Coupling Green Infrastructure with Gray Infrastructure for Large Storms

RUTGERS
New Jersey Agricultural Experiment Station

Water Quantity

Is Green Infrastructure a solution?

…an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green Infrastructure projects:

- capture,
- filter,
- absorb, and
- reuse

stormwater to maintain or mimic natural systems and treat runoff as a resource.

Green Infrastructure

Stormwater management practices that protect, restore, and mimic the native hydrologic condition by providing the following functions:

- Infiltration
- Filtration
- Storage
- Evaporation
- Transpiration

Green Infrastructure Practices

Bioretention Systems

- Rain Gardens
- Bioswales
- Stormwater Planters
- Curb Extensions
- Tree Filter Boxes

Permeable Pavements

Rainwater Harvesting

- Rain barrels
- Cisterns

Dry Wells

Rooftop Systems

- Green Roofs
- Blue Roofs








TYPES OF BIORETENTION

- Larger Bioretention Systems
- Rain Gardens
- Bioretention Swales/ Bioswales/Vegetated Swales
- Stormwater Planters & Planter Boxes
- Vegetated Curb Extensions

Larger Bioretention Systems

- Larger housing developments
- Commercial areas
- Parking lots

Rain Gardens

- Single-family lots
- Small commercial areas

Bioretention Swales/ Bioswales/ Vegetated Swales

- Roadside systems

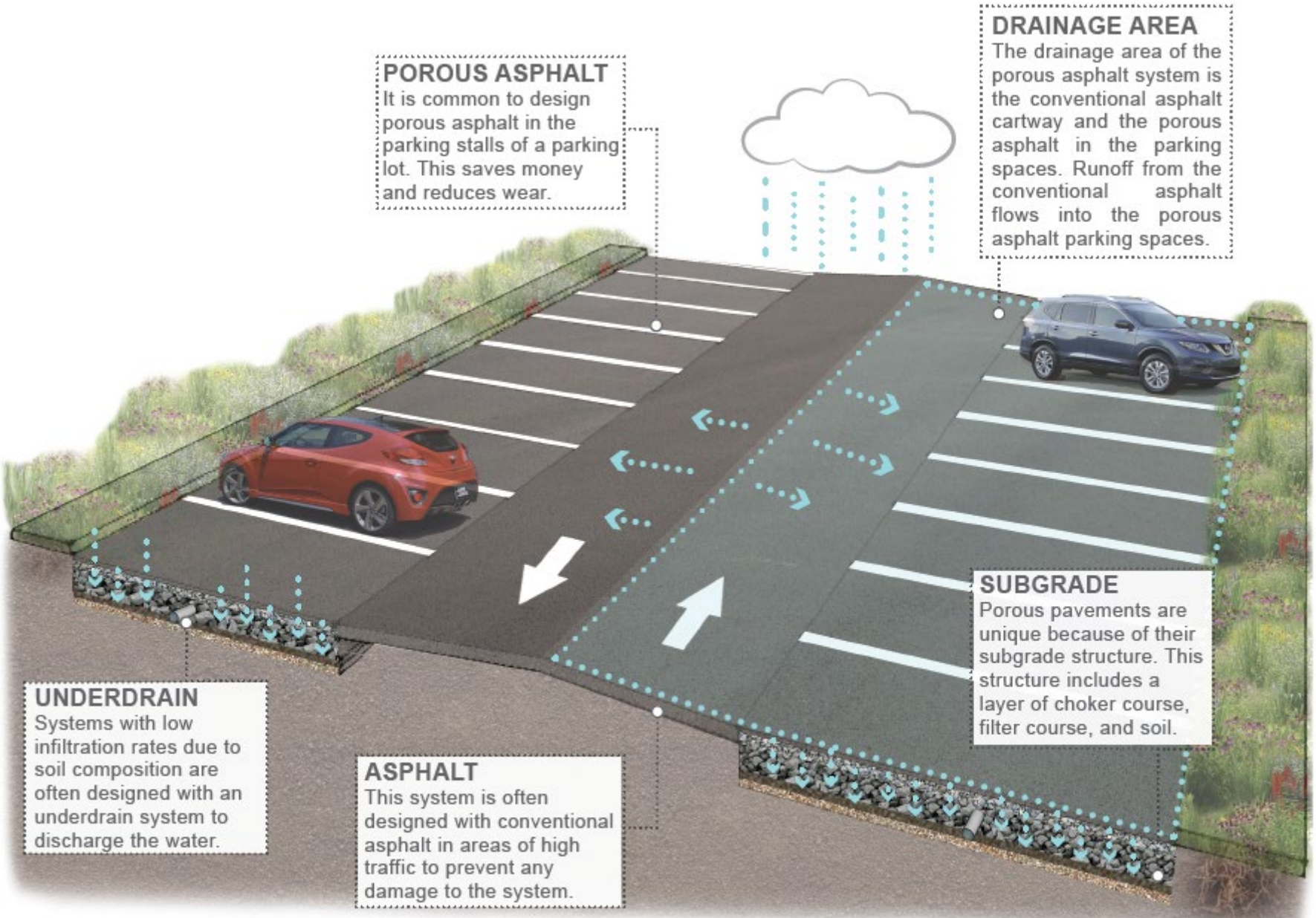
Stormwater Planters/ Planter Boxes

- Highly urban areas
- Roadside and adjacent to buildings

Vegetated Curb Extensions

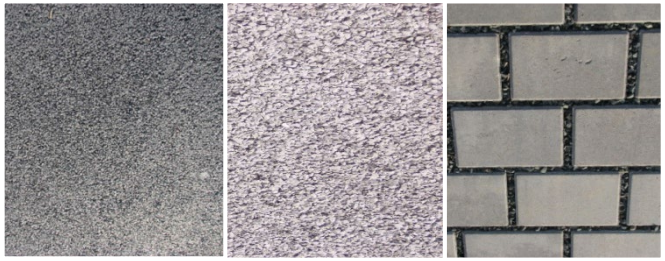
- Bioretention incorporated into road in urban and suburban areas

Permeable Pavement



Permeable Pavements

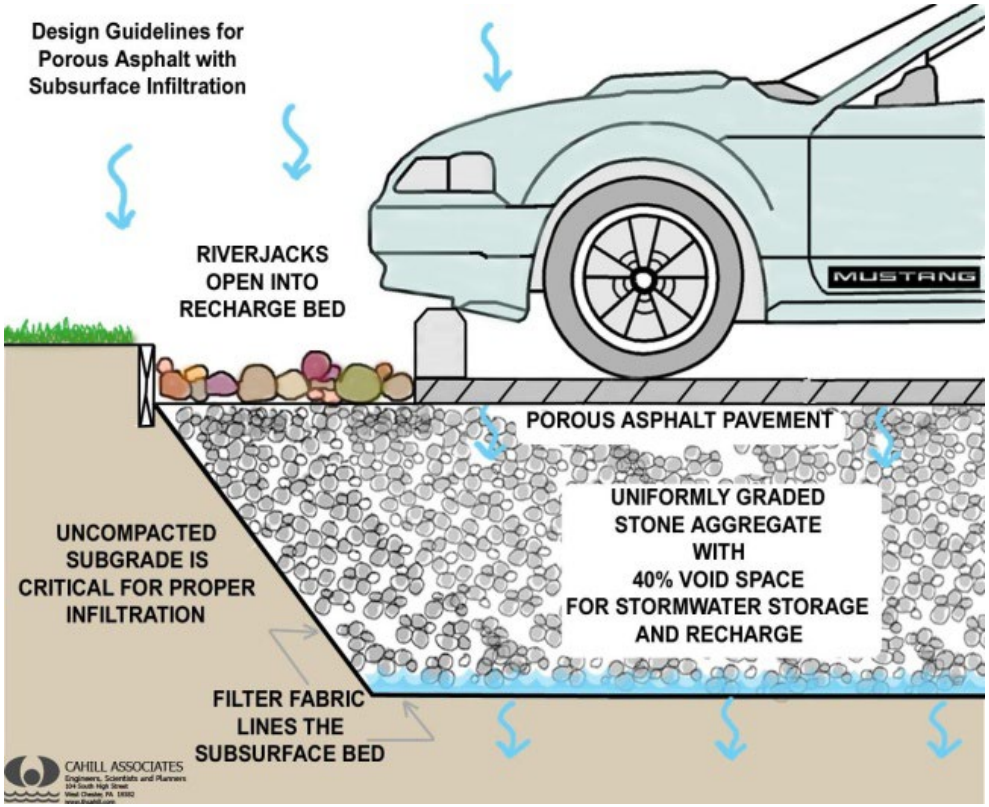
- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Permeable pavers systems are concrete pavers with infiltration between the spaces of the pavers
- Ideal application for porous pavement is to treat a low traffic or overflow parking area



ADVANTAGES

- Manage stormwater runoff
- Minimize site disturbance
- Promote groundwater recharge
- Low life cycle costs, alternative to costly traditional stormwater management methods
- Mitigation of urban heat island effect
- Contaminant removal as water moves through layers of system

COMPONENTS



Porous Asphalt

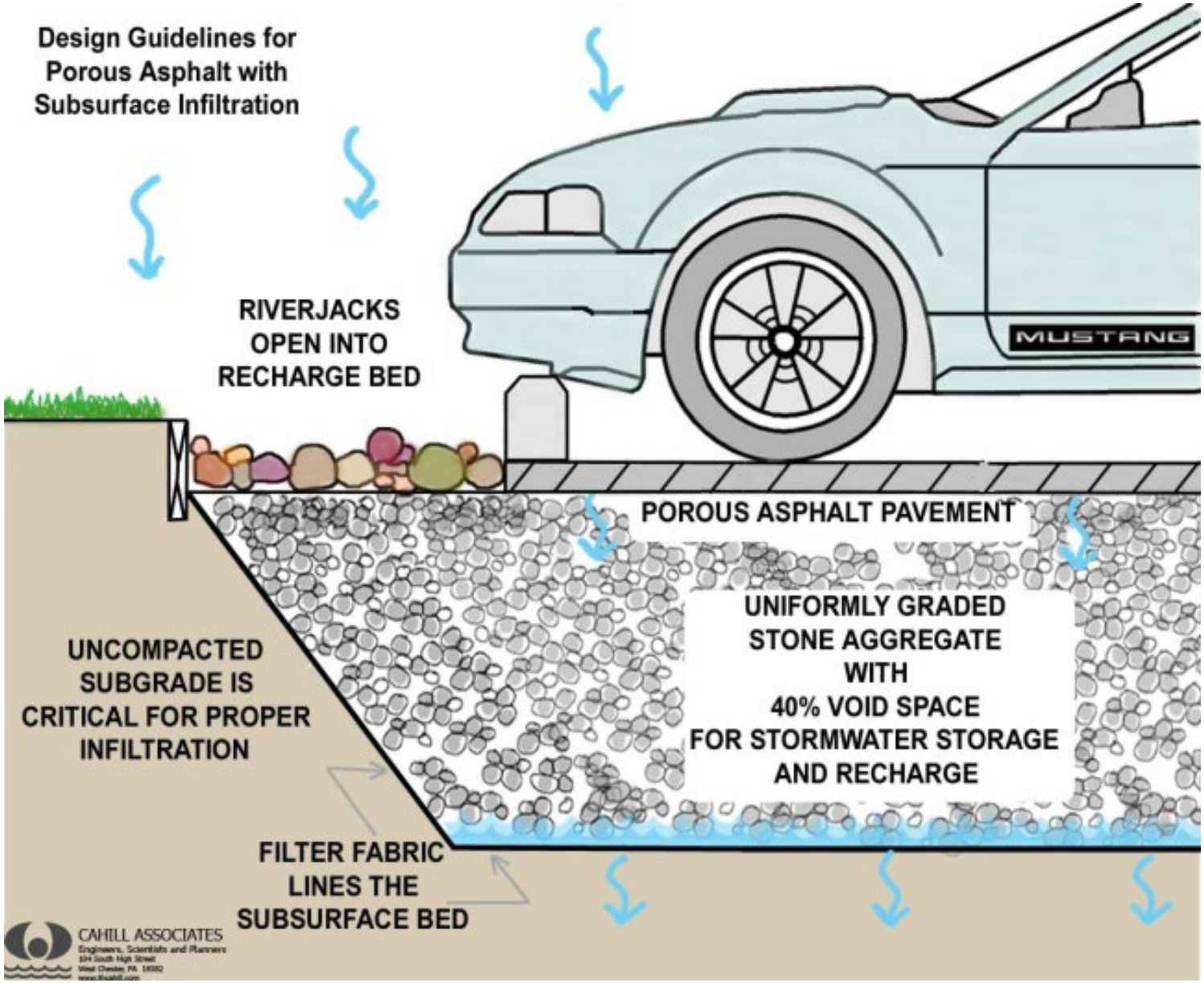

Pervious Concrete


Permeable Pavers


Grass Pavers

Let's get back to flooding – bioretention is an option but does it take up too much space?


7. 24. 2003


Design Guidelines for
Porous Asphalt with
Subsurface Infiltration
RIVERJACKS
OPEN INTO
RECHARGE BED
MUSTANG
POROUS ASPHALT PAVEMENT
UNIFORMLY GRADED
STONE AGGREGATE
WITH
40% VOID SPACE
FOR STORMWATER STORAGE
AND RECHARGE
UNCOMPACTED
SUBGRADE IS
CRITICAL FOR PROPER
INFILTRATION
FILTER FABRIC
LINES THE
SUBSURFACE BED
CAHILL ASSOCIATES
Engineers, Scientists and Planners
104 South High Street
West Chester, PA 19382

HILLSBOROUGH PLAZA

GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
256 US-206, HILLSBOROUGH CITY]
SOMERSET COUNTY, NEW JERSEY

PROJECT DESCRIPTION:

GREEN INFRASTRUCTURE DEMONSTRATION PROJECT WILL BE INSTALLED IN 256 US-206 PLAZA.

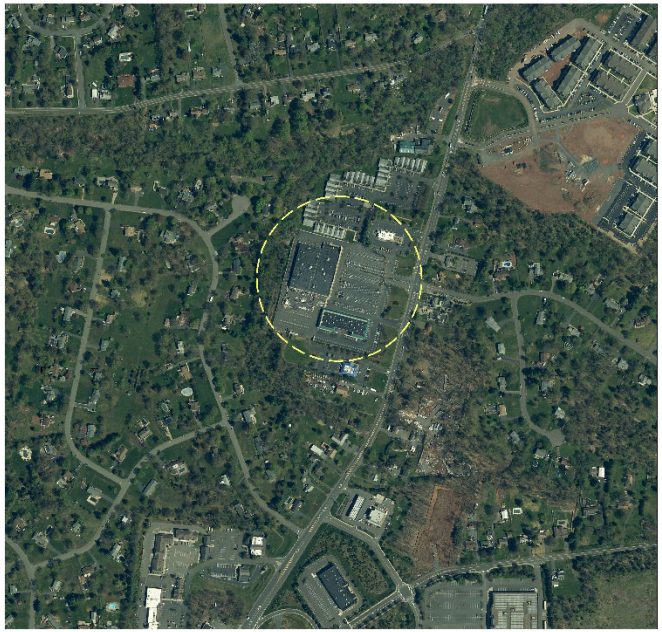
1. ISLANDS OF PARKING LOT WILL BE DE-PAVED AND RE-INSTALLED TO BE RAIN GARDENS, TO CAPTURE, INFILTRATE THE STORMWATER RUNOFF FROM THE ROAD.
2. RAIN GARDENS WILL BE INSTALLED ON THE GRASS AREA AROUND THE PLAZA, TO CAPTURE, INFILTRATE THE STORMWATER RUNOFF FROM THE ROAD.
3. PARKING LOT AT THE SOUTH SIDE OF PLANET FITNESS WILL BE REPLACED WITH PERVIOUS CONCRETE TO CAPTURE THE STORMWATER RUNOFF FROM THE ROAD AND THE ROOF.
4. UNDERGROUND STORAGE TANK WILL BE INSTALLED UNDER THE PARKING LOT TO INCREASE THE CAPACITY OF GREEN INFRASTRUCTURES.

THE PROJECT WILL SERVE AS A DEMONSTRATION FOR CITIZEN TO LEARN ABOUT SUSTAINABLE STORMWATER MANAGEMENT AND LOCAL POLLINATOR ECOLOGY.

LIST OF DRAWINGS:

SHEET NAME	TITLE
COVER	COVER SHEET
P-1	EXISTING CONDITIONS AND DEMOLITION PLAN
P-2	PROPOSED SITE PLAN
DT-1	DETAILS
DT-2	DETAILS 2
DT-3	DETAILS 3
DT-4	DETAILS 4

LOCATION MAP (N.T.S):



LEGEND:

- EXISTING DRAINAGE AREA
- EDGE OF PAVEMENT
- EXISTING CENTERLINE
- EXISTING TREELINE
- EXISTING TREE/SHRUB
- EXISTING BUILDING
- EXISTING LIGHT POLE
- AREA TO BE DEPAVED
- PROPOSED GREEN INFRASTRUCTURE
- PROPOSED POROUS ASPHALT
- PROPOSED TOP OF BERM

GENERAL NOTES:

1. SURVEY CONDUCTED BY RUTGERS COOPERATIVE EXTENSION WATER RESOURCES PROGRAM. ALL ELEVATIONS ARE RELATIVE TO THE 100.00' BENCHMARK POINT. (OR ELEVATION DATA OBTAINED FROM [INSERT DATA SOURCE HERE, TYP NOAA DIGITAL COASTAL LIDAR]. ELEVATION ARE HEIGHT ABOVE MEAN SEA LEVEL SET BY NAVD 1988).
2. EXISTING SOILS ARE PENN SILT LOAM WHICH ARE CLASSIFIED AS HYDROLOGIC SOIL GROUP C WHICH HAVE LOW INFILTRATION RATES BASED ON THE NRCS WEB SOIL SURVEY (websoilsurvey.sc.egov.usda.gov).
3. ANY OVERHEAD AND UNDERGROUND UTILITIES SHOWN ARE FROM FIELD OBSERVATIONS AND ARE NOT A COMPLETE REPRESENTATION. A UTILITY MARKOUT NEEDS TO BE CONDUCTED PRIOR TO MOBILIZATION BY THOSE RESPONSIBLE FOR EXCAVATION. NJ ONE CALL: 811 OR 800-272-1000

PLAN REVISIONS		
REV. DATE	REV. SUMMARY	REV. SHEETS

CHRISTOPHER G. OBROPTA, Ph.D., P.E.
PROFESSIONAL ENGINEER, N.J. LIC. NO. 24GE

DATE: XX/XX/XX

DRAWN: | CHECKED: KH | APPROVED: OGO | DATE: 3/17/2021

DRAFT

NO.	DATE	DESCRIPTION

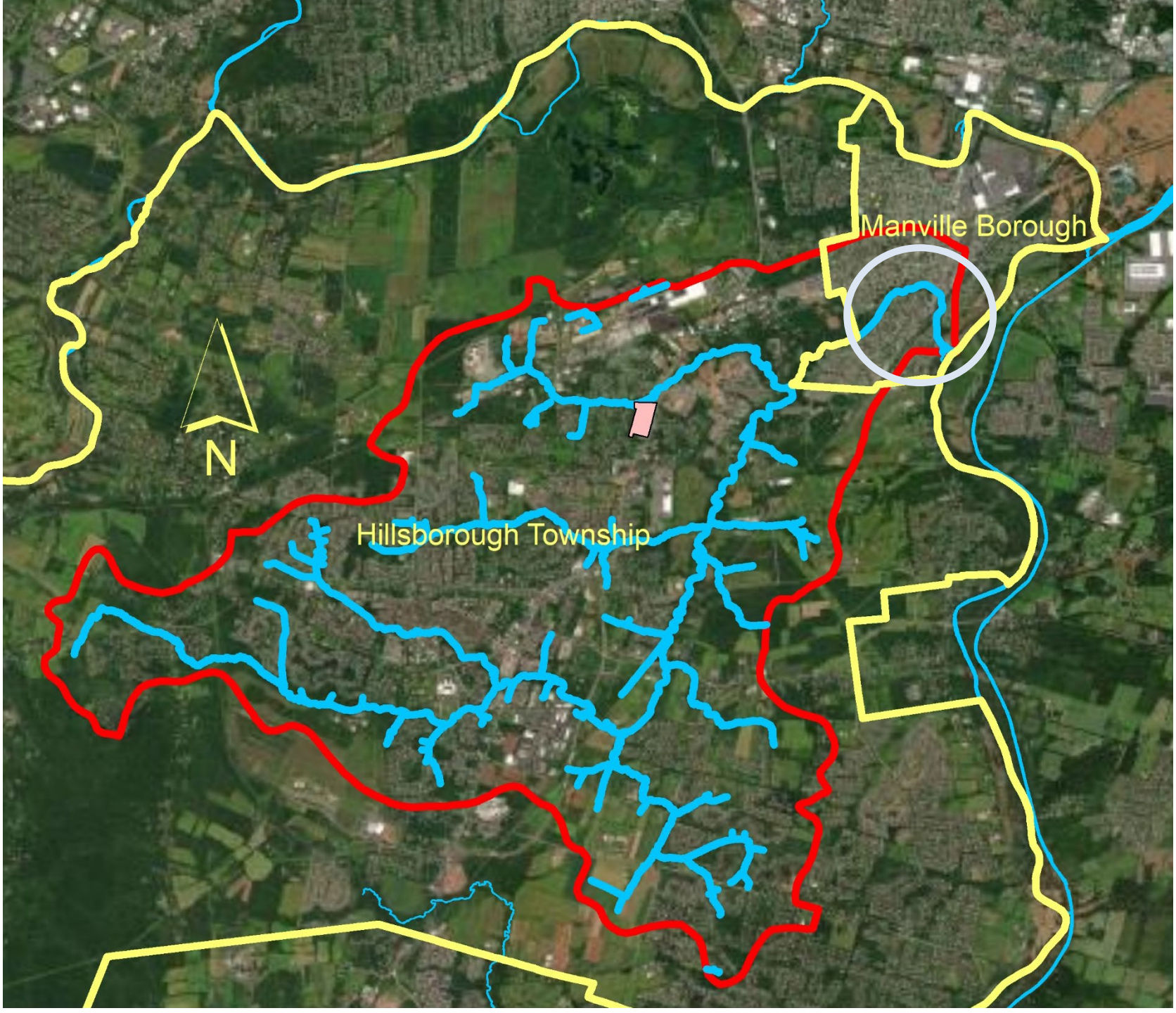
PLAN SCALE: AS SHOWN

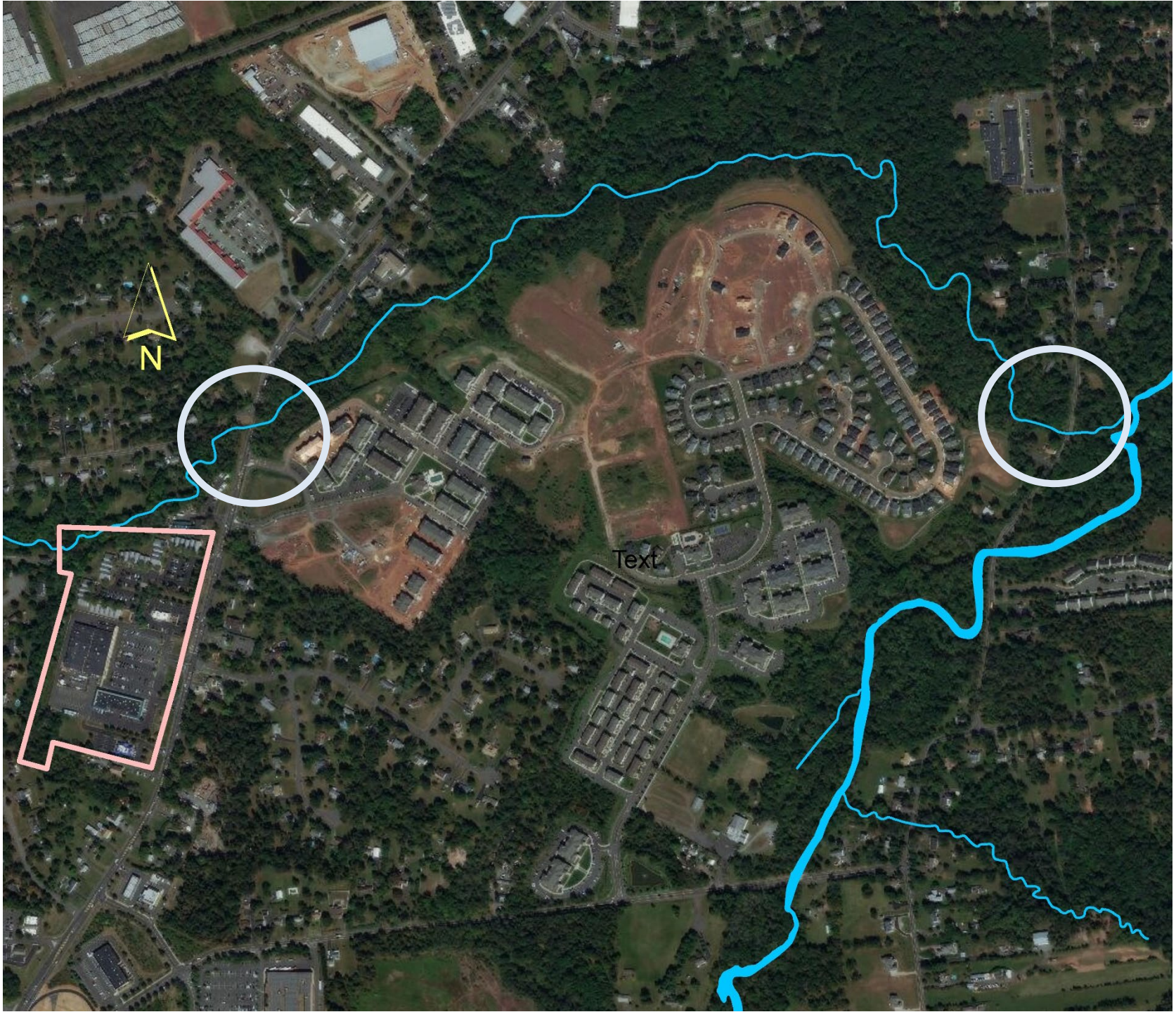
HILLSBOROUGH PLAZA
GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
256 US-126, HILLSBOROUGH CITY]
SOMERSET COUNTY, NJ

COVER SHEET

RUTGERS New Jersey Agricultural Experiment Station

SHEET NAME
COVER


Manville Borough
N
Hillsborough Township

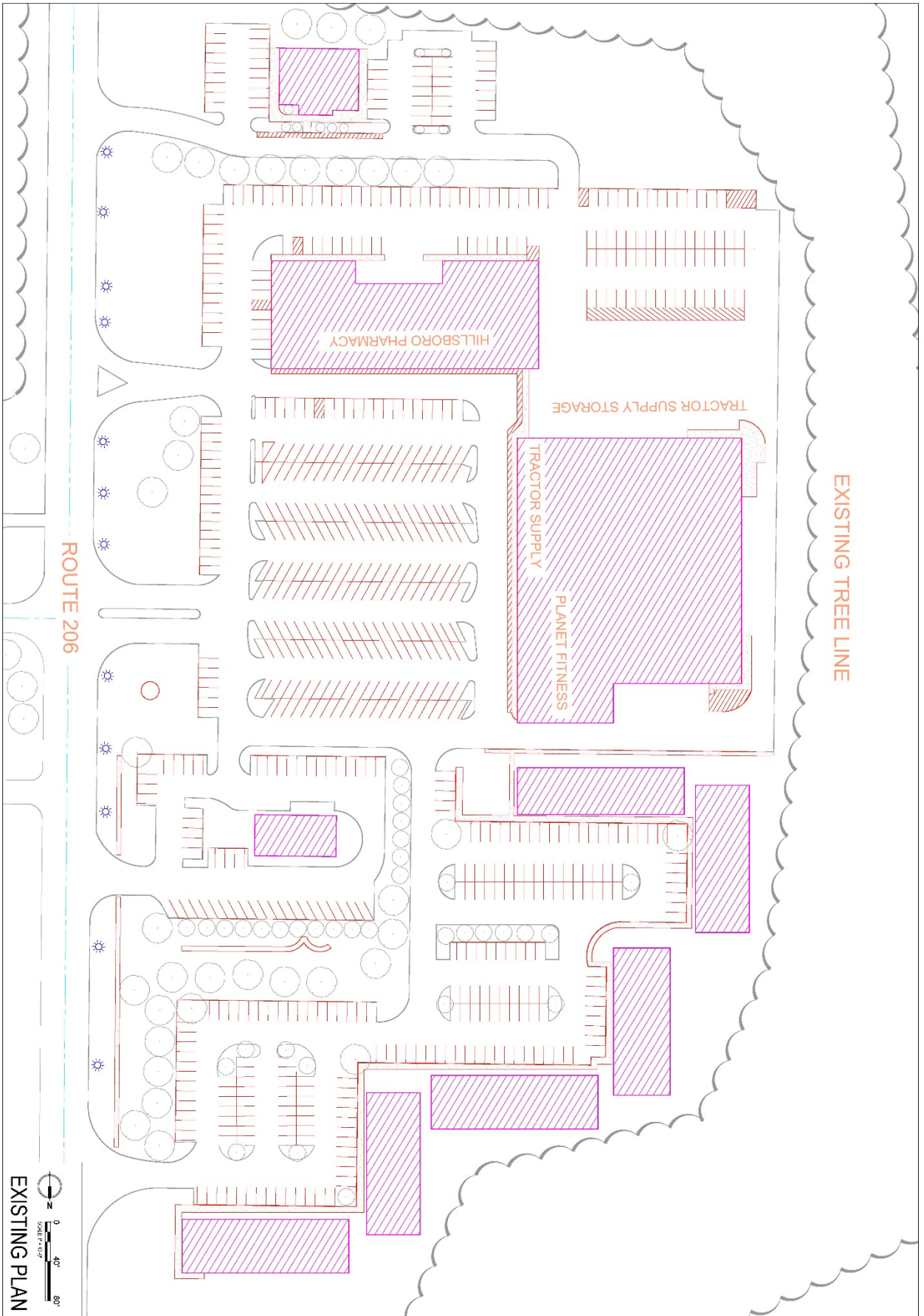

N
Text

Hillsborough Plaza
256 Route 206
Hillsborough, New Jersey


DOLLAR TREE
Google


DOLLAR TREE
Google


FIRE LANE



EXISTING PLAN

N

SCALE: 1"=40'

0 40' 80'

SHEET NAME
P-1

RUTGERS
New Jersey Agricultural Experiment Station

HILLSBOROGH PLAZA
GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
256 US-126, HILLSBOROUGH CITY]
SOMERSET COUNTY, NJ

EXISTING CONDITIONS AND DEMOLITION PLAN

PLAN REVISIONS

No	DATE	DESCRIPTION

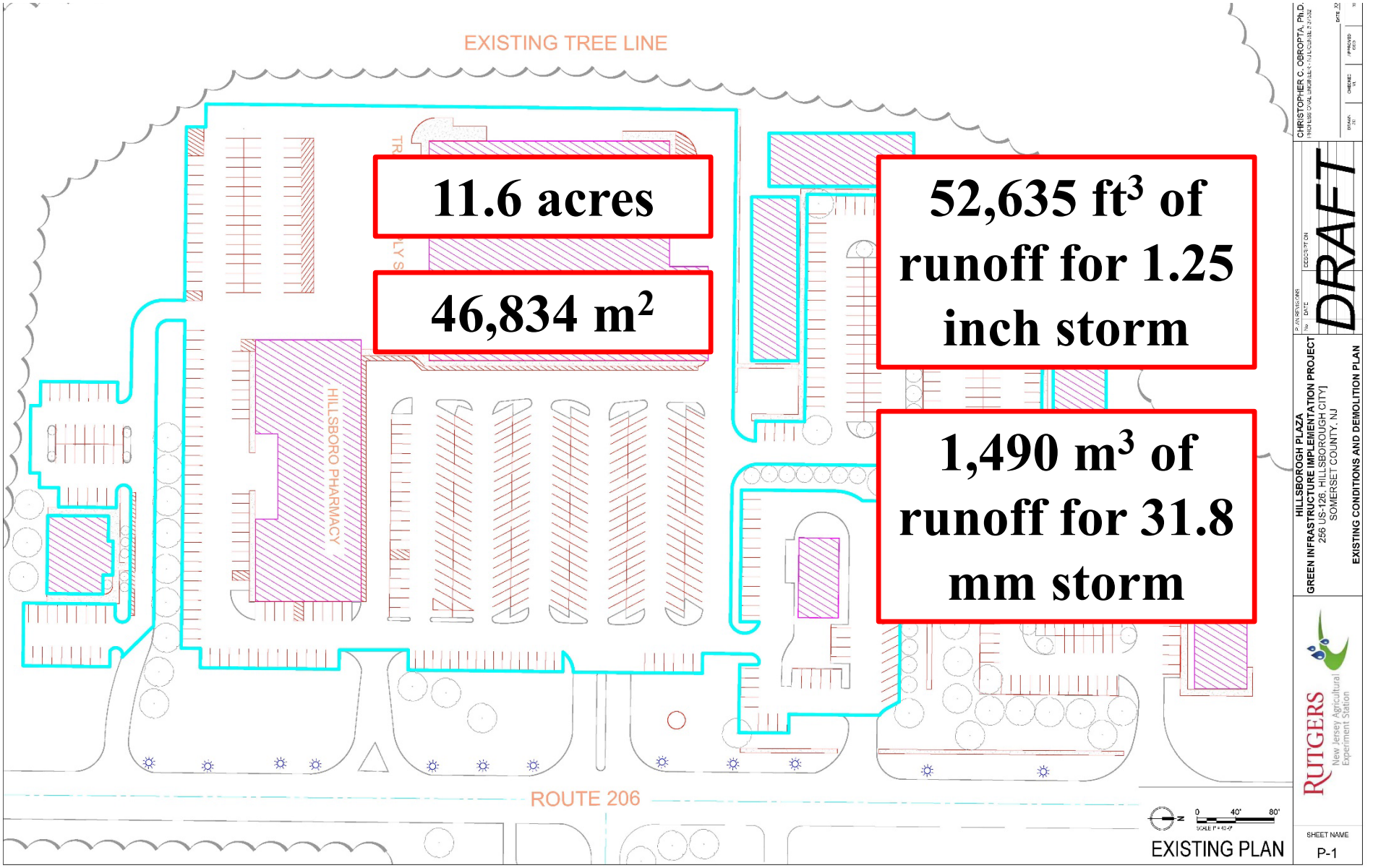
DRAFT

CHRISTOPHER C. OBROPTA, Ph.D., P.E.
PROFESSIONAL ENGINEER - NJ LICENSE # 37532

DATE XX/XX/XX

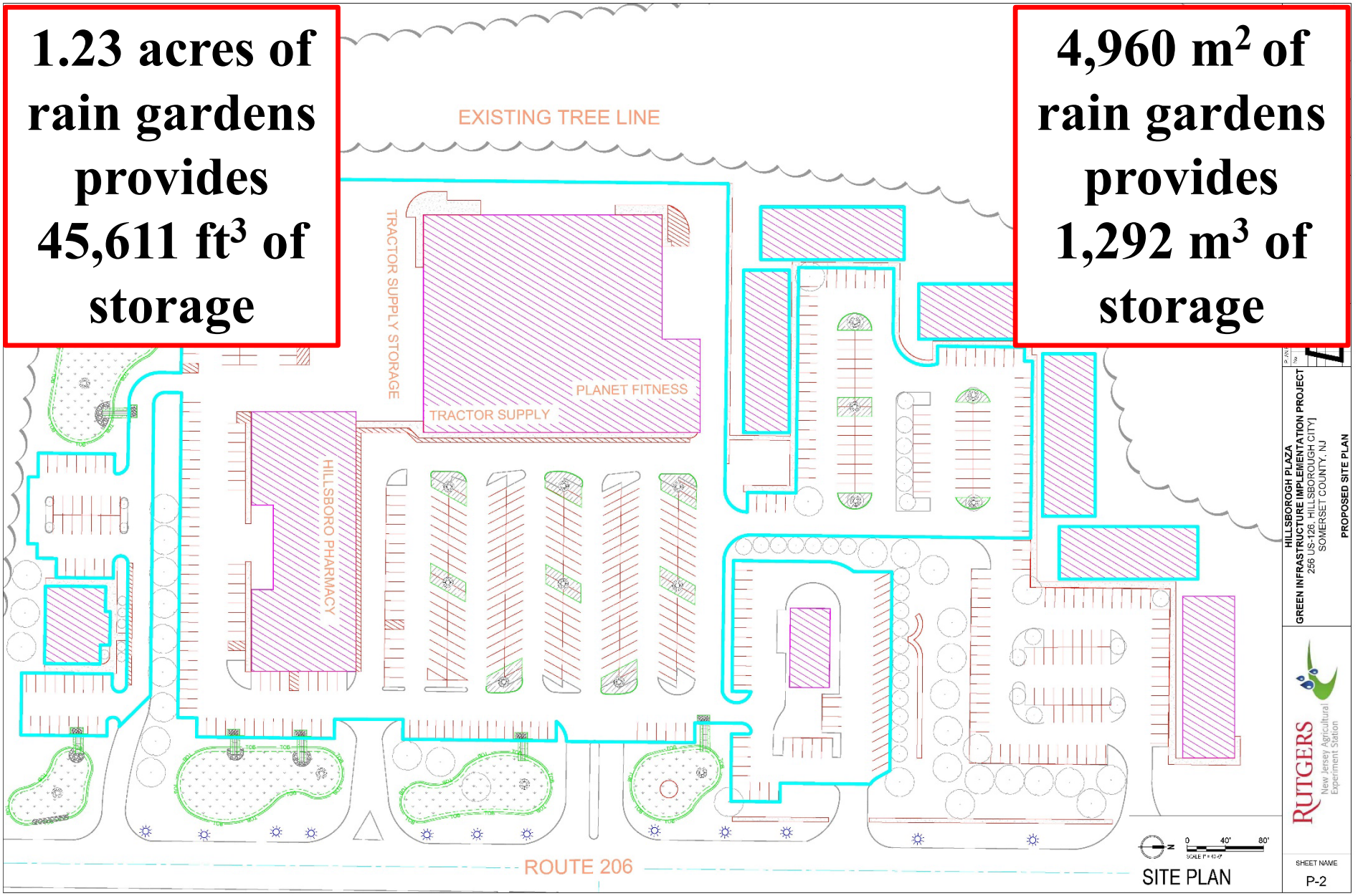
DRAWN	CHECKED	APPROVED	DATE
JD	VL	CCO	10/25/2022

Water Quality Storm Analysis (1.25 inches)



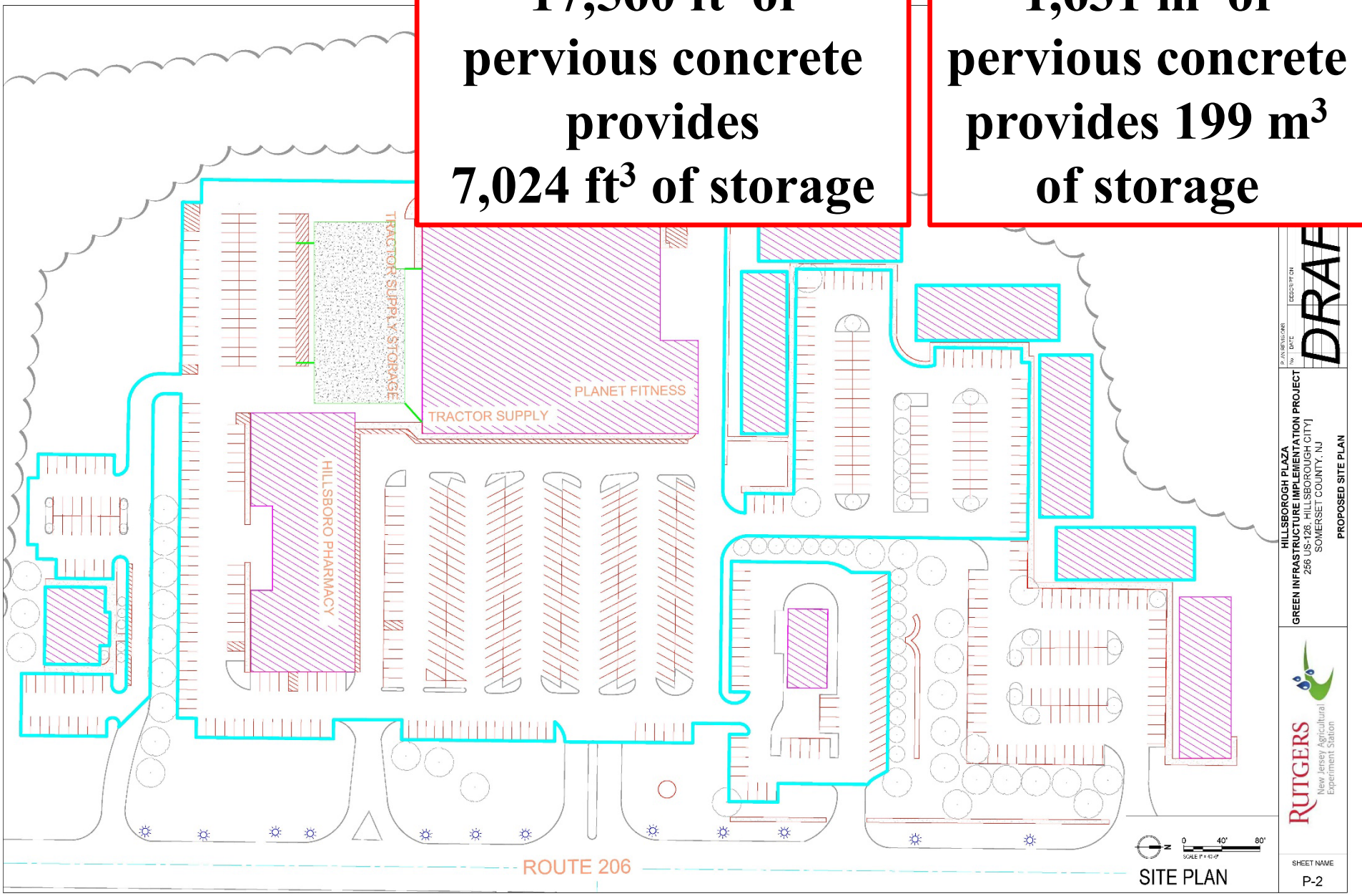
1.23 acres of rain gardens provides 45,611 ft^3 of storage

4,960 m^2 of rain gardens provides 1,292 m^3 of storage

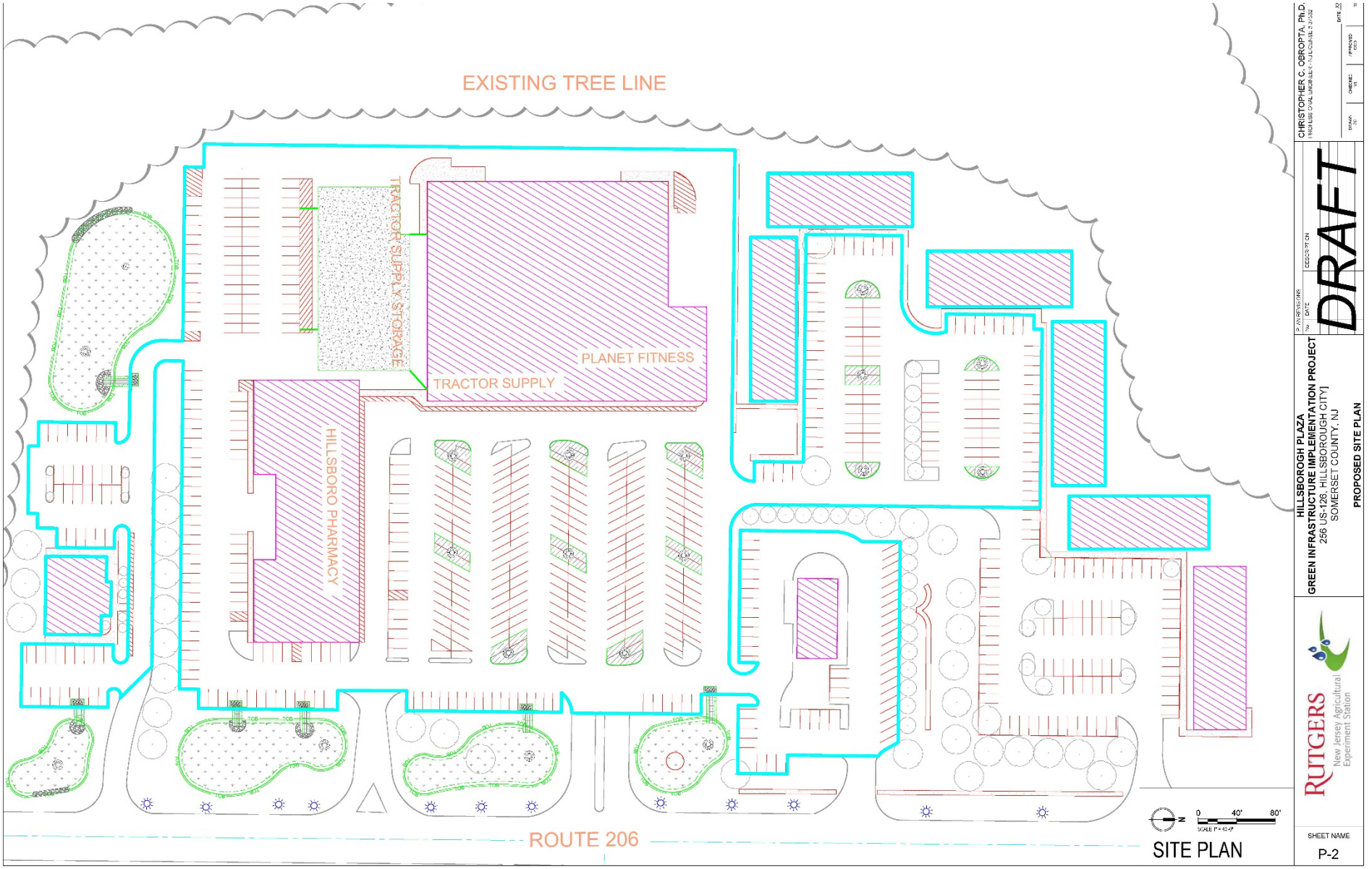


17,560 ft² of pervious concrete provides 7,024 ft³ of storage

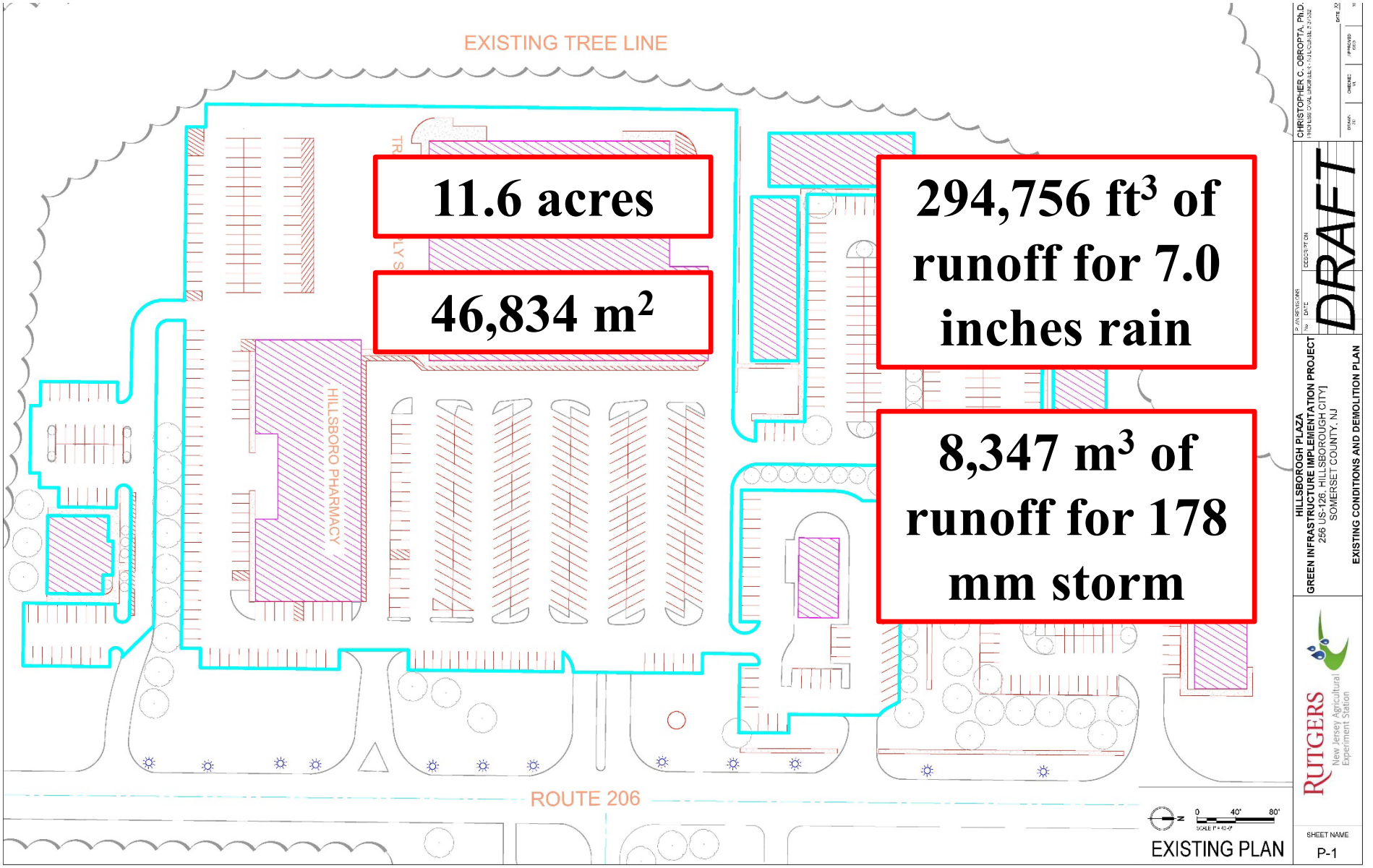
1,631 m² of pervious concrete provides 199 m³ of storage



All of the Green Infrastructure Practices



100-Year Storm Analysis (8.25 inches)



2.4 acres of underground storage system provides 351,208 ft^3 of storage

9,712 m^2 of underground storage provides 9,945 m^3 of storage

64,800 ft (19,750 m) of two-foot (0.6 m) diameter pipe

HILLSBOROGH PLAZA
GREEN INFRASTRUCTURE IMPLEMENTATION P
256 US-128, HILLSBOROUGH CITY]
SOMERSET COUNTY, NJ
PROPOSED SITE PLAN

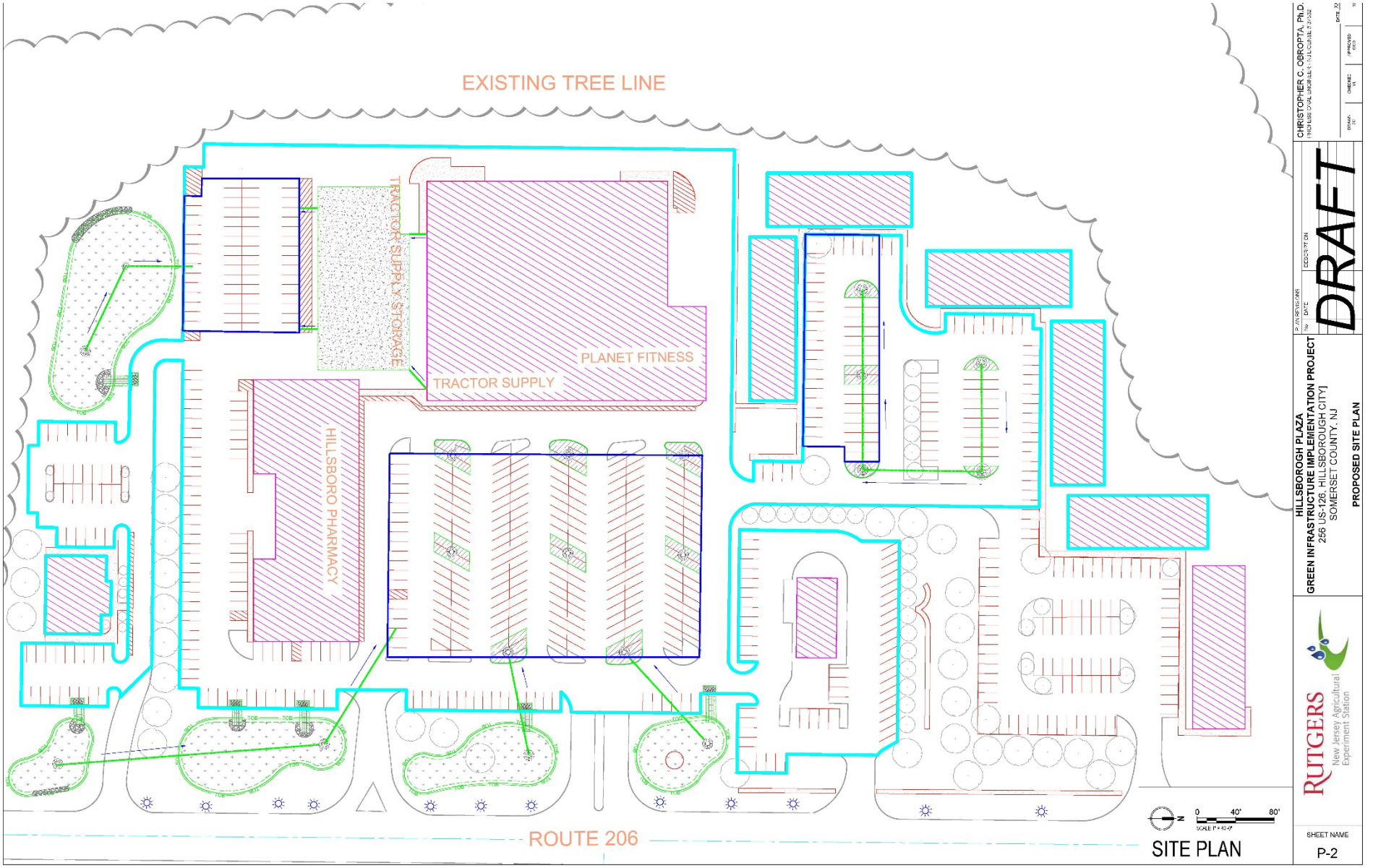
RUTGERS
New Jersey Agricultural Experiment Station

SHEET NAME
P-2

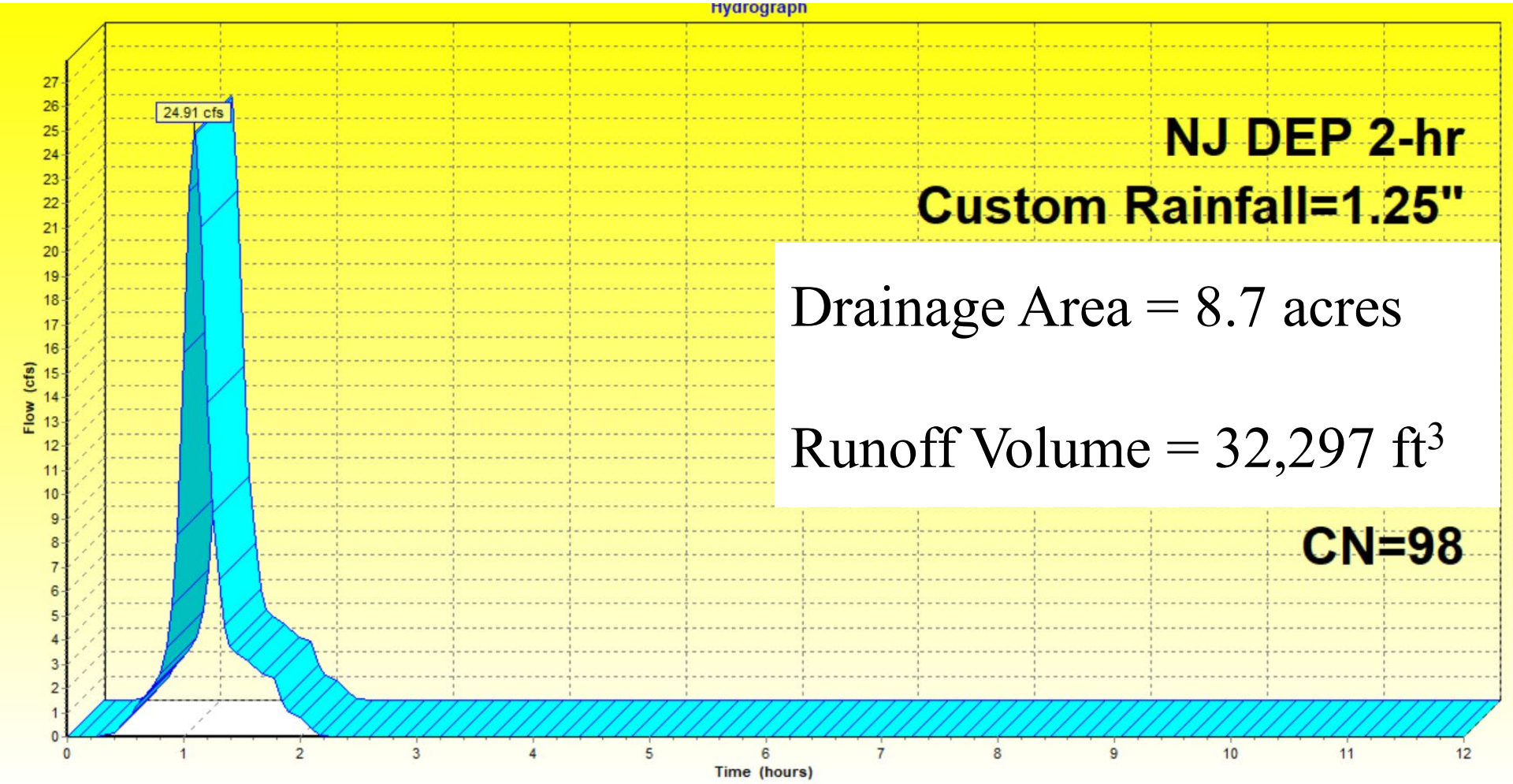
ROUTE 206

SITE PLAN

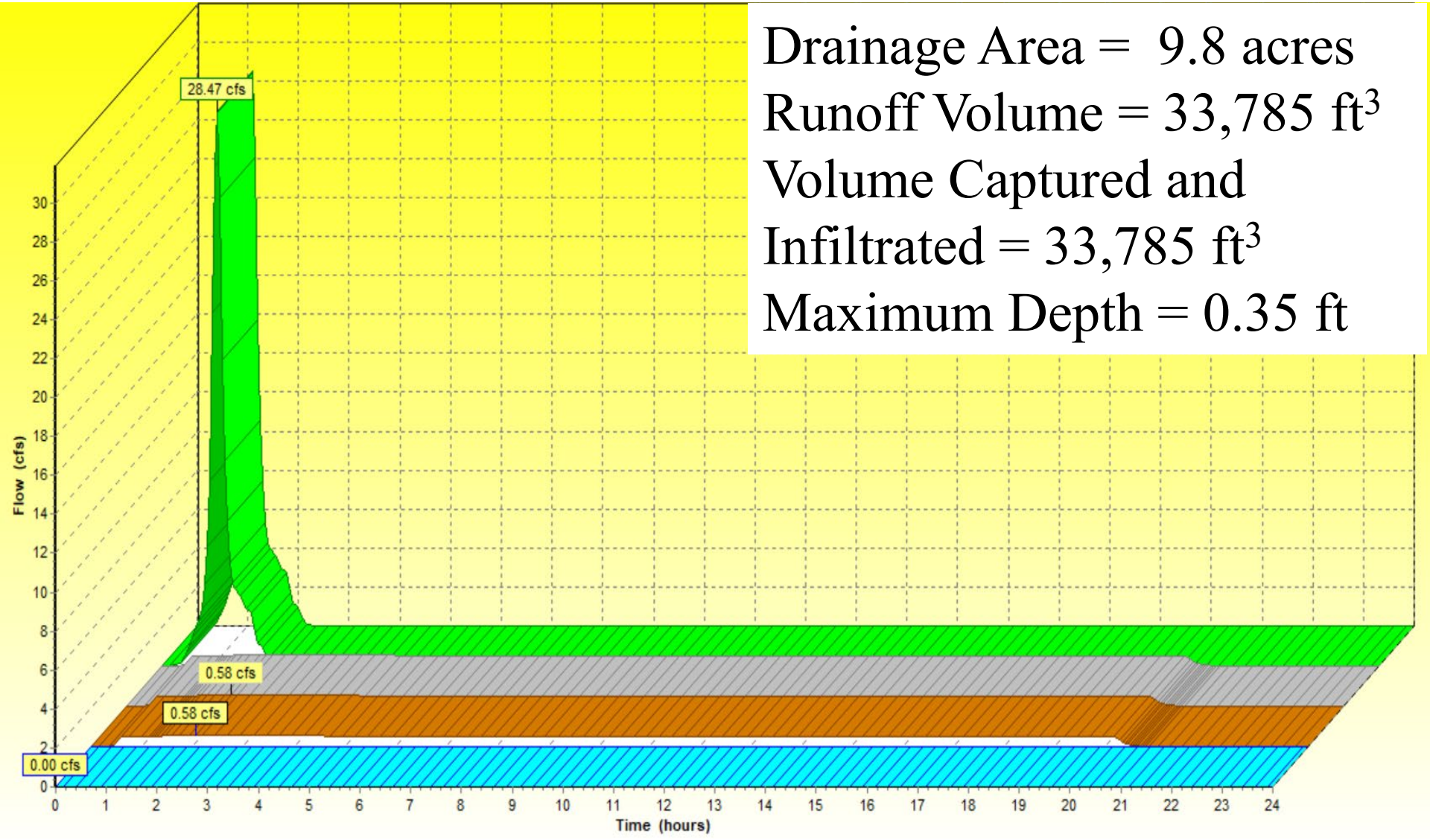
Green and Gray Infrastructure Practices



EXISTING CONDITIONS (3/4th of the site)
(NEW JERSEY WATER QUALITY PEAK DISCHARGE 1.25")



PROPOSED CONDITIONS (RAIN GARDENS)
(NEW JERSEY WATER QUALITY PEAK DISCHARGE 1.25")



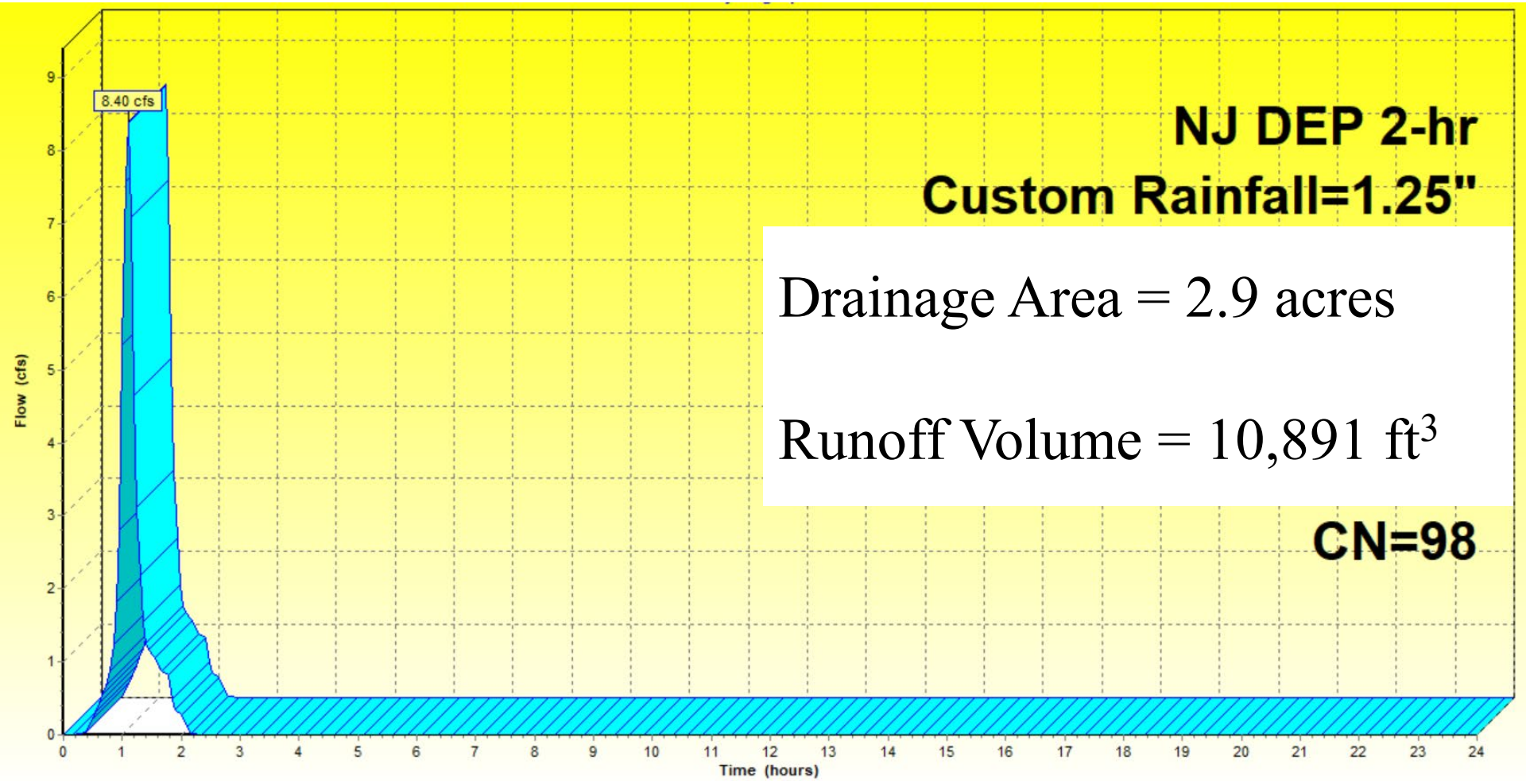
Drainage Area = 9.8 acres

Runoff Volume = 33,785 ft^3

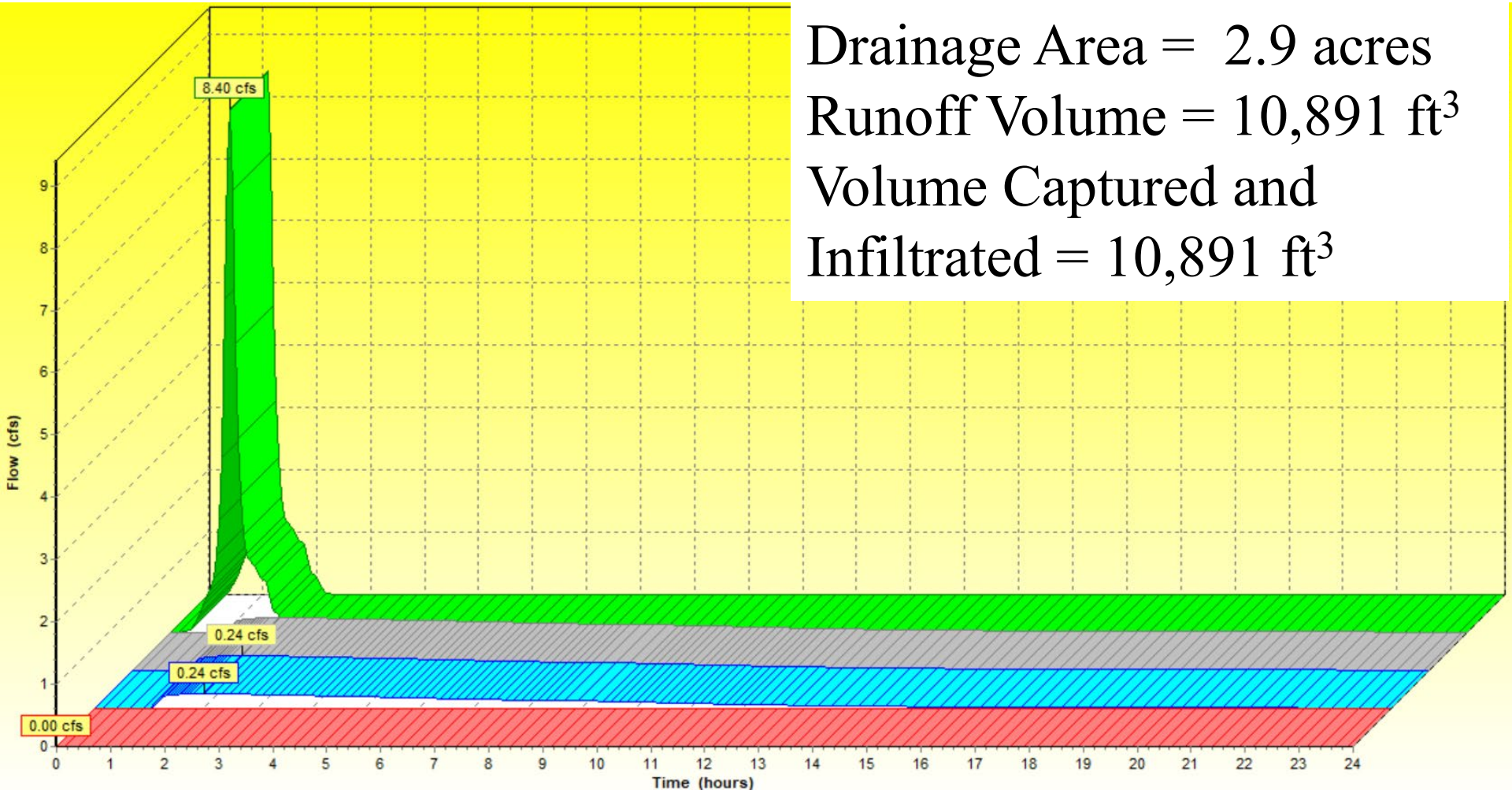
Volume Captured and Infiltrated = 33,785 ft^3

Maximum Depth = 0.35 ft

EXISTING CONDITIONS (1/4th of the site)
(NEW JERSEY WATER QUALITY PEAK DISCHARGE 1.25")



PROPOSED CONDITIONS (PERVIOUS CONCRETE)
(NEW JERSEY WATER QUALITY PEAK DISCHARGE 1.25")

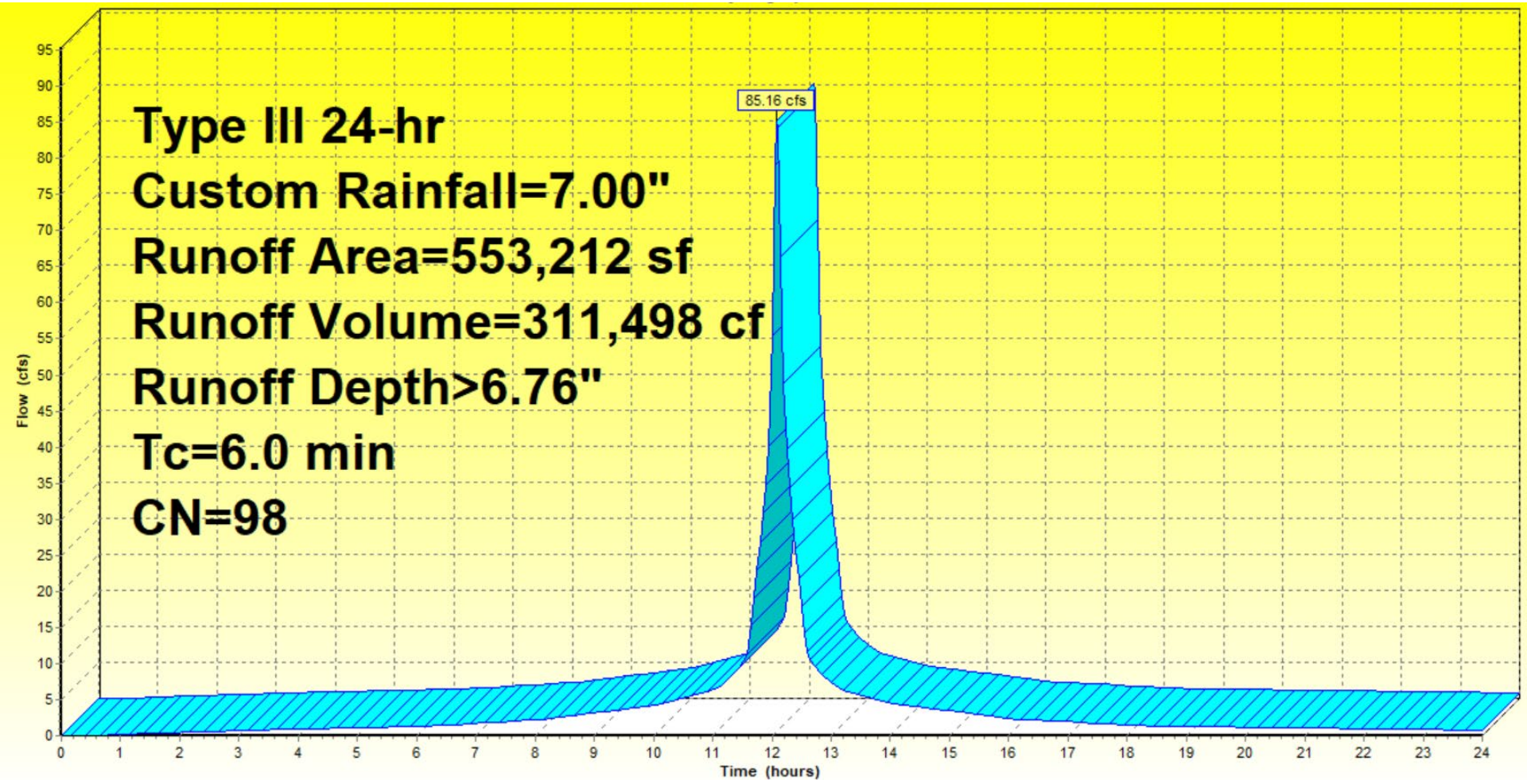


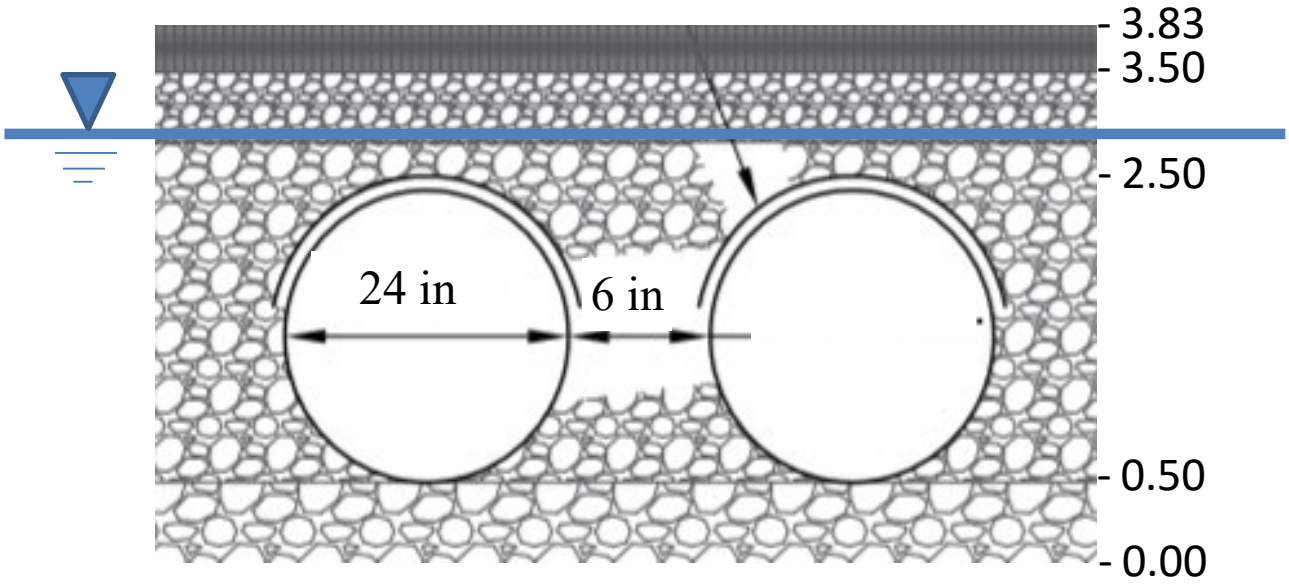
Drainage Area = 2.9 acres

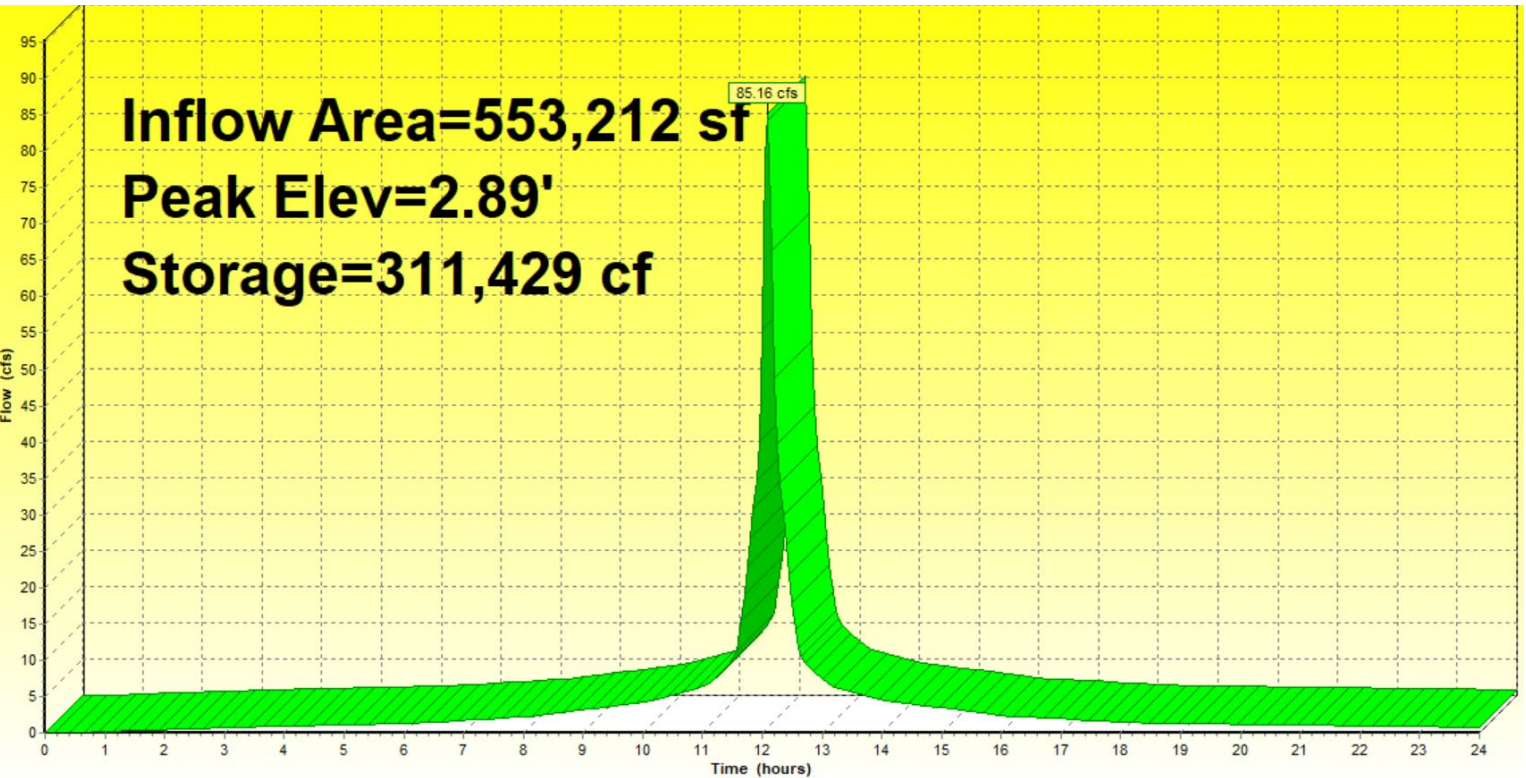
Runoff Volume = 10,891 ft^3

Volume Captured and Infiltrated = 10,891 ft^3

UNDERGROUND STORAGE SYSTEM FOR REMAINDER OF 100-YEAR STORM




3.83
3.50
2.50
24 in
6 in
0.50
0.00


Inflow Area=553,212 sf
Peak Elev=2.89'
Storage=311,429 cf
85.16 cfs
Flow (cfs)
Time (hours)

Remaining Questions

1. Is it possible to route all the stormwater runoff for the 1.25-inch storm to the green infrastructure practices?
2. Is it possible to bypass the larger storms to the underground storage system?
3. How long do we hold the larger storms before we can safely release the stormwater?
4. If we over-design the system, can we get stormwater flows from nearby areas to this location for storage?
5. How many developed areas must get this treatment to reduce flooding downstream?
6. What is the cost?