Proposed Short Course
Wellesley Country Club
300 Wellesley Avenue
Wellesley, MA

Issued for:

Major Site Plan Review

& Aquifer Overlay
District Special Permit

Proponent:

Wellesley Country Club
300 Wellesley Avenue
Wellesley, MA 02482

Submitted to:

Town of Wellesley
Zoning Board of Appeals
525 Washington Street
Wellesley, MA 02482

Prepared by:

ALLEN & MAJOR ASSOCIATES, INC.

10 Main Street
Middleboro, MA 02346

Tel: (508) 923-1010
Fax: (508) 923-6309

A&M PROJECT #1828-02E

January 6, 2015—Revision 1

TOWN OF WELLESLEY MASSACHUSETTS

ZONING BOARD OF APPEALS

TOWN HALL • 525 WASHINGTON STREET • WELLESLEY, MA 02482-5992

RICHARD L. SEEGEL, CHAIRMAN
J. RANDOLPH BECKER, VICE CHAIRMAN
DAVID G. SHEFFIELD

LENORE R. MAHONEY
EXECUTIVE SECRETARY
TELEPHONE
(781) 431-1019 EXT. 2208

ROBERT W. LEVY
WALTER B. ADAMS
DEREK B. REDGATE

PROCESS SCHEDULE FOR SITE PLAN APPROVAL PROJECTS

1. Petitioner meets with Executive Secretary to discuss project. At initial meeting, petitioner is given the List of Plans, Check List, Time Line, Official Development Prospectus, and Process Schedule.

Preliminary Meetings

A. Voluntary

(1). Department of Public Works
   a. Petitioner arranges preliminary meeting with Town Engineer, which will include other DPW representatives. Petitioner will be prepared to discuss in detail the water, sewer, drainage, electric, parking and landscaping requirements associated with the project. Petitioner will bring preliminary engineering and landscape/parking plans to this meeting.
   b. No less than Ten (10) weeks prior to the Public Hearing, the applicant will send **one** full set of plans to the Town Engineer for review by the Department of Public Works. Plans should include all requirements on the Check List. Within ten (10) days of receipt of the plans, the Department of Public Works will send a letter of review to the petitioner, summarizing comments and concerns and issues to be addressed.

(2). Wetlands Protection Committee
   a. If the location of the construction is within a Resource Area, a Water Supply Protection District or a Flood Plain District, the petitioner must obtain all necessary approvals and Orders of Conditions at least ten (10) days prior to the date of the Public Hearing on the petition.

(3). Public Safety Officer – Fire Department

(4). Board of Health

(5). Design Review Board

Process Schedule Continued

1. No less than six (6) weeks prior to Board of Appeals Public Hearing, the applicant shall submit thirteen (13) copies of the application for Site Plan Review, Development Prospectus, the Check List and any supplemental materials, 12 large sets of all required plans & 6 sets of 11 x 17 plans), incorporating all DPW comments, to the office of the Board of Appeals.

2. The Executive Secretary shall time-stamp 2 copies of all materials and plans submitted in the Town Clerk's office. Individual packages of all plans and materials with a cover letter shall be distributed to the Planning Board, Design Review Board, Wetlands Protection Committee, Town Engineer, Board of Health, Fire Chief, Police Chief and Municipal Light Plan, for review and recommendations.

3. The Board of Appeals will automatically continue the scheduled Site Plan Approval Public Hearing, if all revised plans and/or additional requested materials have not been approved by all departments no less than ten (10) days prior to the hearing.

4. Public Hearing on petition for Site Plan Approval
   If the above requirements have not been completed, or if the Board requests additional information or plan revisions at the initial hearing, the Board may continue the hearing for one month.

5. Decision
   The decision shall be issued between three to four weeks following the last Public Hearing.

6. General Comments
   If the project requires a Special Permit for a Project of Significant Impact issued by the Planning Board, the Preliminary steps in the process may be undertaken concurrent with the processing of the Special Permit. However, no submission shall be made to the Board of Appeals until the Special Permit has been granted and the twenty-day appeal period has expired.

ALL WETLANDS PROTECTION ISSUES (DETERMINATION OF NEGATIVE APPLICABILITY OR ORDER OF CONDITIONS) MUST BE RESOLVED AND SUBMITTED TO THE BOARD BEFORE THE ZBA PUBLIC HEARING.

THE BOARD RECOMMENDS THAT THE PETITIONER REVIEW THE ZONING BOARD OF APPEALS RULES AND REGULATIONS.

TOWN OF WELLESLEY MASSACHUSETTS

ZONING BOARD OF APPEALS

TOWN HALL • 525 WASHINGTON STREET • WELLESLEY, MA 02482-5992

Special Permit Granting Authority
Wellesley Town Hall
Wellesley, MA 02482

Date: August 19, 2015 (Application revised 1-6-16)

ZBA Number: _____

Pursuant to the provisions of Section XVIA, subparagraph _____, and Section _____ of the Zoning Bylaw, the undersigned hereby requests Site Plan Approval for the construction of Six hole short course located adjacent to Brookside Road and the Needham Town line.

Located at 300 Wellesley Avenue

Within a Single Residential 30 and Water Supply District District (s).

The following plans are submitted:

1. Existing Site Features Plan — Plan # 1 (Title Block Number)
2. Site Development Plan — Plan # G-1
3. Plot Plan — Plan # 1
4. Grading & Drainage Plan — Plan # G-1
5. Utilities Site Plan — Plan # (n/a)
6. Landscaping/Parking Plan — Plan # (n/a)
7. Architectural Plans — Plan # (n/a) through _____
8. Subsurface Conditions Plan — Plan # G-1
9. Utilities Detail Plans — Plan # D-1 through _____
   a. Structure Details — Plan # _____
   b. Plumbing Details — Plan # _____
   c. Electric Details — Plan # _____

(Twelve (12) full sized copies of each plan, seven (7) 11inch by 17 inch copies of each plan, a check in the amount of $2,000.00 payable to the Town of Wellesley, and a check in the amount of _____ payable to the Town of Wellesley Fire Department (for Site Plan Approval without PSI).

OWNER OF RECORD/PETITIONER: Wellesley Country Club c/o Martin Ryan (General Manager)
ADDRESS: 300 Wellesley Avenue
TELEPHONE NUMBER: 781-235-7333 FAX NUMBER: 781-235-9908

PROJECT CONTACT PERSON: Phil Cordeiro, P.E. - Allen & Major Associates
ADDRESS: 10 Main Street, Lakeville, MA 02347
TELEPHONE NUMBER: 508-923-1010 FAX NUMBER: 508-923-6309

TOWN OF WELLESLEY

ZONING BOARD OF APPEALS

SITE PLAN APPROVAL REVIEW
PLANS AND SUBMITTAL CHECKLIST

Plans and submittals for site plan approval review are submitted to the Department of Public Works for its review and approval on behalf of the Zoning Board of Appeals shall contain the items listed in this checklist. Electric plans will be reviewed by representatives of the Wellesley Municipal Light Plant.

PLANS		CHECK
1. EXISTING SITE FEATURES PLAN		
a)	Location, type, size or dimension of existing trees and rock masses	x
b)	Surface drainage and topography with one foot contours	x
c)	Property lines, zoning districts, adjacent roadways, historical or archeological features	x
d)	Rights of way and easements (temporary and permanent)	x
e)	Wetlands and floodplains	x
f)	Adjacent public, footpaths, trails and other natural or man-made features such as walls and fences	x
g)	Plan to be Scale 1" = 40' or larger	x
h)	Plan must be stamped, dated and signed by a Registered Land Surveyor in the Commonwealth of Massachusetts	x
2. SITE PLAN DEVELOPMENT		
a)	Building locations, finish floor elevations at basement and first floor	n/a
b)	Grading detail for entire site with existing and proposed contours	x
c)	Existing and proposed curb cuts, design as per Town Policy by Board of Selectmen dated 5/15/73	n/a
d)	Property lines and easement lines	x
e)	All elevations on the Town of Wellesley datum base	x
f)	North directional arrows shall be provided and point due north	x
g)	Plan must be stamped, dated and signed by a Registered Architect, Registered Land Surveyor or Professional Engineer in the Commonwealth of Massachusetts	x
3. PLOT PLAN		
a)	Existing buildings and structures	x
b)	Proposed structure(s) including all dimensions and distances from front, rear and side property lines	x
c)	Area of lot or lots included in the project	x
d)	Zoning district lines and portion of lot in different zoning district (if applicable)	n/a
e)	Names of all abutters as they appear on the most recent tax list	x
f)	The location of all permanent survey monuments	x
g)	Not less than 3 permanent benchmarks, preferably triangulated, shall be shown	
h)	Plan must be stamped, dated and signed by a Registered Land Surveyor in the Commonwealth of Massachusetts	x

4. GRADING AND DRAINAGE PLAN

a)	Existing and proposed contours in one foot intervals of elevation	x
b)	Location of existing and proposed storm drainage structures	x
c)	Profile showing proposed utilities in relation to the ground surface	x
d)	Erosion control measures such as haybales and siltation fencing	x
e)	Plan must be stamped, dated and signed by a Registered Professional Engineer in the Commonwealth of Massachusetts	x

5. UTILITIES SITE PLAN

a)	Building location and elevations	n/a
b)	Existing utilities on project site and in abutting street	x
c)	Location, depth, size, (slope where applicable) and material of:	
	• Water service and hydrants	n/a
	• Gas service	x
	• Sanitary sewer connection (pipe to be SRD-35 PVC, green)	n/a
	• Storm drain installations	n/a
	• Electric service	n/a
	• Fire alarm connection	n/a
	• Telephone service	n/a
d)	Number utility structures such as manholes and catch basins for identification purposes	n/a
e)	Detail specifications for installation of all utilities including street pavement restoration as per current DPW standards	x
f)	Flow direction arrows on drain and sewer lines	n/a
g)	Plan must be stamped, dated and signed by a Registered Professional Engineer in the Commonwealth of Massachusetts	x

6. LANDSCAPING/PARKING PLAN

a)	Proposed landscaping of property	n/a
b)	Size, type and location of proposed plant materials with botanical names	n/a
c)	Consider the impact for plantings at their maturity size as relates to sight distances	n/a
d)	Landscaping plan shall be coordinated with the grading plan	n/a
e)	Tree planting and shrub planting details	n/a
f)	Hardscape details such as walkways and patios	x
g)	See attached listing of undesirable plants as prepared by the Town Horticulturalist	x
h)	Plan must be stamped, dated and signed by a Registered Landscape Architect in the Commonwealth of Massachusetts	n/a
i)	No bushes or trees of any kind shall be planted within 10 feet in any direction of a Fire Department connection or a Master Fire Alarm box. Connections include hydrants, standpipes and sprinkler feeds on the outside of buildings.	n/a
j)	Parking lot plans shall include dimensions of parking spaces, maneuvering aisles, islands, turning radii, percentage of landscaped open space, percentage of interior landscaping, appropriate number of handicapped parking spaces, and directional flow arrows. All parking spaces shall be numbered	n/a

7. ARCHITECTURAL PLANS

a)	Proposed floor plans	n/a
b)	Elevations of all sides of all buildings	n/a
c)	Sections identifying type and exterior finish of proposed buildings	n/a
d)	Plan must be stamped, dated and signed by a Registered Architect in the Commonwealth of Massachusetts	n/a

8. SUBSURFACE CONDITIONS PLAN

a)	Boring location with boring numbers	x
b)	Boring logs	x
c)	Ledge encountered and depth	x
d)	Water encountered and depth	x
e)	Percolation test info (if applicable)	x

9. UTILITIES DETAIL PLAN

a)	Structure details	
	• Sanitary sewer manholes	
	• Drain manholes, detention structures, etc.	n/a
	• Catchbasins (gas and oil separators required at parking lots)	n/a
	• Outside grease trap if restaurant is proposed	n/a
b)	Plumbing details	
	• Water service size and entrance location	n/a
	• Water meter size, location and piping detail	n/a
	• Size and location of water service backflow protection devices (if applicable)	n/a
	• Sanitary sewer size and entrance location with elevations	n/a
	• Size and location of sanitary sewer check valves (if applicable)	n/a
	• Oil/water separators and MDC gas traps (if applicable)	n/a
	• Pumping equipment (if applicable)	n/a
c)	Electrical Details	
	• Location service entrance	n/a
	• Size of Service	n/a
	• Meter location and switchgear arrangement	n/a
	• Provision for future expansion	n/a
	• Transformer size and facilities for pad or vault room	n/a
	• Data including load requirements	n/a

GENERAL PLAN COMMENTS

a)	All plans must be stamped, signed and dated by a Registered Professional Engineer, or Architect in the Commonwealth of Massachusetts responsible for the particular plan's contents	x
b)	Title Blocks shall provide the name of project, job site location, architects and engineer responsible for plan contents, date and plan scale	x
c)	All plans must be numbered and titled	x
d)	All dates of revisions shall be included	x
e)	Provide retaining wall design details	n/a
f)	Provide locus plan drawn at a scale of 1" = 500' showing the relation of the project to adjoining properties within a radius of ¼ mile	x
g)	The cover sheet shall provide the names, mailing addresses and phone numbers of the land owner, building owner, architects and engineers and project contact person, and Table of Contents	x
h)	Location of all mechanical systems must be shown	n/a

SUBMITTALS

a)	Drain calculations showing capacities of the existing and proposed drain systems	x
b)	Runoff calculations for the 10, 25 and 100 year storm event for storm drains, leaching basins or holding areas	x
c)	Post development rate of peak runoff less than pre-development rate of peak runoff	x
d)	Information showing that the DEP Stormwater Management Standards will be met	x
e)	Operation and maintenance plan for drainage system	x
f)	Evaluation of existing municipal systems capacities	n/a
g)	Quantification and documentation of infiltration/inflow reduction measures	n/a
h)	Quantification and documentation of water conservation measures	n/a
i)	Written statement from a Registered Professional Engineer in the Commonwealth of Massachusetts regarding the adequacy of the water flow for the fire protection system	n/a
j)	Construction area to be fenced	x
k)	Traffic Management Plan during construction period	x
l)	Area of construction worker and equipment parking	x
m)	Materials staging area	x

UNDESIRABLE PLANTS FOR LANDSCAPE DESIGNS SUBMITTED WITHIN THE TOWN OF WELLESLEY

TREES:

*	*Acer platanoides*	Norway Maple
*	*Acer pseudoplatanus*	Sycamore Maple
	Acer saccharinum	Silver Maple
*	*Ailanthus altissima*	Tree-of-Heaven
	Elaeagnus angustifolia	Russian-olive
	Morus alba	White Mulberry
*	*Phelodendron amurense*	Amur Cork-tree
	Populus alba	White Poplar
	Pyrus c. 'Bradford'	Bradford Pear
	Pyrus c. 'New Bradford'	New Bradford Pear
*	*Robinia pseudoacacia*	Black Locust
	Tsuga canadensis	Eastern Hemlock

SHRUBS:

	Alnus glutinosa	Common Alder
*	*Berberis thunbergii*	JapaneseBarberry
*	*Berberis vulgaris*	Common Barberry
*	*Elaeagnus umbellata*	Autumn-olive
*	*Euonymus alatus*	Burning Bush
*	*Frangula alnus*	Glossy Buckthorn
*	*Ligustrum obtusifolium*	Border Privet
	Ligustrum sinese	Chinese Privet
	Ligustrum vulgare	Common Privet
*	*Lonicera maackii*	Amur Honeysuckle
*	*Lonicera morrowii*	Morrow Honeysuckle
*	*Lonicera tatarica*	Tatarian Honeysuckle
*	*Lonivera x bella*	Bell's Honeysuckle
*	*Rhamnus cathartica*	Common Buckthorn
*	*Rosa multiflora*	Multiflora Rose

VINES:

*	*Ampelopsis brevipedunculata*	Porcelain Ampelopsis
*	*Celastrus orbiculatus*	Chinese Bittersweet
*	*Cynanchum spp.*	Swallow-worts
*	*Humulus japonicas*	Japanese Hops
*	*Lonicera japonica*	Japanese Honeysuckle
*	*Polygonum perfoliatum*	Mile-a-minute Vine
	Wisteria sinensis	Chinese

ORNAMENTALS:

*	*Aegopodium podagraria*	Goutweed
*	*Iris pseudacorus*	Yellow Flag Iris
*	*Lythrum salicaria*	Purple Loosestrife
*	*Phalaris arundinaceae*	Ribbon Grass

* Indicates species listed *A Guide to Invasive Plants in MA*

TOWN OF WELLESLEY MASSACHUSETTS

ZONING BOARD OF APPEALS

TOWN HALL • 525 WASHINGTON STREET • WELLESLEY, MA 02482-5992

OFFICIAL DEVELOPMENT PROSPECTUS

Applicable to Major Construction Projects
Submitted Under Section XVIA of the Zoning Bylaw
And Comprehensive Permit Projects Submitted
Under Chapter 40B

Date: August 19, 2015 (application revised 01-06-16)

Year/Number: 2015

I. IDENTIFICATION

Petitioner: Wellesley Country Club - Martin Ryan (General Manager)

Address: 300 Wellesley Avenue, Wellesley, MA

Telephone: 781-237-7333

Land Owner of Record: Wellesley Country Club

Location of Property: 300 Wellesley Avenue, Wellesley, MA

Proposed Use of Property: Golf Course

Zoning Districts: (Including all overlay districts)

Residential 30 & Water Supply Protection District

Are any other special permits or variances, other than Site Plan Approval required for this project? Yes x No _____

If yes, what is required? Special Permit for Construction in the Water Supply Protection District

II. DESCRIPTION

Describe in detail the plan to be executed under the appropriate categories below

1. Land Area 138 +/- acres (enitrety of club property); 7.5+/- acres development area

2. Square footage of proposed construction footprint 0

3. Square footage of existing building footprint >50,000 (multiple buildings)

4. Square footage of total structure footprint 0

5. Total floor area of existing building >50,000 s.f. (multiple buildings)

6. Total floor area of proposed construction 0

7. Total floor area after proposed construction completed same (no change)

8. Floor area ratio: (Commercial)

9. Number of Buildings 0 proposed

10. Number of Stories of each Building 0

11. Height of each Building 0

12. Number of Parking Spaces: (Existing/Proposed)

Standard 348 / 348 Compact _____/___ Handicapped 13 / 13

Covered _____/_____ Open _____/_____

Total (Existing and proposed) 348

Total Number Required No requirement per zoning; No changes to parking

13. Number of handicapped sidewalk curb cuts provided 10 (all existing)

14. Lot coverage in square feet (%)

	Before	After
1) Buildings	(1.2%)	(1.2%)
2) Drives & Parking	(3.2%)	(3.2%)
3) Other uses (identify uses and coverage)	(n/a)	(n/a)

15. Open Space

1) Landscaped area	(95.9%)	(95.9%)
2) Natural (i.e. woods, fields)	(95.9%)	(95.9%)
3) Recreational	(95.9%)	(95.9%)

A. Residential Construction

1. Number of Dwelling Units
   Efficiency n/a One Bedroom n/a Two Bedroom n/a
   Three Bedroom n/a Other n/a

2. How many units will be provided with handicapped access to bathrooms, toilets, entrances, egresses, etc.? n/a

3. Density in square feet of land per dwelling unit.
   Existing n/a Proposed n/a

4. Density in square feet of land per person:
   Existing n/a Proposed n/a

III. TRAFFIC IMPACT ANALYSIS AND DATA
(Explain basis for data entered)

If, as a result of the proposed construction, the following conditions will exist, Questions 1-5 must be answered:

a. If the floor area of the building exceeds 10,000 sf; or

b. If 50 or more vehicle trips will be generated by the completed project in any single hour of the day.

1. Projected traffic generation of proposed new development:

a. Peak Day	In	Out	Total
24-Hour			
Am Peak Hour			
PM Peak Hour			

b. Typical or Average Day

24-Hour			
Am Peak Hour			
PM Peak Hour			

2. Current two-way traffic flows on frontage street(s):

	24 Hour	AM Peak Hour	PM Peak Hour
Street Wellesley Avenue	9180	1038	856
Street Forest Street	5880	433	560

3. Data compiled by: Ron Muller Associates Inc.

4. Date of data compilation: August 2012; Current project is not anticipated to generated additional traffic

I. What energy source will be used for heating water?
Electric n/a Gas n/a Fuel Oil n/a Other n/a

J. Will electric resistance heating or heat pumps be used? Yes____No x____

K. Will the facility include an emergency electric generator?

Yes____No x____

If YES, would you be willing to run it to reduce your peak load?

Yes____No x____

V. FIRE PROTECTION

A. *Fire flow presently available at site n/a

B. *Total floor area of building (Largest single building if more than one building) n/a

C. Type of Building Construction n/a

D. *Required fire flow for building (Maximum required for a single building if more than one building) n/a

E. *If required fire flow (D) exceeds available fire flow (A), describe plans to provide required fire flow (D)

n/a

F. Describe access for fire apparatus to building (s) no proposed buildings

*Written statement indicating these figures signed by a registered professional engineer must accompany submittal.

VI. ENVIRONMENTAL IMPACT

A. What percentage of the property is Wetlands 0 (development area)
Floodplains 0 (development area)

Will either be altered as a result of the project? No

B. Will the proposed development contribute in any way to pollution of groundwater, surface water, or waterway: Yes____No x____

Oil____ Salt____ Chemicals x____ Other____

Explain

The course will use fertilizers as part of its turf establishment plan. While the chemicals are not desirable in the water district, on site monitoring wells will be used to ensure the drinking water supply is not affected. To date, existing monitoring wells have not yielded signs of pollutants in the water district.

Describe proposed measures to eliminate or minimize such pollution:

The club has established, and provided, a turf management plan outlining the use of approved pesticides and fertilizers applied per manufacturers' recommendations.

Chemicals are applied to the minimum necessary for maintenance of the property.

C. Does the proposed development involve storage of any of the following materials above or below the ground?

_____ deicing chemicals or other related materials
x _____ commercial fertilizers and other related materials
_____ hazardous materials
_____ liquid petroleum products

If YES to any of the above, list specific materials to be stored:

Golf course maintenance products including pesticides and fertilizers will be used in support of this project. They will be storage in a secure facility located onsite.

D. Impact on surface drainage

1a. Current rate of peak runoff 10.28 (100-yr - 6.7") cubic ft/second
b. Current volume of runoff 61,915 cf cubic feet or acre-feet

2a. Post-development rate of peak runoff 5.18 (100 yr -6.7") cfs
b. Post-development volume of runoff 8,376 cubic feet or acre-feet

(Design storm and rainfall intensity should be cited for #1 & #2)

3. Describe measures to eliminate or minimize any increase in rate of runoff The proposed project introduces perforated subdrains beneath the course to recharge water to the ground. Prior to discharge to the wetland

a dry detention basin is proposed to offset the increase in impervious area (cart paths) and the loss of the absorptive properties of the tree cover.

4. Might the project result in significant changes in existing drainage patterns? Will any abutting or other property be adversely affected by the changes? The project maintains the existing on-site drainage patterns.

Abutters should not be affected. Abutter properties flow onto the course area and will continue post-development of the short course.

E. Does the proposed structure include installation of floor drains?
Yes____ Nox____ If YES, how many? ____

F. Will the project affect the condition, use, or access to any existing public open space or recreation area? If so, how?

The proposed project is consistent with the remainder of the property and should not result in a degradation of open space or recreation areas apart from the loss of

wooded area.

G. Does the proposed development involve outside lighting? Yes____No x____
if YES, state height of lighting fixtures n/a

Will the outside lighting shine directly on abutting premises?
Yes n/a No n/a

If YES, explain

n/a

Describe proposed steps to minimize this impact No lighting is proposed as part of this project.

H. Might any site or structure of historic or archeological significance be affected? Yes____No x____

Describe The project is not located in an area of historic significance

I. Will the project require the removal of any street trees protected under M.G.L. Ch. 87? Yes____No x____
If YES, how many?_____

J. Will the project involve blasting or pile driving? Yes____No x____

1. What is the approximate volume of the material to be removed?

The project is a net import of material

Where will this material be disposed? Earth materials will remain on site; Loam and sand may be imported.

K. Is an Environmental Notification Form required to be filed under M.G.L. Ch. 30, Section 61-62H, the Mass. Environmental Policy Act?
Yes____No x____

VII. IMPACT OF WATER SUPPLY

A. Will the project result in an increase of 10,000 square feet or more of impervious area within a Water Supply Protection District defined by Section XIVE of the Zoning Bylaw? Yes x____No____

If so, does it satisfy the design and operation standards of Section XIVE? Yes x____No____

B. Will the project result in finished exterior grades lower than the existing grade and less than 5 feet of soil overburden above the maximum ground water elevation within a Water Supply Protection District? Yes____No x____

C. Will catch basins be installed? Yes____No[x]____
If so, how many? _____

Do catch basins presently exist? Yes____No[x]____
If so, how many? 0 (within development area)

Are catch basins fitted with oil and grease traps? Yes____No[x]____
How many? Existing n/a Proposed n/a

D. Will water saving appliances be used or water conservation devices be used in all plumbing? Yes____No[x]____

VIII. FINANCIAL IMPACT

A. Estimated Building Permit Valuation n/a

B. Estimated assessed value $19,146,000.00 (2015 assessor evaluation)

TOWN OF WELLESLEY MASSACHUSETTS

ZONING BOARD OF APPEALS
TOWN HALL • 525 WASHINGTON STREET • WELLESLEY, MA 02482-5992

Date: August 19, 2015 ZBA: _____

Petition for:	Residential Fee		Commercial & Municipal Fee	
Variance		$200		
Special Permit		$200		$500
Special Permit/Findings		$200		
Special Permit Renewals		$150		
Signs				$300
Site Plan Approval without PSI			x	$2,000 & Fire Department Consulting Fee
Site Plan Approval with PSI				$3,500
Appeals		$200		$300
Comprehensive Permit				$750
Publication & Mailing Fees/All Petitions		$25		$25
Petitioner assumes all costs for Peer Review				

Property Location: 300 Wellesley Avenue Zoning District: Residential 30

Property located in a:			
	Historic District	Yes	No x
	Wetlands Protection Area		x
	Water Supply Protection District	x	

Applicable Section(s) of the Zoning Bylaw:
XVIA

Explanation of Request: Major Site plan approval for construction of 6 short course golf holes. Special Permit for construction within the Water supply Protection District

Requested Relief:

	Lot Area		Front Yard Depth (Street Setback)
	Lot Coverage		Side Yard Width (Side Line Setback)
	Frontage		Rear Yard Depth (Rear Line Setback)
	Front Yard Width	x	Other No relief requested

OWNER OF PROPERTY: Wellesley Country Club

MAILING ADDRESS: 300 Wellesley Avenue

PHONE: WORK: 781-235-7333 HOME: N/A

SIGNATURE OF OWNER: _____

PETITIONER (If different than Owner): Martin Ryan, General Manager

MAILING ADDRESS: Same

PHONE: WORK: 781-235-7333 HOME: n/a

ZONING BOARD OF APPEALS
SITE PLAN SUBMITTAL
TIMELINE

PRELIMINARY MEETING WITH DPW
(Preliminary Engineering & Landscape Plans)

OTHER MEETINGS AS REQUIRED WITH:
DRB, MLP, FIRE DEPT., WPC & BOH

ONE FULL SET OF ENGINEERING & LANDSCAPE PLANS TO DPW	**10 WEEKS PRIOR TO HEARING**
DPW RESPONSE TO APPLICANT ON PLANS	**10 DAYS AFTER RECEIPT OF PLANS**
13 COPIES OF SUBMITTAL TO THE ZBA	**6 WEEKS PRIOR TO HEARING**
PLANS MUST BE APPROVED BY DPW OR ZBA HEARING CONTINUED	**10 DAYS PRIOR TO HEARING**
ZBA HEARING	

ALLEN & MAJOR ASSOCIATES, INC.

10 Main Street
Lakeville, MA 02347
Tel: (508) 923-1010
Fax: (508) 923-6309

January 6, 2016

Town of Wellesley-DPW
George J. Saraceno, Senior Civil Engineer
Engineering Division
20 Municipal Way
Wellesley, MA. 02481

RE: A&M Project # 1828-02E
RE: Wellesley Country Club
300 Wellesley Avenue
Proposed Short Course Project

On behalf of our Client, the Wellesley Country Club (WCC), Allen & Major Associates Inc. (A&M) is providing this letter and supporting documentation in response to a letter dated December 24, 2015 from George J. Saraceno, Senior Civil Engineer from the Town of Wellesley Department of Public Works. The original comments are provided below followed by the response in **bold**.

Comment 1: *The applicant should provide the DPW with a copy of the chemicals and amounts used on an annual basis at the Club.*

Response 1: **Please refer to the attached IPM document that includes the chemicals that are used as part of the turf management plan. An additional document has been included to outline the procedures that will be used to establish the turf within the new short course area.**

Comment 2: *Before the completion of the project the applicant should install a monitoring well near the wetland area along Brookside Road.*

Response 2: **The club currently maintains a series of onsite monitoring wells on the property including well MW-1 located along Brookside Road in proximity to the first isolated wetland depression. In support of this project, WCC is prepared two additional monitoring wells adjacent to hole #5 (short course) and adjacent to the construction access roadway adjacent to isolated wetland depression #2. These wells are shown on the proposed grading and drainage plan.**

Comment 3: *The applicant should provide a groundwater sampling program, which should be reviewed and approved by the DPW with the requirement to conduct quarterly screening including one sample in the spring and one in the fall, of all active groundwater wells and the above mentioned monitoring well, for possible impacts from nutrients and pesticides. The sampling protocol should include Synthetic Organic Chemicals (SOC's) and other chemicals of concern.*

Response 3: **WCC has implemented a well sampling plan overseen by Michael Toohill, Senior Environmental Scientist of the BSC Group. The onsite wells have historically been sampled for Nitrate-Nitrite as Nitrogen levels, Total Phosphorous, and Phosphorous as PO4. Attached is the last sampling report from December 2015 based on testing conducted in November 2015. The lab**

results showed that the levels were well below drinking water standards (where applicable). WCC can provide quarterly samples to include testing of SOC's as requested. WCC will also work with the DPW to identify "other cehmicals of concern" to provide a known baseline for testing as a condition of approval for the short course project. A&M would ask the Board and DPW to consider a period to require quarterly testing at which time the sampling may be reduced to twice annually if the testing is consistently below reporting thresholds.

Comment 4: *The applicant should prepare and submit for a review a Phosphorous Control Plan.*

Response 4: **The applicant is currently reviewing the Phosphorous plan for the club and will submit information under separate cover.**

Comment 5: *The Club averages approximately 20 MGY of water withdrawal. The applicant shall provide the DPW with copies of the DEP annual water withdrawal reports for the Club and new Short Course.*

Response 5: **Attached are the reports requested. WCC shall submit the annual water withdrawal report as coordinated with the submission of well sampling data noted above. The club is allowed 25 MGY under the State permit.**

Comment 6: *Provide a site locus map that shows the entirety of the property, new Short Course and location of the Town's water supply, including Zone II and all existing surface and ground water withdrawal locations.*

Response 6: **The project locus map is included herein as requested.**

Comment 7: *The tables for the pre-development and post-development peak run-off rates by watershed should be combined to compare the two conditions side by side for the Short Course. The combined peak runoff rates for sub-watershed 1 and 2 are reduced for all storm events, which are designed to recharge groundwater through a series of perforated underdrains below the bunkers, tees and greens for each course and through a dry detention area, which also provides infiltration. The post-development peak-runoff rates for the sub-watershed 3 which flows and is conveyed to an existing isolated wetland are equal to or reduced for all storm events. Surface water runoff from the Short Course area is not expected to create ponding issues on Brookside Road as Brookside Road is higher in elevation than the wetlands that receive most of the stormwater runoff.*

Response 7: **Noted. For simplified review, the current pre- and post-development comparisons are as follows:**

Watershed 1	**Pre-Development (cfs) (at Isolated wetland 1)**	**Post-Development (cfs) (at Isolated wetland 1)**
2-yr storm	**0.04**	**0.00**
10-yr-storm	**1.07**	**0.00**
25-yr storm	**3.63**	**0.00**
50-yr storm	**6.21**	**0.00**
100-yr storm	**10.28**	**5.18**

Watershed 2	Pre-Development (cfs) (at Isolated wetland 1)	Post-Development (cfs) (at Isolated wetland 1)
2-yr storm	0.01	0.01
10-yr-storm	0.39	0.39
25-yr storm	2.07	2.06
50-yr storm	3.88	3.86
100-yr storm	6.25	6.22

The supporting data for the above tables can be found in the attached HydroCAD data worksheets.

Comment 8: *We understand that the Club will not expand membership as part of the project, however we believe that there is potential for a modest increase in activity and corresponding vehicle trips. The applicant should quantify this.*

Response 8: **There is no methodology available to quantify any perceived increase. The hours of the short course shall be identical to the main course hours making the traffic demand loads and peak times the same. Discussions with the DPW department expressed concern that if the short course usage is heavily trafficked by children, then an increase in traffic would occur in the after school hours between 2 and 4 pm. WCC will work with the DPW to monitor the Wellesley Avenue corridor as appropriate.**

Comment 9: *As a result of this project the Club will remove an area where grass clippings, stump and debris storage currently occurs. We have been informed that these functions will be moved off site. The applicant should provide some outline of this operation including, type, frequency, size and anticipated route for new trucks.*

Response 9: **With the proposed project in place, the applicant will no longer use the current area for large scale storage of debris and waste. Grass clippings obtained from green maintenance will no longer be stored and will be spread throughout the rough areas. All other lawn areas of the course are recycled in-place. Secondary use would be for temporary storage of fallen tree limbs. Leaf debris will not be stockpiled. Any materials will be placed into an onsite dumpster that will be emptied approximately once per month in the spring and fall seasons (March through May and September through October) and possibly twice per month during the peak summer season (June through August). The truck are expected to utilize the current access to the property at the Town line entrance for this purpose along Brookside Road and then exit northerly towards Wellesley Avenue and ultimately towards Worcester Street (MassDOT Route 9) and the highway points of access.**

Comment 10: *The applicant should outline hours of operation, days, seasons and if possibly any special events that can be anticipated for the Short Course.*

Response 10: **The club currently anticipates the short course operating the same hours as the main course. That is currently a season of mid-April through the end of November dependent on the weather. Weekdays the course is available from**

8:00 am to dusk. Weekends, it is available from 7:00 am to dusk. No special events are currently planned.

Comment 11: The applicant should provide a construction management plan, the locations of temporary parking, stockpiling, milestone scheduling particularly the schedule for the tree removal work, truck routes, hours and duration of work.

Response 11: Please see the attached Construction Management Plan as requested.

Comment 12: We recommend the applicant repave Brookside Road between Wellesley Ave and the southernmost construction access point.

Response 12: WCC is sensitive to the scenic and environmental benefits provided by Brookside Road, however, reconstruction of the roadway for a length of approximately 800 linear feet is economically infeasible for the current project scope and requires additional permitting through the Planning Board under the scenic review bylaw and the Conservation Commission for work within 100 feet of a resource area.

In addition to the information requested in the December 24 letter, A&M is also in receipt of preliminary comments from an e-mail dated September 15, 2015. The pertinent responses from that e-mail area as follows:

Comment 1: Provide a net/cut and fill calculations and trucking routes to the site.

Response 1: The proposed cut and fill analysis is approximated at 7,900 cubic yards of cut and 8,550 cubic yards of fill for a net material import required of approximately 650 cubic yards. The net import will include loam in support of the course finish and sand materials. As presently designed, the project is nearly balanced with all earth moving occurring onsite minimizing the need for trailer import of materials.

Please refer to the Construction/Traffic Management Plan for discussion of the proposed truck routing.

Comment 2: Is a survey plan necessary for the Wellesley portion of the project?

Response 2: The majority of the project occurs within the Town of Needham so a plot plan locus was prepared for that specific area. Given that the club land in Wellesley is much larger, a plot plan was not developed but can be provided if necessary.

Comment 3: Show the minimum slope required for the proposed solid wall and perforated ADS pipe.

Response 3: The pipe slopes have been noted on the grading and drainage plan as requested. All perforated pipes will be laid with a minimum 0.5% slope. Solid wall conveyance pipes will be laid with a minimum 1.0% grade or as necessary to follow grade with minimal cover. The discharge points will be field located at the time of construction to follow existing drainage patterns and course topography.

Comment 4: Show the location of the staging, stockpile area and construction entrance pad on the proposed Erosion Control plan.

Response 4: The construction entrance pad has been added to the plans. A designated for the stockpile and staging area has also been added. The staging area will be the current stockpile area used for leaf debris and composting. Since the project is primarily an earthmoving operation from a cut location to a fill location, stockpiles are likely to be minimized to stripped loam, tailings, and tree clearing debris. Please note that the Erosion and Control Plan and Grading and Drainage Plan have been combined so the entirety of the project is coordinated.

Comment 5: On the proposed erosion control plan at hole 4, add a note to clarify that the proposed pipe is either solid wall or perforated.

Response 5: A note has been added as requested. In general, the perforated pipe is located under all the golf course features and the solid wall is a conveyance pipe to the outfalls.

Comment 6: Show the location of the turbidity curtain on the Proposed Erosion Control Plan.
Response 6: There's no turbidity curtain proposed as part of this project. The reference in the legend has been removed.

Comment 7: If stone check dams will be used on the project, please show on the erosion control plan.

Response 7: There are no stone check dams proposed as part of this project. The reference in the legend has been removed.

Comment 8: Please note if the concrete headwalls will be poured in-place or pre-cast.

Response 8: There are no headwalls proposed as part of this project. The reference in the legend has been removed. The outfalls from the 4" drainage pipes will be cut ends of pipes blended to fit in with the topography of the course.

Comment 9: Provide a detail for the proposed golf cart path. How may tons of asphalt will be required for the project.

Response 9: A detail on the cart path has been added to the plans. The current design is based on providing 2" of bituminous on an 8" gravel base. Approximately 15,000 square feet of new asphalt will be set yielding and approximate tonnage of 175 tons.

Comment 10: A temporary construction fence and tree protection detail have been provided but not indicated on the plans.

Response 10: It is the intent of these details to provide guidance to the contractor as necessary during construction. A construction fence will be located along the Brookside Road entrance. During removal of the trees, if any specimen trees are marked to remain during construction they will be protected with the detail shown. The trees will be determined in the field.

Comment 11: Has the Town of Needham provided any feedback?

Response 11: WCC has appeared in front of the Needham Zoning Board of Appeals and have had discussions regarding the direct abutters and beatification of the Brookside Road corridor. In terms of engineering review, the Town Engineer, Anthony Del Gazio, has asked that the project provide compliance with the Needham NPDES permit, ensure no increased runoff to the direct abutters by way of calculation of constructed waterway diversion, and no increased runoff to Brookside Road.

Comment 12: Is the wetland are shown isolated?

Response 12: Yes, the two wetland areas shown are isolated depressions that retain stormwater and eventually overtop into Brookside Road. The plans were reviewed with the Conservation Agents for both the Town of Needham and Wellesley prior to Zoning Board submission. Neither Agent felt that a submission to Conservation was required.

Comment 13: Should the open storage area be moved away from the 100' wetland buffer?

Response 13: The open storage area is located based on the current storage area. WCC can work to minimize placement of any material within 100 feet of the wetland resource area.

We believe these responses should satisfactorily address the comments received and look forward to discussing this project further with you and subsequently the Zoning Board of Appeals at a hearing on Thursday January 21, 2016. Should you have any additional questions, please feel free to contact me.

Very truly yours,

ALLEN & MAJOR ASSOCIATES, INC.

Philip Cordeiro, PE
Branch Manager
pcordeiro@allenmajor.com

cc: Zoning Board of Appeals (via L. Mahoney)
Marty Ryan - General Manager, WCC
Richard Ruggiero, Ted Dolan - WCC
Les Shea, Esq – Wilder & Shea

enclosures

Wellesley Country Club – Executive Short Course
Construction Traffic Management Plan

The construction traffic management plan (CTMP) is intended to identify, resolve and mitigate impact to local traffic resulting from the proposed Pool replacement and renovation at 300 Wellesley Ave and the surrounding area.

Project Description:

The executive short course project proposed for the Wellesley Country Club consists of construction of 6 short distance holes located on the southerly side of Wellesley Avenue adjacent to Brookside Road. The proposed construction area straddles the Town line between Needham and Wellesley. A portion of the development area is currently utilized as a material stockpiling and staging area and is home to leaf and grass composting piles. The remainder is undeveloped wooded property owned by the club. No buildings, structures, foundations, walls, or lighting are proposed as part of this project. The area will be developed consistent with the other golf play areas currently onsite incorporating the topography of the property into the play of each hole.

Access to the short course will be maintained under normal club operations. All patrons are required to check in at the main clubhouse for play. Members would then travel by foot or golf cart across Wellesley Avenue at the signalize crossing and then utilize the onsite bituminous cart parts. A portion of the existing paths are to be extended as part of the project providing access to the course. In the event of course use by children, subsequent to check in at the clubhouse, they will be escorted to the course by Club staff. The Club does not anticipate, and shall not allow, members to use Brookside Road as an access point to the course or as a temporary drop off. The Club will seek to add a locked gate outside of the Brookside Road right of way to prevent unauthorized access.

The construction sequence plan is intended to include:

Task	Estimated Duration	Description
1	3	• Stake hole centerlines, tees and green, flag initial clearing limits. • Pre-construction conference with the developer, site contractor, design engineer and interested town officials prior to the start of any site work • Prepare and file a Stormwater Pollution Prevention Plan (SWPPP) and EPA Notice of Intent (to be completed at least 14 days prior to Task 3)
2	3	• Rough cut the access road • Install stabilized construction entrance and erosion control along access road • Establish construction staging area
3	10	• Remove trees and brush within playing areas of new holes requiring clearing. It is the goal of the Club to perform clearing operations in the winter while the ground is frozen and when the course is closed. • Selectively thin woods and clear brush along fairway

		edges as directed by the architect.
4	3	• Install additional temporary soil erosion and sediment control measures • Inspect and repair all erosion control devises as necessary after each rain event.
5	7	• Grub all stumps within playing areas and thinned hole edges • Stockpile stumps in upland areas of site as indicated on plans. Grind stumps. • Haul wood chips offsite or use for erosion protection • Strip topsoil and stockpile in designated locations
6	10	• Perform earthwork, rough grading and shaping of golf features • Any disturbed area upon which active construction will not take place for a period greater than fourteen days (14) days shall be temporarily stabilized • Install perforate sub drain pipes and outfalls
7	30	• Construct golf features, including greens and tees • Install irrigation system
8	15	• Re-spread topsoil over completed area • Install cart paths • Construct access gate • Installation of onsite dumpster
9	20	• Commence soil preparation and grassing • Install pre-plant soil amendments • Sod green surrounds with rough sod • Seed and mulch areas as soil preparation is completed
10	30	• Perform erosion repair as necessary, remove trapped sediments from collector devices as appropriate, re-prepare and re-seed barren areas and commence turf grass maintenance • Prepare punch list of uncompleted construction items and commence close-out of construction
11	180	• Oversee grow-in and establishment of turf with regular and consistent irrigation, mowing, and fertilization • Upon establishment of suitable turf cover, commence removal of temporary erosion control devised as areas become stabilized and threat of erosion is removed.

Note: Durations are approximate.

Construction Operations:

Security: Temporary construction fencing with shall be installed along the Brookside Road corridor to limit access to the property by non-authorized vehicles. The fence will be panelized to allow for relocation and adjustments that may arise during the length of construction. Access to the work zone will

be through a double gate located at the construction area for access and construction vehicles only. No staging or queuing shall be allowed on Brookside Road.

A temporary construction sign (under 12 ft per Town regulations) located on the fence will identify the restricted access to Construction personnel

Construction Activities: All construction activities will be completed in accordance with the Zoning regulations and requirements of Local, State and Federal regulations.

Dust and Dirt Control: The Contractor shall be required to establish a stabilized construction entrance and wash down area to prevent construction material tracking on the club property or onto adjacent roadways. The stabilized entrance will adhere to standard passive truck practices to prevent tracking of the sediment onto adjacent roadways. Roadways shall be monitoring by the site contractor and cleaned as necessary during the construction period. The direct access to wetland resource areas by uncontrolled runoff and lack of curbing along Brookside Road is of paramount concern and will be monitored as part of the SWPPP and NPDES permit. Site watering will be implemented as necessary to prevent windblown dust from leaving the property.

Construction Hours: The anticipated construction activities will take place Monday thru Friday between the hours of 7:00 AM and 5:00 PM. There may be an occasional requirement to work on a Saturday between the hours of 8:00 AM and 3:00 PM. If a Saturday is required, both the Police and Fire Departments will be notified. Work on Sundays is not anticipated, however, if necessary based on conditions will be requested through the appropriate representatives of the Towns of Needham and Wellesley allowed to authorize it.

Deliveries/Truck Traffic/Parking Management: The primary activity associated with the short course project is the excavation, relocation, importing, and exporting of earth materials and construction debris (trees, wood chips). These vehicles may range from 10 wheel dump trucks to 18 wheel trailer trucks dependent on the materials. Access to the construction area is solely through the construction access roadway located along Brookside Road. Delivery and construction vehicles shall be required to utilize the Brookside Road only to the construction access point and required to exist northerly traveling towards Wellesley Avenue ultimately to Worcester Street (Route 9) and the highway access points. Directional signage shall be erected by the contractor to ensure drivers comply with the approved routing.

All deliveries for construction of this project shall be coordinated within the designated short course limit of work as illustrated on the site plans.

Trucks and construction vehicles will not be allowed to park, stop, or idle on Wellesley Avenue or Brookside Road.

The short course parking will not impact the existing parking demands of the club members and any scheduled events.

Construction Personnel Parking: All construction personnel will be required to park within the fenced construction area.

March 6, 2013

Construction Phasing/Schedule: The overall construction will commence in Fall of 2016 and is to be completed by Spring 2017. As noted in the scope table above, the winter season is the ideal time for removal of the onsite trees while early spring is appropriate for site seeding.

Communication: The Contractor will work with the owner and the Town of Wellesley/Needham to ensure a smooth operation through the project completion. The project area has several abutters that have been in communication with the Club and will coordinate as necessary with them.

A list of key contact personnel will be provided to the Town and posted onsite when it becomes available.

This list shall include, among others,

Club representative/coordinator
Construction Project Manager (acting on behalf of the Club)
Project design team (architects, site engineers, surveyors)
Construction Project Manager
Construction Site Superintendent

Project Team:

Owner: Wellesley Country Club
Martin Ryan, General Manager
300 Wellesley Ave, Wellesley, MA
Tel: (781) 235- 7333

Contractor: TBD

Architect: Mungeum Cornish Golf Dsign
Mark Mungeum
195 South West Main Street
Douglas, MA 01516
tel: 508-873-0103

Engineer: Allen & Major Associates, Inc.
Philip Cordeiro, PE
10 Main Street
Lakeville, MA 02347
tel: 508-923-1010

It shall be a requirement of the contractor to keep onsite at all times a copy of the project approvals and permits issued by the Town and copies of all site plans, building drawings, etc. referenced within those documents.

BSC GROUP
thoughtfully transforming our environments

33 Waldo Street
Worcester, MA 01608

Tel: 508-792-4500
800-288-8123
Fax: 508-792-4509

www.bscgroup.com

December 1, 2015

Bill Sansone
Golf Course Superintendent
Wellesley Country Club
300 Wellesley Avenue
Wellesley, MA 02481

Re: Water Quality Sampling Report for 2015

Dear Mr. Sansone:

Samples collected on November 12, 2015 at the Club have been analyzed and compared to Massachusetts Drinking Water Standards (where applicable). In summary, the results for all samples for 2015 were well below the current drinking water standards set by Massachusetts DEP.

Samples in 2015 were taken at existing monitoring wells, piezometers, and surface water locations throughout the course. Some of the sampling points were dry and not sampled—those are noted below. All sampling points were originally established in 2006.

Methods

Samples were collected from three of the groundwater wells and three surface water quality monitoring stations. The locations and characteristics of all sampling stations are given in Table 1.

The wells and piezometers were sampled using a low flow pump (Geopump) and ¼ inch diameter HDPE tubing. The stream was sampled using grab sample techniques. The analytes for each sampling point are given in Table 2.

Table 1--Surface and Groundwater Monitoring Locations at the Wellesley Country Club

Monitoring Station ID	Location	Type	Depth (Ft)	Latitude	Longitude
MW-1	Right of the cart path between the 8th green and 9th tees	Flush mount monitoring well	12.2	N42°18.087'	W71°15.343'
MW-2	Behind (and to the left) of the 5th green	Flush mount monitoring well	14.0	N42° 17.994'	W71° 15.800'
MW-3	In front (and to the right) of the 13th green	Flush mount monitoring well	5.3	N42° 18.430'	W71° 15.368'
MW-4 (SU-4)	Deep well at the 13th hole	Raised casing monitoring well	23.9	N42°18.435'	W71°15.364'
PZ-1	Upslope 8th green	Piezometer	13.9	N42°18.057'	W71°15.340’
PZ-2	Downslope 8th green	Piezometer	13.5	N42°18.083'	W71°15.330'
PZ-3	Upslope 3rd green	Piezometer	6.6	N42°18.201'	W71°15.332'
PZ-4	Downslope 3rd green	Piezometer	6.2	N42°18.227'	W71°15.306'
SUR-1	Academy Brook at the 5th hole where it enters the golf course	Surface water monitoring station	NA	N42°17.996'	W71°15.804'
SUR-4	Academy Brook at the 13th hole where it exits the golf course	Surface water monitoring station	NA	N42°18.425'	W71°15.385'
SUR-7	Academy Brook at the 16th hole where it enters the golf course	Surface water monitoring station	NA	N42°18.301'	W71°15.636'

Table 2--Surface and Groundwater Sampling Parameters at the Wellesley Country Club

Sampling Points	Analytes
Piezometers PZ-1, PZ-2, PZ-3, PZ-4	Nitrate-Nitrite as Nitrogen (EPA 353.2)
Wells MW-1, MW-2, MW-3, MW-4 (SU-4)	Nitrate-Nitrite as Nitrogen (EPA 353.2), Total Phosphorus (SM 4500 P E), and orthophosphate (SM 4500 P E)
Academy Brook SUR-1, SUR-4, SUR-7	Nitrate-Nitrite as Nitrogen (EPA 353.2), Total Phosphorus (SM 4500 P E), and orthophosphate (SM 4500 P E)

We sampled each point using appropriate methods and glassware, prepared a chain of custody record for each sample, and arranged to have the samples analyzed by a State Certified laboratory.

Results

Table 3 shows the results of the sampling for November 2015 and compares the results to drinking water standards (where appropriate). Due to the extreme dry weather Piezometer PZ-3 and Monitoring Well MW-3 were dry and therefore not sampled.

Table 3—2013 Surface and Groundwater Sampling Results at the Wellesley Country Club

Sampling Points	Nitrate-Nitrite as Nitrogen	Total Phosphorus	Phosphorus as PO4
Mass. Drinking Water Standard	**10 mg/L**	**N/A**	**N/A**
PZ-1	2.4 mg/L	N/A	N/A
PZ-2	1.7 mg/L	N/A	N/A
PZ-3	Not sampled--dry	N/A	N/A
PZ-4	ND	N/A	N/A
MW-1	0.51 mg/L	0.41 mg/L	1.3 mg/L
MW-2	1.9 mg/L	0.11 mg/L	0.32 mg/L
MW-3	Not sampled--dry	Not sampled--dry	Not sampled--dry
MW-4	2.3 mg/L	0.032 mg/L	0.098 mg/L
SUR-1	2.0 mg/L	0.058 mg/L	0.18 mg/L
SUR-4	0.42 mg/L	0.019 mg/L	0.057 mg/L
SUR-7	0.32 mg/L	0.12 mg/L	0.36 mg/L

ND = not detected (below detection limit)

Conclusions

Data collected from the November 12, 2015 water quality sampling events at the Club indicates that the ground and surface water at the Wellesley Country Club are well below the current drinking water standards set by Massachusetts DEP and that ground and surface water are not being adversely affected by operations at the golf course.

Sincerely,

Michael J. Toohill, PWS, CE
Sr. Environmental Scientist

SUR-1
MW-2
Bezanson Pond
Centennial Reservation Trail
Abbott Rd
Livermore Rd
Franklin Rd
Windsor Rd
Lincoln Rd
Berkshire Rd
Babson Park
Inverness Rd
Allen Rd
Clark Rd
Ordway Rd
MW-3
MW-4
SUR-4
Charles River Path
Monroe Rd
Oakland St
Comeau St
Hunnewell St
Grasmere Rd
Briarwood Cir
SUR-7
PZ-4
PZ-3
Wellesley Country Club
Wellesley Ave
MW-1
PZ-2
PZ-1
Brookside Rd
Taylor St
WCC Monitoring Locations
SUR-1
MW-2
W Gate Rd
Bryant Way
Babson College Drive
Nichols Road
Sullivan Rd
Central Ave
Gefalo St
Clarke Rd
Clarke Cir
© 2015 Google
Google earth
1995
lat 42.302637° lon -71.259081° elev 146 ft eye alt 6562 ft

ALLEN & MAJOR ASSOCIATES, INC.

STORMWATER MANAGEMENT (DRAINAGE) OPERATION AND MAINTENANCE PLAN

In accordance with the standards set forth by the Stormwater Management Regulations issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. (A&M) has prepared the following Operation and Maintenance plan for the proposed stormwater management system at the Wellesley Country Club (short course).

This plan is focuses on post construction maintenance of the on-site drainage system. Operation and Maintenance (O&M) practices discussed below are recommendations made by the Design Engineer based on available reference material on Best Management Practices (BMP's) and experience. The property owner is responsible for implementation of the plan, and is encouraged to revise / supplement this plan accordingly based on actual site conditions.

This O&M plan is based on the Grading and Drainage plan prepared by Allen & Major Associates, Inc. last revised January 6, 2016.

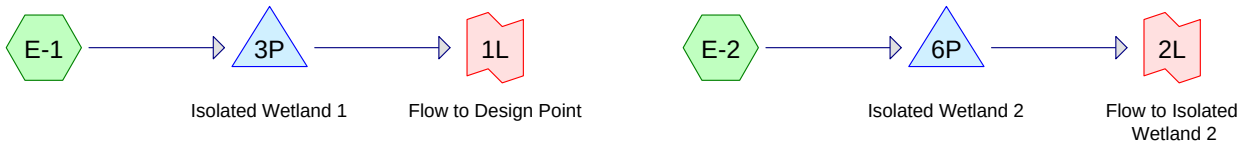
Basic Information

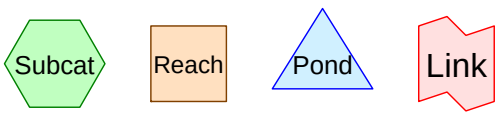
Owner: **Wellesley Country Club**
Address: 300 Wellesley Avenue
City: Wellesley, MA

1. **Paved Areas**
   Paved areas should be swept as part of the routine site maintenance. Pavement sweeping is an excellent source control for sedimentation to the existing drainage system and should be performed at least twice annually. The cart paths may not experience sediment build up and this component may be altered based on visual inspection.

2. **Winter De-icing**
   Salt for de-icing on the paved areas during the winter months shall be limited to the minimum amount practicable on parking areas only. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities. On course paths should not be de-iced.

3. **Dry detention basin**
   The detention basin should be inspected twice annually for signs of buildup. Accumulated debris should be removed promptly. Inspection of the underdrain discharge points should be reviewed at the same time to ensure no buildup of material or erosion at the outlets.





Routing Diagram for 1828-02E - Drainage Routing - Revision 1
Prepared by Microsoft, Printed 1/7/2016

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
70,219	49	50-75% Grass cover, Fair, HSG A-offsite (E-1)
1,177,597	39	>75% Grass cover, Good, HSG A (E-1, E-2)
7,405	98	Buildings/Pavement-offsite (E-1)
25,878	98	Cart Paths (E-1, E-2)
216,798	36	Woods, Fair, HSG A (E-1, E-2)
85,726	36	Woods, Fair, HSG A-offsite (E-1)
13,242	98	wetland (E-1, E-2)
1,596,865	**41**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
1,550,340	HSG A	E-1, E-2
0	HSG B	
0	HSG C	
0	HSG D	
46,525	Other	E-1, E-2
1,596,865		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
70,219	0	0	0	0	70,219	50-75% Grass cover, Fair	
1,177,597	0	0	0	0	1,177,597	>75% Grass cover, Good	
0	0	0	0	7,405	7,405	Buildings/Pavement-offsite	
0	0	0	0	25,878	25,878	Cart Paths	
302,524	0	0	0	0	302,524	Woods, Fair	
0	0	0	0	13,242	13,242	wetland	
1,550,340	**0**	**0**	**0**	**46,525**	**1,596,865**	**TOTAL AREA**	

Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Runoff Area=850,248 sf 3.97% Impervious Runoff Depth=0.01"
Tc=10.0 min CN=42 Runoff=0.04 cfs 954 cf

Subcatchment E-2: Runoff Area=746,617 sf 1.72% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=40 Runoff=0.01 cfs 164 cf

Pond 3P: Isolated Wetland 1 Peak Elev=82.32' Storage=0 cf Inflow=0.04 cfs 954 cf
Discarded=0.04 cfs 954 cf Primary=0.00 cfs 0 cf Outflow=0.04 cfs 954 cf

Pond 6P: Isolated Wetland 2 Peak Elev=75.55' Storage=13 cf Inflow=0.01 cfs 164 cf
Discarded=0.01 cfs 164 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 164 cf

Link 1L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 2L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 1,596,865 sf Runoff Volume = 1,118 cf Average Runoff Depth = 0.01"
97.09% Pervious = 1,550,340 sf 2.91% Impervious = 46,525 sf

Summary for Subcatchment E-1:

[49] Hint: Tc<2dt may require smaller dt

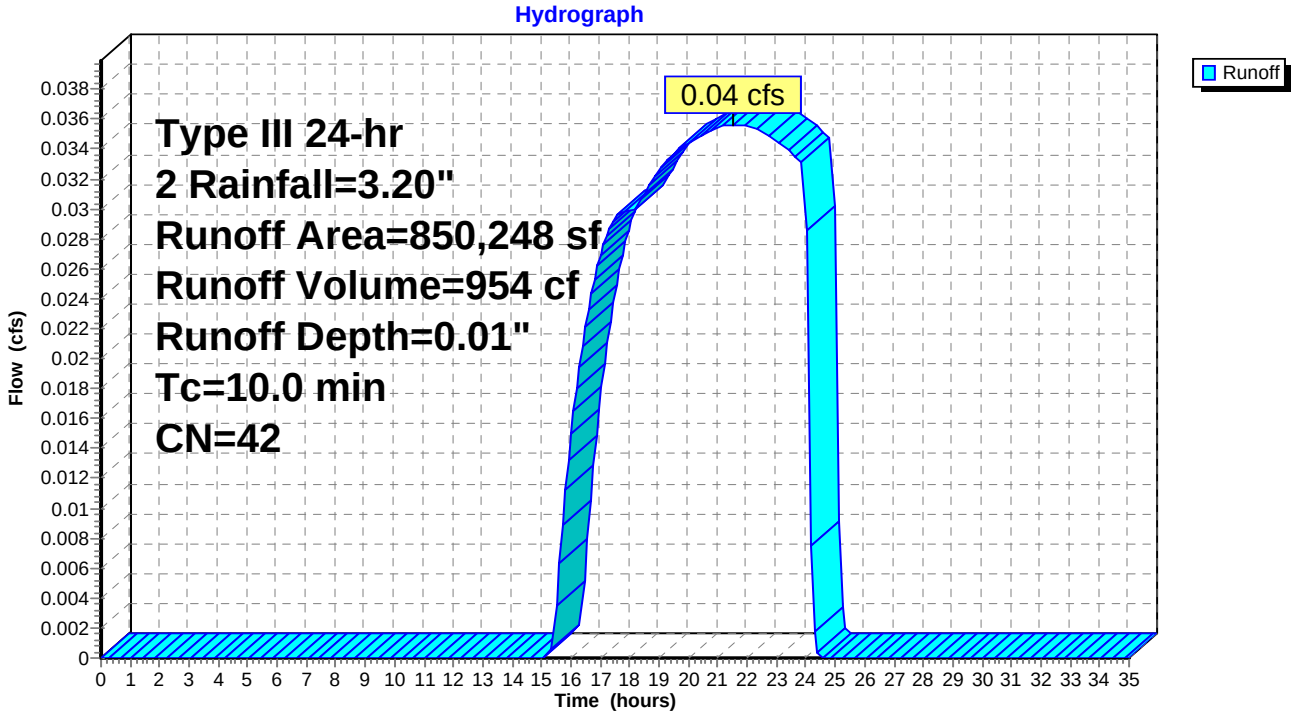
Runoff = 0.04 cfs @ 21.55 hrs, Volume= 954 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (sf)	CN	Description
	252,383	39	>75% Grass cover, Good, HSG A
*	16,034	98	Cart Paths
*	5,271	98	wetland
	88,122	36	Woods, Fair, HSG A
*	314,808	39	>75% Grass cover, Good, HSG A
*	5,009	98	Cart Paths
*	5,271	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	7,405	98	Buildings/Pavement-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
	850,248	42	Weighted Average
	816,529		96.03% Pervious Area
	33,719		3.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-1:



Summary for Subcatchment E-2:

[49] Hint: Tc<2dt may require smaller dt

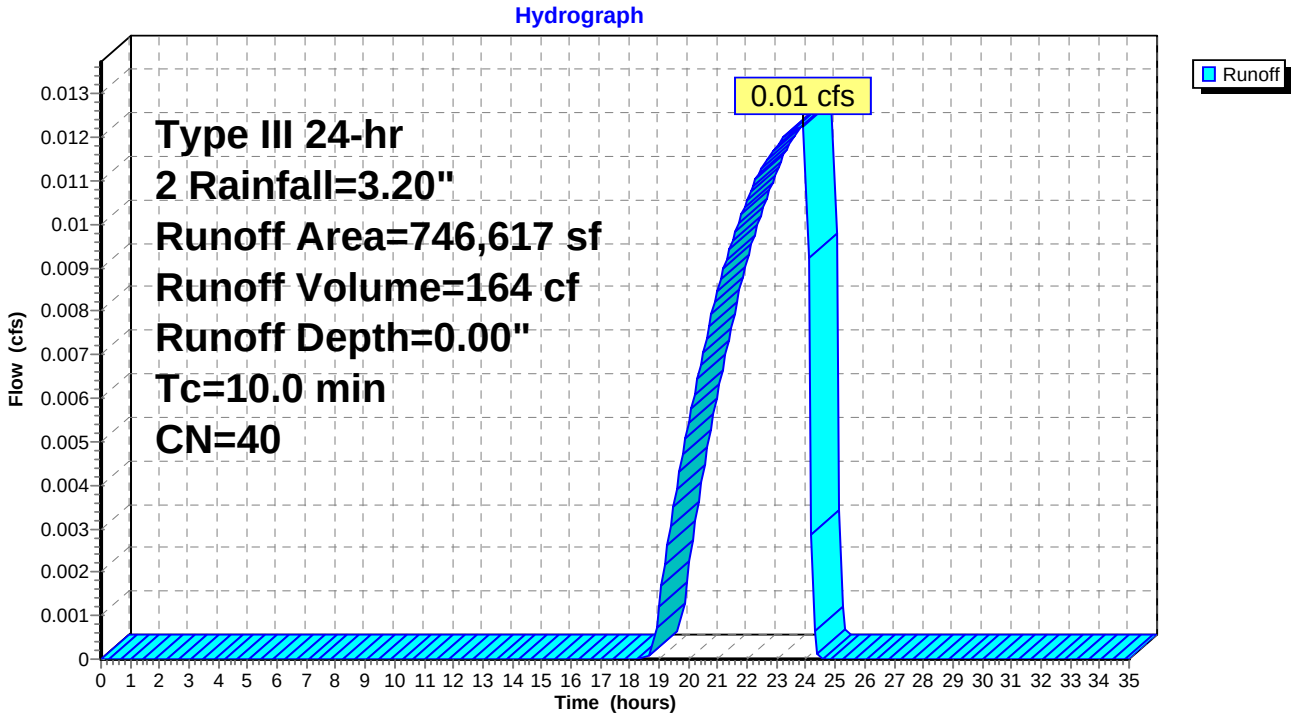
Runoff = 0.01 cfs @ 23.90 hrs, Volume= 164 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (sf)	CN	Description
	610,406	39	>75% Grass cover, Good, HSG A
*	4,835	98	Cart Paths
*	7,971	98	wetland
	123,405	36	Woods, Fair, HSG A
	746,617	40	Weighted Average
	733,811		98.28% Pervious Area
	12,806		1.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-2:



Summary for Pond 3P: Isolated Wetland 1

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.01" for 2 event
Inflow = 0.04 cfs @ 21.55 hrs, Volume= 954 cf
Outflow = 0.04 cfs @ 21.55 hrs, Volume= 954 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.04 cfs @ 21.55 hrs, Volume= 954 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 82.32' @ 21.40 hrs Surf.Area= 3,101 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

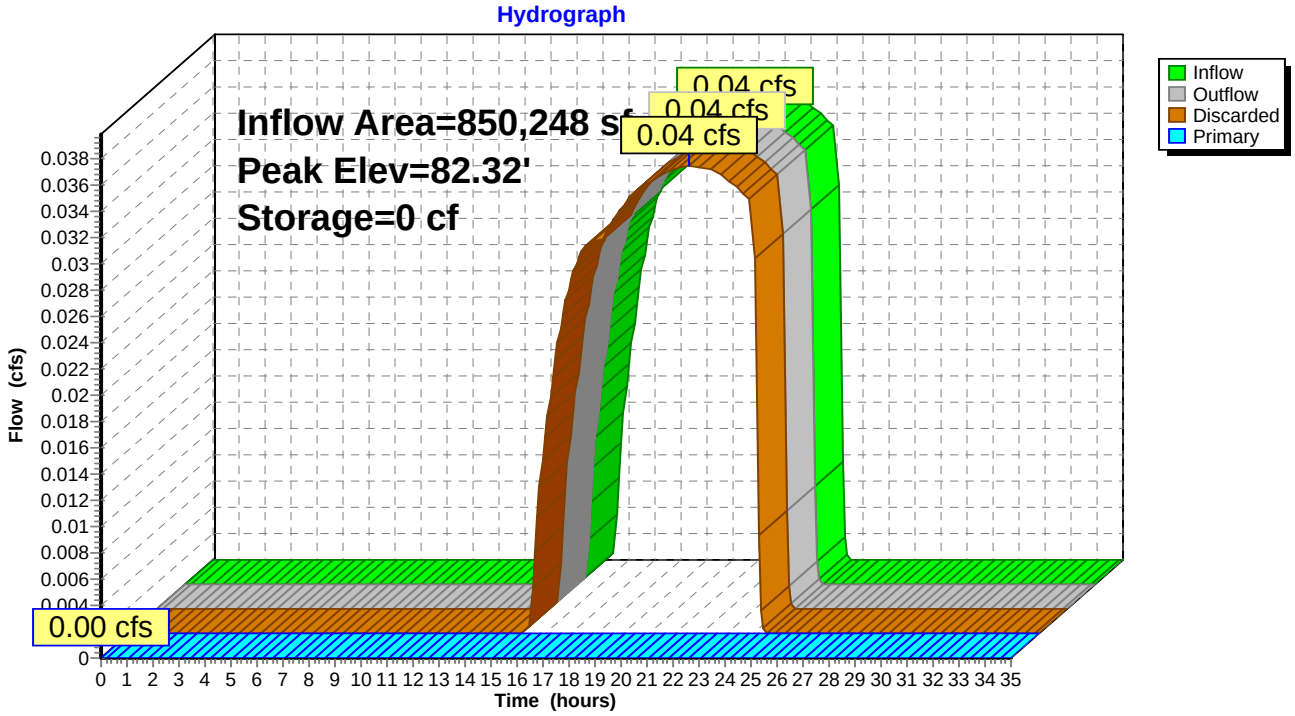
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

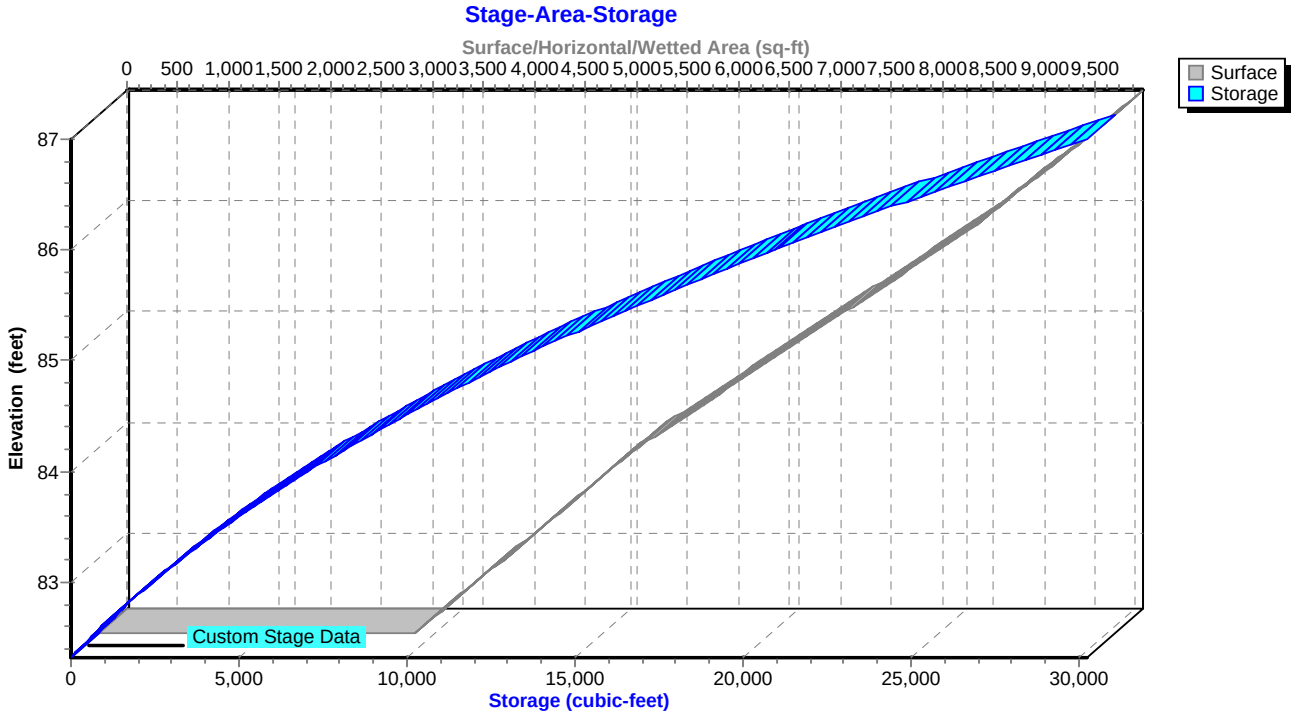
Discarded OutFlow Max=0.07 cfs @ 21.55 hrs HW=82.32' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 3P: Isolated Wetland 1



Pond 3P: Isolated Wetland 1



Summary for Pond 6P: Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.01 cfs @ 23.90 hrs, Volume= 164 cf
Outflow = 0.01 cfs @ 23.97 hrs, Volume= 164 cf, Atten= 2%, Lag= 4.3 min
Discarded = 0.01 cfs @ 23.97 hrs, Volume= 164 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 75.55' @ 23.97 hrs Surf.Area= 517 sf Storage= 13 cf

Plug-Flow detention time= 14.4 min calculated for 163 cf (100% of inflow)
Center-of-Mass det. time= 14.4 min (1,340.1 - 1,325.6)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

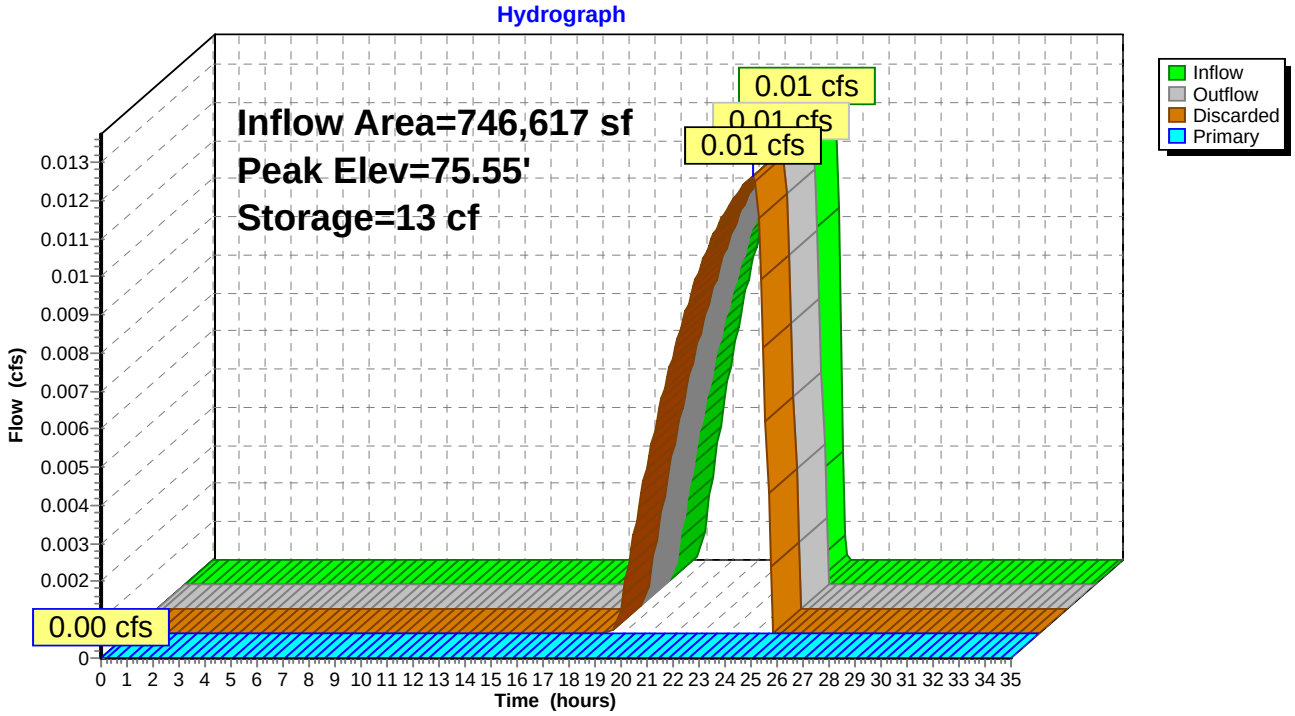
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

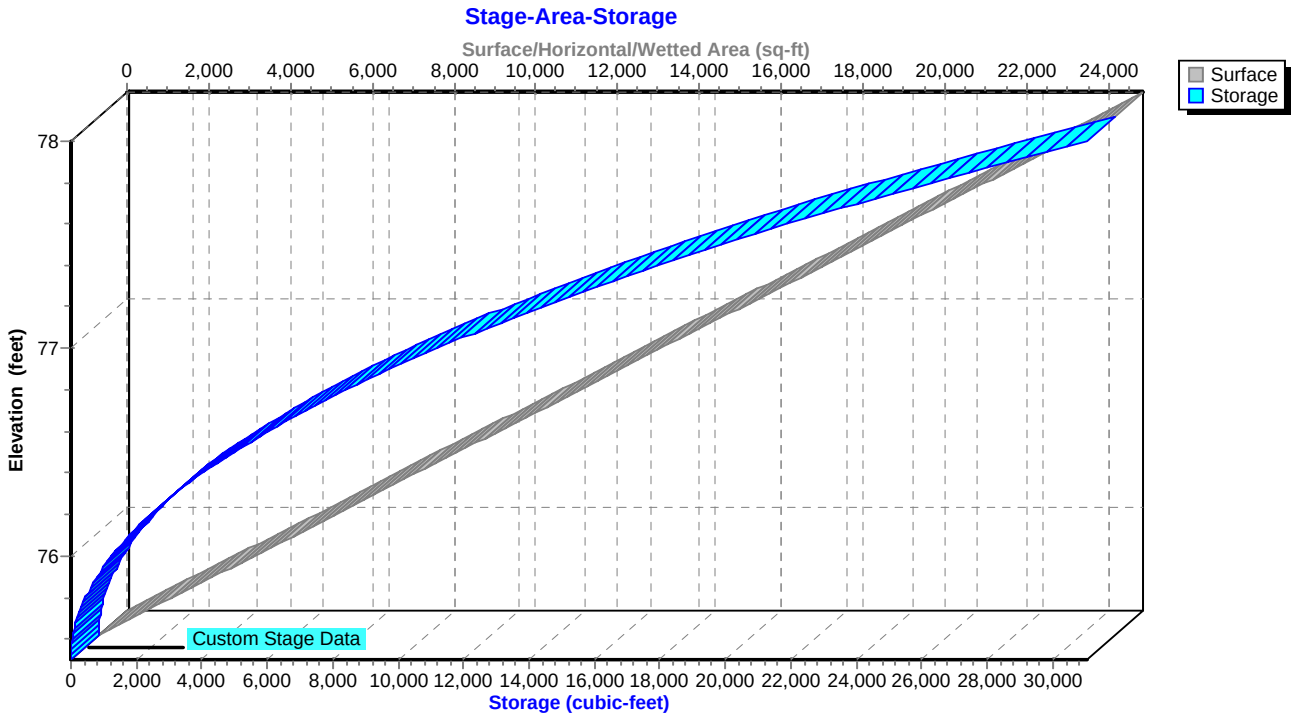
Discarded OutFlow Max=0.01 cfs @ 23.97 hrs HW=75.55' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Isolated Wetland 2



Pond 6P: Isolated Wetland 2

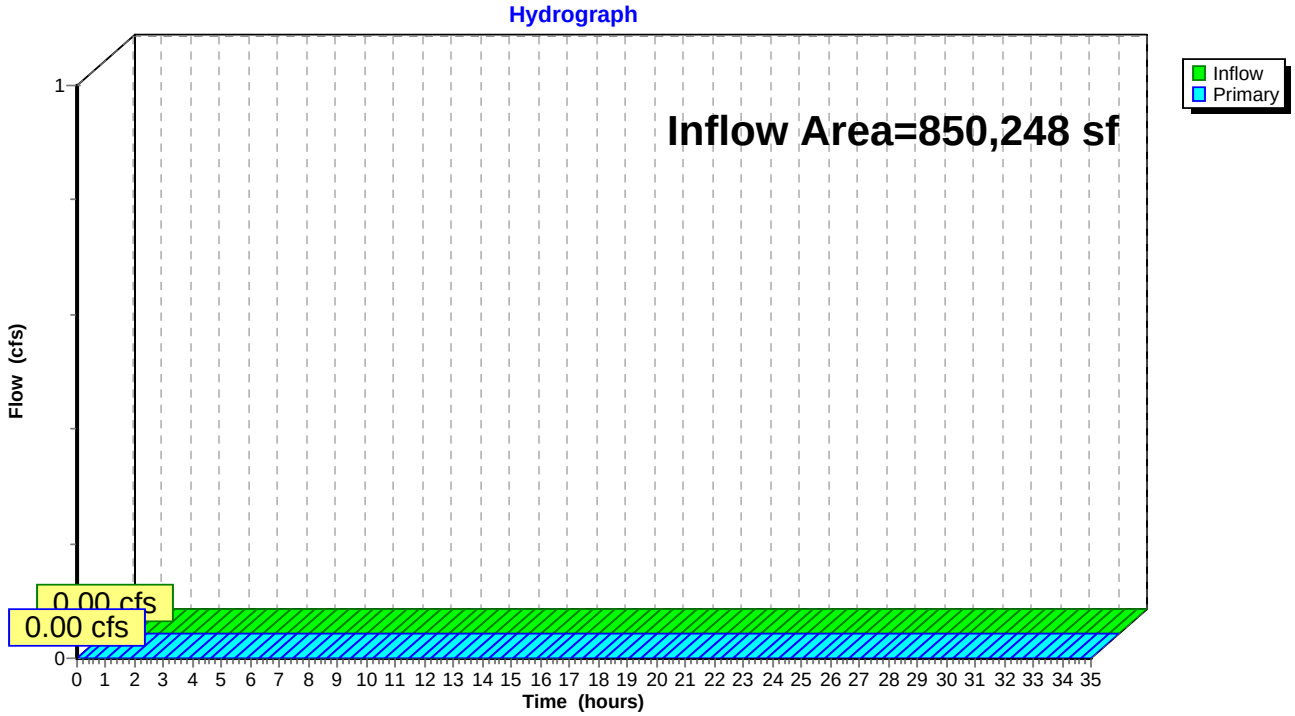


Summary for Link 1L: Flow to Design Point

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 1L: Flow to Design Point

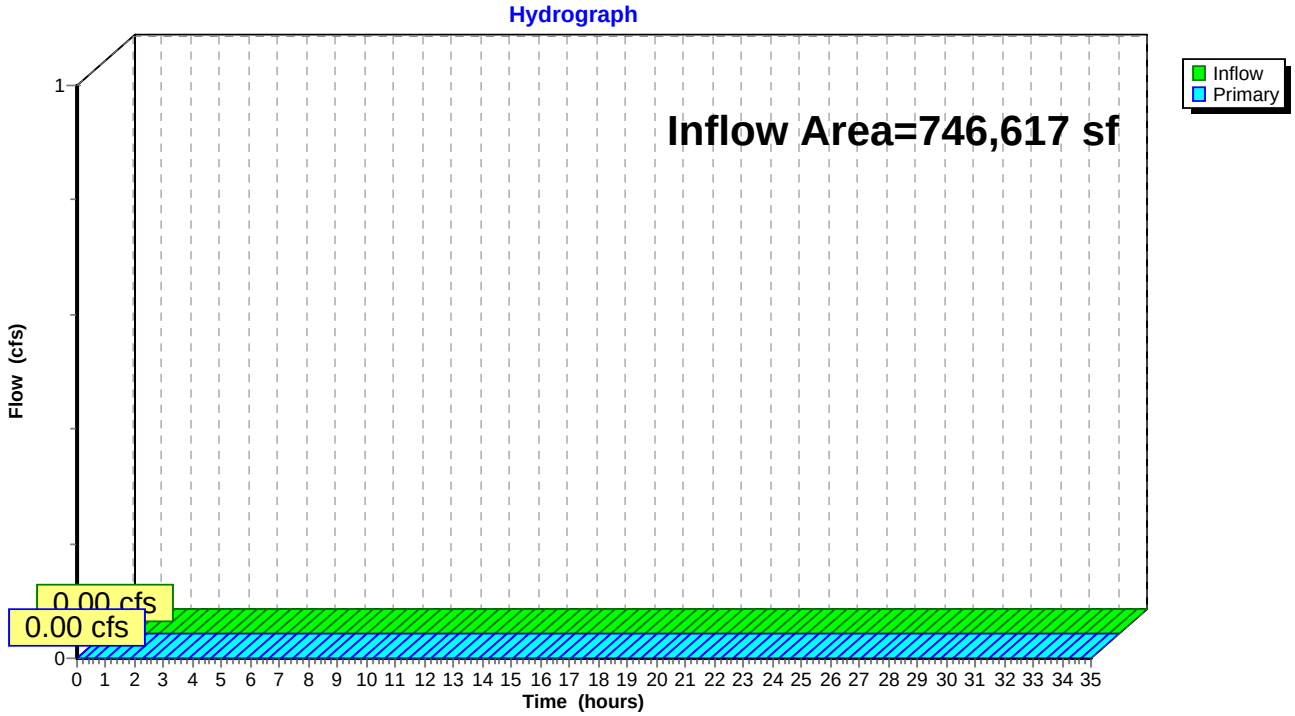


Summary for Link 2L: Flow to Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 2L: Flow to Isolated Wetland 2



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Runoff Area=850,248 sf 3.97% Impervious Runoff Depth=0.23"
Tc=10.0 min CN=42 Runoff=1.07 cfs 16,091 cf

Subcatchment E-2: Runoff Area=746,617 sf 1.72% Impervious Runoff Depth=0.16"
Tc=10.0 min CN=40 Runoff=0.39 cfs 10,173 cf

Pond 3P: Isolated Wetland 1 Peak Elev=84.62' Storage=10,625 cf Inflow=1.07 cfs 16,091 cf
Discarded=0.15 cfs 10,518 cf Primary=0.00 cfs 0 cf Outflow=0.15 cfs 10,518 cf

Pond 6P: Isolated Wetland 2 Peak Elev=76.34' Storage=3,489 cf Inflow=0.39 cfs 10,173 cf
Discarded=0.19 cfs 10,174 cf Primary=0.00 cfs 0 cf Outflow=0.19 cfs 10,174 cf

Link 1L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 2L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 1,596,865 sf Runoff Volume = 26,264 cf Average Runoff Depth = 0.20"
97.09% Pervious = 1,550,340 sf 2.91% Impervious = 46,525 sf

Summary for Subcatchment E-1:

[49] Hint: Tc<2dt may require smaller dt

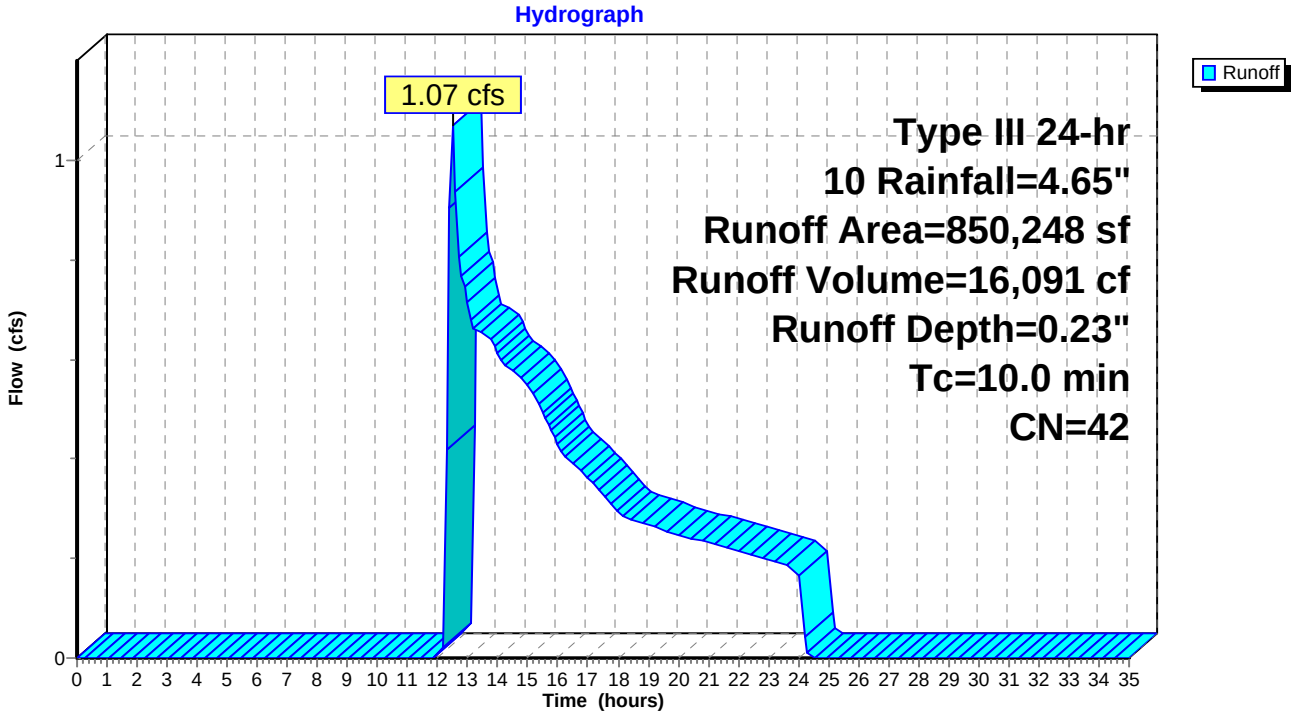
Runoff = 1.07 cfs @ 12.50 hrs, Volume= 16,091 cf, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 Rainfall=4.65"

	Area (sf)	CN	Description
	252,383	39	>75% Grass cover, Good, HSG A
*	16,034	98	Cart Paths
*	5,271	98	wetland
	88,122	36	Woods, Fair, HSG A
*	314,808	39	>75% Grass cover, Good, HSG A
*	5,009	98	Cart Paths
*	5,271	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	7,405	98	Buildings/Pavement-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
	850,248	42	Weighted Average
	816,529		96.03% Pervious Area
	33,719		3.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-1:



Summary for Subcatchment E-2:

[49] Hint: Tc<2dt may require smaller dt

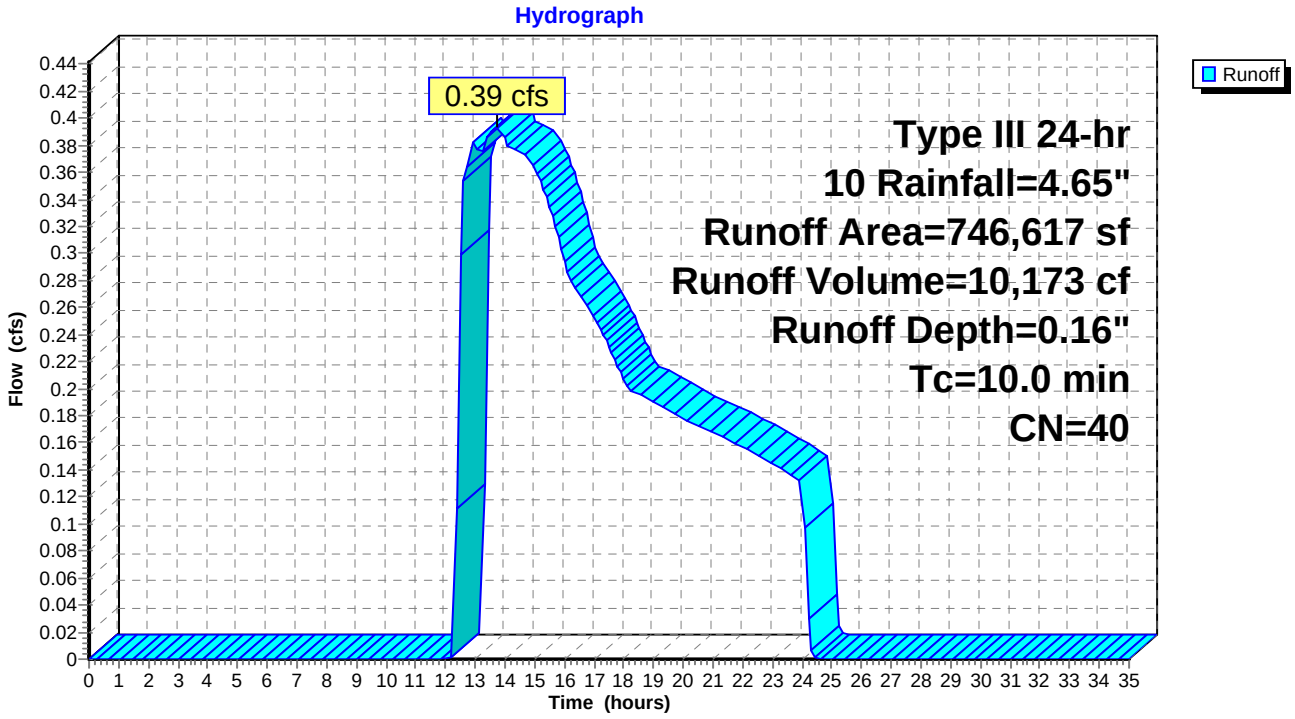
Runoff = 0.39 cfs @ 13.70 hrs, Volume= 10,173 cf, Depth= 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 Rainfall=4.65"

	Area (sf)	CN	Description
	610,406	39	>75% Grass cover, Good, HSG A
*	4,835	98	Cart Paths
*	7,971	98	wetland
	123,405	36	Woods, Fair, HSG A
	746,617	40	Weighted Average
	733,811		98.28% Pervious Area
	12,806		1.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-2:



Summary for Pond 3P: Isolated Wetland 1

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.23" for 10 event
Inflow = 1.07 cfs @ 12.50 hrs, Volume= 16,091 cf
Outflow = 0.15 cfs @ 24.06 hrs, Volume= 10,518 cf, Atten= 86%, Lag= 693.6 min
Discarded = 0.15 cfs @ 24.06 hrs, Volume= 10,518 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 84.62' @ 24.06 hrs Surf.Area= 6,311 sf Storage= 10,625 cf

Plug-Flow detention time= 557.2 min calculated for 10,488 cf (65% of inflow)
Center-of-Mass det. time= 432.1 min (1,429.2 - 997.0)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

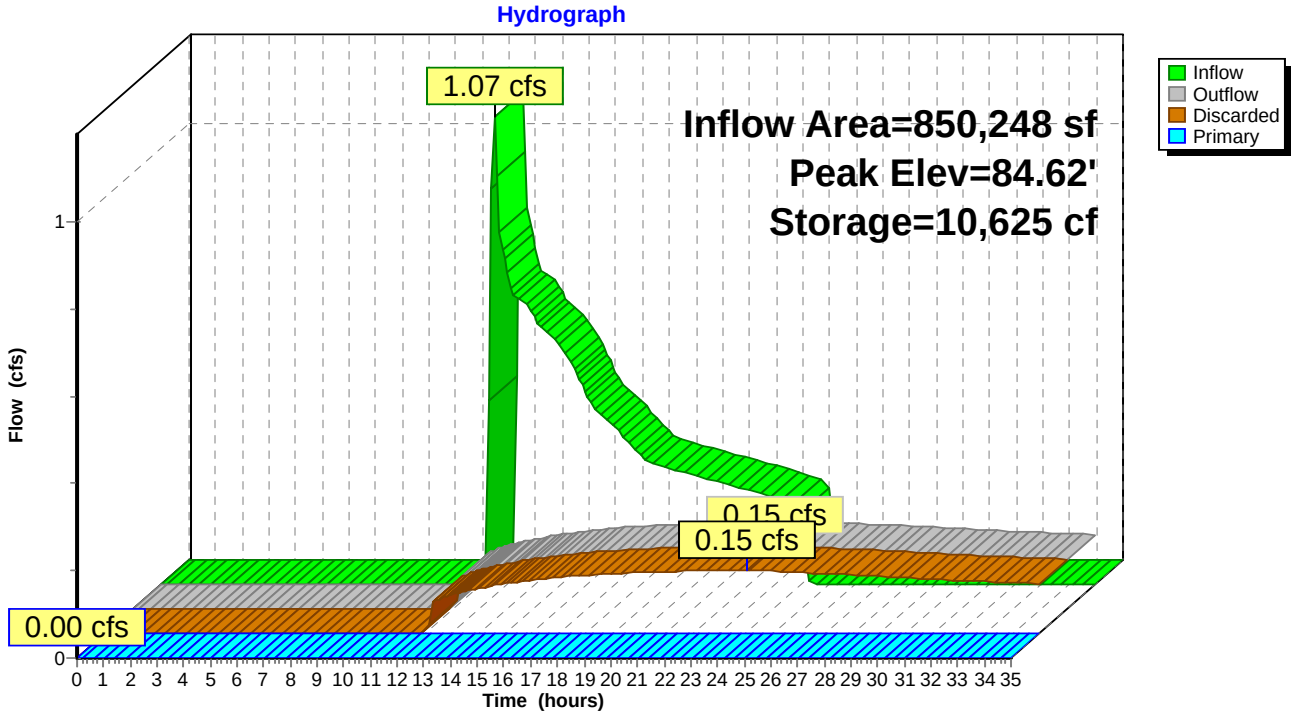
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

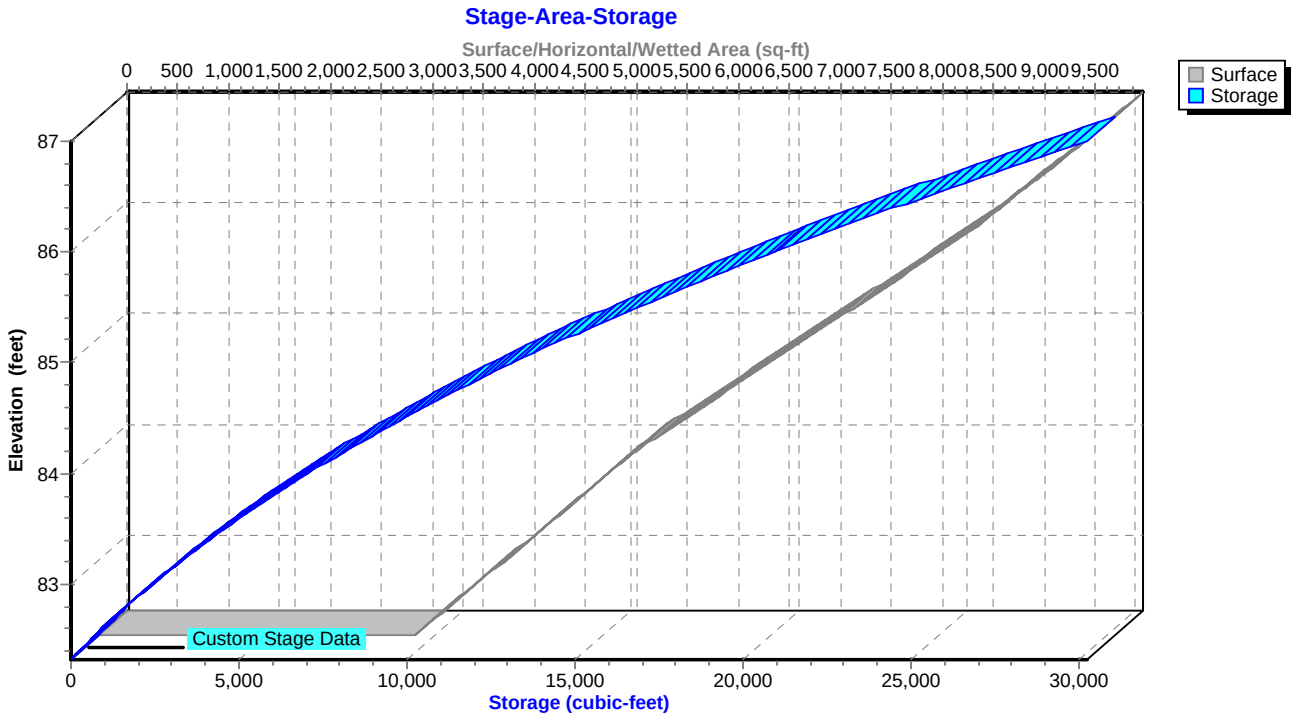
Discarded OutFlow Max=0.15 cfs @ 24.06 hrs HW=84.62' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Isolated Wetland 1



Pond 3P: Isolated Wetland 1



Summary for Pond 6P: Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.16" for 10 event
Inflow = 0.39 cfs @ 13.70 hrs, Volume= 10,173 cf
Outflow = 0.19 cfs @ 18.79 hrs, Volume= 10,174 cf, Atten= 51%, Lag= 305.8 min
Discarded = 0.19 cfs @ 18.79 hrs, Volume= 10,174 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 76.34' @ 18.79 hrs Surf.Area= 8,328 sf Storage= 3,489 cf

Plug-Flow detention time= 250.1 min calculated for 10,145 cf (100% of inflow)
Center-of-Mass det. time= 250.9 min (1,276.2 - 1,025.3)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

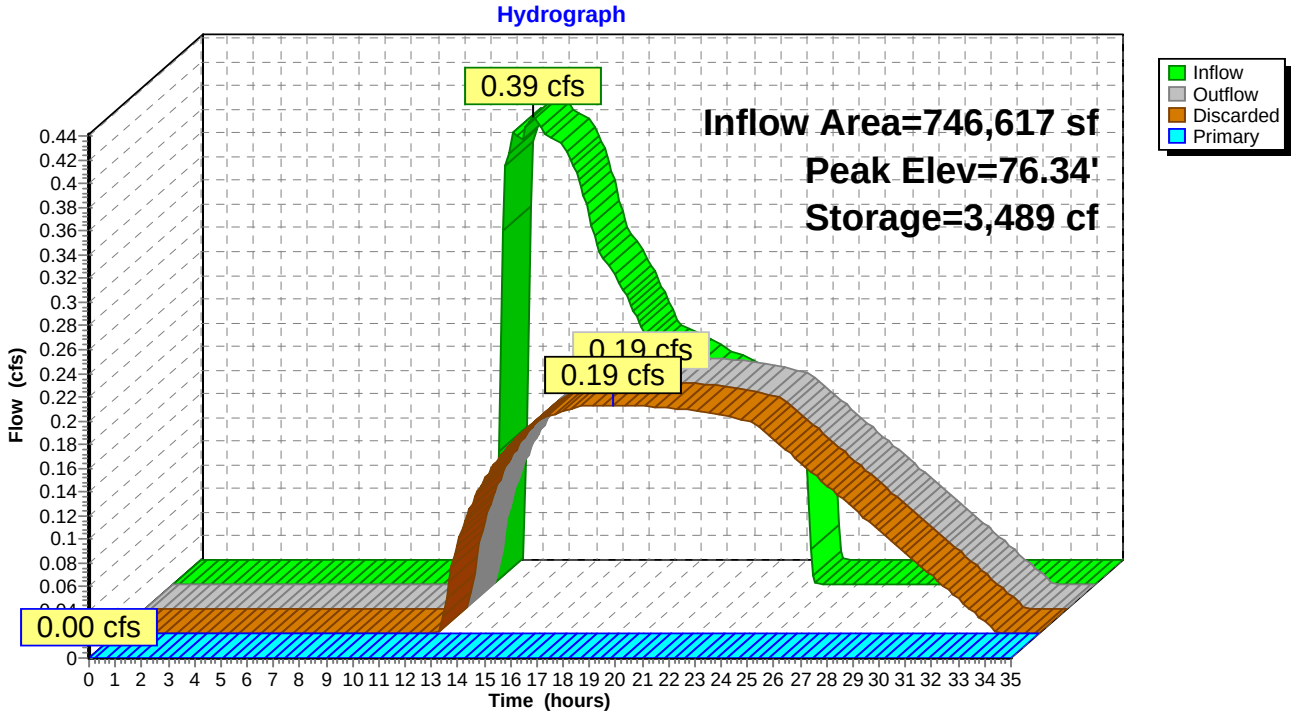
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

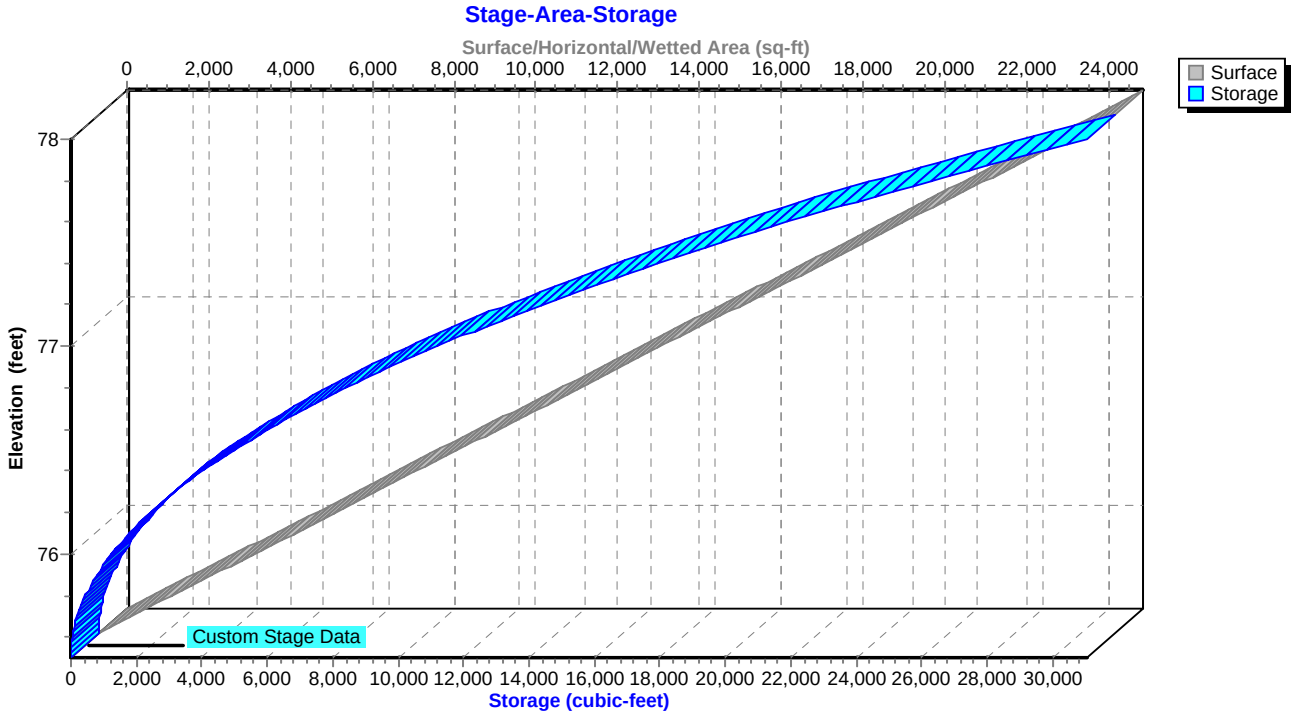
Discarded OutFlow Max=0.19 cfs @ 18.79 hrs HW=76.34' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Isolated Wetland 2



Pond 6P: Isolated Wetland 2

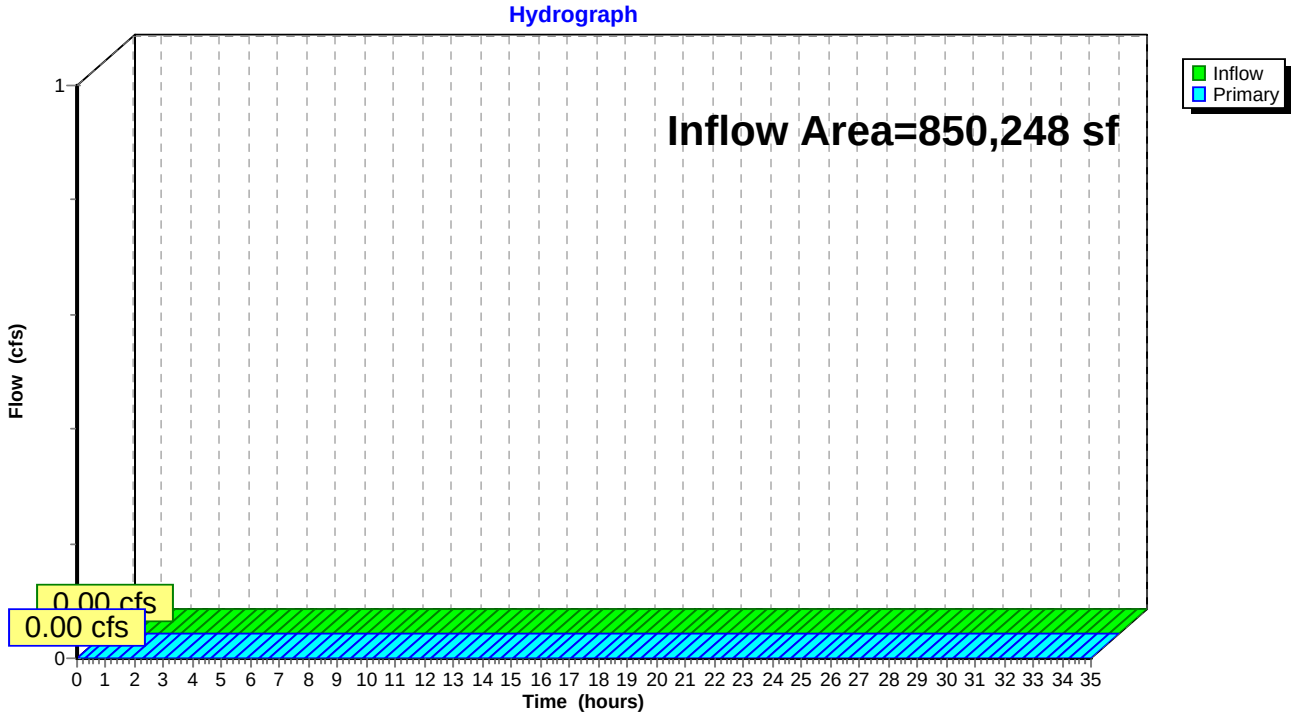


Summary for Link 1L: Flow to Design Point

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.00" for 10 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 1L: Flow to Design Point

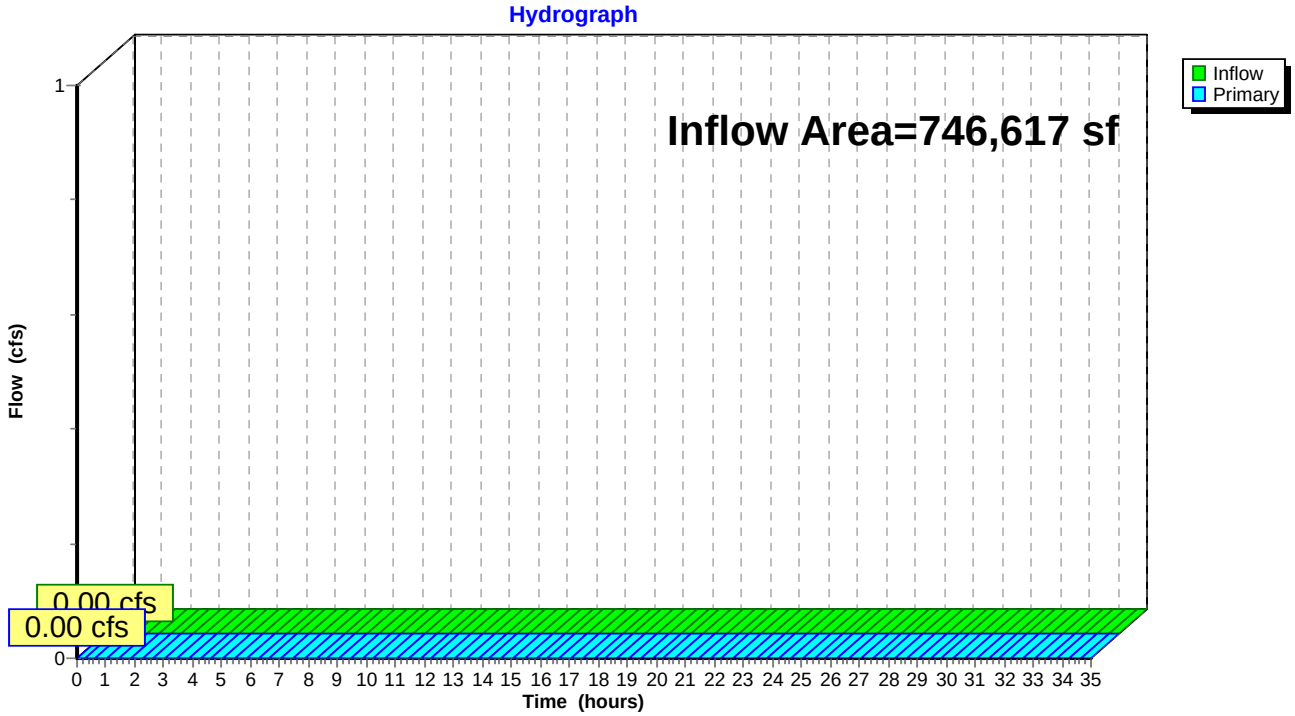


Summary for Link 2L: Flow to Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.00" for 10 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 2L: Flow to Isolated Wetland 2



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Runoff Area=850,248 sf 3.97% Impervious Runoff Depth=0.45"
Tc=10.0 min CN=42 Runoff=3.63 cfs 32,102 cf

Subcatchment E-2: Runoff Area=746,617 sf 1.72% Impervious Runoff Depth=0.36"
Tc=10.0 min CN=40 Runoff=2.07 cfs 22,221 cf

Pond 3P: Isolated Wetland 1 Peak Elev=86.36' Storage=24,089 cf Inflow=3.63 cfs 32,102 cf
Discarded=0.21 cfs 15,636 cf Primary=0.00 cfs 0 cf Outflow=0.21 cfs 15,636 cf

Pond 6P: Isolated Wetland 2 Peak Elev=76.94' Storage=10,255 cf Inflow=2.07 cfs 22,221 cf
Discarded=0.33 cfs 21,170 cf Primary=0.00 cfs 0 cf Outflow=0.33 cfs 21,170 cf

Link 1L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 2L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 1,596,865 sf Runoff Volume = 54,322 cf Average Runoff Depth = 0.41"
97.09% Pervious = 1,550,340 sf 2.91% Impervious = 46,525 sf

Summary for Subcatchment E-1:

[49] Hint: Tc<2dt may require smaller dt

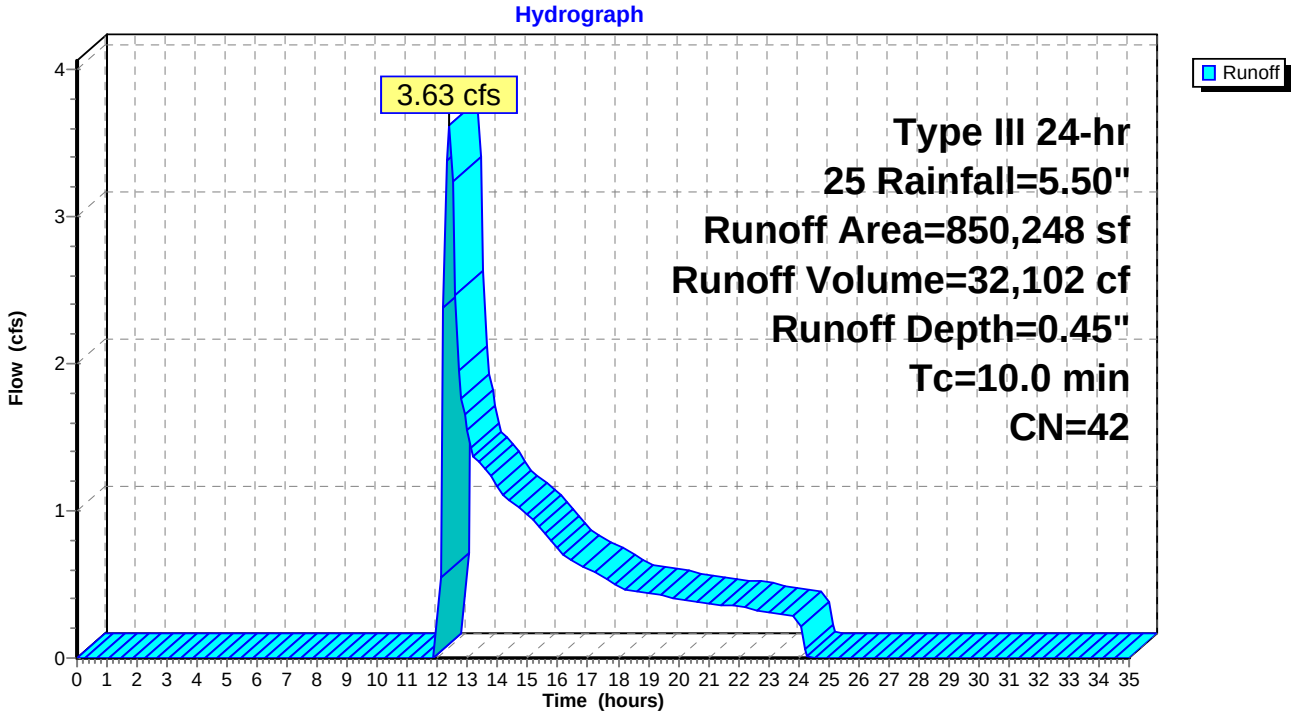
Runoff = 3.63 cfs @ 12.39 hrs, Volume= 32,102 cf, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (sf)	CN	Description
	252,383	39	>75% Grass cover, Good, HSG A
*	16,034	98	Cart Paths
*	5,271	98	wetland
	88,122	36	Woods, Fair, HSG A
*	314,808	39	>75% Grass cover, Good, HSG A
*	5,009	98	Cart Paths
*	5,271	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	7,405	98	Buildings/Pavement-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
	850,248	42	Weighted Average
	816,529		96.03% Pervious Area
	33,719		3.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-1:



Summary for Subcatchment E-2:

[49] Hint: Tc<2dt may require smaller dt

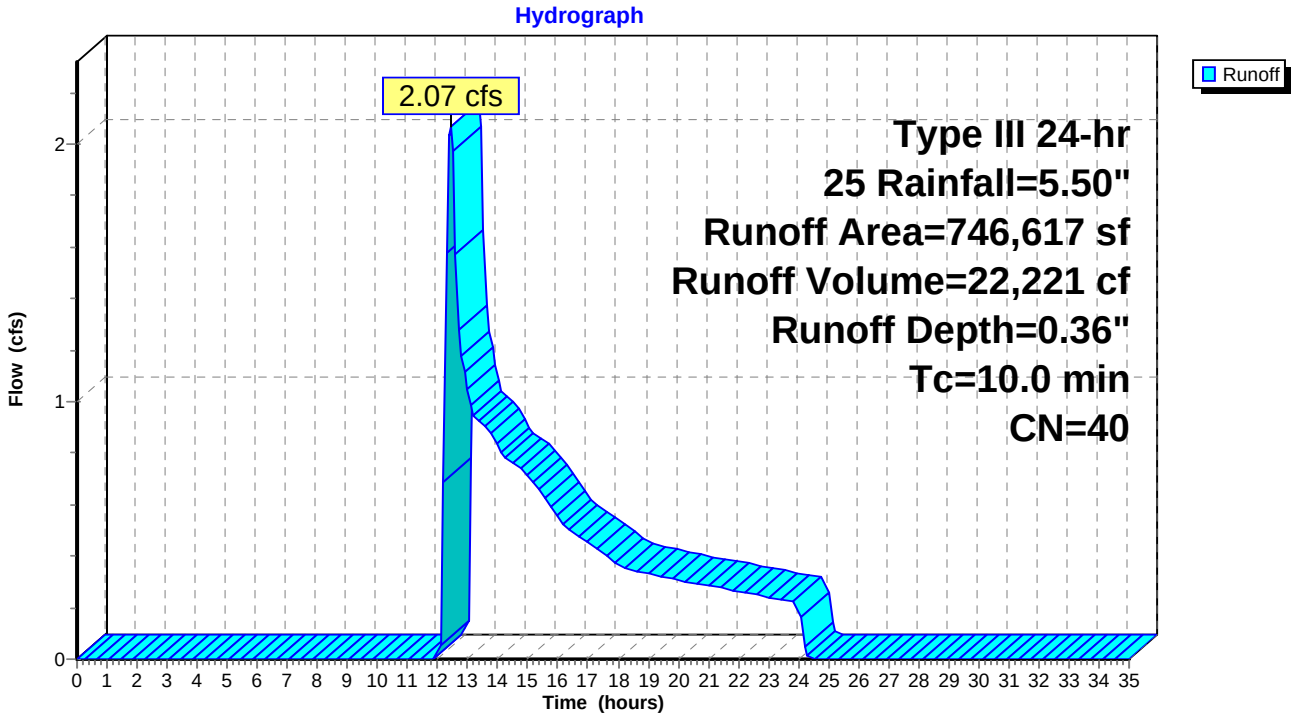
Runoff = 2.07 cfs @ 12.44 hrs, Volume= 22,221 cf, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (sf)	CN	Description
	610,406	39	>75% Grass cover, Good, HSG A
*	4,835	98	Cart Paths
*	7,971	98	wetland
	123,405	36	Woods, Fair, HSG A
	746,617	40	Weighted Average
	733,811		98.28% Pervious Area
	12,806		1.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-2:



Summary for Pond 3P: Isolated Wetland 1

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.45" for 25 event
Inflow = 3.63 cfs @ 12.39 hrs, Volume= 32,102 cf
Outflow = 0.21 cfs @ 24.08 hrs, Volume= 15,636 cf, Atten= 94%, Lag= 701.7 min
Discarded = 0.21 cfs @ 24.08 hrs, Volume= 15,636 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 86.36' @ 24.08 hrs Surf.Area= 9,089 sf Storage= 24,089 cf

Plug-Flow detention time= 643.3 min calculated for 15,592 cf (49% of inflow)
Center-of-Mass det. time= 480.0 min (1,435.4 - 955.3)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

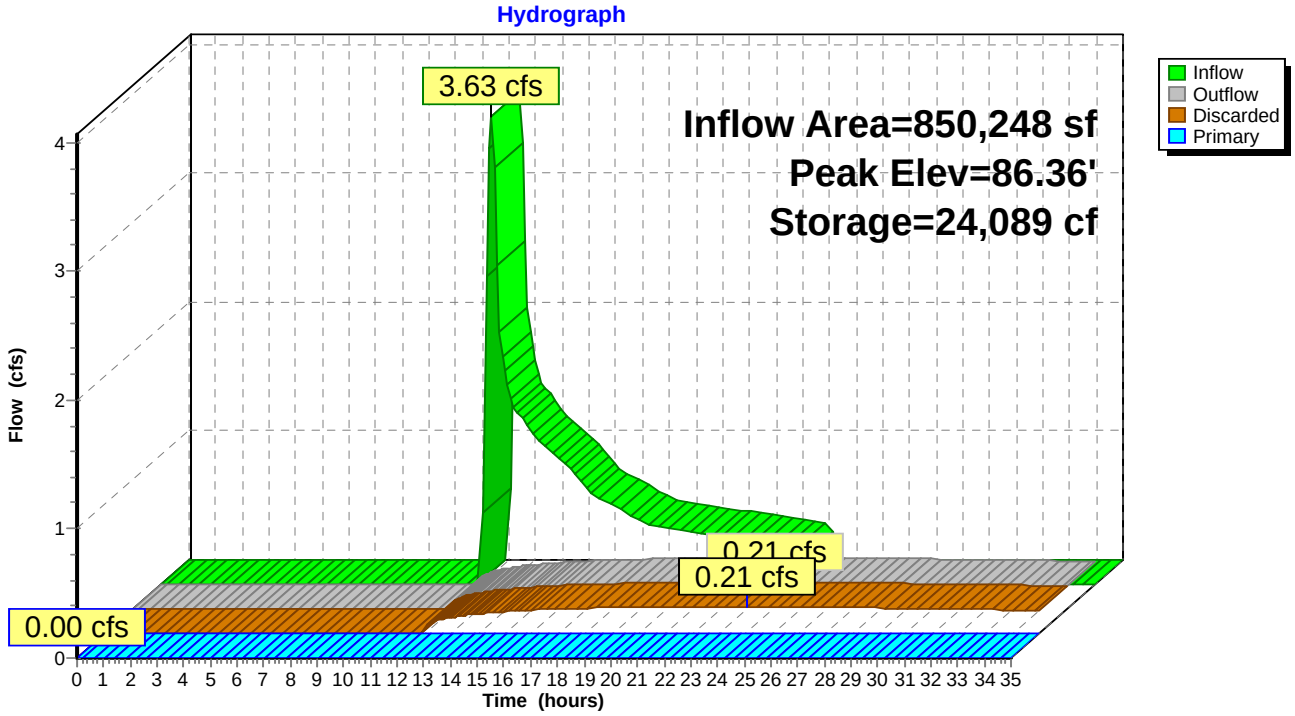
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

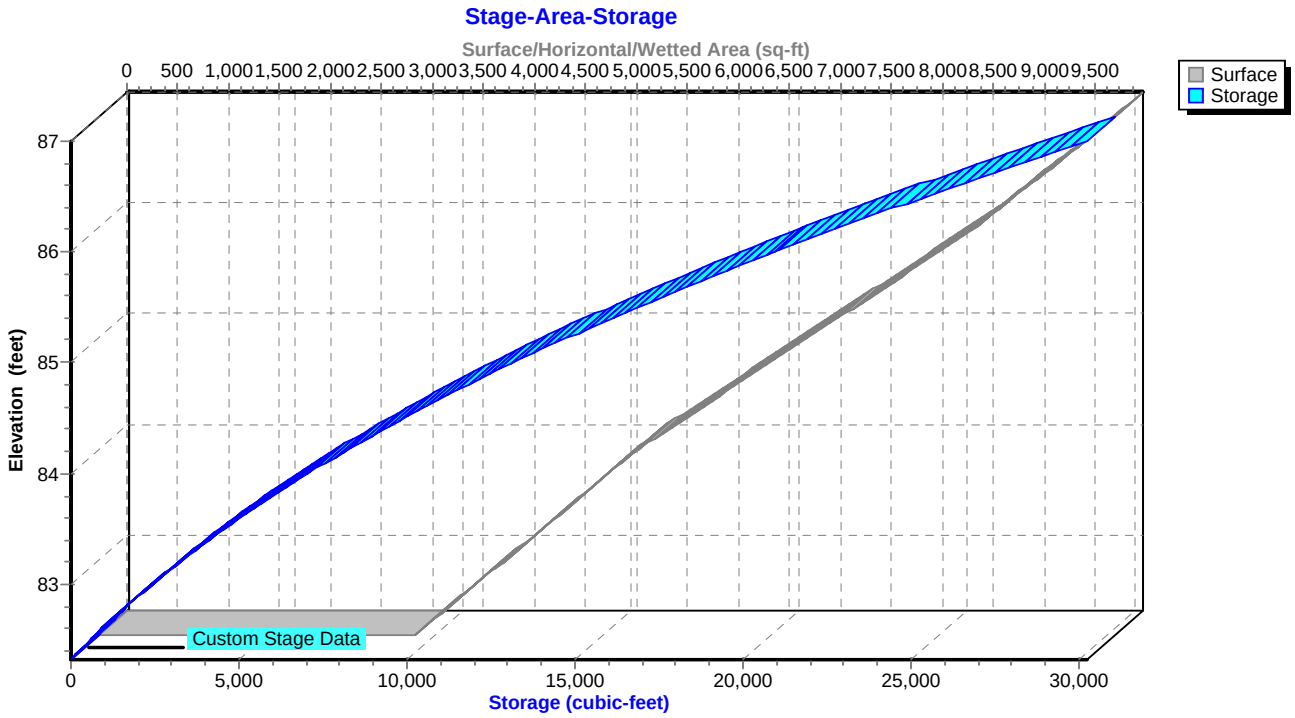
Discarded OutFlow Max=0.21 cfs @ 24.08 hrs HW=86.36' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 3P: Isolated Wetland 1



Pond 3P: Isolated Wetland 1



Summary for Pond 6P: Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.36" for 25 event
Inflow = 2.07 cfs @ 12.44 hrs, Volume= 22,221 cf
Outflow = 0.33 cfs @ 19.07 hrs, Volume= 21,170 cf, Atten= 84%, Lag= 398.1 min
Discarded = 0.33 cfs @ 19.07 hrs, Volume= 21,170 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 76.94' @ 19.07 hrs Surf.Area= 14,278 sf Storage= 10,255 cf

Plug-Flow detention time= 398.2 min calculated for 21,109 cf (95% of inflow)
Center-of-Mass det. time= 377.5 min (1,351.2 - 973.7)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

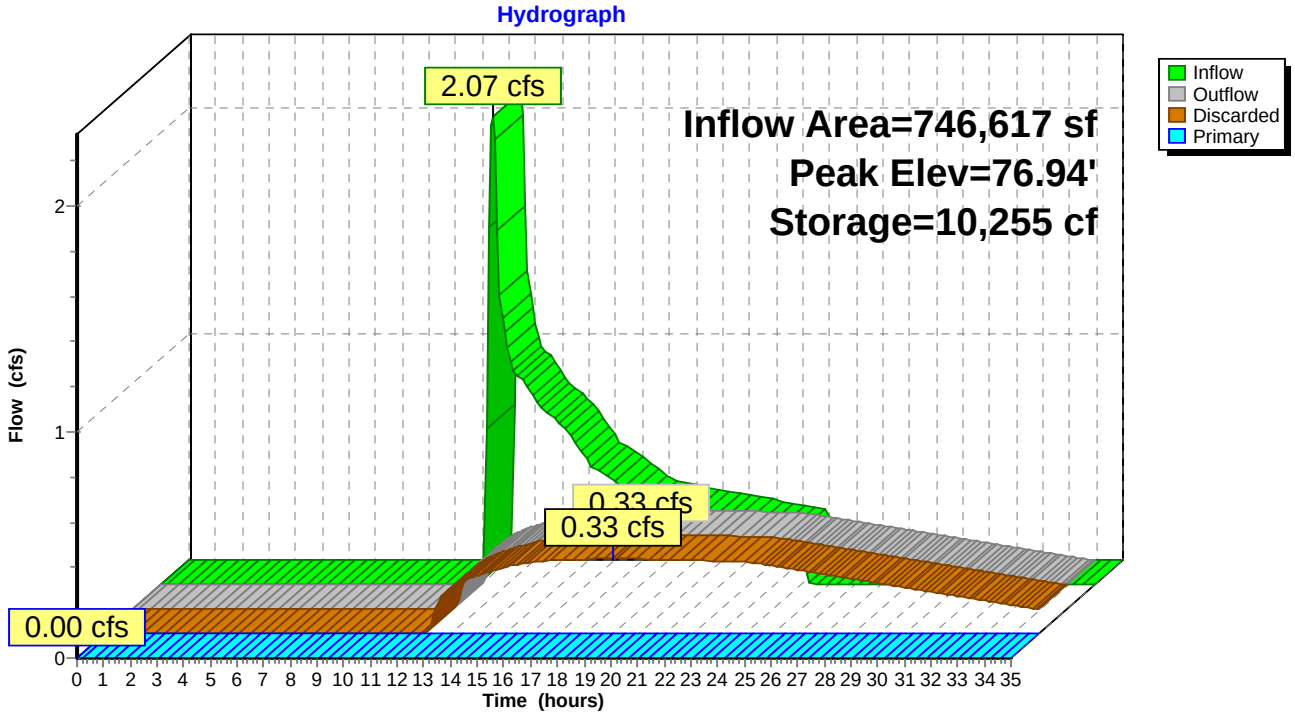
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

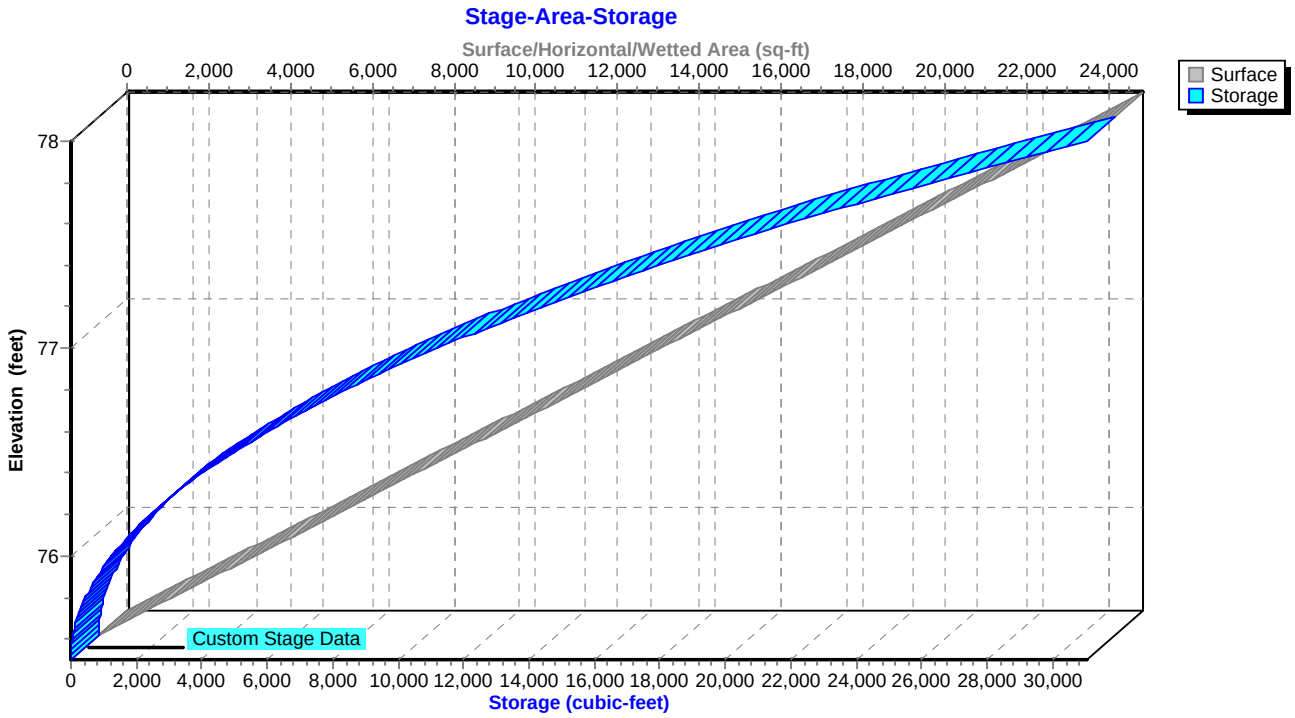
Discarded OutFlow Max=0.33 cfs @ 19.07 hrs HW=76.94' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Isolated Wetland 2



Pond 6P: Isolated Wetland 2

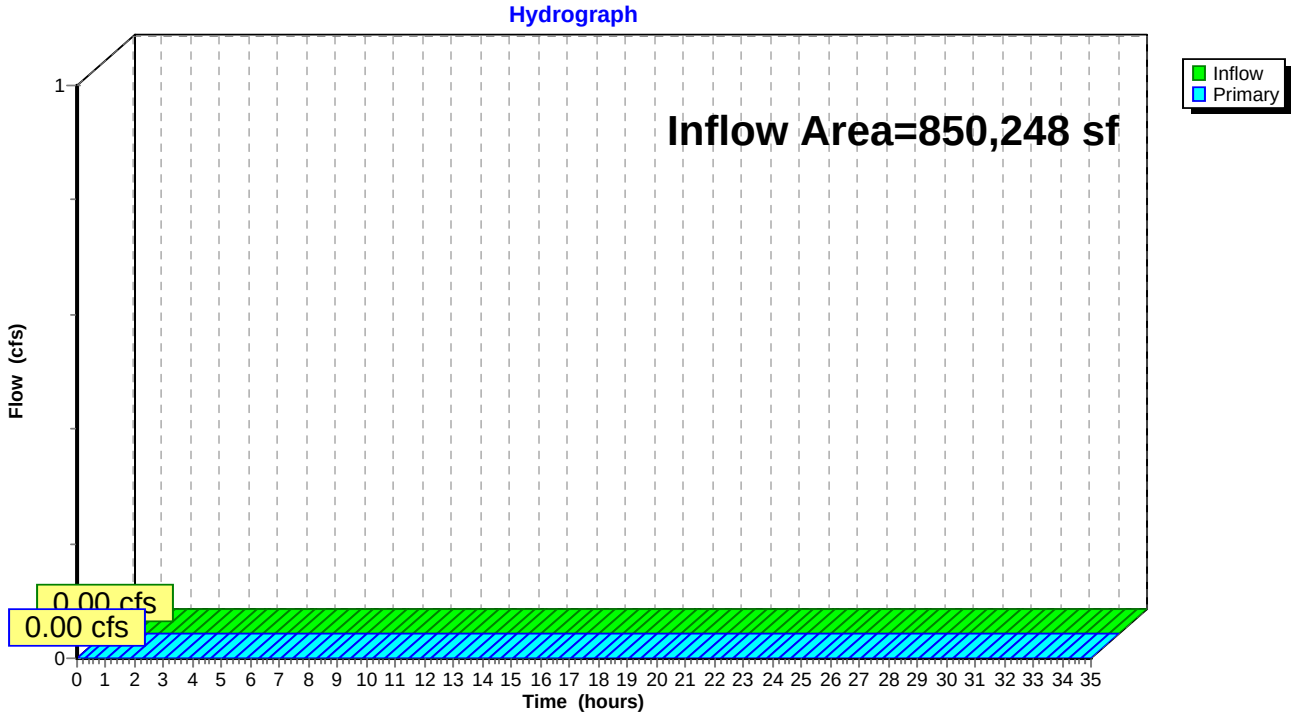


Summary for Link 1L: Flow to Design Point

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.00" for 25 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 1L: Flow to Design Point

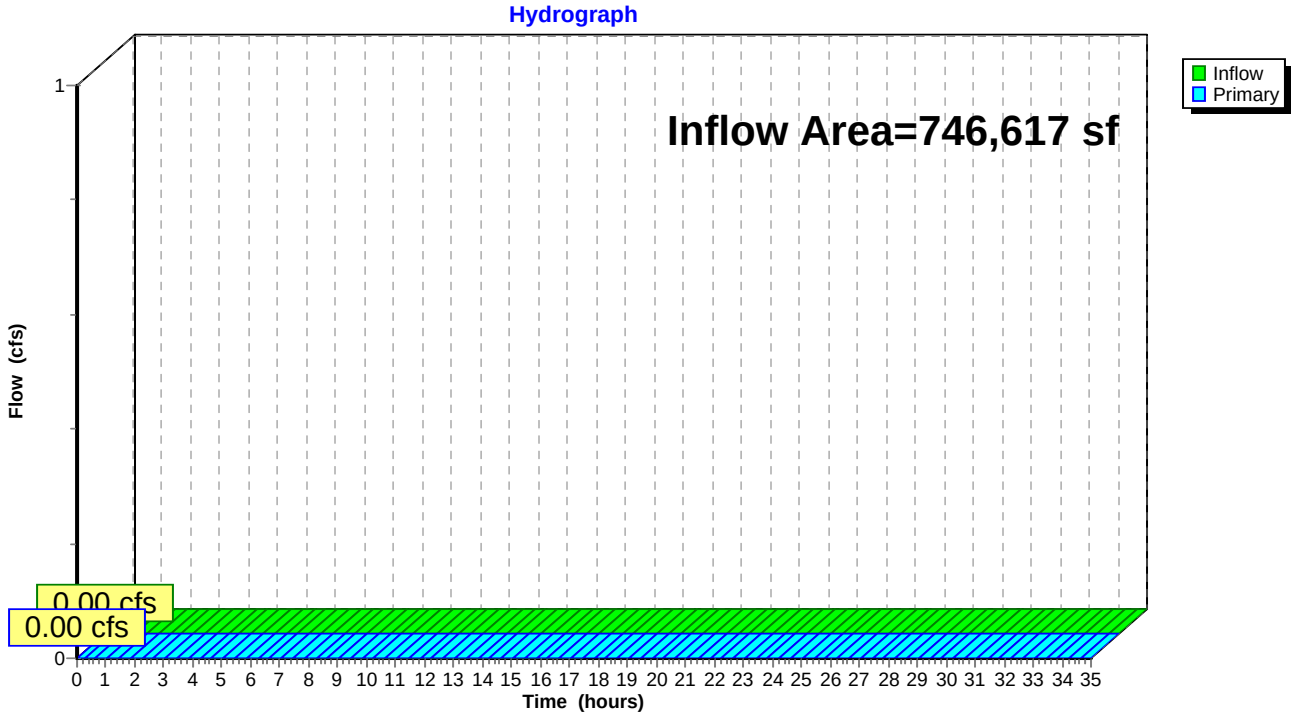


Summary for Link 2L: Flow to Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.00" for 25 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 2L: Flow to Isolated Wetland 2



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Runoff Area=850,248 sf 3.97% Impervious Runoff Depth=0.65"
Tc=10.0 min CN=42 Runoff=6.21 cfs 46,042 cf

Subcatchment E-2: Runoff Area=746,617 sf 1.72% Impervious Runoff Depth=0.53"
Tc=10.0 min CN=40 Runoff=3.88 cfs 33,034 cf

Pond 3P: Isolated Wetland 1 Peak Elev=86.98' Storage=29,981 cf Inflow=6.21 cfs 46,042 cf
Discarded=0.23 cfs 17,749 cf Primary=0.47 cfs 6,900 cf Outflow=0.70 cfs 24,649 cf

Pond 6P: Isolated Wetland 2 Peak Elev=77.36' Storage=17,195 cf Inflow=3.88 cfs 33,034 cf
Discarded=0.43 cfs 29,114 cf Primary=0.00 cfs 0 cf Outflow=0.43 cfs 29,114 cf

Link 1L: Flow to Design Point Inflow=0.47 cfs 6,900 cf
Primary=0.47 cfs 6,900 cf

Link 2L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 1,596,865 sf Runoff Volume = 79,076 cf Average Runoff Depth = 0.59"
97.09% Pervious = 1,550,340 sf 2.91% Impervious = 46,525 sf

Summary for Subcatchment E-1:

[49] Hint: Tc<2dt may require smaller dt

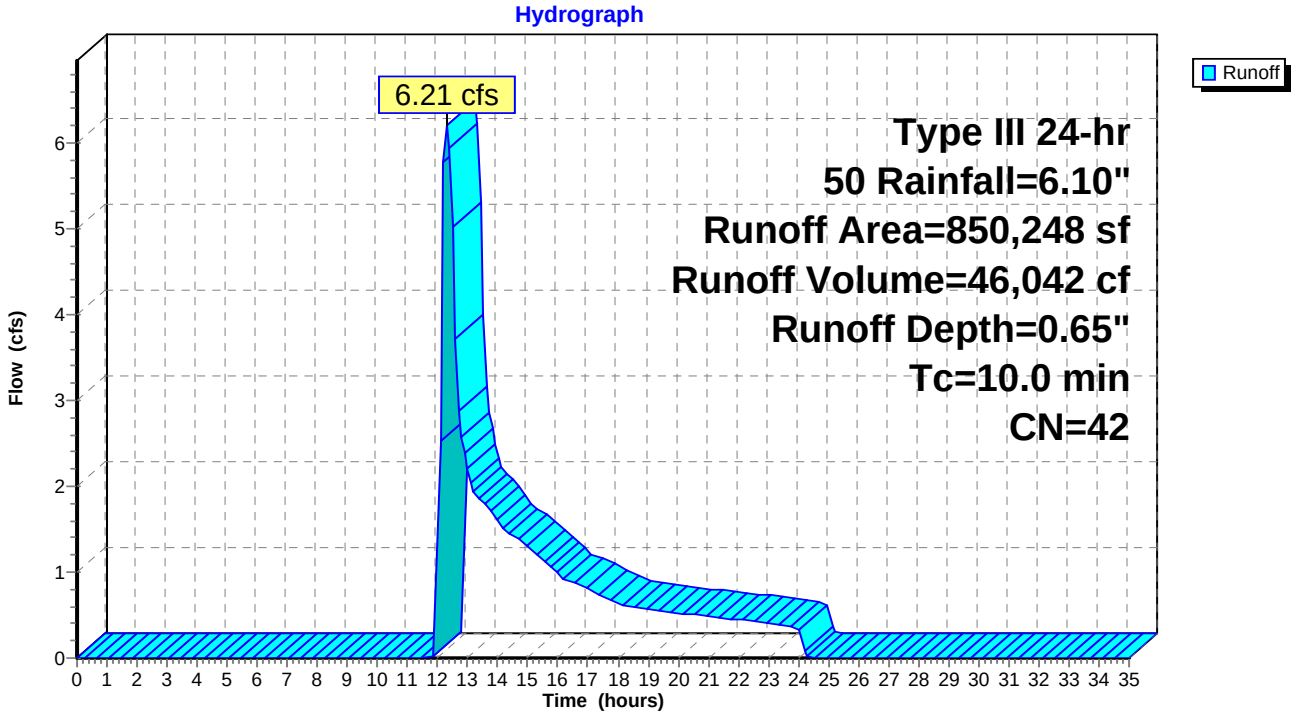
Runoff = 6.21 cfs @ 12.31 hrs, Volume= 46,042 cf, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (sf)	CN	Description
	252,383	39	>75% Grass cover, Good, HSG A
*	16,034	98	Cart Paths
*	5,271	98	wetland
	88,122	36	Woods, Fair, HSG A
*	314,808	39	>75% Grass cover, Good, HSG A
*	5,009	98	Cart Paths
*	5,271	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	7,405	98	Buildings/Pavement-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
	850,248	42	Weighted Average
	816,529		96.03% Pervious Area
	33,719		3.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-1:



Summary for Subcatchment E-2:

[49] Hint: Tc<2dt may require smaller dt

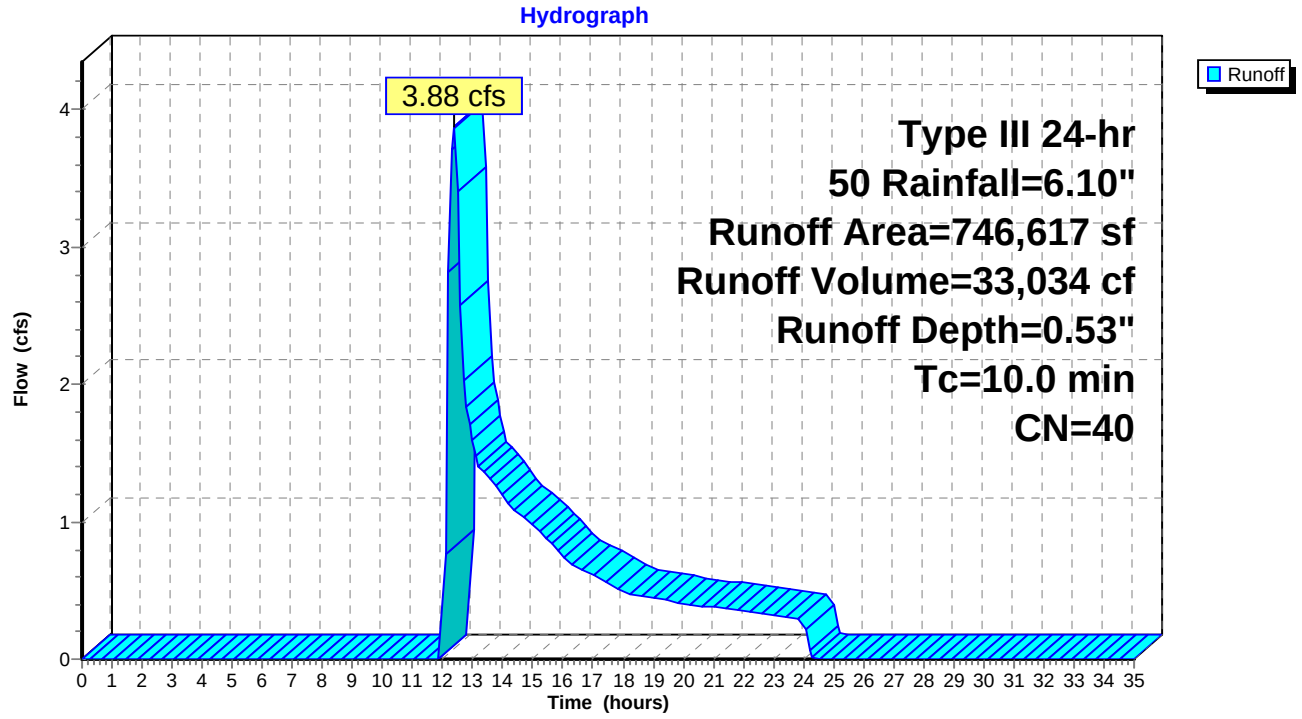
Runoff = 3.88 cfs @ 12.37 hrs, Volume= 33,034 cf, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (sf)	CN	Description
	610,406	39	>75% Grass cover, Good, HSG A
*	4,835	98	Cart Paths
*	7,971	98	wetland
	123,405	36	Woods, Fair, HSG A
	746,617	40	Weighted Average
	733,811		98.28% Pervious Area
	12,806		1.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-2:



Summary for Pond 3P: Isolated Wetland 1

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.65" for 50 event
Inflow = 6.21 cfs @ 12.31 hrs, Volume= 46,042 cf
Outflow = 0.70 cfs @ 17.63 hrs, Volume= 24,649 cf, Atten= 89%, Lag= 318.9 min
Discarded = 0.23 cfs @ 17.63 hrs, Volume= 17,749 cf
Primary = 0.47 cfs @ 17.63 hrs, Volume= 6,900 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 86.98' @ 17.63 hrs Surf.Area= 9,932 sf Storage= 29,981 cf

Plug-Flow detention time= 577.0 min calculated for 24,649 cf (54% of inflow)
Center-of-Mass det. time= 425.0 min (1,361.6 - 936.6)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

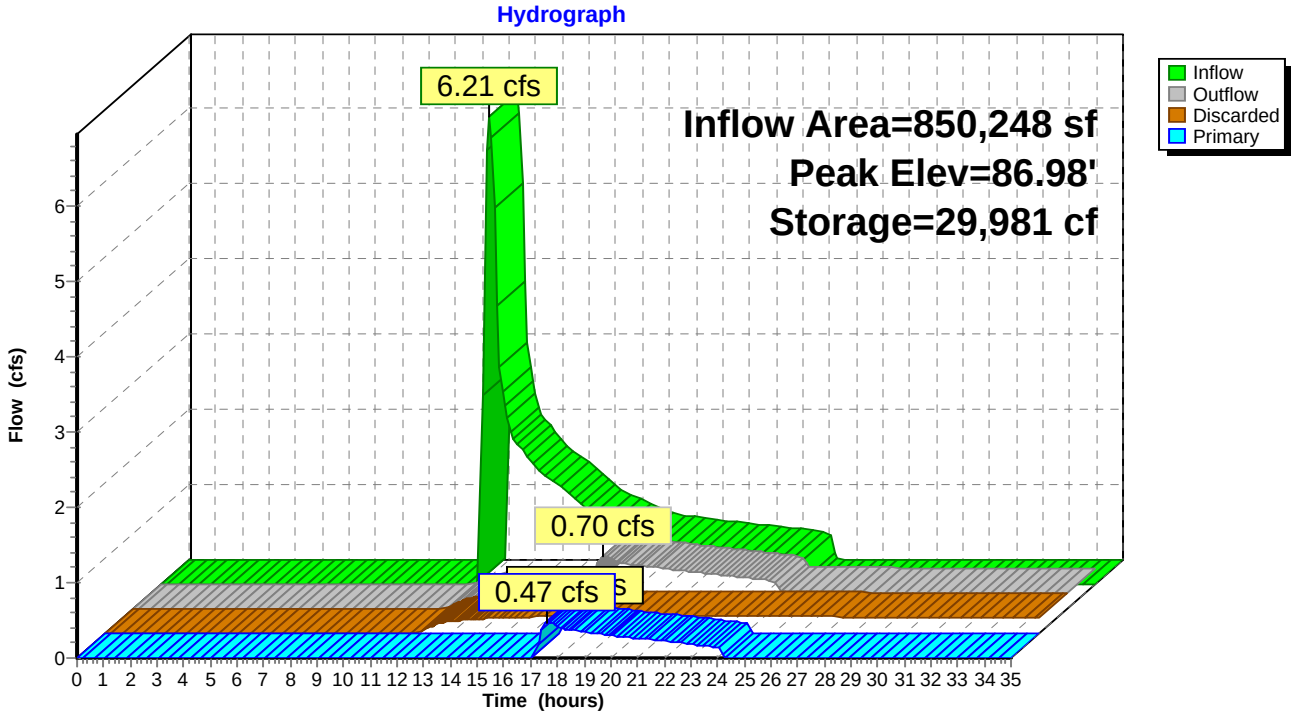
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

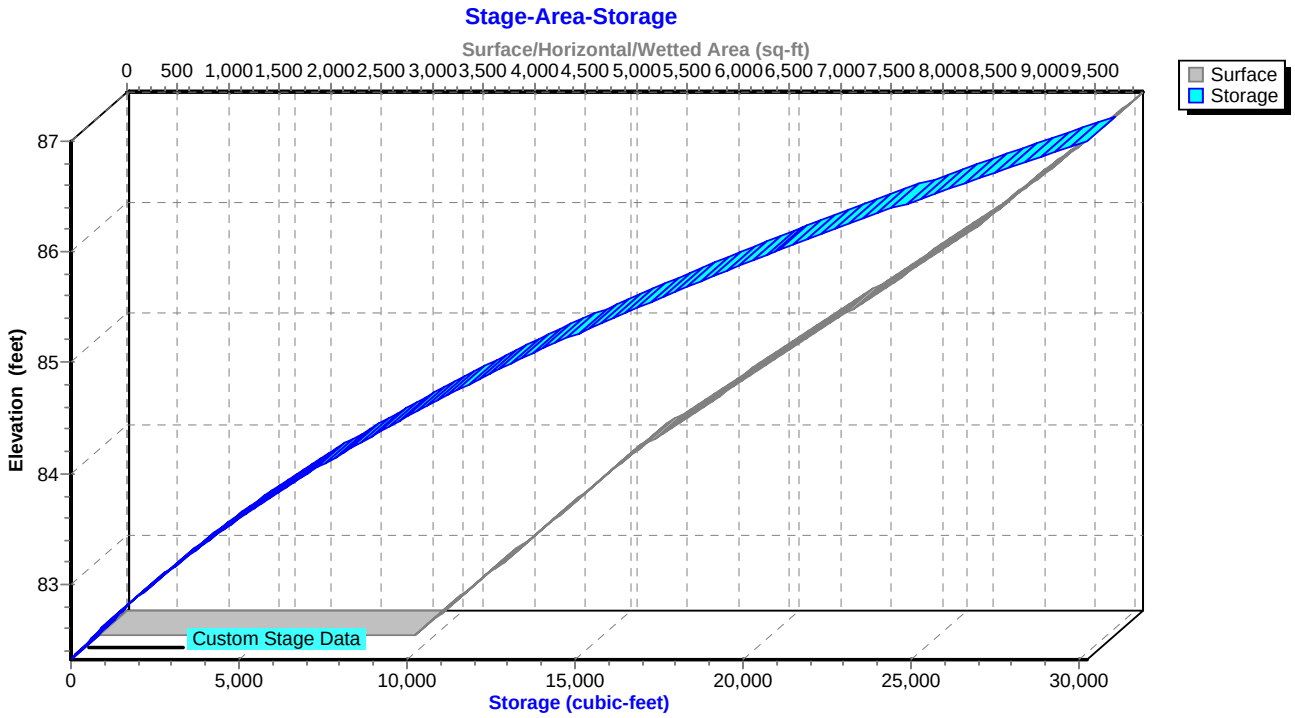
Discarded OutFlow Max=0.23 cfs @ 17.63 hrs HW=86.98' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.47 cfs @ 17.63 hrs HW=86.98' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.47 cfs @ 0.39 fps)

Pond 3P: Isolated Wetland 1



Pond 3P: Isolated Wetland 1



Summary for Pond 6P: Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.53" for 50 event
Inflow = 3.88 cfs @ 12.37 hrs, Volume= 33,034 cf
Outflow = 0.43 cfs @ 19.43 hrs, Volume= 29,114 cf, Atten= 89%, Lag= 423.1 min
Discarded = 0.43 cfs @ 19.43 hrs, Volume= 29,114 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 77.36' @ 19.43 hrs Surf.Area= 18,488 sf Storage= 17,195 cf

Plug-Flow detention time= 473.2 min calculated for 29,031 cf (88% of inflow)
Center-of-Mass det. time= 421.1 min (1,372.3 - 951.2)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

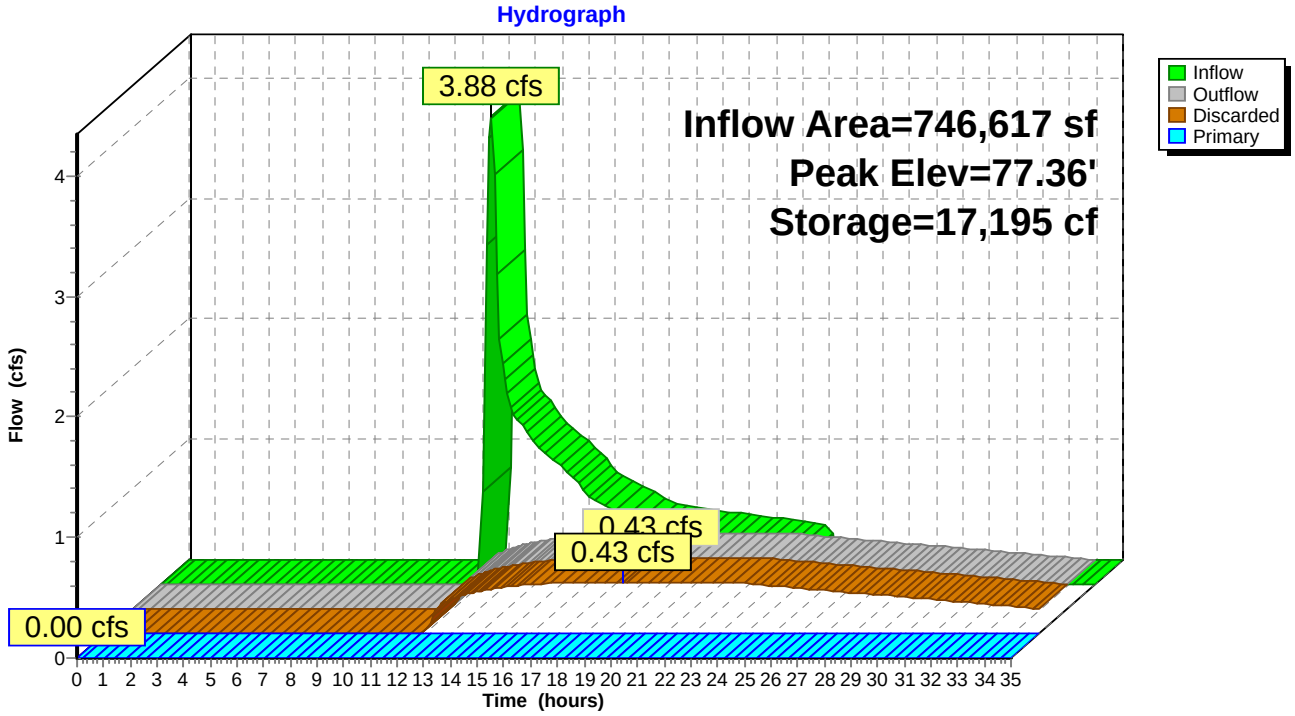
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

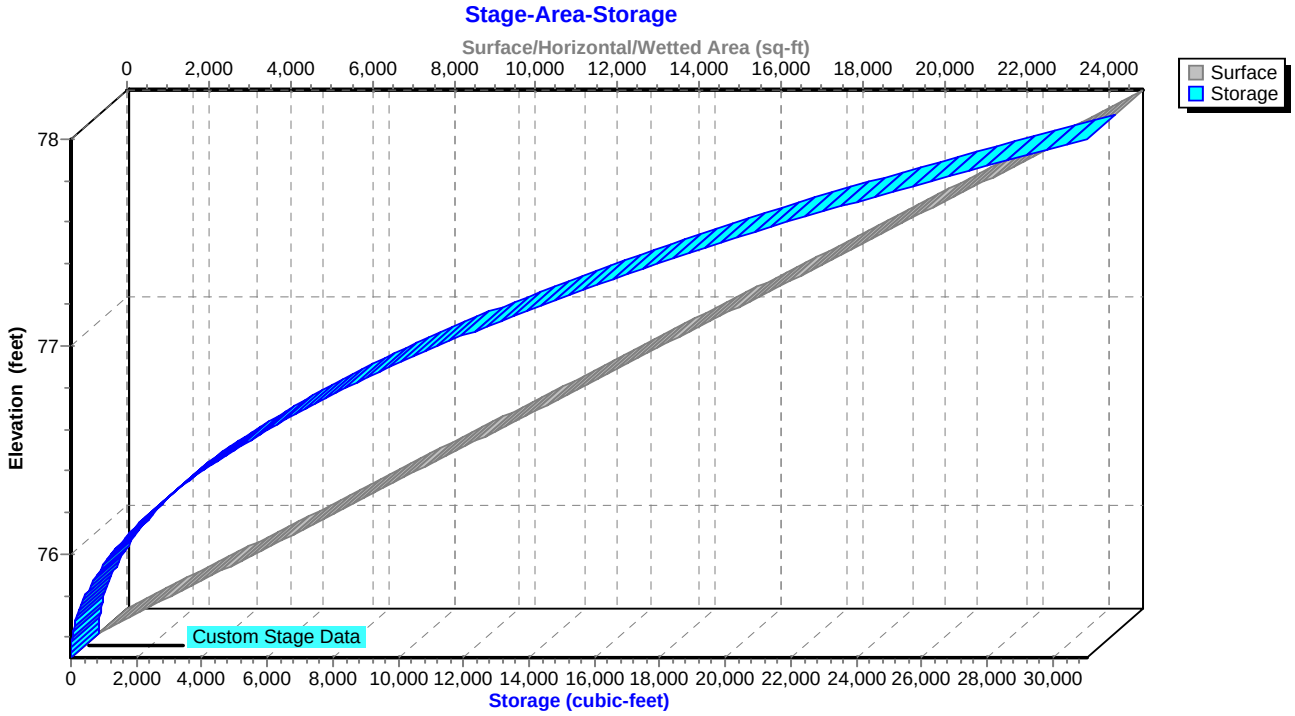
Discarded OutFlow Max=0.43 cfs @ 19.43 hrs HW=77.36' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Isolated Wetland 2



Pond 6P: Isolated Wetland 2

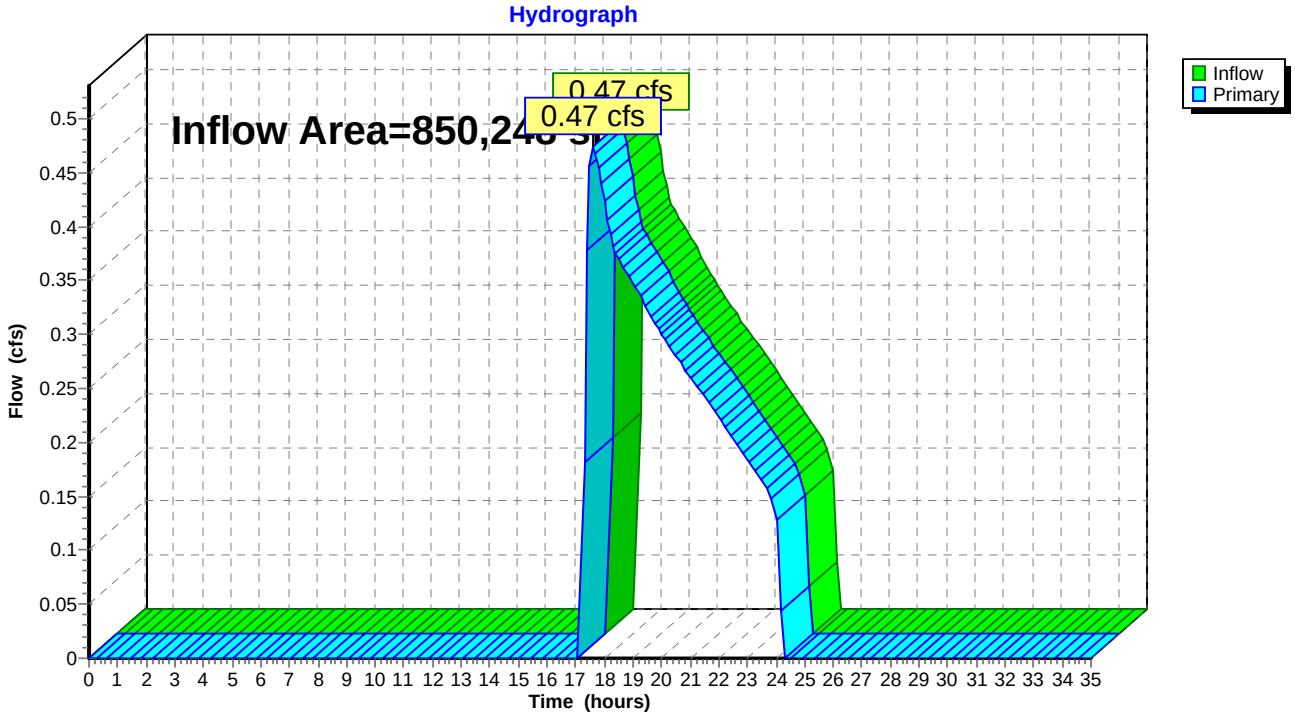


Summary for Link 1L: Flow to Design Point

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.10" for 50 event
Inflow = 0.47 cfs @ 17.63 hrs, Volume= 6,900 cf
Primary = 0.47 cfs @ 17.63 hrs, Volume= 6,900 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 1L: Flow to Design Point

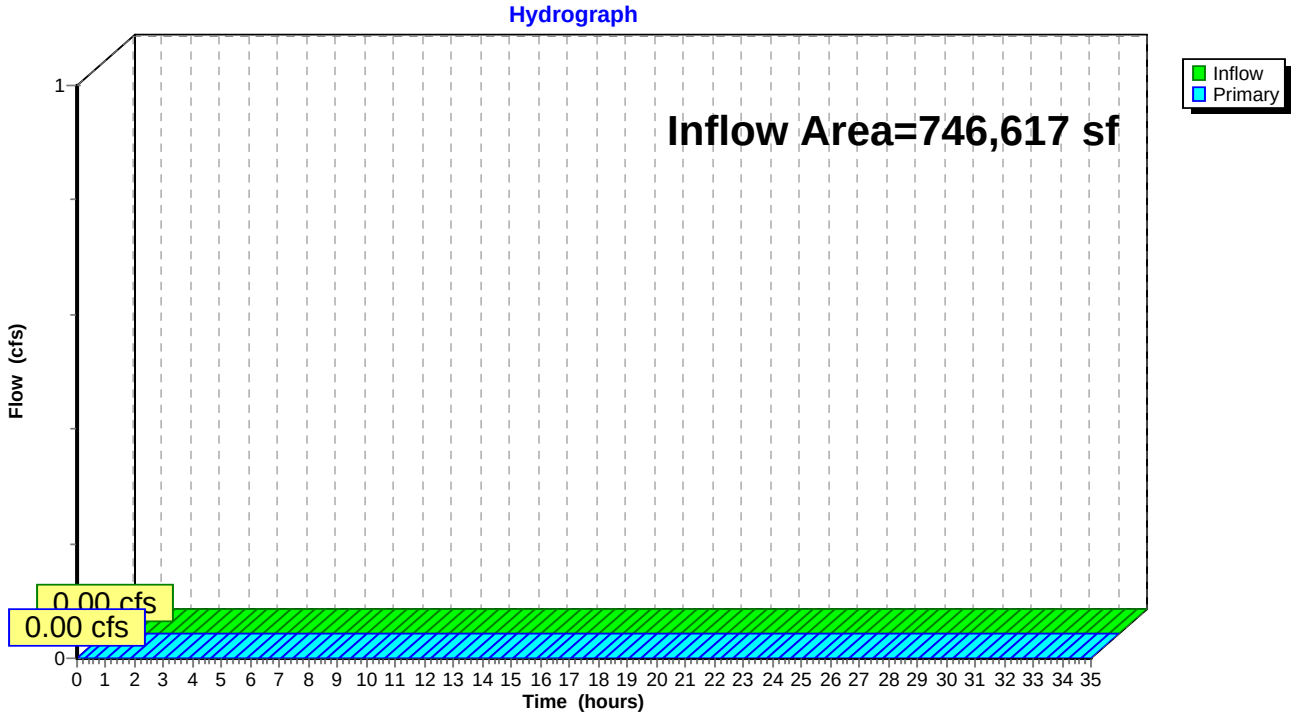


Summary for Link 2L: Flow to Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.00" for 50 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 2L: Flow to Isolated Wetland 2



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Runoff Area=850,248 sf 3.97% Impervious Runoff Depth=0.87"
Tc=10.0 min CN=42 Runoff=10.28 cfs 61,915 cf

Subcatchment E-2: Runoff Area=746,617 sf 1.72% Impervious Runoff Depth=0.73"
Tc=10.0 min CN=40 Runoff=6.25 cfs 45,549 cf

Pond 3P: Isolated Wetland 1 Peak Elev=87.01' Storage=30,223 cf Inflow=10.28 cfs 61,915 cf
Discarded=0.23 cfs 18,161 cf Primary=1.66 cfs 22,335 cf Outflow=1.89 cfs 40,496 cf

Pond 6P: Isolated Wetland 2 Peak Elev=77.78' Storage=25,797 cf Inflow=6.25 cfs 45,549 cf
Discarded=0.52 cfs 36,978 cf Primary=0.00 cfs 0 cf Outflow=0.52 cfs 36,978 cf

Link 1L: Flow to Design Point Inflow=1.66 cfs 22,335 cf
Primary=1.66 cfs 22,335 cf

Link 2L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 1,596,865 sf Runoff Volume = 107,464 cf Average Runoff Depth = 0.81"
97.09% Pervious = 1,550,340 sf 2.91% Impervious = 46,525 sf

Summary for Subcatchment E-1:

[49] Hint: Tc<2dt may require smaller dt

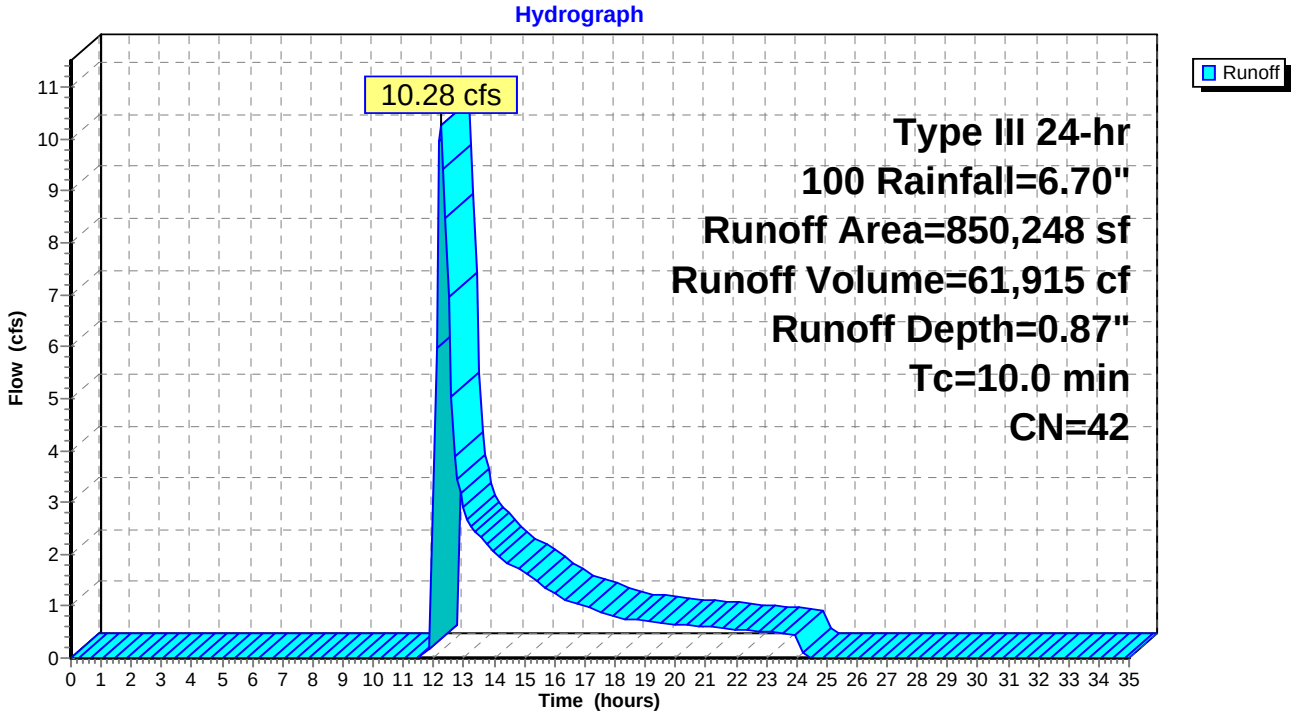
Runoff = 10.28 cfs @ 12.24 hrs, Volume= 61,915 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 Rainfall=6.70"

	Area (sf)	CN	Description
	252,383	39	>75% Grass cover, Good, HSG A
*	16,034	98	Cart Paths
*	5,271	98	wetland
	88,122	36	Woods, Fair, HSG A
*	314,808	39	>75% Grass cover, Good, HSG A
*	5,009	98	Cart Paths
*	5,271	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	7,405	98	Buildings/Pavement-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
	850,248	42	Weighted Average
	816,529		96.03% Pervious Area
	33,719		3.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-1:



Summary for Subcatchment E-2:

[49] Hint: Tc<2dt may require smaller dt

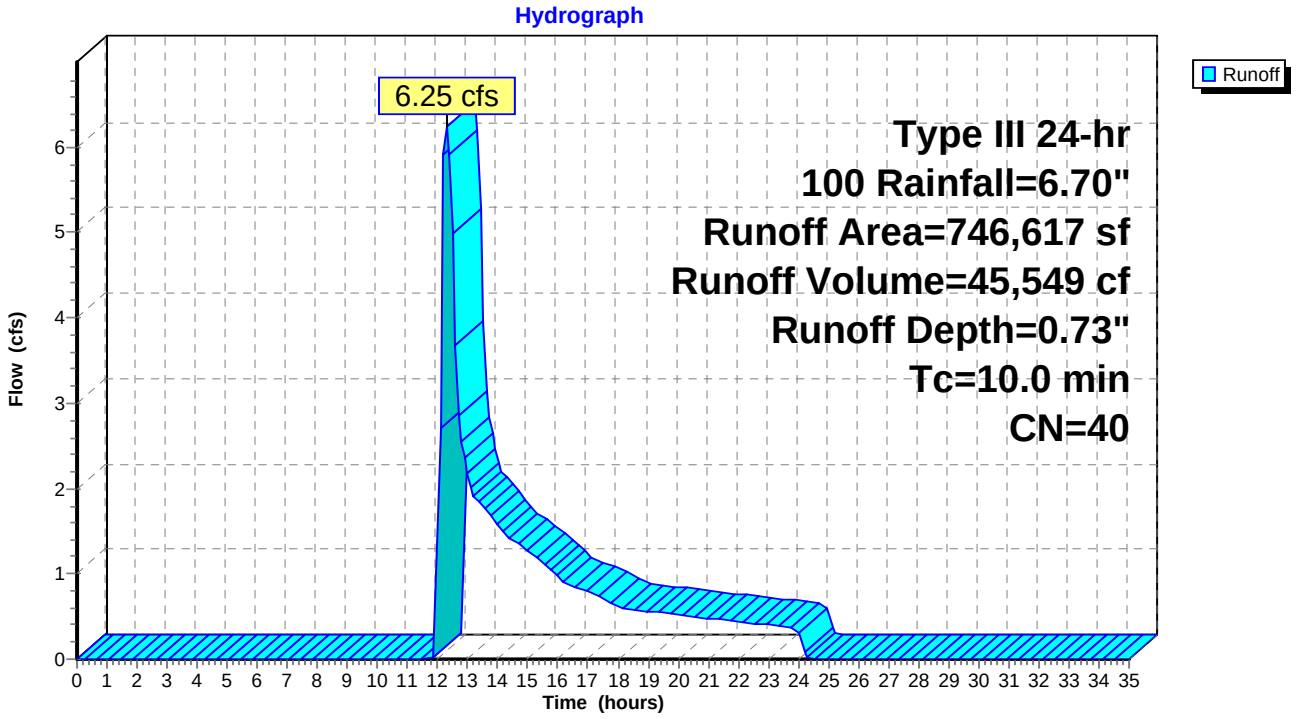
Runoff = 6.25 cfs @ 12.30 hrs, Volume= 45,549 cf, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 Rainfall=6.70"

	Area (sf)	CN	Description
	610,406	39	>75% Grass cover, Good, HSG A
*	4,835	98	Cart Paths
*	7,971	98	wetland
	123,405	36	Woods, Fair, HSG A
	746,617	40	Weighted Average
	733,811		98.28% Pervious Area
	12,806		1.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment E-2:



Summary for Pond 3P: Isolated Wetland 1

[93] Warning: Storage range exceeded by 0.01'
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.87" for 100 event
Inflow = 10.28 cfs @ 12.24 hrs, Volume= 61,915 cf
Outflow = 1.89 cfs @ 14.49 hrs, Volume= 40,496 cf, Atten= 82%, Lag= 135.0 min
Discarded = 0.23 cfs @ 14.40 hrs, Volume= 18,161 cf
Primary = 1.66 cfs @ 14.49 hrs, Volume= 22,335 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 87.01' @ 14.49 hrs Surf.Area= 9,965 sf Storage= 30,223 cf

Plug-Flow detention time= 415.7 min calculated for 40,381 cf (65% of inflow)
Center-of-Mass det. time= 293.2 min (1,215.8 - 922.6)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

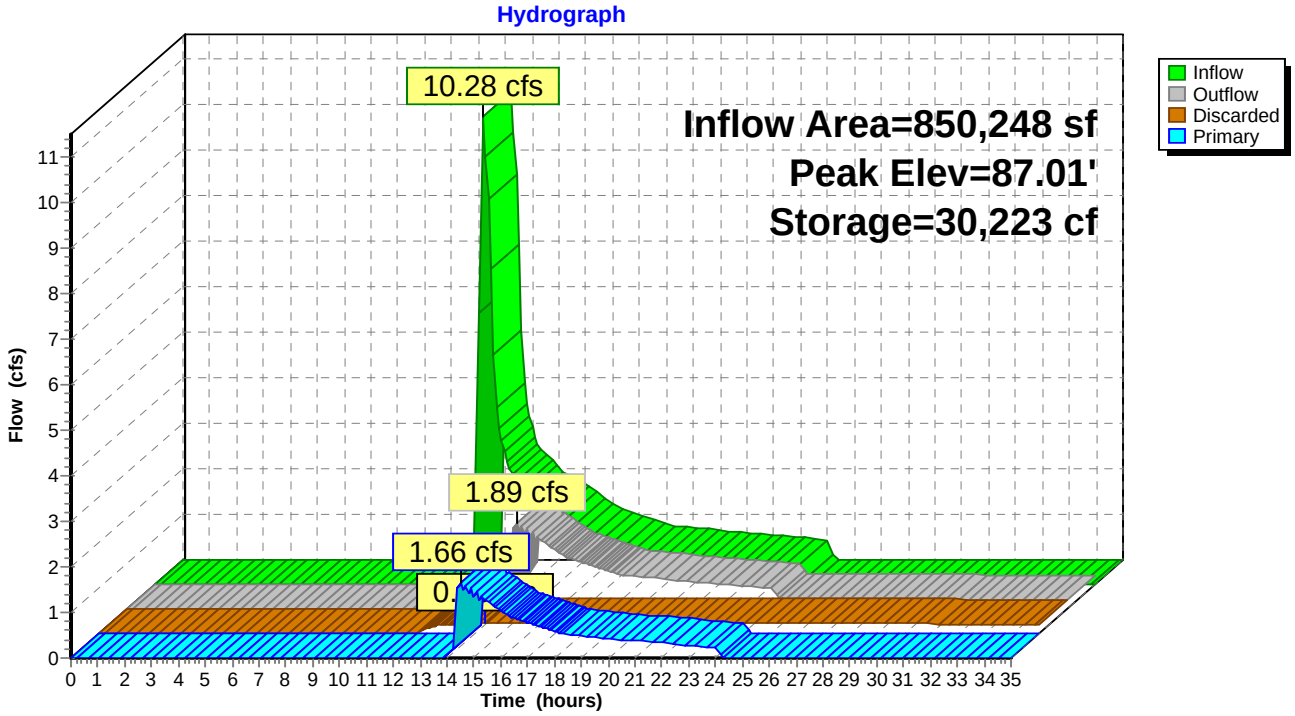
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

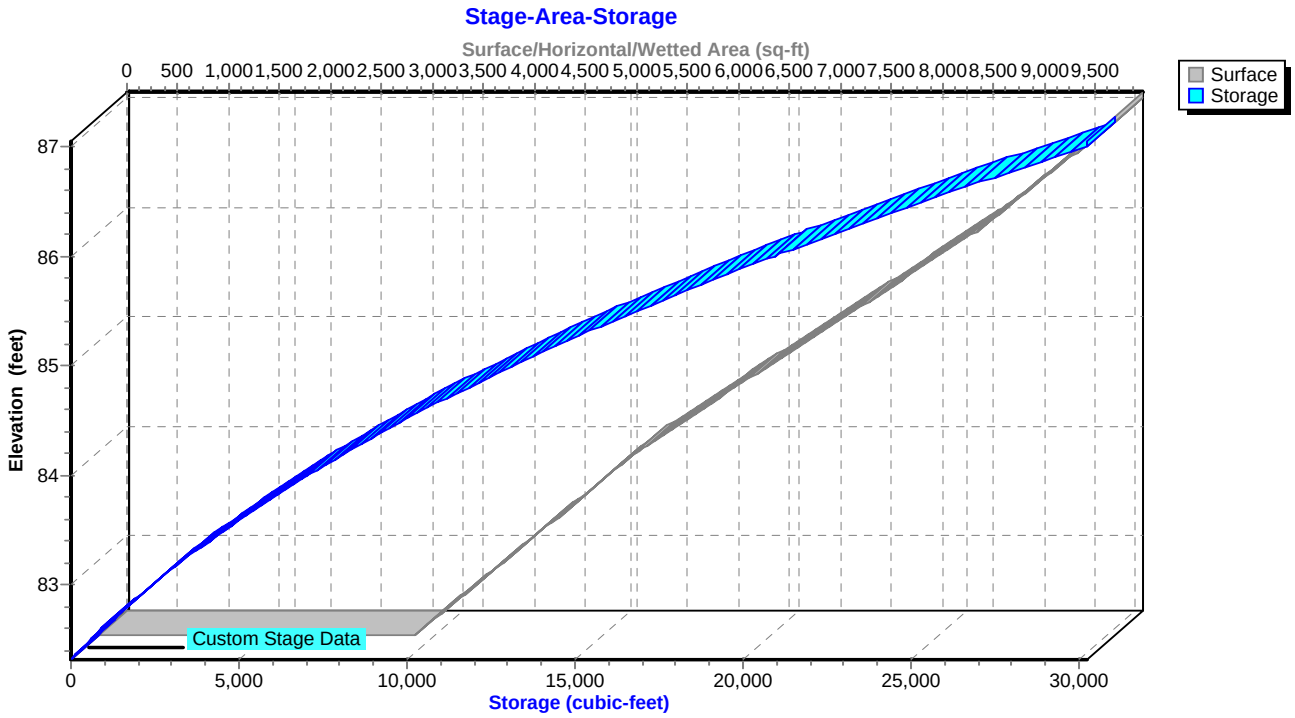
Discarded OutFlow Max=0.23 cfs @ 14.40 hrs HW=87.01' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=1.65 cfs @ 14.49 hrs HW=87.01' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 1.65 cfs @ 0.60 fps)

Pond 3P: Isolated Wetland 1



Pond 3P: Isolated Wetland 1



Summary for Pond 6P: Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.73" for 100 event
Inflow = 6.25 cfs @ 12.30 hrs, Volume= 45,549 cf
Outflow = 0.52 cfs @ 19.78 hrs, Volume= 36,978 cf, Atten= 92%, Lag= 448.9 min
Discarded = 0.52 cfs @ 19.78 hrs, Volume= 36,978 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 77.78' @ 19.78 hrs Surf.Area= 22,645 sf Storage= 25,797 cf

Plug-Flow detention time= 529.8 min calculated for 36,978 cf (81% of inflow)
Center-of-Mass det. time= 449.7 min (1,384.4 - 934.8)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

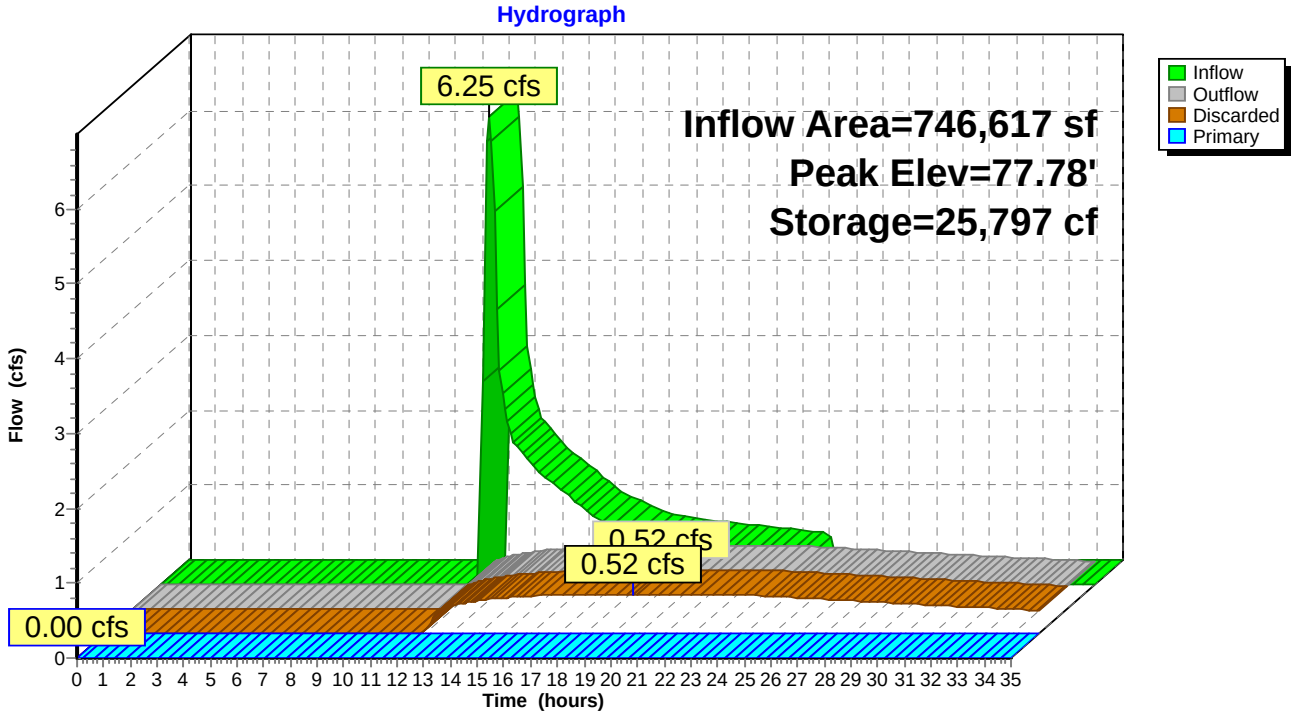
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

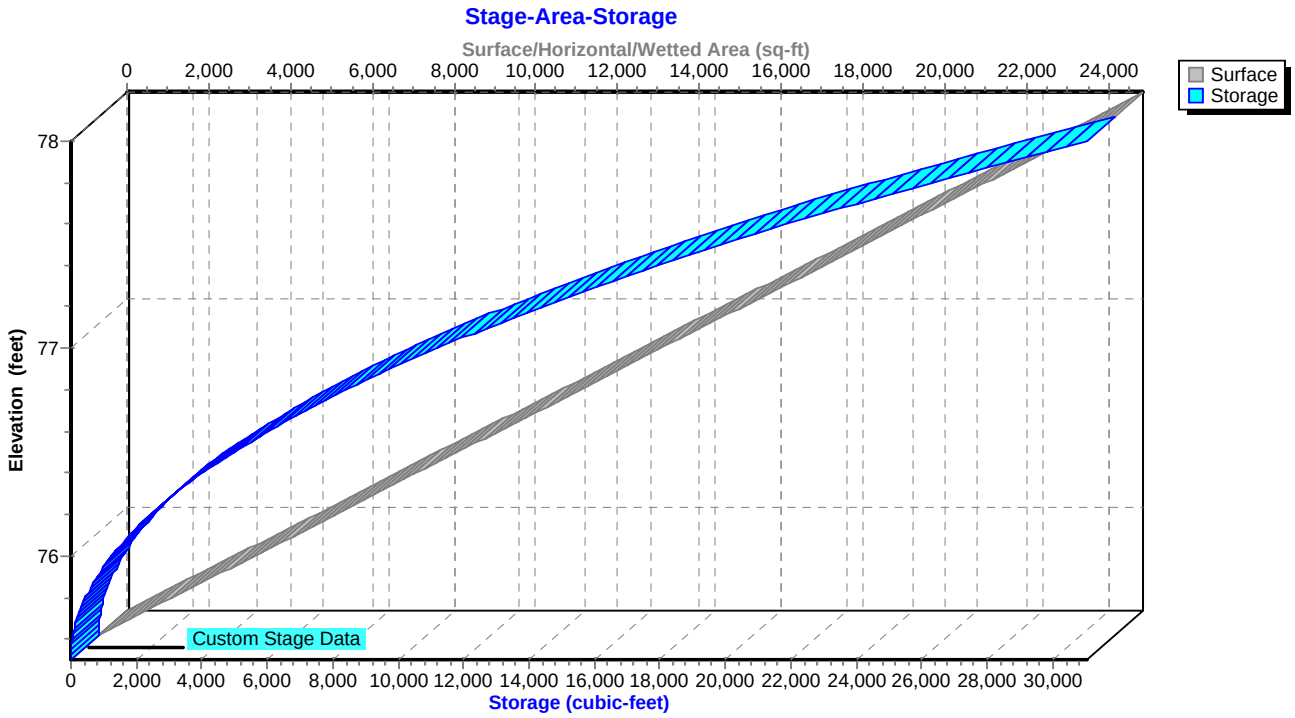
Discarded OutFlow Max=0.52 cfs @ 19.78 hrs HW=77.78' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Isolated Wetland 2



Pond 6P: Isolated Wetland 2

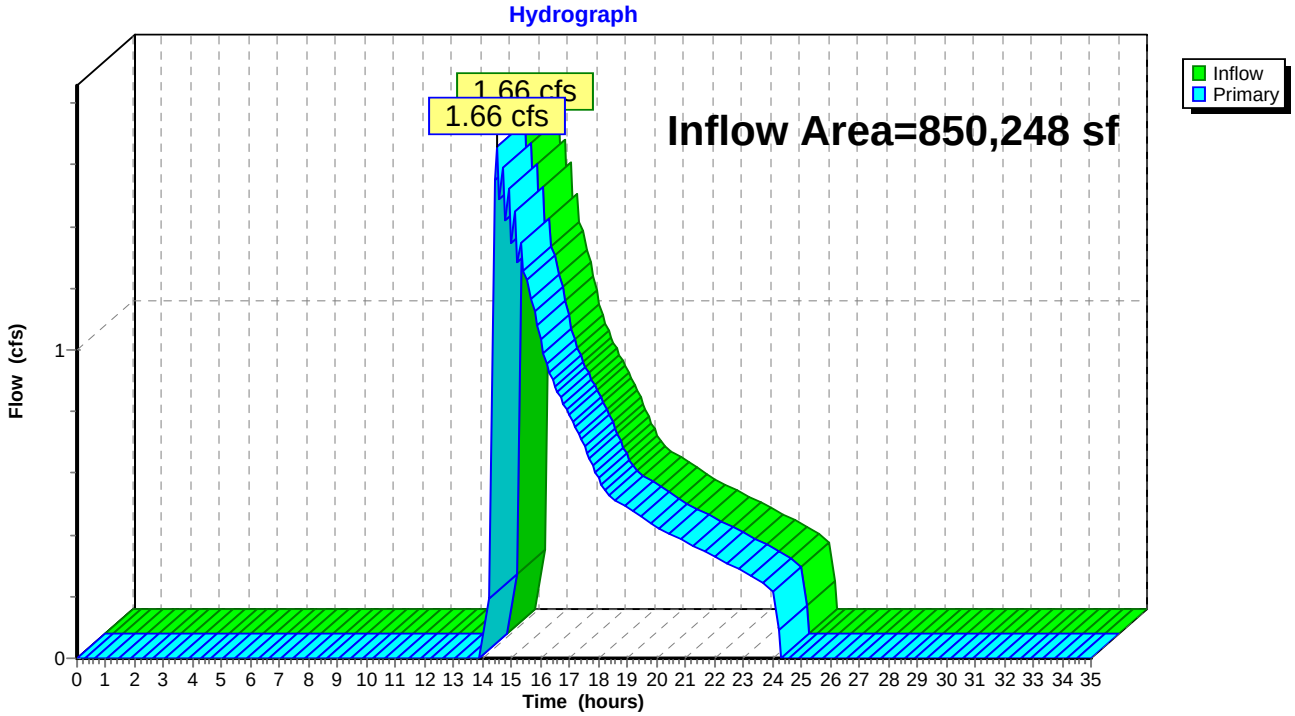


Summary for Link 1L: Flow to Design Point

Inflow Area = 850,248 sf, 3.97% Impervious, Inflow Depth = 0.32" for 100 event
Inflow = 1.66 cfs @ 14.49 hrs, Volume= 22,335 cf
Primary = 1.66 cfs @ 14.49 hrs, Volume= 22,335 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 1L: Flow to Design Point

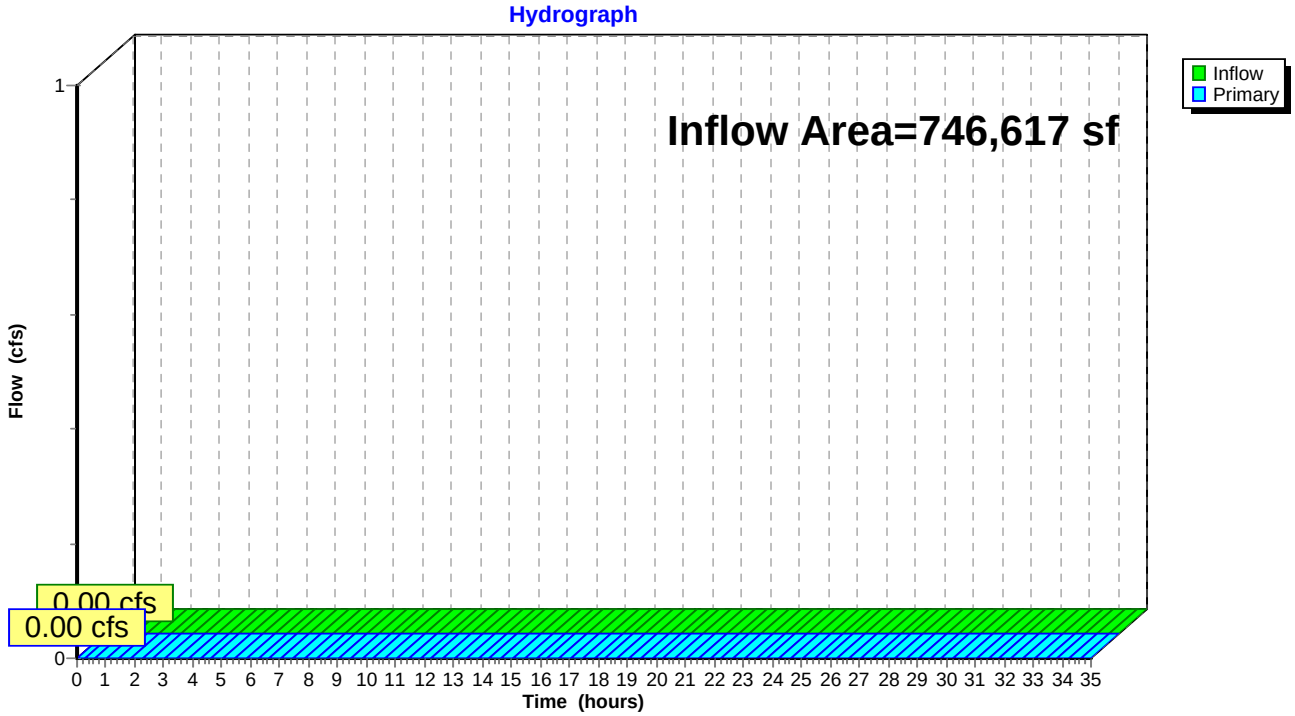


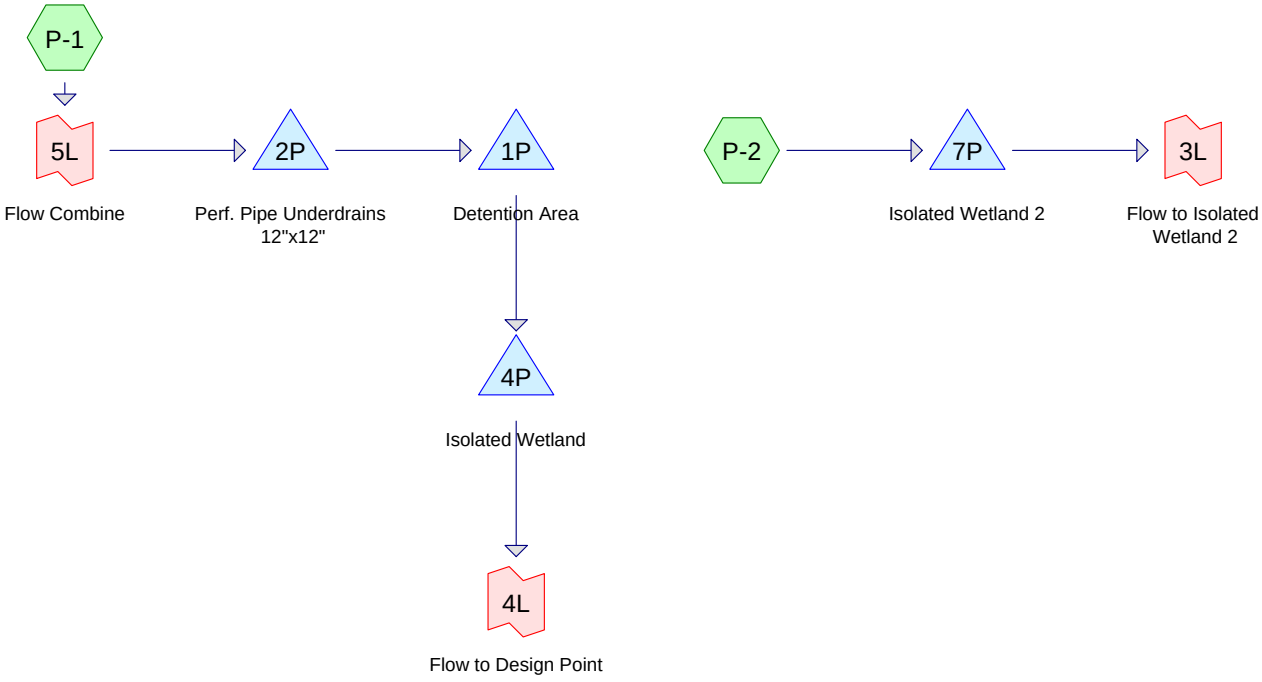
Summary for Link 2L: Flow to Isolated Wetland 2

Inflow Area = 746,617 sf, 1.72% Impervious, Inflow Depth = 0.00" for 100 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 2L: Flow to Isolated Wetland 2





Subcat Reach Pond Link

Routing Diagram for 1828-02E - Drainage Routing - Revision 1
Prepared by Microsoft, Printed 1/7/2016

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
70,219	49	50-75% Grass cover, Fair, HSG A-offsite (P-1)
1,203,040	39	>75% Grass cover, Good, HSG A (P-1, P-2)
7,405	98	Buildings/Driveways-offsite (P-1)
20,865	98	Cart Paths (P-1, P-2)
3,746	98	New Cart Paths (P-2)
180,512	36	Woods, Fair, HSG A (P-1, P-2)
85,726	36	Woods, Fair, HSG A-offsite (P-1)
12,153	98	new cart paths (P-1)
13,242	98	wetland (P-1, P-2)
1,596,909	**41**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
1,539,497	HSG A	P-1, P-2
0	HSG B	
0	HSG C	
0	HSG D	
57,412	Other	P-1, P-2
1,596,909		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
70,219	0	0	0	0	70,219	50-75% Grass cover, Fair	
1,203,040	0	0	0	0	1,203,040	>75% Grass cover, Good	
0	0	0	0	7,405	7,405	Buildings/Driveways-offsite	
0	0	0	0	20,865	20,865	Cart Paths	
0	0	0	0	3,746	3,746	New Cart Paths	
266,238	0	0	0	0	266,238	Woods, Fair	
0	0	0	0	12,153	12,153	new cart paths	
0	0	0	0	13,242	13,242	wetland	
1,539,497	**0**	**0**	**0**	**57,412**	**1,596,909**	**TOTAL AREA**	

Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1: Runoff Area=853,340 sf 4.79% Impervious Runoff Depth=0.01"
Tc=10.0 min CN=42 Runoff=0.04 cfs 958 cf

Subcatchment P-2: Runoff Area=17.070 ac 2.23% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=40 Runoff=0.01 cfs 163 cf

Pond 1P: Detention Area Peak Elev=95.50' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond 2P: Perf. Pipe Underdrains 12"x12" Peak Elev=100.00' Storage=0 cf Inflow=0.04 cfs 958 cf
Discarded=0.04 cfs 958 cf Primary=0.00 cfs 0 cf Outflow=0.04 cfs 958 cf

Pond 4P: Isolated Wetland Peak Elev=82.32' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond 7P: Isolated Wetland 2 Peak Elev=75.55' Storage=13 cf Inflow=0.01 cfs 163 cf
Discarded=0.01 cfs 163 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 163 cf

Link 3L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 4L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 5L: Flow Combine Inflow=0.04 cfs 958 cf
Primary=0.04 cfs 958 cf

Total Runoff Area = 1,596,909 sf Runoff Volume = 1,121 cf Average Runoff Depth = 0.01"
96.40% Pervious = 1,539,497 sf 3.60% Impervious = 57,412 sf

Summary for Subcatchment P-1:

[49] Hint: Tc<2dt may require smaller dt

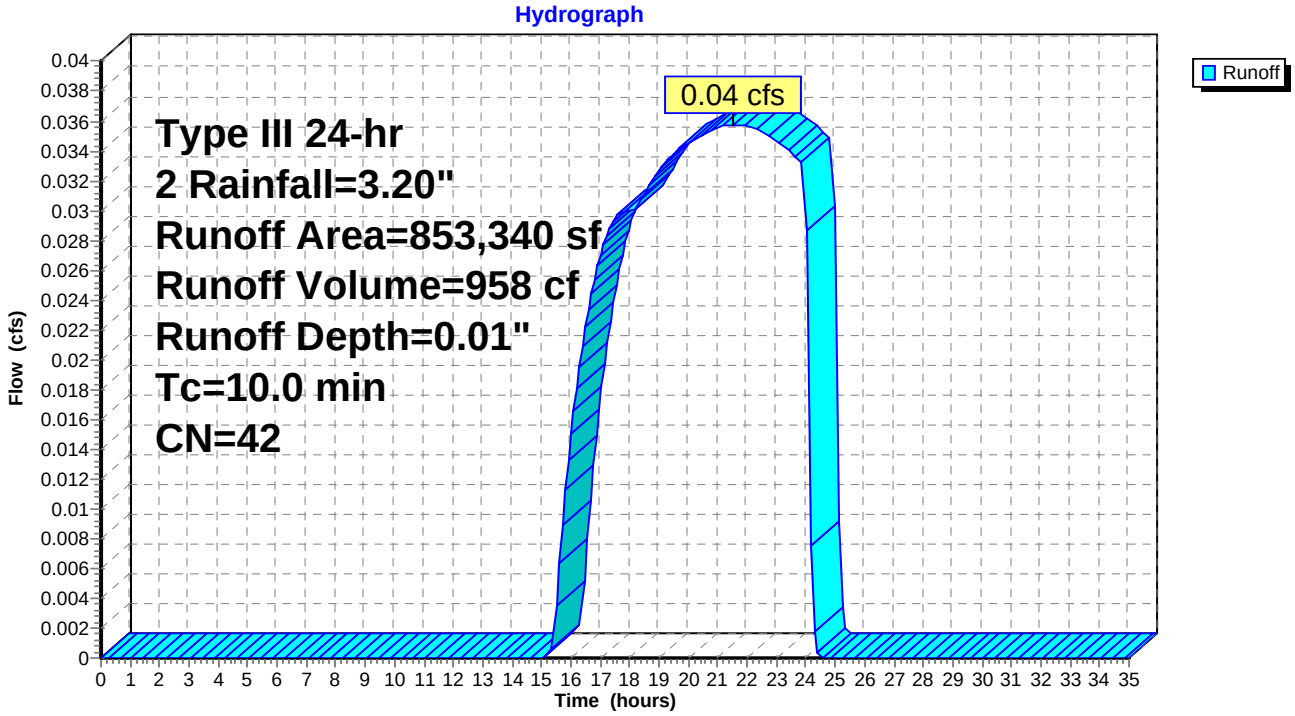
Runoff = 0.04 cfs @ 21.55 hrs, Volume= 958 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (sf)	CN	Description
	258,180	39	>75% Grass cover, Good, HSG A
*	16,030	98	Cart Paths
*	5,271	98	wetland
	44,039	36	Woods, Fair, HSG A
*	12,153	98	new cart paths
*	310,278	39	>75% Grass cover, Good, HSG A
*	44,039	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
*	7,405	98	Buildings/Driveways-offsite
	853,340	42	Weighted Average
	812,481		95.21% Pervious Area
	40,859		4.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-1:



Summary for Subcatchment P-2:

[49] Hint: Tc<2dt may require smaller dt

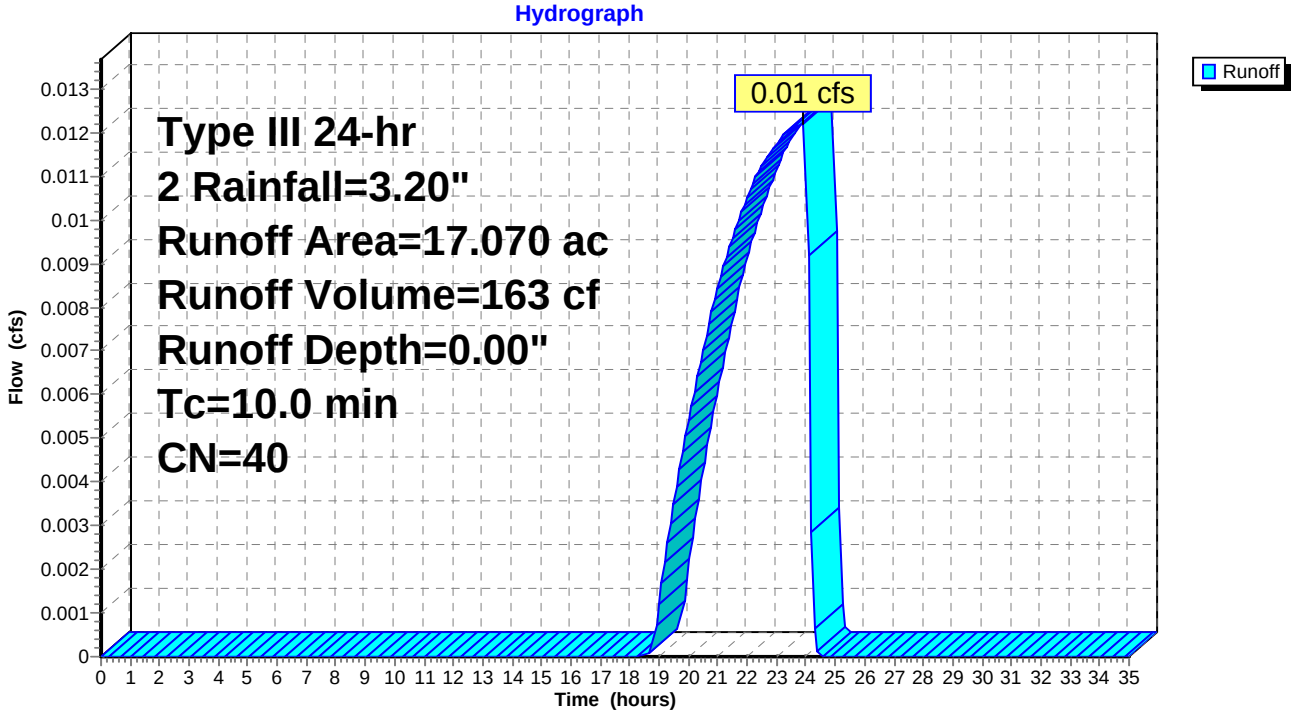
Runoff = 0.01 cfs @ 23.90 hrs, Volume= 163 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (ac)	CN	Description
	14.568	39	>75% Grass cover, Good, HSG A
*	0.111	98	Cart Paths
*	0.183	98	wetland
	2.122	36	Woods, Fair, HSG A
*	0.086	98	New Cart Paths
	17.070	40	Weighted Average
	16.690		97.77% Pervious Area
	0.380		2.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-2:



Summary for Pond 1P: Detention Area

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 95.50' @ 0.00 hrs Surf.Area= 0 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	9,643 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

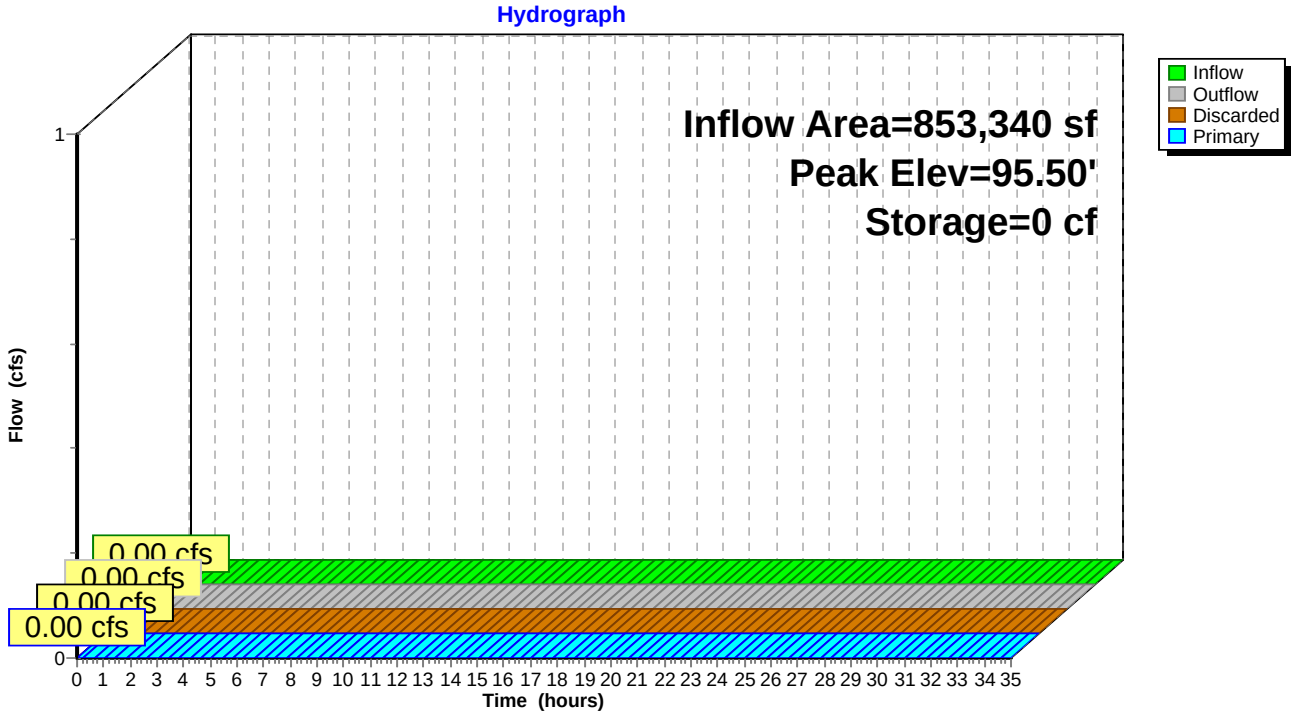
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
95.50	0	0	0
96.00	1,546	387	387
98.00	3,620	5,166	5,553
99.00	4,561	4,091	9,643

Device	Routing	Invert	Outlet Devices
#1	Discarded	95.50'	**15.000 in/hr Exfiltration over Surface area**
#2	Primary	98.80'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

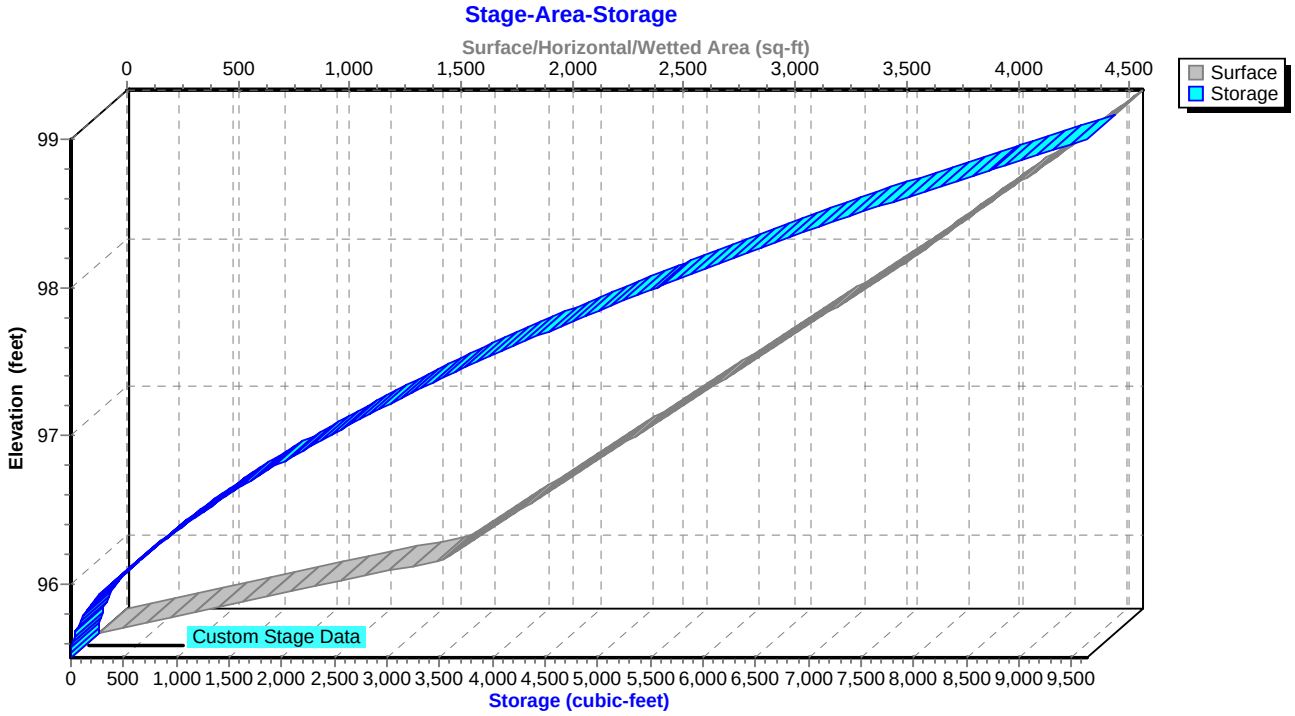
Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=95.50' (Free Discharge)
↑**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=95.50' TW=82.32' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Detention Area



Pond 1P: Detention Area



Summary for Pond 2P: Perf. Pipe Underdrains 12"x12"

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.01" for 2 event
Inflow = 0.04 cfs @ 21.55 hrs, Volume= 958 cf
Outflow = 0.04 cfs @ 21.55 hrs, Volume= 958 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.04 cfs @ 21.55 hrs, Volume= 958 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 100.00' @ 21.40 hrs Surf.Area= 1,360 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

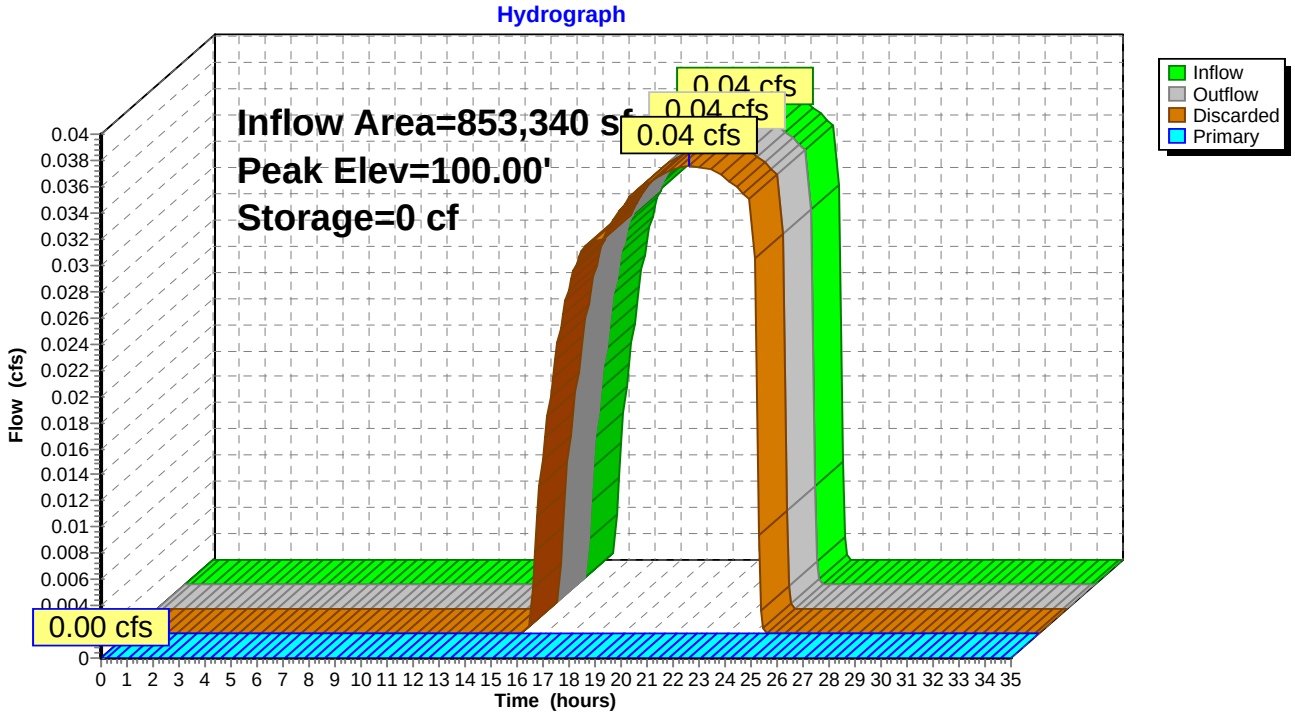
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	1,037 cf	**1.00'W x 1,360.00'L x 1.00'H Prismatoid Z=1.0** 2,722 cf Overall - 131 cf Embedded = 2,591 cf x 40.0% Voids
#2	100.33'	119 cf	**4.0" Round Pipe Storage** Inside #1 L= 1,360.0' 131 cf Overall - 0.1" Wall Thickness = 119 cf
		1,155 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**2.500 in/hr Exfiltration over Surface area**
#2	Primary	100.95'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

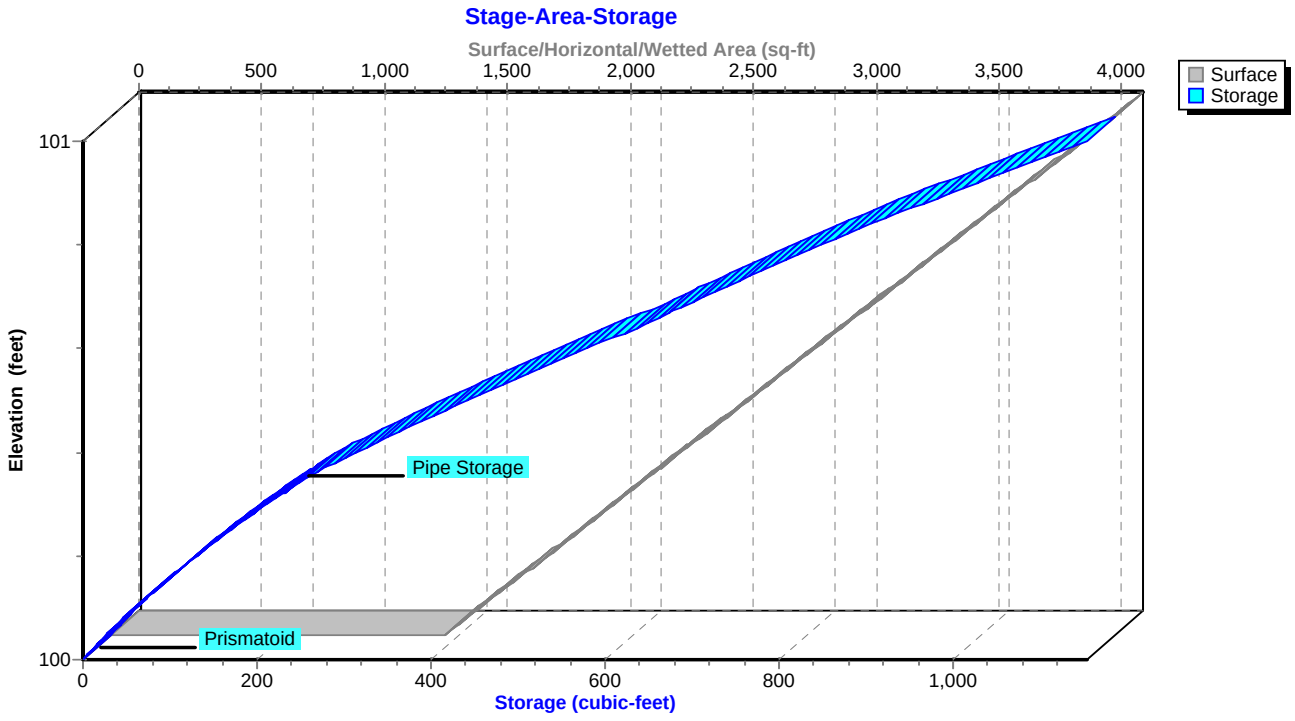
Discarded OutFlow Max=0.08 cfs @ 21.55 hrs HW=100.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=100.00' TW=95.50' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Perf. Pipe Underdrains 12"x12"



Pond 2P: Perf. Pipe Underdrains 12"x12"



Summary for Pond 4P: Isolated Wetland

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 82.32' @ 0.00 hrs Surf.Area= 3,101 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

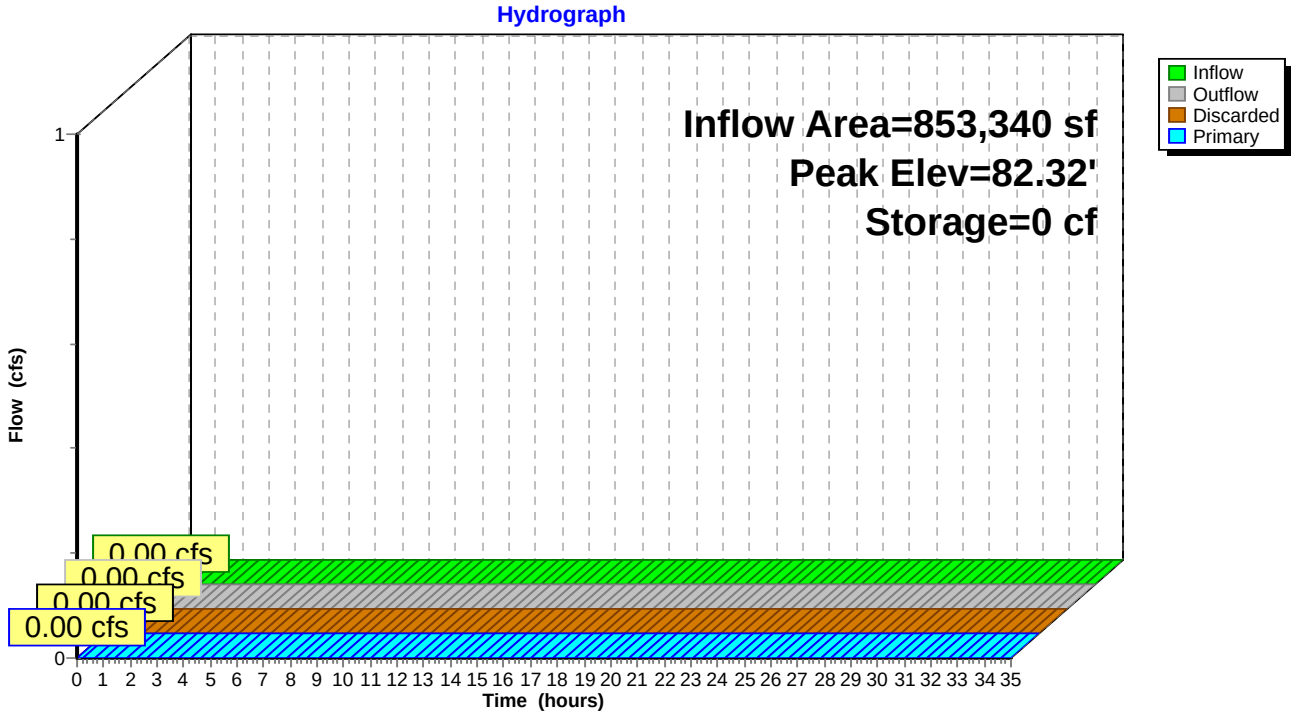
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

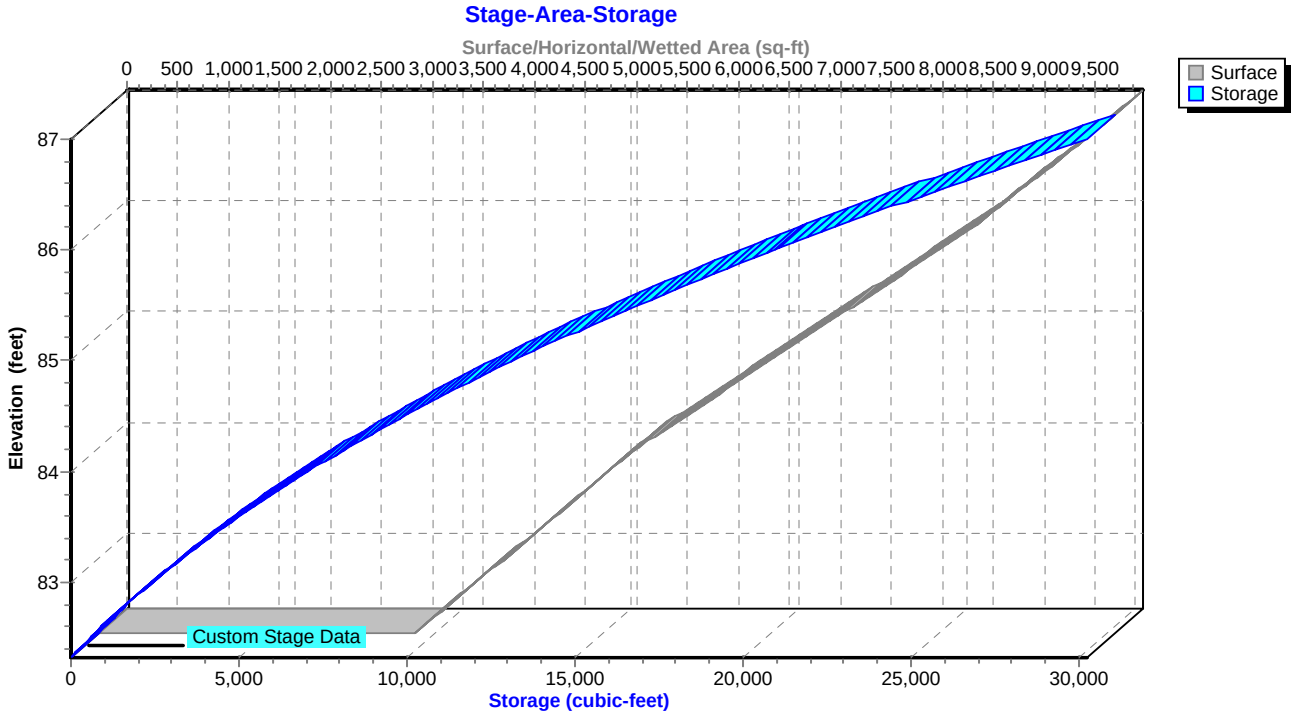
Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' (Free Discharge)
└**1=Exfiltration** (Passes 0.00 cfs of 0.07 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Isolated Wetland



Pond 4P: Isolated Wetland



Summary for Pond 7P: Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.01 cfs @ 23.90 hrs, Volume= 163 cf
Outflow = 0.01 cfs @ 23.97 hrs, Volume= 163 cf, Atten= 2%, Lag= 4.3 min
Discarded = 0.01 cfs @ 23.97 hrs, Volume= 163 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 75.55' @ 23.97 hrs Surf.Area= 515 sf Storage= 13 cf

Plug-Flow detention time= 14.3 min calculated for 163 cf (100% of inflow)
Center-of-Mass det. time= 14.4 min (1,340.0 - 1,325.6)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

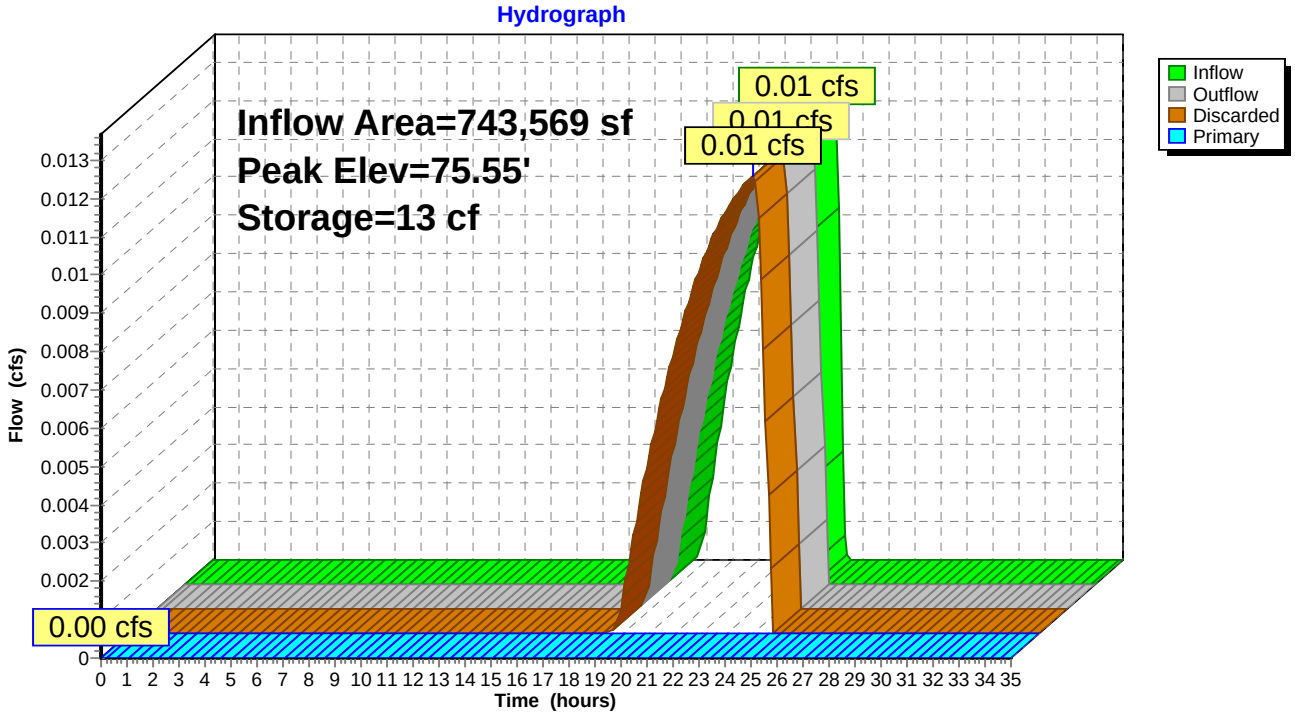
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

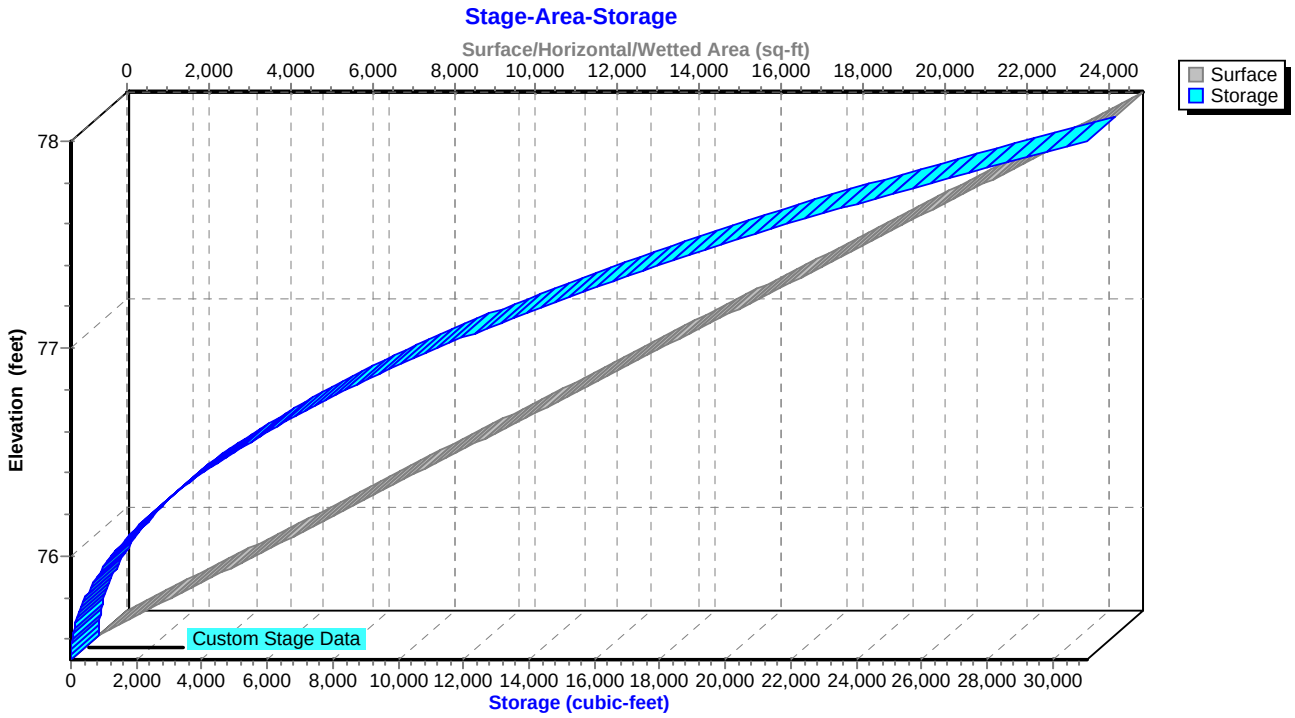
Discarded OutFlow Max=0.01 cfs @ 23.97 hrs HW=75.55' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Isolated Wetland 2



Pond 7P: Isolated Wetland 2

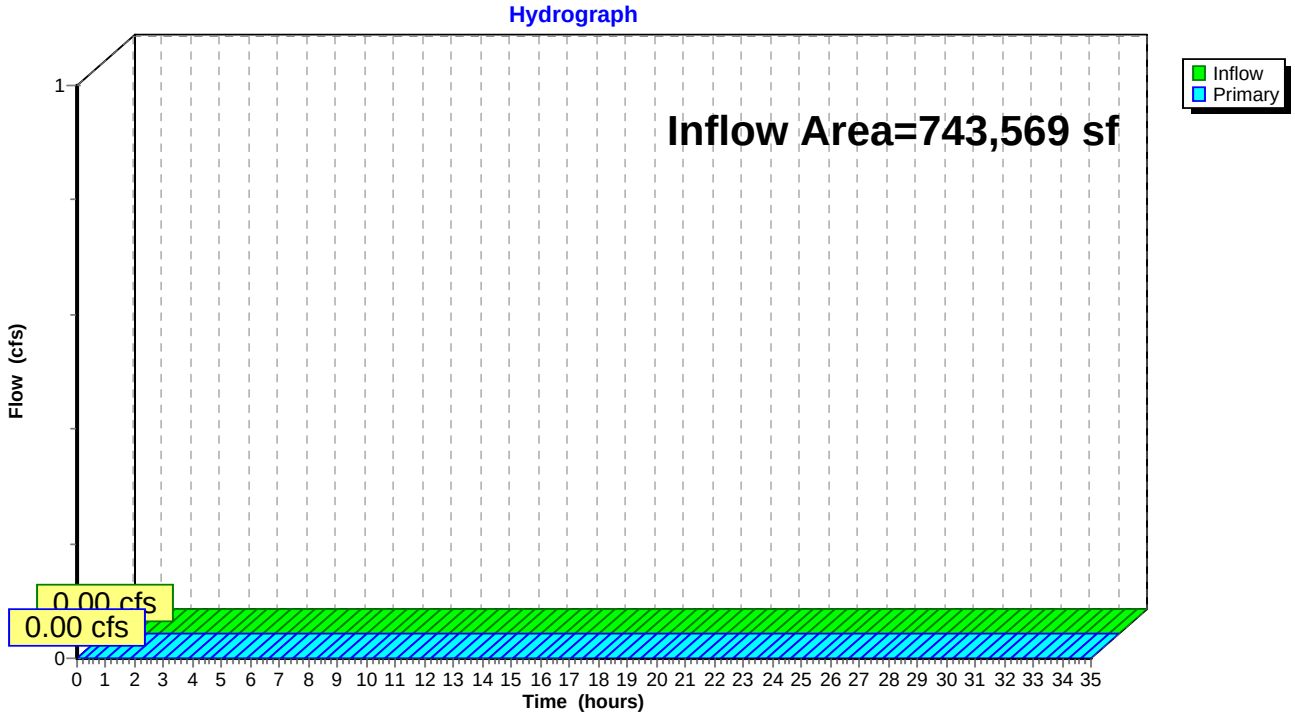


Summary for Link 3L: Flow to Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 3L: Flow to Isolated Wetland 2

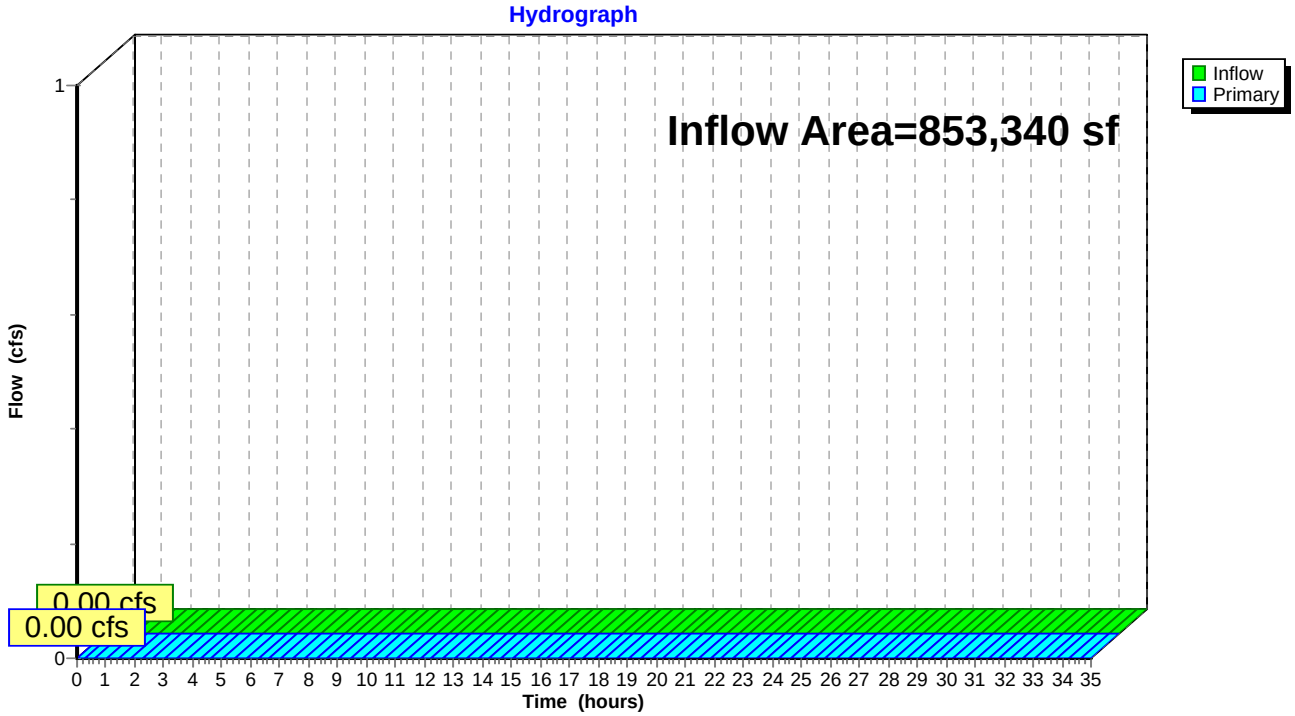


Summary for Link 4L: Flow to Design Point

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 2 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 4L: Flow to Design Point

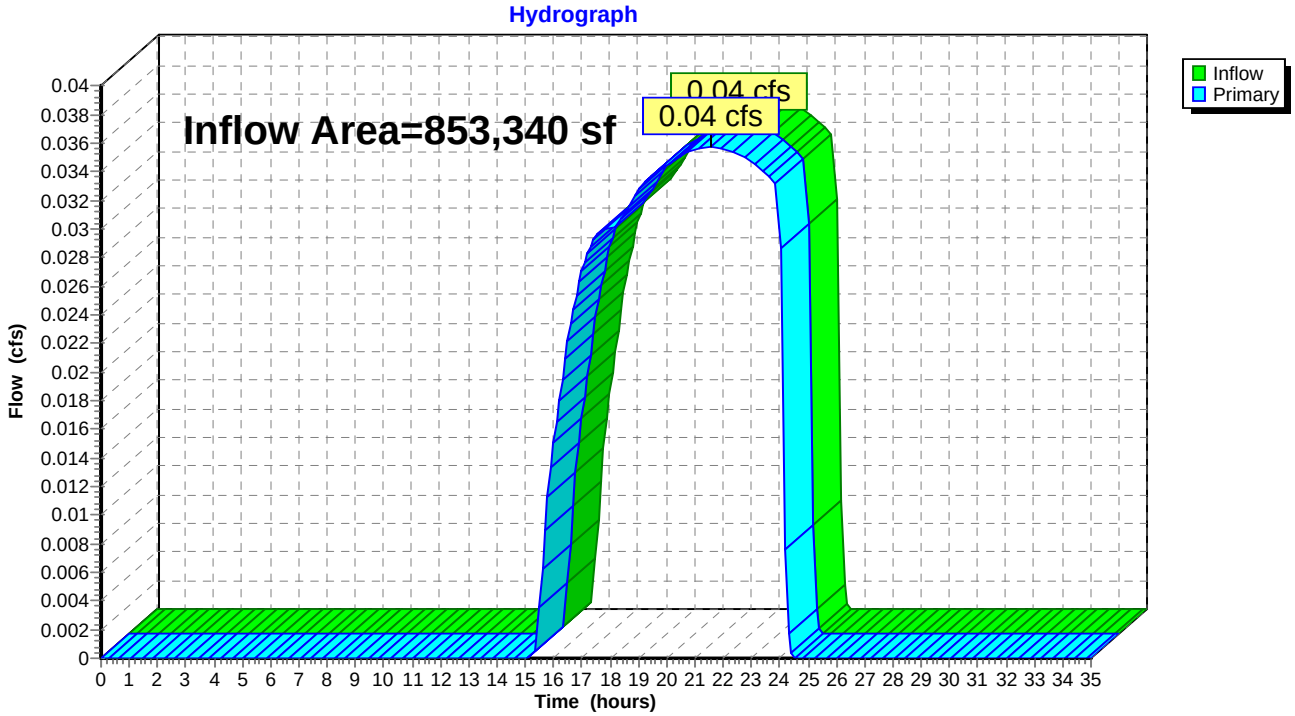


Summary for Link 5L: Flow Combine

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.01" for 2 event
Inflow = 0.04 cfs @ 21.55 hrs, Volume= 958 cf
Primary = 0.04 cfs @ 21.55 hrs, Volume= 958 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 5L: Flow Combine



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1: Runoff Area=853,340 sf 4.79% Impervious Runoff Depth=0.23"
Tc=10.0 min CN=42 Runoff=1.08 cfs 16,149 cf

Subcatchment P-2: Runoff Area=17.070 ac 2.23% Impervious Runoff Depth=0.16"
Tc=10.0 min CN=40 Runoff=0.39 cfs 10,132 cf

Pond 1P: Detention Area Peak Elev=95.90' Storage=245 cf Inflow=0.72 cfs 5,532 cf
Discarded=0.43 cfs 5,532 cf Primary=0.00 cfs 0 cf Outflow=0.43 cfs 5,532 cf

Pond 2P: Perf. Pipe Underdrains 12"x12" Peak Elev=101.01' Storage=1,155 cf Inflow=1.08 cfs 16,149 cf
Discarded=0.24 cfs 10,621 cf Primary=0.72 cfs 5,532 cf Outflow=0.96 cfs 16,152 cf

Pond 4P: Isolated Wetland Peak Elev=82.32' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond 7P: Isolated Wetland 2 Peak Elev=76.34' Storage=3,469 cf Inflow=0.39 cfs 10,132 cf
Discarded=0.19 cfs 10,132 cf Primary=0.00 cfs 0 cf Outflow=0.19 cfs 10,132 cf

Link 3L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 4L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 5L: Flow Combine Inflow=1.08 cfs 16,149 cf
Primary=1.08 cfs 16,149 cf

Total Runoff Area = 1,596,909 sf Runoff Volume = 26,281 cf Average Runoff Depth = 0.20"
96.40% Pervious = 1,539,497 sf 3.60% Impervious = 57,412 sf

Summary for Subcatchment P-1:

[49] Hint: Tc<2dt may require smaller dt

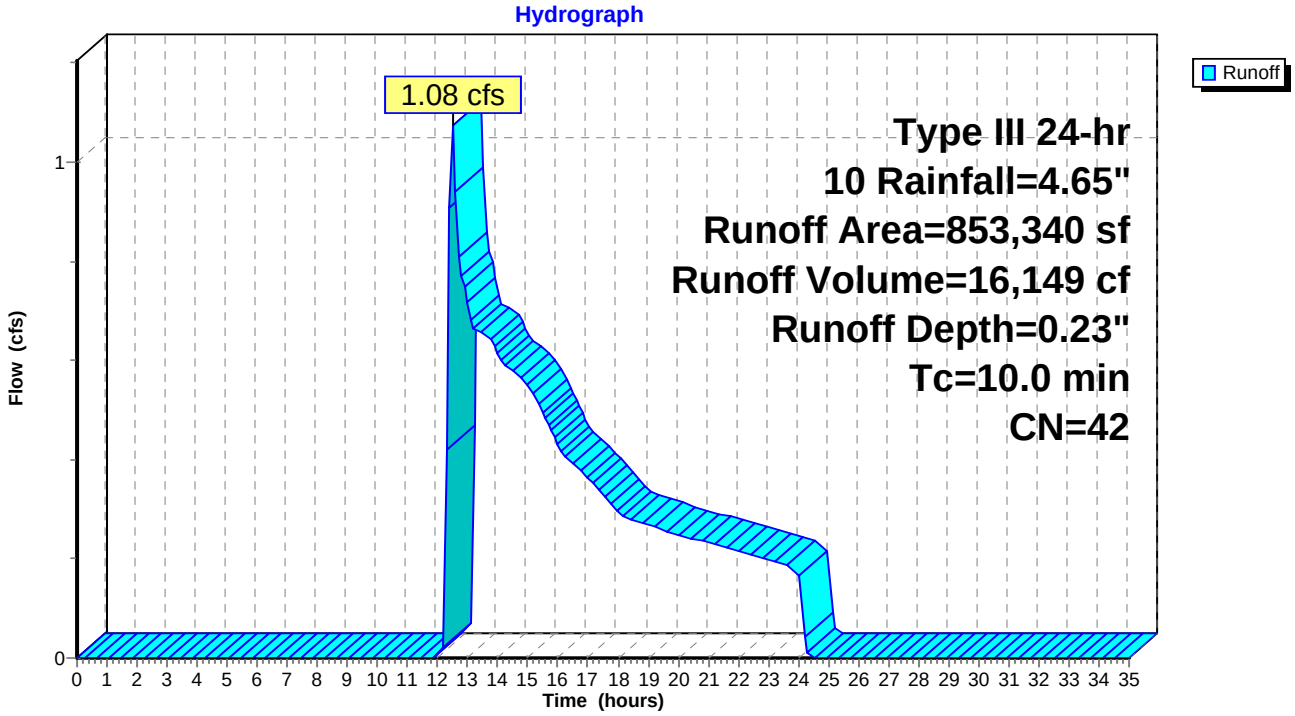
Runoff = 1.08 cfs @ 12.50 hrs, Volume= 16,149 cf, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 Rainfall=4.65"

	Area (sf)	CN	Description
	258,180	39	>75% Grass cover, Good, HSG A
*	16,030	98	Cart Paths
*	5,271	98	wetland
	44,039	36	Woods, Fair, HSG A
*	12,153	98	new cart paths
*	310,278	39	>75% Grass cover, Good, HSG A
*	44,039	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
*	7,405	98	Buildings/Driveways-offsite
	853,340	42	Weighted Average
	812,481		95.21% Pervious Area
	40,859		4.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-1:



Summary for Subcatchment P-2:

[49] Hint: Tc<2dt may require smaller dt

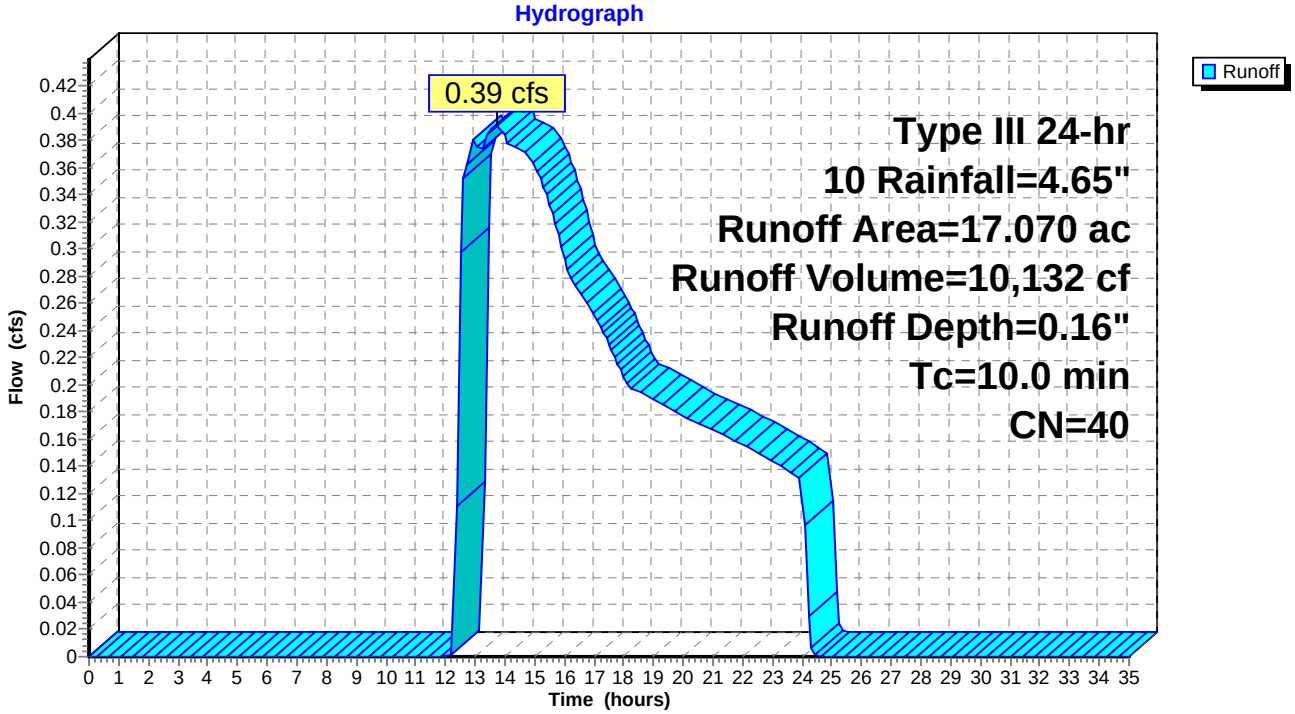
Runoff = 0.39 cfs @ 13.70 hrs, Volume= 10,132 cf, Depth= 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 Rainfall=4.65"

	Area (ac)	CN	Description
	14.568	39	>75% Grass cover, Good, HSG A
*	0.111	98	Cart Paths
*	0.183	98	wetland
	2.122	36	Woods, Fair, HSG A
*	0.086	98	New Cart Paths
	17.070	40	Weighted Average
	16.690		97.77% Pervious Area
	0.380		2.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-2:



Summary for Pond 1P: Detention Area

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.08" for 10 event
Inflow = 0.72 cfs @ 12.82 hrs, Volume= 5,532 cf
Outflow = 0.43 cfs @ 13.31 hrs, Volume= 5,532 cf, Atten= 41%, Lag= 29.0 min
Discarded = 0.43 cfs @ 13.31 hrs, Volume= 5,532 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 95.90' @ 13.31 hrs Surf.Area= 1,231 sf Storage= 245 cf

Plug-Flow detention time= 6.9 min calculated for 5,516 cf (100% of inflow)
Center-of-Mass det. time= 6.8 min (901.7 - 894.9)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	9,643 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

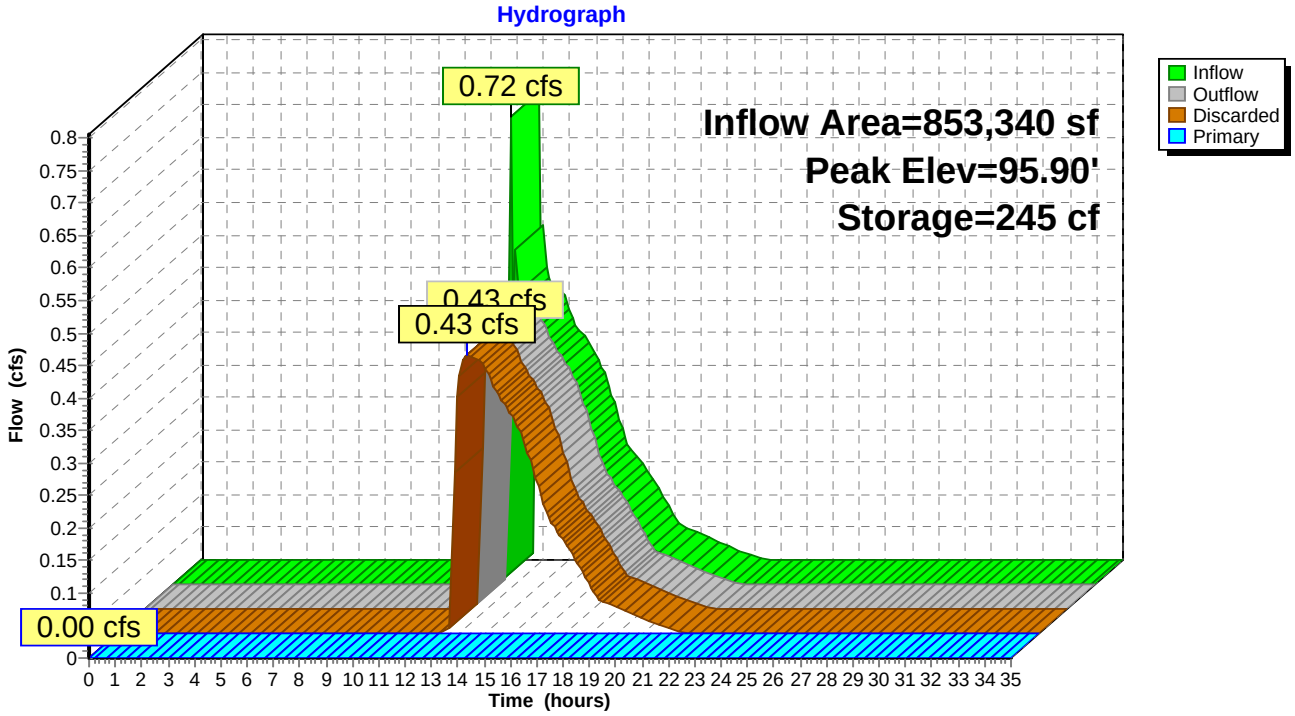
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
95.50	0	0	0
96.00	1,546	387	387
98.00	3,620	5,166	5,553
99.00	4,561	4,091	9,643

Device	Routing	Invert	Outlet Devices
#1	Discarded	95.50'	**15.000 in/hr Exfiltration over Surface area**
#2	Primary	98.80'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

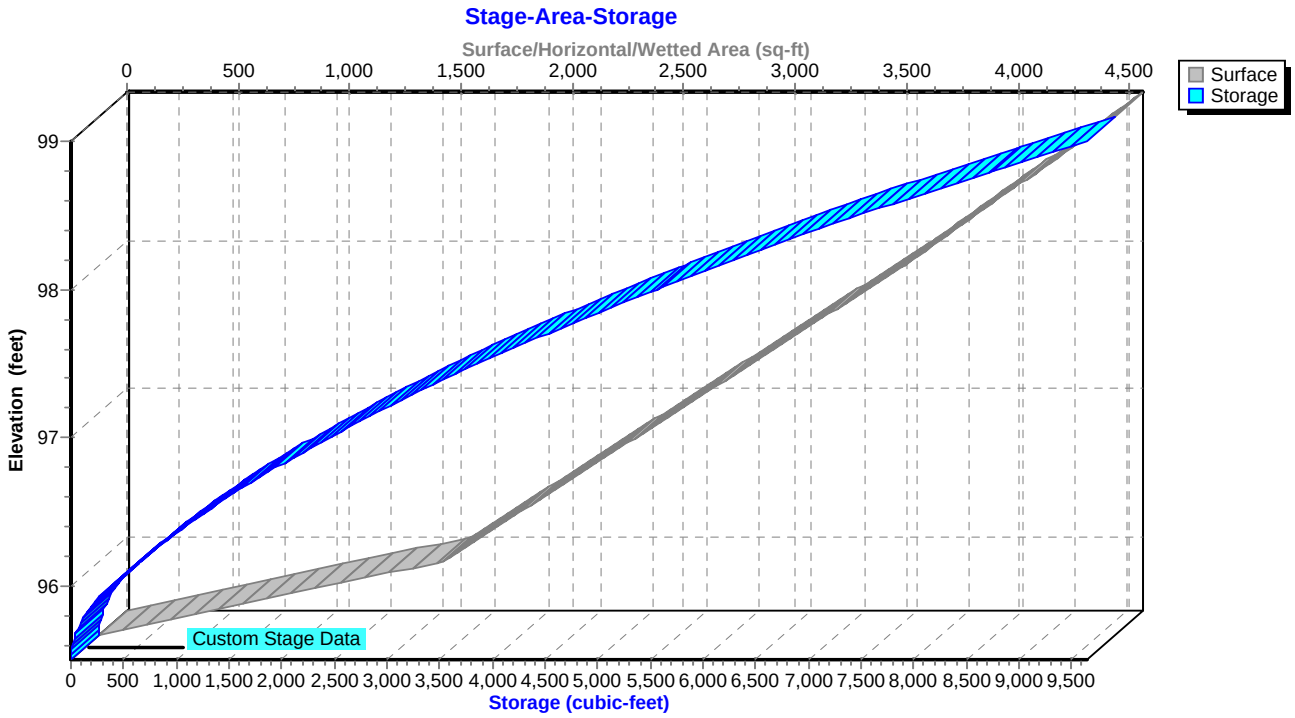
Discarded OutFlow Max=0.43 cfs @ 13.31 hrs HW=95.90' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=95.50' TW=82.32' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Detention Area



Pond 1P: Detention Area



Summary for Pond 2P: Perf. Pipe Underdrains 12"x12"

[93] Warning: Storage range exceeded by 0.01'

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.23" for 10 event
Inflow = 1.08 cfs @ 12.50 hrs, Volume= 16,149 cf
Outflow = 0.96 cfs @ 12.82 hrs, Volume= 16,152 cf, Atten= 11%, Lag= 19.0 min
Discarded = 0.24 cfs @ 12.80 hrs, Volume= 10,621 cf
Primary = 0.72 cfs @ 12.82 hrs, Volume= 5,532 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 101.01' @ 12.80 hrs Surf.Area= 4,086 sf Storage= 1,155 cf

Plug-Flow detention time= 49.2 min calculated for 16,106 cf (100% of inflow)
Center-of-Mass det. time= 49.4 min (1,046.4 - 997.0)

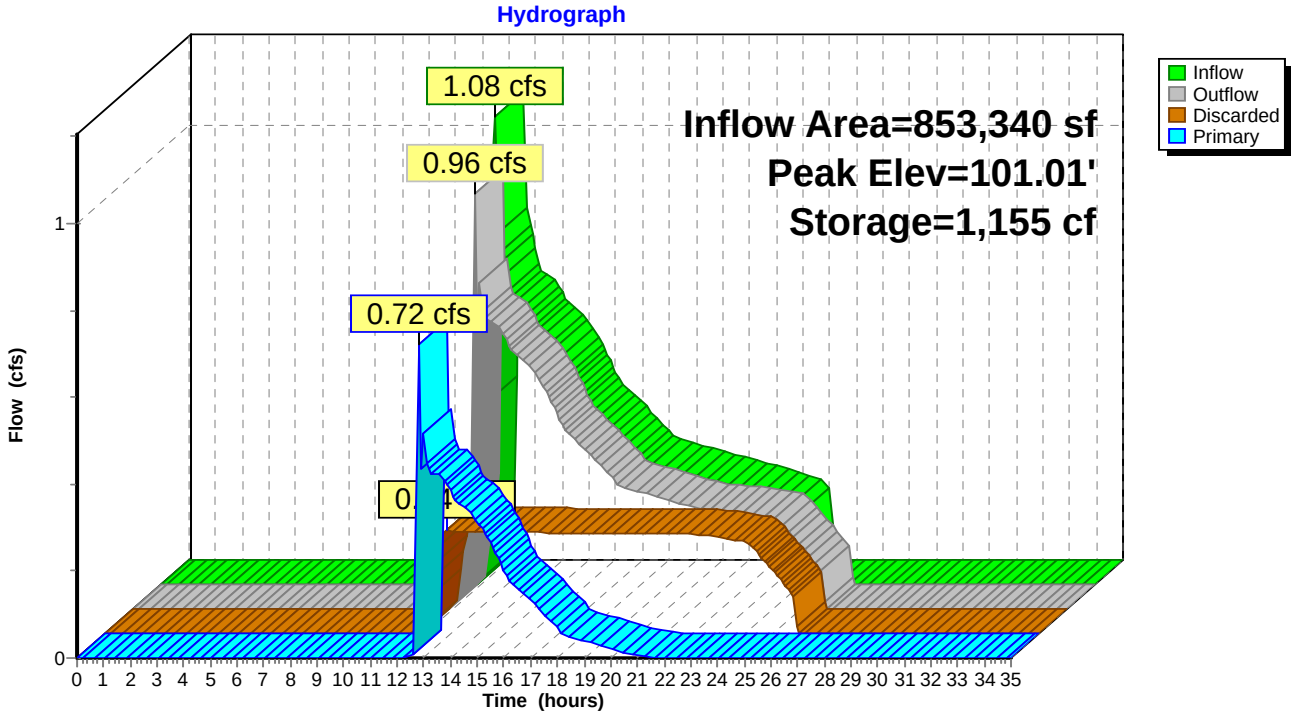
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	1,037 cf	**1.00'W x 1,360.00'L x 1.00'H Prismatoid Z=1.0** 2,722 cf Overall - 131 cf Embedded = 2,591 cf x 40.0% Voids
#2	100.33'	119 cf	**4.0" Round Pipe Storage** Inside #1 L= 1,360.0' 131 cf Overall - 0.1" Wall Thickness = 119 cf
		1,155 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**2.500 in/hr Exfiltration over Surface area**
#2	Primary	100.95'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

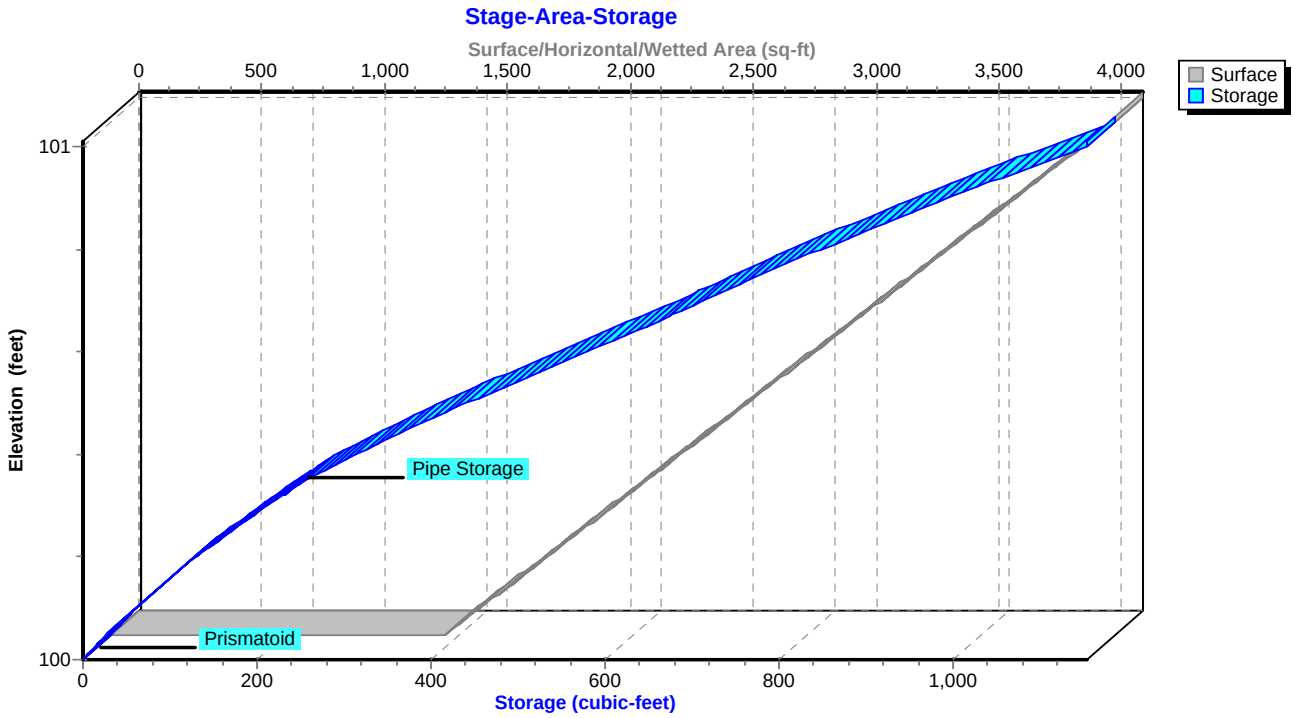
Discarded OutFlow Max=0.24 cfs @ 12.80 hrs HW=101.01' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=0.64 cfs @ 12.82 hrs HW=101.00' TW=95.75' (Dynamic Tailwater)
↑└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.64 cfs @ 0.61 fps)

Pond 2P: Perf. Pipe Underdrains 12"x12"



Pond 2P: Perf. Pipe Underdrains 12"x12"



Summary for Pond 4P: Isolated Wetland

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 10 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 82.32' @ 0.00 hrs Surf.Area= 3,101 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

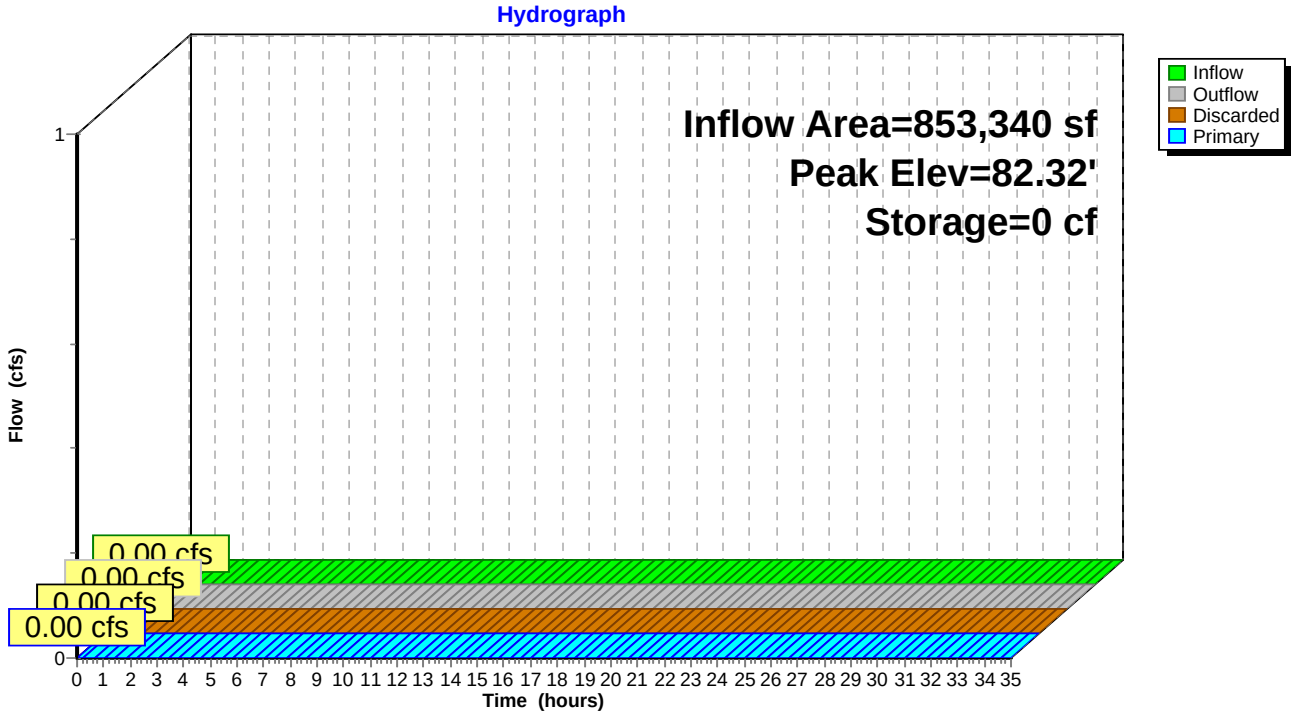
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

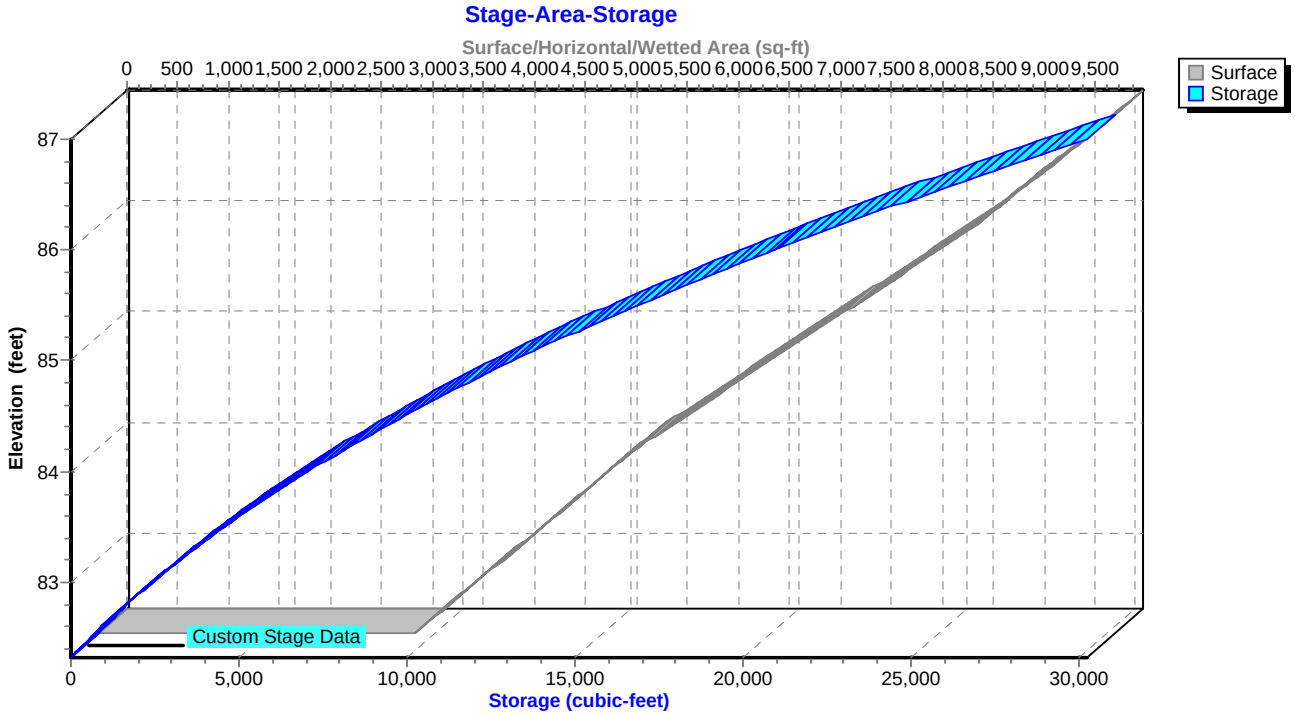
Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.07 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Isolated Wetland



Pond 4P: Isolated Wetland



Summary for Pond 7P: Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.16" for 10 event
Inflow = 0.39 cfs @ 13.70 hrs, Volume= 10,132 cf
Outflow = 0.19 cfs @ 18.77 hrs, Volume= 10,132 cf, Atten= 51%, Lag= 304.4 min
Discarded = 0.19 cfs @ 18.77 hrs, Volume= 10,132 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 76.34' @ 18.77 hrs Surf.Area= 8,304 sf Storage= 3,469 cf

Plug-Flow detention time= 249.4 min calculated for 10,103 cf (100% of inflow)
Center-of-Mass det. time= 250.2 min (1,275.6 - 1,025.3)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

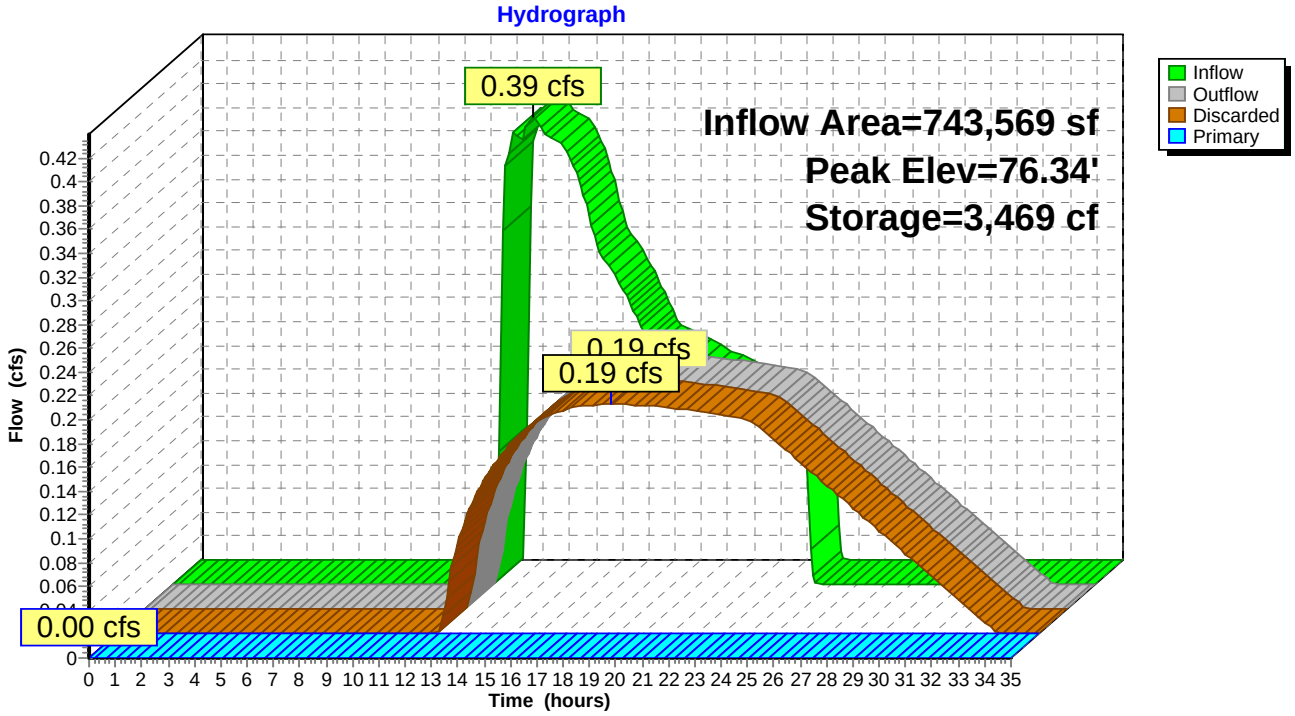
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

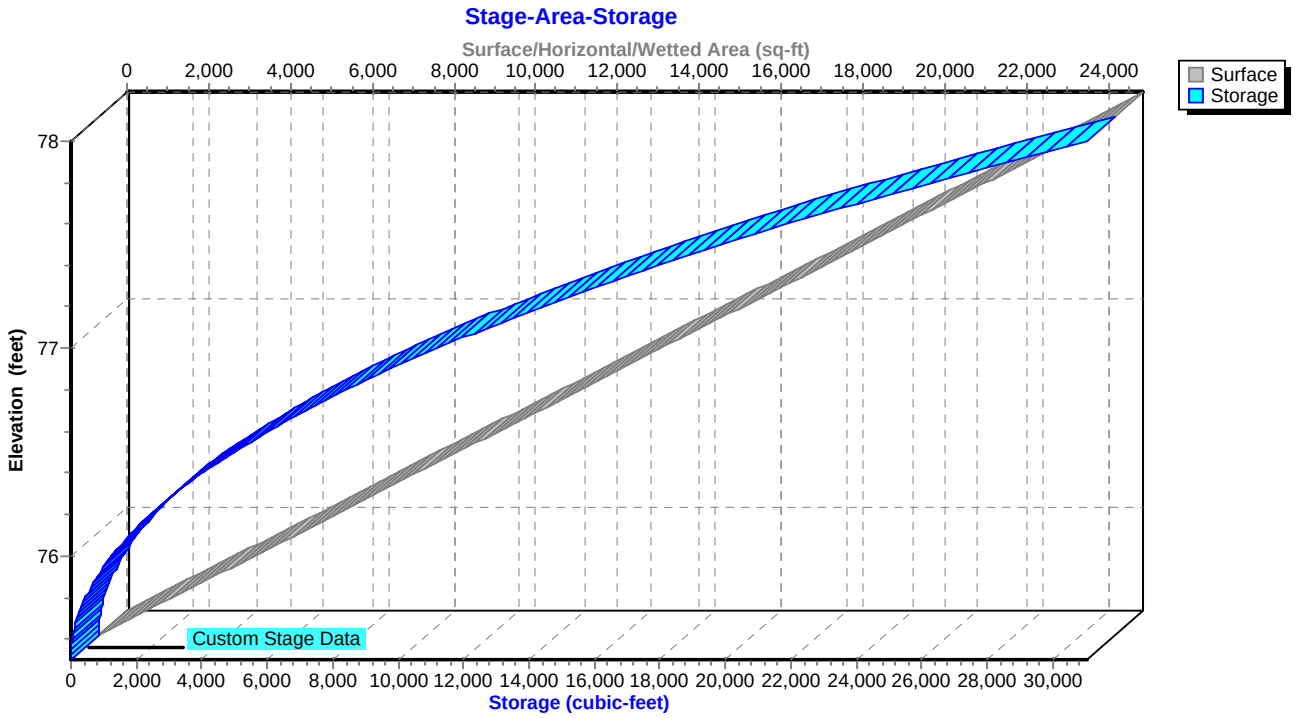
Discarded OutFlow Max=0.19 cfs @ 18.77 hrs HW=76.34' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Isolated Wetland 2



Pond 7P: Isolated Wetland 2

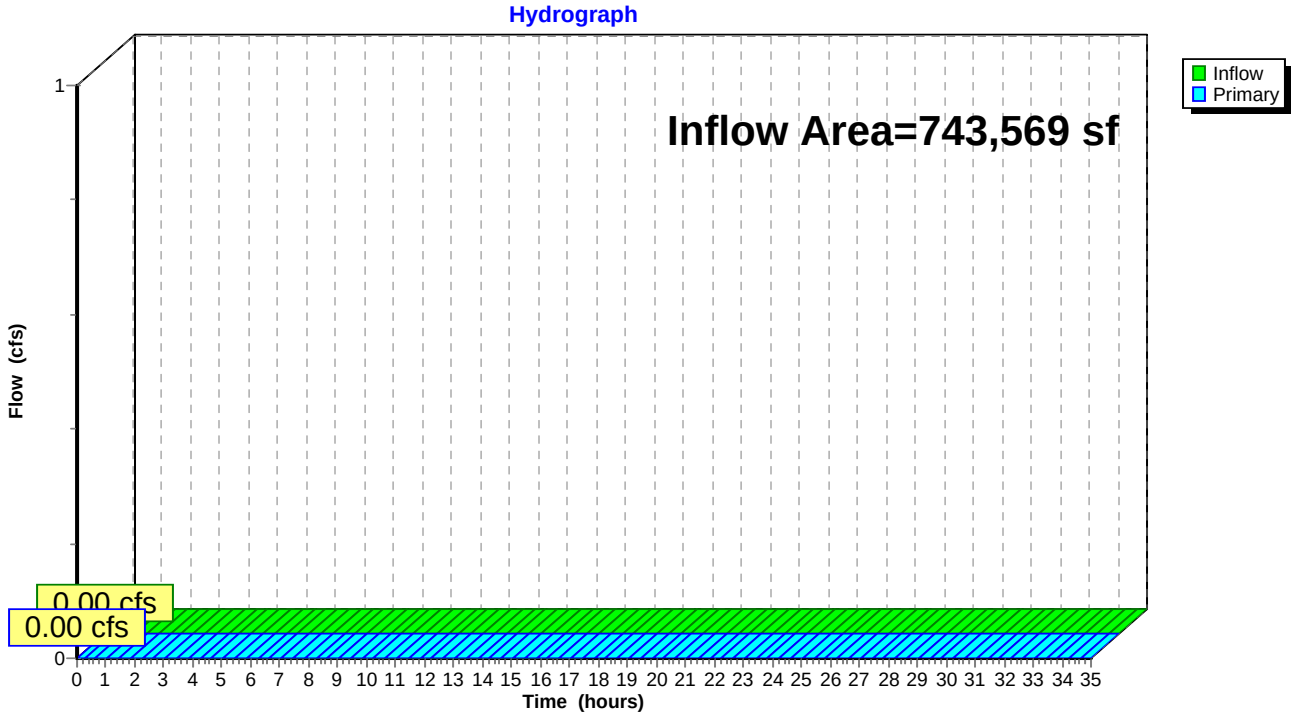


Summary for Link 3L: Flow to Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.00" for 10 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 3L: Flow to Isolated Wetland 2

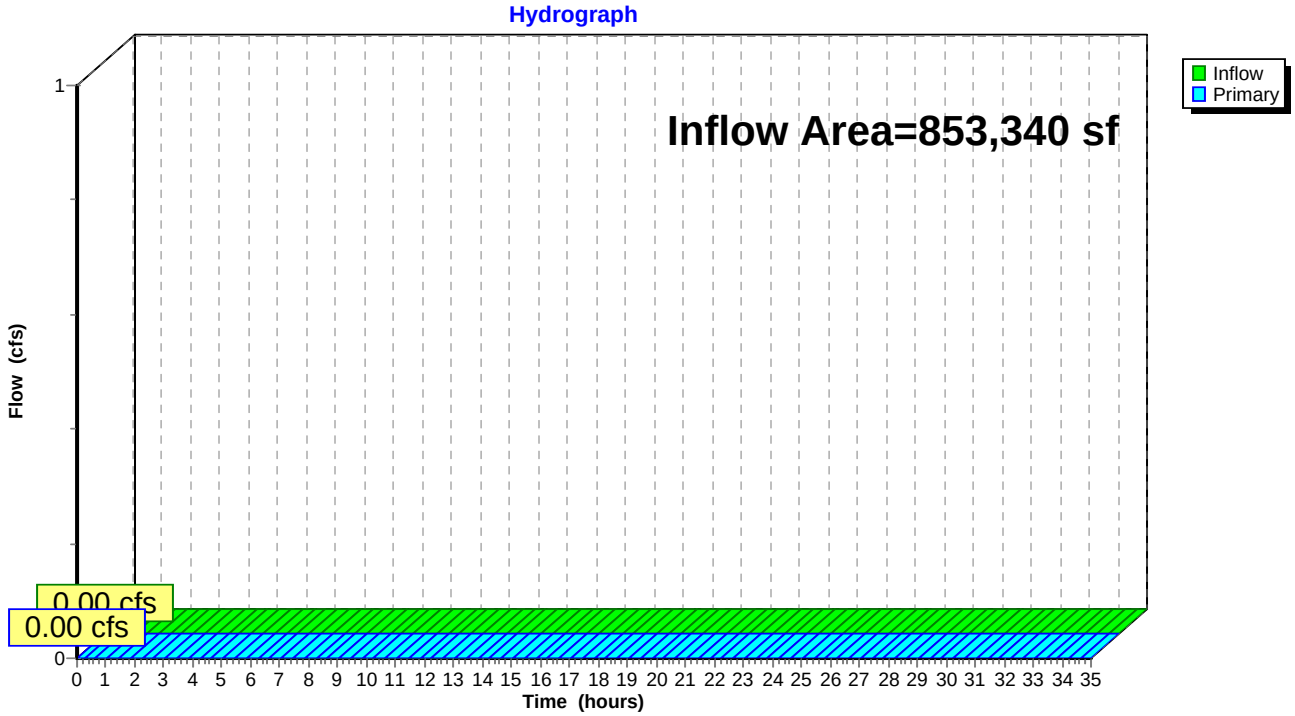


Summary for Link 4L: Flow to Design Point

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 10 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 4L: Flow to Design Point

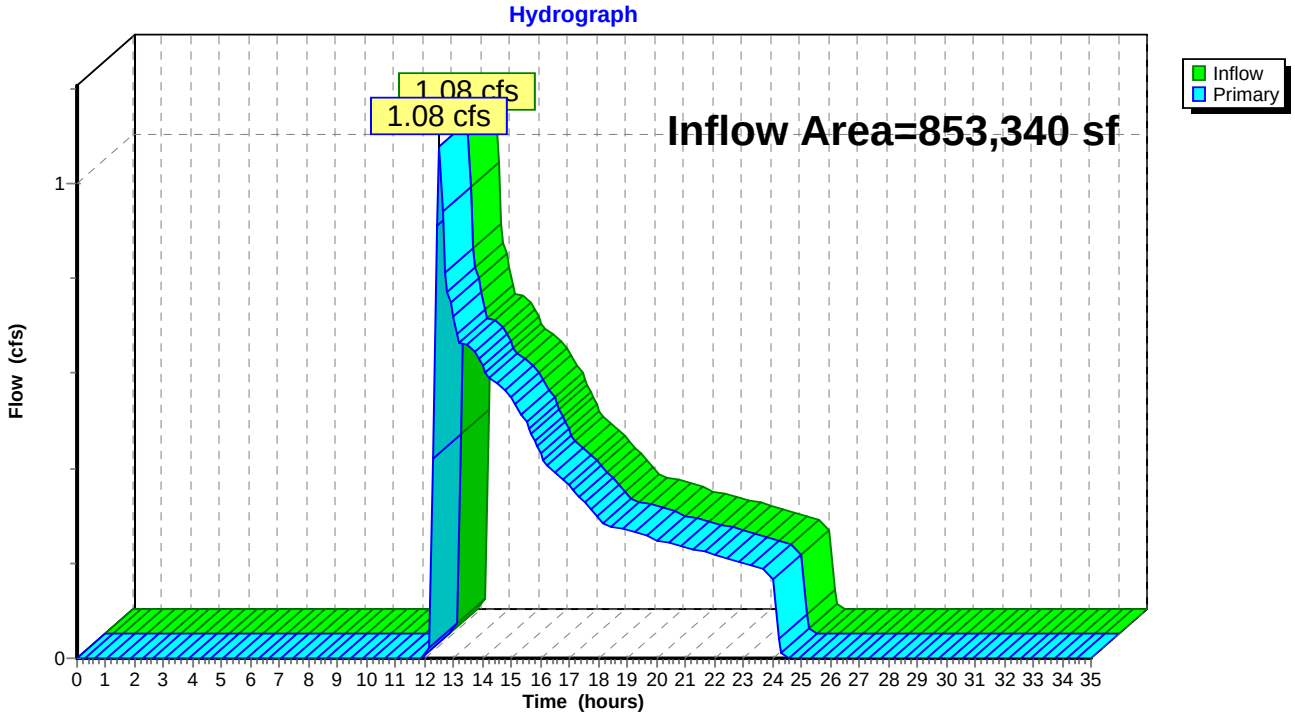


Summary for Link 5L: Flow Combine

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.23" for 10 event
Inflow = 1.08 cfs @ 12.50 hrs, Volume= 16,149 cf
Primary = 1.08 cfs @ 12.50 hrs, Volume= 16,149 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 5L: Flow Combine



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1: Runoff Area=853,340 sf 4.79% Impervious Runoff Depth=0.45"
Tc=10.0 min CN=42 Runoff=3.64 cfs 32,218 cf

Subcatchment P-2: Runoff Area=17.070 ac 2.23% Impervious Runoff Depth=0.36"
Tc=10.0 min CN=40 Runoff=2.06 cfs 22,130 cf

Pond 1P: Detention Area Peak Elev=97.47' Storage=3,793 cf Inflow=4.46 cfs 21,010 cf
Discarded=1.07 cfs 21,011 cf Primary=0.00 cfs 0 cf Outflow=1.07 cfs 21,011 cf

Pond 2P: Perf. Pipe Underdrains 12"x12" Peak Elev=101.14' Storage=1,155 cf Inflow=3.64 cfs 32,218 cf
Discarded=0.24 cfs 11,213 cf Primary=4.46 cfs 21,010 cf Outflow=4.70 cfs 32,224 cf

Pond 4P: Isolated Wetland Peak Elev=82.32' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond 7P: Isolated Wetland 2 Peak Elev=76.93' Storage=10,201 cf Inflow=2.06 cfs 22,130 cf
Discarded=0.33 cfs 21,098 cf Primary=0.00 cfs 0 cf Outflow=0.33 cfs 21,098 cf

Link 3L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 4L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 5L: Flow Combine Inflow=3.64 cfs 32,218 cf
Primary=3.64 cfs 32,218 cf

Total Runoff Area = 1,596,909 sf Runoff Volume = 54,348 cf Average Runoff Depth = 0.41"
96.40% Pervious = 1,539,497 sf 3.60% Impervious = 57,412 sf

Summary for Subcatchment P-1:

[49] Hint: Tc<2dt may require smaller dt

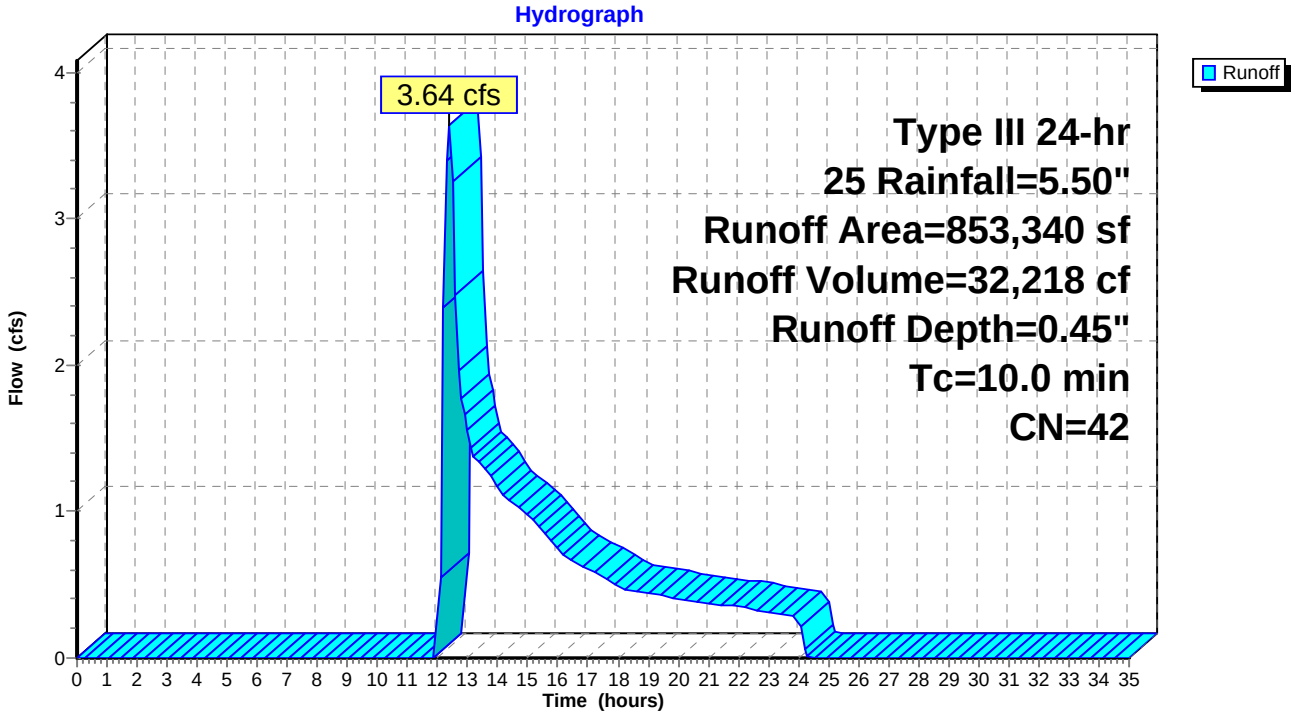
Runoff = 3.64 cfs @ 12.39 hrs, Volume= 32,218 cf, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (sf)	CN	Description
	258,180	39	>75% Grass cover, Good, HSG A
*	16,030	98	Cart Paths
*	5,271	98	wetland
	44,039	36	Woods, Fair, HSG A
*	12,153	98	new cart paths
*	310,278	39	>75% Grass cover, Good, HSG A
*	44,039	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
*	7,405	98	Buildings/Driveways-offsite
	853,340	42	Weighted Average
	812,481		95.21% Pervious Area
	40,859		4.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-1:



Summary for Subcatchment P-2:

[49] Hint: Tc<2dt may require smaller dt

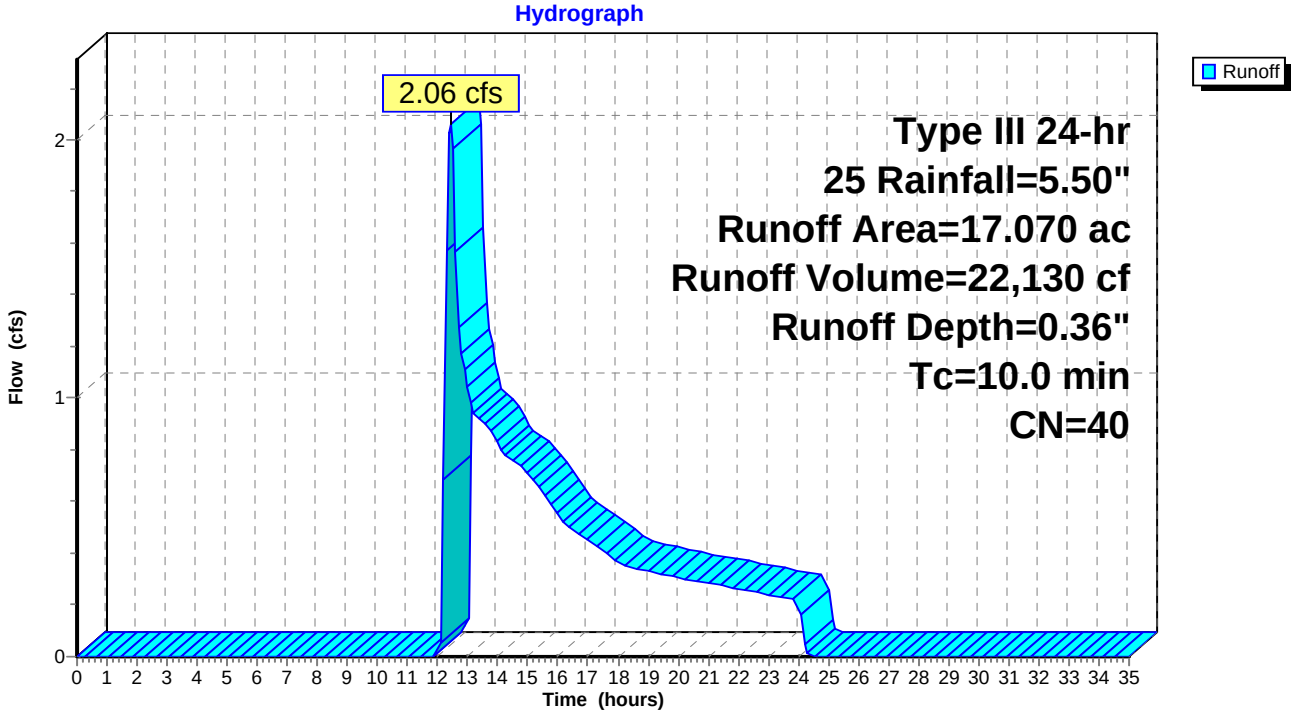
Runoff = 2.06 cfs @ 12.44 hrs, Volume= 22,130 cf, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (ac)	CN	Description
	14.568	39	>75% Grass cover, Good, HSG A
*	0.111	98	Cart Paths
*	0.183	98	wetland
	2.122	36	Woods, Fair, HSG A
*	0.086	98	New Cart Paths
	17.070	40	Weighted Average
	16.690		97.77% Pervious Area
	0.380		2.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-2:



Summary for Pond 1P: Detention Area

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.30" for 25 event
Inflow = 4.46 cfs @ 12.40 hrs, Volume= 21,010 cf
Outflow = 1.07 cfs @ 13.50 hrs, Volume= 21,011 cf, Atten= 76%, Lag= 66.2 min
Discarded = 1.07 cfs @ 13.50 hrs, Volume= 21,011 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 97.47' @ 13.50 hrs Surf.Area= 3,075 sf Storage= 3,793 cf

Plug-Flow detention time= 38.8 min calculated for 20,951 cf (100% of inflow)
Center-of-Mass det. time= 38.7 min (943.4 - 904.6)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	9,643 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

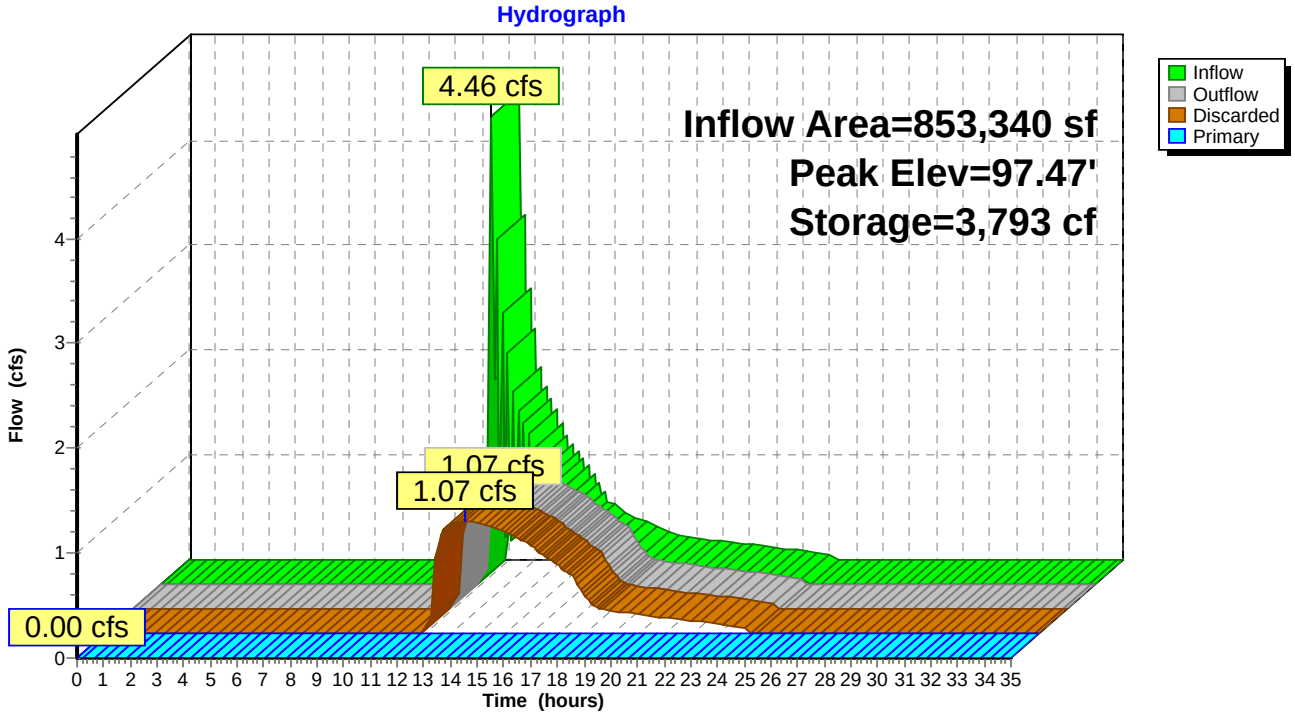
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
95.50	0	0	0
96.00	1,546	387	387
98.00	3,620	5,166	5,553
99.00	4,561	4,091	9,643

Device	Routing	Invert	Outlet Devices
#1	Discarded	95.50'	**15.000 in/hr Exfiltration over Surface area**
#2	Primary	98.80'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

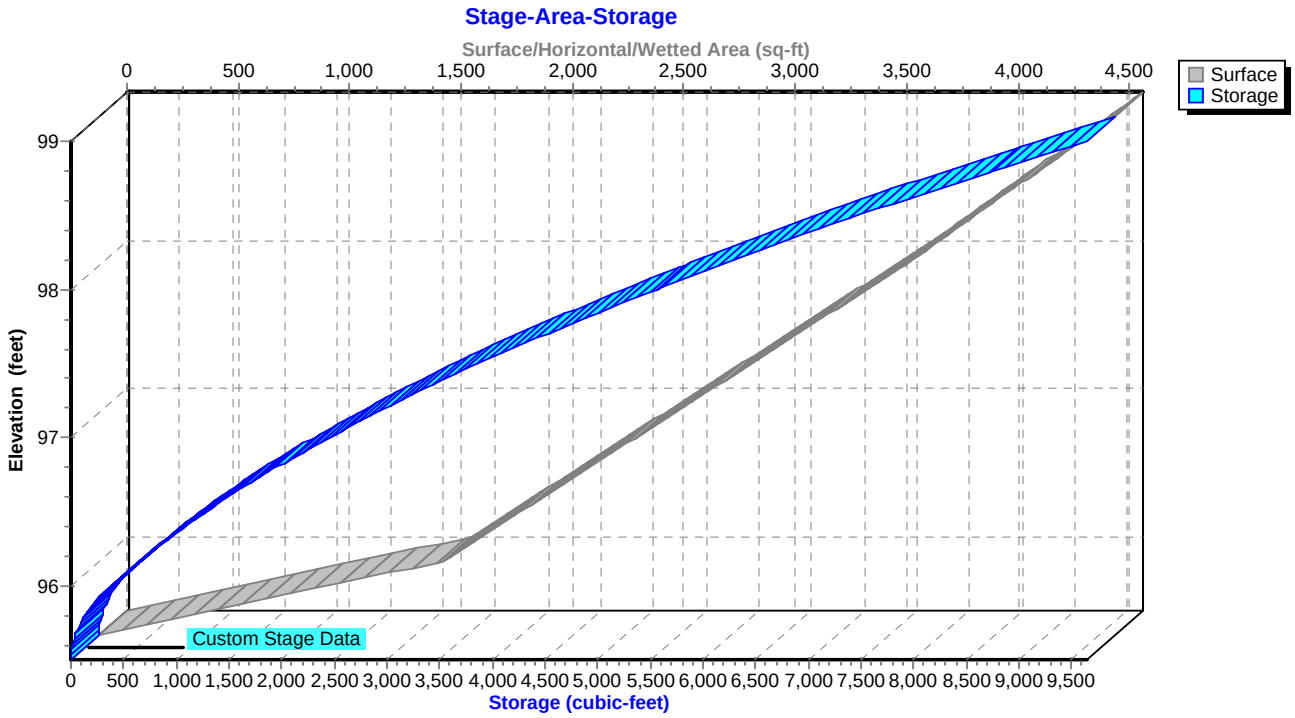
Discarded OutFlow Max=1.07 cfs @ 13.50 hrs HW=97.47' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=95.50' TW=82.32' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Detention Area



Pond 1P: Detention Area



Summary for Pond 2P: Perf. Pipe Underdrains 12"x12"

[93] Warning: Storage range exceeded by 0.14'
[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.45" for 25 event
Inflow = 3.64 cfs @ 12.39 hrs, Volume= 32,218 cf
Outflow = 4.70 cfs @ 12.40 hrs, Volume= 32,224 cf, Atten= 0%, Lag= 0.6 min
Discarded = 0.24 cfs @ 12.30 hrs, Volume= 11,213 cf
Primary = 4.46 cfs @ 12.40 hrs, Volume= 21,010 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 101.14' @ 12.40 hrs Surf.Area= 4,086 sf Storage= 1,155 cf

Plug-Flow detention time= 26.5 min calculated for 32,132 cf (100% of inflow)
Center-of-Mass det. time= 26.9 min (982.2 - 955.3)

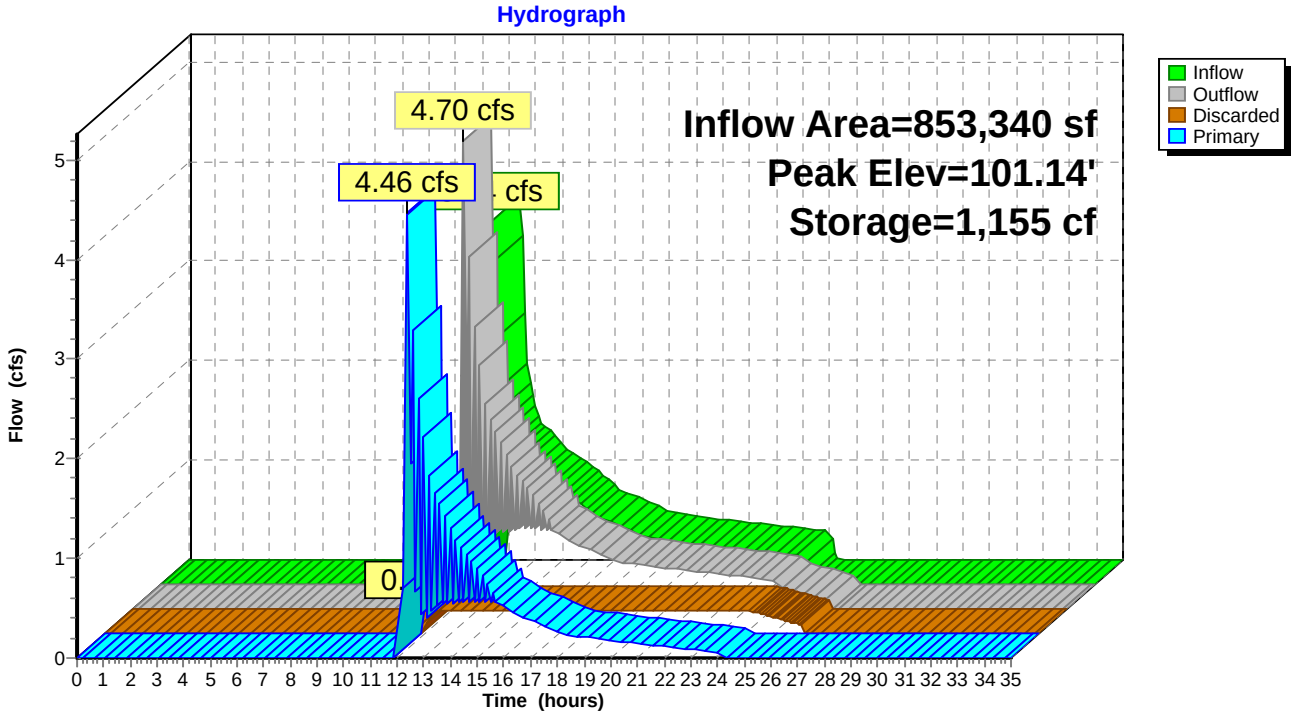
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	1,037 cf	**1.00'W x 1,360.00'L x 1.00'H Prismatoid Z=1.0** 2,722 cf Overall - 131 cf Embedded = 2,591 cf x 40.0% Voids
#2	100.33'	119 cf	**4.0" Round Pipe Storage** Inside #1 L= 1,360.0' 131 cf Overall - 0.1" Wall Thickness = 119 cf
		1,155 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**2.500 in/hr Exfiltration over Surface area**
#2	Primary	100.95'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

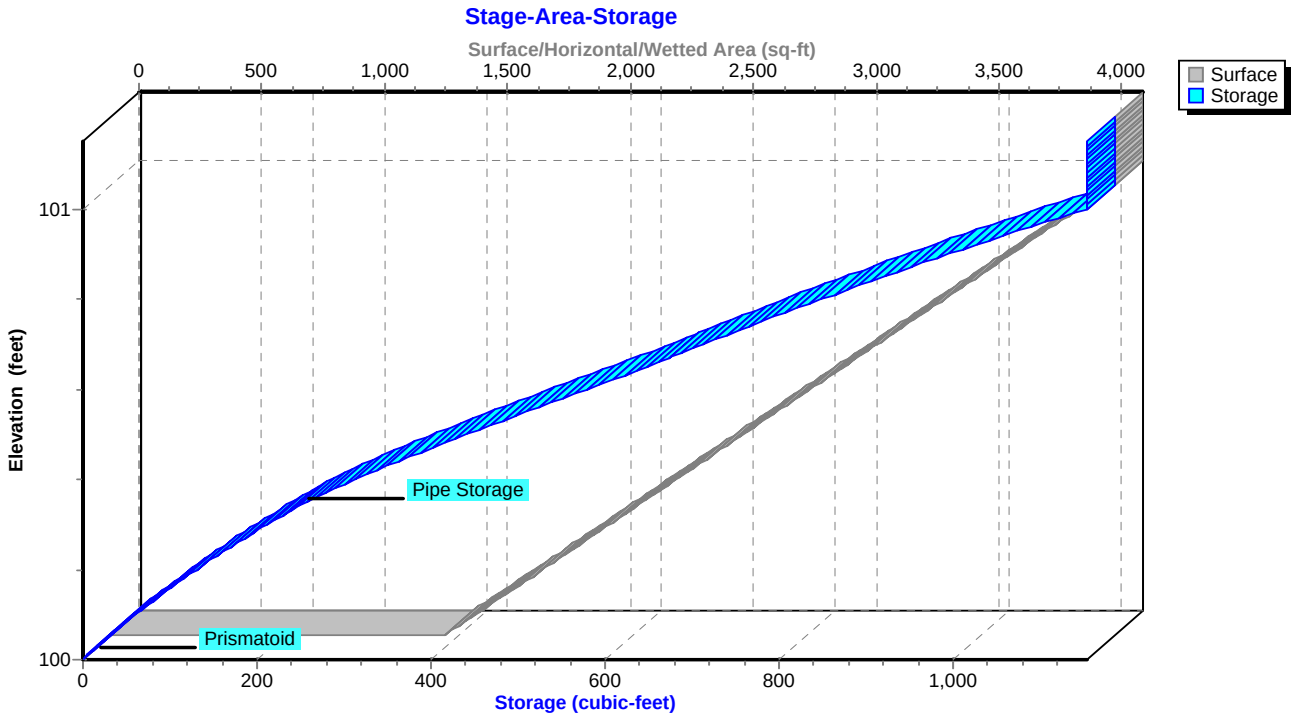
Discarded OutFlow Max=0.24 cfs @ 12.30 hrs HW=101.07' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=4.42 cfs @ 12.40 hrs HW=101.14' TW=96.48' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 4.42 cfs @ 1.17 fps)

Pond 2P: Perf. Pipe Underdrains 12"x12"



Pond 2P: Perf. Pipe Underdrains 12"x12"



Summary for Pond 4P: Isolated Wetland

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 25 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 82.32' @ 0.00 hrs Surf.Area= 3,101 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

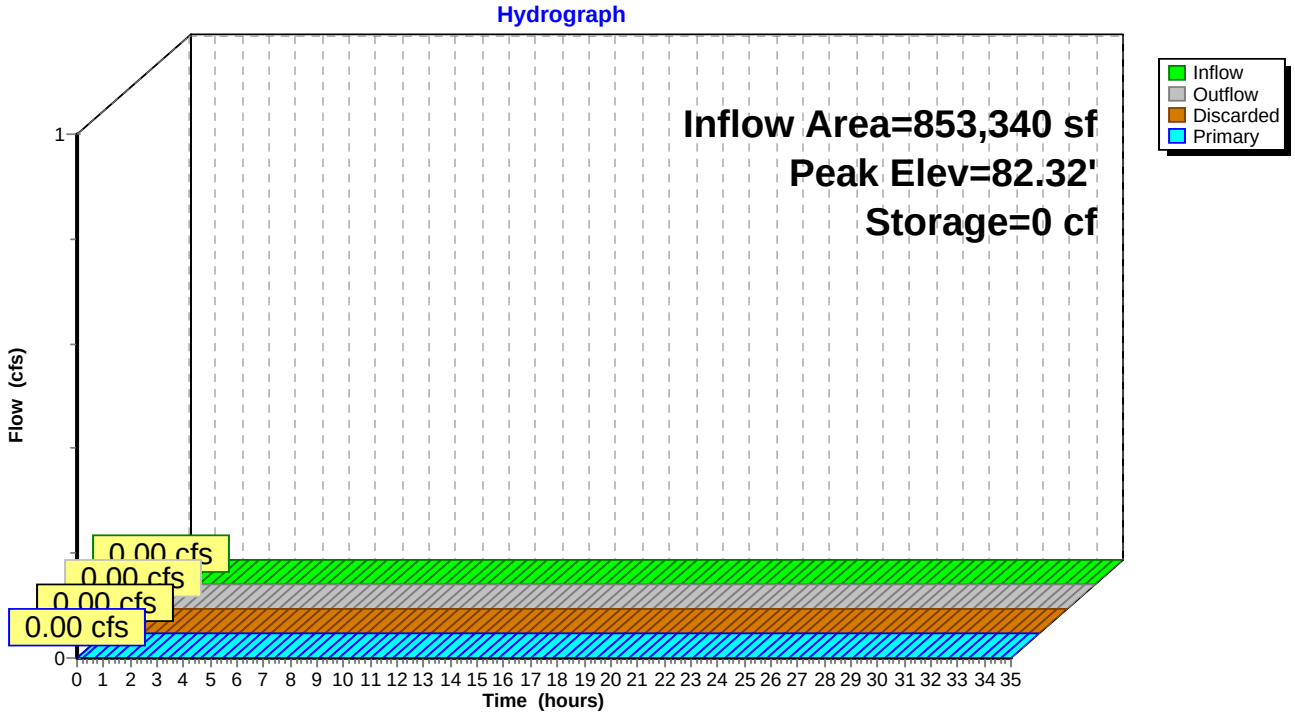
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

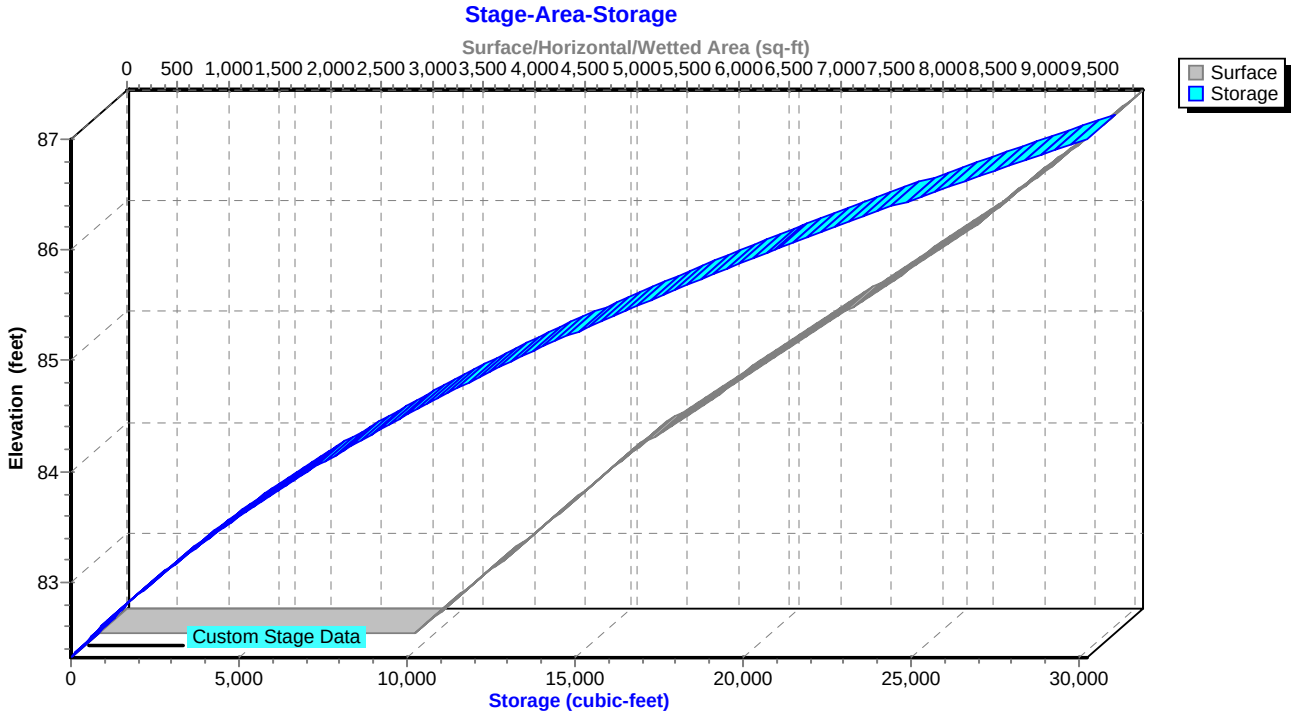
Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.07 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Isolated Wetland



Pond 4P: Isolated Wetland



Summary for Pond 7P: Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.36" for 25 event
Inflow = 2.06 cfs @ 12.44 hrs, Volume= 22,130 cf
Outflow = 0.33 cfs @ 19.05 hrs, Volume= 21,098 cf, Atten= 84%, Lag= 396.9 min
Discarded = 0.33 cfs @ 19.05 hrs, Volume= 21,098 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 76.93' @ 19.05 hrs Surf.Area= 14,240 sf Storage= 10,201 cf

Plug-Flow detention time= 397.5 min calculated for 21,038 cf (95% of inflow)
Center-of-Mass det. time= 377.1 min (1,350.8 - 973.7)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

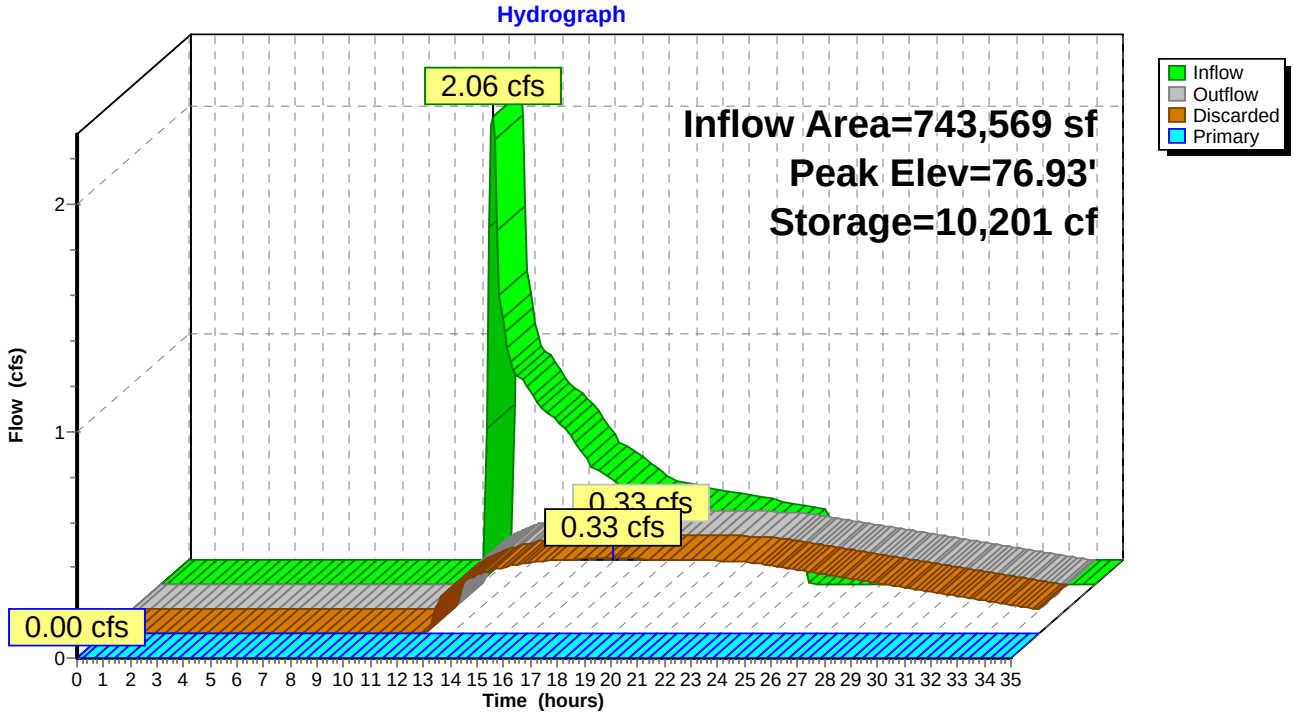
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

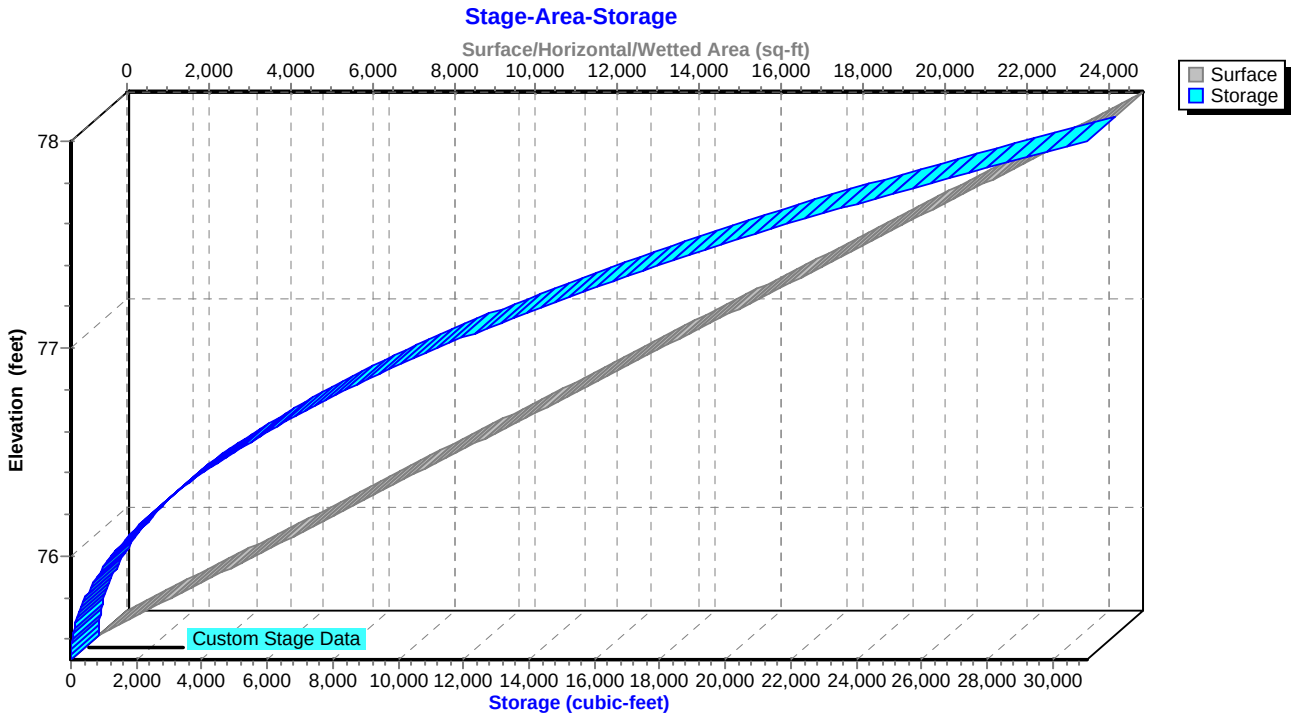
Discarded OutFlow Max=0.33 cfs @ 19.05 hrs HW=76.93' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Isolated Wetland 2



Pond 7P: Isolated Wetland 2

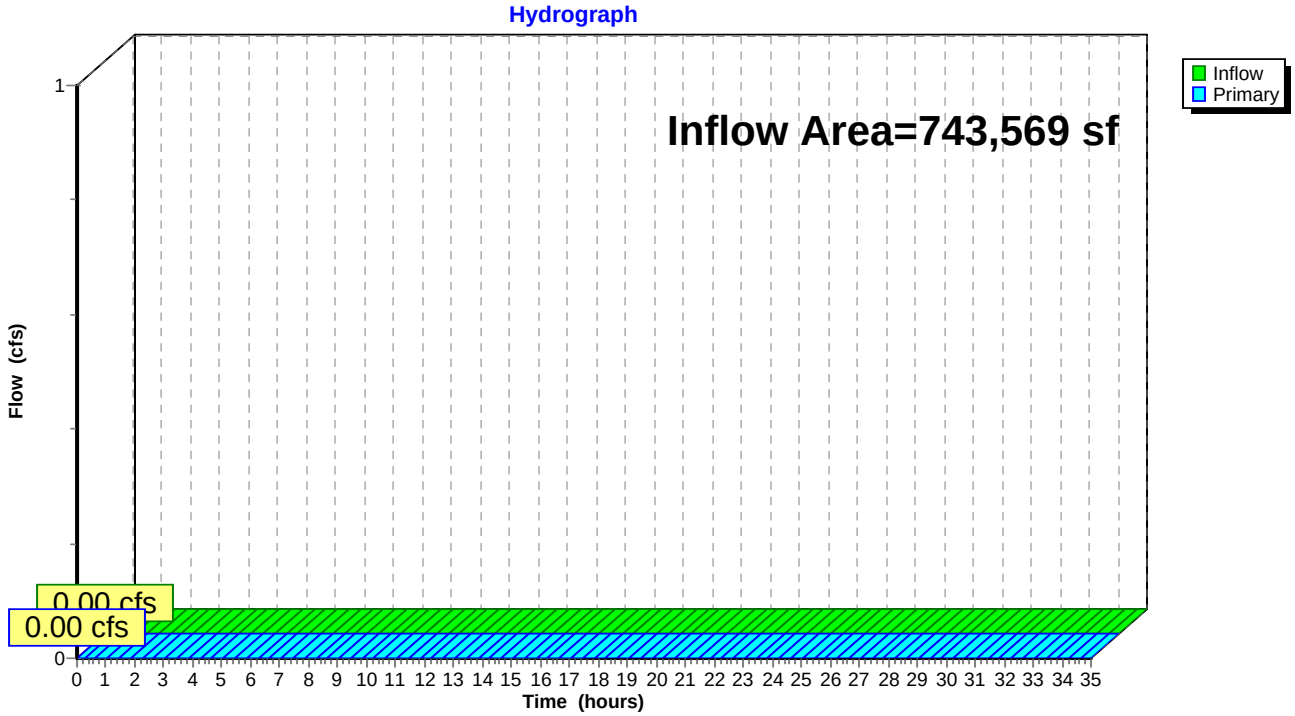


Summary for Link 3L: Flow to Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.00" for 25 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 3L: Flow to Isolated Wetland 2

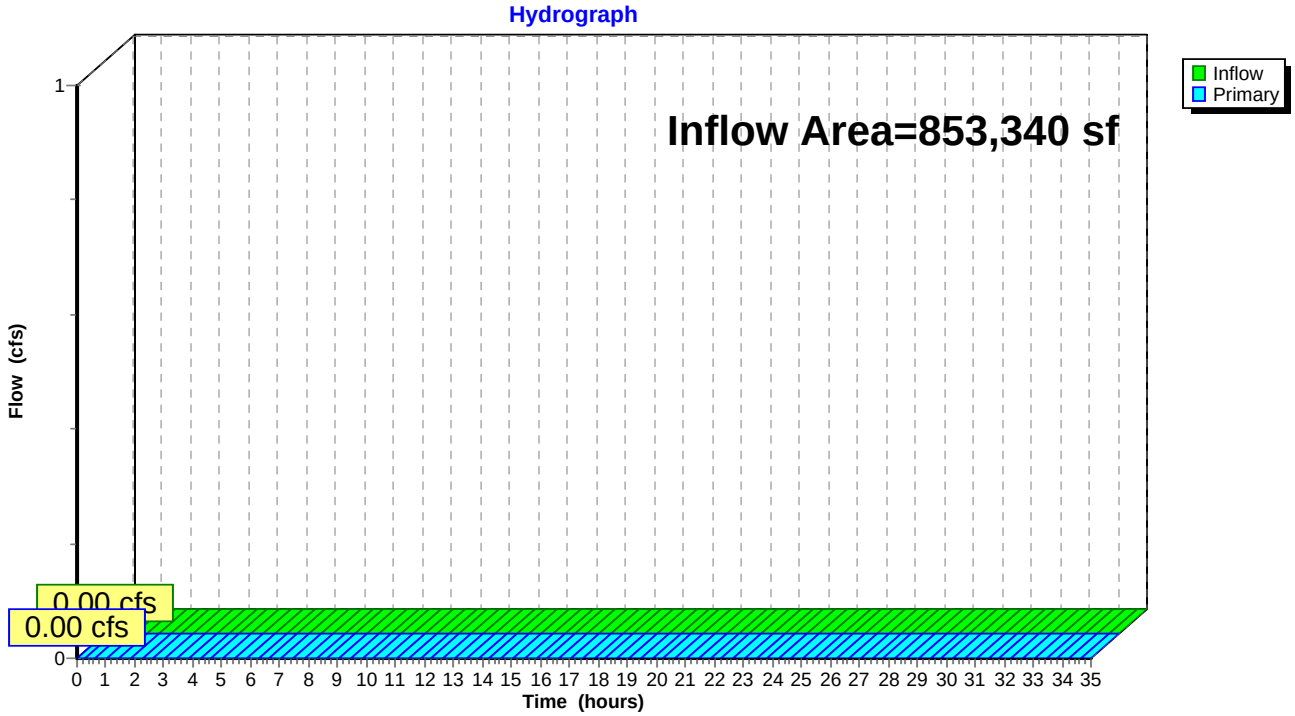


Summary for Link 4L: Flow to Design Point

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 25 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 4L: Flow to Design Point

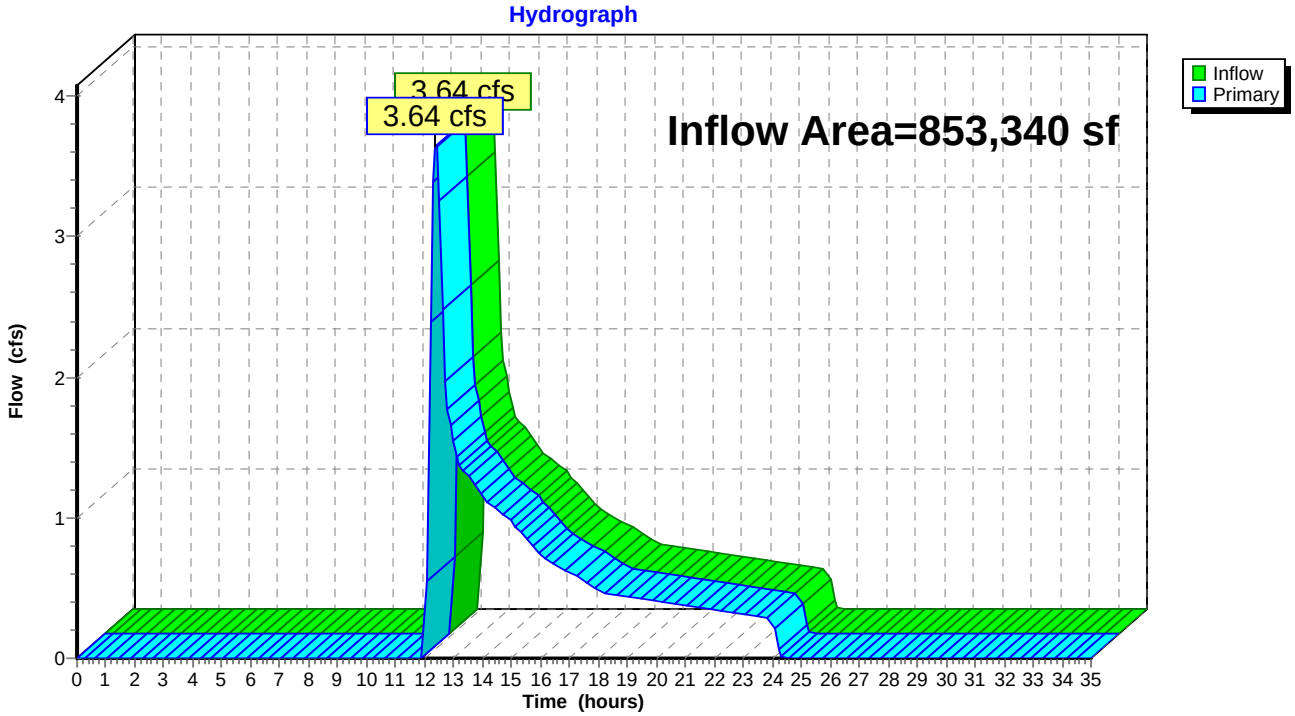


Summary for Link 5L: Flow Combine

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.45" for 25 event
Inflow = 3.64 cfs @ 12.39 hrs, Volume= 32,218 cf
Primary = 3.64 cfs @ 12.39 hrs, Volume= 32,218 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 5L: Flow Combine



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1: Runoff Area=853,340 sf 4.79% Impervious Runoff Depth=0.65"
Tc=10.0 min CN=42 Runoff=6.23 cfs 46,210 cf

Subcatchment P-2: Runoff Area=17.070 ac 2.23% Impervious Runoff Depth=0.53"
Tc=10.0 min CN=40 Runoff=3.86 cfs 32,899 cf

Pond 1P: Detention Area Peak Elev=98.76' Storage=8,565 cf Inflow=7.63 cfs 34,868 cf
Discarded=1.50 cfs 34,874 cf Primary=0.00 cfs 0 cf Outflow=1.50 cfs 34,874 cf

Pond 2P: Perf. Pipe Underdrains 12"x12" Peak Elev=101.22' Storage=1,155 cf Inflow=6.23 cfs 46,210 cf
Discarded=0.24 cfs 11,343 cf Primary=7.63 cfs 34,868 cf Outflow=7.86 cfs 46,211 cf

Pond 4P: Isolated Wetland Peak Elev=82.32' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond 7P: Isolated Wetland 2 Peak Elev=77.36' Storage=17,108 cf Inflow=3.86 cfs 32,899 cf
Discarded=0.43 cfs 29,025 cf Primary=0.00 cfs 0 cf Outflow=0.43 cfs 29,025 cf

Link 3L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 4L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 5L: Flow Combine Inflow=6.23 cfs 46,210 cf
Primary=6.23 cfs 46,210 cf

Total Runoff Area = 1,596,909 sf Runoff Volume = 79,109 cf Average Runoff Depth = 0.59"
96.40% Pervious = 1,539,497 sf 3.60% Impervious = 57,412 sf

Summary for Subcatchment P-1:

[49] Hint: Tc<2dt may require smaller dt

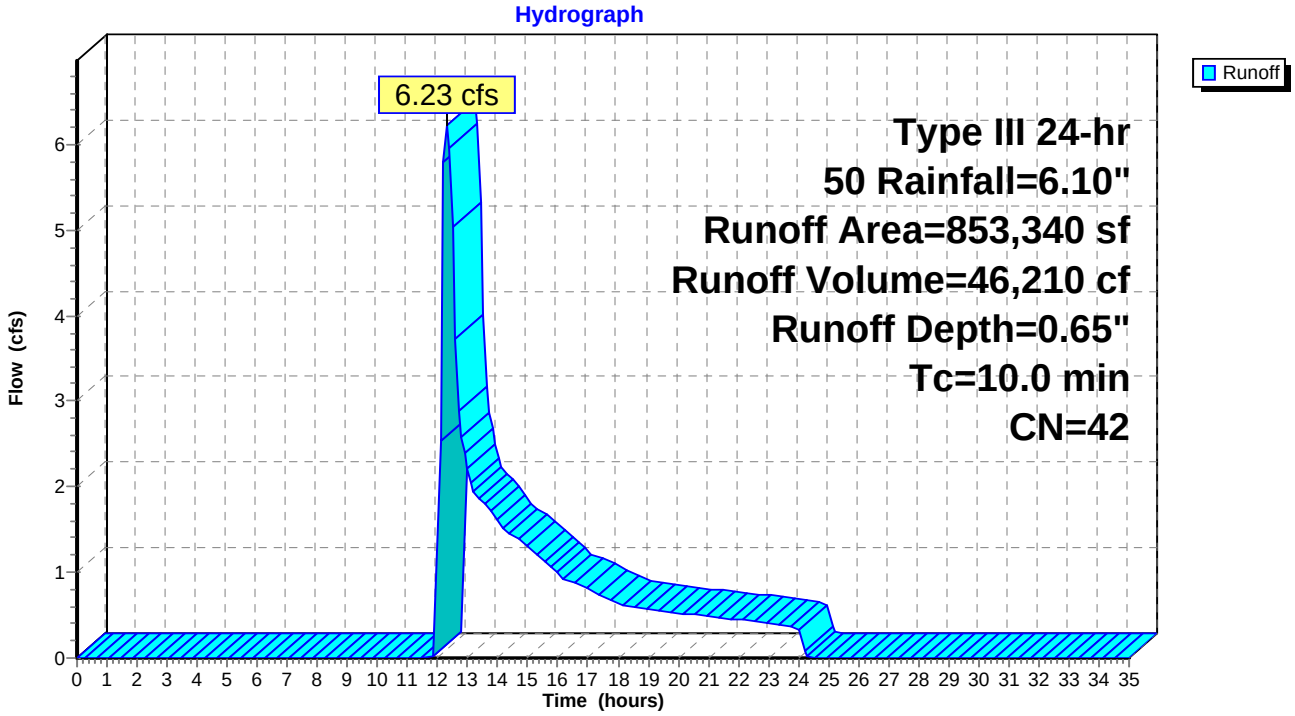
Runoff = 6.23 cfs @ 12.31 hrs, Volume= 46,210 cf, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (sf)	CN	Description
	258,180	39	>75% Grass cover, Good, HSG A
*	16,030	98	Cart Paths
*	5,271	98	wetland
	44,039	36	Woods, Fair, HSG A
*	12,153	98	new cart paths
*	310,278	39	>75% Grass cover, Good, HSG A
*	44,039	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
*	7,405	98	Buildings/Driveways-offsite
	853,340	42	Weighted Average
	812,481		95.21% Pervious Area
	40,859		4.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-1:



Summary for Subcatchment P-2:

[49] Hint: Tc<2dt may require smaller dt

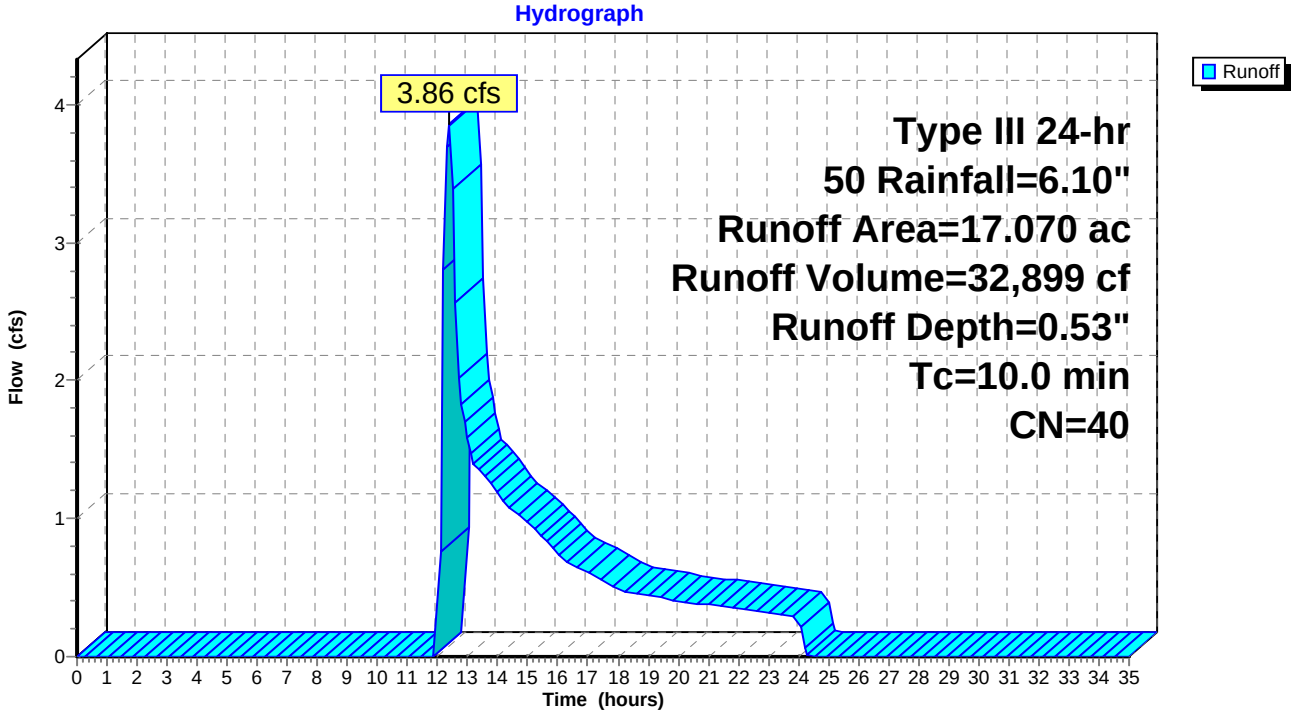
Runoff = 3.86 cfs @ 12.37 hrs, Volume= 32,899 cf, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (ac)	CN	Description
	14.568	39	>75% Grass cover, Good, HSG A
*	0.111	98	Cart Paths
*	0.183	98	wetland
	2.122	36	Woods, Fair, HSG A
*	0.086	98	New Cart Paths
	17.070	40	Weighted Average
	16.690		97.77% Pervious Area
	0.380		2.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-2:



Summary for Pond 1P: Detention Area

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.49" for 50 event
Inflow = 7.63 cfs @ 12.30 hrs, Volume= 34,868 cf
Outflow = 1.50 cfs @ 13.64 hrs, Volume= 34,874 cf, Atten= 80%, Lag= 80.4 min
Discarded = 1.50 cfs @ 13.64 hrs, Volume= 34,874 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 98.76' @ 13.64 hrs Surf.Area= 4,333 sf Storage= 8,565 cf

Plug-Flow detention time= 65.6 min calculated for 34,775 cf (100% of inflow)
Center-of-Mass det. time= 65.5 min (965.7 - 900.2)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	9,643 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

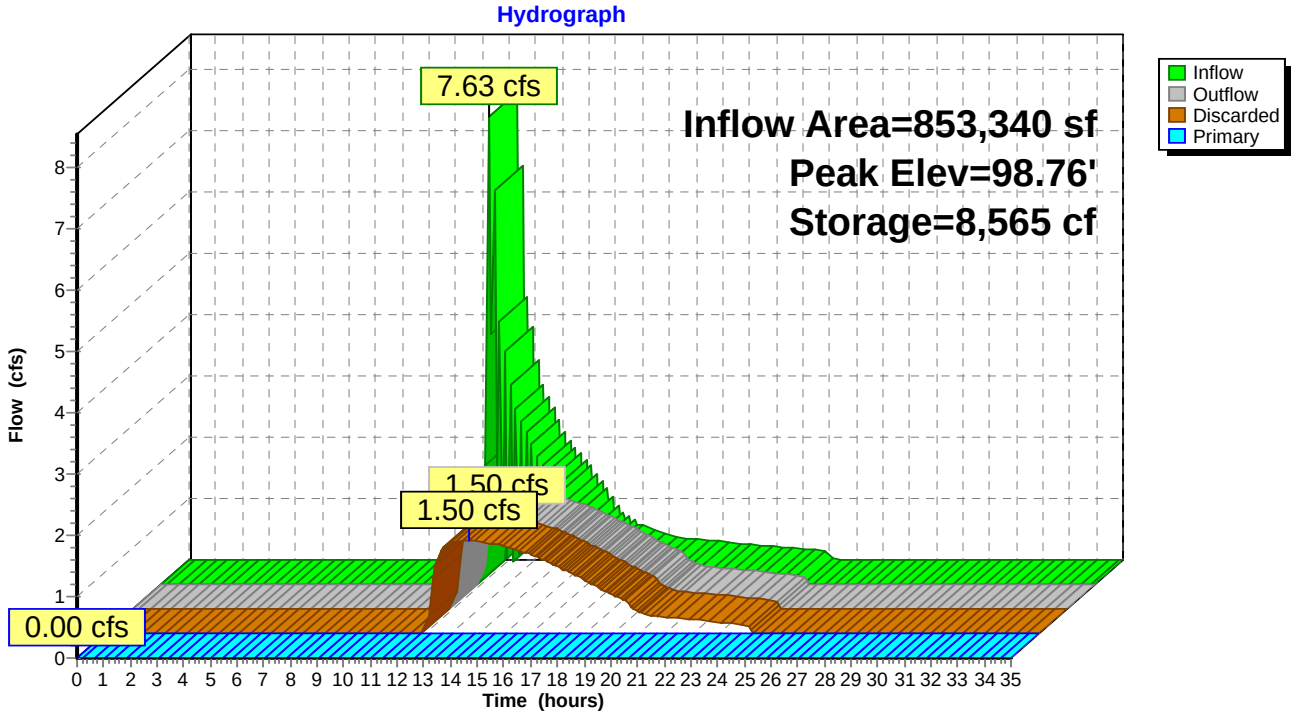
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
95.50	0	0	0
96.00	1,546	387	387
98.00	3,620	5,166	5,553
99.00	4,561	4,091	9,643

Device	Routing	Invert	Outlet Devices
#1	Discarded	95.50'	**15.000 in/hr Exfiltration over Surface area**
#2	Primary	98.80'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

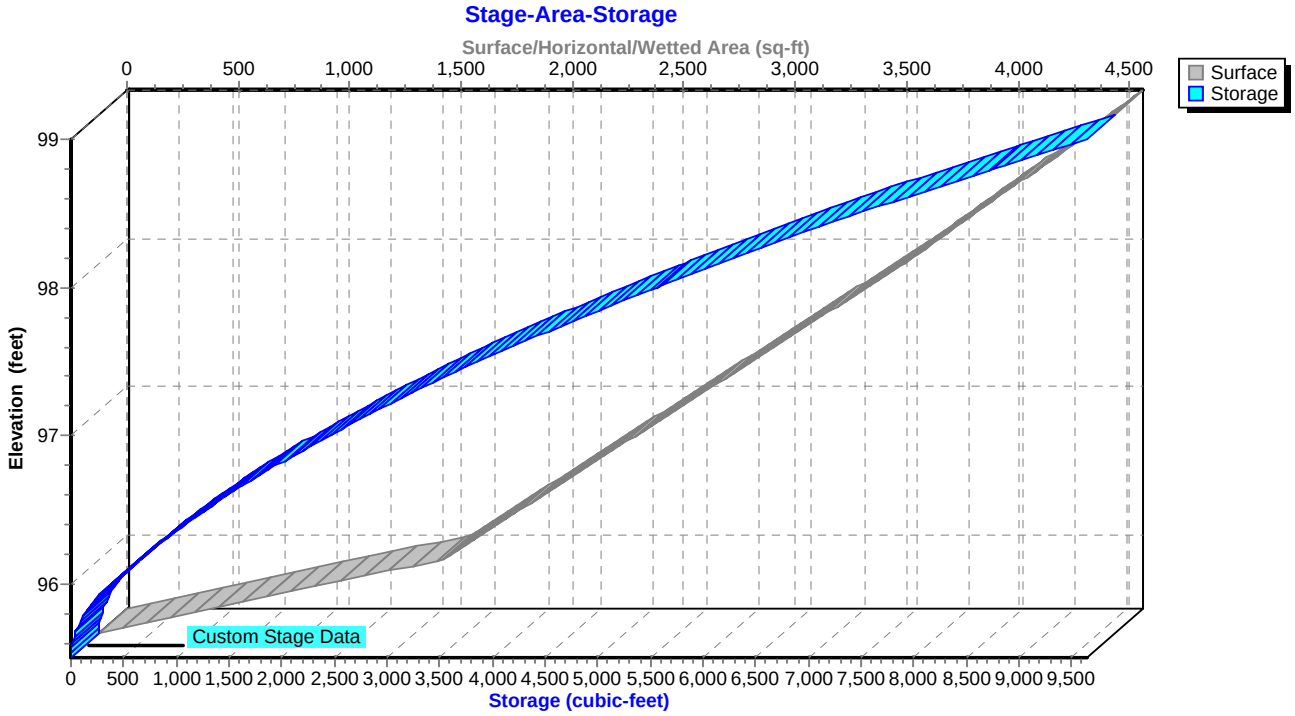
Discarded OutFlow Max=1.50 cfs @ 13.64 hrs HW=98.76' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.50 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=95.50' TW=82.32' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Detention Area



Pond 1P: Detention Area



Summary for Pond 2P: Perf. Pipe Underdrains 12"x12"

[93] Warning: Storage range exceeded by 0.22'
[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=20)

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.65" for 50 event
Inflow = 6.23 cfs @ 12.31 hrs, Volume= 46,210 cf
Outflow = 7.86 cfs @ 12.30 hrs, Volume= 46,211 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.24 cfs @ 12.20 hrs, Volume= 11,343 cf
Primary = 7.63 cfs @ 12.30 hrs, Volume= 34,868 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 101.22' @ 12.30 hrs Surf.Area= 4,086 sf Storage= 1,155 cf

Plug-Flow detention time= 18.7 min calculated for 46,080 cf (100% of inflow)
Center-of-Mass det. time= 19.0 min (955.6 - 936.6)

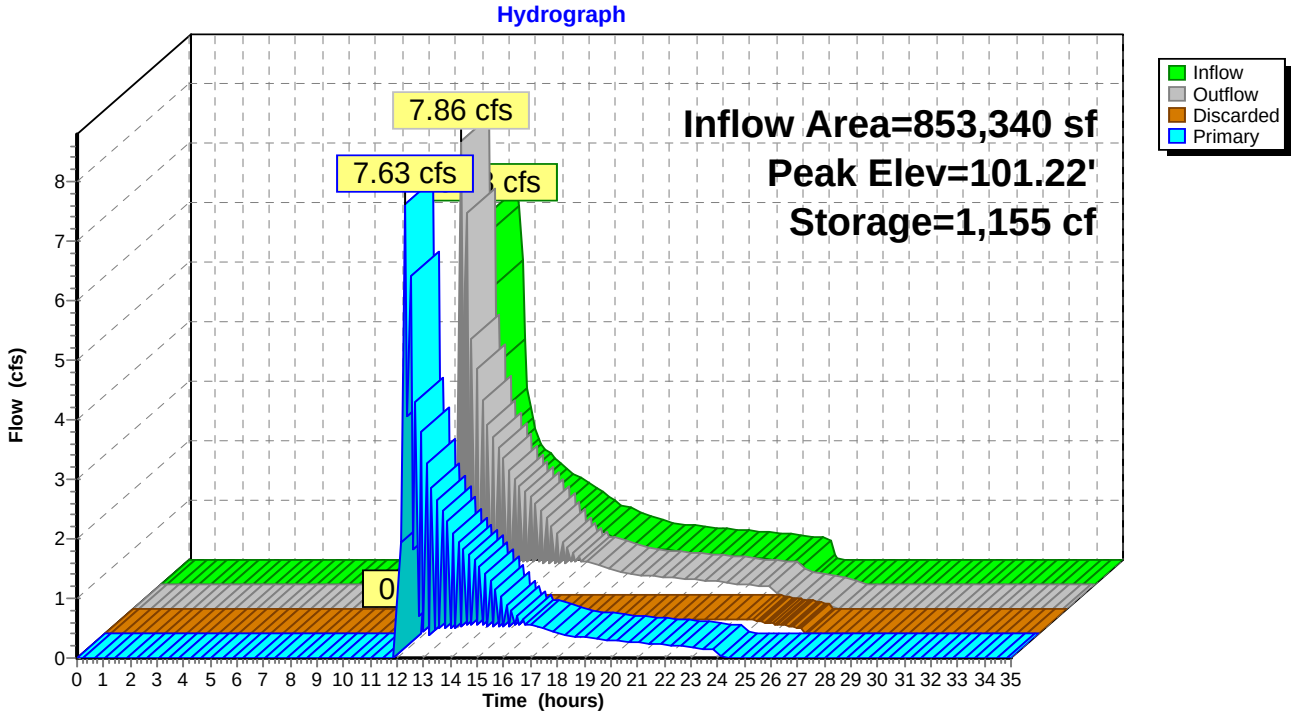
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	1,037 cf	**1.00'W x 1,360.00'L x 1.00'H Prismatoid Z=1.0** 2,722 cf Overall - 131 cf Embedded = 2,591 cf x 40.0% Voids
#2	100.33'	119 cf	**4.0" Round Pipe Storage** Inside #1 L= 1,360.0' 131 cf Overall - 0.1" Wall Thickness = 119 cf
		1,155 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**2.500 in/hr Exfiltration over Surface area**
#2	Primary	100.95'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

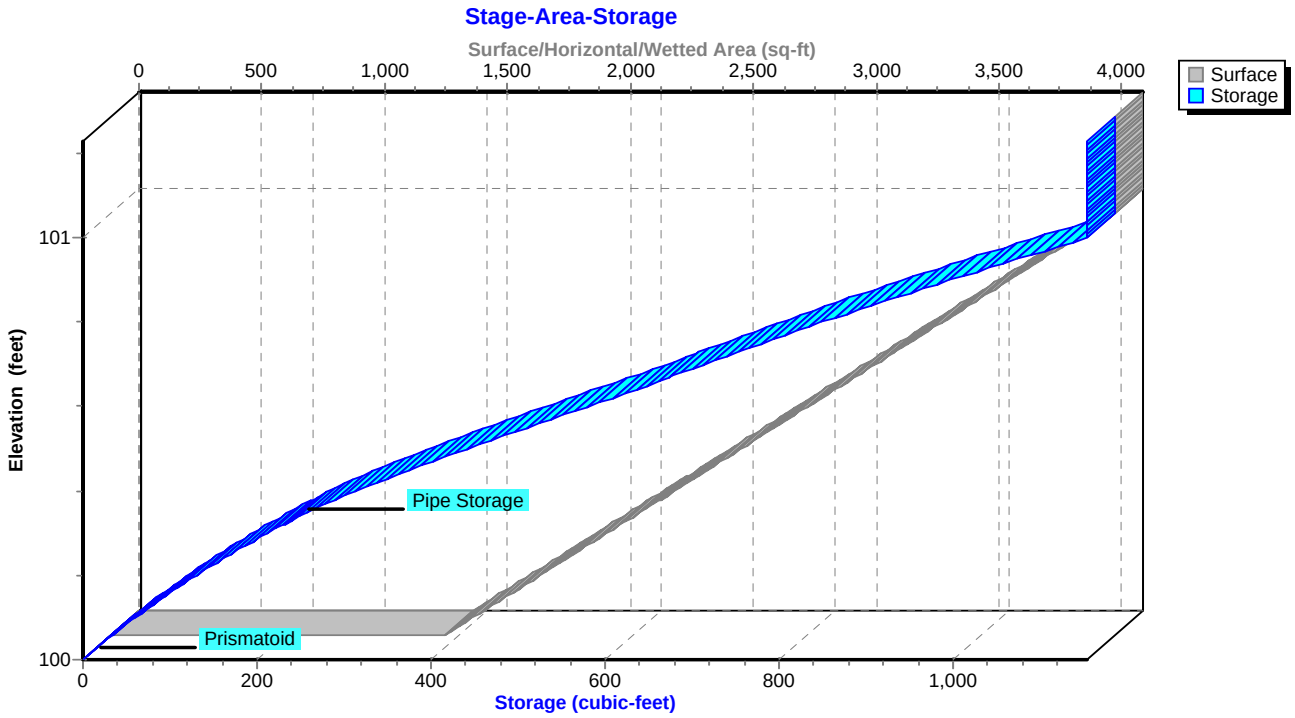
Discarded OutFlow Max=0.24 cfs @ 12.20 hrs HW=101.12' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=7.58 cfs @ 12.30 hrs HW=101.22' TW=96.99' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 7.58 cfs @ 1.40 fps)

Pond 2P: Perf. Pipe Underdrains 12"x12"



Pond 2P: Perf. Pipe Underdrains 12"x12"



Summary for Pond 4P: Isolated Wetland

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 50 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 82.32' @ 0.00 hrs Surf.Area= 3,101 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

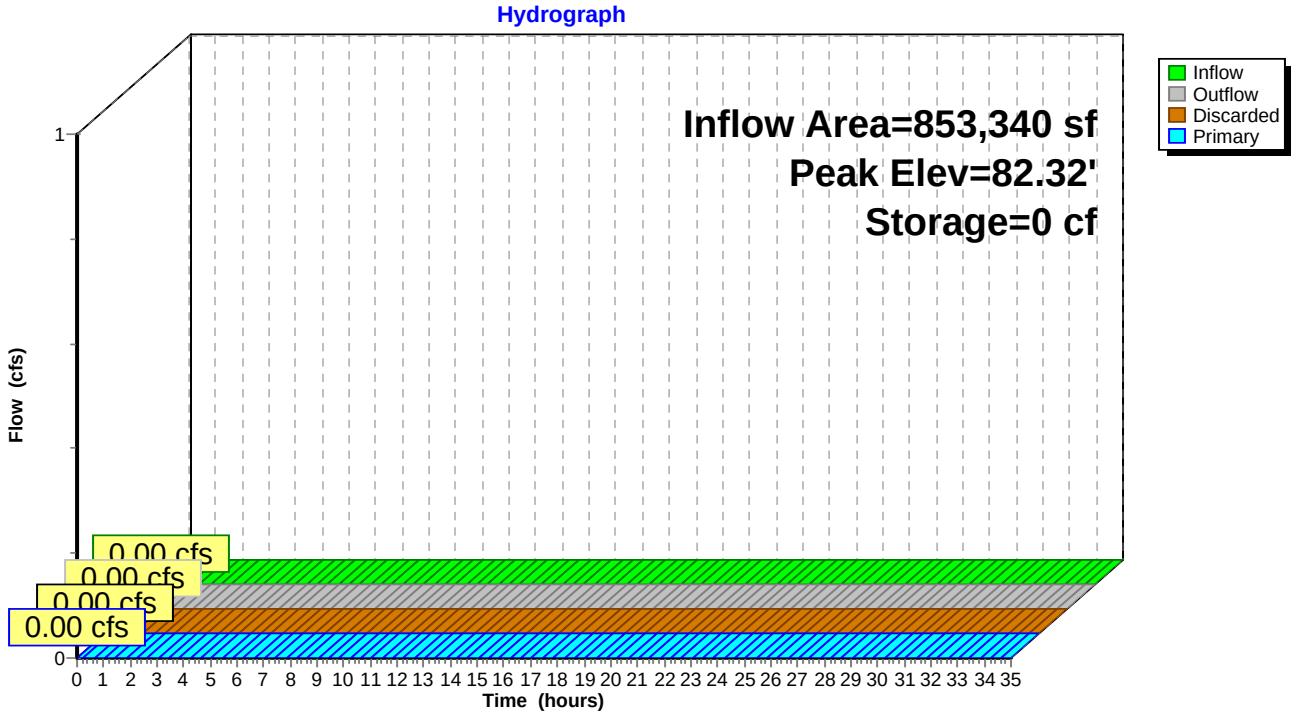
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

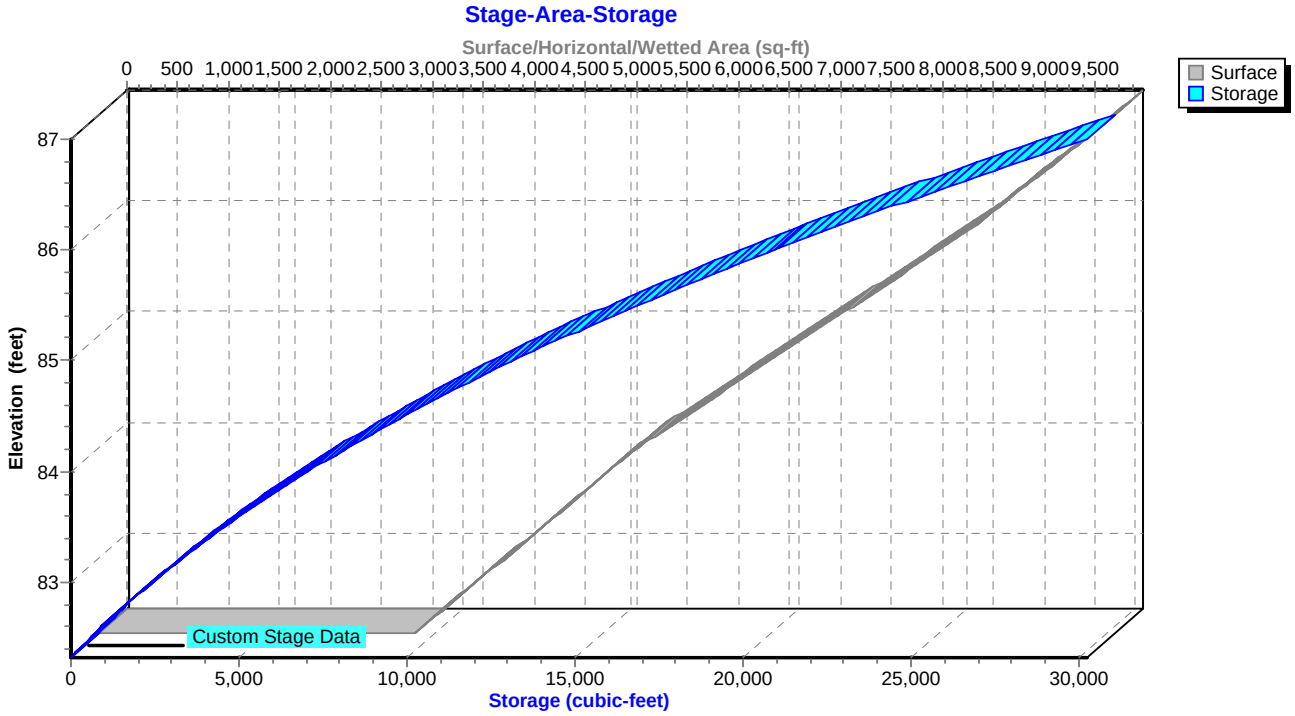
Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' (Free Discharge)
↑**1=Exfiltration** (Passes 0.00 cfs of 0.07 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Isolated Wetland



Pond 4P: Isolated Wetland



Summary for Pond 7P: Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.53" for 50 event
Inflow = 3.86 cfs @ 12.37 hrs, Volume= 32,899 cf
Outflow = 0.43 cfs @ 19.41 hrs, Volume= 29,025 cf, Atten= 89%, Lag= 422.0 min
Discarded = 0.43 cfs @ 19.41 hrs, Volume= 29,025 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 77.36' @ 19.41 hrs Surf.Area= 18,441 sf Storage= 17,108 cf

Plug-Flow detention time= 473.6 min calculated for 29,025 cf (88% of inflow)
Center-of-Mass det. time= 420.8 min (1,372.0 - 951.2)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

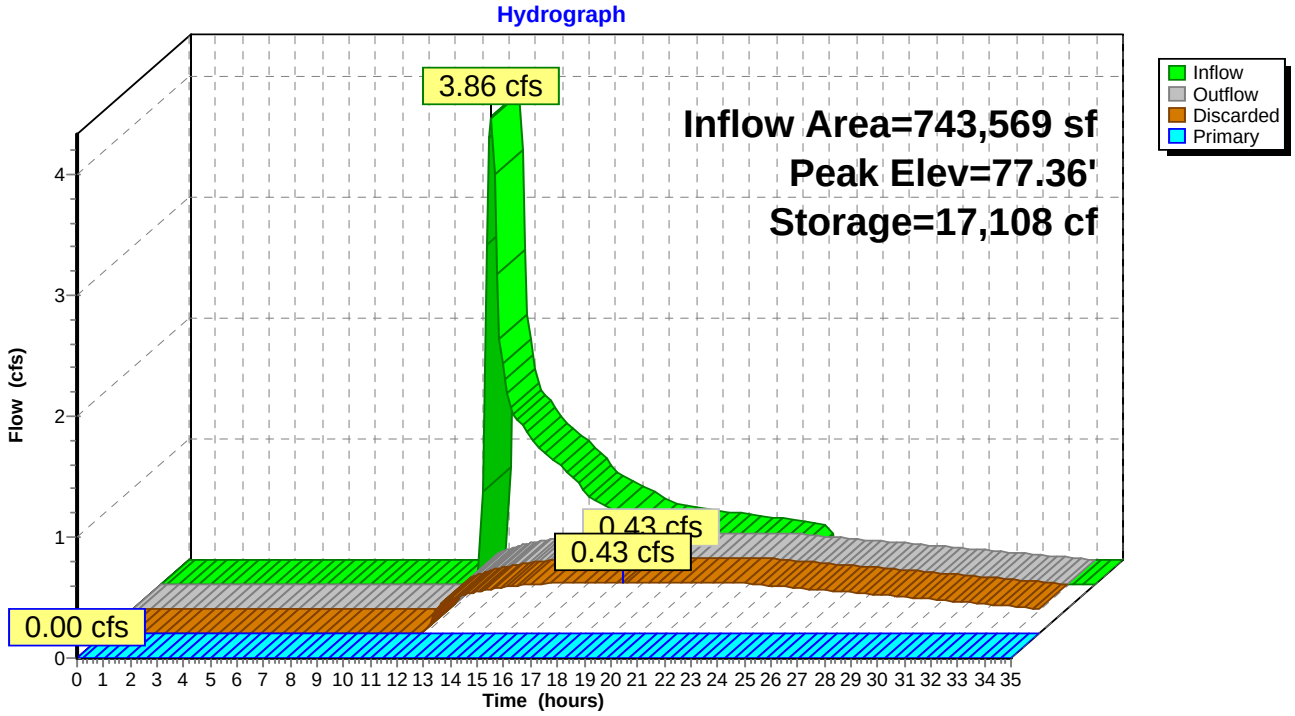
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

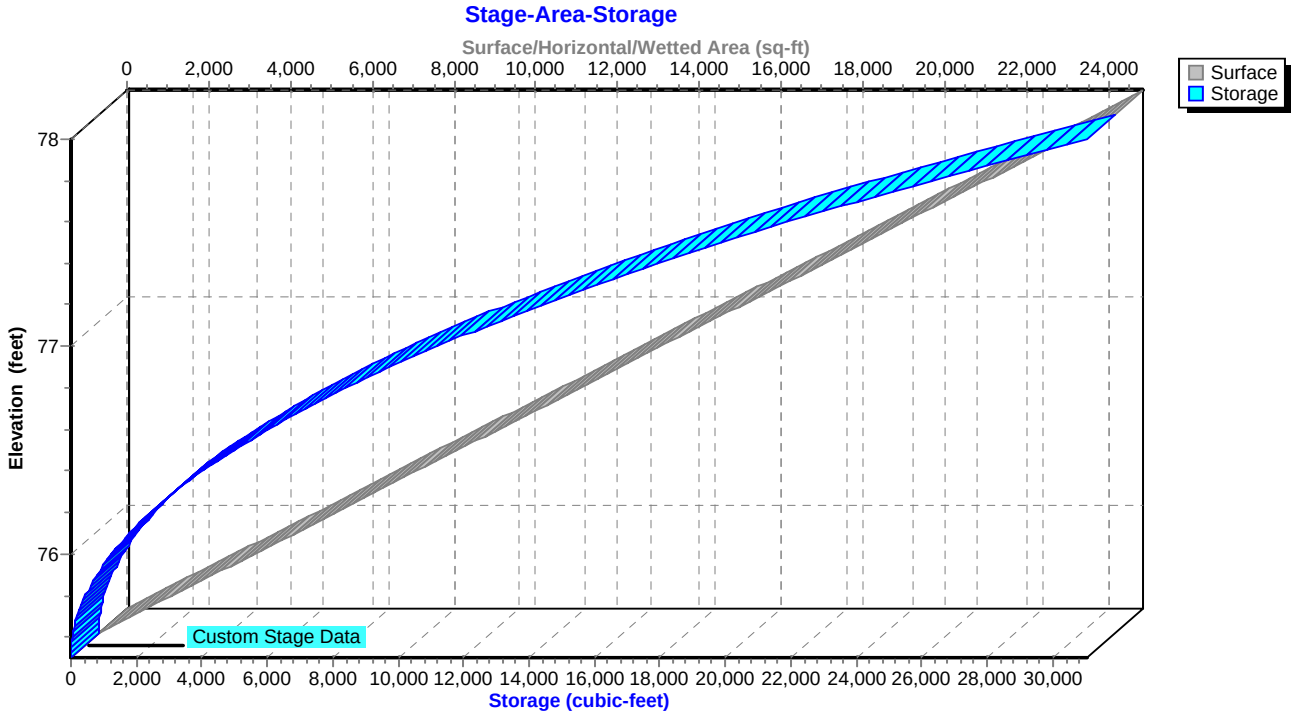
Discarded OutFlow Max=0.43 cfs @ 19.41 hrs HW=77.36' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Isolated Wetland 2



Pond 7P: Isolated Wetland 2

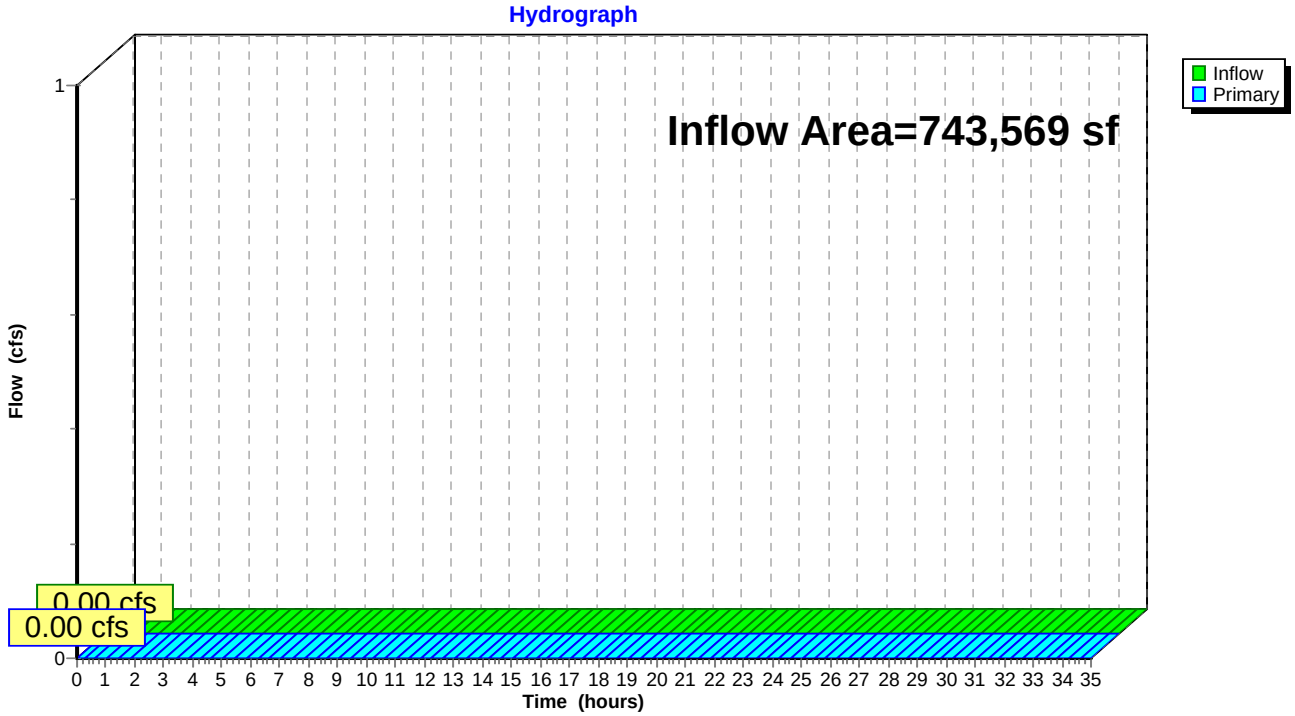


Summary for Link 3L: Flow to Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.00" for 50 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 3L: Flow to Isolated Wetland 2

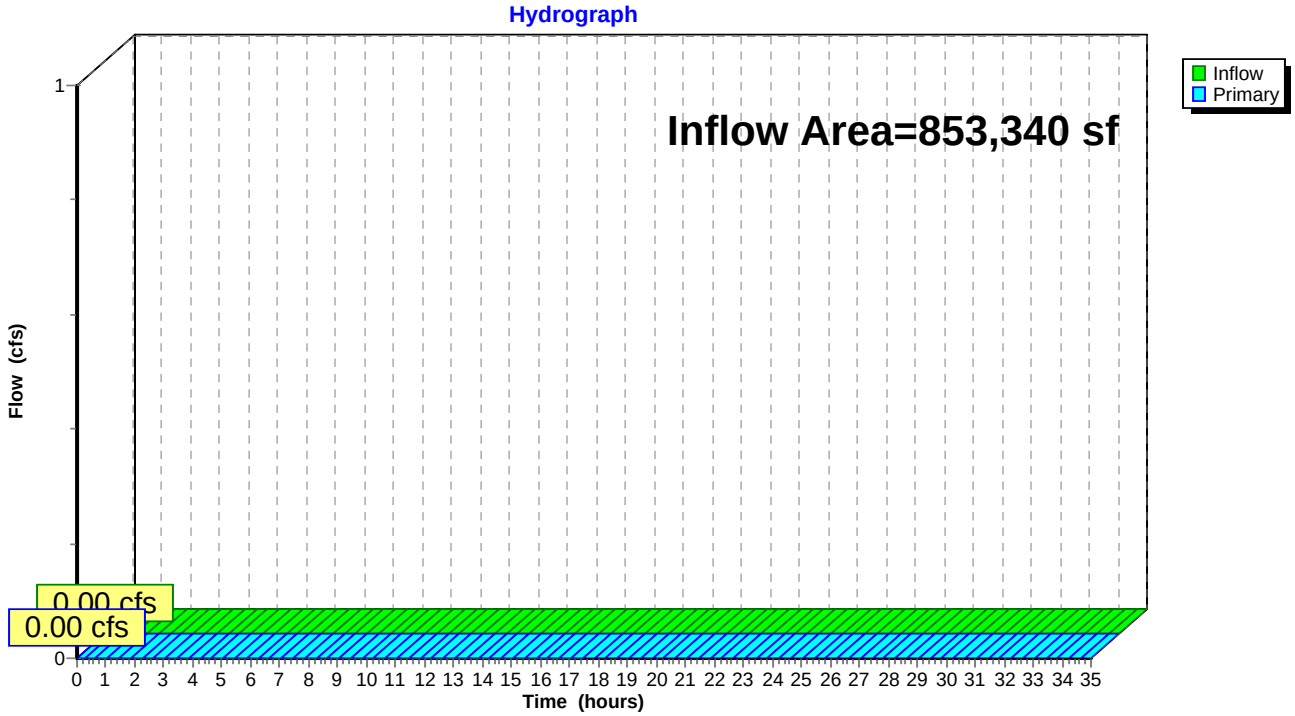


Summary for Link 4L: Flow to Design Point

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 50 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 4L: Flow to Design Point

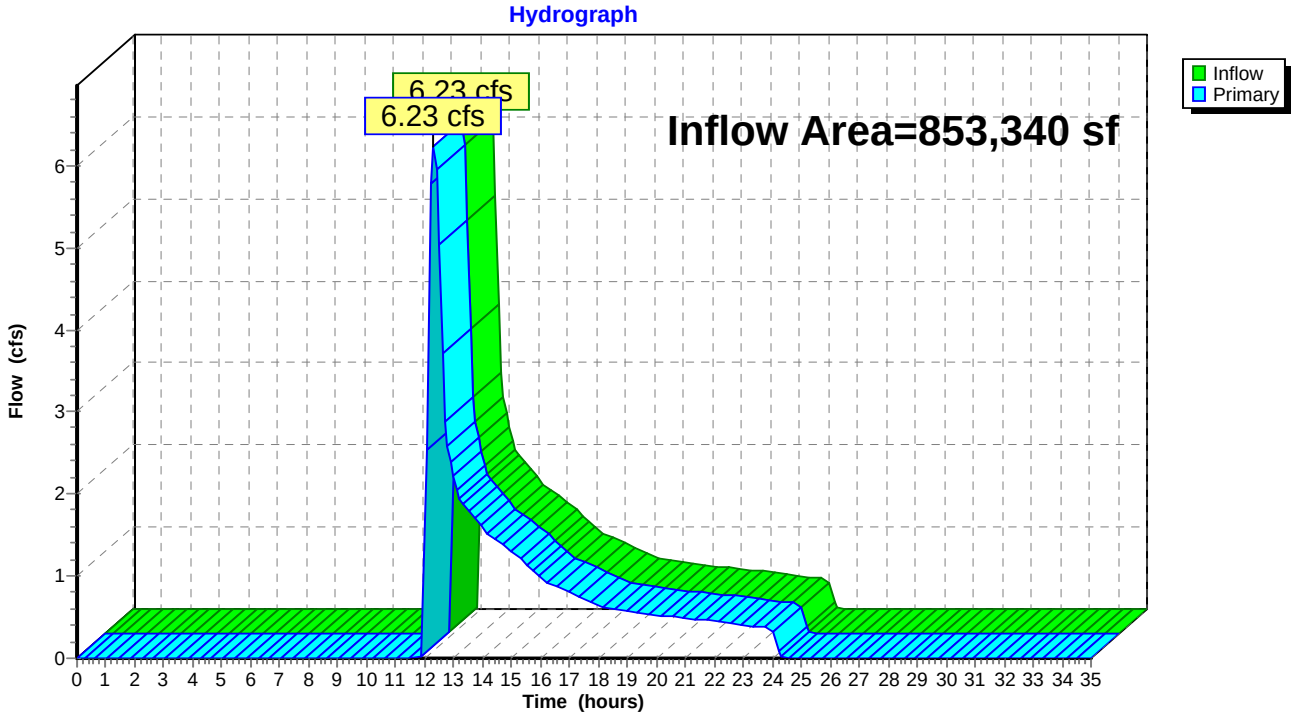


Summary for Link 5L: Flow Combine

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.65" for 50 event
Inflow = 6.23 cfs @ 12.31 hrs, Volume= 46,210 cf
Primary = 6.23 cfs @ 12.31 hrs, Volume= 46,210 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 5L: Flow Combine



Time span=0.00-35.00 hrs, dt=0.10 hrs, 351 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1: Runoff Area=853,340 sf 4.79% Impervious Runoff Depth=0.87"
Tc=10.0 min CN=42 Runoff=10.32 cfs 62,140 cf

Subcatchment P-2: Runoff Area=17.070 ac 2.23% Impervious Runoff Depth=0.73"
Tc=10.0 min CN=40 Runoff=6.22 cfs 45,363 cf

Pond 1P: Detention Area Peak Elev=98.99' Storage=9,593 cf Inflow=15.01 cfs 50,722 cf
Discarded=1.58 cfs 42,347 cf Primary=5.18 cfs 8,376 cf Outflow=6.77 cfs 50,723 cf

Pond 2P: Perf. Pipe Underdrains 12"x12" Peak Elev=101.37' Storage=1,155 cf Inflow=10.32 cfs 62,140 cf
Discarded=0.24 cfs 11,426 cf Primary=15.01 cfs 50,722 cf Outflow=15.25 cfs 62,148 cf

Pond 4P: Isolated Wetland Peak Elev=84.08' Storage=7,457 cf Inflow=5.18 cfs 8,376 cf
Discarded=0.13 cfs 8,199 cf Primary=0.00 cfs 0 cf Outflow=0.13 cfs 8,199 cf

Pond 7P: Isolated Wetland 2 Peak Elev=77.77' Storage=25,669 cf Inflow=6.22 cfs 45,363 cf
Discarded=0.52 cfs 36,872 cf Primary=0.00 cfs 0 cf Outflow=0.52 cfs 36,872 cf

Link 3L: Flow to Isolated Wetland 2 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 4L: Flow to Design Point Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 5L: Flow Combine Inflow=10.32 cfs 62,140 cf
Primary=10.32 cfs 62,140 cf

Total Runoff Area = 1,596,909 sf Runoff Volume = 107,503 cf Average Runoff Depth = 0.81"
96.40% Pervious = 1,539,497 sf 3.60% Impervious = 57,412 sf

Summary for Subcatchment P-1:

[49] Hint: Tc<2dt may require smaller dt

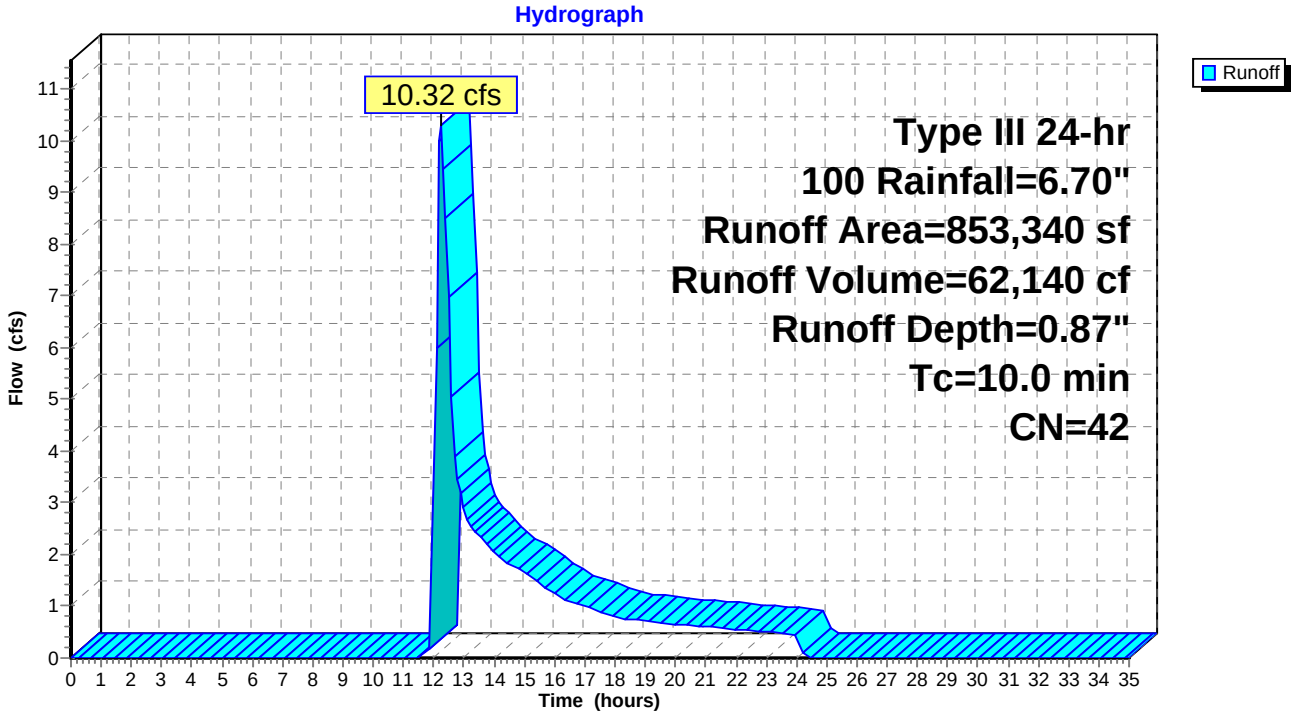
Runoff = 10.32 cfs @ 12.24 hrs, Volume= 62,140 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 Rainfall=6.70"

	Area (sf)	CN	Description
	258,180	39	>75% Grass cover, Good, HSG A
*	16,030	98	Cart Paths
*	5,271	98	wetland
	44,039	36	Woods, Fair, HSG A
*	12,153	98	new cart paths
*	310,278	39	>75% Grass cover, Good, HSG A
*	44,039	36	Woods, Fair, HSG A
*	85,726	36	Woods, Fair, HSG A-offsite
*	70,219	49	50-75% Grass cover, Fair, HSG A-offsite
*	7,405	98	Buildings/Driveways-offsite
	853,340	42	Weighted Average
	812,481		95.21% Pervious Area
	40,859		4.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-1:



Summary for Subcatchment P-2:

[49] Hint: Tc<2dt may require smaller dt

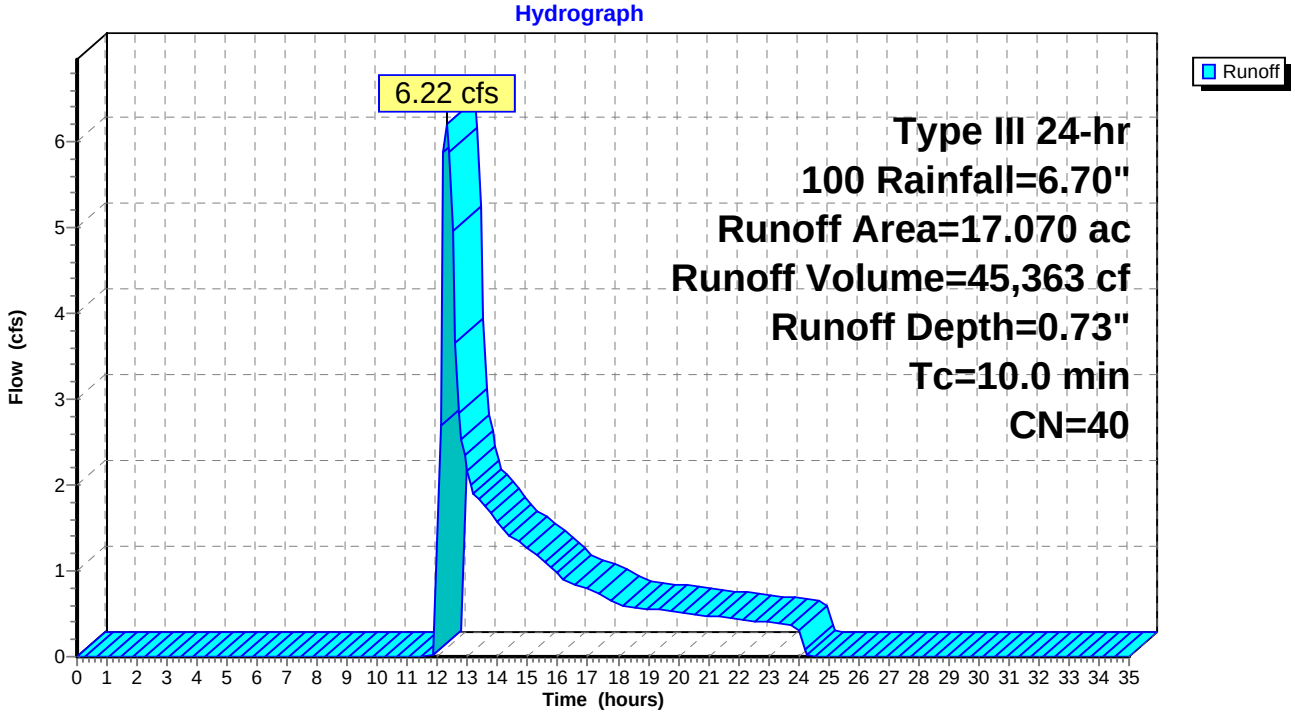
Runoff = 6.22 cfs @ 12.30 hrs, Volume= 45,363 cf, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 Rainfall=6.70"

	Area (ac)	CN	Description
	14.568	39	>75% Grass cover, Good, HSG A
*	0.111	98	Cart Paths
*	0.183	98	wetland
	2.122	36	Woods, Fair, HSG A
*	0.086	98	New Cart Paths
	17.070	40	Weighted Average
	16.690		97.77% Pervious Area
	0.380		2.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Direct Entry**

Subcatchment P-2:



Summary for Pond 1P: Detention Area

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.71" for 100 event
Inflow = 15.01 cfs @ 12.21 hrs, Volume= 50,722 cf
Outflow = 6.77 cfs @ 12.54 hrs, Volume= 50,723 cf, Atten= 55%, Lag= 19.8 min
Discarded = 1.58 cfs @ 12.50 hrs, Volume= 42,347 cf
Primary = 5.18 cfs @ 12.54 hrs, Volume= 8,376 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 98.99' @ 12.50 hrs Surf.Area= 4,551 sf Storage= 9,593 cf

Plug-Flow detention time= 60.2 min calculated for 50,578 cf (100% of inflow)
Center-of-Mass det. time= 60.1 min (954.5 - 894.4)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	9,643 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

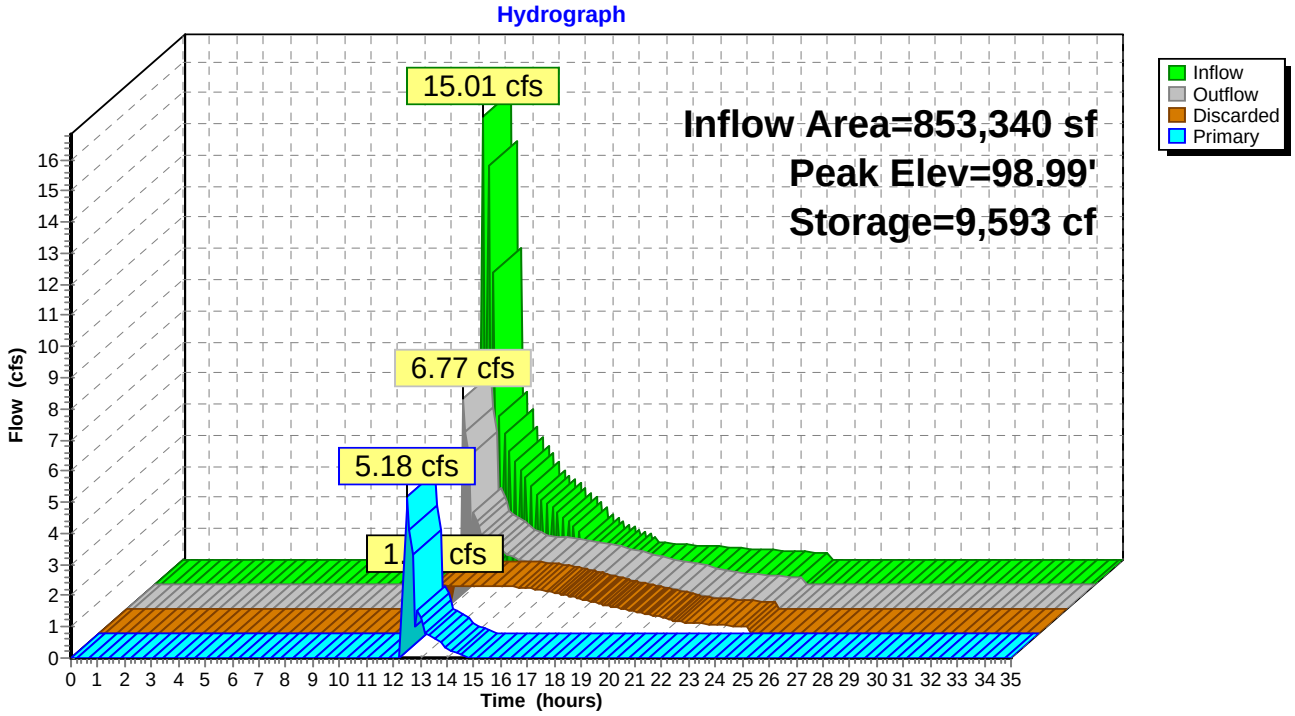
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
95.50	0	0	0
96.00	1,546	387	387
98.00	3,620	5,166	5,553
99.00	4,561	4,091	9,643

Device	Routing	Invert	Outlet Devices
#1	Discarded	95.50'	**15.000 in/hr Exfiltration over Surface area**
#2	Primary	98.80'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

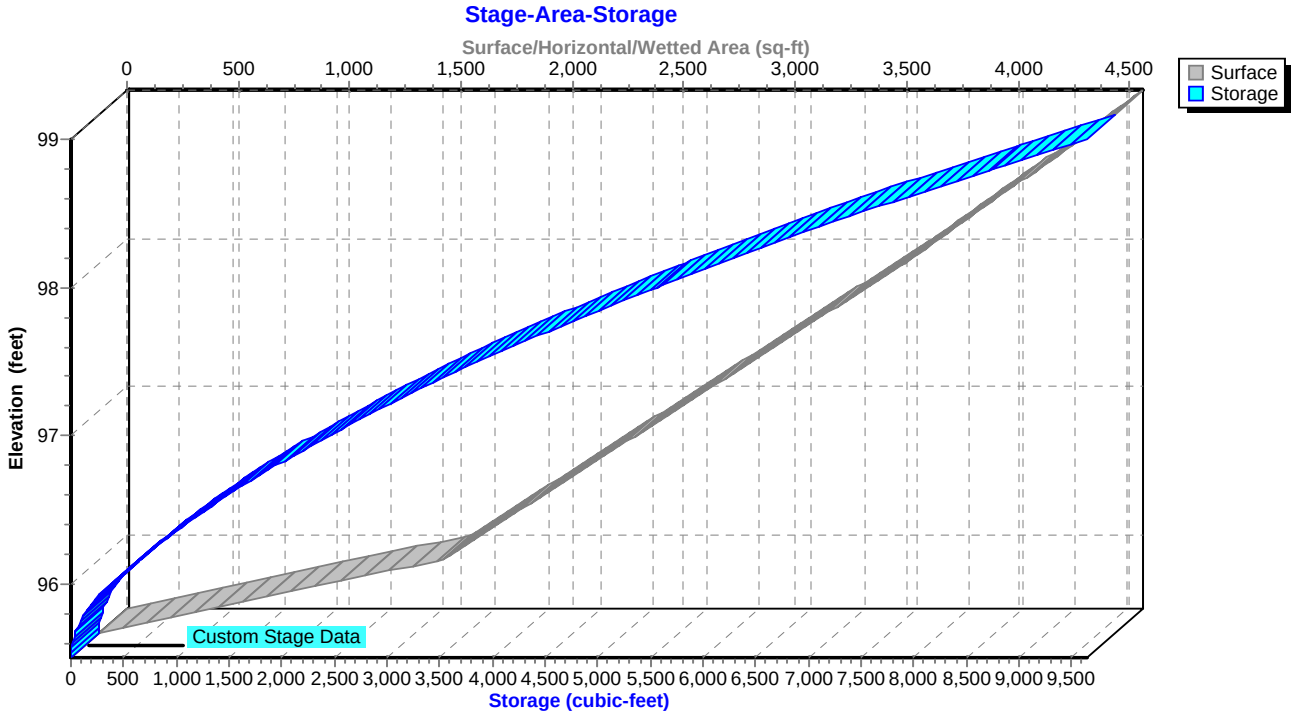
Discarded OutFlow Max=1.58 cfs @ 12.50 hrs HW=98.99' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.58 cfs)

Primary OutFlow Max=4.53 cfs @ 12.54 hrs HW=98.98' TW=82.74' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 4.53 cfs @ 1.00 fps)

Pond 1P: Detention Area



Pond 1P: Detention Area



Summary for Pond 2P: Perf. Pipe Underdrains 12"x12"

[93] Warning: Storage range exceeded by 0.37'
[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=26)

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.87" for 100 event
Inflow = 10.32 cfs @ 12.24 hrs, Volume= 62,140 cf
Outflow = 15.25 cfs @ 12.21 hrs, Volume= 62,148 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.24 cfs @ 12.20 hrs, Volume= 11,426 cf
Primary = 15.01 cfs @ 12.21 hrs, Volume= 50,722 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 101.37' @ 12.20 hrs Surf.Area= 4,086 sf Storage= 1,155 cf

Plug-Flow detention time= 14.0 min calculated for 61,971 cf (100% of inflow)
Center-of-Mass det. time= 14.3 min (937.0 - 922.6)

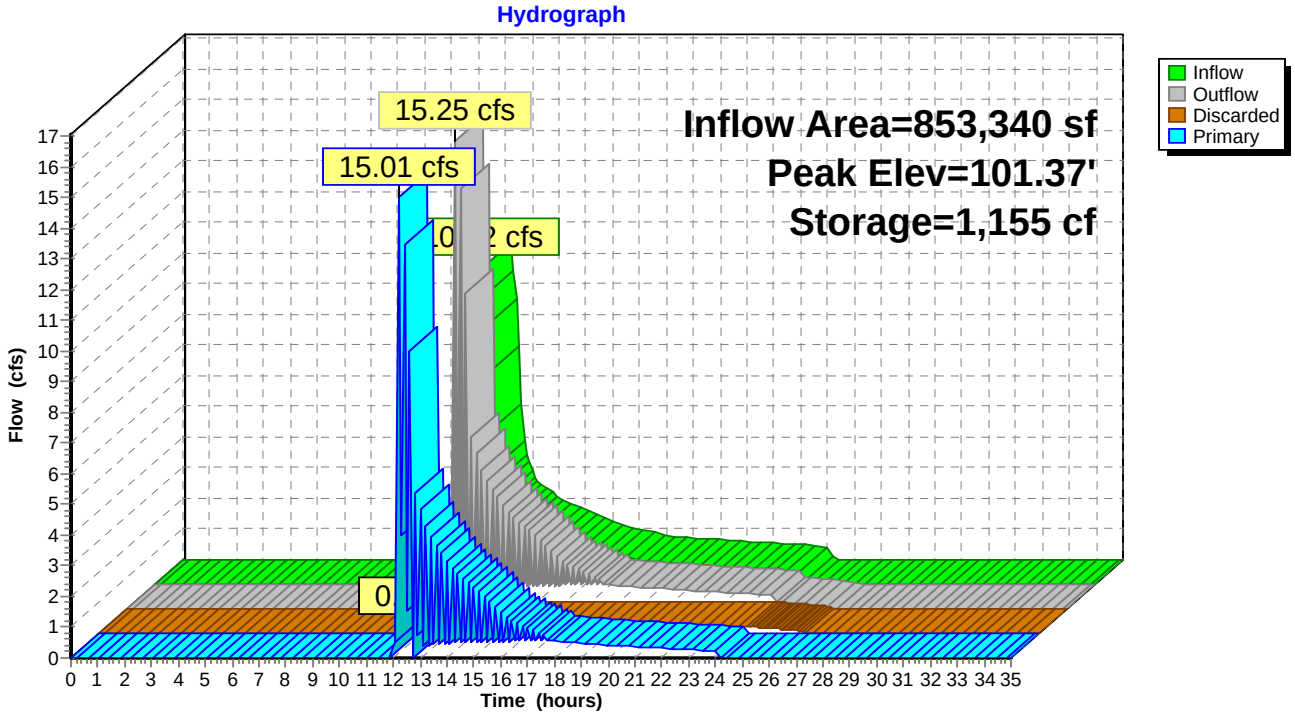
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	1,037 cf	**1.00'W x 1,360.00'L x 1.00'H Prismatoid Z=1.0** 2,722 cf Overall - 131 cf Embedded = 2,591 cf x 40.0% Voids
#2	100.33'	119 cf	**4.0" Round Pipe Storage** Inside #1 L= 1,360.0' 131 cf Overall - 0.1" Wall Thickness = 119 cf
		1,155 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**2.500 in/hr Exfiltration over Surface area**
#2	Primary	100.95'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

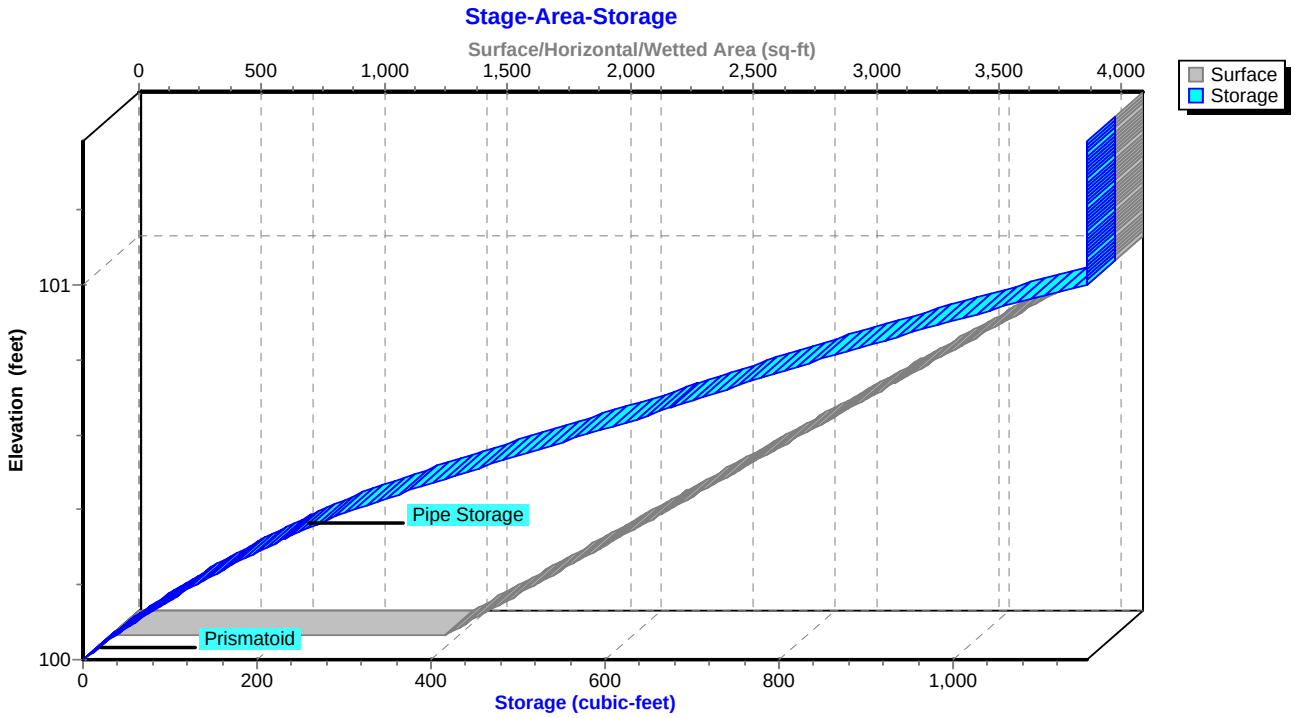
Discarded OutFlow Max=0.24 cfs @ 12.20 hrs HW=101.37' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=14.05 cfs @ 12.21 hrs HW=101.36' TW=97.14' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 14.05 cfs @ 1.73 fps)

Pond 2P: Perf. Pipe Underdrains 12"x12"



Pond 2P: Perf. Pipe Underdrains 12"x12"



Summary for Pond 4P: Isolated Wetland

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.12" for 100 event
Inflow = 5.18 cfs @ 12.54 hrs, Volume= 8,376 cf
Outflow = 0.13 cfs @ 14.42 hrs, Volume= 8,199 cf, Atten= 98%, Lag= 113.1 min
Discarded = 0.13 cfs @ 14.42 hrs, Volume= 8,199 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 84.08' @ 14.42 hrs Surf.Area= 5,415 sf Storage= 7,457 cf

Plug-Flow detention time= 591.6 min calculated for 8,175 cf (98% of inflow)
Center-of-Mass det. time= 591.5 min (1,368.4 - 776.9)

Volume	Invert	Avail.Storage	Storage Description
#1	82.32'	30,223 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

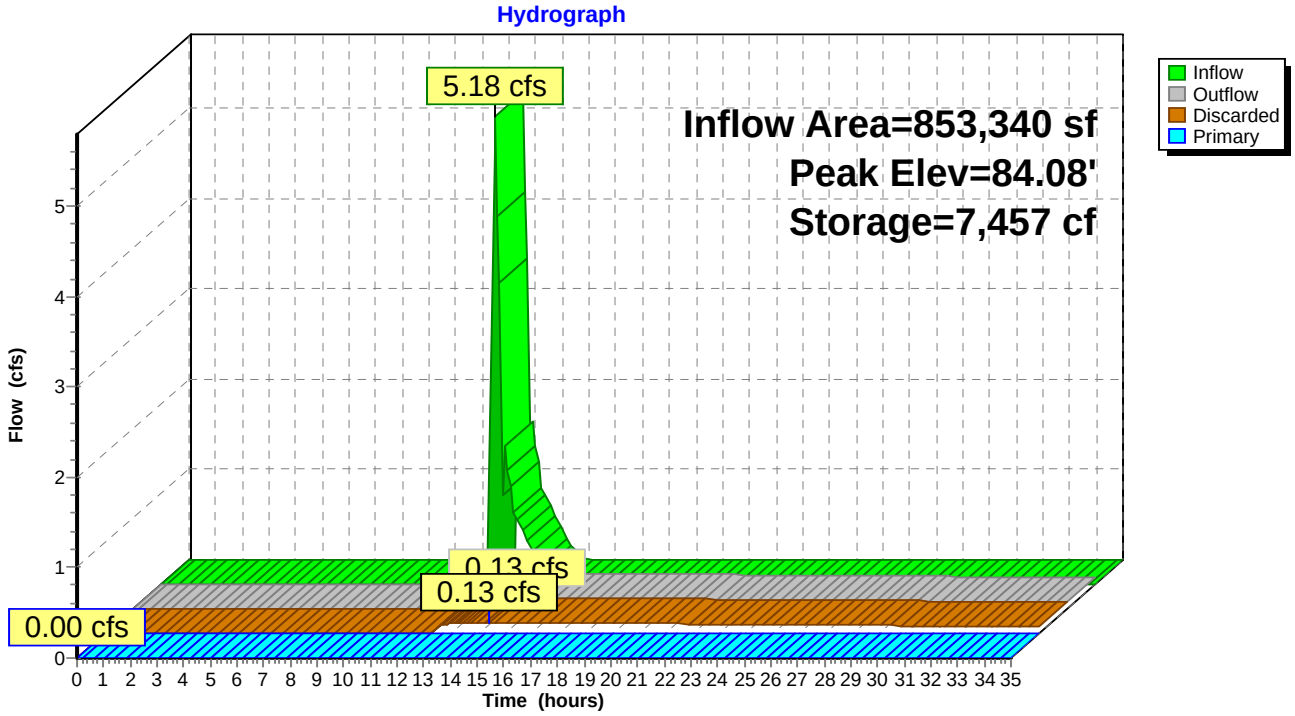
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.32	3,101	0	0
84.00	5,288	7,047	7,047
86.00	8,604	13,892	20,939
87.00	9,965	9,285	30,223

Device	Routing	Invert	Outlet Devices
#1	Discarded	82.32'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	86.95'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

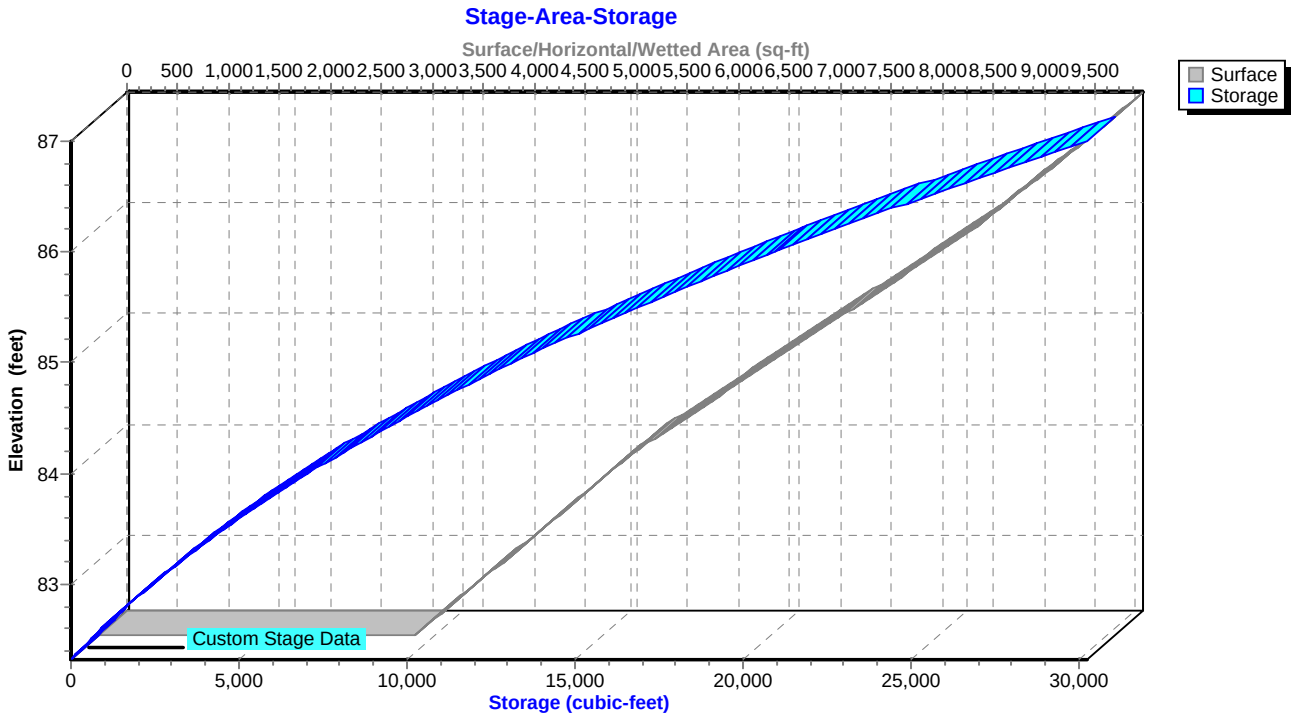
Discarded OutFlow Max=0.13 cfs @ 14.42 hrs HW=84.08' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.32' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 4P: Isolated Wetland



Pond 4P: Isolated Wetland



Summary for Pond 7P: Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.73" for 100 event
Inflow = 6.22 cfs @ 12.30 hrs, Volume= 45,363 cf
Outflow = 0.52 cfs @ 19.76 hrs, Volume= 36,872 cf, Atten= 92%, Lag= 447.9 min
Discarded = 0.52 cfs @ 19.76 hrs, Volume= 36,872 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 77.77' @ 19.76 hrs Surf.Area= 22,589 sf Storage= 25,669 cf

Plug-Flow detention time= 529.3 min calculated for 36,872 cf (81% of inflow)
Center-of-Mass det. time= 449.4 min (1,384.2 - 934.8)

Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	31,060 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

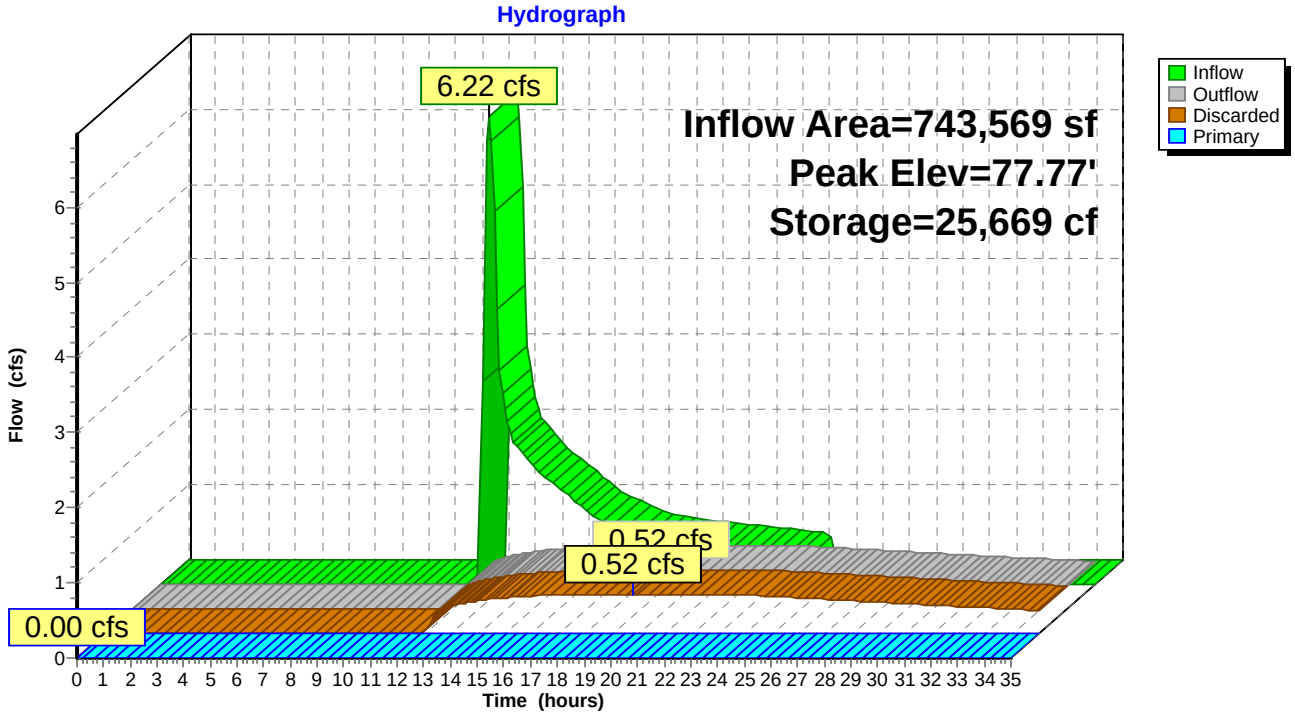
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.50	0	0	0
78.00	24,848	31,060	31,060

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**1.000 in/hr Exfiltration over Surface area**
#2	Primary	77.90'	**47.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

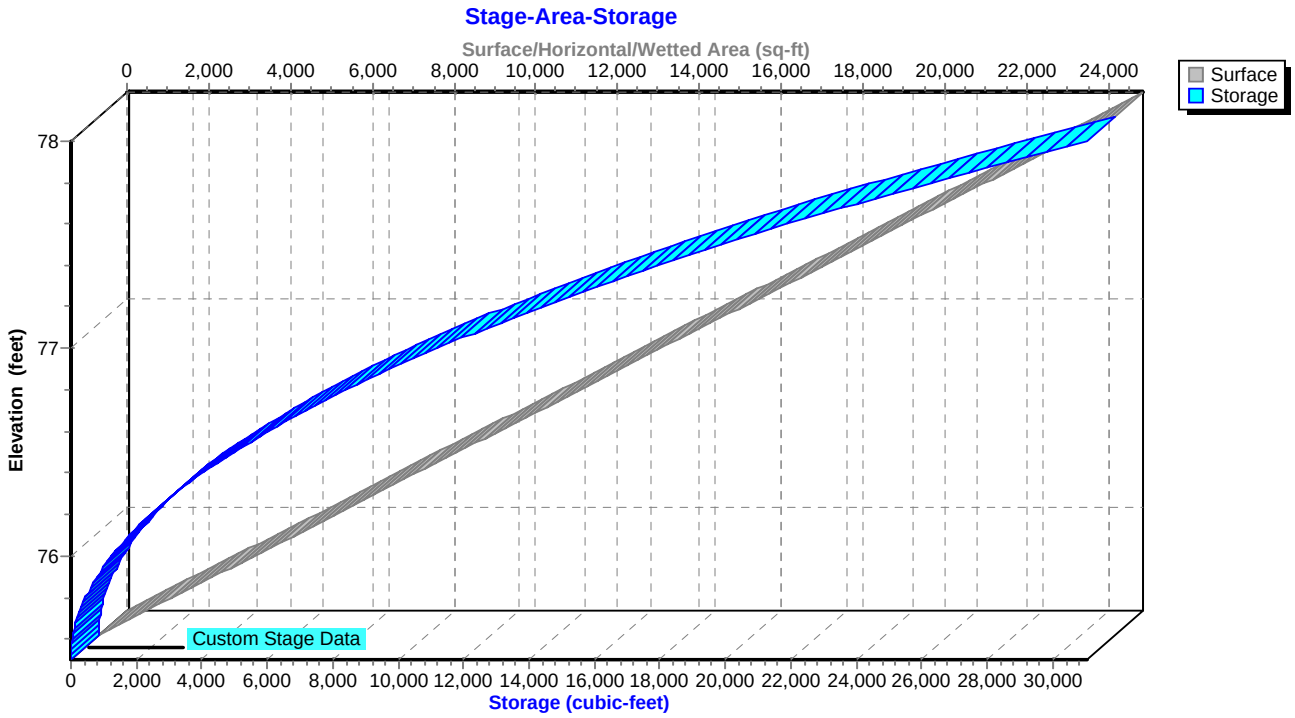
Discarded OutFlow Max=0.52 cfs @ 19.76 hrs HW=77.77' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Isolated Wetland 2



Pond 7P: Isolated Wetland 2

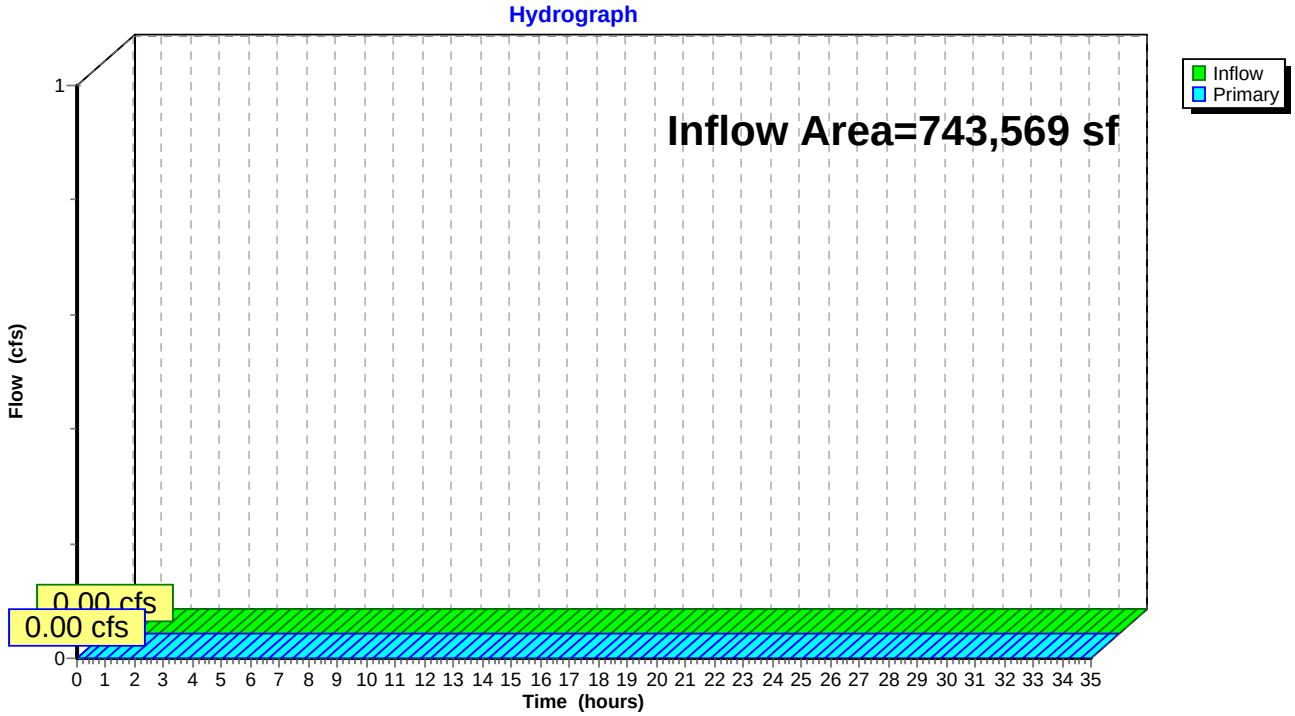


Summary for Link 3L: Flow to Isolated Wetland 2

Inflow Area = 743,569 sf, 2.23% Impervious, Inflow Depth = 0.00" for 100 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 3L: Flow to Isolated Wetland 2

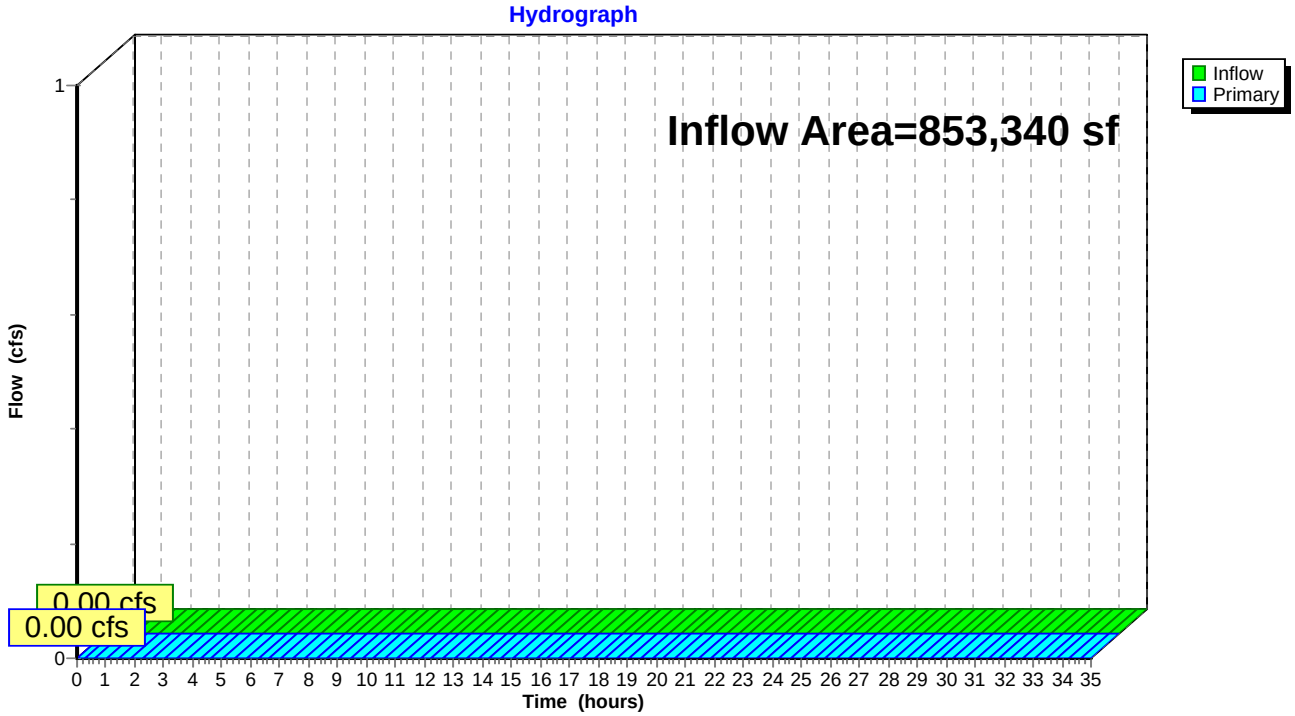


Summary for Link 4L: Flow to Design Point

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.00" for 100 event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 4L: Flow to Design Point

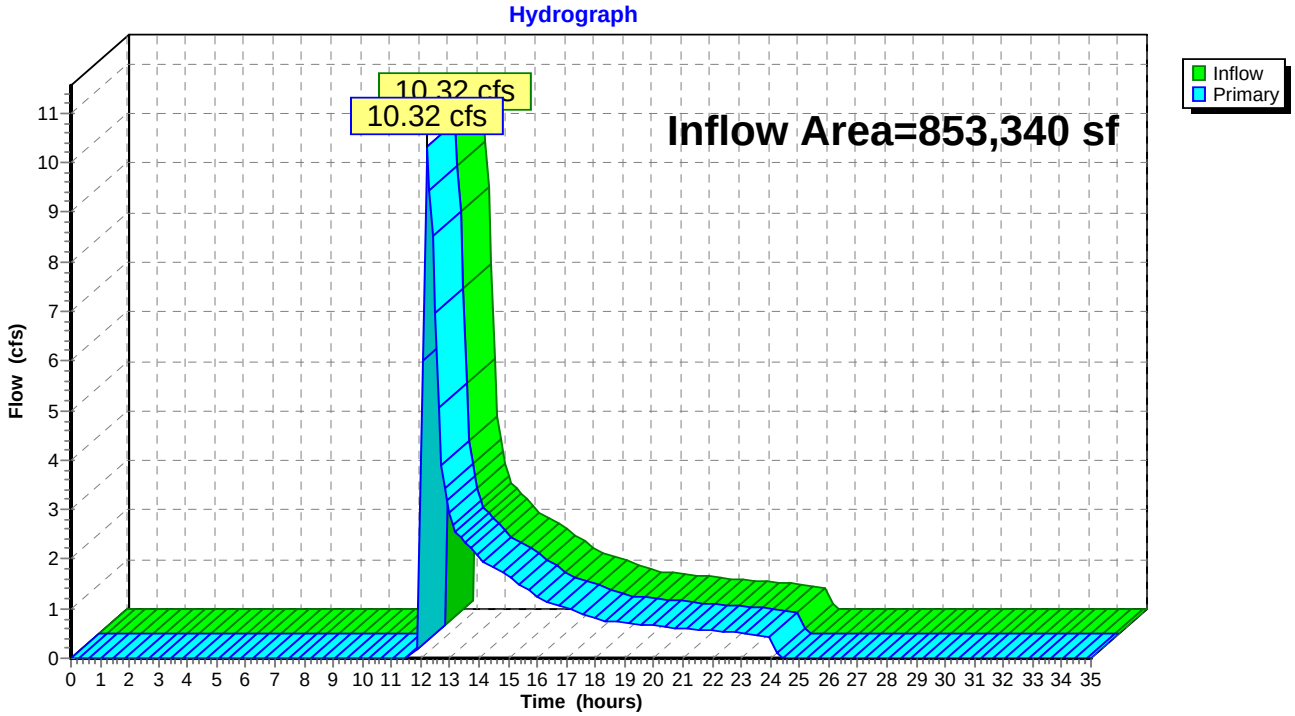


Summary for Link 5L: Flow Combine

Inflow Area = 853,340 sf, 4.79% Impervious, Inflow Depth = 0.87" for 100 event
Inflow = 10.32 cfs @ 12.24 hrs, Volume= 62,140 cf
Primary = 10.32 cfs @ 12.24 hrs, Volume= 62,140 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-35.00 hrs, dt= 0.10 hrs

Link 5L: Flow Combine



Turfgrass Management Plan for The Wellesley Country Club Using an Integrated Pest Management Approach

Prepared by:

Michael Toohill
Senior Environmental Scientist
Coneco Engineers & Scientists, Inc.
Chelmsford, Massachusetts

and

Bill Sansone
Golf Course Superintendent
Wellesley Country Club
Wellesley, Massachusetts

May 2007 (revised June 2012)

Coneco Project 6592.E

Table of Contents

PROJECT OVERVIEW

This Golf Course Turf Management Plan has been developed as part of an overall strategy for the operation of the Wellesley Country Club golf course. It addresses turf management strategies, and provides for uniform and controlled handling of turf management products. This site-specific turf management program is based on the principles of Integrated Pest Management and follows the program originally developed by William A. Torello, PhD, retired Director of the Turfgrass Research Program, Department of Plant and Soil Sciences, University of Massachusetts at Amherst. The concept of Integrated Pest Management/Turf Management (IPM/TM) has been developed over the past 15-year period as a "systems" approach to turfgrass management with the prime objectives directed at reduction to acceptable limits or elimination of potentially adverse environmental effects. University turfgrass programs throughout the nation as well as the USDA and private industry have focused intensely upon the goal of reduced input. Research programs (long and short term) have yielded important data concerning water and soil management, fertility and nutrition of turfgrass, genetic improvement of turfgrass toward lower maintenance requirements and pest resistance. Further studies into the efficacy and fate of commonly utilized pesticides and fertilizers along with precise models to predict the timing and extent of pest problems and the development of biological controls for insect, disease and weed problems have also been extensively researched. Much effort has also gone into characterizing the turfgrass environment with regard to its very unique features compared to any other agricultural commodity. The concept of IPM is, very basically, to integrate all the above listed research knowledge into a "systems approach" to turfgrass management with the ultimate result of reducing all facets of input into the environment. IPM not only greatly reduces environmental impact it also is an extremely cost-effective approach for professional turf managers, which is an extremely attractive facet that course owners very much appreciate.

Critical components of IPM/TM include:

- turfgrass species and cultivars;
- soil management practices;
- clipping and cultivation practices;
- fertilizer/nutrient management;
- irrigation and drainage management;
- chemical, biological and cultural pest management;
- complete and accurate record keeping.

Conservation of soil, water, energy and other natural resources are also primary goals of IPM. IPM seeks to minimize the disadvantages associated with intensive nutrient, pesticide and water inputs and to maximize the advantages of their use. The development of site-specific IPM programs offers one of the few comprehensive solutions for systematic control of environmental problems related to management of ecosystems. Such integrated approaches offer options for selections of alternate control strategies and to maximize chemical efficiency. IPM does not preclude the use of pesticides and inorganic fertilizers when needed.

The basic components of IPM are:

- A system using multiple control methods, including biologic controls;
- A decision process based on intensive use of information;

- A risk reduction system;
- A cost effective and site-specific management strategy.

THE TURFGRASS ENVIRONMENT

v *Soils*

Soil composition is the starting point for an IPM program. Properly structured soil supports healthy turf that can crowd out undesired weeds during grow-in and fend off pest attacks with minimal chemical intervention. Soil composition also greatly influences the risks of ground water contamination from the transport of nutrients and/or pesticides. Soils are comprised of a wide variety of mineral and organic complexes. Organics are derived from decomposition of plant and animal matter are generally classified as humic and fulvic acids, and humin, based on their water solubility in terms of pH.

Both the organic matter and mineral complexes in soils function in cation exchange (CEO), pH buffering, and water retention. Though the organic component seldom is greater than 6% by dry weight of the soil, it contributes the most to each of these functions. A typical mineral fraction will have a CEC of 0.05 to 0.3 mol kg1 whereas the organic component will range from 1 to 2 mol kg1, depending on the pH buffering. These and other characteristics contribute to the benefits of organic matter in soils by providing slow-release sources of N, P, and K useful to plants and organisms, as well as buffering soil pH. Microbial activity and heat retention are improved with increasing levels of organic matter compounds. These benefits combine to create healthy root development through improved nutrient availability.

The nutrient status of turfgrass can be determined by a combination of several components, such as soil or tissue testing, on a continual monitoring basis. In addition, it can also include analysis of visual symptoms on an individual leaf, a single plant or across a landscape. In addition, the turfgrass manager's experience and knowledge of the turf's nutritional needs under the specific climate, soil, use patterns and budget can also play a part in the analysis.

Soils at the Wellesley Country Club site consist primarily of sandy loams (Hinckley, Merrimac, Scio, and Sudbury) with Hinckley sandy loams dominating (approximately 49% of the total property). Other sandy loams and loamy sands account for another 33% of the land area. Developed portions of the club account for about 9% of the land area. Finally, silty and mucky soils and water account for approximately 9% of the land area. Therefore, most of the area used by the golf course consists of moderately to well-drained soils.

v *Turfgrass Varieties*

Greens, tees, and fairways are planted with grasses that meet the requirements of the game and that also lend themselves to being managed in an environmentally sensitive manner. These playing surfaces require a high level of maintenance because of the need for the turfgrass to resist and recover from damage incurred during play and from close and frequent mowing. It is important to establish appropriate turfgrass for each playing surface (greens, tees, fairways, roughs).

The following criteria are used to determine appropriate turfgrass species for use on a course:

- Climatological and soil conditions of the site;
- Desirability for golf in the playing & environmental setting;
- Drought tolerance;
- Resistance to disease and insects;
- Resistance to annual grasses and weeds;
- Establishment in sunny and shady environments;
- Winter recovery and tolerance to snowmold conditions;
- Compatibility with other grasses including forbs and sedges;
- Irrigation water quality;
- Availability of seed that is clean of harmful pests and grown in accordance with good turf growing practices.

At the Wellesley Country Club the greens are a mixture of bentgrasses (*Agrostis sp.*) and *Poa* (meadow bluegrass or low-gro bluegrass), as are the tees. The fairways are primarily fescue (*Festuca spp.*) with bentgrass, poa and some other bluegrasses in places. The primary roughs have a composition similar to the fairways. This blend of bluegrass and fine-leafed fescues is suitable for loamy sands as well as till soils. During summer drought, the fine-leafed fescues, even in dormancy, provide an excellent lie for golf balls. Both chewings fescue and red fescue perform under droughty conditions with minimal nitrogen fertilization levels.

FERTILITY

The fertility program has been devised and maintained to use minimally acceptable application rates according to the following criteria:

- Determination and selection of realistic goals for turfgrass quality at all locations such as tees, fairways, greens and rough areas. The objective is to use fertility rates recommended by research programs so that fertilizer input is reduced. Tees and greens receive higher maintenance levels and require higher rates of fertility, while fairways fertilizer input is reduced and rough areas are left to natural nutrient turnover wherever possible.
- Utilize organic or slow-release forms of nitrogen on all locations to the greatest extent possible. Current practices at the Wellesley Country Club include fertilizing with a combination of liquid and granular fertilizers on an as-needed basis based on tissue testing. In 2011 fertilizers included “Sea Blend” (a granular fertilizer derived from sea kelp) and a combination of urea-based and ammonia-based liquid fertilizers. Fairways are predominantly fertilized with natural or synthetic forms of nitrogen while tees and greens include at least 25% of their total nitrogen as a slow release form. In June and September organic fertilizers are used and in July and August liquid fertilizers are used. In May synthetic fertilizers are used after aeration. Liquid fertilizers are used sparingly (less than 1/10th pound liquid nitrogen per week). Natural organics radically reduce or even eliminate the leaching of nitrate while at the same time dramatically stimulating soil microbial populations and activities, which enhance pesticide immobility and degradation. Greens comprised of 70-80% sand need to be fertilized (particularly with nitrogen) very frequently - usually at a rate of 1/4 to 1/2 pound of nitrogen per 1000 sq. ft. every six weeks. At the Wellesley Country Club there are six “USGA type” greens

(the 2 putting greens and the greens at the 6th, 7th, 10th, and 12th golf holes) which are approximately 80% sand. The remaining greens are "push-up" greens which are made from the native sandy-loam soils (approximately 60% soil and 40% sand to 50% soil and 50% sand).

- The Wellesley Country Club had begun to use potassium applications in June, August, September, and October to help with drought tolerance, wear stress, and winter hardiness of the turf. This also appears to have helped reduced nitrogen inputs.
- The Wellesley Country Club has also been using gypsum to neutralize sodium in the soil which makes calcium more bioavailable.

Timing fertilizer application to coincide with the period of active plant growth and nutrient uptake optimizes nitrate absorption and reduces the amount of soluble nitrogen available for leaching. Slow release fertilizers that do not release excessive nitrogen during heavy rain are applied during the wet months. Studies show that when evapo-transpiration is closely matched by irrigation during seasonably wet months and periods of active plant growth, water soluble nitrogen can be applied at rates of up to 1 pound of nitrogen per 1000 sq. ft. per month without any significant accumulation or leaching. Application rates at the Wellesley Country Club are far below that level.

INTEGRATED PEST MANAGEMENT

There are several aspects to developing a site-specific Integrated Pest Management (IPM) Plan. In the case of an existing course several things can be incorporated into the golf course design that can optimize turf vigor and/or minimize pest activity (e.g., adequate irrigation and drainage, well adapted species and varieties, air movement). In addition, the course design can reduce the reliance on pesticides by using native plants and selecting ornamental trees and shrubs carefully to minimize pest activity. All of these structural strategies are part of an IPM program, optimizing the adaptation of the turf plant and enabling it to withstand some pest pressure without exceeding tolerance levels.

The Golf Course Superintendents Association of America (GCSAA) wholeheartedly endorses environmental stewardship and collaborated with several other organizations (including the U.S Environmental Protection Agency, National Coalition Against the Misuse of Pesticides, and The Sierra Club) to develop a set of Environmental Principles for Golf Courses in the United States. The primary precepts of these principles are:

- to enhance local communities ecologically and economically;
- to develop environmentally responsible golf courses that are economically viable;
- to recognize that every golf course must be developed and managed with consideration for the unique conditions of the ecosystem of which it is a part;
- to use natural resources efficiently;
- to respect adjacent land use when planning, constructing, maintaining, and operating golf courses;
- to create desirable playing conditions through practices that preserve environmental quality;
- to educate golfers and potential developers about the principles of environmental responsibility;

- to promote the understanding that environmentally sound golf courses are quality golf courses.

Most of these precepts are directly or indirectly related to IPM and stress the importance of environmental stewardship. The specifics of IPM related to pest management include: scouting/monitoring pest activity and turf health, setting tolerance levels (thresholds), selecting and implementing appropriate management strategies, and evaluating the results.

v ***Scouting and Monitoring***

For each potential turf pest, a golf course superintendent must develop techniques to look for the pest and to measure the pest population. Scouting is conducted at the course on a daily basis. For insects, this is relatively easy. Most insect activity can be monitored by simply looking at the turf (and seeing insects moving), collecting soil samples, or applying a soapy flush to drive insects to the surface. Similarly, weed activity is relatively straightforward. Once a seed has germinated and the plant has emerged above ground, standard botanical guides can be used to identify the weed, and transect lines can be used to quantify weed populations. Identification and quantification of turf diseases, however, is much more difficult because several causal agents can produce very similar symptoms. It is imperative that the golf course superintendent has a good working relationship with a reputable disease diagnostics laboratory - one that has a rapid turn-around for processing samples. The Wellesley Country Club does tissue testing on its greens every six weeks and takes soil plugs on an as-needed basis to help correctly identify diseases. These tissue samples and soil plugs are sent to outside diagnostic laboratory for inspection by plant pathologists. In addition, the Wellesley Country Club joined the UMass Dollar Spot (fungus) resistance assay as a test site for fungicide resistance (testing efficacy of treatments) in 2011.

Monitoring also includes observations of general turf vigor and can identify areas that have an agronomic imbalance of some sort - e.g., a localized dry spot, impenetrable thatch, poor drainage or a leaky irrigation head, uneven application of fertilizer, compaction from repeated traffic, or wear spots from repeated mowing patterns. Each of these situations can weaken turf so that it becomes less able to tolerate a pest infestation.

v ***Setting Tolerance Levels***

One of the most challenging aspects of an IPM program is setting quantifiable numbers for tolerance levels or action thresholds. These thresholds are discussed in more detail later in this document. While the act of scouting and confirming the presence of a pest is fairly straightforward, determining how many is too many is much more complicated. In general, turfgrass can handle one or two stresses but cannot handle several stresses simultaneously. If there are agronomic imbalances, the turf is less likely to be able to tolerate insect or weed or disease activity. In addition the turf use (green vs. tee vs. fairway vs. rough) has a direct bearing on the tolerance level. Normally tolerance levels will be lowest on greens and highest on roughs.

v ***Selecting Management Strategies***

If scouting documents the presence, or the inevitable development of an unacceptably high population of pests, the superintendent then must decide whether to manage the pest. Many factors will be considered, including the time of year (and ability of the turf to recover from pest activity), tournament schedules, and golfer/traffic demands. In an IPM program, every effort is made to reduce agronomic stresses, thereby enabling turf to survive some pest activity. However, even in the best-maintained golf course environments, pest activity may build to a level that requires some pest-specific action. Normally in an IPM program the order in which management strategies are considered is cultural, then biological, then chemical.

v ***Cultural Practices Designed to Reduce Pesticide/Nutrient Input***

Aeration: Compaction of the underlying soil on golf courses is a major problem, particularly on courses receiving many rounds of golf per day/week/month/year. A compacted soil will promote disease, insect and weed problems and necessitate the overuse of chemical controls as well as increasing fertilizer demands. Compaction also promotes surface run-off of irrigation/rainfall leading to movement of applied chemicals. A program of "aeration" and "topdressing" has been developed according to the soil types and level of play (number of golf rounds) calculated.

At the Wellesley Country Club aeration occurs six times per year on greens (2 cores and 4 "dry-jet"). Core-aeration consist of using equipment which pulls up a plug of soil which washes back into the resulting holes (in the fairways) or which is raked and augmented with sand (top dressed) on the greens and tees. Dry-Jet is an outside service that uses high pressure water to create vertical channels that are then filled with sand. Greens are usually core-aerated during the first week of April, and in late August. Dry-jetting usually occurs in April and August, October and mid-November. Tees are aerated in April, and September. Fairways are aerated in the spring and at the end of September. Since golf greens receive a more "focused" amount of compaction, additional solid tine (5" length) aeration occurs during June, July, and August and 12" tine aeration occurs during the spring and winter. On the tees and aprons (short grass areas around the greens) tine aeration is usually done in November. This progressive program of aeration and topdressing significantly reduces the usage of pesticides in general.

Mowing: A general rule of thumb with regard to turfgrass culture is that the higher the mowing height, the more extensive the root system and the "healthier" the turf will be, particularly with regard to inherent disease/insect resistance. Mowing heights will be maintained at the highest level possible while still maintaining modern golf turf quality demands. Not only will turf be more resistant to pests, but higher mowing heights will result in much less weed infestation due to "shading" of the soil surface and competition for mineral nutrients and water. Mowing equipment is kept in "top notch" condition so that grasses are not scalped or cut poorly which would increase the possibility of disease occurrence.

Irrigation: Appropriate irrigation is considered critical not only to maintaining a proper IPM program but also for economic considerations. The length of time (and hence the amount of water) it takes to adequately water particular areas (i.e. fairways, greens, roughs) is determined by the time it takes to wet the turf to the depth of its root system. Most turfgrass roots extend to four to six inches into the soil. Infrequent and deep watering are preferred to shallow and more frequent events to avoid over usage of water as well as to limit the amount of moisture on

surface foliage to inhibit disease infestation. Deep watering also promotes deep rooting. Greens areas will unavoidably be irrigated more since they are mown much lower than fairways and, therefore, will have shallower roots. Proper irrigation is, as mentioned earlier, critical to maintain high quality turfs as well as reduce pest infestations, which will reduce pesticide and fertilizer usage.

At the Wellesley Country Club moisture meters (Spectrum Technologies) are used on a daily basis to measure moisture content throughout the course. There is a weather station at the course and total control over all parts of the irrigation system. The course has a "state-of-the-art" irrigation system which provides adequate irrigation to all areas of the golf course without significant overlapping. There is control of each individual sprinkler head and the heads are set for "head-to-head" coverage. The heads are set on computerized timers and are designed to provide optimum irrigation without excess water waste. In addition, irrigation equipment is kept in proper repair, providing all areas of turf with adequate coverage.

De-thatching: Thatch is a layer of dead turf material (primarily stem tissues) found at the surface of the soil and can build-up to unacceptable levels if not removed. A deep layer of thatch tends to intercept irrigation water keeping disease susceptible crowns of grasses too wet and impeding flow of water to the root zone. A thick layer of thatch will also tie up insecticides and other pesticides at the surface not allowing for control of root-feeding insects or root diseases. Conversely, a minimal level of thatch is necessary for organic matter deposition as well as promoting the proper "cushioning" necessary for fine turfs. All tees and fairways are de-thatched five times a year. Greens are dethatched four times a year.

- ***Chemical Practices Designed to Reduce Pesticide/Nutrient Inputs***

Fertilization: A lack of soil nutrient levels promotes weed infestation as well as reduces overall vigor resulting in increased pesticide usage. All greens are tested twice a year before aeration for soil pH levels and cation exchange. In addition tissue samples from the turf are also tested every six weeks. All tees and fairways are tested on a three year rotating basis or more frequently if conditions warrant. Fertilization practices are modified to optimum levels according to soil tests. Slow release and organic fertilizer materials are used extensively throughout the course. The use of these materials results in much more efficient use of applied nutrients and also greatly reduces the leaching and runoff losses of nitrogen. Slow release and organic sources of nitrogen also encourage a steady and controlled growth habit as well as reduce the extent of disease infestation, which results in much lower usage of pesticides. Use of organic fertilizers also greatly encourages soil microbial activity, which enhances production of beneficial organic matter/soil nutrients as well as promoting the breakdown of residual pesticides.

Pesticides: If a pest population exceeds tolerance levels and no reliable cultural control strategies are available, a pesticide may be necessary to suppress the pest. In an IPM program, it is understood that applications are made only to areas that have populations that exceed the tolerance level, or can reasonably be expected (based on observations in previous years, current populations, and expected weather patterns) to exceed that level. Pesticides are selected to minimize impact to non-target organisms (e.g., predatory insects, earthworms) whenever possible.

- ***Record Keeping & Evaluating Results***

Until recently, documentation of IPM-related activities proved to be difficult, but in the past few years several handbooks and recording forms have been developed. These forms provide a means by which a superintendent can scout the property and file the results of the scouting information in a filing system easily reviewed. State and federal regulations mandate that records of pesticide applications be kept and filed for review. A similar filing system can be developed to track the application of cultural techniques. A detailed record keeping system is in place at the Wellesley Country Club. This system enables the superintendent to review efforts from previous years and determine which techniques were most effective.

WEED CONTROL

In an IPM program, the turf management staff should try to identify the underlying conditions that predispose particular areas to weed infestation and address those causes. However, some weed activity will always be present on a golf course.

- ***Monitoring Weed Populations***

While it is easy to notice the presence of weeds on a finely maintained turf such as a golf course, it is not so easy to quantify the number of weeds present or the annual recurrence of weed populations. At the Wellesley Country Club a log of areas prone to outbreak, and the specific type of outbreak, are kept on an annual basis. These logs help the superintendent develop a program to address areas experiencing repeated outbreaks and help to determine the efficacy of treatment methods.

- ***Cultural Strategies***

Many weeds serve as indicators of agronomic imbalances. Any cultural activity which encourages vigorous turf should ultimately make weed survival more difficult. Mowing heights typical of golf courses put some weeds at a competitive disadvantage, and providing adequate fertilizer usually makes it more difficult for some weeds to compete.

- ***Chemical Strategies***

Several herbicides are labeled for use against turf weeds, with a variety of characteristics. Some are specific against grassy weeds, others are specific against broadleaf weeds, and a few are effective against both kinds of weeds. There are many different chemical classes, and a range of environmental characteristics.

Pre-emergence Weed Control: These chemicals provide effective control of crabgrass and other annual grass weeds for several weeks or months, depending upon dosage and products. The effectiveness of these materials is based upon their ability to provide control without turf injury. The best approach is application before annual seeds germinate and, as such, timing is important. These herbicides are applied at least two weeks prior to expected weed seed germination – usually late April to early May. These chemicals need to be watered-in

immediately after application. Only one or two of these compounds would be used once or twice yearly. The primary products that will be considered for use are:

- Siduron (Tupersan)
- Dithiopyr (Dimension IEC)
- Quinchlorac (Drive)

At the Wellesley Country Club areas affected by crabgrass and annual weeds are mapped throughout the year and then the following year the trouble spots are treated with a pre-emergent herbicide as appropriate.

Post-emergence Weed Control: These chemicals control emerged grassy weeds and broadleaf weeds. These herbicides are applied after weed seeds germinate and are the most utilized materials for weed control. As such, there are many products available for use which have similar efficacy. Selection of materials is primarily up to the experience and judgment of the superintendent who bases the decisions on efficacy, economics and environmental impact. The primary products that will be considered for use are:

- 2, 4D (Millenium)
- Quinchlorac (Drive)
- Sethoxydin

- ***Actions by the Grounds Staff***

The Wellesley Country Club staff has developed a management plan that concentrates on key pests (crabgrass, annual bluegrass, and various broad-leafed weeds) and identifies some of the underlying conditions that could predispose the area to weed encroachment. They:

- monitor weed activity daily on greens and tees when weeds are most likely to occur, and as needed on fairways and roughs;
- quantify weed activity on greens and tees at least once a year, using random area search or transect lines;
- developed a record keeping system so scouting records can be traced from year to year;
- set and refine action thresholds regularly.

INSECT PEST CONTROL

There are relatively few species of insects that pose problems on golf courses, but those insects are fully capable of destroying substantial areas of turfgrass if left unmanaged. In general we expect the golf course to experience relatively minor outbreaks but management and staff must be prepared to respond to pest populations as they develop.

The only insect pests known to be serious problems on golf courses are white grubs, sod webworms and cutworms, hyperodes weevils, and bluegrass billbugs. Biological control strategies are an important part of IPM and greatly complement chemical control.

- ***Monitoring Insect Populations***

White grubs can be monitored by taking a series of soil samples with a cup cutter. A core of turf is removed to a depth of about 4 inches, and the entire core placed on a small piece of plywood or cardboard. Any grubs that are present will be very apparent. Each sample is 0.1 sq. ft., so determining the number of grubs per square foot is very straightforward.

Black turfgrass ataenius larvae (grubs) can be sampled in the same manner. Cup cutter cores are taken from areas where activity is suspected. Adults can be forced to the surface by an irritating drench (such as lemon-scented liquid dish detergent in water). Adults also can be seen walking on the surface of greens and fairways and may be observed in baskets of greens mowers.

Annual bluegrass weevil larvae can be sampled using a cup cutter or by cutting a triangular wedge in the turf. Larvae (and pupae) will be visible near the crowns of the plants and in the thatch. Adults can be forced to the surface by an irritating drench (lemon-scented liquid dish detergent in water), and often are observed in baskets of greens mowers, especially in late June and early July.

Cutworms and webworms can be sampled by using an irritating drench. Smaller stages (less than 0.25 inch) may not reach the surface, but larger stages will wriggle to the surface quickly. Adult moths are attracted to blacklight traps.

Turfgrass ants are most easily quantified by counting the number of visible mounds in a known area. This can be accomplished by marking out (or visualizing) a series of squares ten feet on a side or by constructing a square frame, two or three feet on a side, and randomly tossing the frame onto the area to be surveyed. The number of mounds are counted and recorded from several such samples to estimate an overall activity level.

Monitoring should be scheduled to coincide with insect development. Grub populations can be mapped in April and May, and distribution maps subsequently used to predict "hot spots" in August. Annual bluegrass weevil adults can be seen in spring and summer (on warm sunny days), while larvae may be present from mid May through late August. Peak larval activity usually will be in late June and again in early August. Black turfgrass ataenius larvae usually occur from early June through mid August, with peak populations in late June and again in early August. Black cutworms and webworms can damage turf from mid May through mid September, and will be present in all stages (small, medium, and large caterpillars) throughout the growing season. Turfgrass ants are active from early May through late summer, with greatest activity in July and August.

- ***Setting Thresholds***

As with any pest, action thresholds or tolerance levels will depend on many external factors, many of which relate to turfgrass vigor (e.g., availability of water, drainage, local weather conditions (heat stress), mowing height, compaction, and recuperative potential of the turfgrass). Thresholds must be site-specific and often vary from one part of a golf course to another or within a growing season. The following table presents some general guidelines for action thresholds that can be used as starting points for determining threshold populations for pest insects. Thresholds should be refined each year, incorporating observations of pest activity and response to weather conditions in previous years.

Table 1: Common Turfgrass Insect Pests

Common Name	Turf Area Affected	Suggested Threshold (per sq.ft. unless otherwise noted)
Annual bluegrass weevil	Greens, Tees, Collars	20 to 60 larvae (spring) 10 to 30 larvae (summer)
	Fairways	30 to 80 larvae (spring) 15 to 40 larvae (summer)
Black cutworm	Greens and Tees	5 to 10 pockmarks per green/tee
Bluegrass billbug	Fairways Roughs	10 to 15 larvae 15 to 20 larvae
Hairy chinch bug	Roughs (irrigated) Roughs (un-irrigated)	30 to nymphs 15 to 40 nymphs
Turfgrass ant	Fairways Greens/Tees	0.5 to 1 mound 0.1 to 0.2 mounds
Webworms	Greens/Tees Fairways	15 to 30 grubs 30 to 60 grubs
Black turfgrass ataenius	Greens, Tees, Collars Fairways	15 to 30 grubs 30 to 60 grubs
European chafer	Fairways Roughs (irrigated) Roughs (un-irrigated)	4 to 8 grubs 5 to 10 grubs 4 to 8 grubs
Japanese beetle	Fairways Roughs (irrigated) Roughs (un-irrigated)	6 to 12 grubs 8 to 15 grubs 4 to 8 grubs
Oriental beetle	Fairways Roughs (irrigated) Roughs (un-irrigated)	6 to 12 grubs 8 to 15 grubs 4 to 8 grubs

v ***Cultural Strategies***

Most insects that are pests on golf courses in Eastern Massachusetts have a wide range of conditions in which they can thrive, so very few cultural strategies will reduce populations. General good agronomic practices will enhance turf vigor and enable it to tolerate more insect damage than stressed turf, but there are few specific, cultural techniques that will reduce insect populations directly.

Turfgrass Species and Cultivars: The annual bluegrass weevil strongly prefers to feed on annual bluegrass, so the establishment of the golf course becomes critically important. All possible steps should be taken to ensure that the golf course has minimal annual bluegrass - e.g., use of plant growth regulators as needed after establishment to reduce annual bluegrass incidence. Cultivars of fine fescues and perennial ryegrasses that contain endophytes will reduce sod webworm, chinch bug, and billbug survival, but have little effect on cutworms and white grubs.

- ***Biological Control***

There are several biological control agents and "biopesticides" available on the market but few of them perform reliably enough to be used with confidence on golf courses in Massachusetts. Some of the options that are available commercially or are under development include:

- Milky Spore: A natural bacteria that causes a disease of the digestive system of Japanese beetle grubs. It is non-toxic to humans and other non-target organisms.
- Bacillus Thuringiensis (BT): A bacteria that causes disease in several kinds of insects. Recently several new strains of BT have been identified which are quite specific in the kinds of insects they attack. The strains that are available are effective to varying degrees on cutworms and sod webworms.
- Entomopathogenic Nematodes: Small microscopic worms which attack certain insects such as cutworms and sod webworms and to some degree, white grubs.
- Neem: A derivative of the neem tree which grows in India and other tropical settings. The compound is natural and repels several kinds of insects and often caused them to stop feeding. Neem also acts as an insect growth regulator preventing some insects from molting normally from one stage to another. Neem controls cutworms and sod webworms in turf.

- ***Chemical Controls***

Several insecticides are labeled for use against turf insects, with a variety of characteristics. Some insecticides are mobile and can penetrate thatch, and so are appropriate to use against white grubs in the soil. Others are less mobile and remain in thatch, and are appropriate to use against surface and thatch insects like annual bluegrass weevils and black turfgrass ataenius adults.

Chemical control methods will be utilized only as specified in the IPM plan and only as a last alternative method. Materials known to be comparatively safe with regard to soil mobility, half-life properties and ground water contamination will be used. The following is a list of insecticides being considered for use:

- Imidicloprid (Merit) for grubs
- Bifenthrin for weevils, cinch bugs, black turfgrass antaenaus
- Dylox for white grubs

Other products that may be developed in the future which have these properties will be considered for use on the course.

- ***Actions by the Grounds Staff***

The Wellesley Country Club staff has developed an insect management plan that concentrates on key pests (white grubs, annual bluegrass weevil, black turfgrass ataenius, cutworms, and ants). They monitor insect activity daily on greens and tees during the seasons when that activity is likely to occur (Table 1), and as needed on fairways and roughs. They track actual insect population measurements when activity is greatest so evaluation of control strategies can

be made). They have developed a record keeping system so scouting records can be traced from year to year and so that action thresholds can be evaluated. Good housekeeping practices such as removing clippings from greens, tees, and collars, and disposal of those clippings at least 50 feet away from the nearest green or tee help to reduce reinvasion by black cutworm caterpillars. They use endophytic cultivars of perennial ryegrass or fescues in rough areas if those cultivars also meet the needs of disease management.

DISEASE CONTROL

- ***Cultural Strategies***

Most of the grasses used on the primary playing areas (greens, tees, and fairways) are cultivars of bentgrass and bluegrass, and these provide some inherent tolerance to some diseases. However, disease resistance is very specific so no single cultivar or species is resistant to all turf diseases, and some cultivars that are resistant to certain diseases are also more susceptible to others. In New England we can assume that pathogens will find at least some turf areas that have susceptible hosts.

Environmental conditions are the primary factor in determining how severe a disease outbreak may be. Some diseases (e.g., snow molds) thrive in cool conditions, while others (e.g., pythium blight and brown patch) are very damaging at high temperatures and high humidity. Most diseases are more active in moist conditions, whether following heavy rains or in areas where soils drain poorly. When summer temperatures and high humidity prevail, watering practices can be amended slightly to avoid extending the period of leaf wetness.

Several other cultural strategies can put the turf at a competitive advantage or the disease at a disadvantage. Fertilizing with sources of nitrogen and other nutrients that provide precise delivery of those nutrients to the plant reduces the lush plant growth that sometimes induces greater activity of certain pathogens (e.g., brown patch, leaf spots) while nutrient deficiency may lead to increased activity of other diseases (e.g., dollar spot, red thread). Every effort will be made to provide optimum fertility throughout the growing season to minimize or delay onset of disease activity.

While low mowing heights sometimes provide a level of stress that leaves a turf stand more vulnerable to disease, golfer expectations are such that there will be little latitude for raising mowing heights. However, other techniques should be explored for providing fast, consistent ball roll on the putting greens while allowing some flexibility in mowing height - e.g., double cutting, topdressing regularly, or using rollers. In addition any area with known active leaf disease should be mowed last in a daily rotation and mowers should be cleaned thoroughly at the end of the day to reduce the spread of pathogens from an infested area to an uninfested area.

- ***Chemical Control Strategies***

In an IPM program, scouting and monitoring can detect the presence of conditions that will lead to disease outbreaks, and every effort is made to reduce disease severity by refining cultural strategies. However, it is impossible to eliminate disease activity with cultural and/or biological control strategies alone. Every effort will be made to minimize the use of fungicides, by

monitoring weather conditions, using predictive models to determine when outbreaks are most likely, and regularly scouting the agronomic conditions of the course (including thatch thickness and density) and adjusting practices as appropriate to enhance turf vigor and put pathogens at a disadvantage.

Fungicides can be used as a tactic to protect plants from being infected by pathogens. Many fungicides protect the plant from within, and must be applied before a pathogen becomes active. While some people believe this preventive application is contrary to an IPM program, such applications can be justified. First and foremost, in some cases the preventive (and systemic) applications are the only effective alternative for a given disease. In many cases, there are no fungicides that will reduce disease incidence after infection has incurred. Furthermore, when such applications are made in conjunction with weather monitoring and predictive models, they are made only when disease outbreak is likely. Intervals between applications can be extended when using predictive models, thereby further minimizing use of fungicides.

To complicate matters, many turfgrass diseases (most notably, Pythium blight and dollar spot in New England) have developed resistance to one or more fungicides. Once resistance develops subsequent applications of the same material or closely related compounds are ineffective. The result is that a turf manager must manage fungicide use very carefully: minimize the number of applications by using predictive models and extending the interval between applications, keep good records of evaluations of applications, and avoid using compounds to which a pathogen has developed resistance.

A turf disease can only develop if three factors are present: the causal organism (usually a specific fungus), a susceptible host, and favorable environmental conditions. The fungi causing turf diseases normally are present throughout the year, and can be recovered from turf samples even when no obvious symptoms are apparent, so we can assume the organism is virtually always present, even on a newly established golf course.

Fungicides kill or inhibit the growth of fungi and there are two general types of fungicides: contact (or protectant) and systemic. Contact types cover the plant surface and prevent infections while systemic types are absorbed into plant tissues and may provide some curative action. Turfgrass management requires the use of several pest-specific fungicides to treat for a variety of diseases (snowmold, patch disease, pythium blight, basal rot anthracnose, summer patch anthracnose, etc.). The following is a list of possible choices of fungicides to treat for these diseases:

- Propiconazole (Banner)
- Zinc ion/manganese ethylenebisdithiocarbamate (Pentathalon)
- Iprodione (Rovral)
- Fluoxastrobin (Disarm)
- Metaconaziole (Tourney)
- Polyoxyn (Endorse)
- Fludioxonil (Medallion)
- Azoxystrobin (Heritage)
- Metalaxyl (Subdue)
- Fosetyl (Signature)

- propamocarb (Banol, ProPlant)
- Thiophanate

As newer products are developed they will be considered for use.

v ***Actions by the Grounds Staff***

The grounds staff will adjust irrigation schedules during periods of peak disease activity to minimize the period of leaf wetness. Normally this means irrigation would be avoided in early evening or early morning hours when dew has just begun to form (evening) or is beginning to evaporate (morning). In warm humid weather dew and/or guttation water should be removed from greens, tees, and fairways early in the morning. Mowing schedules will be amended as necessary so that diseased areas are mowed last in a daily rotation. Mowers will be cleaned thoroughly to avoid transporting pathogens to new locations. Fungicide or plant protective applications will be made based on predictive models where they exist and have been validated in the field. Intervals between applications will be extended as much as possible (based on weather conditions and normal persistence of each product). The plant protective program focuses on the issue of disease resistance and avoids repeated applications of the same product targeting diseases that are known to develop resistance to that product in New England.

MANAGEMENT GUIDELINES

v ***Reduced Frequency of Pesticide Usage***

IPM procedures radically reduce the frequency and rates of pesticide usage in general. The selection of less toxic, less mobile and less persistent pesticides coupled with the use of alternate strategies such as biological control and recommended cultural practices will reduce potentially adverse environmental effects. Controlling the timing and amounts of a particular pesticide application in relation to local environmental conditions, especially rainfall, will reduce offsite movement and enhance degradation characteristics of utilized compounds. This is especially effective when determining Action Thresholds of each target pest so that pesticides are used only when populations become economically critical and in need for control.

v ***Selection Criteria and Usage of Pesticides***

Only pesticides specifically labeled for usage in Massachusetts will be used, and only by properly registered, certified and trained personnel. Selection criteria for the type of pesticide will include consideration of the target species or disease, pesticide characteristics and site characteristics. Important pesticide characteristics such as efficacy; solubility; formulation; degradation rate; volatility; adsorption; potential toxicity to natural pest enemies and toxicity to wildlife or non-target species will be carefully considered prior to usage or development of a timing program. Selection of less toxic, less mobile and less persistent pesticides or use of alternate control strategies will reduce potentially adverse environmental effects. Proper equipment maintenance and calibration coupled with the selection of formulations that reduce mobility will enhance pesticide efficacy as well as degradation. Application methods such as incorporation or placement below the soil/thatch surface and “watering-in” will reduce exposure to runoff and enhance soil adsorption.

- ***Handling, Storage and Disposal***

Pesticides are stored in a state- and federally-approved storage locker to ensure complete safety and security of all utilized materials. All applicators are required to use protective clothing, gloves, shoes and respirators when recommended and all unused chemicals and containers are properly stored or disposed of by State and Federal guidelines. The application of a pesticide is made under the direction of a licensed applicator, and in accordance with all state and federal laws and in accordance with all label specifications. The golf course superintendent is licensed in the proper Pesticide Control categories. Records are kept of all pesticide use and reports are prepared and submitted to the state regarding all pesticide usage at the course.

- ***Alternate Pest Control Strategies***

A significant component of an IPM/TM plan includes the use of non-pesticide approaches toward pest control. The most fundamental approach will be the maintenance of an actively growing and competitive turfgrass environment, which is well known to out-compete weed species, promote active soil microbial activity and reduce the inoculum of soil borne disease organisms. Whenever possible, turfgrass species selections will focus upon the use of endophyte-enhanced varieties which are extremely effective in biological resistance to almost all above ground insect pests.

Endophyte enhanced species of turfgrass are also much more disease resistant as well as having increased environmental resistance to drought and heat stresses. The use of natural biological control species such as parasitic nematodes, pathogenic bacteria as well as natural insect predation of pest species will be incorporated into the overall pest management plan. Commercially available insect attractants and traps will also be strategically placed throughout the course when active thresholds are determined.

- ***Maintenance of Secondary Rough***

Maintaining fairway margins as unsprayed rough will serve as a buffer between the more intensively managed turf and adjacent wildlife habitat. Communities of native insects and other arthropods will be able to use edge habitat, without impact from drift or short distance leaching of insecticides and fungicides and native plants will not be impacted by herbicides. This area also serves as a reservoir for natural biological controls such as Tiphia wasps which prey on white grubs.

- ***Soil, Sediment, and Water Quality Monitoring***

IPM programs are designed to reduce the input of chemicals into the environment by using them in a curative rather than preventative fashion where appropriate. There is still a need to use fertilizers and pesticides so that the turf remains healthy and less prone to disease. Because of that, the IPM program is backed up by a routine monitoring program which provides information on the fate of these chemical in the environment.

Several of the pesticides listed were chosen for low mobility in ground and surface waters, which means that they may persist in soil. Because of this it is recommended that areas treated with more persistent chemicals be tested occasionally for build-up of these chemicals.

The Wellesley Country Club has instituted a voluntary groundwater and surface water monitoring program to test for nutrient and pesticide runoff. Throughout the property is a network of deep wells, shallow wells, piezometers, and surface water monitoring stations which are placed so that comparisons to upslope (background) and downslope samples can be made. In addition, the club has tested the sediment in several of the ponds onsite to see if materials have entered these systems. The details and results of the sampling program are forwarded to the Wellesley Board of Health, Wellesley Water Department, and the Wellesley Natural Resources Commission.

WELLESLEY COUNTRY CLUB
Wellesley, Massachusetts

SHORT COURSE GROW-IN – PROPOSED MANAGEMENT PLAN

INTRODUCTION AND PURPOSE

The maintenance of healthy and dense turf on a golf course is critical to both enhancing course quality and allowing the implementation of environmentally sound management practices. Healthy turf is best able to withstand the stresses of golfer traffic, combat pest and disease infestation, and respond favorably to efforts aimed at reducing the use of chemical fertilizers and pesticides in the management of golf courses.

The natural characteristics of turf grass limit movement of pesticides and fertilizers into underlying soils and ground water. Thatch produced by the turf acts as an organic filter to chemically bind pesticides that otherwise might enter surface and ground waters. Turf grass root systems are both extensive and fibrous, resulting in maximum absorption of pesticide residues, which may penetrate the turf canopy and thatch layers. Also, the naturally acidic soils of the northeast maximize the adsorption of fertilizer elements, especially phosphorus.

The purpose of this turf establishment program is to identify the fertility program, cultural practices, and pest management procedures to be implemented during both the construction and long term maintenance of Wellesley Country Club's Short Course. This plan has been drawn from the collective experiences of the golf course architect, regional golf course superintendents, University agronomists, extension personnel, water quality scientists, and a review of applied research.

FERTILITY PROGRAM

The availability of basic growth nutrients of nitrogen, phosphorus and potassium is essential to the growth of any vegetation species and turf grasses are no exception. Adequate quantities must be available to the turf in specific periods in its life cycle to stimulate and maintain growth. These nutrients are naturally available in the existing soils but must be supplemented to support the proper growth of turf. Supplemental inputs of nutrients are achieved through the implementation of a fertility program. The focus of such a program is to deliver only such nutrients as are necessary to support suitable turf growth in a manner that both maximizes their availability to the turf and eliminates waste and the release of excess nutrients to surface and ground waters.

The results of virtually all research studies completed on the fate of nutrients applied to turf have supported adherence to the following general guidelines in order to minimize

and/or eliminate the potential for any release of nutrients due to fertilizer applications on golf turf.

1. Irrigation should be limited to the replacement of lost soil moisture and the evapotranspiration loses of the turf.

2. When appropriate, nitrogen applications should be made using slow release sources such as natural organic sources, IBDU, methylene urea's, and coated ureas. For Eastover, a heavy reliance on natural organic fertilizers will be utilized.

3. All fertilizer applications should be timed to occur at the time of active plant uptake.

4. Applications should not be made immediately preceding a significant storm event.

5. Application rates should be limited to the documented needs of the turf given an understanding of site-specific soil deficiencies.

Turf Grass Establishment Period

The turf grass establishment period consists of the first and second years following the germination of the turf. The basic fertility requirements during this period are as follows. Applications should be adjusted accordingly during this period if desired growth is not achieved or if clipping weights/examination of foliage indicate that reduced applications would be suitable:

GREENS & COLLARS (24,750 SF):

PRE-PLANT – these items to be incorporated with a bunker rake before seeding:

- Sustane Bolster 4-4-4 plus 3 Fe at rate of 25 lbs per 1000 SF.
- Hi Cal Lime as directed by soil sample results (Rate typically 1-2 lbs
- Andersons A-Tep Hi Mag, at rate of 3 lbs per 1000 SF.
- Andersons 0-0-45 with PCSOP/SOP, coated fertilizer at rate of 10 lbs per 1,000 SF.
- Bulk starter fertilizer 12-24-12 at rate of 5 lbs per 1,000 SF to achieve 0.6 lbs of N and 1.0 lbs of P per 1,000 SF.

POST-PLANT BUT PRE-GERMINATION:

- Primer Select wetting agent 9oz per 1,000 SF for water retention.

AFTER GERMINATION:

- Starting 1 week after germination ½ lb N per 1,000 SF every 2 weeks using Grigg Brothers 16-4-8 Turf Rally until greens are completely filled in.

Once greens have good coverage achieved, additional application of fertilizers can be performed. This will require adjustments, but below is a program will be modified as clipping yield and density is achieved.

Perform a weekly rotation between the below products:

- Sustane Bolster 4-4-4 plus 3 Fe, Apply 25 - 10 lbs per 1000
- Bulk Starter 12-24-12 5# per 1,000 SF at rate of 0.6 lbs N and 1.0 lb P per 1,000 SF.

Apply on a Bi-Weekly basis and perform periodic tissue and soil test to monitor progress

- Andersons A-Tep Hi Mag, at rate of 3 lbs. per 1000
- Solu-Cal Greens. 5 lbs. per 1000

Water retention will be critical to the establishment of the seedlings. The above wetting agent program should aid in water retention. Make sure to check label and water in thoroughly after application.

Adjust program as necessary and apply plant protectants (such as fungicides and pesticides) as necessary. The establishment period will last for about one year after initial seeding, after which inputs can be backed off so that plant is receiving roughly 3.0 lbs of N per 1,000 SF annually.

FAIRWAYS, TEES AND PRIMARY ROUGHS (7.06 ACRES):

PRE-PLANT – these items to be incorporated into soil prior to seeding:

- Lime as required by soil test and disk in
- 18-24-12 25%UFLEXX at rate of 1.5 lbs P per 1,000 SF not more than 24 hours before seeding is to occur.

AFTER GERMINATION:

- Bulk Starter 12-24-12 at rate of 5 lbs per 1,000 SF to provide of 0.6 lbs N and 1.0 lb P per 1,000 SF approximately once every 3-4 weeks during growing period. Total amount of N used will be 4-5 lbs in first year. Inputs will reduce to 2-3 lbs per year.

INTEGRATED PEST MANAGEMENT

All pest control activities at Wellesley Country Club will adhere to integrated pest management (IPM) practices. IPM is an approach to pest control which seeks to anticipate and address the full range of physical, cultural, and biological factors affecting the development of pest populations at a given site. This approach does not seek, as a goal, the eradication of pest populations; rather, it seeks to prevent the growth of pest populations and/or disease infestations above acceptable threshold levels. To achieve these goals an IPM program is one that must be flexible and reduce reliance on any single mechanism, such as chemical pesticide applications. Given that this is a holistic approach to pest control, the implementation of an IPM program has the direct benefit of reducing the use of chemical pesticides in the maintenance program for the golf course.

The implementation of an IPM program requires the disciplined completion of a specific protocol of tasks. The results of each task are synthesized to ensure an integrated approach to decision making. The results of some tasks serve as base data on the characteristics of the site and local pest population while the results of others serve as feedback relative to the effectiveness of the control program. Regardless of the ultimate application of the information generated, each task is critical to the successful implementation of IPM.

The key components of an effective Integrated Pest Management program and a description of the specific tasks to take place are as follows:

A. Initial Information Gathering - Identification of Potential Pests

The gathering of information on potential pest populations ensures that as the turf becomes established the superintendent has the knowledge and tools necessary to anticipate and address likely pest problems. The background information to be gathered during this task should include:

1. Identification of likely pest species and information on their specific life cycles and their physical, cultural, and biological requirements.
2. Identification of all applicable controls available for each identified pest species. These controls would include cultural, biological, and chemical options.
3. Information on pest infestations and successful control strategies experienced in the area of the site.

There are many potential pests of turf grasses including the fungal species Pythium and Rhizoctonia, the bacteria Xanthamonas, various insects and nematodes, weeds such as nutsedge, and mammals such as shrews, moles, and ground hogs. An initial list of potential pests at Wellesley Country Club is provided below. It must be recognized that this list is not exhaustive. The list is provided solely for the purposes of providing the superintendent with a foundation for an expanded list to be developed as a site specific history of pest activity is established:

Weeds	**Fungi/Diseases**	**Insects**	**Small Animals**
Annual Bluegrass	Dollar Spot	Sod Webworm	Raccoons
Crabgrass	Snow Mold	Japanese Beetle	Ground Hog
Dandelion	Pythium Blight	White grub	Moles
Spurge	Pythium root rot	Ants	Shrews
Plantain	Summer patch	Cutworm	Canada Geese
Clover	Brown patch	Nematodes	
	Necrotic ring spot	Annual Bluegrass	
	Typhula blight	weevil	

Sources of initial information include university extension services, USGA Green Section agronomists, local exterminators, local lawn care professionals, and superintendents of other area golf courses. Each of these potential sources should be consulted personally by the course superintendent.

B. Regular Monitoring

Monitoring consists of the frequent examination of each course management area to determine the status of pest and non-pest organisms. Information to be gathered includes the identification of species present, their level of activity, and the extent of impact. Monitoring is essential to the superintendent's ability to make early and accurate diagnoses of pest presence and threat prior to the pest reaching unacceptable levels.

Monitoring for weed, insect, and small animal pests can be done through visual inspection of the turf surface, thatch and root zones. The intensity of monitoring activities for weed and insect pests should be adjusted to reflect the life cycles of the potential pests. For example, monitoring for specific weed pests should be intensified when the species are most likely to germinate given the time of the growing season and specific environmental conditions conducive to such germination. While turf will not display symptomatic signs before weed germination, symptoms of moderate insect infestations may be detectable. Accordingly, monitoring for insect pests should include sample counts to both establish an action threshold and determine when the threshold is exceeded.

Monitoring for early disease and fungal detection is more difficult. Early detection often is impossible and the rapidity and severity of damage caused by such diseases as Pythium blight dictate the need for preventative applications of fungicides when and if environmental conditions are favorable for the development of the disease. The incidence of disease has been found to be closely linked to measurable environmental conditions, primarily high temperatures and humidity, degree of sun exposure, and leaf wetness. Optimum temperatures for the development of a number of diseases likely to affect Wellesley Country Club are as follows:

DISEASE	OPTIMUM TEMPERATURE RANGE(F)
Dollar Spot	60 to 85
Snow Mold	68 to 77
Pythium Root Rot	52 to 70
Pythium blight	74 to 93
Summer patch	83 to 87
Brown patch	70 to 90
Yellow tuft	48 to 75
Necrotic ring spot	59 to 82

A number of diagnostic tools have become available in recent years to aid in the early detection of diseases, but their effectiveness remains spotty. These tools range from simple predictor models using readily collected environmental data to diagnostic kits utilizing biochemical information. Examples of the predictor models include those developed for the Pythium blight by Nutter et al. (1983). An example of the biochemical diagnostic kits is that developed by the Agri-Diagnostic Associates. The Agri-Diagnostics detection kit includes immunoassays for four diseases: Pythium blight, Brown patch, Yellow patch, and Dollar spot.

C. Record-Keeping

These tasks provide the feedback information necessary to ensure the selection of best available control over time. The data base established through the completion of these tasks represents the site specific experience garnered through the implementation of IPM. Each control effort should be followed by a review of the treatment's effectiveness and detailed records should be kept in a computerized data base for enhanced retrieval and correlative analysis. Records should specify the location of treatments, the severity of the infestation, the type and level of treatment applied the date of treatment, and the specific environmental conditions encountered at the management area immediately prior to, during, and immediately following treatment.

D. Determination of Damage Thresholds for Each Management Areas

Turf management areas on a golf course for which an area-specific program must be implemented include greens, tees, fairways, roughs and turf buffers. Each area is exposed to different types and levels of use activity, different cultural practices, and different pest susceptibilities. Turf species selection and the appropriate choice and use of cultural and mechanical maintenance practices are critical first steps to ensure effective and efficient pest control. Turf selection for the new holes has been presented and area-specific cultural and mechanical maintenance practices are to be performed as on the existing course.

As the objective of the IPM is the control of pest populations at acceptable levels, it is crucial that sound efforts be made to establish acceptability thresholds for each pest. The threshold of acceptability will vary for each pest and for each management area of a golf course. For example, greens are expected to support a higher quality turf than rough areas; accordingly, the acceptability threshold for a given pest on a green will be much lower than the threshold for a rough area. The setting of thresholds involves consideration of economics and the tolerance of patrons. The superintendent will establish appropriate thresholds based on these considerations.

E. Determination of Action Levels

Action levels are levels of synthesized information which indicate that damage thresholds are or are about to be exceeded. Such synthesized information will include weather and cultural data, the specific period of the pest life cycle, and the accumulated knowledge of previous experiences controlling the pest on the site. Although some guidance on the initial setting of action levels can be obtained, the levels thus established should be set very conservatively and adjusted upward only as site-specific history information has been developed. Initially, the superintendent should consult with other golf course superintendents in the area to establish action thresholds. When an action level is reached it can be predicted that if no control action is taken, the pest will increase to injurious levels.

F. Treatment or Management Decision

The full range of potentially effective treatments for each pest should be identified and assessed as to its applicability to given situations. This range would include biological, cultural, and chemical treatments. Appropriate cultural practices which have the effect of reducing pest infestations to levels below the action level shall be considered. The following discussion focuses on biological and chemical control treatments.

Biological control is defined as the regulation of pest populations by their natural enemies, including antagonists, parasites, and predators. Biological controls, if target specific, can be effective. However, frequently this effectiveness is unpredictable. This unpredictability means that the superintendent will be taking a risk in selecting such treatment that may place the turf in jeopardy. For this reason a decision to select a biological control must be made early in order to provide an opportunity to implement other strategies.

In general, biological control efforts have been targeted to insect pests. Research on biological control of disease and weed problems has only recently begun. One effectively proven biological control is the use of bacteria Bacillus papillae to produce milky spore disease which, in turn, controls the growth of White grub populations. It has been suggested that predatory nematodes be considered for the control of Japanese beetle grubs and black cutworms. Other biological controllers of insect populations include such small mammals as moles and shrews. These small mammals, however, often cause more damage to the turf than the insects.

Chemical pesticide applications are essential elements of any effective IPM program. As with cultural and biological controls, chemical applications should be made only as necessary to prevent the pest infestations from surpassing acceptable thresholds and only if the application constitutes the best available

control. Best available control refers to the control effort which will achieve the desired result at an acceptable cost and minimum environmental impact relative to other available options. Environmental impact in this context includes damage to non-target species, water quality and air quality.

It is anticipated that a number of currently available and utilized pesticides will be used in the establishment and maintenance of the new holes at Wellesley Country Club, and that yet to be developed pesticides eventually will be used when appropriate. Given the constantly evolving nature of the chemical industry, it is impossible to identify all the chemical pesticides to be employed over the life of the course. At best, a list of currently available and acceptable pesticides may be provided together with a set of operating guidelines for the use of these and future products.

The following basic guidelines will govern the use of chemical pesticides at Wellesley Country Club's Short Course:

1. Use pesticides only as a component of IPM and only to the extent that they represent best available control either singly or in combination with other non-chemical control mechanisms.
2. Use only those pesticides that have been registered for use in the State of Connecticut.
3. Store and apply pesticides in strict conformance with label directions.
4. Use new products, as they become available only to the extent that they represent best available control relative to existing products.

All pesticides (fungicides, herbicides, insecticides) used at Wellesley Country Club will be confined to ones that have low potential for mobility and low water solubility. In general, larger initial amounts of chemicals (eg >2-3 lbs./acre ingredient) usually take more time to breakdown than smaller amounts(eg <2 lbs./acre active ingredient).

As a rule of thumb, highly water-soluble chemicals leach faster than the less-soluble ones. Chemicals with >30 ppm solubility may be considered mobile in any soil when their persistence is high and absorption low. The pesticides selected for use will be chosen based on three important soil environmental factors:

1. low water solubility
2. rapid degradation
3. low soil mobility/high soil adsorption

Pesticide spraying at Wellesley Country Club will be done by a Commercial Certified Pesticide Applicator. Spraying of pesticides on the golf course will only be done on an as needed basis and only on those areas that are infected.

The decision making process is the essence of IPM. Decisions must be made by the superintendent based on the best available data and knowledge of the site gained by site specific experiences. The goal of all decisions is to utilize the best available control so that acceptability thresholds for each turf pest are not exceeded.

Turf Products to be Used on Short Course

Fertilizers

14-18-10----------Button Turf Products
Growin 5-4-5----------Lebanan Turf
0-52-0----------Performance Nutrition
19-26-5----------Anderson's

Fungicides

Mefenoxam----Quali Pro
Disarm----------Arysta Lifescience
Prophesy-------Anderson's
Tupersan-------PBI Gordon

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

IAN A. BOWLES
Secretary

LAURIE BURT
Commissioner

RENEWAL REGISTRATION STATEMENT FOR VERIFIED WATER WITHDRAWAL

The Massachusetts Department of Environmental Protection ("the Department") hereby accepts the Registration Renewal Request filed by the following Registrant pursuant to 310 CMR 36.10 for the water withdrawal described below. The Registrant is hereby authorized to withdraw up to the registered volume of water from the registered withdrawal point(s) until the expiration date, as set forth below, in compliance with M.G.L. c. 21G and 310 CMR 36.00, subject to the Registration Conditions set forth below.

GENERAL INFORMATION

Registration Number: **32031703** River Basin: CHARLES

Registrant: WELLESLEY COUNTRY CLUB
294 WELLESLEY AVE
WELLESLEY, MA 02481

Number of registered withdrawal points: 3
Groundwater: 2 Surface water: 1

Type	Source Name	Location
SW	ROSEMARY BROOK	WELLESLEY AVENUE
GW	WELL #13	WELLESLEY AVENUE
GW	WELL #17	WELLESLEY AVENUE

Use: Golf Course Irrigation

Average Volume per Day (MGD): 0.12 Total Annual Volume (MGY): 25.2

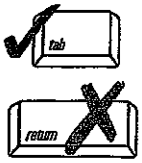
Days of Operation: 210

Effective Date: January 1, 2008 Expiration Date: December 31, 2017

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Drinking Water Program - Water Management Act

Registered & Permitted Withdrawals Annual Report Form - Year 2014

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Instructions

- This Annual Report Form is for reporting water withdrawals regulated under the Water Management Act (MGL c. 21G). The Annual Report Form should be completed by anyone whose Water Management Act registration(s) and/or permit(s) fall under the Industrial, Agricultural, Golf Course or Other category.
- Completion of this Annual Report Form is a requirement of Massachusetts law.
- Cranberry growers file a separate Annual Report Form for Cranberry Growers
- If you have water withdrawal points located in more than one watershed, please complete a separate Annual Report Form for each watershed (e.g if you have separate permits and/or registrations for the Charles and Blackstone watersheds).
- Annual Reports must be submitted even if no withdrawals were made during the year.
- A Transfer Form (BRP WM01) is required before a registered and/or permitted company changes ownership.
- Please contact Water Management Act Program staff at (617) 654-6522 if you have questions concerning completion of this form.
- This form and form BRP WM01 can be downloaded at

www.mass.gov/eea/agencies/massdep/water/approvals/water-management-act-forms.html

Section B - Complete Section B, Individual Withdrawal Points Information, for <u>each</u> ground water or surface water withdrawal point.

Individual Withdrawal Points Information requires that recorded or metered volumes be entered. If estimated, give the best monthly estimate based on the method outlined in your registration statement. Document your estimate and identify the method used. Attach documentation if necessary.

Section C – Annual Average Daily Withdrawal Volume calculation is the summation of all the Section B Individual Withdrawal Points.

Section D - New Withdrawal Points should be completed only if a new water source was added at the site(s) during the 2014 calendar year.

Section E - Registration and Permit Conditions should be completed if conditions are required to be met on an annual basis.

Section F - Certification must be completed by the certifying and responsible party.

Please complete and submit the Annual Report Form by **February 27, 2015** to:

MassDEP
Water Management Act Program
One Winter Street, 5th Floor
Boston, MA 02108

A. General Information

1. Facility information: (☐ Check if this is a new mailing address. Also show new address on page 3.)

Wellesley Country Club — Facility Name
300 Wellesley Ave — Facility Address
Wellesley — Town/City
02481 — Zip Code
billd@wellesleycc.com — Please provide email address
3-20-317.03 — Registration Number (if applicable)
.12 — Registered Annual Average Daily Volume (mgd)
Permit Number (if applicable)
Permitted Annual Average Daily Volume (mgd)
Charles — Watershed

Note: your registration number and/or permit number appear on your mailing label and are identified in your registration and/or permit.

Watershed is one of 27 major MA surface water drainage basins. Your registration and/or permit identify the watershed.

2. Responsible Party Information:

Bill Sansone — Name
781-772-1673 — Office Phone
617-828-0957 — Mobile Phone
300 Wellesley Ave — Mailing Address
Wellesley — Town/City
Zip Code

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Drinking Water Program - Water Management Act

Registered & Permitted Withdrawals
Annual Report Form - Year 2014

B. Individual Withdrawal Point Information

Enter volumes pumped as measured by meters and/or estimated for each point for each month. Also tally the withdrawal point, monthly and annual totals.

Make additional copies of this page if you have more than three withdrawal points in this watershed.

*** You must attach copies of the most recent calibration report for each meter.**

Please use separate annual report forms if you are reporting on withdrawals from more than one watershed.

1. Withdrawal point	well #3 (Name)	well #9 (Name)	well #4 (Name)	
2. Location of withdrawal point	Wellesley (City/Town)	Wellesley (City/Town)	Wellesley (City/Town)	
3. Metered or estimated	☒ metered ☐ estimated	☒ metered ☐ estimated	☒ metered ☐ estimated	
4. Meter type	data industrial	data industrial	data industrial	
5. If metered, date of last calibration* (*Annual meter calibration is required.)	Date	Date	Date	
2014				**Monthly and Annual Totals**
January	0	0	0	
February	0	0	0	
March	0	0		
April	1,583,796	0	0	1,583,796
May	2,393,060	0	676,313	3,069,373
June	4,812,695	0	976,267	5,788,962
July	6,055,947	0	4,782,764	11,038,711
August	7,333,824	0	6,465,344	13,789,168
September	2,256,067	0	1,797,891	4,053,958
October	99,415	0	0	99,415
November	0	0	0	
December	0	0	0	
6. Annual Totals	24,534,804 Millions of Gallons	0 Millions of Gallons	10,404,579 Millions of Gallons	35,038,798* Millions of Gallons

*enter this value in Section C for the "Total 2014 Volume"

7. Provide the dates and volumes of the maximum day withdrawals in million gallons per day (mgd):

Date of Maximum Daily Pumping:	8/19/14 Date (mm/dd/yyyy)	— Date(mm/dd/yyyy)	8/19/14 Date(mm/dd/yyyy)	8/19/14 Date(mm/dd/yyyy)
Volume on Day of Max. Pumping:	676,467 Volume (mgd)	— Volume (mgd)	922,679 Volume (mgd)	1,098,196 Volume (mgd)

8. If withdrawal points are not metered, how was the estimate of gallons pumped derived?

☒ a. Time of Operation (hours pumped times pump capacity) ☐ b. Other Method (describe):

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Drinking Water Program - Water Management Act

Registered & Permitted Withdrawals Annual Report Form - Year 2014

C. Average Annual Daily Withdrawal Volume Calculation

Calculate the Average Annual Daily Withdrawal Volume: Divide the total 2014 millions of gallons pumped, (from **B. 6.** on previous page) by the number of days of operation specified on your permit or registration for this watershed (do NOT divide the total by the actual days of pumping):

35,038,798	/	210	=	166,851
Total 2014 Volume (million gallons, from **B. 6.** above)		Specified Days of Operation		Average Annual Daily Withdrawal Volume (million gallons per day)

D. New Withdrawal Points

If you have added any new withdrawal points, you may need a Water Management Permit. Contact Water Management Act Program Boston staff immediately at (617) 654-6522 to discuss.
Name and describe the location of any new withdrawal points you added in 2014 (i.e. any sources not listed on your permit or registration):

Name _____ Location _____ ☐ Groundwater OR ☐ Surface Water

Name _____ Location _____ ☐ Groundwater OR ☐ Surface Water

Name _____ Location _____ ☐ Groundwater OR ☐ Surface Water

E. Permit and Registration Conditions

As a condition of your Water Management registration and/or permit, DEP may require that you provide certain information on an annual basis (for example, wetlands or groundwater level monitoring reports). Please review your permit and/or registration to determine if any reporting requirements apply.

Type of Condition	Was a report submitted to MassDEP Regional office?	Approximate date report was submitted to MassDEP regional office:
_____	☐ Yes ☐ No	_____ date
_____	☐ Yes ☐ No	_____ date
_____	☐ Yes ☐ No	_____ date

F. Certification

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete."

Bill Sansone
Signature of Certifying Person

Bill Sansone
Print Name of Certifying Person

Superintendent	781-772-1673	2/25/15
Title	Phone	Date

mailing address (if different from front)	State	Zip Code

Wellesley Country Club

Water Usage – Proposed 6-Hole Facility

Prepared August, 2015

Preface

Wellesley Country Club is proposing the addition of a 6-Hole short game facility adjacent to existing holes seven and eight. A preliminary sprinkler layout has been laid out in order to determine water usage for these new holes.

Design Parameters

The new holes have been irrigated using a basic double-row system from green through tee. Due to the economical use of land for this design, this results in essentially wall-to-wall coverage on the new short course.

All sprinklers used on this design have the ability to operate in both full-circle mode and part-circle mode. This will allow the superintendent, in the event of water restrictions, to adjust coverage areas and dramatically reduce the irrigated acreage. This will be in addition to management adjustments that can be made, through the central computer, to adjust runtimes per individual sprinkler head.

Water Usage

Water usage calculations were run for peak daily and monthly consumption, as well as seasonal consumption. The necessary irrigation was derived from the PET (potential evapotranspiration) estimate found on the Northeast Regional Climate Center website. This estimate is based on the historical data from 1975 – 2004 for Boston, MA, the nearest city represented in the data set.

Using this date set, PET is set at 4.03" for the month of July, which can be considered the period of peak seasonal irrigation. All evapotranspiration rates are set using a reference crop, typically alfalfa. For our use, we need to apply a crop coefficient (K_c) for cool-season turf grass of 0.8 to arrive at an adjusted peak monthly requirement of 3.22". **This requirement does not factor in any accepted rainfall on the site.**

Peak Daily Usage

Peak daily usage is dependent on a number of factors: primarily the daily ET, but also weather patterns preceding and following that day, maintenance practices, soil-moisture content, among others.

For this report, it is assumed that the club is watering 5 days a week to meet weekly requirements. As described earlier, adjusted PET for July is 3.22". For the purpose of determining a peak daily use, we will ignore the crop coefficient, and estimate a peak daily usage of 1.01"/5 days or .2".

Golf Course	Wellesley Country Club
Date	08/13/15
Author	WJS

Sprinkler Model	Sprinkler GPM	Precip. Rate	Quantity	Desired App.	Run Time	Gallonage	
Greens							
751-80-32 (FC-SQ)	21.4	0.57	8	0.20	21	3,604	
751-80-32 (PC-SQ)	21.4	1.14	6	0.20	11	1,352	
751-80-32 (FC-TRI)	21.4	0.66	14	0.20	18	5,447	
751-80-32 (PC-TRI)	21.4	1.32	4	0.20	9	778	
						Greens Subtotal	11,181
Tees							
751-80-32 (FC-SQ)	21.4	0.57	21	0.20	21	9,461	
751-80-32 (PC-SQ)	21.4	1.14	10	0.20	11	2,253	
751-80-32 (PC-TRI)	21.4	1.32	2	0.20	9	389	
						Tee Subtotal	12,103
Fairways							
751-80-32 (FC-SQ)	21.4	0.57	28	0.20	21	12,615	
751-80-32 (PC-SQ)	21.4	1.14	4	0.20	11	901	
						Fairway Subtotal	13,516
Other Areas							
751-80-32 (FC-SQ)	21.4	0.57	5	0.20	21	2,253	
751-80-32 (PC-SQ)	21.4	1.14	3	0.20	11	676	
751-80-32 (PC-TRI)	21.4	1.32	1	0.20	9	195	
						Other Subtotal	3,123
						Peak Daily Usage	**39,923**

Peak Monthly Usage

Peak monthly usage per historical data and the crop coefficient is 3.22" per week. While this doesn't factor in any rainfall, it can be used as a reasonable estimate of peak weekly usage during droughty periods.

Golf Course	Wellesley Country Club
Date	08/13/15
Author	WJS

Sprinkler Model	Sprinkler GPM	Precip. Rate	Quantity	Desired App.	Run Time	Gallonage	
Greens							
751-80-32 (FC-SQ)	21.4	0.57	8	3.22	339	58,028	
751-80-32 (PC-SQ)	21.4	1.14	6	3.22	169	21,760	
751-80-32 (FC-TRI)	21.4	0.66	14	3.22	293	87,701	
751-80-32 (PC-TRI)	21.4	1.32	4	3.22	146	12,529	
						Greens Subtotal	180,018
Tees							
751-80-32 (FC-SQ)	21.4	0.57	21	3.22	339	152,323	
751-80-32 (PC-SQ)	21.4	1.14	10	3.22	169	36,267	
751-80-32 (PC-TRI)	21.4	1.32	2	3.22	146	6,264	
						Tee Subtotal	194,855
Fairways							
751-80-32 (FC-SQ)	21.4	0.57	28	3.22	339	203,097	
751-80-32 (PC-SQ)	21.4	1.14	4	3.22	169	14,507	
						Fairway Subtotal	217,604
Other Areas							
751-80-32 (FC-SQ)	21.4	0.57	5	3.22	339	36,267	
751-80-32 (PC-SQ)	21.4	1.14	3	3.22	169	10,880	
751-80-32 (PC-TRI)	21.4	1.32	1	3.22	146	3,132	
						Other Subtotal	50,280
						Peak Monthly Usage	**642,757**

Peak Seasonal Usage

Peak seasonal usage can factor in historical rainfall, as the law of averages should be in effect over this larger time-span. With rainfall factored in, using PET and the crop coefficient, seasonal usage should be right around 5" of water applied. In a slightly drier-than-normal year, we might assume 7" or water applied. This total seasonal usage is 5.54% of the total annual volume of 25.2M gallons allowed on Wellesley Country Club's current Water Withdrawal Permit.

Golf Course	Wellesley Country Club
Date	08/13/15
Author	WJS

Sprinkler Model	Sprinkler GPM	Precip. Rate	Quantity	Desired App.	Run Time	Gallonage	
Greens							
751-80-32 (FC-SQ)	21.4	0.57	8	7.00	737	126,147	
751-80-32 (PC-SQ)	21.4	1.14	6	7.00	368	47,305	
751-80-32 (FC-TRI)	21.4	0.66	14	7.00	636	190,655	
751-80-32 (PC-TRI)	21.4	1.32	4	7.00	318	27,236	
						Greens Subtotal	391,344
Tees							
751-80-32 (FC-SQ)	21.4	0.57	21	7.00	737	331,137	
751-80-32 (PC-SQ)	21.4	1.14	10	7.00	368	78,842	
751-80-32 (PC-TRI)	21.4	1.32	2	7.00	318	13,618	
						Tee Subtotal	423,597
Fairways							
751-80-32 (FC-SQ)	21.4	0.57	28	7.00	737	441,516	
751-80-32 (PC-SQ)	21.4	1.14	4	7.00	368	31,537	
						Fairway Subtotal	473,053
Other Areas							
751-80-32 (FC-SQ)	21.4	0.57	5	7.00	737	78,842	
751-80-32 (PC-SQ)	21.4	1.14	3	7.00	368	23,653	
751-80-32 (PC-TRI)	21.4	1.32	1	7.00	318	6,809	
						Other Subtotal	109,304
						Seasonal Water Usage	**1,397,297**