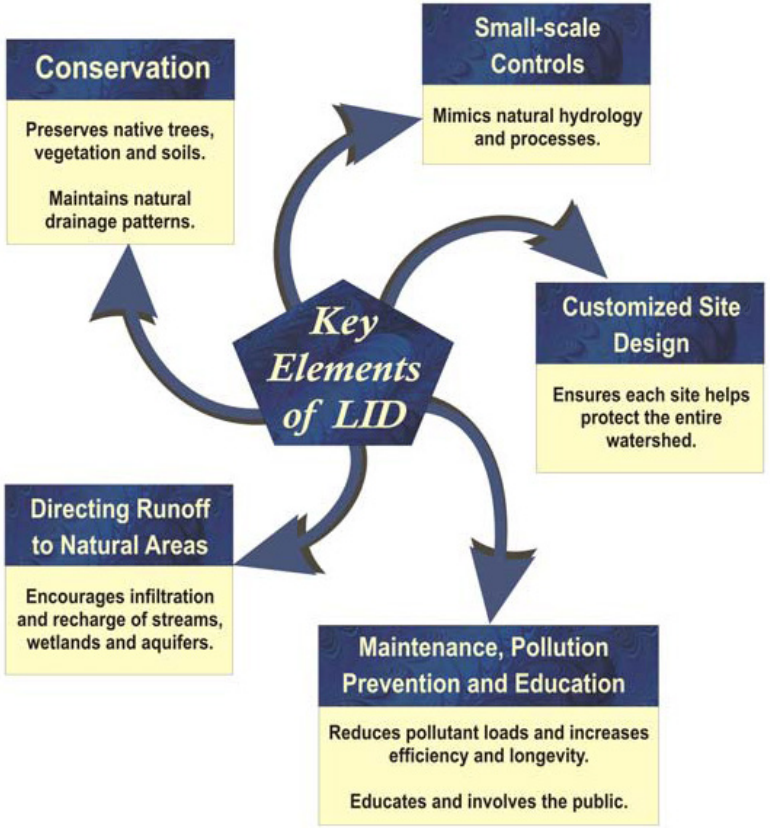
NAVFAC
Naval Facilities Engineering Command
NAVFAC Atlantic

Low Impact Development (LID)

Implementation and Site Development of NAVFAC Projects

LID Defined

- A set of stormwater management strategies for maintaining or restoring the natural hydrologic functions of a site.
  - Strategies can be natural or man-made
  - Includes site design strategies and decentralized source control techniques to limit runoff (Integrated Management Practices).
  - Primarily focused on the infiltration, evaporation, transpiration, and reuse of rainwater.
  - A revised philosophy intended to reduce runoff rate and volume, and improve quality at the source

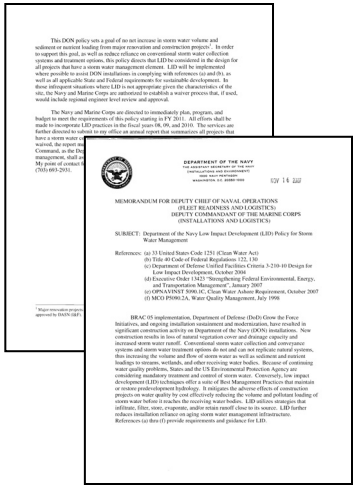


A (Very) Brief History of LID

- Began in Prince George's Co, MD with the use of bioretention cells in 1990's.
- This led to incorporating LID into the County's resource protection program.
- Prince George's County produced the first municipal LID manual in 1998.
- Later expanded into a nationally distributed document in 2000.
- Initial LID UFC released in 2004
- Penn memo and EISA were released in 2007
- Revised LID UFC 2009 (pending)
- Executive order 13514 (Oct. 5, 2009)

Why is LID Required on NAVFAC Projects?

- Assistant Secretary of the Navy (I&E) BJ Penn implemented a policy on 16 Nov 2007 (known as the Penn memo) with a stated objective of "no net increase in stormwater runoff volume and sediment of nutrient loading from major renovation and construction projects."
  - Policy takes effect FY 2011, however "all efforts shall be made to incorporate LID practices in FY's 08, 09, and 10."
  - Major renovations with a stormwater component exceeding $5M
  - Major construction exceeding $750K
- DoD/Navy/FEC Policy
- Clean Water Act (CWA) and NPDES Ph2 (state permitting)
- NAVFAC Engineering & Construction Bulletin (12 Dec 2007) provides strategies for obtaining LEED Silver (to meet ASN I&E Memo of Aug 2006) and identifies required 20 – 22 credit points, including credits SS6.1 and SS6.2
- Energy Independence and Security Act (EISA) Section 438



This DON policy sets a goal of no net increase in storm water volume and sediment or nutrient loading from major renovation and construction projects[1]. In order to support this goal, as well as reduce reliance on conventional storm water collection systems and treatment options, this policy directs that LID be considered in the design for all projects that have a storm water management element. LID will be implemented where possible to assist DON installations in complying with references (a) and (b), as well as all applicable State and Federal requirements for sustainable development. In those infrequent situations where LID is not appropriate given the characteristics of the site, the Navy and Marine Corps are authorized to establish a waiver process that, if used, would include regional engineer level review and approval.

The Navy and Marine Corps are directed to immediately plan, program, and budget to meet the requirements of this policy starting in FY 2011. All efforts shall be made to incorporate LID practices in the fiscal years 08, 09, and 2010. The services are further directed to submit to my office an annual report that summarizes all projects that have a storm water c
waived, the report m
Command, as the Dep
management, shall a
My point of contact f
(703) 695-2931.

[1] Major renovation projects
approved by DASN (I&E).

DEPARTMENT OF THE NAVY
THE ASSISTANT SECRETARY OF THE NAVY
(INSTALLATIONS AND ENVIRONMENT)
1000 NAVY PENTAGON
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NOV 14 2007

MEMORANDUM FOR DEPUTY CHIEF OF NAVAL OPERATIONS
(FLEET READINESS AND LOGISTICS)
DEPUTY COMMANDANT OF THE MARINE CORPS
(INSTALLATIONS AND LOGISTICS)

SUBJECT: Department of the Navy Low Impact Development (LID) Policy for Storm Water Management

References: (a) 33 United States Code 1251 (Clean Water Act)
(b) Title 40 Code of Federal Regulations 122, 130
(c) Department of Defense Unified Facilities Criteria 3-210-10 Design for Low Impact Development, October 2004
(d) Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management", January 2007
(e) OPNAVINST 5090.1C, Clean Water Ashore Requirement, October 2007
(f) MCO P5090.2A, Water Quality Management, July 1998

BRAC 05 implementation, Department of Defense (DoD) Grow the Force Initiatives, and ongoing installation sustainment and modernization, have resulted in significant construction activity on Department of the Navy (DON) installations. New construction results in loss of natural vegetation cover and drainage capacity and increased storm water runoff. Conventional storm water collection and conveyance systems and storm water treatment options do not and can not replicate natural systems, thus increasing the volume and flow of storm water as well as sediment and nutrient loadings to streams, wetlands, and other receiving water bodies. Because of continuing water quality problems, States and the US Environmental Protection Agency are considering mandatory treatment and control of storm water. Conversely, low impact development (LID) techniques offer a suite of Best Management Practices that maintain or restore predevelopment hydrology. It mitigates the adverse effects of construction and development on water quality by reducing the volume and pollutant loading of storm water before it reaches the receiving water bodies. LID utilizes strategies that infiltrate, filter, store, evaporate, and/or retain runoff close to its source. LID further reduces installation reliance on aging storm water management infrastructure. References (a) thru (f) provide requirements and guidance for LID.

- LID features can help satisfy CWA, LID, and LEED requirements

UFC 3-210-10 Low Impact Development (Draft)

- References Penn Memo and EISA as standards
- Directs DOR to apply criteria of governing permit authority
- Reinforces the requirements of obtaining permits, unless an MOU is on file
- Establishes the basis for calculations by defining hierarchy of standards and a recognized pre-development condition.
  - Conditions immediately prior to human development
- References the NRCS CN methodology for runoff and volume calculations
- Defines the rainfall for use in calculations
  - Larger of 95th percentile rainfall, or required water quality depth as design storm
- Provides guidance on use of integrated management practices (IMP's)
- Navy Guidance Document
  - Provides assistance on interpretation and implementation of LID criteria
- Technical Memos
  - Define "No Net Increase in Stormwater Runoff Volume"

Energy Independence and Security Act (EISA)

Definition

- Energy Independence and Security Act (EISA) Section 438
  - "Sec. 438. Storm Water Runoff Requirements for Federal Development Projects. The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."
- Each agency is responsible for ensuring compliance
- Reporting methods are TBD

Performance Options – Per EPA Draft Guidance

- Option 1: Control 95th Percentile Rainfall Event (Q = P x Imp A)
  - Incorporate the 95th percentile storm in the SCS CN method calculations (NAVFAC)
  - Manage rainfall onsite; infiltration, evapo-transpiration, and harvest and reuse
- Option 2: Preserve predevelopment hydrology (rate, volume, duration & temperature)
  - Conduct hydrologic and hydraulic analyses
  - Quantify post-construction hydrographs for the 1, 2, 10, 25, 50 and 100 year 24 hour storm events
  - Maintain pre-development hydrographs for these storm events

Energy Independence and Security Act (EISA)

Performance Options Continued (per EPA Draft Guidance)

- Exceptions granted if:
  - Site conditions preclude the use of infiltration
  - Site conditions preclude the use of soil amendments, plantings, etc used for evapo-transpiration
  - Water harvesting is not practical or possible
  - Plumbing or structural systems in building being modified preclude compliance
  - Compliance results in the retention and/or use of stormwater on the site results in an adverse water balance
- When a defensible exception is granted stormwater practices must be implemented to facilitate stormwater infiltration, evapo-transpiration, and/or harvesting to the "maximum extent technically feasible".
  - The difference between the METF amount and the 95th percentile amount shall be detained to ensure no increase in peak runoff rate, and treated to ensure no increase in receiving stream temperature.
- Memo to file detailing EISA exception

EISA Compliance Direction for DoD Projects

- Applies to ALL federally funded projects that increase impervious area by 5,000sf or more
  - New construction
  - Additions
  - New pavements (including sidewalk)
- Design objective is to maintain the pre-development hydrology
  - Pre-project conditions wrt temperature, rate, volume, and duration
- Use modeling or other recognized tools to establish objective
  - TR-55 curve number method is recommended for Navy projects
- Evaluate design options to meet objective to the maximum extent technically feasible (METF).
- Document EISA design and construction costs
- Complete a post construction analysis of features

EISA DoD Implementation Process

1. Determine applicability

Requirement: apply to all Federal projects with a footprint greater than 5,000 square feet

Or MILCON within funding limits with stormwater component

2. Establish design objective

Requirement: maintain or restore predevelopment hydrology

OPTIONS (use only 1)

1
Total volume of rainfall from 95th percentile storm is to be managed on-site.

2
Determine predevelopment hydrology based on site-specific conditions and local meteorology by using continuous simulation modeling techniques, published data, studies, or other established tools. Determine water volume to be managed onsite.

Design water volume
(to be retained)

3. Evaluate design options

Requirement: meet design objective to maximum extent technically feasible (METF)

Design water volume
(to be retained)

TYPICAL ON-SITE DESIGN OPTIONS

- **Bio-retention areas**
- **Permeable pavements**
- **Cisterns / recycling**
- **Green roofs**

Use any combination of on-site options to achieve the design objective to the METF. Document site-specific constraints.

Selected on-site design options

remaining water volume ?

OFF-SITE OPTIONS
(optional)

Selected off-site design options

TECHNICAL CONSTRAINT EXAMPLES

- Retaining storm water on site would adversely impact receiving water flows
- Site has shallow bedrock, contaminated soils, high groundwater, underground facilities or utilities
- Soil infiltration capacity is limited
- Site is too small to infiltrate significant volume
- Non-potable water demand (for irrigation, toilets, wash-water, etc.) is too small to warrant water harvesting and reuse systems
- Structural, plumbing, or other modifications to existing buildings to manage storm water are infeasible
- State or local requirements restrict water harvesting
- State or local requirements restrict the use of green infrastructure/LID

4. Finalize design and estimate cost

Considering LEED (v2.2)

Credit SS6.1

- **Option 1 – Existing impervious area is less than or equal to 50%**
  - Post development peak discharge and quantity cannot exceed predevelopment discharge and quantity for the one year and two year 24hr storms, or
  - Ensure receiving stream does not erode
- **Option 2 – Existing impervious area is greater than 50%**
  - Reduce the volume of runoff by 25% for the 2-year 24-hr storm

Credit SS6.2

- **Reduce 80% of the average post development TSS from 90% of the runoff.**

Other Criteria Considerations

- UFC 3-200-10N Civil Engineering
- UFC 3-210-10 Low Impact Development
- UFC 4-010-01 Minimum Anti-Terrorism Standards for Buildings
- LEED Requirements
- Base Exterior Architectural Plan (BEAP), or equivalent
- Local, State, and Federal laws

- It is understood there are going to be some conflicts between some criteria.

Permitting and Criteria Compliance

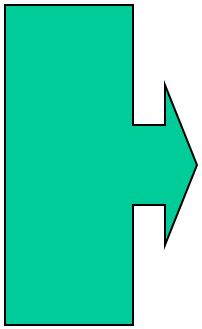
- The Designer of Record remains responsible for obtaining all applicable permits.
- This may lead to multiple sets of stormwater management calculations
  - May also require some discussions with permit authority
  - Must determine most stringent requirement for design

- Hampton Roads IPT
  - DCR is the regulator in Virginia
  - MS4 covers installations and annexes, including NNSY, in Hampton Roads
  - Permitting submitted to Regional Environmental Group Water Program Manager.
- North Carolina IPT
  - NC DENR is the NC regulating authority in NC.
  - The region and process will vary by base.
- Northeast IPT
  - Regulator varies by state

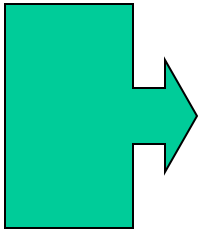
Always consult your regional environmental engineer for permitting requirements when permitting a project or writing an RFP.

LID Planning/Execution Process

1. Define project objectives and goals
   - LEED, EISA, LID, NPDES
2. Perform site evaluation and analysis.
   - Document review to assess site
3. Develop control strategies
   - System costs
4. Concept design or masterplan
   - Part of RFP or design process and requires calculations
5. Develop operations and maintenance procedures
   - Part of the OMSI



Planning/MTP3



RFP/Design Phase

LID Integrated Management Practices (IMP) Categories

5 IMP Categories

- Site Utilization
  - Reducing the impervious footprint
  - Mimic predevelopment hydrologic conditions
  - Increase T_c
- Filtration
  - Natural water quality treatment and increase T_c
- Interception/Infiltration
  - Key strategies to compliance
- Retention of LID Volumes
- Structural Solutions
  - The last line of defense
  - Come with a higher cost

Calculations

- SWM permitting is primarily concerned with peak runoff rate and quality and is governed by state requirements
- LEED
  - v2.2 SS6.1 regulates the peak discharge rate and quantity of the 1-yr and 2-yr storm
  - v2.2 SS6.2 requires the treatment of 90% of the average annual rainfall
- EISA goal is to return a site to it's original hydrologic condition.
- Penn memo – no net increase in volume

Generally the Soil Conservation Service (SCS) curve number (CN) method will be used to generate treated volume as a function of pre-development and post-development peak runoff.

The design storm for calculations shall be the larger of the 95th percentile rainfall depth or the locally legislated required water quality depth.

Strategies

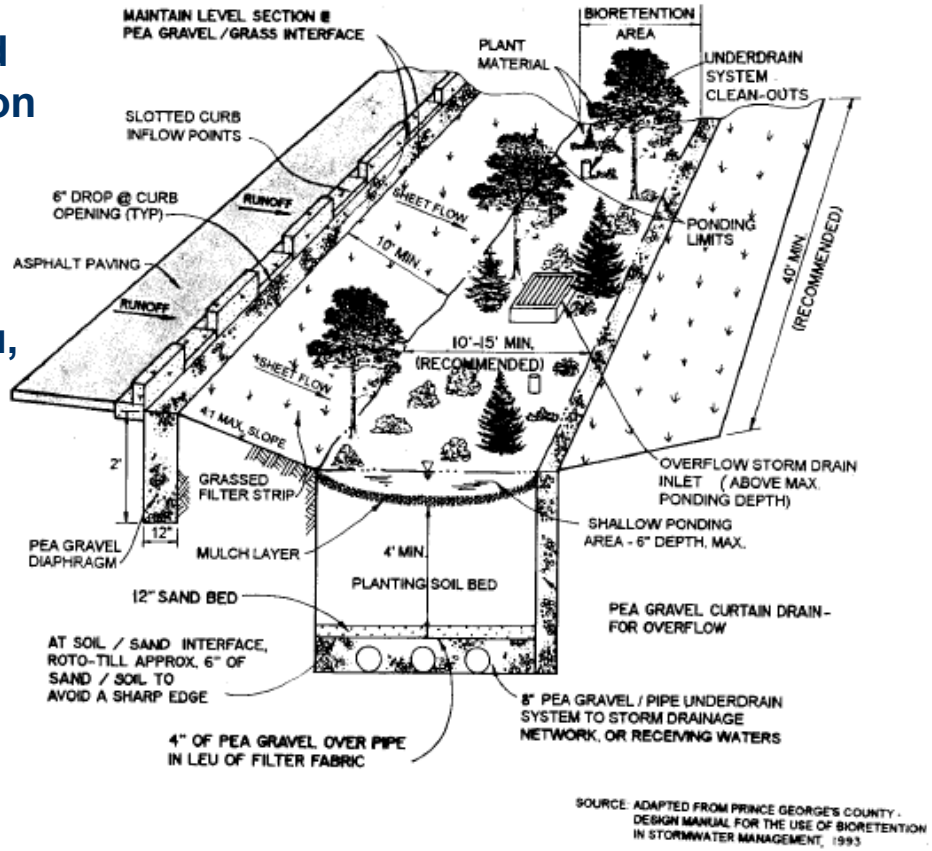
- Bioretention
- Soil Amendments
- Filter Strips
- Vegetated Buffers
- Grassed Swales
- Dry Wells
- Infiltration Basins/Trenches
- Inlet Pollution Removal Devices
- Rainwater Harvesting (Rain Barrels and Cisterns)
- Tree Box Filters
- Vegetated Roofs
- Permeable Pavers

Bioretention/Biofiltration

- Reduces the overall volume discharge and assists with peak discharge rate attenuation through infiltration and temporary storage
- Aids in groundwater recharge
- Runoff temperature control
- High rates of removal of heavy metals (Cu, Pb, Zn)

Six basic components

- Grass buffer strips
- Sand bed
- Ponding area
- Organic/mulch layer
- Planting soil
- Plants



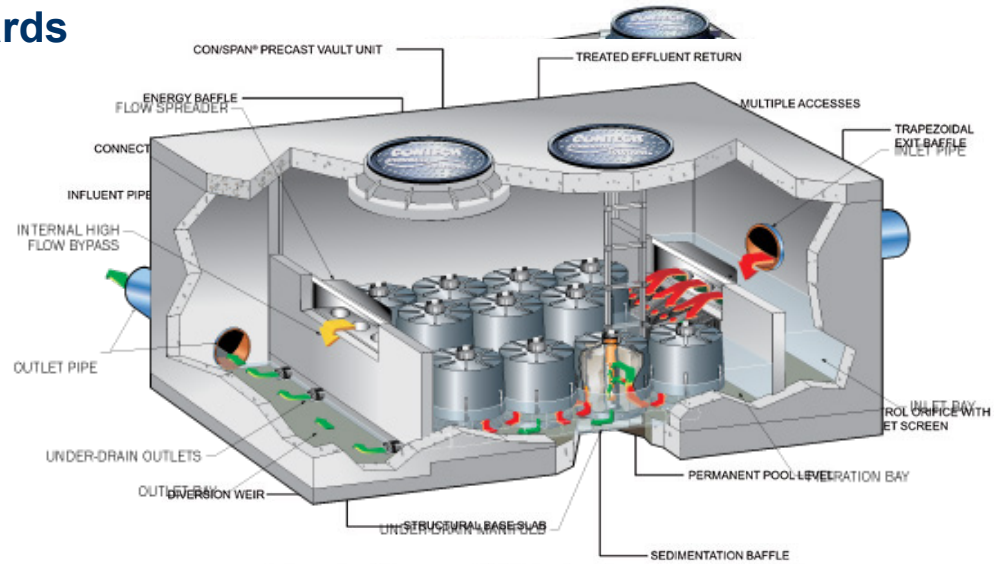
Biofiltration System

Soil Amendments

- Site preparation typically involve removing and stock piling the topsoil, compaction and placement of a thin layer of topsoil.
  - Hydrologic impact of decreased infiltration and increased runoff
  - Increased erosion, discharge rate, and downstream volume
- Soil amendments can be used to minimize development impacts on native soils by restoring their infiltration capacity and chemical characteristics.
  - Soil amendments can include not only compost and mulch but also top soil, lime, and gypsum (nutritional deficiencies and pH control).
  - A thorough soil analysis of the native soil is required to design the ideal mixture.

Inlet Pollution Removal Devices

- Quality treatment of runoff up to design storm
- Can provide peak runoff attenuation
  - Oil/Water separators
  - Hydrodynamic separation (e.g. vortechs, CDS)
  - Volumetric separation (e.g. stormvault)
  - Filtration
- These are used in areas with high concerntrations of impervious area
- Very expensive option
- Consider the outside the gate standards

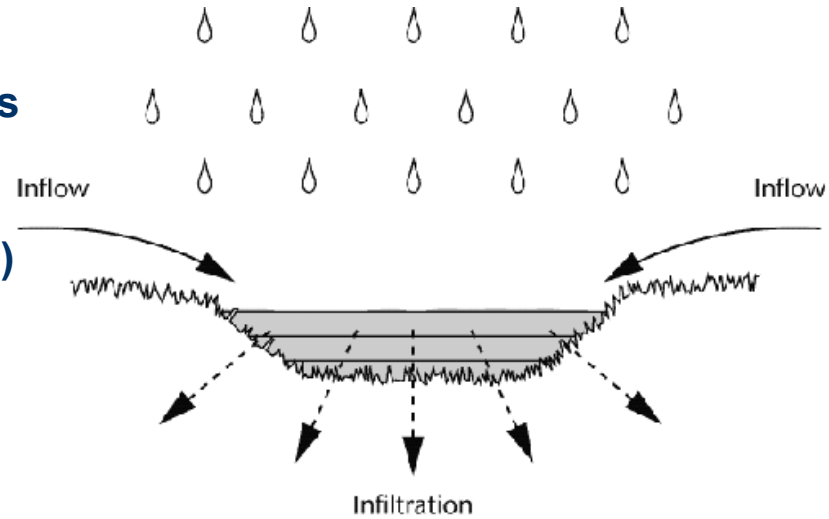


Schematic of Stormvault™ Mitigation System by CON/SPAN®

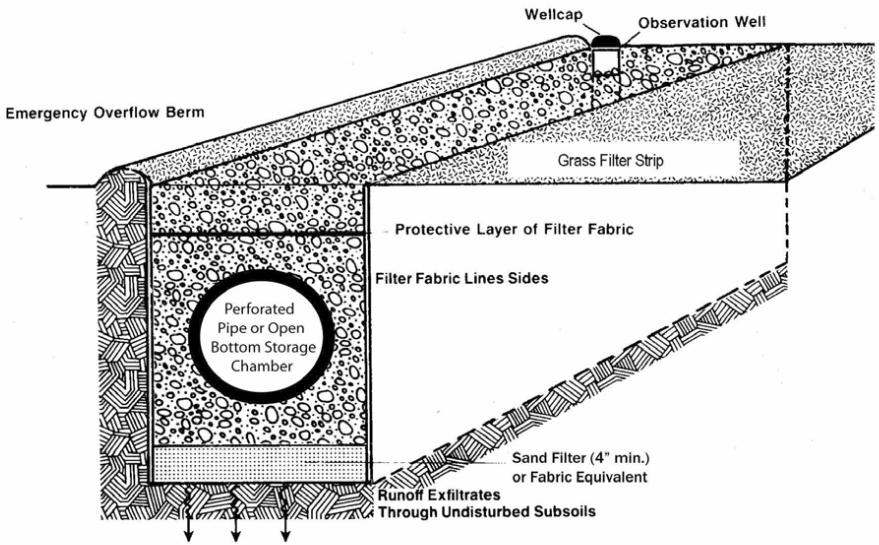
Disclaimer: Inclusion of system illustrations does not constitute an endorsement of system.

Vegetative Measures and Infiltration Devices

- **Filter Strips, Vegetated Buffers, and Grass Swales**
  - **Pretreatment (sediment and pollutant removal)**
  - **Increase Tc**
- **Infiltration Basin and Infiltration Trench (Dry Well)**
  - **Quantity and discharge rate reduction**
  - **Groundwater recharge**
  - **Pollutant removal**



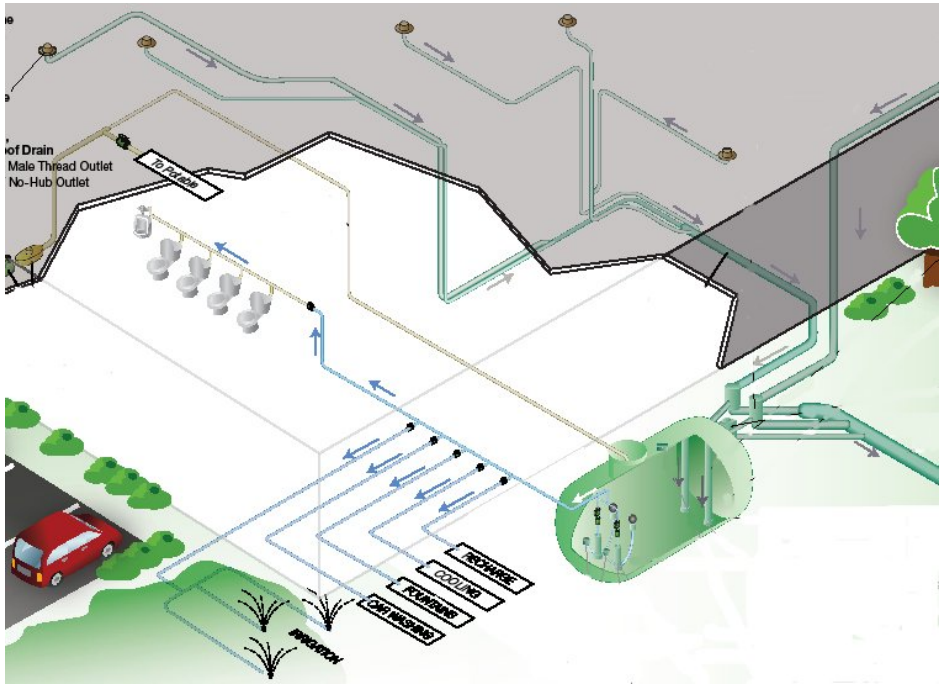
Infiltration Basin

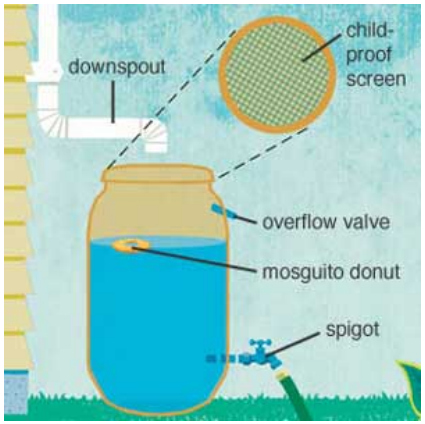


Infiltration Trench

Rainwater Harvesting

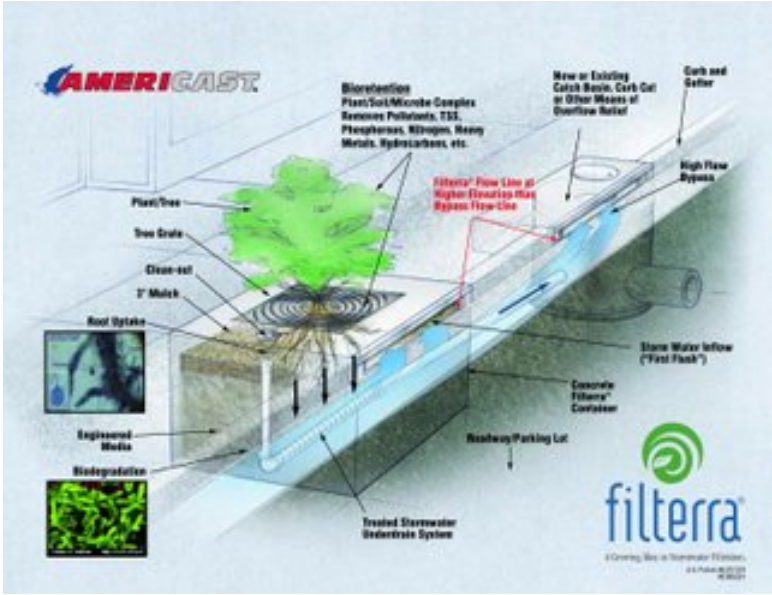
- Includes rain barrels and complete mechanical systems
  - Volume reduction
  - Peak runoff reduction
  - Pollutant removal
  - Thermal pollution reduction
- Rainwater harvesting requires close coordination with mechanical engineers.
- MCAS Cherry Point and VBPS
- Permitting issues





Tree Box Filters

- Quality treatment
  - TSS
  - Heavy metals
  - Phosphorus
- Sedimentation control
- Peak runoff attenuation (minimal)
- Can be used in conjunction with infiltration
- Minimal volume impacts due to effects of evapo-transpiration
- 36sf of treatment per ¼ ac in Mid Atlantic
- www.filterra.com/media/filterra.swf



Disclaimer: Inclusion of system illustrations does not constitute an endorsement of system.

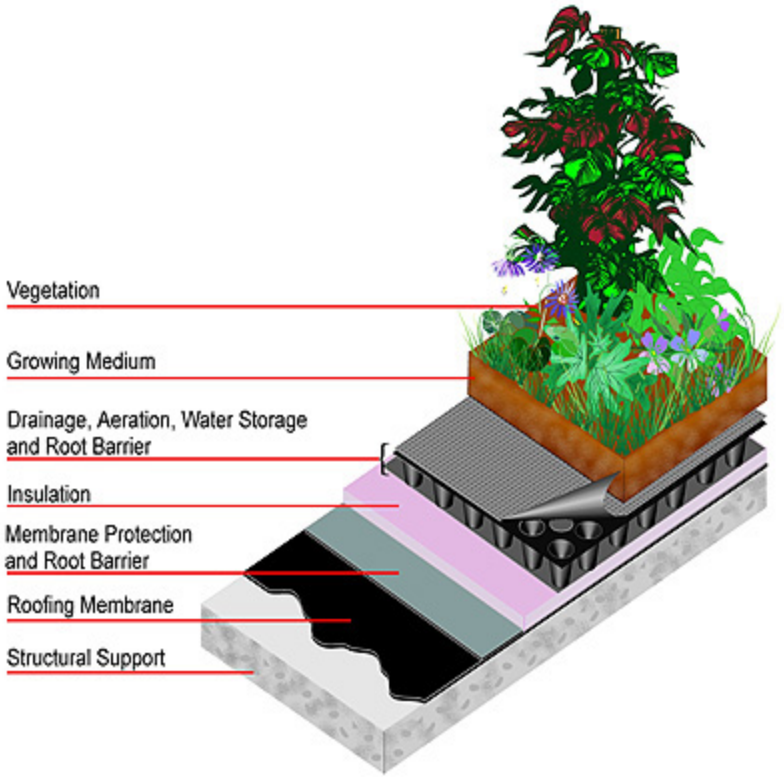
Green Roofs

Provide quantity and quality benefits:

- Evapotranspiration due to foliage on roof.
- Reduces the velocity of runoff.
- Increase of T_c

Other benefits:

- Heat island effect reduction (LEED credit)
- Reduction in impervious area (Permitting)



Permeable Pavers/Pervious Pavements

- Permeable pavements
  - Consider underlying soils infiltration
  - Shall not be used for heavy duty pavements
  - Concrete only
  - High maintenance requirements

Peak attenuation
  - Storage volume in voids
  - Increased Tc
- Decrease impervious area
- Volume reduction
  - Infiltration
- LEED benefits

Example Problem

Occurs during the planning/1391 process

- Step 1: Define project objectives and goals
  - LEED Silver (SS6.1 and SS6.2)
  - Comply with Penn memo
  - EISA applies due to facility size
- Step 2: Perform site evaluation and analysis
  - Infiltration is likely due to soils type
  - Rainwater harvesting is possible due to building usage
- Step 3: Develop control strategies
  - This is a cost based analysis for funding

Occurs during project design

- Step 4: Concept design or masterplan
  - Project design and permitting process
- Step 5: Develop operations and maintenance procedures
  - Included in OMSI.

Calculation Method – SCS Curve Number Method (TR-55)

Process:

1. Determine your rainfall (NOAA, state, etc)
   - 2yr – 3.67”
   - 10yr – 5.65”
   - 95th % - 1.63”
2. Determine existing HSG(s)
   - USDA maps and TR-55 Exhibit A
3. Calculate runoff (Q) (Ch 2)
4. Calculate Tc or Tt (Ch 3)
5. Determine rainfall type (App B)
   - Virginia Beach is Type III
6. Calculate pre and post development peak discharge (Ch 4)
7. Calculate storage volume (Ch 6) for permitting
   - A. Can use the simple method for estimating volume ($V=\Delta Q*A$)
8. Determine EISA/LID volume (UFC)

Hydrologic Soil Groups

Soils are classified by the NRCS into four groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. Where A's generally have the smallest runoff potential and Ds the greatest.

- **Group A** - sand, loamy sand or sandy loam types of soils. Low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.
- **Group B** - silt loam or loam. Moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
- **Group C** - sandy clay loam. Low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
- **Group D** - clay loam, silty clay loam, sandy clay, silty clay or clay. Has the highest runoff potential and very low infiltration rates when thoroughly wetted. Consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

Example Problem #1

Project Site – Existing

- 5.75ac site located at Dam Neck
- Demo existing facility and hardscape, replace with new.
- Impervious cover ($I_{existing}$) is
  - Pre-project = 22.4%
  - Pre-development = 0%
- Newham fine sands; Hydrologic soils group A
- Average land cover condition ($I_{watershed}$) is 24.6%
- Weighted CN
  - Pre-project = 60
  - Pre-development = 49, grass

Site Conditions - Proposed

- Proposed impervious cover (I_{post}) is 25.5%
- Results in Situation 2: $I_{existing} < I_{watershed}$ and $I_{post} > I_{watershed}$
- Type III storm
- Weighted CN = 62
- Training facility with high usage

Example Problem #1 - Calculations

SWM Permit

RR = 0.10lbs/yr

2yr storm

- q_{pre} = 1.905cfs
- q_{post} = 2.285cfs

10yr storm

- q_{pre} = 6.397cfs
- q_{post} = 7.159cfs

Storage

V_2 = 0.04 Ac-Ft

V_{10} = 0.08 Ac-Ft

LID UFC

2yr storm

- q_{pre} = 0.378cfs
- q_{post} = 2.258cfs

10yr storm

- q_{pre} = 2.870cfs
- q_{post} = 7.159cfs

Storage

V_2 = 0. 23 Ac-Ft

V_{10} = 0.45 Ac-Ft

V_{95} = 0.012 Ac-Ft

LID/EISA

95th percentile storm and SCS method

= 0.006 Ac-Ft

95% percentile storm and EPA method = 0.20 Ac-Ft

LEED Silver

SS6.1 – Rate and volume reduction

- Manage stream erosion

SS6.2 – Treat 80% of TSS from 90% of site Runoff

- Treatment Volume = 0.48 Ac-Ft

Include a set of strategies to address the pollutant removal requirement and meet the rate reduction for permitting, protect the receiving channel for LEED SS6.1, treat the first 1” of runoff for LEED SS6.2, and infiltrate or reuse 0.012 Ac-Ft of water over 24 hours to meet LID and EISA.

Example Problem #1 - Solutions

- **Likely strategies**
  - Vegetated buffers placed between hardscape and grassed swales
  - Grassed swales leading to basin
  - Infiltration basin to meet the permitting/LEED/LID requirements
  - Rainwater harvesting for grey water demands
  - Permeable pavers in sections of the parking lot (not HC)
  - Tree boxes in bituminous section of parking lot
  - Bioretention may not be considered due to water table

- **Things to consider:**
  - In situ soils
  - Water table
  - Building use
  - Location relative to sensitive/high quality waters
  - Who is permitting authority

Example Problem #2

Project Site – Existing

- 7.00ac site located at NAS Oceana
- Replacing wooded site with new facility and parking.
- Impervious cover ($I_{existing}$) is
  - Pre-project = 0%
  - Pre-development = 0%
- Acredale silt loam; Hydrologic soils group D
- Average land cover condition ($I_{watershed}$) is 28.8%
- Weighted CN
  - Pre-project = 79
  - Pre-development = 79

Site Conditions - Proposed

- Proposed impervious cover (I_{post}) is 80%
- Results in Situation 2: $I_{existing} < I_{watershed}$ and $I_{post} > I_{watershed}$
- Type III storm
- Weighted CN = 94.4
- Warehouse with low grey water demands

Example Problem #2 - Calculations

SWM Permit

RR = 7.35lbs

2yr storm
- q_{pre} = 1.54cfs
- q_{post} = 15.95cfs

10yr storm
- q_{pre} = 3.10cfs
- q_{post} = 26.95cfs

Storage

V_2 = 0.95 Ac-Ft

V_{10} = 1.54 Ac-Ft

LID UFC

2yr storm
- q_{pre} = 1.54cfs
- q_{post} = 15.95cfs

10yr storm
- q_{pre} = 3.10cfs
- q_{post} = 26.95cfs

Storage

V_2 = 0. 75 Ac-Ft

V_{10} = 0.92 Ac-Ft

V_{95} = 0.61 Ac-Ft

LID/EISA

95th percentile storm and SCS method

= 0.61 Ac-Ft

95th percentile storm and EPA method

= 0.76 Ac-Ft

LEED Silver

SS6.1 – Rate and volume reduction

- Manage stream erosion

SS6.2 – Treat 80% of TSS from 90% of site Runoff

- Treatment Volume = 0.58 Ac-Ft

Include a set of strategies to address the required removal rate and control the runoff rate to meet permitting requirements, adhere to UFC 3-210-10 (Draft), protect the receiving channel for LEED SS6.1, treat the first 1” of runoff for LEED SS6.2, and infiltrate 0.42 Ac-Ft of water over 24 hours to meet LID and EISA.

Example Problem #2 - Solutions

- Likely strategies
  - Vegetated buffers placed between hardscape and grassed swales
  - Grassed swales leading to basin
  - Use permeable pavers, pervious pavement, and grasspave
  - Green roof if not on flightline.
  - Extended detention

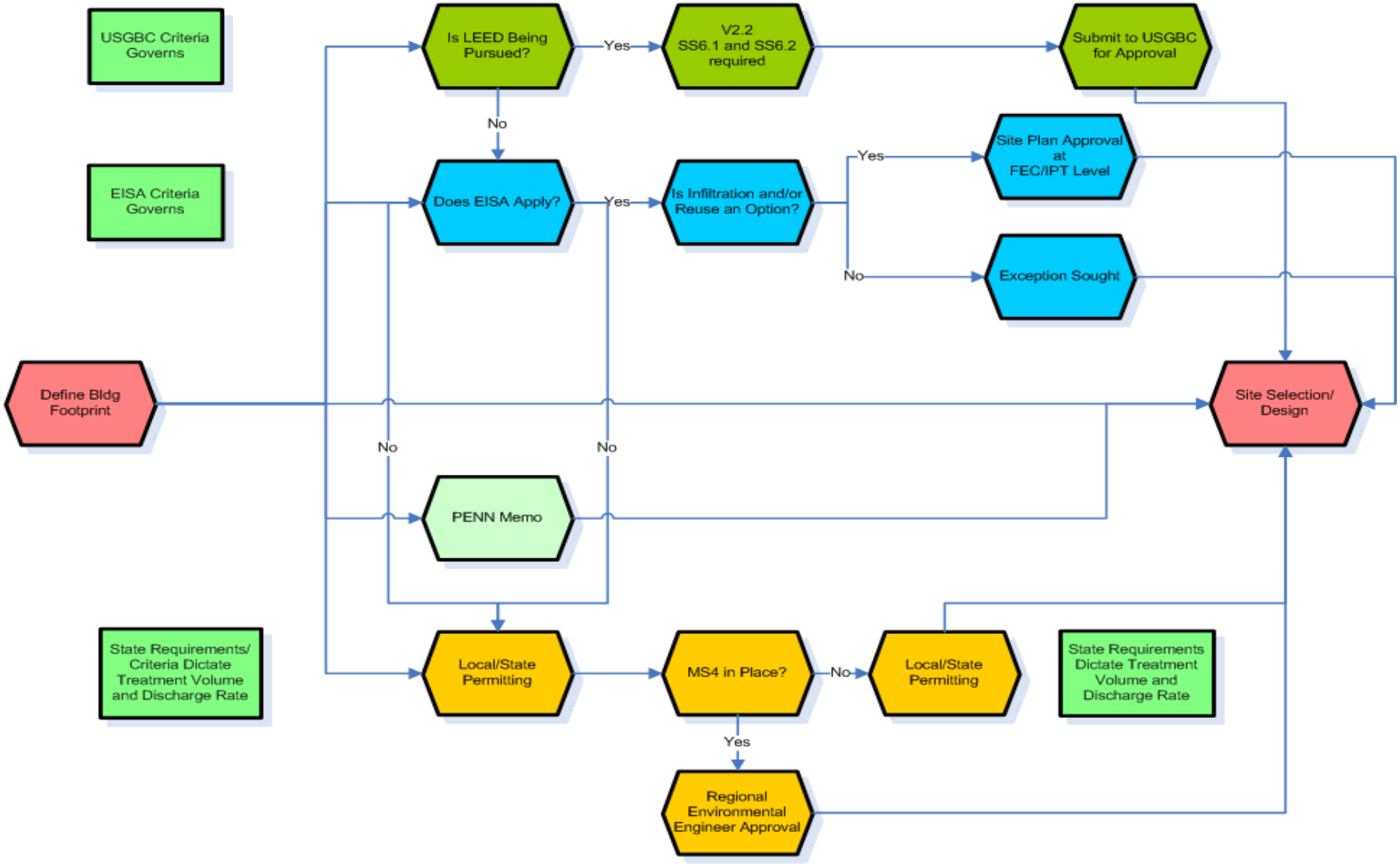
  - High water table, low infiltration rate, and complications with reuse would constitute mitigating circumstances to seek an exception to EISA.
  - DOR would be required to implement the LID to the METF, meet LEED v2.2, and obtain a SWM permit (CNRMA Instructions).

- Things to consider:
  - In situ soils
  - Water table
  - Building use
  - Location relative to flightline
  - Location relative to sensitive/high quality waters
  - Who is permitting authority

Project Discussions

- **Hangar - MCAS Cherry Point**
  - **Required to meet NC DENR permitting**
    - Vegetated buffers and swales
    - Infiltration basins
    - Water reuse system
  - **LEED SS 6.1 and SS 6.2**
  - **EISA was not required, but**
    - Would have satisfied requirements
    - One additional calculation
    - Letter to file
- **Firing Range RFP - Naval Submarine Base New London**
  - **Submit SWM methodology to base EV**
    - Allowed for detention and green roof
  - **LEED SS 6.1 and SS 6.2**
  - **EISA was not required, but**
    - Would have requested waiver

Example Problem – Decision Tree



References

- www.lid-stormwater.net
- Low Impact Development Interim Guidance
- LEED v2.2 Reference Manual
- TR-55 Manual
- Technical Guidance on Implementing Section 438 of Energy Independence and Security Act, February 2009
- NC DENR BMP Manual
- The Texas Manual on Rainwater Harvesting

Frequently Asked Questions

- **Does a green roof constitute pervious or impervious area wrt EISA?**
  - *The roof area should be consider impervious when determining if EISA applies, but the designer should take the roof hydraulic characteristics into account when developing calculations. You should also consult state SWM requirements.*
- **Who/what organization is going to grant exceptions?**
  - *Yet to be determined, however, EV has traditionally compiled and reported all of the LID features employed on projects and designers should include EV with any reports documenting their decisions.*
- **How do we apply wrt temperature change?**
  - *It is understood that this will guide designers away from detention/retention.*
- **Why was TR-55 selected as the preferred method?**
  - *TR-55 is a user friendly, accessible hand calculation method that takes soil characteristics into account.*
- **When will formal policy be provided and how will this impact current direction and pending UFC?**
  - *Recent Executive Order (Oct 5, 2009) requires EPA to establish direction within 60 days, however, the UFC is not expected to change in the immediate future.*
- **Why was the 95th percentile storm selected and how is it generated?**
  - *This storm is generally believed to approximate pre-development hydrologic conditions, and is generated by compiling all of the 24hr storm events over a 30 year period and selecting the 95th percentile amount.*

Thank You!