What makes natural drainage strategies different?

- Collaboration is a necessity
  - Owner, design team, AHJ
  - Contractor involvement
  - Maintenance involvement (if known)

- Think differently
  - Get stormwater “out of jail”
  - Let it disperse/go back in
  - Reuse (pros/cons)

- Site design
  - Layout
  - Space needs
  - Dual function
  - Use of open space
  - Trade-offs (pro underground still exists)

- Cost shift

- Expectations

- Maintenance

Case Study: High Point Redevelopment, Seattle, WA

Longfellow Creek watershed

120 acres, 1,600 housing units, neighborhood center, library, and mixed-use
Density ranges from 16 units/acre to 25 units/acre of ground-related housing

15,000 linear feet of swales
Developing Cross Section & Swale Length

- The cross sections for the NDS swales were developed through discussions with various City of Seattle departments (decisions by inches)
- Street widths: 25 feet/56 right of way; 28 feet/56 ft rw; 32 feet/60 ft rw
- Curb height, swale width, street tree locations, berm locations, side slopes, bottom width, etc. were established
- Porous sidewalks on the swale side

High Point Drainage Criteria

- Water quality treatment: 6 month storm
- NDS combined with the stormwater pond detain and match duration up to the 2 year, 24-hour storm assuming pasture conditions
- Piped conveyance sizing for 25-year storm
- Site drainage distributed at the block scale
- Peak flow control for 100 year storm (0.5 cfs per acre)
- Conveyance of dam safety flows downstream of storm water pond
- Note: Seattle tends to get drizzle versus the high intensity storm event. Ex. 100 year storm event is 3.84 inches/24 hour

Permitting the Project: Who approves what and when?

One Example: High Point Basis of Drainage

Master Use Permit
- Concept Approval by City
- Plat
- Recorded Lot level requirements (subdivision) County
- Building Permits
- by City for each separate Parent Lot development a plan identifying approach to meet the plat drainage thresholds.

Drainage thresholds for each lot in the plat.
- 60% impervious average for subdivision (15% to 70%)
- Downspout dispersal minimum requirements (0% to 100%)
- Designated NDS discharge points (to the swales)
- Soil amendment
- Multiple strategies to meet requirements

Drainage Covenant defined the regulatory and plat requirements
Site Drainage Technical Standards for permitting private development and long term site conditions
Maintenance Association of natural drainage landscape, open space and rights of way. City shares cost. Maintenance Guide
Memorandum of Agreement between the City and the Association

Natural Drainage Strategies - Block-level Design

- Porous pavement
- Swales and Conveyance furrows
- Dispersal trench
- Rain-garden
- Pop-up emitter
High Point Natural Drainage Strategies

Housing: Block-level Design

- Pop Up Emitter
- Gravel Pave
- Splash Blocks

Swales – Use in Natural Drainage Systems
What are they? A non-technical view

- Swale: Flat Bottom Depression
- Ditch: Deep-cut steep side slopes
- Conveyance Swale: Purpose to move water (temp vs permanent)
- Bioretention Swale: Engineered vegetated swale; cleans water
- Bioretention Swale: Vegetated; infiltrates & cleans water
- Natural Drainage Swale: Engineered system with amended subsurface soil layer
- Raingarden: Organic shaped depression with amended soils and plants to soak up and retain water. Typically has overflow.
- Stormwater planter: More structural to complement building functions as retention to reduce stormwater discharge. Planted
- Furrow: Small conveyance swale
- Dispersal or Infiltration Trench: Underground washed rock or gravel to spread out flows

Natural Drainage Strategies – Porous Pavement

- Porous pavement materials - multiple choices
- Drainage through surface material
- Porous sub-base
- Perforated pipe to NDS or PS
- Full credit as pervious area

Natural Drainage Strategies – Conveyance Furrows

- Downspout dispersal: Directs flow to NDS
- Berms and check dams to reduce velocity
- Level spreader reduces concentration at walks

Natural Drainage Strategies – Dispersal Trenches

- Gravel or sod covered
- Spreads flow of large storms
- Infiltrates small storms
- May connect to PSD

Natural Drainage Strategies – Rain Gardens and Pop-up Emitters

- Rain Gardens:
  - Small storm detention
  - Overflow over land or through grate to NDS
- Pop-up:
  - Releases flow away from building
Pop Up Emitters
- Placement for dispersal
- Initial protection required until landscape is installed

High Point Revitalization Project
Phase I under construction, October 2005

Block-level Drainage Design
- Each block uses site-specific drainage strategies
- 62%-70% allowable impervious
- 50% of roof area drainage dispersed
- Porous pavement

Each block uses site-specific drainage strategies
- Porous pavement
- Splash block
- Conveyance furrow
Block-level Drainage Design

- Each block uses site-specific drainage strategies
- Porous pavement
- Splash block
- Conveyance furrow
- Integrated utilities
- Dispersal trench
- Pop-up emitter
- Rain garden
- Adjacent NDS

High Point: Frequently asked questions.

- **What would you change?** Not a simple answer. Ideally you would reorient the site plan (grid) to follow topography; however, that orientation might not work best for blending with the neighborhood. It is not all about drainage.

- **How do you deal with tight sites?** High Point is a big project with lots of small projects. The housing sites are tight. It takes more strategies and attention to grading, drainage flow patterns, footpaths, watch for those “closed areas” that don’t give the water a way to get out. You have to achieve amended soils or you will have soggy yard syndrome.

- **How do you permit it?** Short answer: lots of discussion with AHJ. Note: the codes are changing, it will get easier.

- **The engineer we are working with won’t do it?** Keep talking to them.

- **How do you keep the site dry?** Expectations need to change. To allow the water to get back into our ground we need to let the ground get wet.

- **Why do you still have a pond?** The pond manages larger storms. The natural drainage approach at High Point manages small storms (2 year and less).

High Point Natural Drainage Project

Recognition:
- Seattle Housing Authority
- Seattle Public Utilities

Other agencies:
- Washington State Department of Ecology
- US Department of HUD
- Seattle Department of Planning & Development
- Seattle Department of Transportation
- Seattle City Light

For more information:
- pdf of High Point Site Drainage Technical Standards (design ideas for drainage strategies on housing sites)
  - [www.svrdesign.com](http://www.svrdesign.com)
  - [www.seattle.gov/util/naturalsystems](http://www.seattle.gov/util/naturalsystems)

Consultants:
- SvR Design Company - Civil Engineering Natural Drainage and Right of Way Landscape Architects
- Mithun - Planning Lead and Team lead
- Rental Architects and Landscape Architects
- Nakano Associates Rental Housing Landscape Architects
- Streeter Associates - Block 8/9 Architects

Resource consultants:
- Greg McKinnon at Stoneway Concrete
- Jim Powell at NW Chapter ACPA
- Cedar Grove Compost
- Shannon and Wilson

32nd Ave SW & NDS Contractors:
- Gary Merlino Construction Company
- T. Yorozu Gardening Co.
- Subs to: Absher Construction Co.
Natural Systems
Finding a common language (bring your discipline and experience to the table, “like a good pot luck”)

Natural Systems
Natural Systems

- Respect for other disciplines, their knowledge and experience.
- Design construction, maintenance.
- Ask questions
- Answer questions
- Trust (sometimes the answer is not what you wanted)

Some Example Projects
Broadview Green Grid

Before

Kitsap County Administration Building

Design Team: Miller/Hull, Sykt, Site Workshop, Myers Biodynamics, Abacus

Kitsap County Administration Building

Urban Redevelopment
- Green roofs for runoff control
- Cisterns
- Rainwater harvesting for landscape irrigation

Construction, Fall 2005

Concept 2003

Rain Garden

Cascading Channel

Drawing courtesy of Miller/Hull
Drawings and Construction Documents

- Natural systems may require a rethinking of the order of drawings.
- We may need more details.
- Specifications – jeepers they need to be read.
- Interdisciplinary – yet who stamps what? This is a real issue.
- How do these issues apply to different projects?
  - Residential
  - Commercial
  - Parks
  - Public

Details, Details, Details: What not to forget!

- Natural Drainage and Concept Development
  - It Takes a Team: landscape architects, architects, engineers, historians, arborists, hydrologists, surveyors, owners, neighbors.
  - New homes on an historic hillside.
  - Stormwater planter prototype for runoff control.
  - Amended soils to attenuate runoff.

Design Communication - Concept Development and Permitting

- This is the phase where ideas are discussed.
- Concepts are developed.
- Permit issues are evaluated and designs either:
  - Modified to fit current requirements
  - Agency approached for alternative approval
  - Design Team decides to further study.
- All site related disciplines should be involved in the design approach. Discussion should address design, permitting, construction and maintenance.
- Why the reluctance to a more natural approach? Is it the delivery, tone, discipline, fear or ??? We need to keep trying. The answer is not a specialized firm, the answer is getting more people to understand NDS as the way to do land design.

Seattle: Denny Way Apartments: Concept 2003-04
Planters have a double liner, an impermeable membrane and a vertical drain. Approximately 18 inches of soil overlays a gravel sub-base.

The Challenge of Balance
We use our land for many activities. Natural Drainage is not always the driver of the design, so it is important to use a variety of strategies to achieve the desired goal.

Engineered Soils
Review plant density - denser planting makes for quicker canopy closure and less trampling.

Natural Systems
A palette of colors designed by Nature…
High Point: Tree Protection

- Arborist evaluation
- Valuation posted
- Critical root zone fencing
- Contractor education/incentive
- Utility boring

Lawson Cypress and Big Leaf Maple Trees 228 and 289

Tree Protection - A long term enforcement

- Trees 234 & 237

Tree Protection – Critical Root Zone

- Maintaining room for tree to grow
- Protected area can assist with TESC
- Maintaining natural drainage flow
- Restoration of area
- Discuss what is appropriate for planting in the CRZ

Tree#1 Sequoia
High Point: Tree Protection - The Exceptional Tree  
This is a must save – leave curb; leave foundation under redevelopment

Red Oak - Tree #784

Franchise and Electrical Utilities  
Right of Way is usually a busy place underground  
(note this same issue applies to private property - call before you “design”)

Ground covers preferred, but check in on maintenance

Before  
Change: was lawn now is ground cover – multiple benefits

After

Opportunities

- Look for conditions that allow stormwater to be collected and flow by gravity to a location that allows  
  - Dispersal  
  - Percolation  
  - Filtration  
  - Storage

Natural Drainage Strategies Lessons Learned

- Learning curve for both designers and permitting agencies  
- Owner/Developer understanding of differing site constraints  
- Broad tool kit necessary for site plan treatments  
- Contractor information, discussion, ideas. (keep an ongoing dialog)  
- Temporary sedimentation and control approach and sequencing  
  - This takes collaborative discussion of all disciplines - not just civil.  
- Fine grading for site contractors or under the landscape contractors  
- Commissioning for sites  
- Expect to answer questions- (Why are you doing this?)  
- Expect to make adjustments

Why Natural Drainage?

- Demonstrated results  
- Installed examples now common place  
- Accepted practice with many jurisdictions  
- Accepted treatment by the public (if you explain it)  
- Retrofit is an option  
- Value added/practical
Where are we headed?
The northwest is a leader. Many states have changed their approach, and internationally this is becoming a standard. Share your ideas – it’s a big country, and we all want to see our impact on the land change. Lessons learned can help us all - let’s use the European model of an open discussion.

- Washington State DOE
- King, Snohomish and Pierce Counties
- City of Seattle
- City of Bellingham and Whatcom County

Other places to watch:
- Maryland
  - Prince Georges County
  - Center for Watershed Protection
- District of Columbia
  - California Stormwater Quality Assoc.
- Milwaukee WI
- Chicago

Puget Sound Action Team LID Technical Guidance Manual for Puget Sound:
http://www.psat.wa.gov/Publications/LID_tech_manual05/lid_index.htm