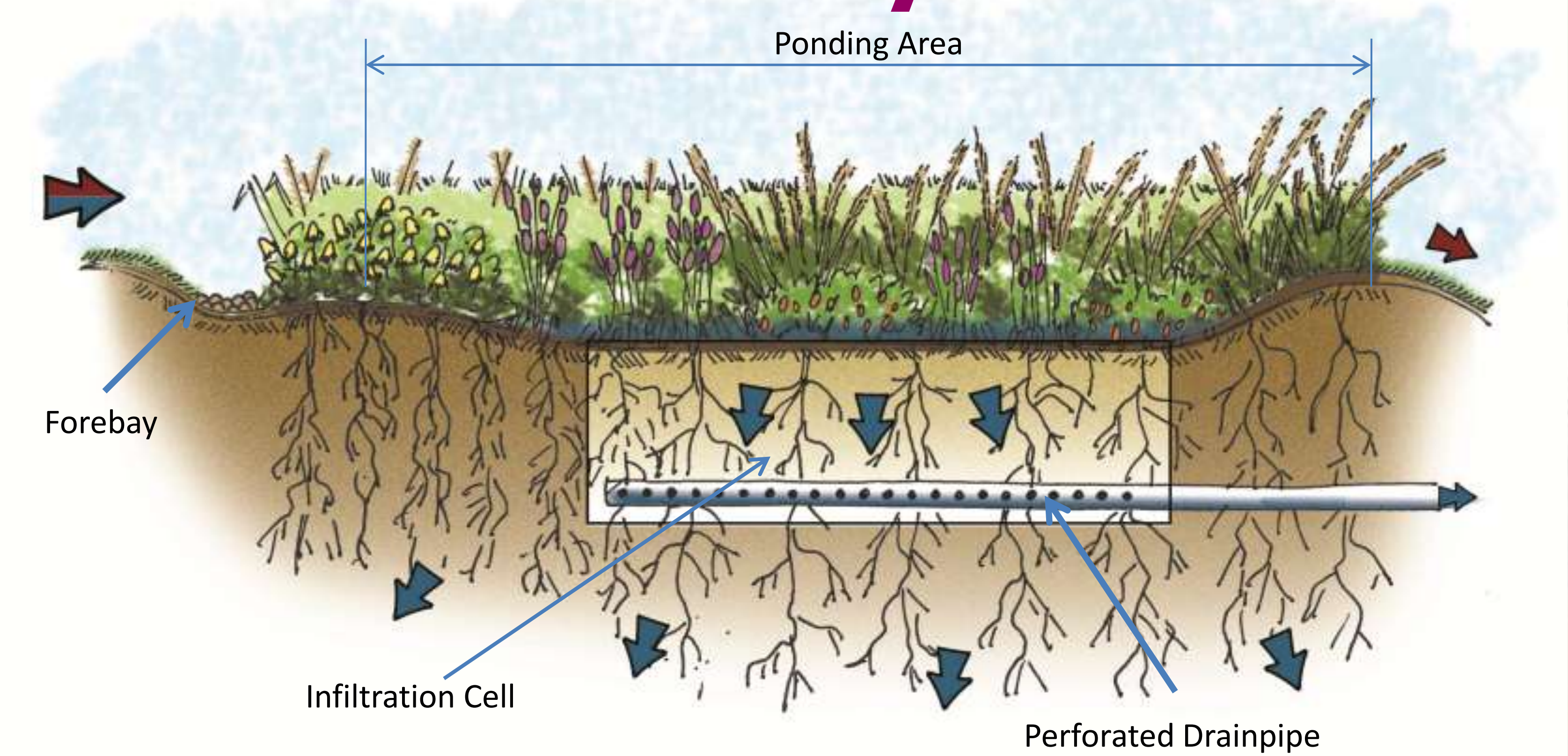
BIORETENTION GARDEN DESIGN

Application

Designing the Bioretention Garden

Because bioretention gardens are typically part of commercial developments or larger public properties, planning and design of the bioretention gardens should begin as early in the development process as possible.

Designing the Bioretention Garden System



Sustainable Design – Context for Bioretention Gardens

- Enhances landscape aesthetic and functionality
- Maximizes environmental benefits and quality
- Minimizes resource inputs and maintenance requirements

Landscapes Designed by "Nature"

- Combinations of plants in communities
- Diverse selection of plant materials
- Landscapes are constantly evolving
- Many subtle characteristics
- Mulch used extensively
- Stormwater treated/used as resource, not as a waste product

Sustainable Design Benefits

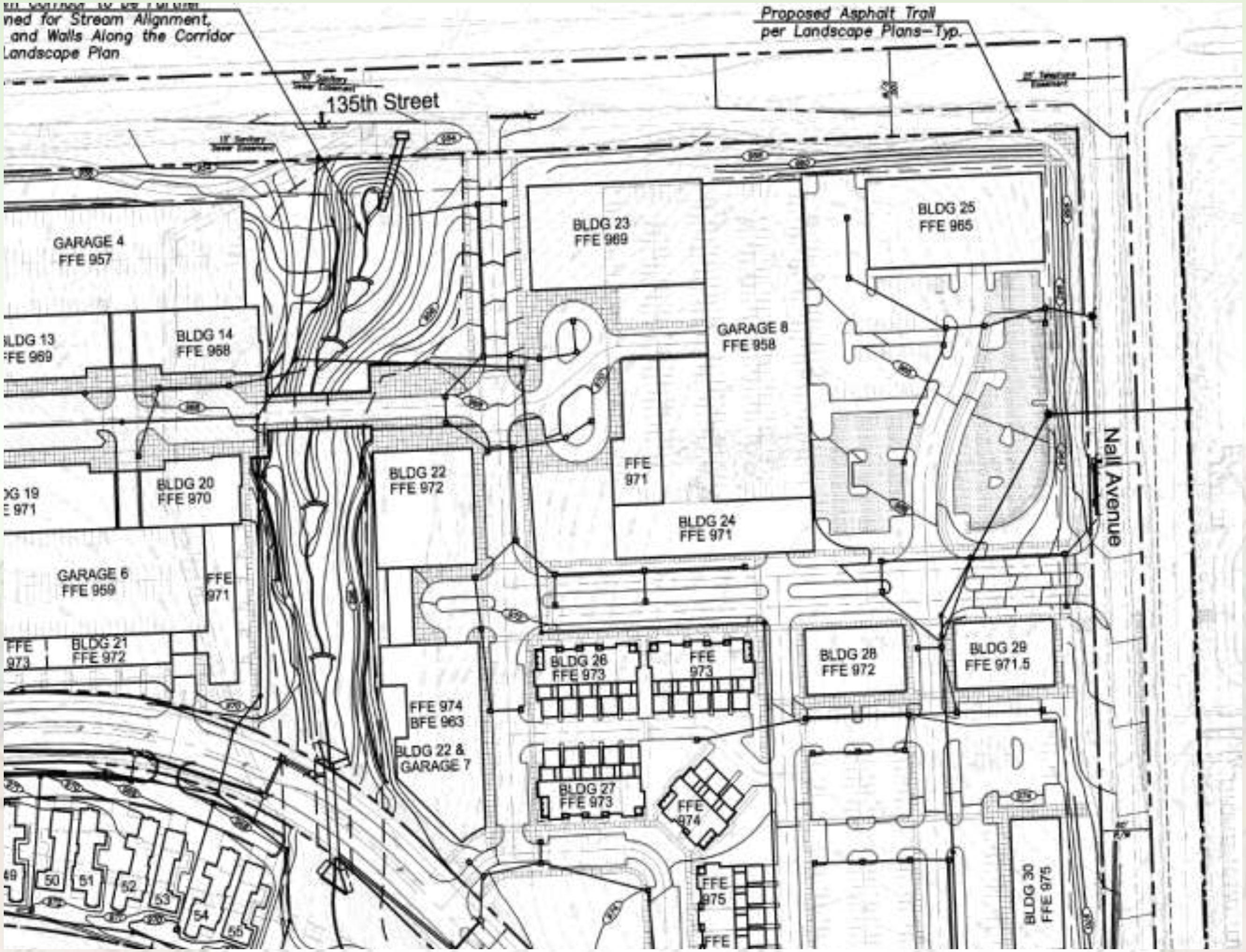
- **High aesthetic value** -- seasonal changes, diverse foliage, flower and fruit, healthy plants, year-round interest, wildlife
- **Easy on the environment** -- reduced pesticides, fertilizers, water use, habitat enhancement
- **Potential for cost savings** -- less maintenance, healthier plants, reduced resource inputs

Locating Bioretention Gardens

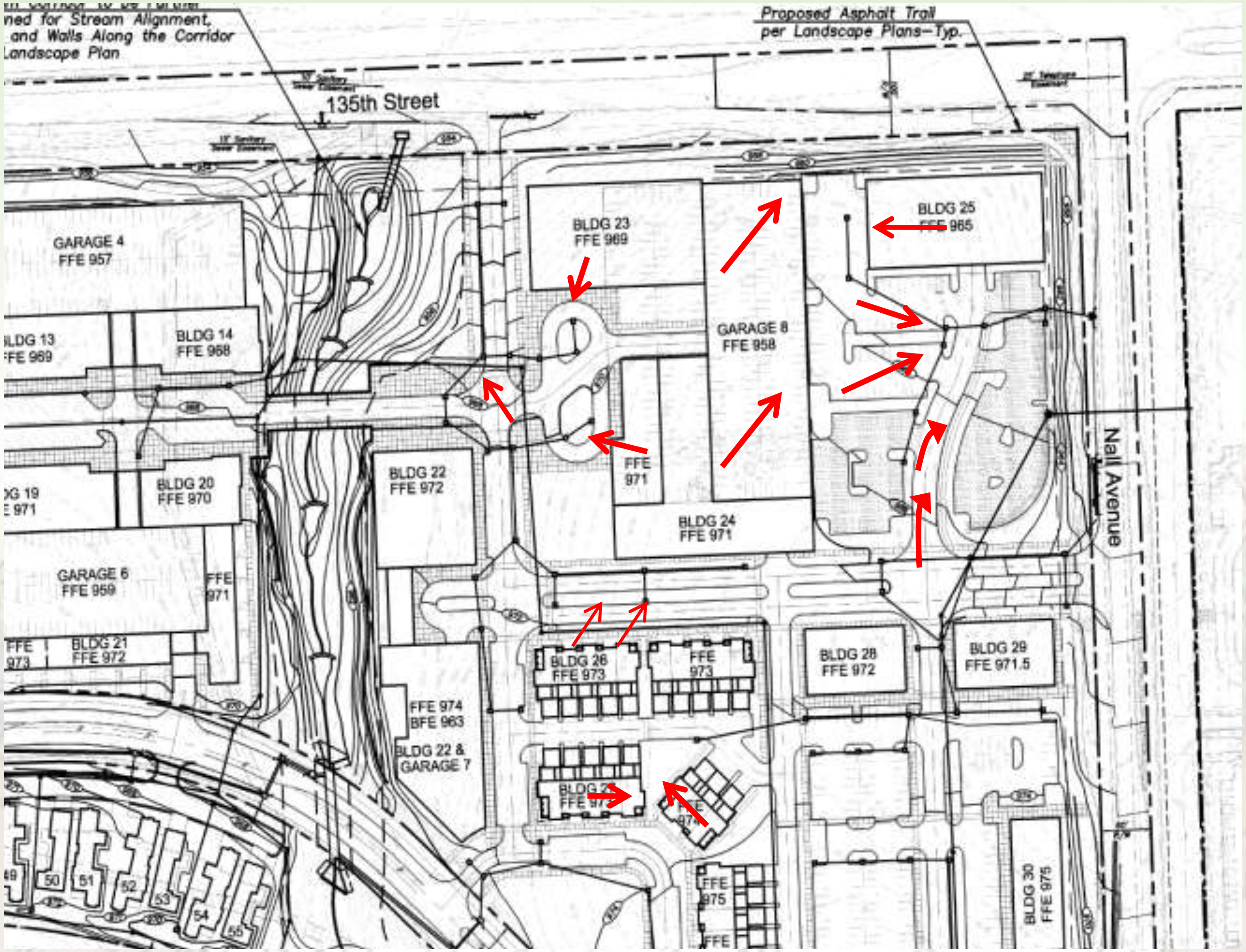
- Topography of your site
- Drainage Area
  - Your site
  - Adjoining sites
  - Flow paths
- Site features: Buildings, parking lots, landscaping

Become part of the planning process as early as possible!!

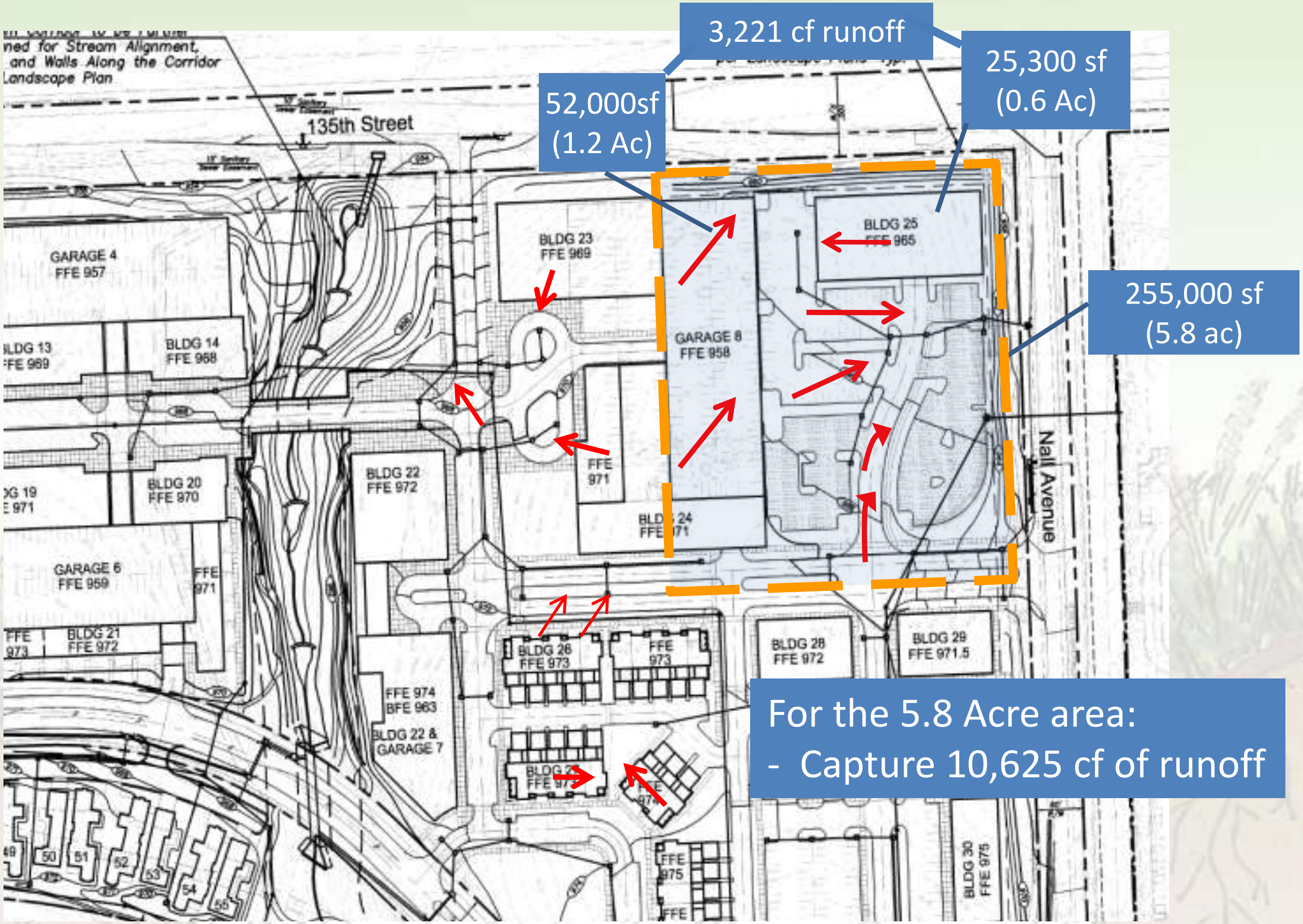
Locating the Bioretention Garden



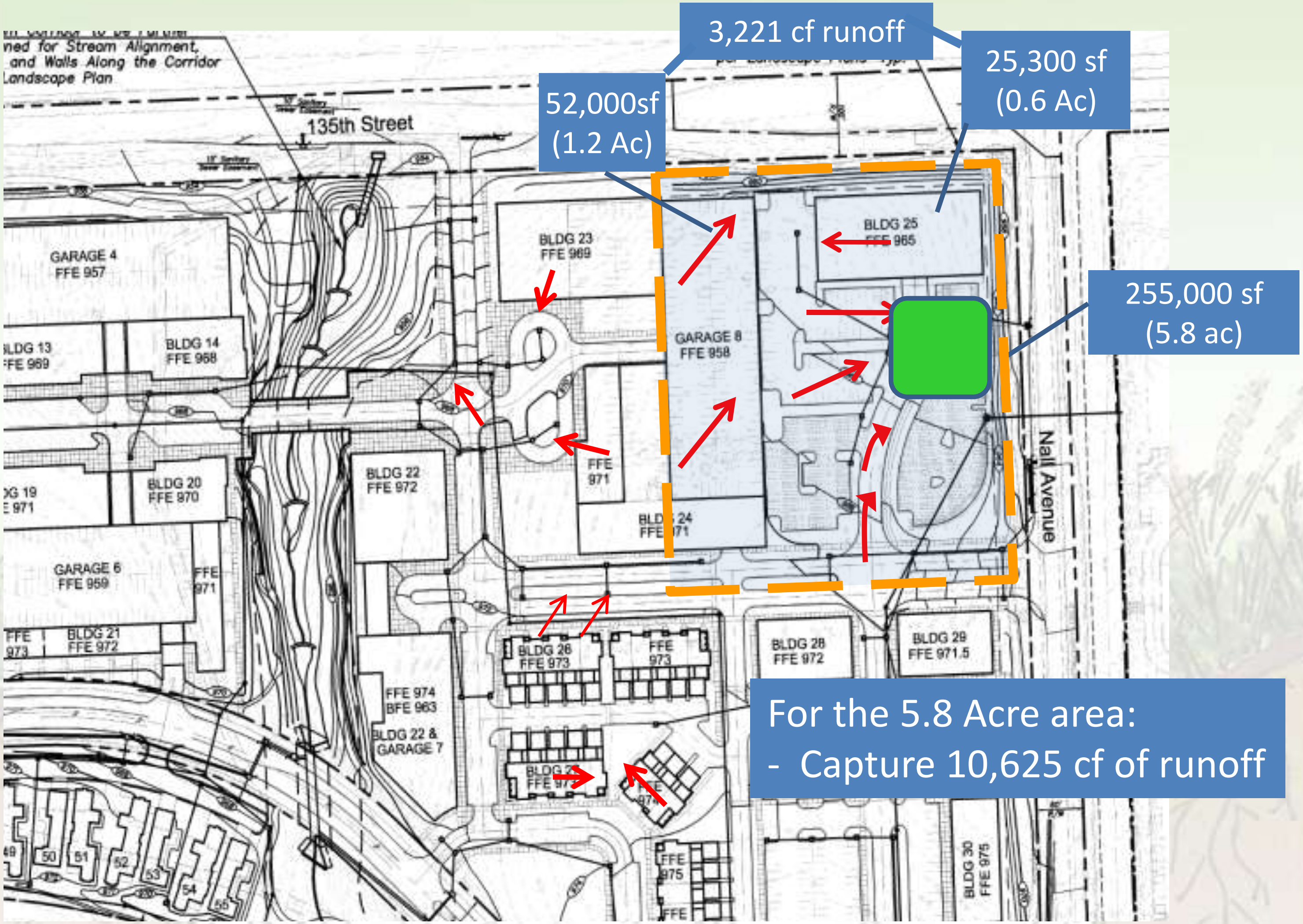
Locating the Bioretention Garden



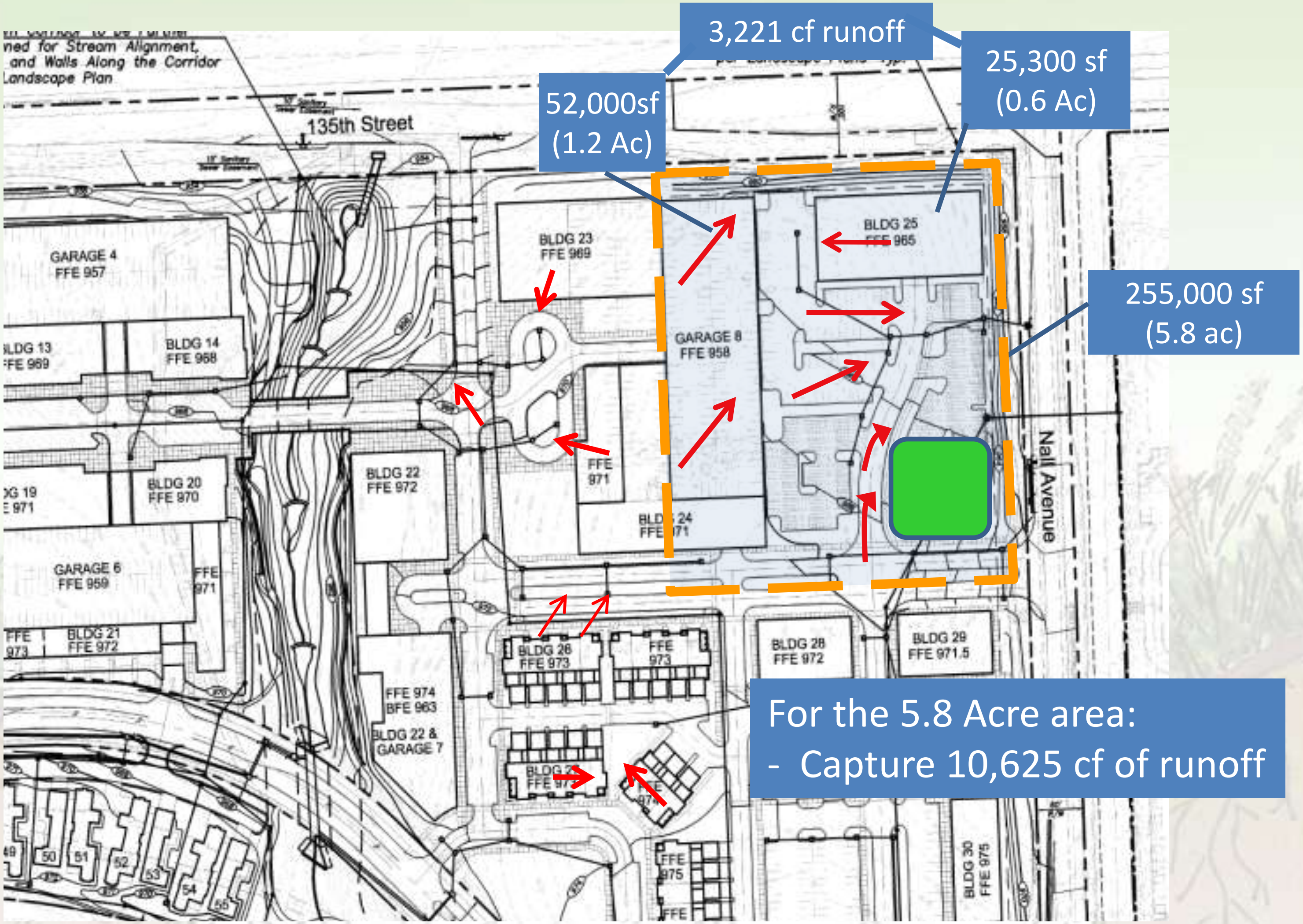
Locating and Sizing the Bioretention Garden



Locating and Sizing the Bioretention Garden



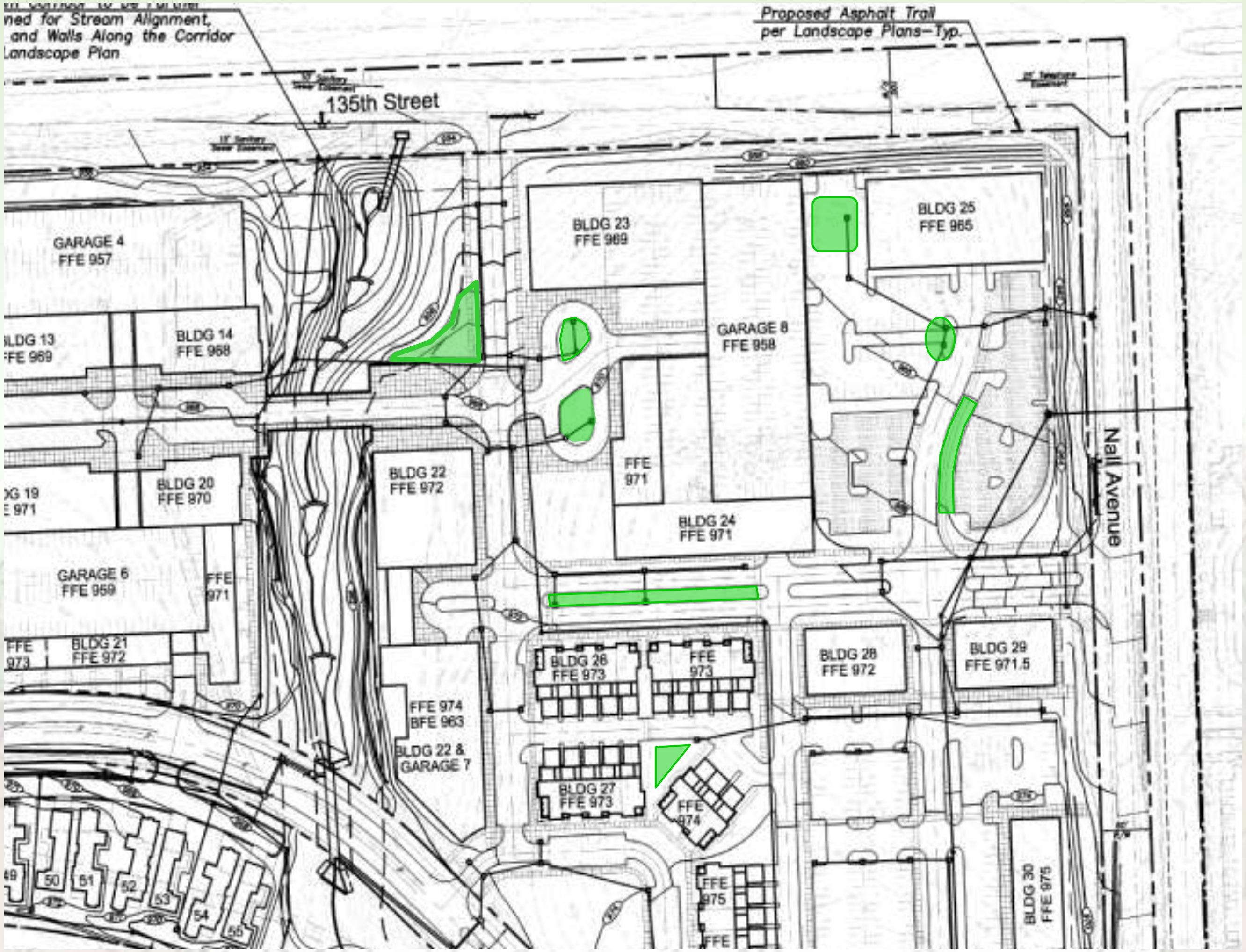
Locating and Sizing the Bioretention Garden



For the 5.8 Acre area:

- Capture 10,625 cf of runoff

Locating and Sizing the Bioretention Garden



Sizing the Bioretention Garden

The design volume (V_D) is equal to the WQCV unless routing of impervious areas to pervious areas occurs. The WQCV is based on 0.5 inches of runoff.

$$A_P = \frac{V_D}{h_{avg}}$$

A_P	=	Ponding Area (acres)
V_D	=	Design Volume (acre-feet)
h_{avg}	=	Average ponding depth above plant in soil bed (feet) = (h_{max} / 2)

Infiltration and Subsurface Drainage

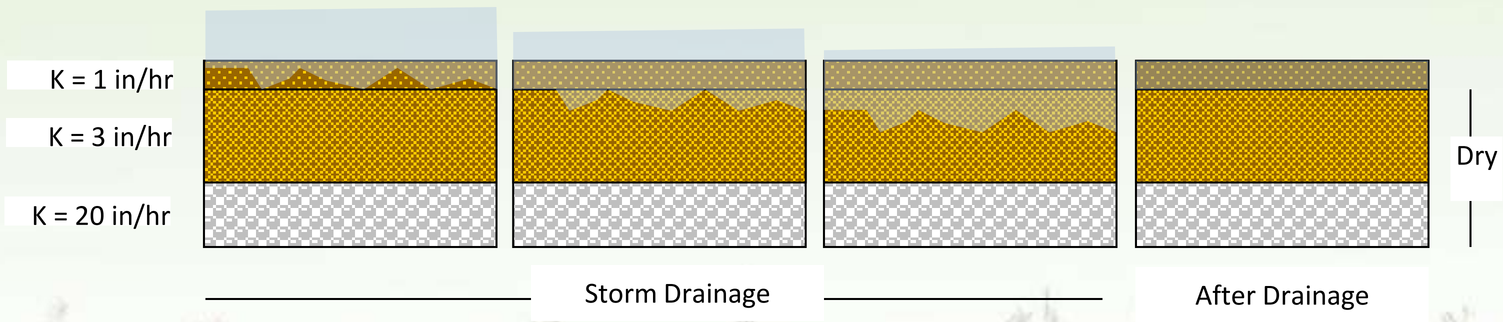
Infiltration Cell

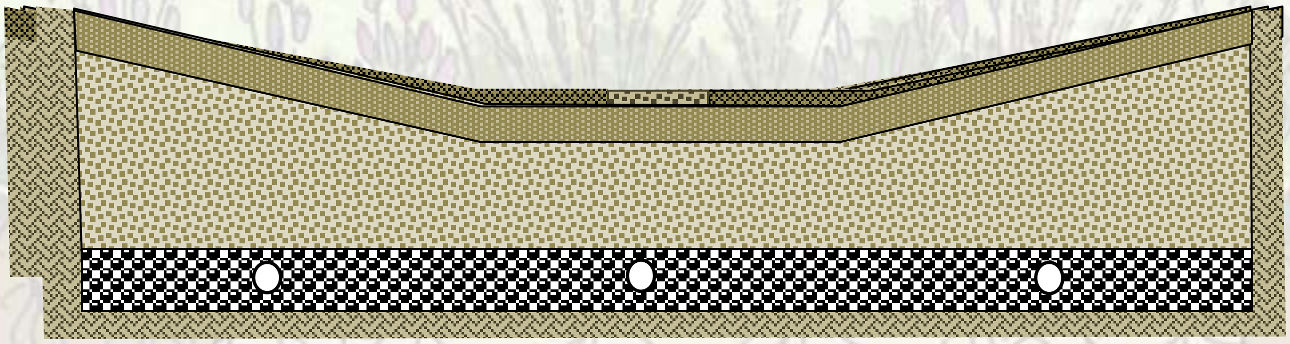
- Amended Soil Mix
- Subsurface Drain
- Getting the Right Dimensions

Amended Soil Mix

- Many manuals recommend a mix of 50% sand, 20% organic matter, and 30% topsoil
- Some people "bulk" their amended soil with hardwood mulch…. **DON'T**
- 50% *FINE* sand and 50% compost works very well – especially in the first year
- Know your infiltration rate
- **DO NOT** place a "planting soil" over the amended soil

Design Improvement for Infiltration





Sizing the Infiltration Cell

- Assume an infiltration rate of 10 in/hr in the amended soil mix
  - Confirm rate with a compacted column infiltration test
- Size the infiltration cell to drain the above ground storage volume in 24 hours
- Depth of the infiltration cell can be variable, but recommend 18″ to 24″ deep
- Width of the infiltration cell can vary from 12″ to 18″

Sizing the Infiltration Cell

$$A_F = \frac{V_D \; x \; d_f}{k \; x \; t_f \; x \; (h_{avg} + d_f)}$$

- Where:
- A_F = Filter bed surface area (acres)
- V_D = Design Volume (acre-feet)
- d_f = Filter bed depth (ft)= 1.5 ft
- h_{avg} = Average ponding depth above plant in soil bed (feet) = (h_{max} / 2)
- t_f = Time required for V_D to filter through soil (days) = 2 days
- k = BSM infiltration rate (feet per day) = approximately 20 ft per day based on monitoring data

From the Draft Omaha Stormwater Guidance CDM-Smith

Sizing the Infiltration Cell

- Install a valve in the drainage pipe
  - common and even required in many locations
  - Can control rate of discharge if the infiltration rate remains too fast
- Size your pipe for desired drainage rate – 4" (ID) PVC should be maximum size
- Perforated pipe only within the infiltration cell
- Wrap with gravel and filter fabric
- No gravel beyond infiltration cell
- Gravel only around the drainage pipe

Sizing the Infiltration Cell

To determine the filter bed length:

$$L_f\,(ft) = \sqrt{87120\ x\ A_F}$$

L_f = Filter bed length (feet)
A_F = Filter bed surface area (acres)

From the Draft Omaha
Stormwater Guidance
CDM-Smith

Soil Conditioning

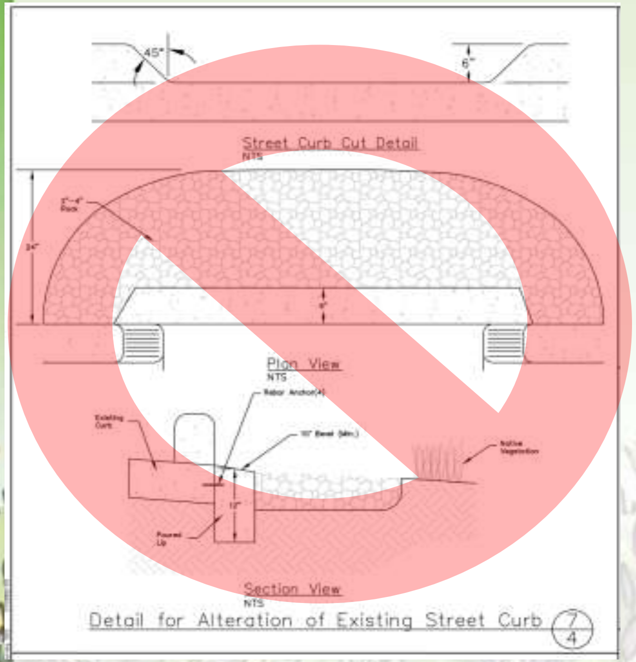
- Many soils in Nebraska need conditioning
  - Tight, clayey soils in east and central
    - Improve soil biology
    - Bread dense structure
  - Sandier soils in far west
    - Water and nutrient holding capacity
    - Improve soil biology
- Compost adds necessary organic matter
  - Carbon facilitates microbial activity
  - Mix into the top 6 inches of the bioretention garden soil

Inlets and Outlets

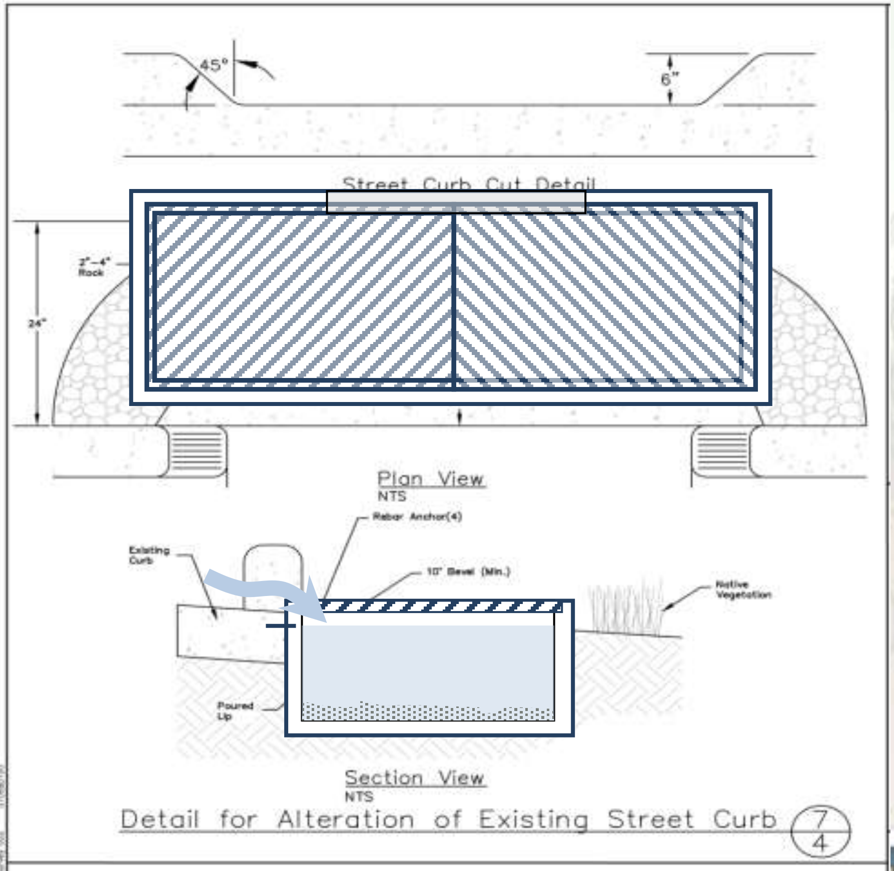
Inlets

- Curb cuts from streets, level spreaders, pipe inlets, swales
- Pretreatment: grass filters, forebays

Inlets



45°
6"
Street Curb Cut Detail
NTS
Plan View
NTS
Section View
NTS
Detail for Alteration of Existing Street Curb
7
4



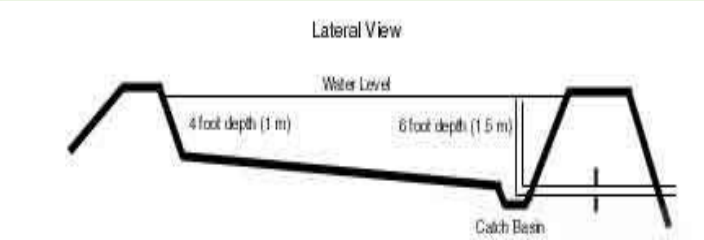
45°
6"
Street Curb Cut Detail
2"-4" Rock
24"
Plan View
NTS
Rebar Anchor(4)
Existing Curb
10" Bevel (Min.)
Native Vegetation
Poured Lip
Section View
NTS
Detail for Alteration of Existing Street Curb
7
4

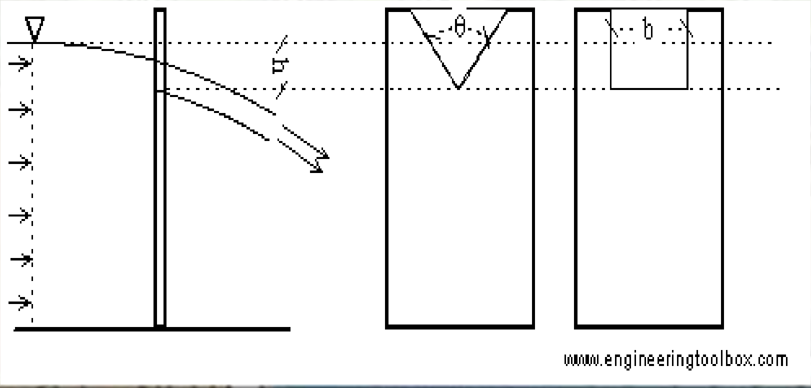
Outlets

- Must be designed to safely pass the 10-year, 24-hour storm
- Excess stormwater runoff can also be diverted away from the bioretention garden
  - selective grading, smaller curb cuts, or smaller inlet pipes.
- Additional design requirements in Chapter 6 of the Omaha Regional Stormwater Design Manual

Outlets


www.landandwater.com


Lateral View
Water Level
4 foot depth (1 m)
6 foot depth (1.5 m)
Catch Basin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www.engineeringtoolbox.com

Inlets and Outlets

Outlets

- Pipes, weirs (structures and soft), sheet flow
- Direct drainage to known drainage paths