Increasing Climate Resilience throughout the Royce Brook Watershed

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RUTGERS
New Jersey Agricultural
Experiment Station

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Project goal is to reduce flooding in Hillsborough and Manville

(supported by NFWF Coastal Resiliency Fund)

- Design stormwater management systems that will manage the 100-year storm from existing development
- Prioritize nature-based solutions
- Design retrofits to manage the increase in rainfall due to climate change for sites that already have stormwater management

Condition (100-yr Design Storm)	24-hour rainfall total (in)
2000 Rainfall Total	8.21
2020 Rainfall Total	8.95
2100 Rainfall Total	12.15

Types of Nature-Based Solutions (FEMA, 2021)

- **WATERSHED OR LANDSCAPE SCALE**: Interconnected systems of natural areas and open space

  These are large-scale practices that require long-term planning and coordination.

- **NEIGHBORHOOD OR SITE SCALE**: Distributed stormwater management practices that manage rainwater where it falls

  These practices can often be built into a site, corridor, or neighborhood without requiring additional space.

- **COASTAL AREAS**: Nature-based solutions that stabilize the shoreline, reducing erosion and buffering the coast from storm impacts

  While many watershed and neighborhood-scale solutions work in coastal areas, these systems are designed to support coastal resilience.

WATERSHED SCALE

LAND CONSERVATION

Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities.

Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.

GREENWAYS

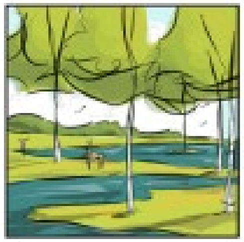
Greenways are corridors of protected open space managed for both conservation and recreation.

Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.

FLOODPLAIN RESTORATION

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat.

Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.



WETLAND RESTORATION AND PROTECTION

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff.

Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.

STORMWATER PARKS

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding.

By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.

NEIGHBORHOOD OR SITE SCALE

RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.

VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.

GREEN ROOFS

A green [illegible] fitted with a planting [illegible] ation. A green roof [illegible] y soaking up rainfall. [illegible] educe energy costs for [illegible] uilding.

[illegible] oofs, which have deep[illegible] ore common on commerc[illegible] ildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.

RAINWATER HARVESTING

[illegible] ainwater [illegible] ing systems [illegible] fall for later [illegible] ff and can reduce [illegible] potable water.

[illegible] ms include rain [illegible] ns of gallons [illegible] s that store hundreds o[illegible] sands of gallons.

PERMEABLE PAVEMENT

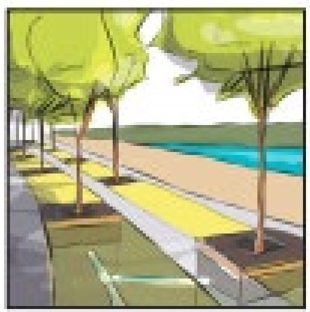
Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.

REE C

uce stormwater
ng rainfall on
leaves and increasing
ion. By keeping
er in the summer,
e ca so reduce the
"urban hea and effect."

Because of trees' many benefits, many cities have set urban tree canopy goals.



TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.

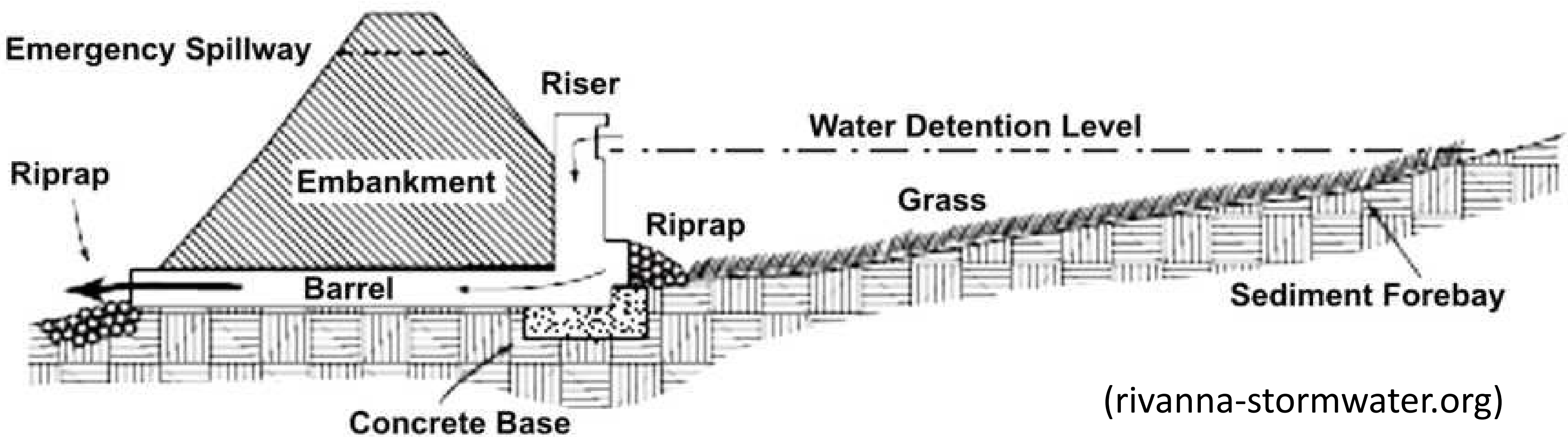
GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwate runoff and improve water quality.

Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

How can we reduce 100-YR storm flooding?

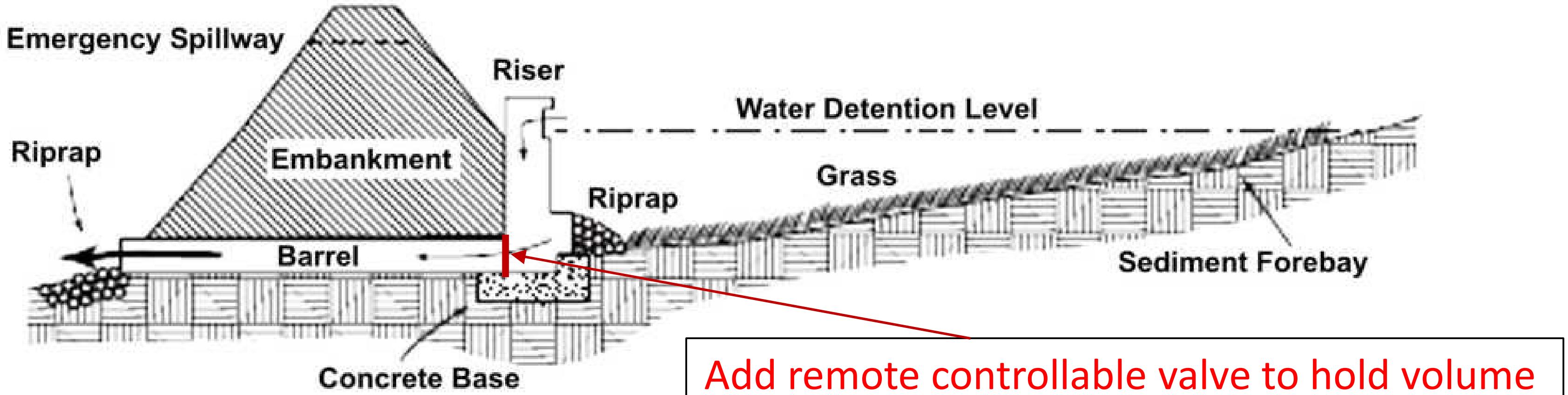
- Capture stormwater and detain it to reduce the peak flow of the flooding
  - Typical detention basin approach
  - Effective if no backup downstream
  - Can combine with distributed systems to hold more volume



(rivanna-stormwater.org)

How can we reduce 100-YR storm flooding?

- Hold a retain stormwater as long as possible
  - More effective when floodwater backed up downstream
  - Digital control system to hold volume and release water once flood recedes
    - Would not work well as passive system due to smaller storm event management not draining quick enough
  - Difficult to combine with distributed storage systems



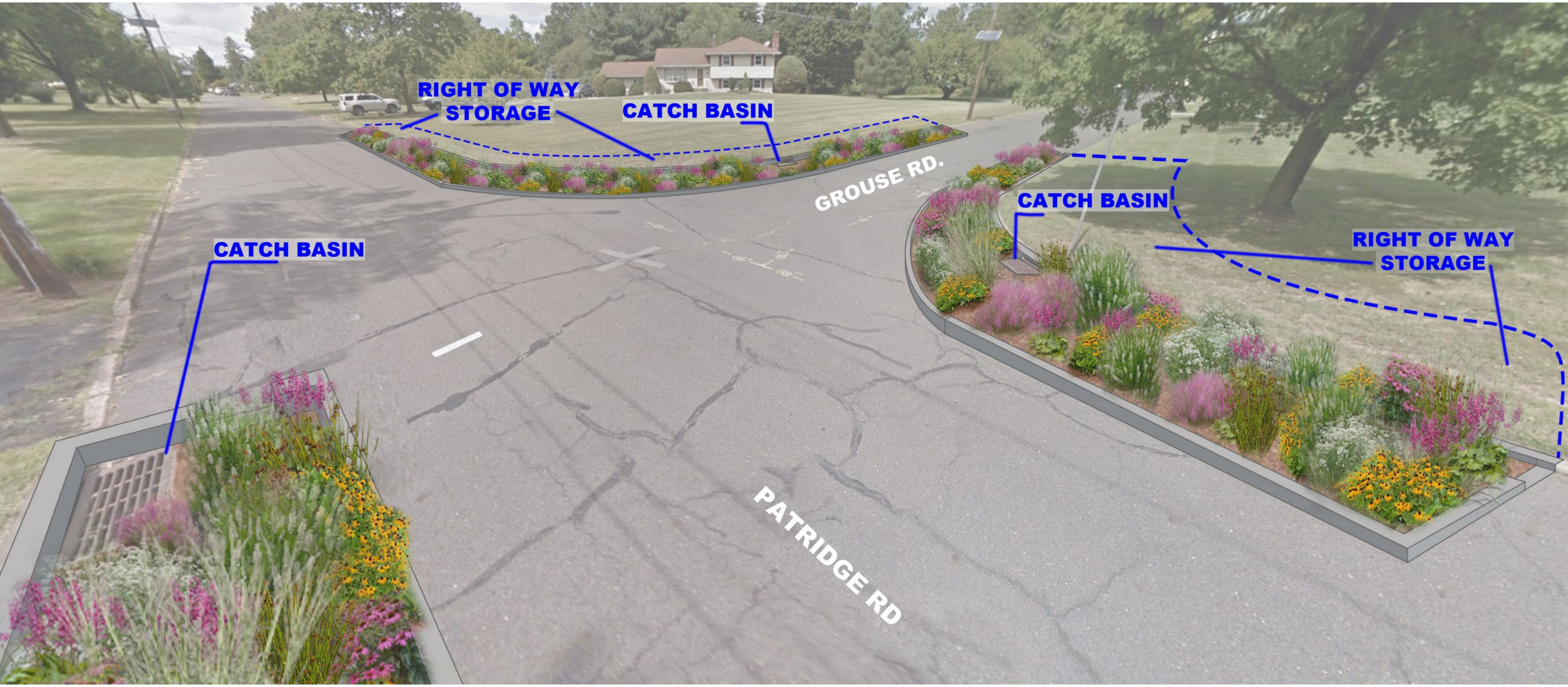
(rivanna-stormwater.org)

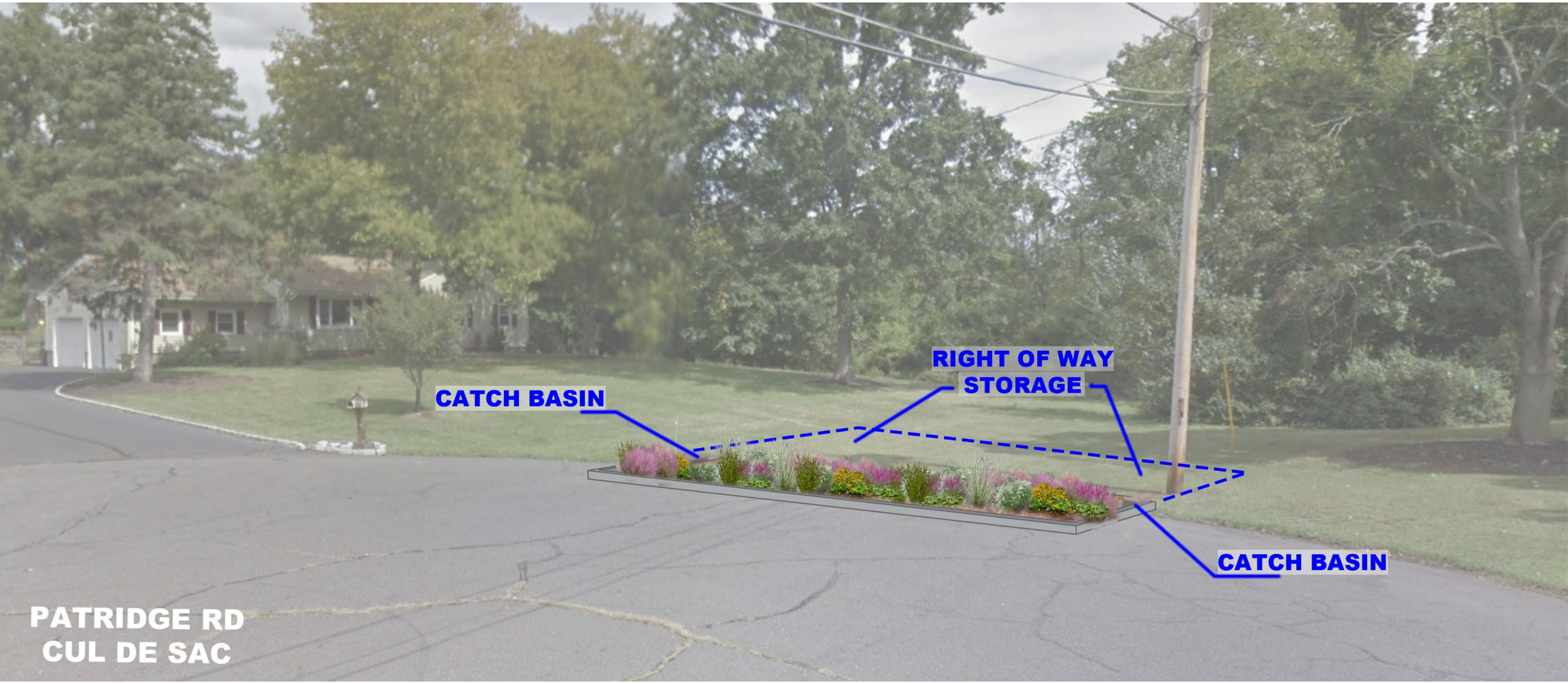
Where do we target our efforts?

- Target developments with:
  - little to no existing stormwater management
  - available land to capture and hold large volumes of stormwater
  - willing participants for buyouts to create land for stormwater management
- Identify key flooding hotspots and identify areas contributing upstream of those areas
- Use right-of-way areas to capture stormwater
- In-line stream storage (complicated design and difficult to obtain NJDEP permits)

How can we hold the volume?

- Smaller distributed systems
  - Individual household rain gardens
  - Pervious pavement
  - Right-of-way stormwater planters


RIGHT OF WAY
STORAGE
CATCH BASIN
GROUSE RD.
CATCH BASIN
CATCH BASIN
RIGHT OF WAY
STORAGE
PATRIDGE RD


RIGHT OF WAY
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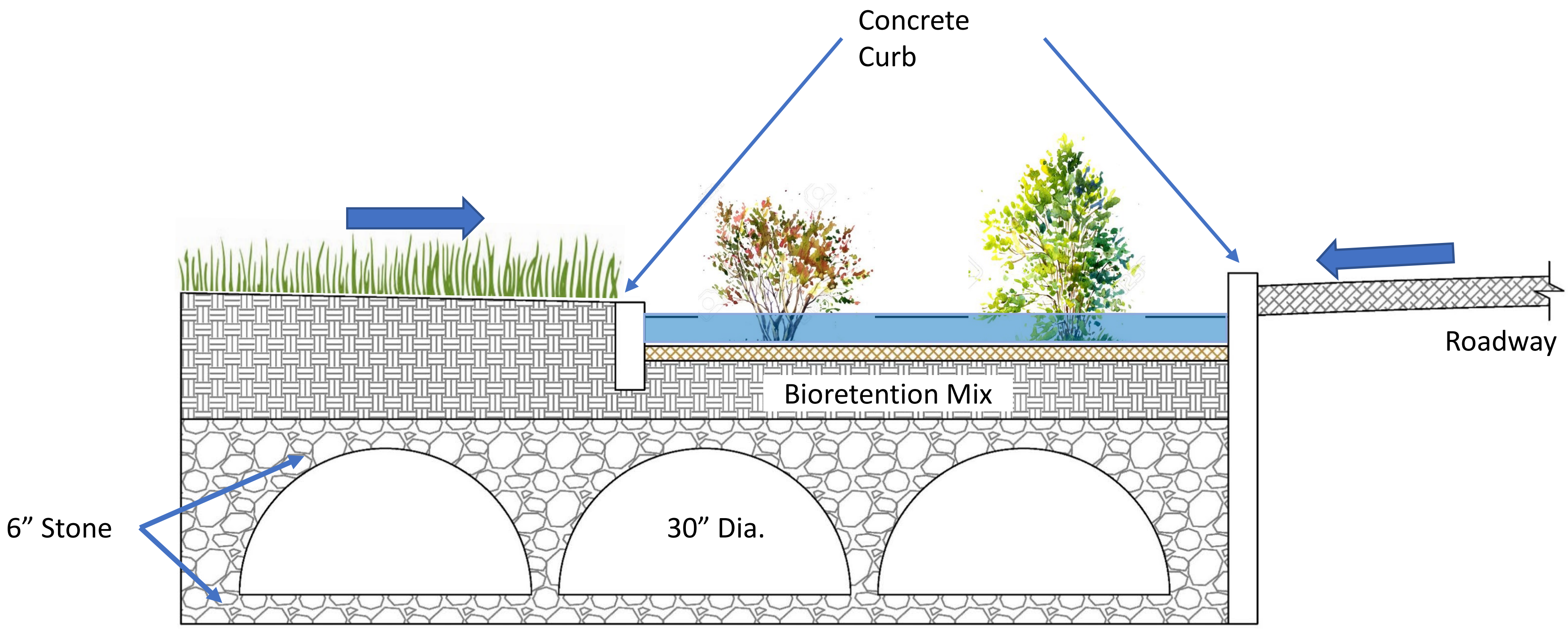

Concrete
Curb
Roadway
Bioretention Mix
6” Stone
30” Dia.

How can we hold the volume?

- Large detention/ bioretention basins
  - Can provide largest volume storage to land area

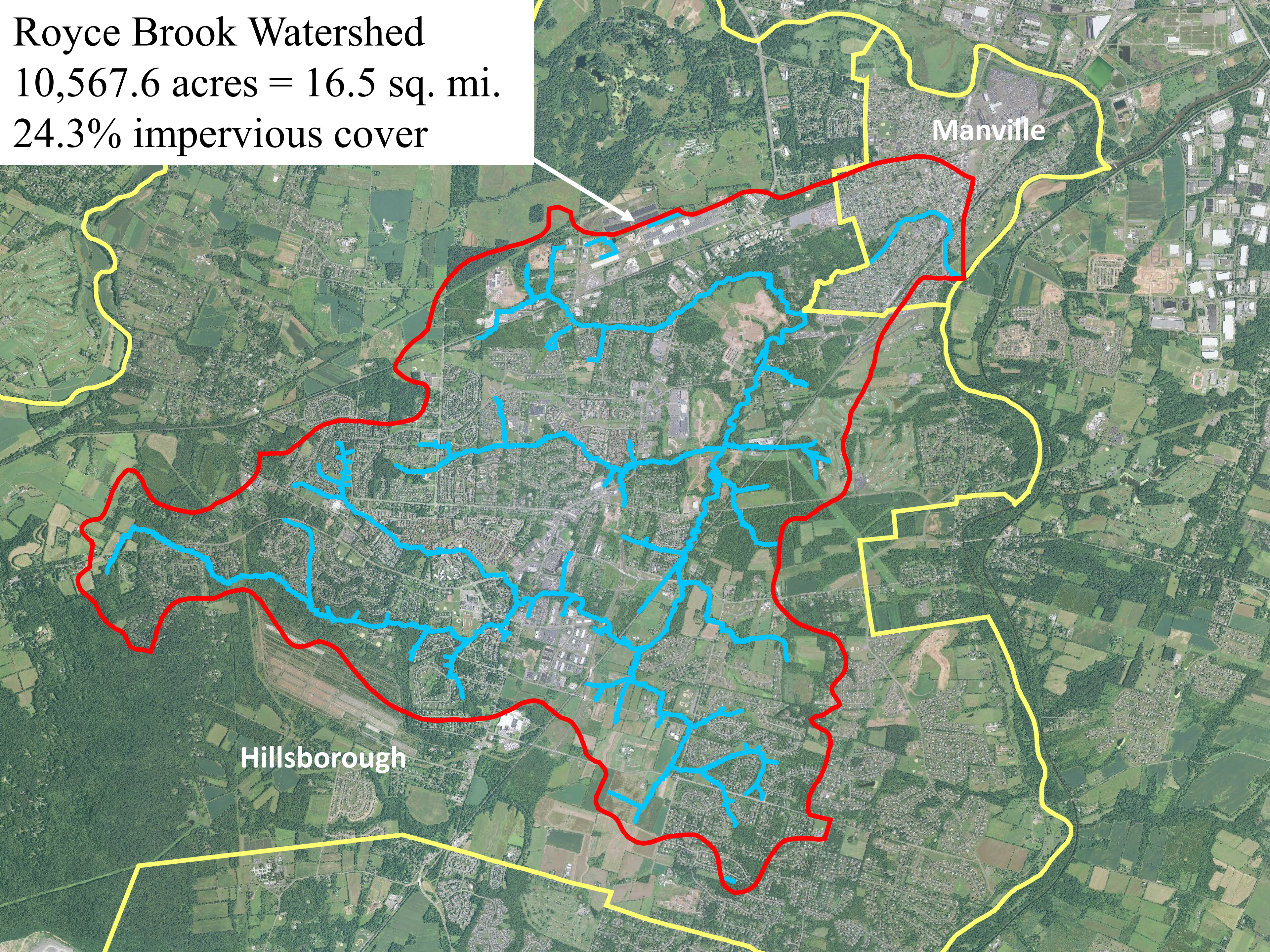
- Underground storage systems
  - Can create systems under lots by combining storage; allows mixed use of stormwater management area and recreational uses (i.e., parks)

What are design options for retrofitting sites?

- Right of way only and public land
- Create distributed projects on private lands

- Residential
  - Small buyouts of residential area to create available land for stormwater capture
  - Large buyouts to maximize stormwater capture

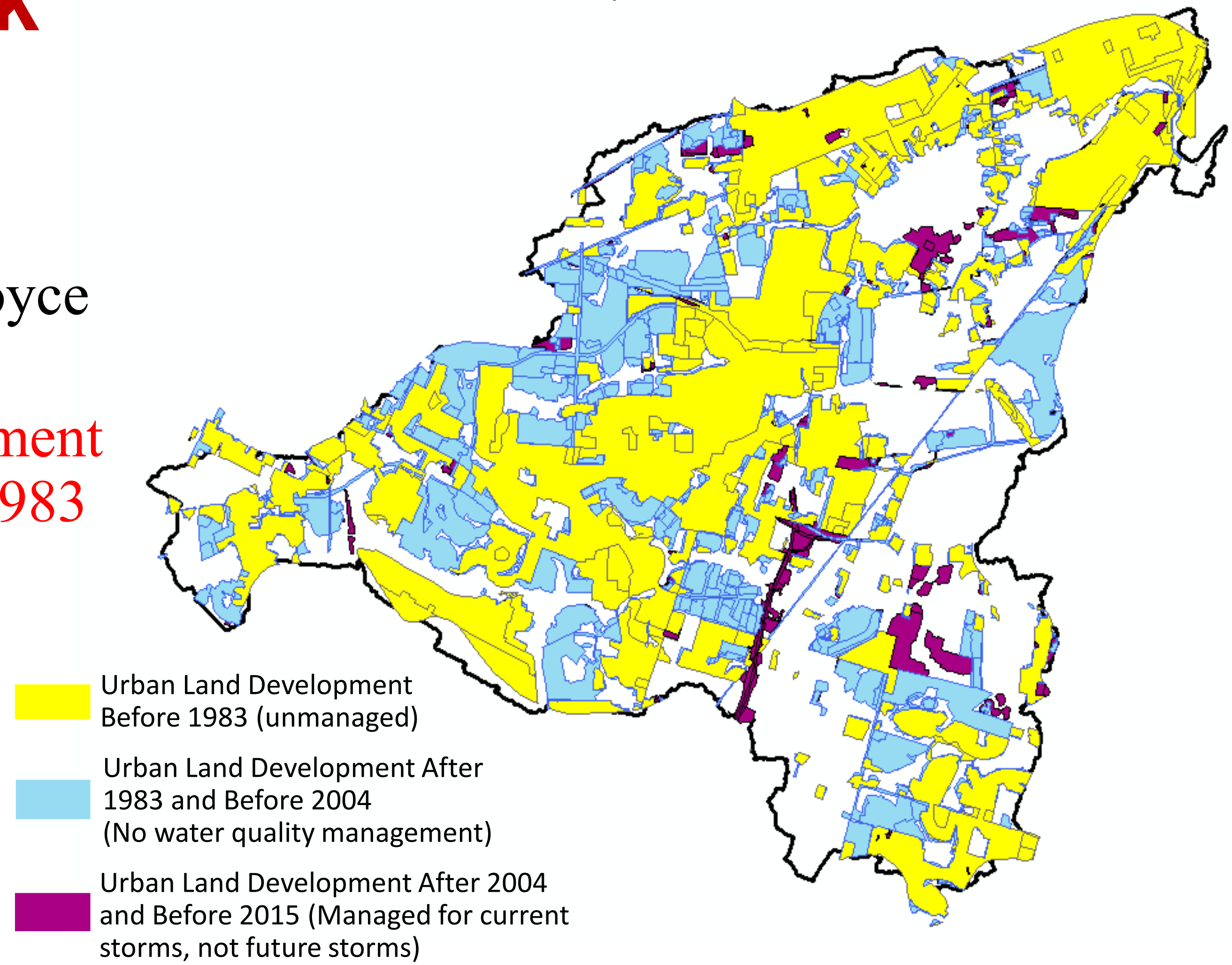
- Commercial
  - Underground storage in parking lots
  - Remove sections of unutilized areas to create larger storage systems


Royce Brook Watershed
10,567.6 acres = 16.5 sq. mi.
24.3% impervious cover
Manville
Hillsborough

What land is being managed in the Royce Brook Watershed?

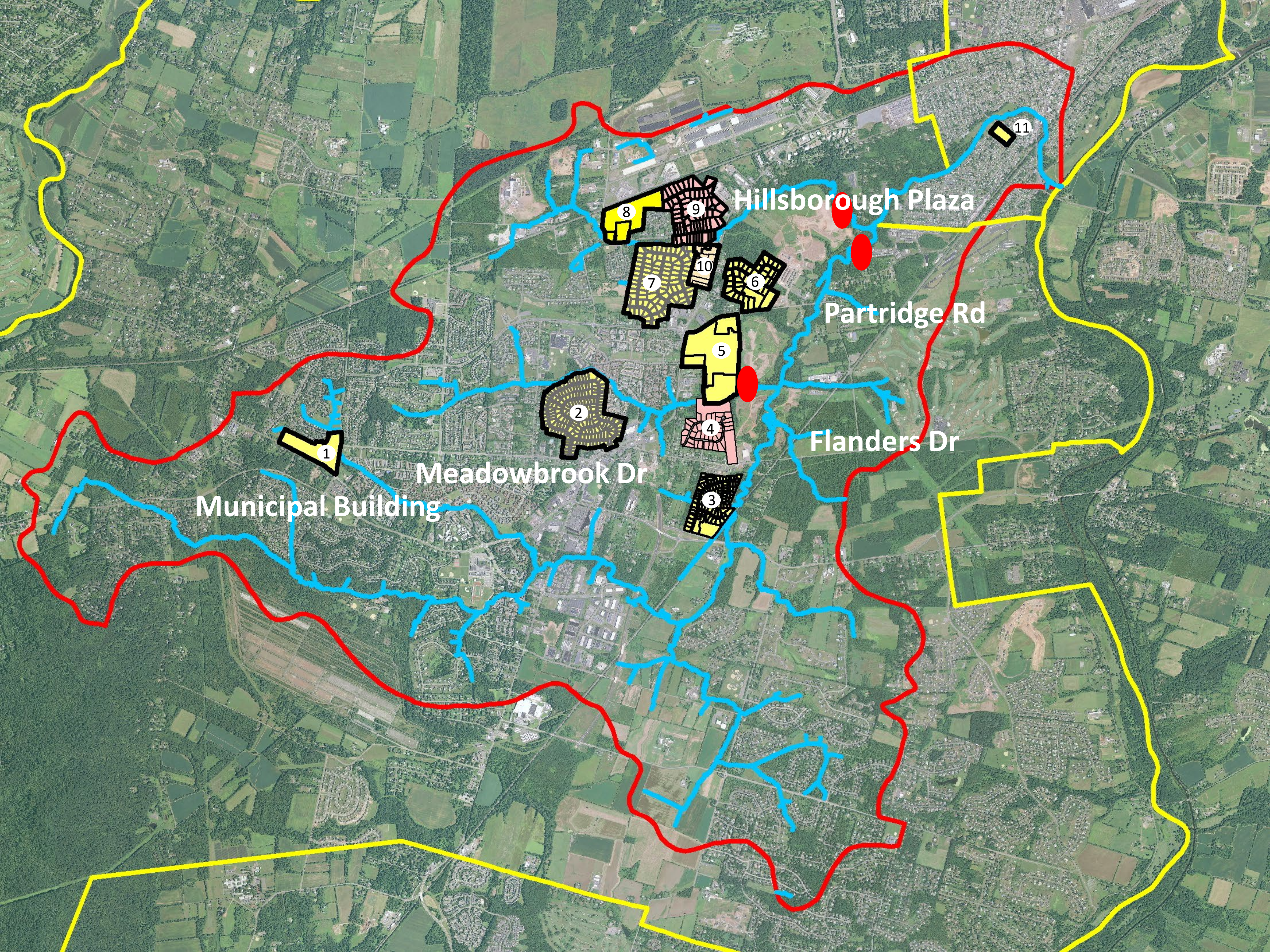
- Urban land in the Royce Brook Watershed
- Majority of development was created before 1983

Managed and Unmanaged Urban Land Use in the Royce Brook Watershed



11 potential development sites for retrofitting

- 673.4 acres = 1.05 sq. mi.
- Six residential developments
- Three commercial sites (one with some stormwater management)
- One municipal site
- One public school
- Possible solutions
  - Constructed wetlands
  - Bioretention
  - Permeable pavement
  - Roadside rain gardens
  - Homeowner rain gardens


Hillsborough Plaza
Partridge Rd
Flanders Dr
Meadowbrook Dr
Municipal Building
1
2
3
4
5
6
7
8
9
10
11

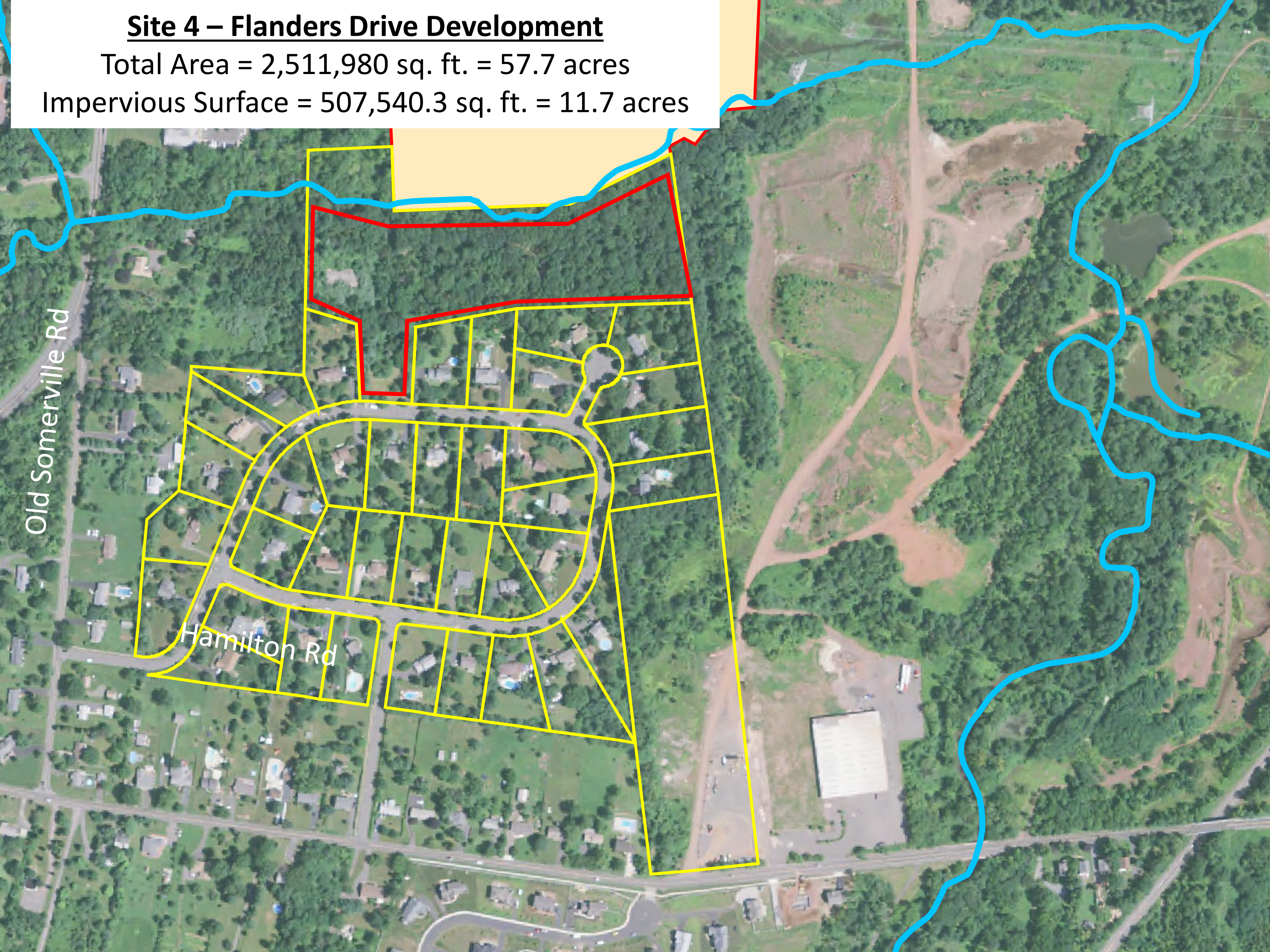
Let's look at one of these sites for three different scenarios

- Design limited to municipal lands
- Design to retrofit
  - At least 80% reduction of predevelopment peak
- Design unrestrained to reach 100% capture and hold

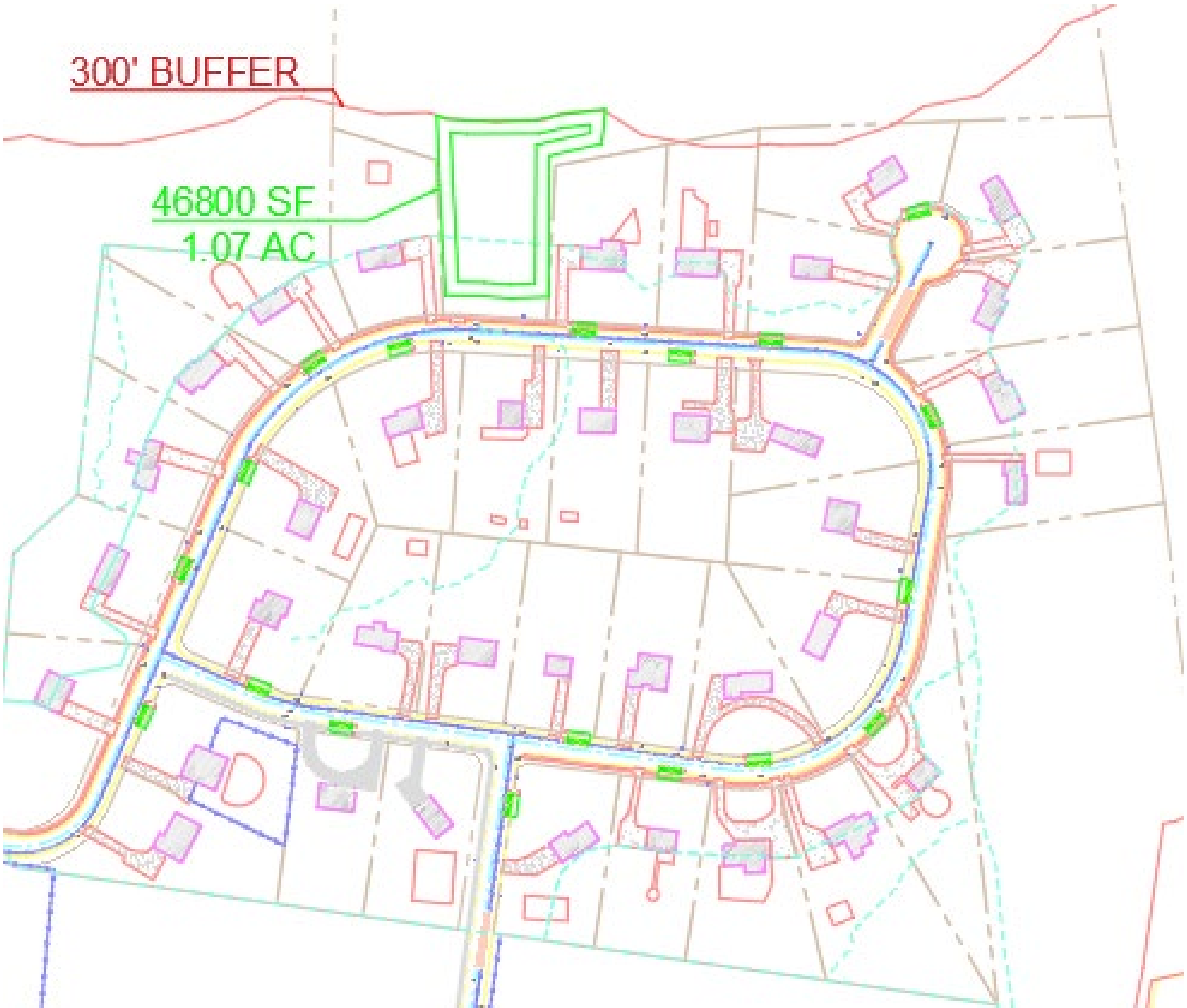
Site 4 – Flanders Drive Development

Total Area = 2,511,980 sq. ft. = 57.7 acres

Impervious Surface = 507,540.3 sq. ft. = 11.7 acres



Municipal Land Only

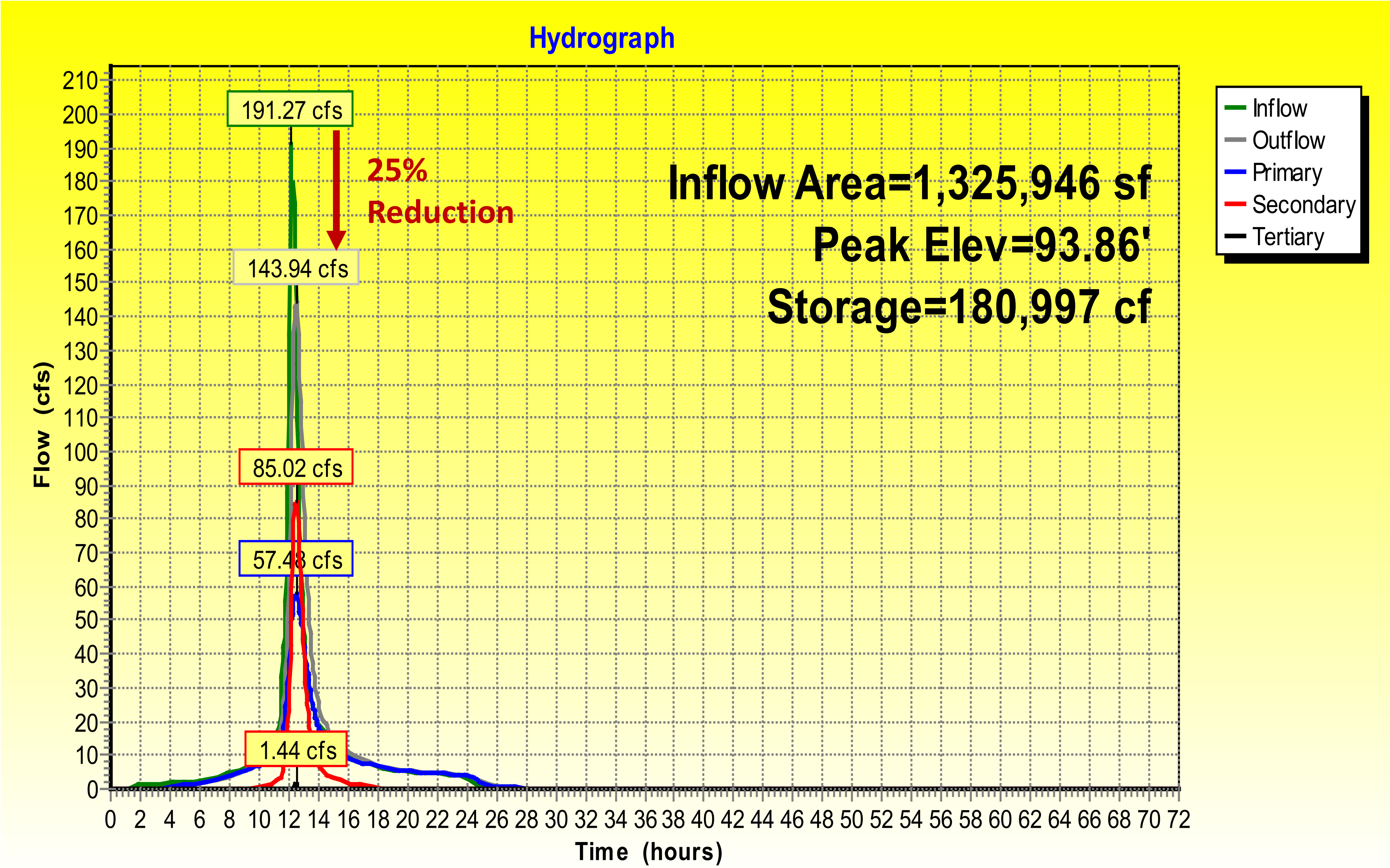


Municipal Land Only

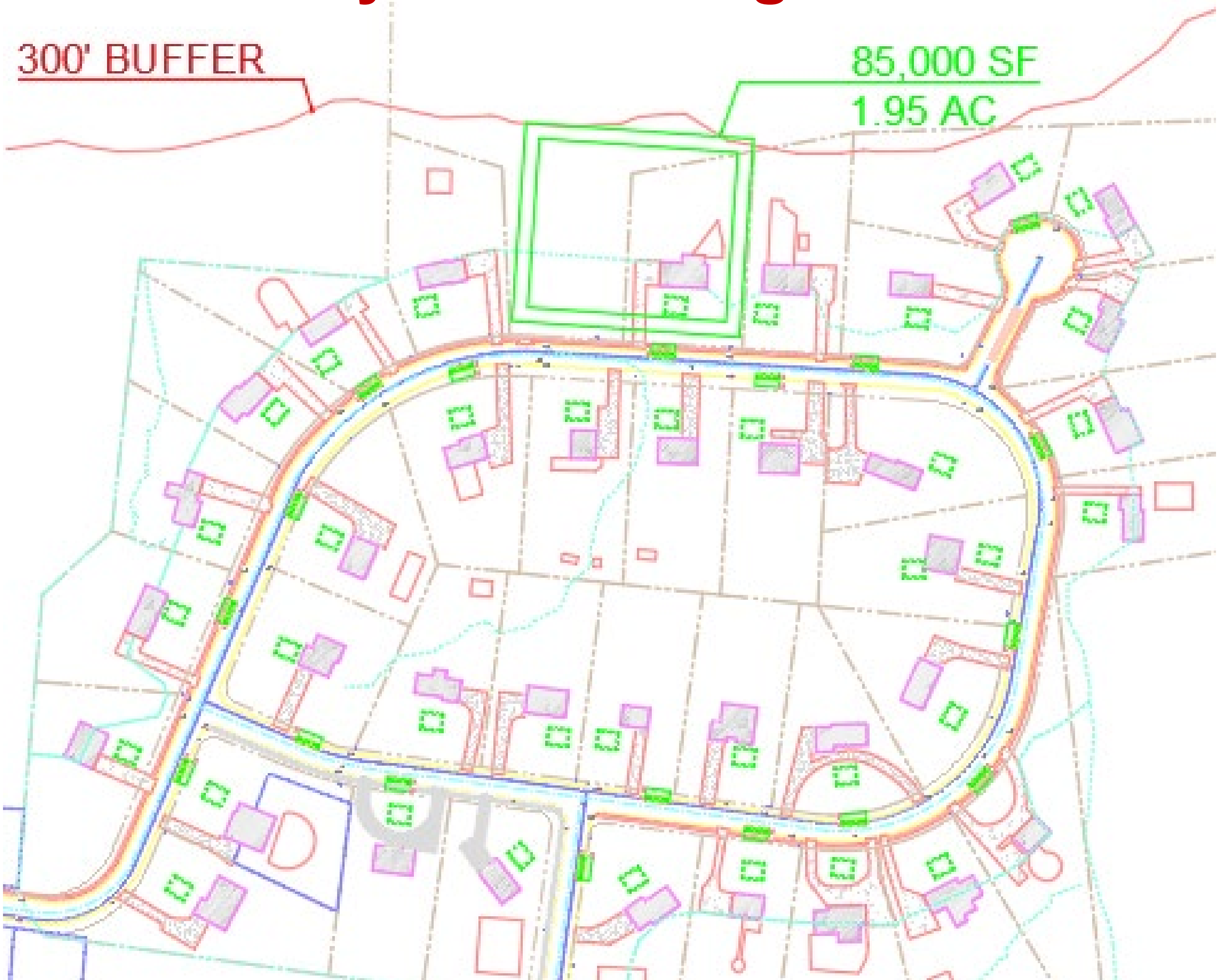
- Reduces peak by 25% meeting stormwater regulations
- Space for one basin and distributed systems in ROW

	Storage Volume (cf)	% Contribution
Basin	187,528	88%
Rain Gardens - Road	25,464	12%
Total Storage Volume	212,992	cf
Peak Discharge	144	cfs
Peak Reduction	25%	% of inflow (191.3cfs)
Detention Time 75%	14.4	hrs
Basin Area	1.07	ac

Target Peak Flow = 154 cfs


Hydrograph
191.27 cfs
25%
Reduction
143.94 cfs
85.02 cfs
57.48 cfs
1.44 cfs
Inflow Area=1,325,946 sf
Peak Elev=93.86'
Storage=180,997 cf
Inflow
Outflow
Primary
Secondary
Tertiary
Flow (cfs)
Time (hours)

Satisfy Current Regulations



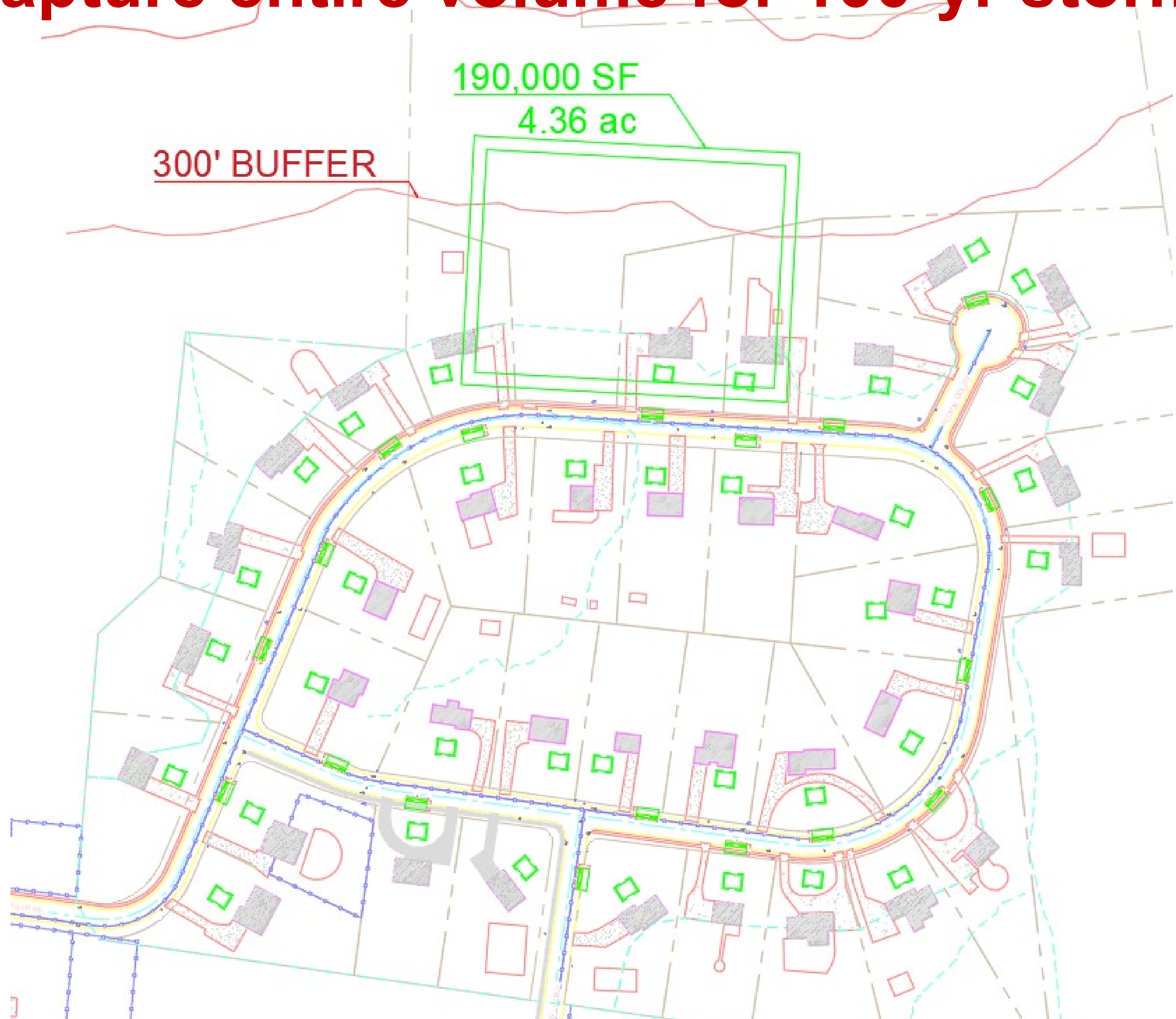
Current Regulations

- Reduce peak to 80% of pre-development peak (100-yr storm)

	Storage Volume (cf)	% Contribution
Basin	370,550	78%
Permeable Pavement	58,570	12%
Rain Gardens – Roof	20,276	4%
Rain Gardens - Road	25,464	5%
Total Storage Volume	474,860	cf
Peak Discharge	52.72	cfs
Peak Reduction	72%	% of Inflow (191.3cfs)
Detention Time 75%	17.0	hrs
Basin Area	1.95	ac

Target Peak Flow = 85.5 cfs

Capture entire volume for 100-yr storm



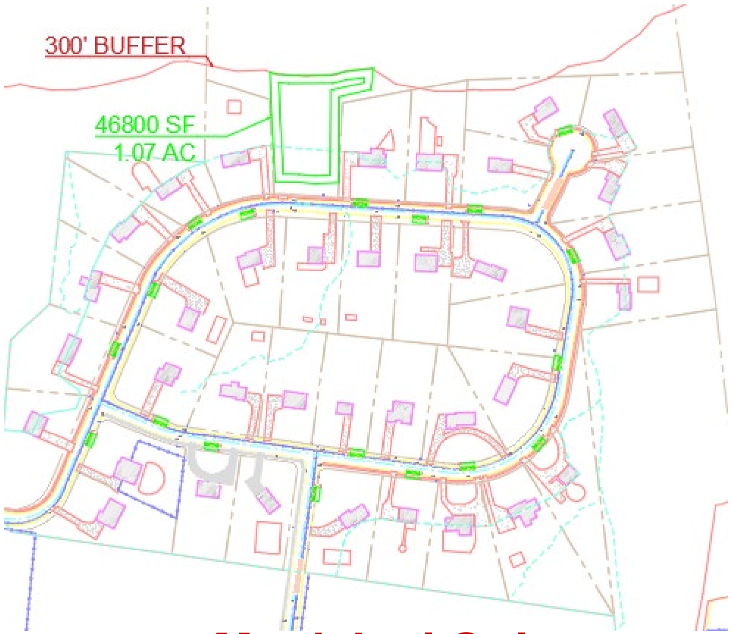
Capture entire volume for 100-yr storm

- All of the volume held in basin
- Valve will need to be released later and drained in reasonable time

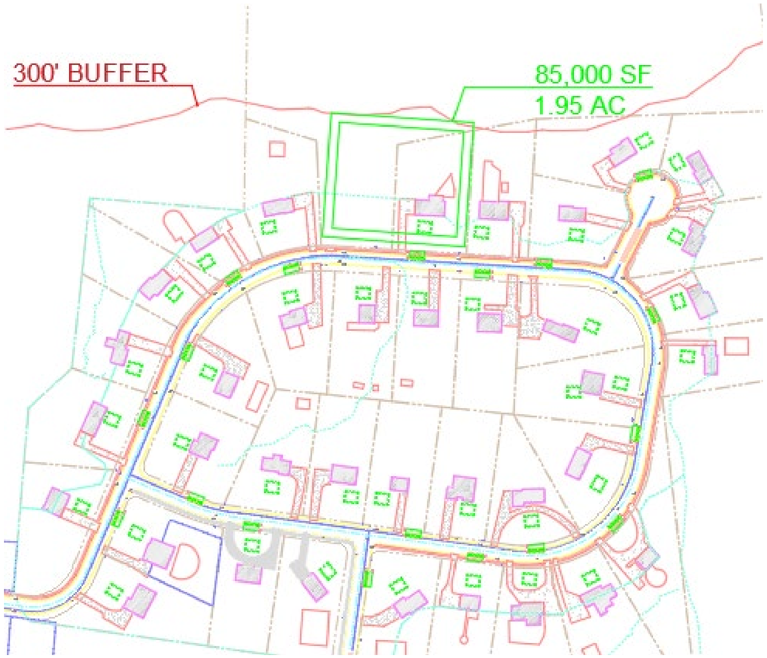
	Storage Volume (cf)	% Contribution
Basin	866,,000	89%
Porous Pavement	58,570	6%
Rain Gardens – Roof	20,276	2%
Rain Gardens - Road	25,464	3%
Total Storage Volume	970,310	cf
Peak Discharge	0	cfs
Peak Reduction	100%	% of Inflow (191.3cfs)
Basin Storage Peak	853,911	cf
Detention Time 75%	NA	hrs
Detention Time 100%	NA	hrs
Basin Area	4.36	ac

Case comparison

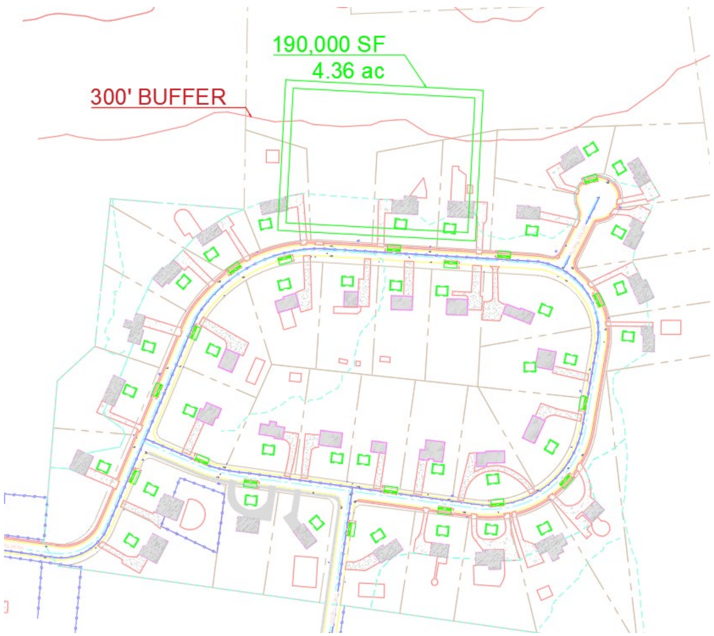
Parameter	Municipal	Current Reg	All Storage
Basin Size (acre)	1.07	1.95	4.36
Peak Red.	25%	72%	100%
Storage (CF)	212,992	474,860	970,310
Det. Time 75% (hr)	14.4	17.0	n/a



Municipal Only



Current Regulation



All Storage

Questions?

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