (Case #1 - Peninsula College)
  - Engineered Media Mix (Case #2)
    - LID Manual
    - Custom Mixes

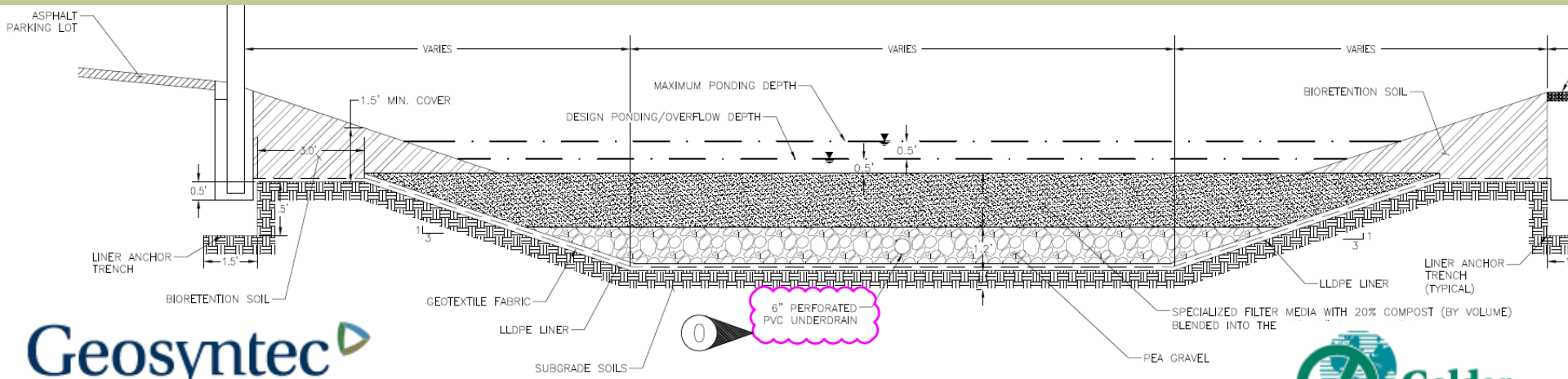
Are there “bad” soils that spoil sustainable solutions?

- “Bad” soils can be considered to be soils that don’t infiltrate well, liquefy when wet, or have contamination.
- How does sustainable sites work with “bad” soils?
- Bad soils can occur for a variety of reasons:
  - Previous contamination
  - Very clayey soils
  - Soils that infiltrate way too fast can also be problematic

Liners and Underdrains

Caution when using either of these.

- Liners are permeable – need to know to what level a liner is to be used to block groundwater from flowing into bioretention area.
  - LLDPE Liner (40 MILS, double-sided texture)
  - Subgrade soils (Silts and Clays, or Silty/Clayey sands)
  - Examples from SOLMAX for Liners.
- Underdrains will cause runoff to sometimes move quickly through the media.
  - Underdrain Examples (Types of Underdrains)



Custom Bioretention Mixes – Above and Beyond

- Parking lot runoff is known to have large amounts of zinc and copper from vehicles.
- Enhanced Media mixes (18-inches of bioretention mixes are for concentrations between 0.005 to 0.02 mg/l, dissolved copper and dissolved Zinc ranging from 0.02 to 0.3 mg/l.
- Filtration media – zeolite, activated carbon (or Bio-Char), washed sand mixtures
- Bench scale testing – Rain in Seattle versus in Portland have different acidic levels. Zeolites can vary as well.

Working with Contractors

- When “bad” soils appear, it is important to have a good relationship with the Contractor.
- Contractor, Engineer, and Owner need to work together to find the best solutions.
- Working together:

  - Provide checkpoints or hold points in the specifications for critical path items.

  - Know that there can be unknowns (i.e. old abandoned utilities, live electrical lines, gaps in site characterization) and that both parties will work together in resolving the utility conflicts.

  - Prepare a plan for over excavated soils – Can they be reused on-site?

  - Stay involved.

  - Verify the design before the concrete is installed. Are all the islands lined up? Is there enough clearance to go around the island?

Water Quality Treatment Integration

"Compost qualities often determine the success or failure of bioretention soil media, in terms of infiltration and plant growth (2013 LID Manual)"

- Key Integration – Landscape Architect specifies and reviews Compost Specifications.
- Compost can contain high levels of heavy metals

- Have compost tested for total and dissolved Zn and Cu
- Cost of test is ~$160

Landscape Design for bioretention

- Preserve vegetation when possible.
- Enhance/ complement the surrounding area/ vegetation.
- Maintain views and safety.
- Design with maintenance in mind.
- Know your client and develop the design in collaboration with those who will maintain it (if possible).
- Fall/ winter planting.
- Communicate the design to those who will maintain it .

Plant selection for bioretention

- Native plant material
- Woody plant material
- Minimize pruning
- Soil pH
- Evergreen plants intercepts more stormwater
- One tree can reduce stormwater runoff by over 4,000 gallons per year.
- Availability at nurseries
- Use cultivars for low growing, narrower varieties of native plants
- Use groupings of plants – no mass planting.

Plant selection for bioretention

Native plant material for wet zones:

<u>Emergents</u>

Carex obnupta-Slough sedge
Juncus effusus- Soft rush
Juncus patens- Grey rush
Scirpus acutus-Hardstem bulrush

<u>Shrubs</u>

Cornus sericea- Red osier dogwood
Lonicera involucrata- Twinberry
Spirea douglasii- Douglas spirea

<u>Trees</u>

Alnus rubra- Red Alder (large tree!)
Malus fusca- Pacific Crabapple
Pinus contorta ‘contorta’ –Shore pine

Mulching and bioretention

- Use arborist wood chip mulch on the side slopes
- use coarse compost at bottom

Landscape Maintenance

- Establishment and long term maintenance of bioretention facilities (landscape management plan)- define purpose of facility
- Trash removal
- Weeding
- Maintaining organic layers
- Vegetation management
- 3 establishment years- higher maintenance needed

Lessons Learned

Controlling Flow from Large Volumes of Water

- Flow can become channelized quickly and cause rutting or blowouts.
  - Position large rocks in a row to act as flow spreader (using natural elements)
  - Wheel stops can help disperse flow
  - Notched curb
  - Vegetation
- Lesson Learned:
  - Groundwater seeped between the bottom of the curb and the asphalt overlay and started creating a green slime on the surface.
  - Remedy – Placed bentonite behind the curb to block the migration on the downhill side of island planters.

- Proper soil preparation – avoid erosion

Right plant –right place

- Avoid pruning – use plant material in the right place.

Irrigation

- High-efficiency rotor heads for all bioretention areas and biofiltration swales. Drip irrigation everywhere else.
- Always specify controller with rain sensor
- Irrigation during establishment period
- Avoid overspray

- Document and ensure quality plant material

- If mulch is blown in; plant groundcovers after mulch has been placed.

- Protect from wildlife (birds, deer) during establishment period (2-3 years).

- Protect the plants
- Ground level behind curb is at top of curb.

- Weeds- change what can, accept what cannot, know the difference.

Thank you!

Questions?

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