STORMWATER MANAGEMENT REPORT

To Accompany

LAND USE APPLICATION FOR 'D' AND 'C' VARIANCES AND PRELIMINARY & FINAL MAJOR SITE PLAN APPROVALS

Upon

Block 39, Lots 1, 2, 3, 4, 5, 7, 8, 9, 11, 12.01 & 12.02

Within The

Borough of West Long Branch, Monmouth County, Nj

Prepared For

MONMOUTH UNIVERSITY

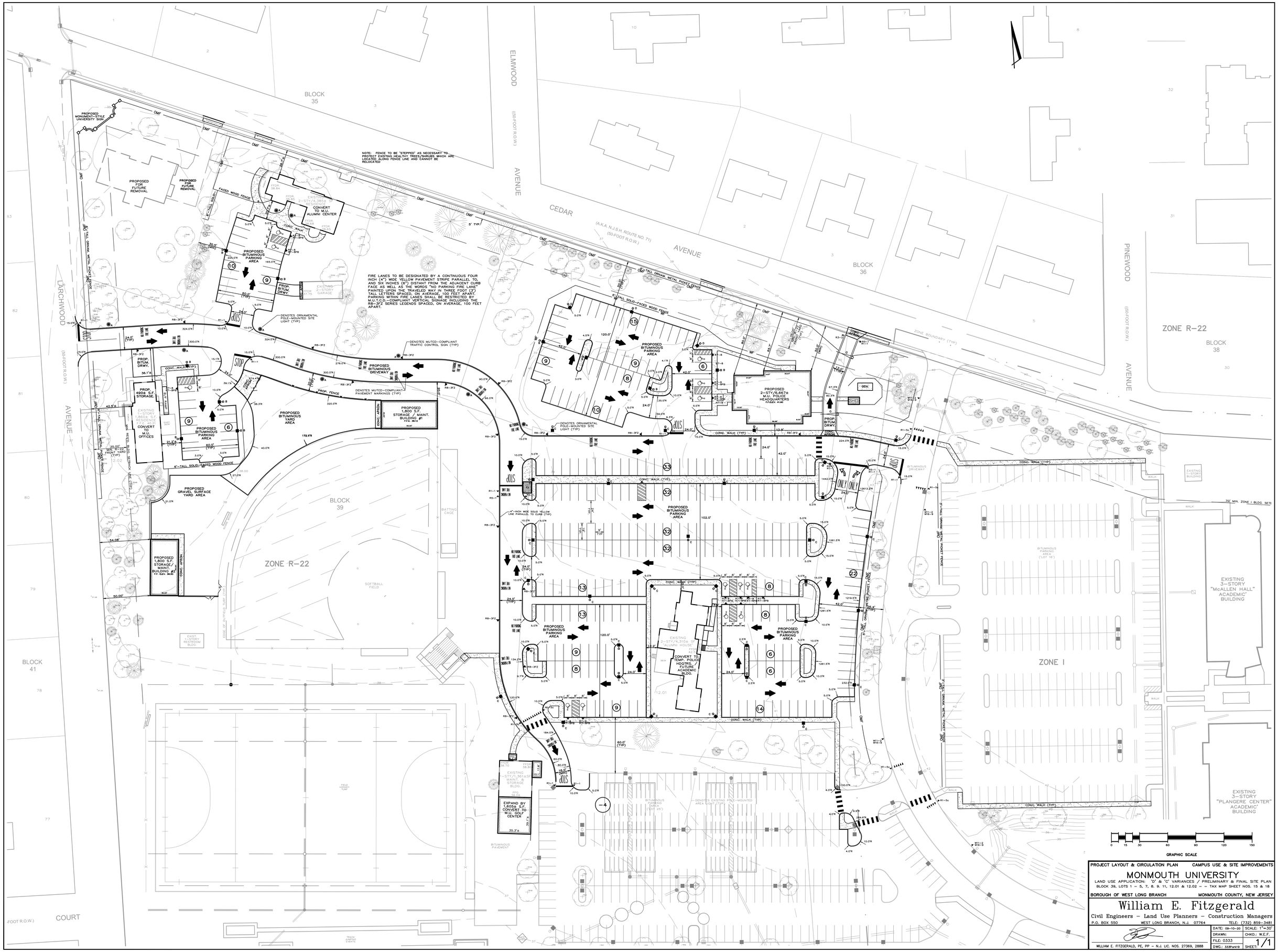
By

William E. Fitzgerald, P.E.
P.O. Box 550
West Long Branch, New Jersey 07764

E-mail: wfitz@wef-pe.com

September 10, 2020
Revised Through: 12-03-20

CONTENTS



PROJECT LAYOUT & CIRCULATION PLAN — CAMPUS USE & SITE IMPROVEMENTS

MONMOUTH UNIVERSITY

LAND USE APPLICATION: "D" & "C" VARIANCES / PRELIMINARY & FINAL SITE PLAN
BLOCK 39, LOTS 1 – 5, 7, 8, 9, 11, 12.01 & 12.02 – – TAX MAP SHEET NOS. 15 & 18

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald
Civil Engineers – Land Use Planners – Construction Managers
P.O. BOX 550 — WEST LONG BRANCH, N.J. 07764 — TELE: (732) 859-3481
WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 28881

DATE: 09-10-20	SCALE: 1"=30'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	SHEET: 1/1
DWG.: 333Parkl9	

STORMWATER MANAGEMENT REPORT – I

PROJECT OVERVIEW

To Accompany

LAND USE APPLICATION FOR 'D' AND 'C' VARIANCES AND PRELIMINARY & FINAL MAJOR SITE PLAN APPROVALS

Upon

Block 39, Lots 1, 2, 3, 4, 5, 7, 8, 9, 11, 12.01 & 12.02

Within The

Borough of West Long Branch, Monmouth County, Nj

Prepared For

MONMOUTH UNIVERSITY

By

William E. Fitzgerald, P.E.
P.O. Box 550
West Long Branch, New Jersey 07764

E-mail: wfitz@wef-pe.com

September 10, 2020

C O N T E N T S

DESCRIPTION OF PROJECT

Monmouth University is requesting preliminary and final major site plan approvals, variances pursuant to N.J.S.A. 40:55D-70(c) and (d), and, if/as necessary, design waivers to redevelop and utilize, for University operations, 9.967±acres of land which it owns, within Block 39, that are predominantly zoned for R-22 single family residential use but which are contiguous with the University's Main campus and which do not abut any residential property that is not University-owned. Properties to be redeveloped and/or receive improvements under the project are depicted as Block 39, Lots 1, 2, 3, 4, 5, 7, 12.01 and 12.02 upon sheet no. 18 of the West Long Branch Tax Map.

Project improvements include:

- - a new Campus ingress/egress driveway from Larchwood Avenue;
- - construction of new University Police Department headquarters;
- - relocation of existing University Alumni Center;
- - use change(s) for existing University Alumni Center building;
- - conversion of existing, 1-story, single family residence to University general office use;
- - relocation/consolidation of Lot 12.02 Facilities Management operations
- - indoor golf practice center;
- - construction of 326 onsite parking stalls
- - a new monument-style University identification sign;
- - an extensive drainage collection, stormwater management and conveyance system to support the redevelopment; and,
- - miscellaneous / ancillary site improvements including utilities, site lighting, fencing, landscaping, etc.

Notable design elements and features of the project include elimination of several residential driveways/aprons along Cedar Avenue; preservation/enhancement of the streetscape along Cedar and Larchwood Avenues via ornamental project site perimeter fencing and installation of plantings to supplement screening afforded by existing well-developed vegetation. Additionally, horizontal and vertical improvement layouts have been designed to minimize, to the maximum extent practicable, disturbance to / loss of mature lawn areas, existing trees and shrubbery.

SCOPE OF REPORT

This study presents detailed hydrologic and hydraulic analyses demonstrating feasibility and impact evaluation of the above-described redevelopment upon the 10.2±-acre project area of the Campus relative to current Stormwater Management Regulations of the State and Borough.

METHODOLOGY

Hydrologic and Hydraulic Analyses: Runoff volumes resulting from precipitation events are estimated using the Runoff Curve Number Method of the U.S.D.A. Natural Resources Conservation Service (formerly the Soil Conservation Service). Briefly, the method rates the runoff producing potential of a given land area by assignment of a "Runoff Curve Number (CN: $0 < CN \leq 98$) derived from a consideration of the hydrologic condition of the area's soils, the antecedent moisture condition of the soils, and land-use cover and/or treatment

upon the soils (i.e., the area's soil-cover complex). The method utilizes the CN to compute, directly, an estimate of the runoff depth, in inches, that will result from a given precipitation depth, in inches. The method is described, in detail, in U.S.D.A. publications, most notably, "Section 4, Hydrology" of the "National Engineering Handbook" and Technical Release No. 55, "Urban Hydrology for Small Watersheds." Other methodologies include the "Rational Method" as described at N.J.A.C. 5:21, et seq., "Residential Site Improvement Standards", techniques for computing runoff volumes and groundwater recharge contained within the N.J. Geological Survey publication, GSR-32: "A Method for Evaluating Groundwater Recharge Areas in New Jersey," the "New Jersey Stormwater Best Management Practices Manual" and the "Standards for Soil Erosion and Sediment Control in New Jersey."

Software Utilized: The primary software utilized for pre- and post-development hydrologic and hydraulic modeling of the project is the HydroCAD Stormwater Modeling package, Version 10.1, produced by HydroCAD Software Solutions, LLC. Details regarding all aspects of the software are available, online, at https://www.hydrocad.net/info.htm

Some tabular analyses and/or presentation tables have been prepared using the Microsoft Excel spreadsheet.

Further, the following are noted:

(1) Hydrographs generated from watershed drainage areas and stormwater management basins are tabulated upon a single, unified time line permitting event analysis based upon decomposition and/or superposition of relevant hydrographs;

(2) All hydrograph analyses performed have utilized entire hydrograph timelines and volumes. Printed hydrograph tabulations and/or graphical hydrographs have been abbreviated for the sake of paper and/or space, however, no portion of any hydrograph has been truncated prior to the completion of the analyses contained herein.

STORMWATER MANAGEMENT OVERVIEW

General: Of the 9.967±acre project area, 8.692± acres presently drain, via overland flow, to the intersection of Cedar and Larchwood Avenues. The drainage area is illustrated upon Dwg. "SWM-1." The proposed development will slightly increase this drainage area to 8.847± acres as illustrated upon Dwg. "SWM-2." The area will contain the great majority of project improvements and, more significantly, increased impervious coverage. Its development plan includes (1) a drainage conveyance system connecting each of the internal project areas with the existing State and Municipal drainage system at the corner of Cedar and Larchwood Avenues; as well as, (2) an individual drainage collection and stormwater management system for each of the internal project "Stormwater Management Areas" (designated as "SWMA"). All drainage and stormwater management designs conform with applicable State and Municipal regulations and performance standards as summarized in the following paragraphs.

The post-development 1.120± -acre project area not tributary to the Cedar/Larchwood intersection will continue drain to the internal drainage collection system of the Campus and thru one of two existing, large stormwater management facilities. Because the total impervious coverage increase upon this area is only 6,579 s.f. from which runoff flow is split between the two existing stormwater management installations, no expansion of existing stormwater management facilities is proposed. After development the impervious coverage draining to the open stormwater management basin upon Lot 7 will increase by 2,840± s.f. and the impervious cover draining to the large subsurface stormwater management system beneath the existing parking field upon Lots 7 and 12.02 will increase by 3,739± s.f.

Pre-Development (i.e., Existing) Stormwater Discharge Rates: Drawing SWM-1 entitled "Pre-Dev. M.U. Catchment Area Draining to Cedar/Larchwood Intersection" illustrates the portion of the University-owned lots which surrounds, and includes, the area of the proposed project. As shown, 8.692±acres of this area, labeled as 'E1.2', drain to an existing drainage inlet adjacent to the southeasterly corner of the intersection of Cedar and Larchwood Avenues (labeled 'IAP' for 'Impact Analysis Point').

In the past (i.e., prior to 1996), Block 39 Lots 1, 2, 3, 4, 5 and 7 were fully developed and utilized as detached, single-family residences. Former Lot 12, a once-operating dairy farm, was subdivided into Lot 12.01 which was developed/utilized as a single family residence and Lot 12.02 containing both single-famiIy and farm uses.

In 1996, the University received W.L.B. Zoning Board Variance and Site Plan approvals to convert virtually all of the farm area of Lot 12.02 to athletic fields. In approximately 2013, the single family residence upon Lot 12.01 was approved for use as an "Alumni House" with very few changes and/or additions to then-existing exterior/site improvements.

Approximately seven (7) years ago, the single-family residence and appurtenant improvements upon Lot 3 were demolished.

Pursuant to current State and Municipal Stormwater Management Regulations, the current state of drainage catchment E1.2 was analyzed, in detail, to determine stormwater flow rates to Impact Analysis Point IAP These pre-development (i.e., current) flow rates to IAP are the basis for determining post-development discharge rates to that same offsite point. Detailed analyses of pre-development drainage catchment E1.2 are provided in section II of this Report. A summarization of flow rates is provided in below Table III.1. Pre- / Post-Development Event Summary Tabulation.

Post-Development (i.e., Proposed) Stormwater Discharge Rates: Drawing SWM-2 entitled "Post-Dev. M.U. Area Draining to Cedar/Larchwood Intersection" illustrates the post-development portion of the University-owned lots which includes proposed project improvements and which will drain to the impact analysis point, IAP. As shown, it is approximately 8.9± acres and includes virtually all of the building, parking, and site improvements of the project.

Detailed analyses of the post-development University catchment area draining to IAP are provided in section III of this Report. A summarization of post-development flow rates to IAP is provided in below Table III.1 which enables comparison with both pre-development and allowable rates.

TABLE 1. PRE- / POST-DEVELOPMENT EVENT SUMMARY TABULATION MU Flows to Cedar / Larchwood Intersection ('IAP')						
EVENT	Pre-D MU Flow (cfs)	Req'd % Reduction	Allowable Post-D MU Flow (cfs)	Post-D MU flow (cfs)	Achieved % Reduction	Rate Reduction Compliance
1-Year	1.56			0.75	51.9%	
2-Year	2.19	50.0%	1.10	1.07	51.1%	Yes
5-Year	5.01			2.39	52.3%	
10-Year	7.98	25.0%	5.99	3.65	54.3%	Yes
25-Year	12.71			7.67	39.7%	
50-Year	17.86			12.67	29.1%	
100-Year	23.35	20.0%	18.68	17.32	25.8%	Yes
NJWQDS	1.20			0.59	50.8%	

STATEMENT OF COMPLIANCE

Summary information of this Report section demonstrates project design compliance with current NJDEP and Municipal stormwater management regulations. Detailed calculations, analyses, tabulations and reference materials from which this summary information obtains are contained within further Report sections and appendices.

Stormwater Runoff Quantity Impacts: NJDEP stormwater quantity impact management requirements are found at NJAC 7:8-5.4(a)3. This development includes subsurface stormwater storage/detention beds designed to mitigate development-related stormwater discharge rate increases in accordance with NJAC 7:8-5.4(a)3.iii which requires post-construction peak runoff rates for the 2-, 10-and 100-year storm events to be 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates.

Above Table III.1 provides pre-and post-development rate comparisons for stormwater flows to Impact Analysis Point "IAP" which demonstrate compliance with State and Municipal rate reduction requirements. Rate reductions for other NOAA Type 'D' 24-hour precipitation events and the New Jersey Water Quality Design Storm (NJWQDS) are also provided.

Stormwater Quality: NJDEP stormwater quality management requirements are found at NJAC 7:8-5.5:

> "Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site, expressed as an annual average.

The post-development M.U. catchment tributary to IAP has been divided into fifteen (15) subcatchments, based upon surface flow paths and changes to land use cover, to facilitate modeling and analysis. Ten (10) of these of these subcatchment areas will have either no ground cover change, or a small reduction of impervious coverage, as the result of the project. The most significant coverage reductions will be the removal of paved residential driveways and parking surfaces for which pre-development runoff is not managed. These paved surface reductions will have a positive impact upon water quality.

The remaining five (5) post-development subcatchments will have substantial ground cover and/or use changes including building roofs, circulation drives and parking areas. All of these areas, designated as Stormwater Management Areas (SWMA), will be provided with Manufactured Treatment Device (MTD) water quality treatment installations laboratory verified by the NJCAT, certified by the NJDEP and designed to meet performance requirements cited above and design requirements found at Chapter 9.6 of the "NJ Stormwater Best Management Practices Manual."

Groundwater Recharge: NJDEP groundwater recharge requirements are found at NJAC 7:8-5.4(a)2. As stated at NJAC 7:8-5.4 (a)2.ii, groundwater recharge requirements do not apply to areas which qualify as "urban redevelopment." An "urban redevelopment area" is defined at 7:8-1.2 as "…previously developed portions or areas … delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (Pal)".

Inasmuch as the Project Site area is a long-time, fully-developed area located within a Metropolitan Planning Area (i.e., PA-1) upon the State Planning and Policy Map (SPPM), no specific groundwater recharge requirement applies to this development.

IAP

E1.2

A_{total} = 378,622± s.f.
= 8.692± ac

ELMWOOD AVENUE (50-FOOT R.O.W.)

CEDAR AVENUE (A.K.A. N.J.S.H. ROUTE NO. 71) (50-FOOT R.O.W.)

PINEWOOD AVENUE (60-FOOT R.O.W.)

LARCHWOOD AVENUE (50-FOOT R.O.W.)

BLOCK 35

BLOCK 36

BLOCK 38

BLOCK 39

BLOCK 41

ZONE R-22

ZONE I

ZONE BOUNDARY (TYP)

EXISTING 2-STORY RESIDENCE F.F.E. 38.28

EXISTING 2-STY/4,385± SF RESIDENCE

EXISTING 2-STORY GARAGE

EXISTING 1-STORY 1,860± S.F. RESIDENCE F.F.E. 40.21

EXISTING 2-STORY RESIDENCE F.F.E. 43.87

EXISTING 2-STORY RESIDENCE F.F.E. 46.18

EXISTING 1-STY/1,361±SF MAINT. & STORAGE BLDG.

EXISTING 2-STY/4,310± SF "ALUMNI HOUSE"

EXISTING 3-STORY "McALLEN HALL" ACADEMIC BUILDING

EXIST. RESTROOM BLDG.

BATTING CAGE

SOFTBALL FIELD

FIELD HOCKEY TURF

BITUMINOUS DRIVEWAY

BITUMINOUS PARKING AREA ("LOT 16")

BITUMINOUS PARKING AREA ("LOT 25")

GRAVEL DRIVEWAY

EXIST. 15" R.C.P. SANITARY SEWER

EDGE OF ASPHALT RUNWAY (TYP)

DENOTES EXISTING POLE-MOUNTED AREA LIGHT (TYP)

0 20 40 80 120 160 200

GRAPHIC SCALE

PRE-DEV. M.U. CATCHMENT AREA DRAINING TO CEDAR/LARCHWOOD INTERSECTION

MONMOUTH UNIVERSITY

STORMWATER MANAGEMENT PLAN

BLOCK 39, LOTS 1, 2, 3, 4, 5, 7, 12.01 & 12.02

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald

Civil Engineers – Land Use Planners – Construction Managers

P.O. BOX 550 WEST LONG BRANCH, N.J. 07764 TELE: (732) 859-3481

WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 2888

DATE: 08-31-20	SCALE: 1"=40'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	
DWG.: SWM-1	SHEET: 1

IAP

POST-DEVELOPMENT

A_{total} = 385,375± s.f.
= 8.847± ac

ELMWOOD AVENUE (50-FOOT R.O.W.)

CEDAR AVENUE (A.K.A. N.J.S.H. ROUTE NO. 71) (50-FOOT R.O.W.)

PINEWOOD AVENUE (50-FOOT R.O.W.)

ARCHWOOD AVENUE (50-FOOT R.O.W.)

BLOCK 35

BLOCK 36

BLOCK 38

BLOCK 39

BLOCK 41

ZONE R-22

ZONE I

ZONE BOUNDARY (TYP.)

PROPOSED FOR FUTURE REMOVAL

EXISTING 2-STY/4,385± S.F. RESIDENCE

CONVERT TO M.U. ALUMNI CENTER

EXISTING 2-STORY GARAGE

EXISTING 1-STORY 1,860± S.F. RESIDENCE

CONVERT TO M.U. OFFICES

PROPOSED 1,800 S.F. STORAGE / MAINT. BUILDING #1 F.F.E. 18.5

PROPOSED 1,800 S.F. STORAGE / MAINT. BUILDING #2 F.F. ELEV. 16.5

EXIST. 1-STORY RESTROOM BLDG.

EDGE OF SOFTBALL OUTFIELD FENCE

SOFTBALL FIELD

BATTING CAGE

FIELD HOCKEY GOAL

PROPOSED 2-STY/5,867± M.U. POLICE HEADQUARTERS F.F.E.EL. 41.80

BITUMINOUS DRIVEWAY

BITUMINOUS PARKING AREA ("LOT 16")

BITUMINOUS PARKING AREA ("LOT 25")

EXISTING 2-STY/4,310± SF "ALUMNI HOUSE" F.F.E.EL. 47.3

CONVERT TO TEMP. POLICE HDQTRS. / FUTURE ACADEMIC BLDG.

EXISTING 1-STY/1,361± S.F. MAINT. & STORAGE BLDG. F.F.E.EL. 28.0

EXPAND BY 1,605± S.F. CONVERT TO M.U. GOLF CENTER

EXISTING 3-STORY "McALLEN HALL" ACADEMIC BUILDING

EXISTING 1-STORY BUILDING

WALK

— DENOTES EXISTING POLE-MOUNTED AREA LIGHT (TYP.)

0 20 40 80 120 160 200

GRAPHIC SCALE

POST-DEVEL. M.U. CATCHMENT AREA DRAINING TO IMPACT ANALYSIS PT. "IAP"

MONMOUTH UNIVERSITY

STORMWATER MANAGEMENT PLAN

BLOCK 39, LOTS 1, 2, 3, 4, 5, 7, 12.01 & 12.02

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald

Civil Engineers – Land Use Planners – Construction Managers

P.O. BOX 550 WEST LONG BRANCH, N.J. 07764 TELE: (732) 859-3481

WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 2888

DATE: 08-31-20	SCALE: 1"=40'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	
DWG.: SWM-2	SHEET: 2

STORMWATER MANAGEMENT REPORT – II

PRE-DEVELOPMENT CATCHMENT / SUBCATCHMENT ANALYSES

To Accompany

LAND USE APPLICATION FOR 'D' AND 'C' VARIANCES AND PRELIMINARY & FINAL MAJOR SITE PLAN APPROVALS

Upon

Block 39, Lots 1, 2, 3, 4, 5, 7, 8, 9, 11, 12.01 & 12.02

Within The

Borough of West Long Branch, Monmouth County, Nj

Prepared For

MONMOUTH UNIVERSITY

By

William E. Fitzgerald, P.E.
P.O. Box 550
West Long Branch, New Jersey 07764

E-mail: wfitz@wef-pe.com

September 10, 2020

C O N T E N T S

MAPS & ILLUSTRATIVE REFERENCES

DESCRIPTION OF PROJECT SITE

Location: The area of Monmouth University properties upon which project improvements will be constructed is a 9.967+-acre area of the 19.807-acre tract designated as Lots 1, 2, 3, 4, 5, 7, 12.01 and 12.02, Block 39, upon sheet no. 18 of the Tax Map of the Borough of West Long Branch. This area forms the southeasterly 'quadrant' of the intersection of Cedar Avenue (a.k.a., NJSH Route No. 71) with Larchwood Avenue.

The latitude and longitude of the approximate geometric center of the construction area are 40º16'53.1" and -74º00'33.5", respectively, and the N.J. State Plan Coordinates of that point are N527800, E629020.

Site Boundaries: Site boundary lines, described by bearings and distances, are depicted upon upon a Survey Map of Property, Monmouth University, Borough Of West Long Branch, Monmouth County, New Jersey; Prepared by John T. Luts, PLS, for Monmouth University; Dated 04-19-96; and Revised Thru: 11-16-19

Municipal Land Use Zoning. Lots 1, 2, 3, 4, 5, 12.01 and 12.02 lie entirely within the "R-22" Singly Family Residence land use zone. A small area of Lot 7, in its southwesterly corner, is also included within the R-22 Zone. The vast majority of Lot 7 lies within the "I" Institutional land use zone of the Borough.

Present Land utilization. Lots 1, 2, 3, 5 and a small portion of Lot 12.02 are presently developed as, and utilized for, single family living. The remaining area of Lot 12.02 has been utilized as athletic fields/venues since receiving a 'D' variance for that use in 1996. Lot 4 is presently vacant, the former residence and appurtenant improvements having been demolished approximately seven years ago. Lot 7 is developed with a primary Campus ingress/egress driveway from Cedar Avenue, a 252-vehicle parking field and a stormwater management basin. Lot 12.01 contains a single family residential structure with a driveway and appurtenant improvements which have been utilized as an "Alumni House" since receiving a 'D' variance for that use in 2007.

Topography and Slopes: Existing topography generally consists of flat-to-gentle slopes with virtually no slope steeper than 3% excepting man-made slopes adjacent to structures and/or within the existing stormwater management basin. 8.692±acres of the subject tract drains, overland, to an existing Cedar Avenue storm drain adjacent to the southeasterly corner of the Larchwood Avenue intersection. The remainder of the tract drains generally southward to the existing University drainage collection and stormwater management system. Virtually all impervious cover upon Lot 7 drains to the stormwater management basin, thereon.

Geology and Soils: NRCS soil mapping for the project tract indicates the presence of two USDA soil series: Evesboro sands (HSG 'A') and Klej Urban Land Complex (HSG 'B'). Of the 8.692± acre University-owned land area draining to the intersection of Cedar and Larchwood Avenues, 2.897±acres are mapped as Evesboro Series sands and 5.795±acers are mapped as Klej loamy sands. A copy of the NRCS Web Soil Survey Report is provided within Appendix II.3 of this report.

In addition to utilizing readily available NRCS information, the University retained Dwyer Geosciences to perform onsite geologic and hydrogeologic investigations and testing. The work included thirteen

(13) 25-foot deep Geoprobe soil samplings, installation of six (6) short-term (i.e., 6- month) groundwater level monitoring wells and profile pit excavations, soil sampling and laboratory permeability testing of soil samples at twelve (12) locations across the improvements area of the project. Locations and results of the investigations and testing are provided within Appendix II.4.

Vegetation: Onsite vegetation consists, predominantly, of residential lawn areas including short grasses, trees and shrub plantings.

Regulated Land Areas: No State and/or Federally regulated environmentally sensitive area including surface water, Freshwater Wetlands / Transition Area, Flood Hazard Area, Riparian Area, landfill, etc., is known to exist upon, or within the boundaries of, the project tract.

OVERVIEW OF PRE-DEVELOPMENT HYDROLOGIC ANALYSIS

The 8.692± acre M.U. property area (labeled 'E1.2') draining to the Cedar / Larchwood intersection (impact analysis point IAP) was divided into twelve (12) subcatchment areas based upon soil cover complex and overland runoff flow path (note: there are 12 locations at which overland runoff flows from catchment E1.2 onto the gutter line of an adjacent street and along a street to IAP). The subcatchments and their hydrologic characteristics are illustrated upon drawing "SWM-3."

Two types of subcatchment area were identified:

1. subcatchment areas for which the soil cover was totally impervious and the entire flow path between the uppermost subcatchment point and the impact analysis point IAP was impervious (also referred to as "connected" impervious coverage areas); and,

2. subcatchment areas for which the soil cover was a mix of disconnected impervious surfaces and vegetative cover and the flow path between the uppermost subcatchment point and the impact analysis point IAP was a mix of pervious and impervious surface coverages.

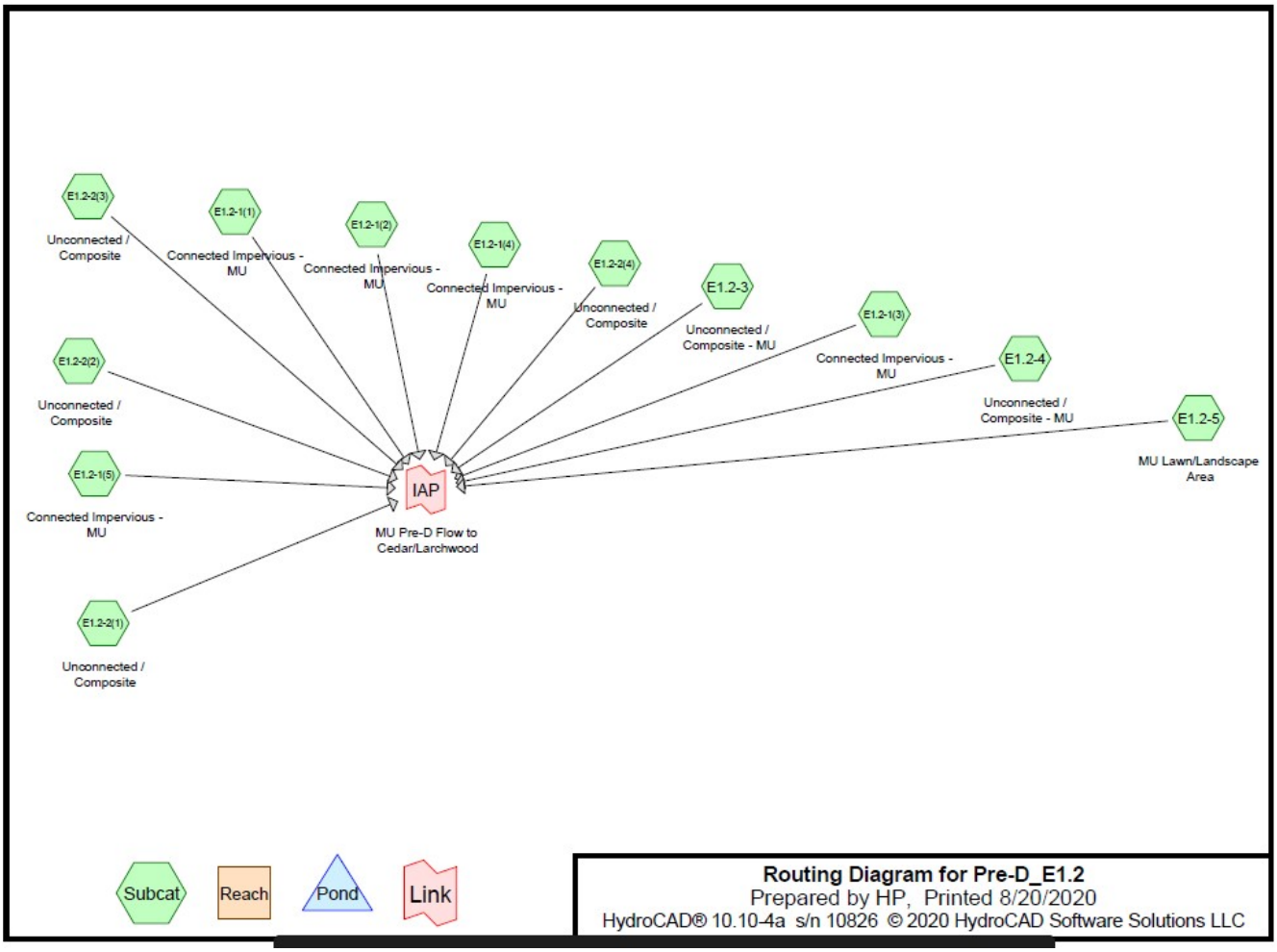
Subcatchments of the first category are E1.2-1(1), E1.2-1(2), E1.2-1(3), E1.2-1(4) and E1.2-1(5).

Subcatchments of the latter category are E1.2-2(1), E1.2-2(2), E1.2-2(3), E1.2-2(4) and E1.2-3. E1.2-3, E1,2-4 and E1.2-5.

Following is summary tabulation of pre-development subcatchment hydrologic properties:

SUMMARY TABULATION: E1.2 SUBCATCHMENTS				
AREA I.D.	AREA		CN	T_c
	(sf)	(ac)		(min)
E1.2-1				
E1.2-1(1)	4,312	0.099	98	6.0
E1.2-1(2)	4,852	0.111	98	6.0
E1.2-1(3)	4,511	0.104	98	9.6
E1.2-1(4)	1,598	0.037	98	11.8
E1.2-1(5)	3,602	0.083	98	6.0
E1.2-2				
E1.2-2(1)	20,365	0.468	40.0	9.4
E1.2-2(2)	84,484	1.939	47.6	14.2
E1.2-2(3)	8,105	0.186	61.0	6.0
E1.2-2(4)	20,871	0.479	63.9	9.8
E1.2-3	170,520	3.915	61.6	24.5
E1.2-4	44,493	1.021	67.8	17.4
E1.2-5	10,909	0.250	61.0	17.2

The catchment model utilized to evaluate pre-development runoff flow rates to impact analysis point IAP is:



from which obtains the following event summary tabulation:

Event	**Inflow** (cfs)
1-Year	1.56
2-Year	2.19
5-Year	5.01
10-Year	7.68
25-Year	12.71
50-Year	17.86
100-Year	23.35
NJWQDS	1.20

APPENDIX II.1

(Note: this appendix contains a copy of the NRCS Web Soil Survey Report upon the Project Tract area)

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Monmouth County, New Jersey

August 25, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,320 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monmouth County, New Jersey
Survey Area Data: Version 14, Jun 1, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 29, 2019—Jul 16, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EveB	Evesboro sand, 0 to 5 percent slopes	7.6	40.0%
KkhB	Klej loamy sand-Urban land complex, 0 to 5 percent slopes	11.5	60.0%
Totals for Area of Interest		**19.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Monmouth County, New Jersey

EveB—Evesboro sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 4j74
Elevation: 0 to 150 feet
Mean annual precipitation: 28 to 59 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 161 to 231 days
Farmland classification: Not prime farmland

Map Unit Composition

Evesboro and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Evesboro

Setting

Landform: Low hills
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy eolian deposits and/or sandy fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
AB - 4 to 17 inches: sand
Bw - 17 to 31 inches: sand
C - 31 to 80 inches: stratified loamy sand to sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Lakehurst

Percent of map unit: 5 percent
Landform: Flats, depressions
Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: No

Atsion

Percent of map unit: 5 percent
Landform: Flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Mullica, rarely flooded

Percent of map unit: 5 percent
Landform: Flood plains, depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Downer

Percent of map unit: 5 percent
Landform: Knolls, low hills
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

KkhB—Klej loamy sand-Urban land complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1js1p
Elevation: 10 to 130 feet
Mean annual precipitation: 28 to 59 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 161 to 231 days
Farmland classification: Not prime farmland

Map Unit Composition

Klej and similar soils: 55 percent
Urban land: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Klej

Setting

Landform: Dunes

Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Unconsolidated sandy marine deposits

Typical profile

Oi - 0 to 3 inches: slightly decomposed plant material
Oe - 3 to 4 inches: moderately decomposed plant material
A - 4 to 14 inches: loamy sand
Bw1 - 14 to 24 inches: loamy sand
Bw2 - 24 to 40 inches: loamy sand
C - 40 to 64 inches: sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Hydric soil rating: No

Description of Urban Land

Setting

Parent material: Surface covered by pavement, concrete, buildings, and other structures underlain by disturbed and natural soil material

Typical profile

C - 0 to 60 inches: variable

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Atsion

Percent of map unit: 5 percent
Landform: Flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Evesboro

Percent of map unit: 5 percent
Landform: Low hills

Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Downer

Percent of map unit: 5 percent
Landform: Knolls, low hills
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX II.2

(Note: this appendix presents results of soil/groundwater observations and modelling conducted by Dwyer Geosciences, Inc., including locations and results of Geoprobe onsite soil borings, groundwater level monitoring wells, profile pit sampling and laboratory permeability testing conducted to evaluate existing groundwater elevations and subsoil permeabilities; a reference drawing for onsite sampling/testing locations is provided with this section of the Report)

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B1
Sampling Method: Geoprobe
Date: 4/24/2019

Grade Elev. (ft-msl): 41.5

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.4 **41.5 - 41.1**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
1.2 - 2.4 **40.3 - 39.1**	Silty/Clayey Sand: 80% fine, subangular, quartz sand; 20% moderately plastic fines; dark gray; loose to slightly firm; moist.
2.4 - 5.0 **39.1 - 36.5**	Sand w/Silt and Clay: 90% fine to medium quartz/glauconite sand; 10% moderately plastic fines; dark orange; loose; moist.
5.0 - 9.6 **36.5 - 31.9**	Sand: medium to coarse, subangular, quartz/glauconite sand; light orange; loose; moist.
9.6 - 12.0 **31.9 - 29.5**	Gravelly Sand: 70% coarse to very coarse, subangular, quartz sand; 30% fine to medium, subrounded, quartz gravel; light gray and light orange; loose; moist.
12.0 - 17.7 **29.5 - 23.8**	Sand: 95% fine to medium, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; loose; moist.

17.7 - 25.0 **23.8 - 16.5**	Sand w/Silt and Clay: 90% fine to medium, subangular, quartz/glauconite sand; 10% moderately plastic fines; dark orange/green; loose; moist to saturated at 19.5 ft.
25.0 - 30.0 **16.5 - 11.5**	Sand: 95% coarse, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; loose; saturated.

Monitoring Well Installed:
20 feet, 2-inch-diameter, Schedule 40, PVC casing;
10 feet, 2-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen set from 20.0 to 30.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B2
Sampling Method: Geoprobe
Date: 4/24/2019

Grade Elev. (ft-msl): 39.4

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.6 **39.4 - 38.8**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
0.6 - 1.6 **38.8 - 37.8**	Silty/Clayey Sand: 70% very fine to fine quartz sand; 30% moderately plastic fines; medium gray/orange; firm; moist.
1.6 - 2.7 **37.8 - 36.7**	Sand: 95% medium, subangular, quartz sand; 5% nonplastic fines; light orange; loose; moist.
2.7 - 4.2 **36.7 - 35.2**	Sand: 95% fine to medium, subangular, quartz/glauconite sand; 5% nonplastic fines; medium orange/green; loose; moist.
4.2 - 12.7 **35.2 - 26.7**	Silty Sand: 85% fine, quartz sand; 15% nonplastic fines; light gray; moist.
12.7 - 16.3 **26.7 - 23.1**	Sand w/Silt and Clay: 90% medium, subangular, quartz/glauconite sand; 10% slightly plastic fines; dark orange/green; loose; moist.
16.3 - 20.0 **23.1 - 19.4**	Silty/Clayey Sand; 85% medium to coarse, subangular, quartz/glauconite sand; 15% moderately plastic fines; dark orange/green; loose; saturated.

20.0 - 25.0 **19.4 - 14.4**	Sand: 95% coarse to very coarse subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; loose; saturated.
25.0 - 30.0 **14.4 - 9.4**	Sand: coarse to very coarse subangular, quartz/glauconite sand; dark orange/green; loose; saturated.

Piezometer Installed:
14 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 14.0 to 24.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B3
Sampling Method: Geoprobe
Date: 4/24/2019

Grade Elev. (ft-msl): 37.7

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.4 **37.7 - 37.3**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; moist.
0.4 - 0.8 **37.3 - 36.9**	Gravelly Sand: 80% fine to medium, subangular, quartz sand; 10% fine to medium, subrounded, quartz gravel; light orange; loose; moist.
0.8 - 1.9 **36.9 - 35.8**	Silty Sand: 70% very fine to fine, quartz sand; 30% nonplastic fines; dark gray; slightly firm; moist.
1.9 - 5.0 **35.8 - 32.7**	Sand: medium, subangular, quartz sand; light orange; loose; moist.
5.0 - 7.8 **32.7 - 29.9**	Clayey/Silty Sand: 80% fine to medium, subangular, quartz sand; 20% moderately plastic fines; medium orange; firm; moist.
7.8 - 9.5 **29.9 - 28.2**	Sand: fine to medium, subangular, quartz sand; medium orange; loose; moist.
9.5 - 10.0 **28.2 - 27.7**	Gravelly Sand w/Silt: 70% medium, subangular, quartz sand; 20% fine, subangular, quartz gravel; 10% nonplastic fines; medium to dark orange; loose; moist.
10.0 - 11.8 **27.7 - 25.9**	Clayey/Silty Sand: 70% very fine to fine, quartz sand; 30% moderately plastic fines; light gray; firm; moist.
11.8 - 12.7 **25.9 - 25.0**	Sand w/Silt: 90% medium, subangular, quartz sand; 10% nonplastic fines; light gray; loose; moist.
12.7 - 14.6 **25.0 - 23.1**	Sand: 95% coarse, subangular, quartz sand; 5% subangular, fine, quartz gravel; light gray and light orange; loose; moist.

14.6 - 15.0 **23.1 - 22.7**	Gravelly Sand: 60% coarse to very coarse; subangular, quartz sand; 40% fine to medium, subangular, quartz gravel; light gray and light orange; loose; moist.
15.0 - 18.9 **22.7 - 18.8**	Gravelly Sand w/Silt: 70% coarse, quartz/glauconite sand; 20% fine, subrounded, quartz gravel; 10% nonplastic fines; dark orange; loose; saturated.
18.9 - 20.0 **18.8 - 17.7**	Clayey Sand: 75% medium to coarse, subangular, quartz/glauconite sand; 25% highly plastic fines; dark orange/green; firm; saturated.
20.0 - 30.0 **17.7 - 7.7**	Sand w/Silt and Clay: 90% coarse, quartz/glauconite sand; 10% slightly plastic fines; dark orange/green; saturated.

Monitoring Well Installed:
20 feet, 2-inch-diameter, Schedule 40, PVC casing;
10 feet, 2-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 20.0 to 30.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B4
Sampling Method: Geoprobe
Date: 4/25/2019

Grade Elev. (ft-msl):

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.7 **0.0 - -0.7**	Clayey/Silty Sand w/Organic Material: 75% fine, quartz sand; 20% moderately plastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
0.7 - 3.0 **-0.7 - -3.0**	Silty/Clayey Sand w/Gravel: 70% fine, quartz sand; 20% moderately plastic fines; 10% fine to medium, angular, quartz/rock gravel; dark gray; firm; moist.
3.0 - 5.0 **-3.0 - -5.0**	Silty/Clayey Sand: 80% fine to medium, quartz sand; 20% moderately plastic fines; dark orange; firm; moist.
5.0 - 8.6 **-5.0 - -8.6**	Sand w/Gravel: 90% coarse to very coarse, subangular, quartz sand; 10% fine, subrounded, quartz gravel; light orange; loose; moist.
8.6 - 10.0 **-8.6 - -10.0**	Sand w/Silt: 90% fine to medium, quartz sand; 10% nonplastic fines; light gray; loose; moist.
10.0 - 13.7 **-10.0 - -13.7**	Sand w/Gravel: 90% coarse, subangular, quartz sand; 10% fine to medium, subrounded, quartz gravel; light gray/yellow; loose; moist.
13.7 - 15.0 **-13.7 - -15.0**	Gravelly Sand: 60% coarse to very coarse, quartz sand; 40% fine to medium, rounded, quartz gravel; light orange; loose; saturated.
15.0 - 17.0 **-15.0 - -17.0**	Sandy Gravel: 80% fine to medium, rounded, quartz gravel; 20% coarse to very coarse, subangular, quartz sand; medium orange; loose; saturated.

17.0 - 20.0 **-17.0 - -20.0**	Gravelly Sand: 60% coarse to very coarse, subangular, quartz sand; 40% fine to medium, subrounded, quartz gravel; light orange; loose; saturated.
20.0 - 25.0 **-20.0 - -25.0**	Sandy, Gravelly, Peat: 65% peat; 20% medium to coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; black, loose, saturated.

Piezometer Installed:
10 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 10.0 to 20.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B5
Sampling Method: Geoprobe
Date: 4/25/2019

Grade Elev. (ft-msl): 40.8

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.5 **40.8 - 40.3**	Clayey/Silty Sand w/Organic Material: 75% fine, quartz sand; 20% moderately plastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
0.5 - 1.1 **40.3 - 39.7**	Silty/Clayey Sand: 80% fine to medium, subangular, quartz sand; 20% moderately plastic fines; dark gray; firm; moist.
1.1 - 7.3 **39.7 - 33.5**	Sand: fine to medium, subangular, quartz/glauconite sand; medium orange/green; loose; moist.
7.3 - 8.2 **33.5 - 32.6**	Clayey Silt: moderately plastic fines; medium orange-gray; firm; saturated.
8.2 - 10.0 **32.6 - 30.8**	Sand: medium to coarse, subangular, quartz sand; light gray and light orange/brown; loose; moist.
10.0 - 11.9 **30.8 - 28.9**	Gravelly Sand: 70% coarse to very coarse, subangular, quartz sand; 30% fine to medium, subrounded, quartz gravel; light orange; loose; moist.
11.9 - 20.0 **28.9 - 20.8**	Sand: 95% fine to medium, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; moist saturated at 18 ft.
20.0 - 25.0 **20.8 - 15.8**	Sand: 95% medium, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; saturated.

25.0 - 30.0 **15.8 - 10.8**	Sand: 95% medium to coarse, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; saturated.

Piezometer Installed:
15 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 15.0 to 25.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B6
Sampling Method: Geoprobe
Date: 4/24/2019

Grade Elev. (ft-msl): 39.2

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.7 **39.2 - 38.5**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
0.7 - 1.7 **38.5 - 37.5**	Silty/Clayey Sand: 80% fine, subangular, quartz sand; 20% moderately plastic fines; dark gray; loose to slightly firm; moist.
1.7 - 5.0 **37.5 - 34.2**	Sand: 95% fine to medium, quartz/glauconite sand; 5% nonplastic fines; medium orange/green; loose; moist.
5.0 - 7.3 **34.2 - 31.9**	Sand w/Silt and Clay: 90% fine, quartz/glauconite sand; 10% slightly plastic fines; dark orange/green; loose; moist.
7.3 - 8.3 **31.9 - 30.9**	Sand: fine, quartz/glauconite sand; light orange; loose; moist.
8.3 - 8.9 **30.9 - 30.3**	Sand w/Gravel: 90% medium to coarse, subangular, quartz sand; 10% fine, subrounded, quartz gravel; medium gray; loose; moist.
8.9 - 10.0 **30.3 - 29.2**	Silty Sand: 80% very fine to fine, quartz sand; 20% nonplastic fines; light gray; loose to slightly firm; moist.
10.0 - 12.2 **29.2 - 27.0**	Silty/Clayey Sand: 80% fine, quartz/glauconite sand; 20% moderately plastic fines; medium orange/brown; loose to slightly firm; near saturated.
12.2 - 15.2 **27.0 - 24.0**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine, rounded, quartz gravel; medium brown/gray; loose; moist.
15.2 - 17.0 **24.0 - 22.2**	Sand: 95% medium to coarse, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; loose; moist.

17.0 - 20.0 **22.2 - 19.2**	Sand w/Silt: 90% medium to coarse, subangular, quartz/glauconite sand; 10% nonplastic fines; dark orange/green; loose; saturated.
20.0 - 30.0 **19.2 - 9.2**	Sand: coarse to very coarse, subangular, quartz/glauconite sand; dark orange/green; loose; saturated.

Piezometer Installed:
14 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 14.0 to 24.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B7
Sampling Method: Geoprobe
Date: 4/23/2019

Grade Elev. (ft-msl): 37.7

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.5 **37.7 - 37.2**	Sand w/Silt and Organic Material 80% very fine, micaceous, quartz sand; 10% nonplastic fines; 10% organic material; dark gray; loose; moist.
0.5 - 2.2 **37.2 - 35.5**	Silty/Clayey Sand: 75% fine to medium, subangular, quartz sand; 25% moderately plastic fines; medium orange; loose to slightly firm; moist.
2.2 - 5.0 **35.5 - 32.7**	Sand: 95% fine to medium, subangular, quartz/glauconite sand; 5% nonplastic fines; medium orange; loose; moist
5.0 - 7.0 **32.7 - 30.7**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
7.0 - 8.7 **30.7 - 29.0**	Silty/Clayey Sand: 75% fine to medium, subangular, quartz sand; 25% moderately plastic fines; medium orange; loose to slightly firm; moist.
8.7 - 10.0 **29.0 - 27.7**	Sand: 95% fine to medium, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; loose; moist.
10.0 - 15.0 **27.7 - 22.7**	Sand: medium to coarse, subangular, quartz/glauconite sand; medium orange/green; loose; moist to near saturated at 15 ft.
15.0 - 20.0 **22.7 - 17.7**	Sand w/Gravel: 90% coarse to very coarse, subangular, quartz/glauconite sand; 10% fine, subangular, quartz gravel; dark orange/green; saturated.

20.0 - 27.5 **17.7 - 10.2**	Sand w/Gravel, Silt and Clay: 80% coarse to very coarse, subangular, quartz/glauconite sand; 10% fine, subangular, quartz gravel; 10% slightly plastic fines; dark orange/green; saturated.
27.5 - 30.0 **10.2 - 7.7**	Sand w/Silt: 90% medium to coarse, glauconite sand; 10% nonplastic fines; dark orange/green; loose; saturated.

Piezometer Installed:
15 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 15.0 to 25.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B8
Sampling Method: Geoprobe
Date: 4/25/2019

Grade Elev. (ft-msl): 40.2

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.6 **40.2 - 39.6**	Clayey/Silty Sand w/Organic Material: 75% fine, quartz sand; 20% moderately plastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
0.6 - 1.5 **39.6 - 38.7**	Silty/Clayey Sand: 80% fine to medium, subangular, quartz sand; 20% moderately plastic fines; dark gray; firm; moist.
1.5 - 5.0 **38.7 - 35.2**	Sand: 95% fine, quartz/glauconite sand; 5% slightly plastic fines; medium orange/green; loose; moist.
5.0 - 9.0 **35.2 - 31.2**	Sand w/Silt and Clay: 90% medium to coarse, subangular, quartz/glauconite sand; 10% moderately plastic fines; dark orange/green to dark red; loose; moist.
9.0 - 17.9 **31.2 - 22.3**	Sand w/Silt and Clay: 90% medium to coarse, subangular, quartz/glauconite sand; 10% moderately plastic fines; dark red; loose; moist.
17.9 - 25.0 **22.3 - 15.2**	Sand: 95% medium to coarse, subangular, quartz/glauconite sand: 5% nonplastic fines; dark orange/green; loose; saturated.
25.0 - 30.0 **15.2 - 10.2**	Sand: 95% coarse to very coarse, subangular, quartz/glauconite sand; 5% nonplastic fines; dark orange/green; saturated.

Piezometer Installed:
15 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 15.0 to 25.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B9
Sampling Method: Geoprobe
Date: 4/25/2019

Grade Elev. (ft-msl): 38.1

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.5 **38.1 - 37.6**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
0.5 - 5.0 **37.6 - 33.1**	Interval Missing
5.0 - 7.8 **33.1 - 30.3**	Sand: medium to coarse, subangular, quartz sand; light orange; loose; moist.
7.8 - 8.8 **30.3 - 29.3**	Gravelly Sand: 70% medium to coarse, subangular, quartz sand; 30% fine to medium, subrounded, quartz gravel; light gray and medium orange; loose; moist.
8.8 - 12.3 **29.3 - 25.8**	Sand: 95% medium to coarse, subangular, quartz sand; 5% slightly plastic fines; dark orange/green; loose; moist.
12.3 - 13.8 **25.8 - 24.3**	Sand: medium to coarse; subangular, quartz/glauconite sand; medium orange/green; loose; moist.
13.8 - 20.0 **24.3 - 18.1**	Sand w/Silt and Clay: 90% medium to coarse, subangular, quartz/glauconite sand; 10% slightly plastic fines; dark orange/green; loose; moist to saturated at 15.0 ft.

20.0 - 23.0 **18.1 - 15.1**	Sand w/Silt and Clay: 90% coarse to very coarse, subangular, quartz/glauconite sand; 10% slightly plastic fines; dark orange/green; loose; saturated.
23.0 - 30.0 **15.1 - 8.1**	Silty/Clayey Sand: 85% coarse to very coarse, quartz/glauconite sand; 15% moderately plastic fines; dark orange/green; loose; saturated.

Monitoring Well Installed:
20 feet, 2-inch-diameter, Schedule 40, PVC casing;
10 feet, 2-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen set from 20.0 to 30.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B10
Sampling Method: Geoprobe
Date: 4/23/2019

Grade Elev. (ft-msl): 37.4

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.4 **37.4 - 37.0**	Sand w/Silt and Organic Material 85% medium, subangular, quartz sand; 10% nonplastic fines; 5% organic material; medium orange; loose; moist.
0.4 - 0.8 **37.0 - 36.6**	Silty Sand: 80% medium, subangular, quartz sand; 20% nonplastic fines; medium orange-gray; loose; moist.
0.8 - 2.1 **36.6 - 35.3**	Silty/Clayey Sand: 75% fine to medium, subangular, quartz sand; 25% moderately plastic fines; medium orange; loose to slightly firm; moist.
2.1 - 5.0 **35.3 - 32.4**	Silty Sand: 85% fine to medium, subangular, quartz sand; 15% nonplastic fines; medium orange; loose; moist
5.0 - 6.8 **32.4 - 30.6**	Sand: 95% fine to medium, subanular, quartz sand; 5% nonplastic fines; medium orange; loose; moist.
6.8 - 8.0 **30.6 - 29.4**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
8.0 - 10.0 **29.4 - 27.4**	Sand w/Silt and Clay: 90% medium, subangular, quartz/glauconite sand; 10% slightly plastic fines; dark orange brown; loose; moist dark gray; very firm; saturated.

10.0 - 22.0 **27.4 - 15.4**	Sand: 95% medium, subangular, quartz/glauconite sand; 5% slightly plastic fines; trace fine, rounded, quartz gravel; dark orange/red/green; loose; moist to saturated at 18 ft.
22.0 - 25.0 **15.4 - 12.4**	Sand w/Silt and Clay: 90% medium to coarse, subangular, quartz/glauconite sand; 10% slightly plastic fines; green/orange; loose; saturated
25.0 - 30.0 **12.4 - 7.4**	Sand: 95% medium to coarse, subangular, quartz/glauconite sand; 5% nonplastic fines; orange/green; saturated.

Piezometer Installed:
10 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 14.0 to 24.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B11
Sampling Method: Geoprobe
Date: 4/23/2019

Grade Elev. (ft-msl): 35.3

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.4 **35.3 - 34.9**	Sand w/Silt and Organic Material 85% medium, subangular, quartz sand; 10% nonplastic fines; 5% organic material; medium orange; loose; moist.
0.4 - 2.0 **34.9 - 33.3**	Silty/Clayey Sand: 75% fine to medium, subangular, quartz sand; 25% moderately plastic fines; medium orange; loose to slightly firm; moist.
2.0 - 5.3 **33.3 - 30.0**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
5.3 - 8.6 **30.0 - 26.7**	Clayey/Sandy Silt: 80% slightly plastic fines; 20% very fine to fine, quartz sand; light gray; firm; saturated
8.6 - 9.4 **26.7 - 25.9**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
9.4 - 20.0 **25.9 - 15.3**	Sand w/Silt: 90% coarse to very coarse, quartz/glauconite sand; 10% nonplastic fines; trace fine, rounded, quartz gravel; dark orange/green; loose; saturated.

20.0 - 25.0 **15.3 - 10.3**	Silty/Clayey Sand: 85% coarse to very coarse, subangular, quartz/glauconite sand; 15% slightly plastic fines; medium orange; loose; saturated.
20.0 - 25.0 **15.3 - 10.3**	Sand w/Silt: 90% coarse to very coarse, subangular, quartz/glauconite sand; 10% nonplastic fines; medium orange; loose; saturated.

Monitoring Well Installed:
20 feet, 2-inch-diameter, Schedule 40, PVC casing;
10 feet, 2-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen set from 20.0 to 30.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B12
Sampling Method: Geoprobe
Date: 4/23/2019

Grade Elev. (ft-msl): 37.2

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.5 **37.2 - 36.7**	Sand w/Silt and Organic Material 85% medium, subangular, quartz sand; 10% nonplastic fines; 5% organic material; medium orange; loose; moist.
0.5 - 1.0 **36.7 - 36.2**	Silty Sand: 80% medium, subangular, quartz sand; 20% nonplastic fines; medium orange-gray; loose; moist.
1.0 - 1.9 **36.2 - 35.3**	Silty/Clayey Sand: 75% fine to medium, subangular, quartz sand; 25% moderately plastic fines; medium orange; loose to slightly firm; moist.
1.9 - 5.9 **35.3 - 31.3**	Silty Sand: 85% fine to medium, subangular, quartz sand; 15% nonplastic fines; medium orange; loose; moist
5.9 - 6.6 **31.3 - 30.6**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
6.6 - 7.2 **30.6 - 30.0**	Gravelly/Clayey Sand: 70% fine to medium, subangular, quartz sand; 15% fine, rounded, quartz gravel; 15% moderately plastic fines; medium gray; loose; moist.
7.2 - 7.6 **30.0 - 29.6**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
7.6 - 7.9 **29.6 - 29.3**	Gravelly/Clayey Sand: 70% fine to medium, subangular, quartz sand; 15% fine, rounded, quartz gravel; 15% moderately plastic fines; medium gray; loose; moist.

7.9 - 9.1 **29.3 - 28.1**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz sand; 15% fine to medium, rounded, quartz gravel; light orange; loose; moist.
9.1 - 12.4 **28.1 - 24.8**	Sand w/Silt and Clay: 90% medium, subangular, quartz/glauconite sand; 10% slightly plastic fines; dark orange brown; loose; moist dark gray; very firm; moist.
12.4 - 20.0 **24.8 - 17.2**	Sand: 95% medium, subangular, quartz/glauconite sand; 5% slightly plastic fines; trace fine, rounded, quartz gravel; dark orange/red/green; loose; moist to saturated at 15 ft.
20.0 - 27.7 **17.2 - 9.5**	Sand: 95% medium, subangular, quartz/glauconite sand; 5% nonplastic fines; trace fine, rounded, quartz gravel; dark orange/red/green; loose; saturated.
27.7 - 30.0 **9.5 - 7.2**	Sand w/Silt: 90% medium, subangular, quartz/glauconite sand; 10% nonplastic fines; trace fine, rounded, quartz gravel; dark orange/red/green; loose; saturated.

Monitoring Well Installed:
20 feet, 2-inch-diameter, Schedule 40, PVC casing;
10 feet, 2-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen
set from 20.0 to 30.0 feet.

Test Boring Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: B13
Sampling Method: Geoprobe
Date: 4/25/2019

Grade Elev. (ft-msl): 24.6

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.6 **24.6 - 24.0**	Sand w/Organic Material: 90% medium to coarse, subangular, quartz sand; 10% organic material; dark gray; loose; moist.
0.6 - 2.8 **24.0 - 21.8**	Sand w/Silt: 90% medium to coarse, subangular, quartz/glauconite sand; 10% nonplastic fines; medium orange/gray and dark brown; loose; moist to saturated at 2.0 ft.
2.8 - 10.0 **21.8 - 14.6**	Sand: 95% medium to coarse, subangular, quartz/glauconite sand; 5% nonplastic fines; medium orange/green; loose; saturated.
10.0 - 13.6 **14.6 - 11.0**	Sand: coarse to very coarse, subangular, quartz/glauconite sand; medium orange/green; loose; saturated.
13.6 - 20.0 **11.0 - 4.6**	Sand w/Silt: 90% coarse, subangular, quartz/glauconite sand; 10% nonplastic fines; medium orange/green; saturated.

Piezometer Installed:
10 feet, 1-inch-diameter, Schedule 40, PVC casing;
10 feet, 1-inch-diameter, Schedule 40, machine slotted, 0.020-slot, PVC screen set from 10.0 to 20.0 feet.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 1.1
Sampling Method: Backhoe
Date: 7/17/2019

Grade Elev. (ft-msl): 33.8

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.6 **33.8 - 33.2**	Gravelly Sand w/Silt, Clay and Organic Material: 50% coarse to very coarse, subangular, quartz sand; 30% medium, angular gravel (fill); 10% moderately plastic fines; 10% organic material; dark gray; single-grain; loose; moist.
0.6 - 2.0 **33.2 - 31.8**	Gravelly Sand w/Silt and Clay: 70% coarse, subangular, quartz/glauconite sand; 20% fine to medium, rounded, quartz gravel; 10% moderately plastic fines; dark orange; single grain; firm; moist.
2.0 - 2.9 **31.8 - 30.9**	Sand w/Silt and Clay: 90% medium to coarse, subangular, quartz/glauconite sand; 10% moderately plastic fines; dark orange/red; single grain; loose; moist.
2.9 - 8.5 **30.9 - 25.3**	Sand: medium to coarse, subangular, quartz/glauconite sand; dark red/green; single grain; loose; moist. occasional ironstone layers up to 5 inches thick. permeameter samples at 5.0 to 5.5 feet

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 1.2
Sampling Method: Backhoe
Date: 7/17/2019

Grade Elev. (ft-msl): 35.4

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.7 **35.4 - 34.7**	Gravelly Sand w/Silt, Clay and Organic Material: 50% coarse to very coarse, subangular, quartz sand; 30% medium, angular gravel (fill); 10% moderately plastic fines; 10% organic material; dark gray; single grain; loose; moist.
0.7 - 2.3 **34.7 - 33.1**	Silty/Clayey Sand: 80% medium to coarse, subangular quartz sand; 15% moderately plastic fines; 5% fine, rounded, quartz gravel; light orange; single grain; slightly firm; moist.
2.3 - 4.0 **33.1 - 31.4**	Gravelly Sand: 60% coarse to very coarse, subangular, quartz sand; 40% fine to medium, rounded, quartz gravel; light orange; single grain; firm; moist.
4.0 - 5.0 **31.4 - 30.4**	Sand w/Silt and Clay: 90% medium to coarse, subangular, quartz/glauconite sand; 10% moderately plastic fines; dark red; single grain; firm; moist.
5.0 - 8.5 **30.4 - 26.9**	Sand: medium to coarse, subangular, quartz/glauconite sand; dark red/green; single grain; loose; moist. occasional ironstone layers up to 5 inches thick. permeameter samples at 6.7 to 7.2 feet

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 2.1
Sampling Method: Backhoe
Date: 7/17/2019

Grade Elev. (ft-msl): 41.2

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 1.0 **41.2 - 40.2**	Silty Sand w/Organic Material: 80% fine, subangular, quartz sand; 15% nonplastic fines; 5% organic material; dark gray; single grain; loose to slightly firm; moist.
1.0 - 2.1 **40.2 - 39.1**	Silty/Clayey Sand: 70% very fine to fine quartz sand; 30% moderately plastic fines; medium gray/orange; massive; firm; moist.
2.1 - 4.5 **39.1 - 36.7**	Sand: 95% fine to medium, subangular, quartz sand; 5% nonplastic fines; medium orange; single grain; loose; moist.
4.5 - 11.3 **36.7 - 29.9**	Sand and Sand w/Silt and Clay: 85% to 95% medium, quartz/glauconite sand; 0% to 10% slightly plastic fines; 5% fine to medium, rounded, quartz gravel; dark orange, single grain; loose; moist. permeameter samples at 10.8 to 11.3 feet

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 2.2
Sampling Method: Backhoe
Date: 7/17/2019

Grade Elev. (ft-msl): 39.5

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.6 **39.5 - 38.9**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; single grain; loose to slightly firm; moist.
0.6 - 1.6 **38.9 - 37.9**	Silty/Clayey Sand: 70% very fine to fine quartz sand; 30% moderately plastic fines; medium gray/orange; massive; firm; moist.
1.6 - 2.7 **37.9 - 36.8**	Sand: 95% medium, subangular, quartz sand; 5% nonplastic fines; light orange; single grain; loose; moist.
2.7 - 5.5 **36.8 - 34.0**	Sand: 95% fine to medium, subangular, quartz/glauconite sand; 5% nonplastic fines; medium orange/green; sngle grain; loose; moist.
5.5 - 8.0 **34.0 - 31.5**	Sand: 95% medium, quartz/glauconite sand; 5% fine to medium, rounded, quartz gravel; dark orange, single grain; loose; moist.
8.0 - 9.7 **31.5 - 29.8**	Sand and Sand w/Silt and Clay: 85% to 95% medium, quartz/glauconite sand; 0% to 10% slightly plastic fines; 5% fine to medium, rounded, quartz gravel; dark orange, single grain; loose; moist. permeameter samples at 9.2 to 9.7 feet

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 3-4.1
Sampling Method: Backhoe and Hand Auger
Date: 7/17/2019

Grade Elev. (ft-msl): 39.8

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 3.3 **39.8 - 36.5**	Sand w/ Silt and Clay: 90% fine, subangular, quartz/glauconite sand; 10% moderately plastic fines; dark orange; single grain; slightly firm; moist.
3.3 - 4.5 **36.5 - 35.3**	Sand: fine to medium, subangular, quartz/glauconite sand; medium brown/orange; single grain; loose; moist.
4.5 - 7.0 **35.3 - 32.8**	Sand: fine to medium, quartz/glauconite sand; medium brown and orange; single grain; loose; moist.
7.0 - 8.1 **32.8 - 31.7**	Sand w/Gravel: 90% fine, subangular, quartz/glauconite sand; 10% fine to medium, rounded, quartz gravel; light gray/green; single grain; loose; moist. permeameter samples at 7.6 to 8.1 feet
8.1 - 8.5 **31.7 - 31.3**	Gravelly Sand w/Silt: 70% fine, quartz/glauconite sand; 20% fine to medium, rounded, quartz gravel; 10% nonplastic fines; light gray; single grain; loose; moist.
8.5 - 9.0 **31.3 - 30.8**	Silty Sand w/Gravel: 65% fine, quartz/glauconite sand; 20% fine to medium, rounded, quartz gravel; 15% nonplastic fines; light gray; single grain; soft; moist.
9.0 - 10.6 **30.8 - 29.2**	Gravelly Sand: 60% coarse to very coarse, subangular, quartz sand; 40% fine to medium, rounded, quartz gravel; medium orange to dark red; single grain; loose; moist.
10.6 - 12.5 **29.2 - 27.3**	Sand: medium to coarse, subangular, quartz/glauconite sand; dark red; single grain; loose; moist.

12.5 - 12.8 **27.3 - 27.0**	Sand w/Silt and Clay: 90% fine to medium, subangular, quartz/glauconite sand; 10% slightly plastic fines; dark red; single grain; loose; moist.
12.8 - 14.3 **27.0 - 25.5**	Sand: fine to medium, subangular, quartz/glauconite sand; dark red; single grain; loose; moist. permeameter samples at 13.3 to 13.8 feet and 13.8 to 14.3 feet

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 3-4.2
Sampling Method: Backhoe and Hand Auger
Date: 7/16/2019

Grade Elev. (ft-msl): 39.1

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 1.0 **39.1 - 38.1**	Silty Sand w/Organic Material: 75% fine, subangular, quartz sand; 20% nonplastic fines; 5% organic material; dark gray; loose to slightly firm; moist.
1.0 - 2.9 **38.1 - 36.2**	Silty/Clayey Sand: 85% fine, subangular, quartz sand; 15% slightly plastic fines; medium gray/brown; single grain; loose to slightly firm; moist.
2.9 - 7.1 **36.2 - 32.0**	Sand w/Silt and Clay: 90% medium, subangular, quartz/glauconite sand; 10% slightly plastic fines; light gray and dark orange; single grain; firm; moist. permeameter samples at 6.9 to 7.1 feet
7.1 - 7.6 **32.0 - 31.5**	Sand w/Gravel: 90% coarse to very coarse, subangular, quartz/glauconite sand; 10% fine to medium, subrounded, quartz gravel; medium orange; single grain; loose; moist.
7.6 - 9.0 **31.5 - 30.1**	Gravelly Sand: 70% coarse to very coarse, subangular, quartz/glauconite sand; 30% fine to medium, subrounded, quartz gravel; light orange grading to light gray; single grain; loose; moist.
9.0 - 9.5 **30.1 - 29.6**	Silty Sand w/Gravel: 75% fine, quartz sand; 15% nonplastic fines; 10% fine, rounded, quartz gravel; light gray; single grain; soft; moist.
9.5 - 10.0 **29.6 - 29.1**	Silty Sand w/Gravel: 70% fine, quartz sand; 20% slightly plastic fines; 10% fine, rounded, quartz gravel; light gray; single grain; soft; moist.

10.0 - 10.7 **29.1 - 28.4**	Gravelly Sand: 60% coarse to very coarse, subangular, quartz sand; 40% fine to medium, rounded, quartz gravel; medium gray; single grain; loose; moist.
10.7 - 13.6 **28.4 - 25.5**	Sand: medium to coarse, subangular, quartz/glauconite sand; gray/green; single grain; loose; moist. permeameter samples at 12.6 to 13.1 feet and 13.1 to 13.6 feet

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 5.1
Sampling Method: Hand Auger
Date: 7/16/2019

Grade Elev. (ft-msl): 39.3

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 1.2 **39.3 - 38.1**	Sand w/Silt and Organic Material 80% very fine, micaceous, quartz sand; 10% nonplastic fines; 10% organic material; dark gray; single grain; loose; moist.
1.2 - 4.0 **38.1 - 35.3**	Silty/Clayey Sand: 75% fine to medium, subangular, quartz sand; 25% moderately plastic fines; medium orange; single grain; loose to slightly firm; moist.
4.0 - 8.5 **35.3 - 30.8**	Sand w/Gravel: 90% coarse to very coarse, subangular, quartz sand; 10% fine to medium, rounded, quartz gravel; trace, light gray, soft, clayey silt lenses; medium orange; single grain; loose; moist. permeameter samples at 4.3 feet.

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 5.2
Sampling Method: Backhoe
Date: 7/16/2019

Grade Elev. (ft-msl): 39.3

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 0.5 **39.3 - 38.8**	Silty Sand 80% very fine quartz sand; 15% moderately plastic fines; 5% organic material; dark brown; single grain; slightly firm; moist.
0.5 - 1.5 **38.8 - 37.8**	Silty Sand 85% very fine to fine quartz sand; 15% slightly plastic fines; medium brown; single grain; slightly firm; dry.
1.5 - 2.0 **37.8 - 37.3**	Clayey/Silty Sand 80% very fine to fine quartz sand; 20% moderately plastic fines; medium brown/tan; massive; firm; moist.
2.0 - 2.5 **37.3 - 36.8**	Sand w/Silt 90% fine quartz sand; 10% moderately plastic fines; medium brown/tan; single grain; loose; moist.
2.5 - 3.5 **36.8 - 35.8**	Sand 95% fine to medium quartz sand; 5% nonplastic fines; medium brown/tan; single grain; loose; moist.
3.5 - 4.0 **35.8 - 35.3**	Sand 100% fine to medium subrounded quartz sand; trace nonplastic fines; medium brownish/tan; single grain; loose; moist.
4.0 - 4.5 **35.3 - 34.8**	Sand w/Silt 90% fine to medium subrounded quartz sand; 10% nonplastic fines; traces of dark brown/dark grey clay; medium tan; single grain; loose; moist. permeameter samples at 4.3 feet.

4.5 - 5.0 **34.8 - 34.3**	Clayey/Silty Sand 80% very fine to fine quartz sand; 20% moderately plastic fines; medium brown/tan; single grain; loose; moist.

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 6.1
Sampling Method: Backhoe
Date: 7/16/2019

Grade Elev. (ft-msl): 38.0

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 1.0 **38.0 - 37.0**	Sand w/Silt and Organic Material: 85% very fine to fine, subangular, quartz sand; 10% nonplastic fines; 5% organic material; medium gray; single-grain; loose; moist.
1.0 - 2.5 **37.0 - 35.5**	Sand: 95% fine, subangular, quartz sand; 5% nonplastic fines; medium orange-gray; single grain; slightly hard; dry.
2.5 - 6.5 **35.5 - 31.5**	Sand: fine to medium, subangular, quartz sand; small gravel pocket (fill) at approx. 3.0 feet. medium orange; single grain; loose; moist; permeameter samples at 5.0 to 5.5 feet.
6.5 - 7.5 **31.5 - 30.5**	Sand w/Gravel: 90% coarse to very coarse, subangular, quartz sand; 10% fine to medium, rounded, quartz gravel; light orange; single grain; loose; moist.
7.5 - 9.5 **30.5 - 28.5**	Sand: medium to coarse, subangular, quartz/glauconite sand; dark orange; single grain; loose; moist.
9.5 - 11.0 **28.5 - 27.0**	Sand: medium to coarse, subangular, quartz/glauconite sand; light yellow gray; single grain; loose; moist.

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 6.2
Sampling Method: Backhoe
Date: 7/16/2019

Grade Elev. (ft-msl): 37.3

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 1.0 **37.3 - 36.3**	Sand w/Silt and Organic Material 80% fine, subangular, quartz sand; 10% nonplastic fines; 10% organic material, roots; medium brown; single-grain; loose; moist.
1.0 - 2.3 **36.3 - 35.0**	Sand w/Silt and Clay: 90% fine, subangular, quartz sand; 10% slightly plastic fines; medium orange-gray; single grain; firm; moist.
2.3 - 3.3 **35.0 - 34.0**	Silty/Clayey Sand: 85% fine, quartz sand; 15% moderately plastic fines; medium gray; massive; firm; moist.
3.3 - 4.1 **34.0 - 33.2**	Sand: 95% fine to medium, subangular, quartz sand; 5% slightly plastic fines; medium orange/green; single grain; loose; moist.
4.1 - 6.2 **33.2 - 31.1**	Sand grading to Sand w/Gravel: 90% grading to 85% medium to coarse grading to coarse to very coarse,subangular, quartz/glauconite sand; 5% nonplastic fines; 5% grading to 10% fine to medium, subrounded, quartz gravel; medium orange; single grain; loose; moist. permeameter samples at 4.3 to 4.8 feet.
6.2 - 9.0 **31.1 - 28.3**	Gravelly Sand: 85% coarse to very coarse, subangular, quartz/glauconite sand; 15% fine to coarse, rounded, quartz gravel; light to medium orange/green; single grain; loose; moist.
9.0 - 11.0 **28.3 - 26.3**	Sand: medium to coarse, subangular, quartz/glauconite sand; light yellow gray; single grain; loose; moist.

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 7.1
Sampling Method: Backhoe
Date: 7/16/2019

Grade Elev. (ft-msl): 38.2

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 1.9 **38.2 - 36.3**	Sand w/Silt and Organic Material 85% very fine to fine, subangular, quartz sand; 10% nonplastic fines; 5% organic material; medium gray; single-grain; loose; moist.
1.9 - 3.6 **36.3 - 34.6**	Sand: 95% fine, subangular, quartz sand; 5% nonplastic fines; medium orange-gray; single grain; slightly hard; dry.
3.6 - 5.8 **34.6 - 32.4**	Sand w/Gravel: 90% medium to coarse, subangular, quartz sand; 10% fine to medium, rounded, quartz gravel; light gray and medium orange-brown; single grain; loose; moist. permeameter samples at 5.7 feet.
5.8 - 11.0 **32.4 - 27.2**	Sand: medium, subangular, quartz/glauconite sand; light gray/green; single grain; loose; moist.

Notes:
No mottling;
No seepage.

Test Pit Log

Dwyer Geosciences, Inc.

Project No.: 717
Project: Monmouth University
Location: TP 7.2
Sampling Method: Backhoe
Date: 7/16/2019

Grade Elev. (ft-msl): 36.8

Depth (ft) Elevation (ft-msl)	Sample Description
0.0 - 2.2 **36.8 - 34.6**	Sand w/Silt and Organic Material 85% very fine to fine, subangular, quartz sand; 10% nonplastic fines; 5% organic material; medium gray; single-grain; loose; moist.
2.2 - 4.0 **34.6 - 32.8**	Sand: 95% fine, subangular, quartz sand; 5% nonplastic fines; medium orange-gray; single grain; slightly hard; dry.
4.0 - 6.0 **32.8 - 30.8**	Sand w/Gravel: 90% fine to medium grading to medium to coarse, subangular, quartz sand; 10% fine to medium, rounded, quartz gravel; medium orange; single grain; loose; moist. permeameter samples at 4.3 feet.
6.0 - 11.0 **30.8 - 25.8**	Sand: 95% medium to coarse, subangular, quartz/glauconite sand; 5% fine to medium, rounded, quartz gravel; light orange/green/gray; single grain; loose; moist.

Notes:
No mottling;
No seepage.

Table 1: Summary of Monmouth University Permeameter Testing

Location	Interval (ft)	K (ft/d)	K (in/hr)	Soil Type
TP1.1 A	5.0 - 5.5	3.8	1.9	medium to coarse, quartz/glauc. Sand
TP1.1 B	5.0 - 5.5	4.9	2.5	medium to coarse, quartz/glauc. Sand
TP1.2 A	6.7 - 7.2	2.9	1.5	medium to coarse, quartz/glauc. Sand
TP1.2 B	6.7 - 7.2	0.9	0.5	medium to coarse, quartz/glauc. Sand
TP2.1 A	10.8 - 11.3	0.0	0.1	medium quartz/glauc. sand and sand w/silt and clay
TP2.1B	10.8 - 11.3	7.5	14.9	medium quartz/glauc. sand and sand w/silt and clay
TP2.2A	9.2 - 9.7	0.6	1.3	medium quartz/glauc. sand and sand w/silt and clay
TP2.2B	9.2 - 9.7	0.3	0.6	medium quartz/glauc. sand and sand w/silt and clay
TP3-4.1 A	7.6 - 8.1	0.2	0.5	fine quartz/glauc. sand w/gravel
TP3-4.1 B	7.6 - 8.1	0.6	1.2	fine quartz/glauc. sand w/gravel
TP3-4.1 C	13.3 - 13.8	1.9	3.7	fine to medium quartz/glauc. Sand
TP3-4.1 D	13.8 - 14.3	9.7	19.4	fine to medium quartz/glauc. Sand
TP3-4.2 A	6.9 - 7.4	1.0	1.9	medium quartz/glauc. sand w/silt and clay
TP3-4.2 B	6.9 - 7.4	3.6	7.2	medium quartz/glauc. sand w/silt and clay
TP3-4.2 C	12.6 - 13.1	11.1	22.2	medium to coarse, quartz/glauc. Sand
TP3-4.2 D	13.1 - 13.6	24.4	48.8	medium to coarse, quartz/glauc. Sand
TP5.1 A	4.3 - 4.8	0.4	0.8	fine to medium quartz sand w/gravel
TP5.1 B	4.8 - 5.3			fine to medium quartz sand w/gravel
TP5.2 A	4.3 - 4.8	4.4	8.7	fine to medium quartz sand w/silt
TP5.2 B	4.3 - 4.8	4.5	9.0	fine to medium quartz sand w/silt
TP6.1	5.0 - 5.5	1.1	2.2	fine to medium quartz sand
TP6.2 A	4.3 - 4.8			medium to coarse quartz sand w/gravel
TP6.2 B	4.3 - 4.8			medium to coarse quartz sand w/gravel
TP7.1 A	5.7 - 6.1	33.2	66.5	medium to coarse quartz sand w/gravel
TP7.1 B	5.7 - 6.1	4.7	9.4	medium to coarse quartz sand w/gravel
TP7.2 A	4.3 - 4.8			fine to medium quartz sand w/gravel
TP7.2 B	4.3 - 4.8			fine to medium quartz sand w/gravel

K = hydraulic conductivity

Table 1: Summary of Monmouth University Permeameter Testing

Location	Interval (ft)	K (ft/d)	K (in/hr)	Soil Type	Comment	Recommendation
TP1.1 A	5.0 - 5.5	3.8	1.9	medium to coarse, quartz/glauc. Sand		
TP1.1 B	5.0 - 5.5	4.9	2.5	medium to coarse, quartz/glauc. Sand		
TP1.2 A	6.7 - 7.2	2.9	1.5	medium to coarse, quartz/glauc. Sand		
TP1.2 B	6.7 - 7.2	0.9	0.5	medium to coarse, quartz/glauc. Sand	sample has 5-10% silt/clay	resample
TP2.1 A	10.8 - 11.3	0.1	0.1	medium quartz/glauc. sand and sand w/silt and clay	sample has 5-10% silt/clay	resample
TP2.1B	10.8 - 11.3	14.9	7.5	medium quartz/glauc. sand and sand w/silt and clay		
TP2.2A	9.2 - 9.7	1.3	0.7	medium quartz/glauc. sand and sand w/silt and clay	overcompacted in lower 0,1 ft due to silt and clay content	no improvement after cleaning end of sample; resample
TP2.2B	9.2 - 9.7	0.6	0.3	medium quartz/glauc. sand and sand w/silt and clay	overcompacted due to silt and clay content	resample
TP3-4.1 A	7.6 - 8.1	0.5	0.3	fine quartz/glauc. sand w/gravel	5% silt/clay becomes gummy when wet	double ring test
TP3-4.1 B	7.6 - 8.1	1.2	0.6	fine quartz/glauc. sand w/gravel	5% silt/clay becomes gummy when wet	double ring test
TP3-4.1 C	13.3 - 13.8	3.7	1.9	fine to medium quartz/glauc. Sand		
TP3-4.1 D	13.8 - 14.3	19.4	9.7	fine to medium quartz/glauc. Sand		
TP3-4.2 A	6.9 - 7.4	5.6	2.8	medium quartz/glauc. sand w/silt and clay	overcompacted due to silt and clay content	results improved after cleaning end of sample
TP3-4.2 B	6.9 - 7.4	7.2	3.6	medium quartz/glauc. sand w/silt and clay		
TP3-4.2 C	12.6 - 13.1	22.2	11.1	medium to coarse, quartz/glauc. Sand		
TP3-4.2 D	13.1 - 13.6	48.8	24.4	medium to coarse, quartz/glauc. Sand		
TP5.1 A	4.3 - 4.8	0.8	0.4	fine to medium quartz sand w/gravel	overcompacted in lower 0,1 ft due to silt and clay content	no improvement after cleaning end of sample; double ring test
TP5.1 B	4.8 - 5.3	5.7	2.9	fine to medium quartz sand w/gravel		
TP5.2 A	4.3 - 4.8	8.7	4.4	fine to medium quartz sand w/silt		
TP5.2 B	4.3 - 4.8	9.0	4.5	fine to medium quartz sand w/silt		
TP6.1	5.0 - 5.5	2.2	1.1	fine to medium quartz sand		
TP6.2 A	4.3 - 4.8	0.4	0.2	medium to coarse quartz sand w/gravel	thin strata of 5 to 10% silt/clay	double ring test
TP6.2 B	4.3 - 4.8	0.2	0.1	medium to coarse quartz sand w/gravel	thin strata of 5 to 10% silt/clay	double ring test
TP7.1 A	5.7 - 6.1	66.5	33.3	medium to coarse quartz sand w/gravel		
TP7.1 B	5.7 - 6.1	9.4	4.7	medium to coarse quartz sand w/gravel		
TP7.2 A	4.3 - 4.8	0.4	0.2	fine to medium quartz sand w/gravel	thin strata of 5 to 10% silt/clay	double ring test
TP7.2 B	4.3 - 4.8	2.7	1.4	fine to medium quartz sand w/gravel		

K = hydraulic conductivity

Monmouth University Ground-Water Levels

					Soil Boring Obs.			5/21-23/19 Well/Piez Measurement		5/1/19 Well/Piez Measurement	
Date Drilled	Location	Stickup (ft)	Grade Elev. (ft-msl)	TOC Elev. (ft-msl)	Date	DTW (ft)	GW Elev. (ft-msl)	DTW (ft)	GW Elev. (ft-msl)	DTW (ft)	GW Elev. (ft-msl)
4/24/2019	B1	0.0	41.5	41.45	4/24/2019	19.5	22.0	19.83	21.62	20.07	21.38
4/24/2019	B2	-0.1	39.7	39.66	4/24/2019	16.3	23.4			17.55	22.11
4/24/2019	B3	0.0	37.7	37.72	4/24/2019	15.0	22.7				
4/25/2019	B4	1.0	#na	#na	4/25/2019	13.7	#na			13.25	#na
4/25/2019	B5	1.0	40.7	41.67	4/25/2019	18.0	22.7			19.82	21.85
4/24/2019	B6	-0.1	39.3	39.31	4/24/2019	17.0	22.3			16.79	22.52
4/23/2019	B7	-0.2	37.8	37.99	4/23/2019	15.0	22.8			15.27	22.72
4/25/2019	B8	1.7	40.3	41.94	4/25/2019	17.9	22.4			20.00	21.94
4/25/2019	B9	2.6	38.4	40.95	4/25/2019	15.0	23.4	17.45	23.50	17.45	23.50
4/23/2019	B10	0.3	37.5	37.78	4/23/2019	15.0	22.5			14.80	22.98
4/23/2019	B11	0.0	35.3	35.27	4/23/2019	9.4	25.9	10.96	24.31		
4/23/2019	B12	0.0	37.2	37.23	4/23/2019	15.0	22.2	13.89	23.34	13.89	23.34
4/25/2019	B13	0.8	24.6	25.45	4/25/2019	2.0	22.6				

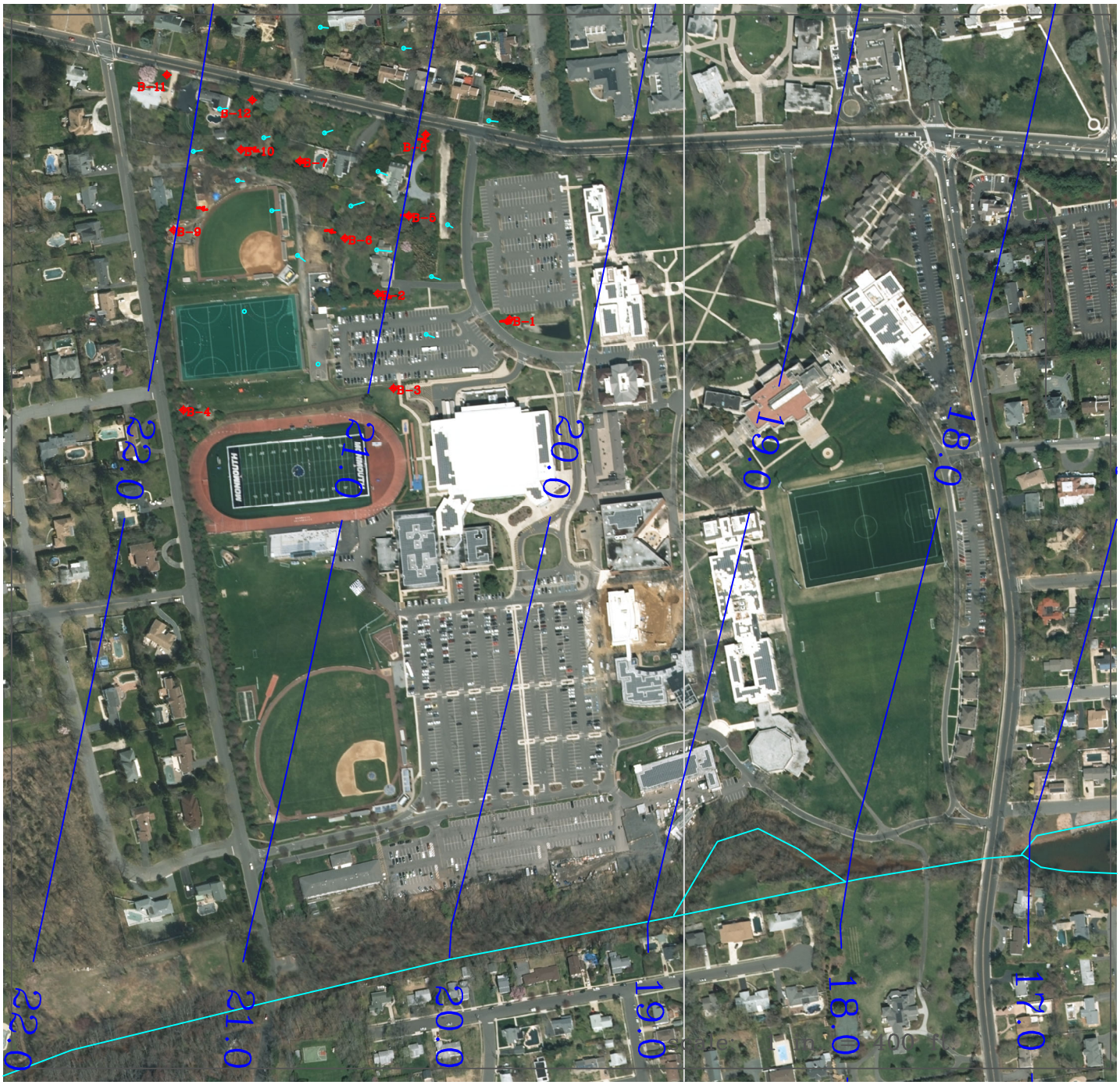

B-11
B-12
B-10
B-7
B-8
B-5
B-9
B-6
B-2
B-1
B-3
B-4
22.0
21.0
20.0
19.0
18.0
22.0
21.0
20.0
19.0
18.0
17.0

Table 2: Ground-Water Model Calibration

				6/12/19 GW Measurement		Model Simulation	
Location	**Stickup (ft)**	**Grade Elev. (ft-msl)**	**TOC Elev. (ft-msl)**	**DTW (ft)**	**GW Elev. (ft-msl)**	**GW Elev. (ft-msl)**	**Difference (ft)**
B1	-0.35	41.45	41.10	19.86	21.24	21.32	0.08
B2	-0.10	39.44	39.66	17.59	22.07	21.99	-0.08
B3	-0.45	37.72	37.27	15.50	21.77	21.82	0.05
B4	1.00	#na	#na	13.32	#na	#na	#na
B5	0.95	40.78	41.67	19.85	21.82	21.91	0.09
B6	-0.10	39.15	39.31	16.83	22.48	22.20	-0.28
B7	-0.20	37.69	37.99	15.29	22.70	22.47	-0.23
B8	1.65	40.16	41.94	20.01	21.93	21.91	-0.02
B9	2.60	38.13	40.95	17.50	23.45	22.99	-0.46
B10	0.30	37.43	37.78	14.83	22.95	22.75	-0.20
B11	-0.40	35.27	34.87	11.52	23.35	23.14	-0.21
B12	-0.45	37.23	36.78	13.92	22.86	22.74	-0.12
B13	0.82	24.58	25.45	4.07	21.38	21.59	0.21
						Mean (ft):	-0.10
						RMS Difference (ft):	0.21

GW = ground water
Elev. = elevation

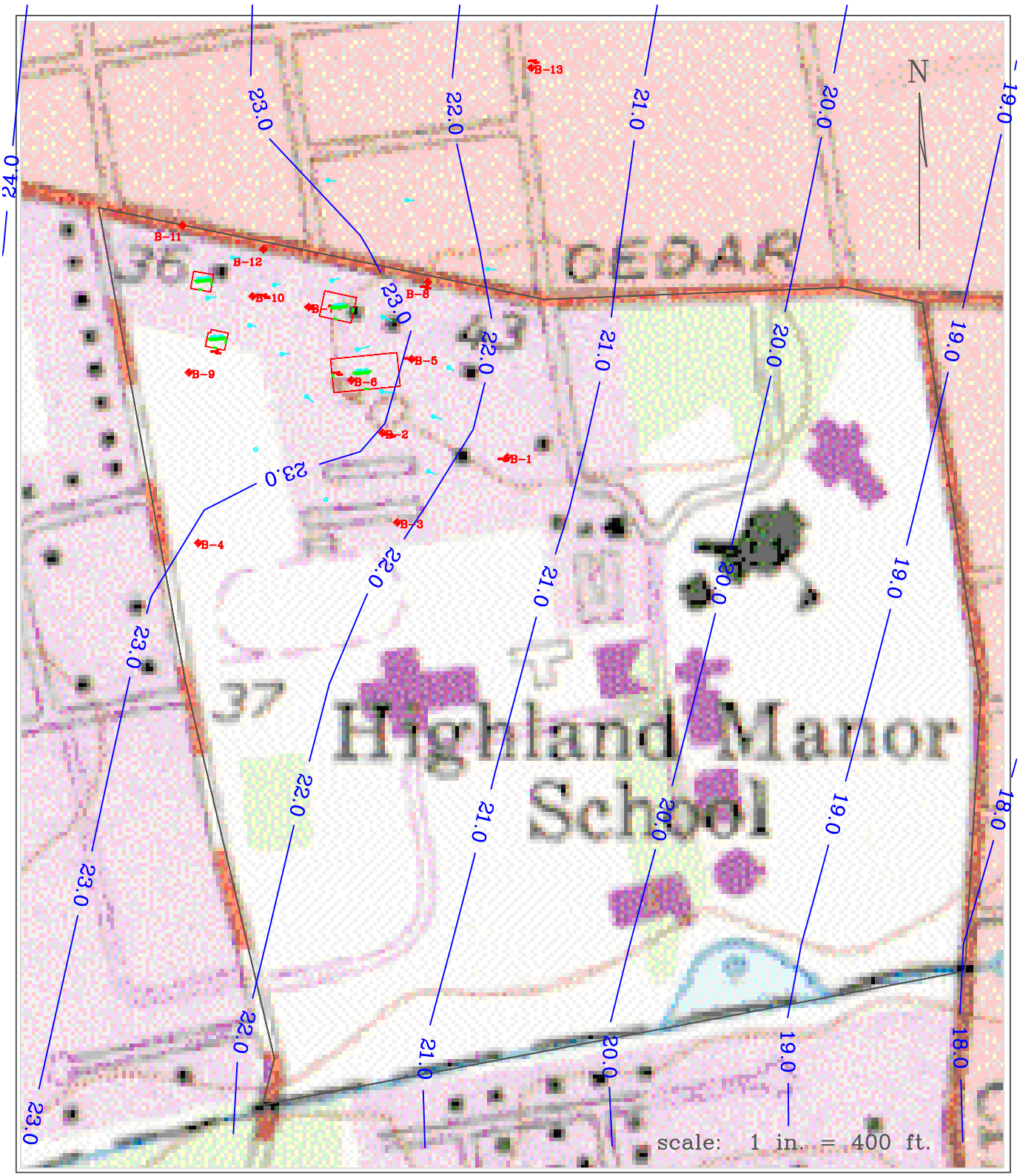


Figure #: Calculated Maximum Water-Table Elevation (ft-msl)

APPENDIX II.3

(Note: this appendix contains detailed tabulations from which subcatchment Runoff Curve Numbers and Times of Concentration were developed)

CATCHMENT E1.2-1(2): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(CONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc
(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T11

SEGMENT		FLOW TYPE			TRAVEL TIME					
From	To	Parameter	Value		Incr.				Cum.	
					(hrs)		(min)		(min)	
T1	T2	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	205	ft						
		Land Slope,s:	0.0039	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.269	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min	2.7	min
T2	T11	SHEET FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.024							
		Flow Length, L:	105	ft						
		2-Yr / 24-hr Precip, P:	2.25	in						
		Land Slope,s:	0.0225	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.045	hrs =	2.7	min	5.4	min
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.089	hrs =	5.4	min		

CATCHMENT E1.2-1(3): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION (CONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T3 - T4 -T16

SEGMENT		FLOW TYPE			TRAVEL TIME					
From	To	Parameter	Value		Incr.				Cum.	
					(hrs)		(min)		(min)	
T1	T2	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	205	ft						
		Land Slope,s:	0.0039	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.269	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min		
T2	T3	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	271	ft						
		Land Slope,s:	0.0041	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.302	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.058	hrs =	3.5	min	6.2	
T3	T4	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	227	ft						
		Land Slope,s:	0.0112	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	2.151	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.029	hrs =	1.8	min	7.9	
T4	T16	SHEET FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.011							
		Flow Length, L:	144	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.017	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.028	hrs =	1.7	min	9.6	
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.160	hrs =	9.6	min		

CATCHMENT E1.2-1(4): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION (CONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T3 - T4 -T5 - T6 - T19

SEGMENT		FLOW TYPE			TRAVEL TIME				
From	To	Parameter	Value		Incr. (hrs)		Incr. (min)		Cum. (min)
T1	T2	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	205	ft					
		Land Slope,s:	0.0039	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	1.269	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min	
T2	T3	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	271	ft					
		Land Slope,s:	0.0041	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	1.302	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.058	hrs =	3.5	min	6.2
T3	T4	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	227	ft					
		Land Slope,s:	0.0112	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	2.151	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.029	hrs =	1.8	min	7.9
T4	T5	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	181	ft					
		Land Slope,s:	0.0049	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	1.423	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.035	hrs =	2.1	min	10.0
T5	T6	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	64	ft					
		Land Slope,s:	0.005	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	1.437	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.012	hrs =	0.7	min	10.8
T6	T19	SHEET FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.011						
		Flow Length, L:	89	ft					
		2-Yr / 24-hr Precip, P:	3.5	in					
		Land Slope,s:	0.0215	ft/ft					
		By Eq. 3-1, Travel Time, T_t =			0.017	hrs =	1.0	min	
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.197	hrs =	11.8	min	
				=	11.8	min			

CATCHMENT E1.2-1(5): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(CONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc
(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T9 - T10 - T20

SEGMENT		FLOW TYPE			TRAVEL TIME				
From	To	Parameter	Value		Incr. (hrs)		Incr. (min)		Cum. (min)
T1	T9	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	159	ft					
		Land Slope,s:	0.0085	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	1.874	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.024	hrs =	1.4	min	
T9	T10	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	125	ft					
		Land Slope,s:	0.0063	ft/ft					
		By Appendix F, Equations							
		For Fig 3-1, Average							
		Velocity, V =	1.614	ft/sec					
		By Eq. 3-3, Travel Time, T_t =			0.022	hrs =	1.3	min	2.7
T10	T20	SHEET FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.011						
		Flow Length, L:	117	ft					
		2-Yr / 24-hr Precip, P:	3.5	in					
		Land Slope,s:	0.018	ft/ft					
		By Eq. 3-1, Travel Time, T_t =			0.023	hrs =	1.4	min	
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.068	hrs =	4.1	min	

SUBCATCHMENT **E_1.2-2(1)** - COMPOSITE RUNOFF CURVE NUMBER DETERMINATION:

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	(sf)	AREA A' (ac)	RUNOFF CURVE No. CN'	A x CN
N/A	BUILDING AREA, UNCONNECTED	175	0.004	98.00	0.394
	PAVED DRIVEWAY	0	0.000	98.00	0.000
	MISC. IMPERVIOUS SURFACE	161	0.004	98.00	0.362
A	BRICK PAVERS	0	0.000	83.00	0.000
	TIMBER DECK	0	0.000	83.00	0.000
	GRAVEL DRIVEWAY	0	0.000	76.00	0.000
	LAWN/LANDSCAPE:	20,029	0.460	39.00	17.932
B	BRICK PAVERS	0	0.000	89.00	0.000
	TIMBER DECK	0	0.000	89.00	0.000
	GRAVEL DRIVEWAY	0	0.000	85.00	0.000
	LAWN/LANDSCAPE:	0	0.000	61.00	0.000
	TOTAL	20,365	0.468		18.688
				Composite 'CN' =	40.0

CATCHMENT E1.2-2(1): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T9 - T10 - T29 - T30 - T31

SEGMENT		FLOW TYPE			TRAVEL TIME					
From	To	Parameter	Value		Incr.				Cum.	
					(hrs)		(min)		(min)	
T1	T9	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	159	ft						
		Land Slope,s:	0.0085	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.874	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.024	hrs =	1.4	min	1.4	min
T9	T10	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	125	ft						
		Land Slope,s:	0.0063	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.614	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.022	hrs =	1.3	min	9.4	
T10	T29	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	167	ft						
		Land Slope,s:	0.006	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.575	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.029	hrs =	1.8	min		
T29	T30	SHEET FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.024							
		Flow Length, L:	149	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0067	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.077	hrs =	4.6	min	9.1	min
T30	T31	SHEET FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.024							
		Flow Length, L:	68	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	1.18	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.005	hrs =	0.3	min	9.4	min
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.157	hrs =	9.4	min		

SUBCATCHMENT **E_1.2-2(2)** - COMPOSITE RUNOFF CURVE NUMBER DETERMINATION:

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	(sf)	AREA A' (ac)	RUNOFF CURVE No. CN'	A x CN
	BUILDING AREA, UNCONNECTED	2,839	0.065	98.00	6.387
	PAVED DRIVEWAY	0	0.000	98.00	0.000
	MISC. IMPERVIOUS SURFACE	25	0.001	98.00	0.056
A	BRICK PAVERS	978	0.022	83.00	1.863
	TIMBER DECK	356	0.008	83.00	0.678
	GRAVEL DRIVEWAY	9,148	0.210	76.00	15.961
	LAWN/LANDSCAPE:	64,527	1.481	39.00	57.772
B	BRICK PAVERS	647	0.015	89.00	1.322
	TIMBER DECK	0	0.000	89.00	0.000
	GRAVEL DRIVEWAY	0	0.000	85.00	0.000
	LAWN/LANDSCAPE:	5,964	0.137	61.00	8.352
	TOTAL	84,484	1.939		92.392
				Composite 'CN' =	47.6

CATCHMENT E1.2-2(2): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIME OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T9 - T21 - T22 - T23

SEGMENT		FLOW TYPE			INCR. TRAVEL TIME				CUM. TRAVEL TIME	
From	To	Parameter	Value							
T1	T9	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	159	ft						
		Land Slope,s:	0.0085	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.874	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.024	hrs =	1.4	min	1.4	min
T9	T21	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.05							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	191	ft						
		Land Slope,s:	0.0094	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	0.985	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.054	hrs =	3.2	min	4.6	min
T21	T22	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Unaved							
		Manning's 'n':	0.05							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	132	ft						
		Land Slope,s:	0.0015	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	0.394	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.093	hrs =	5.6	min	10.2	min
T22	T23	SHEET FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.024							
		Flow Length, L:	150	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.01	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.066	hrs =	3.9	min	14.2	min
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.236	hrs =	14.2	min		

SUBCATCHMENT **E_1.2-2(3)** - COMPOSITE RUNOFF CURVE NUMBER DETERMINATION:

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	(sf)	AREA A' (ac)	RUNOFF CURVE No. CN'	A x CN
	BUILDING AREA, UNCONNECTED	0	0.000	98.00	0.000
	PAVED DRIVEWAY	0	0.000	98.00	0.000
	MISC. IMPERVIOUS SURFACE	0	0.000	98.00	0.000
A	BRICK PAVERS	0	0.000	83.00	0.000
	TIMBER DECK	0	0.000	83.00	0.000
	GRAVEL DRIVEWAY	0	0.000	76.00	0.000
	LAWN/LANDSCAPE:	0	0.000	39.00	0.000
B	BRICK PAVERS	0	0.000	89.00	0.000
	TIMBER DECK	0	0.000	89.00	0.000
	GRAVEL DRIVEWAY	0	0.000	85.00	0.000
	LAWN/LANDSCAPE:	8,105	0.186	61.00	11.350
	TOTAL	8,105	0.186		11.350
				Composite 'CN' =	61.0

SUBCATCHMENT **E_1.2-2(4)** - COMPOSITE RUNOFF CURVE NUMBER DETERMINATION:

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER		AREA A' (ac)	RUNOFF CURVE No. CN'	A x CN
	BUILDING AREA, UNCONNECTED	2,887	0.066	98.00	6.495
	PAVED DRIVEWAY	0	0.000	98.00	0.000
	MISC. IMPERVIOUS SURFACE	442	0.010	98.00	0.994
A	BRICK PAVERS	96	0.002	83.00	0.183
	TIMBER DECK	0	0.000	83.00	0.000
	GRAVEL DRIVEWAY	0	0.000	76.00	0.000
	LAWN/LANDSCAPE:	3,453	0.079	39.00	3.092
B	BRICK PAVERS	371	0.009	89.00	0.758
	TIMBER DECK	0	0.000	89.00	0.000
	GRAVEL DRIVEWAY	0	0.000	85.00	0.000
	LAWN/LANDSCAPE:	13,622	0.313	61.00	19.076
	TOTAL	20,871	0.479		30.598
				Composite 'CN' =	63.9

CATCHMENT E1.2-2(4): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIME OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T24 - T25 - T26

SEGMENT		FLOW TYPE			INCR. TRAVEL TIME				CUM. TRAVEL TIME	
From	To	Parameter	Value							
T1	T2	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	205	ft						
		Land Slope,s:	0.0039	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.269	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min		min
T2	T24	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	178	ft						
		Land Slope,s:	0.0041	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.302	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.038	hrs =	2.3	min	5.0	min
T24	T25	SHEET FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.024							
		Flow Length, L:	47	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0323	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.016	hrs =	1.0	min	5.9	min
T25	T26	SHEET FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.024							
		Flow Length, L:	109	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0055	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.065	hrs =	3.9	min	9.8	min
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.164	hrs				

SUBCATCHMENT **E_1.2-3** - COMPOSITE RUNOFF CURVE NUMBER DETERMINATION:

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	(sf)	AREA A' (ac)	RUNOFF CURVE No. CN'	A x CN
N/A	BUILDING AREA, UNCONNECTED	6,316	0.145	98.00	14.210
	PAVED DRIVEWAY	0	0.000	98.00	0.000
	MISC. IMPERVIOUS SURFACE	3,589	0.082	98.00	8.074
A	BRICK PAVERS	0	0.000	83.00	0.000
	TIMBER DECK	0	0.000	83.00	0.000
	GRAVEL DRIVEWAY	3,869	0.089	76.00	6.750
	LAWN/LANDSCAPE:	19,831	0.455	39.00	17.755
B	BRICK PAVERS	458	0.011	89.00	0.936
	TIMBER DECK	980	0.022	89.00	2.002
	GRAVEL DRIVEWAY	2,982	0.068	85.00	5.819
	LAWN/LANDSCAPE:	132,495	3.042	61.00	185.542
	TOTAL	170,520	3.915		241.088
				Composite 'CN' =	61.6

CATCHMENT E1.2-3: PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIME OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T3 - T12 - T13 - T14 - T15 - T27 - T28

SEGMENT		FLOW TYPE			INCR. TRAVEL TIME				CUM. TRAVEL TIME	
From	To	Parameter	Value							
T1	T2	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	205	ft						
		Land Slope,s:	0.0039	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.269	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min		min
T2	T3	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	271	ft						
		Land Slope,s:	0.0041	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.302	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.058	hrs =	3.5	min	6.2	min
T3	T12	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.05							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	65	ft						
		Land Slope,s:	0.0148	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.237	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.015	hrs =	0.9	min	7.0	min
T12	T13	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.05							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	169	ft						
		Land Slope,s:	0.0059	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	0.781	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.060	hrs =	3.6	min	10.6	min
T13	T14	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Unpaved							
		Manning's 'n':	0.05							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	245	ft						
		Land Slope,s:	0.004	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								

		Velocity, V =	0.643	ft/sec							
		By Eq. 3-3, Travel Time, T_t =			0.106	hrs =	6.4	min	17.0	min	
T14	T15	SHALLOW CONCENTRATED FLOW									
		Surface Description:	Unpaved								
		Manning's 'n':	0.05								
		Hydraulic Radius, r:	0.2	ft							
		Flow Length, L:	179	ft							
		Land Slope,s:	0.0056	ft/ft							
		By Appendix F, Equations									
		For Fig 3-1, Average									
		Velocity, V =	0.761	ft/sec							
		By Eq. 3-3, Travel Time, T_t =			0.065	hrs =	3.9	min	20.9	min	
T15	T27	SHEET FLOW									
		Surface Description:	Unpaved								
		Manning's 'n':	0.024								
		Flow Length, L:	35	ft							
		2-Yr / 24-hr Precip, P:	3.5	in							
		Land Slope,s:	0.0286	ft/ft							
		By Eq. 3-1, Travel Time, T_t =			0.013	hrs =	0.8	min	21.7	min	
T27	T28	SHEET FLOW									
		Surface Description:	Unpaved								
		Manning's 'n':	0.024								
		Flow Length, L:	93	ft							
		2-Yr / 24-hr Precip, P:	3.5	in							
		Land Slope,s:	0.0097	ft/ft							
		By Eq. 3-1, Travel Time, T_t =			0.045	hrs =	2.7	min	24.5	min	
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.408	hrs		=	24.5	min	

SUBCATCHMENT **E_1.2-4** - COMPOSITE RUNOFF CURVE NUMBER DETERMINATION:

USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER		AREA A' (ac)	RUNOFF CURVE No. CN'	A x CN
	BUILDING AREA, UNCONNECTED	2,662	0.061	98.00	5.989
	PAVED DRIVEWAY	0	0.000	98.00	0.000
	MISC. IMPERVIOUS SURFACE	36	0.001	98.00	0.081
A	BRICK PAVERS	0	0.000	83.00	0.000
	TIMBER DECK	0	0.000	83.00	0.000
	GRAVEL DRIVEWAY	0	0.000	76.00	0.000
	LAWN/LANDSCAPE	0	0.000	39.00	0.000
B	BRICK PAVERS	165	0.004	89.00	0.337
	TIMBER DECK	370	0.008	89.00	0.756
	GRAVEL DRIVEWAY	7,807	0.179	85.00	15.234
	LAWN/LANDSCAPE	33,453	0.768	61.00	46.846
	TOTAL	44,493	1.021		69.244
				Composite 'CN' =	67.8

CATCHMENT E1.2-4: PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T3 - T4 - T5 - T17 - T18

SEGMENT		FLOW TYPE			TRAVEL TIME					
From	To	Parameter	Value		Incr.				Cum.	
T1	T2	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	205	ft						
		Land Slope,s:	0.0039	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.269	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min	2.7	min
T2	T3	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	271	ft						
		Land Slope,s:	0.0041	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.302	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.058	hrs =	3.5	min	6.2	min
T3	T4	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	227	ft						
		Land Slope,s:	0.0112	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	2.151	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.029	hrs =	1.8	min	7.9	min
T4	T5	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	181	ft						
		Land Slope,s:	0.0049	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.423	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.035	hrs =	2.1	min	10.0	min
T5	T17	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Gravel							
		Manning's 'n':	0.05							
		Flow Length, L:	99	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0125	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.078	hrs =	4.7	min	14.7	min

T17	T18	SHEET FLOW								
		Surface Description:	Gravel							
		Manning's 'n':	0.011							
		Flow Length, L:	150	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0055	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.045	hrs =	2.7	min	17.4	min
TIME OF CONCENTRATION, Tc = $\sum T_t$ =					0.290	hrs =	17.4	min		

CATCHMENT E1.2-5: PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T3 - T4 - T5 - T6 - T7 - T8

SEGMENT		FLOW TYPE			TRAVEL TIME					
From	To	Parameter	Value		Incr.				Cum.	
T1	T2	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	205	ft						
		Land Slope,s:	0.0039	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.269	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7	min	2.7	min
T2	T3	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	271	ft						
		Land Slope,s:	0.0041	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.302	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.058	hrs =	3.5	min	6.2	min
T3	T4	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	227	ft						
		Land Slope,s:	0.0112	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	2.151	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.029	hrs =	1.8	min	7.9	min
T4	T5	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	181	ft						
		Land Slope,s:	0.0049	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								
		Velocity, V =	1.423	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.035	hrs =	2.1	min	10.0	min
T5	T6	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Hydraulic Radius, r:	0.2	ft						
		Flow Length, L:	64	ft						
		Land Slope,s:	0.005	ft/ft						
		By Appendix F, Equations								
		For Fig 3-1, Average								

		Velocity, V =	1.437	ft/sec						
		By Eq. 3-3, Travel Time, T_t =			0.012	hrs =	0.7	min	10.8	min
T6	T7	SHALLOW CONCENTRATED FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.025							
		Flow Length, L:	57	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0028	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.052	hrs =	3.1	min	13.9	min
T7	T8	SHEET FLOW								
		Surface Description:	Paved							
		Manning's 'n':	0.011							
		Flow Length, L:	149	ft						
		2-Yr / 24-hr Precip, P:	3.5	in						
		Land Slope,s:	0.0033	ft/ft						
		By Eq. 3-1, Travel Time, T_t =			0.055	hrs =	3.3	min	17.2	min
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.286	hrs =	17.2	min		

APPENDIX II.4

(Note: this appendix contains summary tabulations of all precipitation events for all pre-development subcatchments)

Events for Subcatchment E1.2-1(1): Connected Impervious - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.27	0.022	2.67
2-Year	3.30	0.31	0.025	3.07
5-Year	4.40	0.42	0.034	4.16
10-Year	5.20	0.49	0.041	4.96
25-Year	6.50	0.62	0.052	6.26
50-Year	7.70	0.73	0.062	7.46
100-Year	**8.90**	**0.84**	**0.071**	**8.66**
NJWQDS	1.25	0.29	0.009	1.03

Events for Subcatchment E1.2-1(2): Connected Impervious - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.30	0.025	2.67
2-Year	3.30	0.35	0.028	3.07
5-Year	4.40	0.47	0.039	4.16
10-Year	5.20	0.55	0.046	4.96
25-Year	6.50	0.69	0.058	6.26
50-Year	7.70	0.82	0.069	7.46
100-Year	**8.90**	**0.95**	**0.080**	**8.66**
NJWQDS	1.25	0.32	0.010	1.03

Events for Subcatchment E1.2-1(3): Connected Impervious - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.25	0.023	2.67
2-Year	3.30	0.29	0.027	3.07
5-Year	4.40	0.38	0.036	4.16
10-Year	5.20	0.46	0.043	4.96
25-Year	6.50	0.57	0.054	6.26
50-Year	7.70	0.68	0.065	7.46
100-Year	**8.90**	**0.78**	**0.075**	**8.66**
NJWQDS	1.25	0.27	0.009	1.03

Events for Subcatchment E1.2-1(4): Connected Impervious - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.08	0.008	2.67
2-Year	3.30	0.09	0.009	3.07
5-Year	4.40	0.13	0.013	4.16
10-Year	5.20	0.15	0.015	4.96
25-Year	6.50	0.19	0.019	6.26
50-Year	7.70	0.22	0.023	7.46
100-Year	**8.90**	**0.26**	**0.027**	**8.66**
NJWQDS	1.25	0.09	0.003	1.03

Events for Subcatchment E1.2-1(5): Connected Impervious - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.23	0.018	2.67
2-Year	3.30	0.26	0.021	3.07
5-Year	4.40	0.35	0.029	4.16
10-Year	5.20	0.41	0.034	4.96
25-Year	6.50	0.52	0.043	6.26
50-Year	7.70	0.61	0.052	7.46
100-Year	**8.90**	**0.71**	**0.060**	**8.66**
NJWQDS	1.25	0.24	0.007	1.03

Events for Subcatchment E1.2-2(1): Unconnected / Composite

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.00	0.000	0.00
2-Year	3.30	0.00	0.000	0.01
5-Year	4.40	0.01	0.005	0.12
10-Year	5.20	0.03	0.011	0.28
25-Year	6.50	0.15	0.026	0.66
50-Year	7.70	0.37	0.044	1.12
100-Year	**8.90**	**0.65**	**0.065**	**1.67**
NJWQDS	1.25	0.00	0.000	0.00

Events for Subcatchment E1.2-2(2): Unconnected / Composite

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.01	0.008	0.05
2-Year	3.30	0.03	0.017	0.11
5-Year	4.40	0.24	0.062	0.38
10-Year	5.20	0.68	0.107	0.66
25-Year	6.50	1.69	0.200	1.24
50-Year	7.70	2.83	0.302	1.87
100-Year	**8.90**	**4.11**	**0.417**	**2.58**
NJWQDS	1.25	0.00	0.000	0.00

Events for Subcatchment E1.2-2(3): Unconnected / Composite

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.04	0.005	0.33
2-Year	3.30	0.08	0.008	0.49
5-Year	4.40	0.20	0.016	1.02
10-Year	5.20	0.31	0.023	1.49
25-Year	6.50	0.51	0.036	2.35
50-Year	7.70	0.70	0.050	3.22
100-Year	**8.90**	**0.91**	**0.064**	**4.14**
NJWQDS	1.25	0.00	0.000	0.00

Events for Subcatchment E1.2-2(4): Unconnected / Composite

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.14	0.017	0.43
2-Year	3.30	0.24	0.024	0.61
5-Year	4.40	0.55	0.048	1.21
10-Year	5.20	0.81	0.068	1.71
25-Year	6.50	1.27	0.105	2.63
50-Year	7.70	1.72	0.141	3.54
100-Year	**8.90**	**2.20**	**0.180**	**4.51**
NJWQDS	1.25	0.00	0.000	0.00

Events for Subcatchment E1.2-3: Unconnected / Composite - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.32	0.088	0.27
2-Year	3.30	0.65	0.134	0.41
5-Year	4.40	2.01	0.297	0.91
10-Year	5.20	3.25	0.440	1.35
25-Year	6.50	5.54	0.706	2.17
50-Year	7.70	7.88	0.980	3.00
100-Year	**8.90**	**10.37**	**1.273**	**3.90**
NJWQDS	1.25	0.00	0.000	0.00

Events for Subcatchment E1.2-4: Unconnected / Composite - MU

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.39	0.049	0.58
2-Year	3.30	0.57	0.067	0.79
5-Year	4.40	1.16	0.125	1.47
10-Year	5.20	1.63	0.172	2.02
25-Year	6.50	2.47	0.256	3.01
50-Year	7.70	3.29	0.339	3.98
100-Year	**8.90**	**4.13**	**0.426**	**5.00**
NJWQDS	1.25	0.03	0.002	0.02

Events for Subcatchment E1.2-5: MU Lawn/Landscape Area

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.04	0.007	0.33
2-Year	3.30	0.07	0.010	0.49
5-Year	4.40	0.18	0.021	1.02
10-Year	5.20	0.28	0.031	1.49
25-Year	6.50	0.46	0.049	2.35
50-Year	7.70	0.64	0.067	3.22
100-Year	**8.90**	**0.84**	**0.086**	**4.14**
NJWQDS	1.25	0.00	0.000	0.00

E1.2-2(3)
AREA = 8,105± s.f.
= 0.186± ac
CN = 61.0
Tc = 6± min

E1.2-1(1)
AREA = 4,312± sf
= 0.099± acres
CN = 98
Tc = 6.0 min

E1.2-1(2)
AREA = 4,852± sf
= 0.111± acres
CN = 98
Tc = 6.0 min

E1.2-2(4)
AREA = 20,871± s.f.
= 0.479± ac
CN = 63.9
Tc = 9.8± min

E1.2-3
AREA = 170,520± s.f.
= 3.915± ac
CN = 61.6
Tc = 24.5± min

E1.2-1(3)
AREA = 4,511± sf
= 0.104± acres
CN = 98
Tc = 9.6 min

E1.2-4
AREA = 44,493± s.f.
= 1.021± ac
CN = 67.8
Tc = 17.4± min

E1.2-1(4)
AREA = 1,598± sf
= 0.037± acres
CN = 98
Tc = 11.8 min

E1.2-5
Atotal = 10,909± s.f.
= 0.250± ac
CN = 61
Tc = 17.2± min

E1.2-2(2)
AREA = 84,484 s.f.
= 1.939± ac
CN = 47.6
Tc = 14.2± min

E1.2-1(5)
AREA = 3,602± sf
= 0.083± acres
CN = 98
Tc = 6.0 min

E1.2-2(1)
AREA = 20,365± s.f.
= 0.468± ac
CN = 40.0
Tc = 9.4± min

IAP
T1 t = 0.0 min 33.85
T2 t = 2.7 min 34.64
T3 t = 6.2 min 36.58
T4 t = 7.9 min 38.29
T5 t = 10.0 min 39.17
T6 t = 10.8 min 39.49
T7 t = 13.9 min 39.65
T8 t = 17.2 min 40.14
T8' t = 15.8 min 43.0
T9 t = 1.4 min 35.2
T10 t = 2.7 min 35.99
T11 t = 5.4 min 37.0
T12 t = 7.0 min 37.0
T13 t = 10.6 min 38.0
T14 t = 17.0 min 39.0
T15 t = 20.9 min 40.0
T16 t = 9.6 min 40.90
T17 t = 14.7 min 40.86
T18 t = 17.4 min 41.67
T19 t = 11.8 min
T20 t = 4.1 min 38.1
T21 t = 4.6 min 37.0
T22 t = 10.2 min 37.2
T23 t = 14.2 min 38.7
T24 t = 5.0 min 35.97
T25 t = 5.9 min 36.0
T26 t = 9.8 min 37.6
T27 t = 21.7 min 41.0
T28 t = 24.5 min 41.9
T29 t = 4.5 min 37.00
T30 t = 9.1 min 38.0
T31 t = 9.4 min 38.8

HSG 'A' SOILS (2.952± Acres)
HSG 'B' SOILS (5.732± Acres)
HSG BOUNDARY (TYP.)
TRAVEL TIME ANALYSIS POINT (TYP.)
CONCENTRATION TIME FLOW PATH (TYP.)
DESIGNTES IMPERVIOUS AREA DIRECTLY CONNECTED TO ADJACENT STREET GUTTER (TYP.)
— DENOTES EXISTING POLE-MOUNTED AREA LIGHT (TYP.)

ELMWOOD AVENUE (RAPTOR ROUTE)
CEDAR AVENUE (A.K.A. NJ&S1 ROUTE NO. 71) (RAPTOR ROUTE)
PINEWOOD AVENUE (RAPTOR ROUTE)
LARCH ROAD
BLOCK 39
BLOCK 41
BLOCK 36
BLOCK 38
SOFTBALL FIELD
BATTING CAGE
FIELD HOCKEY TURF FIELD
EXIST. 1-STORY RESTROOM BLDG.
EXISTING 1-STORY BUILDING
EXISTING 3-STORY "McALLEN HALL" ACADEMIC BUILDING

0 20 40 80 120 160 200
GRAPHIC SCALE

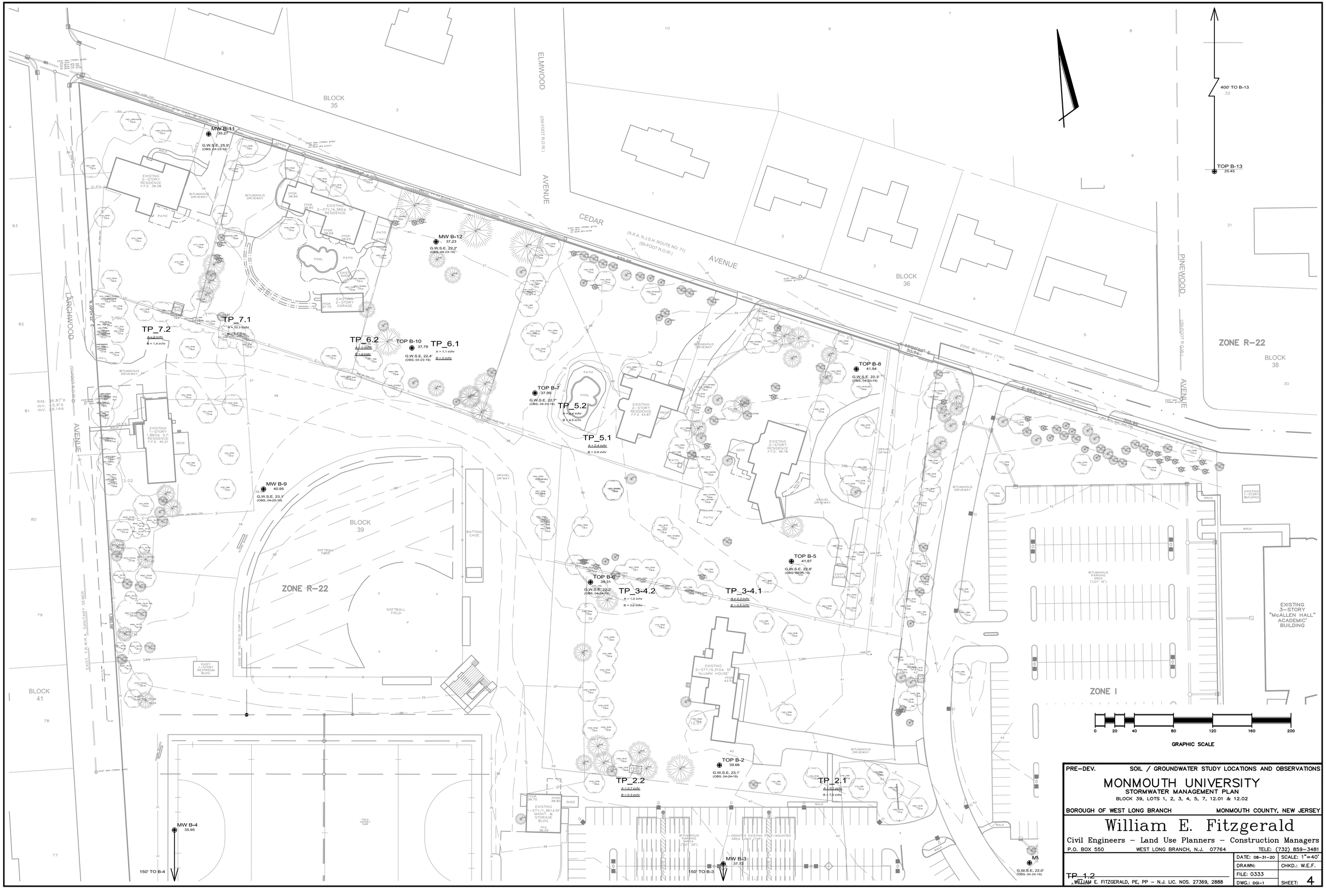
PRE-DEV. M.U. SUBCATCHMENTS DRAINING TO IMPACT ANALYSIS PT. "IAP"

MONMOUTH UNIVERSITY
STORMWATER MANAGEMENT PLAN
BLOCK 39, LOTS 1, 2, 3, 4, 5, 7, 12.01 & 12.02

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald
Civil Engineers – Land Use Planners – Construction Managers
P.O. BOX 550 WEST LONG BRANCH, N.J. 07764 TELE: (732) 859-3481
WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 2888

DATE: 08-31-20	SCALE: 1"=40'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	
DWG.: SWM-3	SHEET: 3



PRE-DEV. SOIL / GROUNDWATER STUDY LOCATIONS AND OBSERVATIONS

MONMOUTH UNIVERSITY

STORMWATER MANAGEMENT PLAN

BLOCK 39, LOTS 1, 2, 3, 4, 5, 7, 12.01 & 12.02

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald

Civil Engineers – Land Use Planners – Construction Managers

P.O. BOX 550 WEST LONG BRANCH, N.J. 07764 TELE: (732) 859-3481

WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 2888

DATE: 08-31-20	SCALE: 1"=40'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	
DWG.: DGI-1	SHEET: 4

STORMWATER MANAGEMENT REPORT – III

POST-DEVELOPMENT CATCHMENT / SUBCATCHMENT ANALYSES

To Accompany

LAND USE APPLICATION FOR 'D' AND 'C' VARIANCES AND PRELIMINARY & FINAL MAJOR SITE PLAN APPROVALS

Upon

Block 39, Lots 1, 2, 3, 4, 5, 7, 8, 9, 11, 12.01 & 12.02

Within The

Borough of West Long Branch, Monmouth County, Nj

Prepared For

MONMOUTH UNIVERSITY

By

William E. Fitzgerald, P.E.
P.O. Box 550
West Long Branch, New Jersey 07764

E-mail: wfitz@wef-pe.com

September 10, 2020

C O N T E N T S

POST-DEVELOPMENT STORMWATER MANAGEMENT OVERVIEW

The 8.847±acre post-development Campus catchment area draining to the Cedar / Larchwood intersection (impact analysis point IAP) is illustrated upon drawing "SWM-4." This catchment consists of two (2) types of subcatchments:

1. subcatchment areas along the perimeter of the proposed development which directly abut adjacent streets and for which the soil cover complex remains unchanged, or contains slightly less impervious coverage, under post-development conditions; and,

2. subcatchment areas for which the soil cover complex will be substantially changed by project improvements and for which post-development runoff is collected and managed to mitigate water quality and quantity impacts of the development.

Subcatchments of the first category are designated P1.2-2(1), P1.2-1(5), P1.2-2(2), E1.2-1(1), P1.2-2(3), P1.2-3(1), P1.2-3(2), P1.2-3(3), E1.2-1(4) and E1.3-5.

Subcatchments of the latter category are referred to as "Stormwater Management Areas" ('SWMA') and are designated SWMA #3, SWMA #4, SWMA #5, SWMA #6 and SWMA #7 upon drawing SWM-4.

As noted in part 'I' of this Report, the development plan includes (1) a drainage conveyance system connecting each of the internal "Stormwater Management Areas" with the existing State and Municipal drainage system at the corner of Cedar and Larchwood Avenues; as well as, (2) an individual drainage collection and stormwater management system for each "Stormwater Management Area."

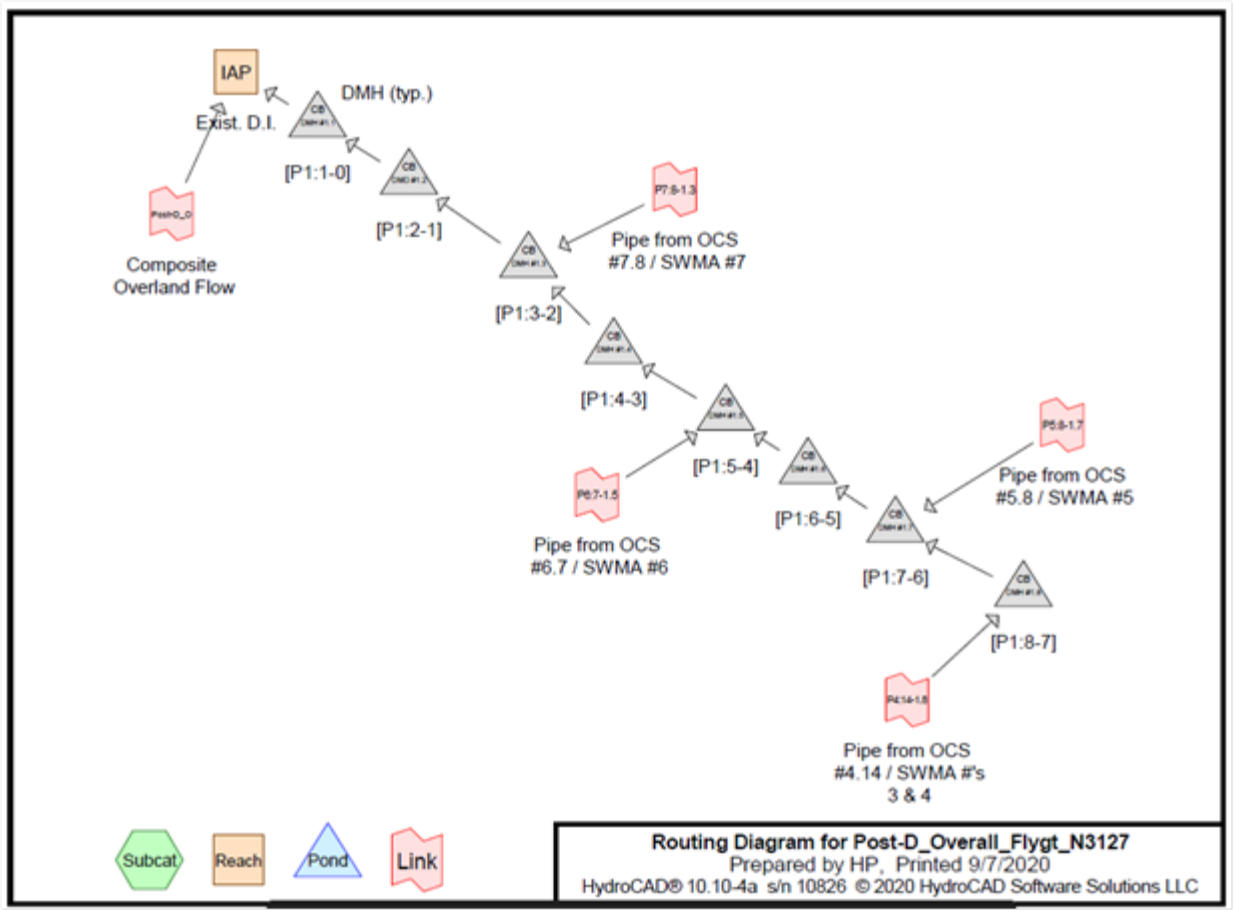
Following is a summary tabulation of post-development subcatchment hydrologic properties:

SUMMARY TABLE: POST-DEVELOPMENT DRAINAGE & SWMA HYDROLOGIC PARAMETERS

PARAMETER	SUBCATCHMENT AREAS DRAINING OVERLAND TO CEDAR/LARCHWOOD INTERSECTION									
NAME	E1.2-1(1)	P1.2-2(3)	P1.2-3(1)	P1.2-3(2)	P1.2-3(3)	E1.2-1(4)	E1.2-5	P1.2-2(2)	P1.2-1(5)	P1.2-2(1)
AREA (ac)	0.099	0.755	0.523	0.373	0.182	0.037	0.250	0.692	0.016	0.458
CN	98.0	57.3	61.0	61.0	61.0	98.0	61.0	50.0	98.0	41.6
T_c (min)	6.0	10.8	9.8	10.0	14.0	11.9	17.2	6.0	6.0	11.5

PARAMETER	POST-D STORMWATER MANAGEMENT AREAS				
NAME	SWMA #3	SWMA #4	SWMA #5	SWMA #6	SWMA #7
AREA (ac)	1.610	1.476	1.252	0.491	0.674
CN	84.9	92.4	82.9	98.0	84.7
T_c (min)	6.0	6.0	6.0	6.0	6.0

Detailed tabulations for development of subcatchment Runoff Curve Numbers and Times of Concentration are provided in Appendix III.1 of this report. The model utilized for evaluation of post-development subcatchment is:



The 'spine' of the model is the stormwater conveyance system that will be constructed to collect runoff discharges from the project Stormwater Management Areas and convey them to the the existing drainage system at the southeasterly corner of the Cedar / Larchwood intersection (i.e., the Impact Analysis Point, 'IAP'). The overland flow 'link' is the composite hydrograph that obtains from the hydrograph superposition model for the ten (10) overland flow subcatchments that is illustrated upon the following page.

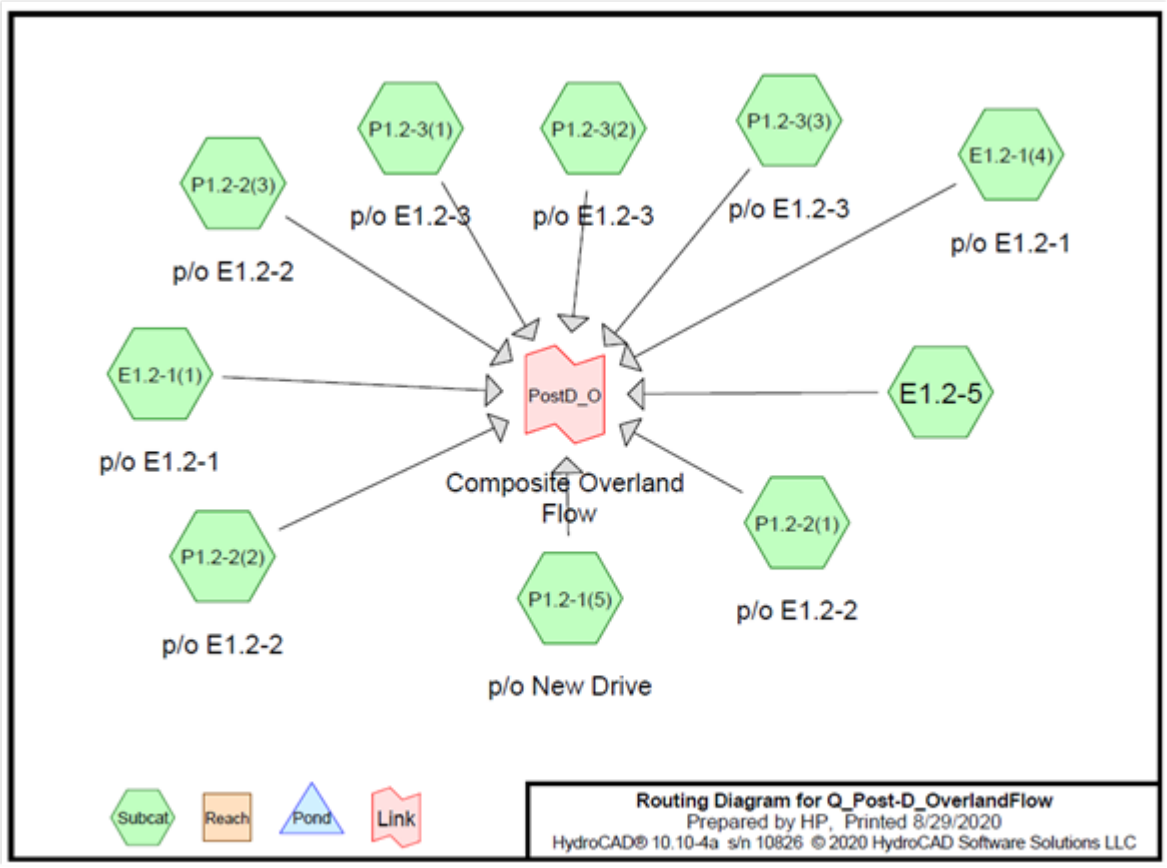
The five (5) Stormwater Management Area subcatchments (SWMA) have the same routing logic a typical illustration of which is also provided upon the following page and described as follows:

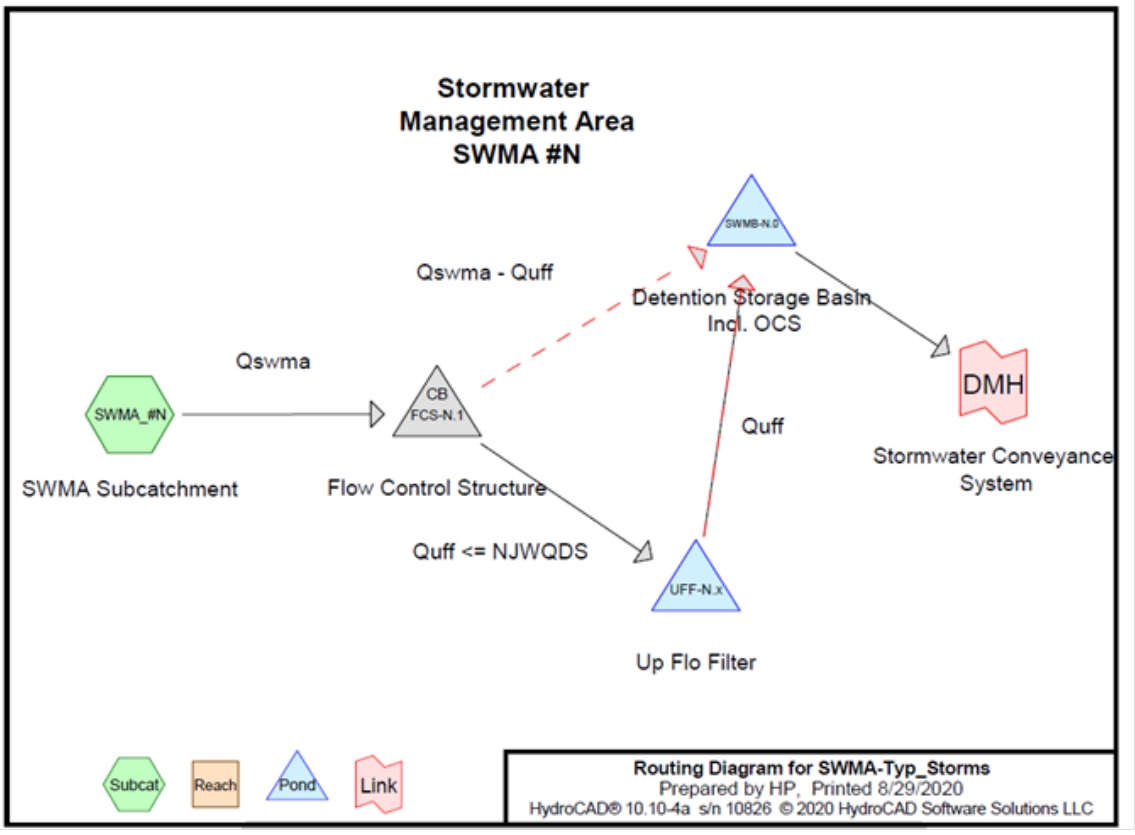
- - each SWMA has a dedicated runoff collection system;

- - collected runoff enters a Flow Control Structure (FCS) which sends flows less than or equal to that of the NJWQS flow rate for the subcatchment, via a Hydro Brake Optimum control device, to an UpFlo Filter MTD installation to remove 80% of TSS before discharging into the subsurface Stormwater Management Storage Bed (SWMB) for the SWMA;

- - flow rates greater that of the NJWQS rate for the subcatchment are diverted, via a weir, directly to the SWMB;

- - discharge from the SWMB is controlled by an Outlet Control Structure (OCS) prior to discharge into a downstream stormwater conveyance system manhole.


P1.2-3(1)
P1.2-3(2)
P1.2-3(3)
E1.2-1(4)
P1.2-2(3)
p/o E1.2-3
p/o E1.2-3
p/o E1.2-3
p/o E1.2-1
p/o E1.2-2
E1.2-1(1)
PostD_O
E1.2-5
p/o E1.2-1
Composite Overland Flow
P1.2-2(1)
P1.2-2(2)
P1.2-1(5)
p/o E1.2-2
p/o E1.2-2
p/o New Drive
Subcat
Reach
Pond
Link
Routing Diagram for Q_Post-D_OverlandFlow
Prepared by HP, Printed 8/29/2020
HydroCAD® 10.10-4a s/n 10826 © 2020 HydroCAD Software Solutions LLC


Stormwater
Management Area
SWMA #N
SWMB-N.0
Qswma - Quff
Detention Storage Basin
Incl. OCS
Qswma
DMH
SWMA_#N
CB
FCS-N.1
Quff
Stormwater Conveyance
System
SWMA Subcatchment
Flow Control Structure
Quff <= NJWQDS
UFF-N.x
Up Flo Filter
Subcat
Reach
Pond
Link
Routing Diagram for SWMA-Typ_Storms
Prepared by HP, Printed 8/29/2020
HydroCAD® 10.10-4a s/n 10826 © 2020 HydroCAD Software Solutions LLC

The following summary tabulation lists peak post-development flow rates to Impact Analysis Point IAP from the overland and SWMA subcatchment hydrographs as well as the peak flows of the composite hydrograph.

IMPACT ANALYSIS POINT, IAP: POST-DEVELOPMENT PEAK FLOWS

EVENT	OVERLAND FLOW HYDROGRAPH	HYDRPGRAPH FROM SWMA's	COMPOSITE HYDROGRAPH
	(cfs)	(cfs)	(cfs)
NJWQDS	0.42	0.21	0.59
1-Year	0.53	0.22	0.75
2-Year	0.85	0.22	1.07
5-Year	2.19	0.44	2.39
10-Year	3.44	0.82	3.65
25-Year	5.91	4.07	7.67
50-Year	8.49	5.56	12.67
100-Year	11.26	7.62	17.32

SUBCATCHMENT HYDROLOGY/HYDRAULICS; DETAILED ANALYSES

Analyses of post-development subcatchment hydrologies and hydraulics are provided in the appendices to this section of the Stormwater Management Report. These analyses include detailed information regarding Runoff Curve Number and Time of Concentration determinations, runoff hydrograph flow rates for a number of precipitation events, Flow Control Structures, water quality MTD's, elevation-storage functions for subsurface stormwater storage beds, elevation-discharge functions for outflow control structures and hydrograph routings.

APPENDIX III.1

(Note: this appendix contains detailed tabulations from which post-development subcatchment Runoff Curve Numbers and Times of Concentration were developed
- - post-development subcatchments which are unchanged from pre-development conditions have retained their identities and are tabulated within Appendix II.1)

CATCHMENT E1.2-1(4): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(CONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T3 - T4 -T5 - T6 - T19

SEGMENT		FLOW TYPE			TRAVEL TIME		
From	To	Parameter	Value				
T1	T2	SHALLOW CONCENTRATED FLOW					
		Surface Description:	Paved				
		Manning's 'n':	0.025				
		Hydraulic Radius, r:	0.2	ft			
		Flow Length, L:	205	ft			
		Land Slope,s:	0.0039	ft/ft			
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.269	ft/sec			
		By Eq. 3-3, Travel Time, T_t =			0.045	hrs =	2.7
T2	T3	SHALLOW CONCENTRATED FLOW					
		Surface Description:	Paved				
		Manning's 'n':	0.025				
		Hydraulic Radius, r:	0.2	ft			
		Flow Length, L:	272	ft			
		Land Slope,s:	0.004	ft/ft			
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.286	ft/sec			
		By Eq. 3-3, Travel Time, T_t =			0.059	hrs =	3.5
T3	T4	SHALLOW CONCENTRATED FLOW					
		Surface Description:	Paved				
		Manning's 'n':	0.025				
		Hydraulic Radius, r:	0.2	ft			
		Flow Length, L:	227	ft			
		Land Slope,s:	0.0113	ft/ft			
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	2.161	ft/sec			
		By Eq. 3-3, Travel Time, T_t =			0.029	hrs =	1.8
T4	T5	SHALLOW CONCENTRATED FLOW					
		Surface Description:	Paved				
		Manning's 'n':	0.025				
		Hydraulic Radius, r:	0.2	ft			
		Flow Length, L:	181	ft			
		Land Slope,s:	0.0049	ft/ft			
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.423	ft/sec			
		By Eq. 3-3, Travel Time, T_t =			0.035	hrs =	2.1
T5	T6	SHALLOW CONCENTRATED FLOW					
		Surface Description:	Paved				
		Manning's 'n':	0.025				
		Hydraulic Radius, r:	0.2	ft			
		Flow Length, L:	64	ft			
		Land Slope,s:	0.005	ft/ft			
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.437	ft/sec			
		By Eq. 3-3, Travel Time, T_t =			0.012	hrs =	0.7
T6	T19	SHEET FLOW					
		Surface Description:	Paved				
		Manning's 'n':	0.011				
		Flow Length, L:	89	ft			
		2-Yr / 24-hr Precip, P:	3.5	in			
		Land Slope,s:	0.0215	ft/ft			
		By Eq. 3-1, Travel Time, T_t =			0.017	hrs =	1.0
		TIME OF CONCENTRATION, Tc = $\sum T_t$ =			0.198	hrs =	11.9
					= 11.9	min	

SUBCATCHMENT: P**1.2-2(1)** - DRAINING TO CEDAR/LARCHWOOD INTERSECTION

COMPOSITE RUNOFF CURVE NUMBER DETERMINATION

POST DEVELOPMENT

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	AREA A (sf)	AREA A (ac)	RUNOFF CURVE No. CN	A x CN
	BUILDINGS / ROOFS / PORCHES:	977	0.022	98	2.2
	BITUMINOUS PAVEMENT	0	0.000	98	0.0
	CONCRETE APRONS, SLABS	161	0.000	98	0.0
A	GRAVEL DRIVEWAY	0	0.000	76	0.0
	PAVERS AND WOOD DECKS	0	0.000	80	0.0
	LAWN/LANDSCAPE:	18,798	0.432	39	16.8
B	GRAVEL DRIVEWAY	0	0.000	85	0.0
	PAVERS AND WOOD DECKS	0	0.000	90	0.0
	LAWN/LANDSCAPE:	0	0.000	61	0.0
	TOTAL	19,936	0.458		19.0

Composite 'CN' = 41.6

CATCHMENT P1.2-2(1): POST-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION

DETERMINATION OF TIME OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T9 - T24 - T25 - T26

SEGMENT		FLOW TYPE					INCR. TRAVEL TIME	
From	To	Parameter	Value					
T1	T9	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	159	ft				
		Land Slope,s:	0.0085	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.874	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.024	hrs =	1.4	min
T9	T10	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	146	ft				
		Land Slope,s:	0.0081	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.830	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.022	hrs =	1.3	min
T10	T24	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	149	ft				
		Land Slope,s:	0.0042	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.317	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.031	hrs =	1.9	min
T24	T25	SHEET FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.024					
		Flow Length, L:	134	ft				
		2-Yr / 24-hr Precip, P:	3.5	in				
		Land Slope,s:	0.0075	ft/ft				
			By Eq. 3-1, Travel Time, T_t =		0.067	hrs =	4.0	min
T25	T26	SHEET FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.024					
		Flow Length, L:	92	ft				
		2-Yr / 24-hr Precip, P:	3.5	in				
		Land Slope,s:	0.0087	ft/ft				
			By Eq. 3-1, Travel Time, T_t =		0.047	hrs =	2.8	min
			TIME OF CONCENTRATION, Tc = $\sum T_t$ =		0.192	hrs =	11.5	min

SUBCATCHMENT: P**1.2-2(2)** - DRAINING TO CEDAR/LARCHWOOD INTERSECTION

COMPOSITE RUNOFF CURVE NUMBER DETERMINATION

POST DEVELOPMENT

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	AREA A (sf)	AREA A (ac)	RUNOFF CURVE No. CN	A x CN
	BUILDINGS / ROOFS / PORCHES:	1,374	0.032	98	3.1
	BITUMINOUS PAVEMENT	0	0.000	98	0.0
	CONCRETE APRONS, SLABS	0	0.000	98	0.0
A	GRAVEL DRIVEWAY	0	0.000	76	0.0
	PAVERS AND WOOD DECKS	0	0.000	80	0.0
	LAWN/LANDSCAPE:	17,905	0.411	39	16.0
B	GRAVEL DRIVEWAY		0.000	85	0.0
	PAVERS AND WOOD DECKS	0	0.000	90	0.0
	LAWN/LANDSCAPE:	10,864	0.249	61	15.2
	TOTAL	30,143	0.692		34.3

Composite 'CN' = 50

CATCHMENT P1.2-2(2): POST-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(MISC. GROUND COVERS; UNCONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T18 - T19 - T20

SEGMENT		FLOW TYPE			TRAVEL TIME				
From	To	Parameter	Value						
T1	T18	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Paved						
		Manning's 'n':	0.011						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	354	ft					
		Land Slope,s:	0.0039	ft/ft					
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	2.885	ft/sec					
			By Eq. 3-3, Travel Time, T_t =		0.034	hrs =		2.0	min
T18	T19	SHALLOW CONCENTRATED FLOW							
		Surface Description:	Unpaved						
		Manning's 'n':	0.025						
		Hydraulic Radius, r:	0.2	ft					
		Flow Length, L:	179	ft					
		Land Slope,s:	0.005	ft/ft					
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.437	ft/sec					
			By Eq. 3-3, Travel Time, T_t =		0.035	hrs =		2.1	min
T19	T20	SHEET FLOW							
		Surface Description:	Unpaved						
		Manning's 'n':	0.025						
		Flow Length, L:	57	ft					
		2-Yr / 24-hr Precip, P:	3.5	in					
		Land Slope,s:	0.011	ft/ft					
			By Eq. 3-1, Travel Time, T_t =		0.030	hrs =		1.8	min
			TIME OF CONCENTRATION, Tc = $\sum T_t$ =		0.099	hrs =		5.9	min
				=	5.9	min			

SUBCATCHMENT: P**1.2-2(3)** - DRAINING TO CEDAR/LARCHWOOD INTERSECTION

COMPOSITE RUNOFF CURVE NUMBER DETERMINATION

POST DEVELOPMENT

USDA SOIL SERIES: EVESBORO / URBAN LAND COMPLEX - HSG 'A'
USDA SOIL SERIES: KLEJ / URBAN LAND COMPLEX - HSG 'B'

SOIL HSG	SOIL COVER	AREA A (sf)	AREA A (ac)	RUNOFF CURVE No. CN	A x CN
	BUILDINGS / ROOFS / PORCHES:	2,569	0.059	98	5.8
	BITUMINOUS PAVEMENT	0	0.000	98	0.0
	CONCRETE APRONS, SLABS	0	0.000	98	0.0
A	GRAVEL DRIVEWAY	0	0.000	76	0.0
	PAVERS AND WOOD DECKS	0	0.000	80	0.0
	LAWN/LANDSCAPE:	9,803	0.225	39	8.8
B	GRAVEL DRIVEWAY		0.000	85	0.0
	PAVERS AND WOOD DECKS	0	0.000	90	0.0
	LAWN/LANDSCAPE:	20,503	0.471	61	28.7
	TOTAL	32,875	0.755		43.3

Composite 'CN' = 57.3

CATCHMENT P1.2-2(3): POST-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(UNCONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc
(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T28- T29 - T30 - T31

SEGMENT		FLOW TYPE			TRAVEL TIME			
From	To	Parameter	Value					
T1	T2	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	205	ft				
		Land Slope,s:	0.0039	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.269	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.045	hrs =	2.7	min
T2	T28	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	178	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.038	hrs =	2.3	min
T28	T29	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.05					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	42	ft				
		Land Slope,s:	0.0131	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.163	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.010	hrs =	0.6	min
T29	T30	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.05					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	107	ft				
		Land Slope,s:	0.0074	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	0.874	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.034	hrs =	2.0	min
T31	T32	SHEET FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.024					
		Flow Length, L:	100	ft				
		2-Yr / 24-hr Precip, P:	3.5	in				
		Land Slope,s:	0.0074	ft/ft				
			By Eq. 3-1, Travel Time, T_t =		0.054	hrs =	3.2	min
			TIME OF CONCENTRATION, Tc = ΣT_t =		0.181	hrs =	10.8	min

CATCHMENT P1.2-3(1): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(UNCONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc
(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T28 - T3 - T12 -T32

SEGMENT		FLOW TYPE			TRAVEL TIME			
From	To	Parameter	Value					
T1	T2	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	205	ft				
		Land Slope,s:	0.0039	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.269	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.045	hrs =	2.7	min
T2	T28	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	178	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.038	hrs =	2.3	min
T28	T3	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.05					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	42	ft				
		Land Slope,s:	0.0131	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.163	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.010	hrs =	0.6	min
T3	T12	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.05					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	107	ft				
		Land Slope,s:	0.0074	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	0.874	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.034	hrs =	2.0	min
T12	T32	SHEET FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.024					
		Flow Length, L:	99	ft				
		2-Yr / 24-hr Precip, P:	3.5	in				
		Land Slope,s:	0.0105	ft/ft				
			By Eq. 3-1, Travel Time, T_t =		0.046	hrs =	2.8	min
			TIME OF CONCENTRATION, Tc = ΣT_t =		0.173	hrs =	10.4	min
			=		10.4	min		

CATCHMENT P1.2-3(2): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(UNCONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T28 - T3 - T4 - T33 - T34

SEGMENT		FLOW TYPE			TRAVEL TIME			
From	To	Parameter	Value					
T1	T2	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	205	ft				
		Land Slope,s:	0.0039	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.269	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.045	hrs =	2.7	min
T2	T27	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	178	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.038	hrs =	2.3	min
T27	T3	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	93	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.020	hrs =	1.2	min
T3	T4	SHALLOW CONCENTRATED FLOW						
		Surface Description:	paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	227	ft				
		Land Slope,s:	0.0112	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	2.151	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.029	hrs =	1.8	min
T4	T33	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	50	ft				
		Land Slope,s:	0.0049	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.423	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.010	hrs =	0.6	min
T33	T34	SHEET FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.024					
		Flow Length, L:	75	ft				
		2-Yr / 24-hr Precip, P:	3.5	in				
		Land Slope,s:	0.0269	ft/ft				
			By Eq. 3-1, Travel Time, T_t =		0.025	hrs =	1.5	min
			TIME OF CONCENTRATION, Tc = ΣT_t =		0.167	hrs =	10.0	min
			=		10.0	min		

CATCHMENT P1.2-3(3): PRE-DEVELOPMENT TO CEDAR / LARCHWOOD INTERSECTION
(UNCONNECTED IMPERVIOUS AREAS)

DETERMINATION OF TIMES OF CONCENTRATION, Tc

(Ref: TR-55, Second Ed., June, 1986)

PATH: T1 - T2 - T28 - T3 - T4 - T33 - T5 - T35

SEGMENT		FLOW TYPE			TRAVEL TIME			
From	To	Parameter	Value					
T1	T2	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	205	ft				
		Land Slope,s:	0.0039	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.269	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.045	hrs =		2.7
T2	T28	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	178	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.038	hrs =		2.3
T28	T3	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	93	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.020	hrs =		1.2
T3	T4	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	178	ft				
		Land Slope,s:	0.0041	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.302	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.038	hrs =		2.3
T4	T33	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	50	ft				
		Land Slope,s:	0.0049	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.423	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.010	hrs =		0.6
T33	T5	SHALLOW CONCENTRATED FLOW						
		Surface Description:	Paved					
		Manning's 'n':	0.025					
		Hydraulic Radius, r:	0.2	ft				
		Flow Length, L:	131	ft				
		Land Slope,s:	0.0049	ft/ft				
		By Appendix F, Equations For Fig 3-1, Average Velocity, V =	1.423	ft/sec				
			By Eq. 3-3, Travel Time, T_t =		0.026	hrs =		1.5
T5	T35	SHEET FLOW						
		Surface Description:	Unpaved					
		Manning's 'n':	0.024					
		Flow Length, L:	126	ft				
		2-Yr / 24-hr Precip, P:	3.5	in				
		Land Slope,s:	0.0098	ft/ft				
			By Eq. 3-1, Travel Time, T_t =		0.058	hrs =		3.5
			TIME OF CONCENTRATION, Tc = ΣT_t =		0.234	hrs =		14.0
					= 14.0	min		

APPENDIX III.2

(Note: this appendix contains summary tabulations of all precipitation events for all post-development subcatchments)

E1.2-1(1)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.27	0.0220	2.67
2-Year	3.30	0.31	0.0250	3.07
5-Year	4.40	0.42	0.0340	4.16
10-Year	5.20	0.49	0.0410	4.96
25-Year	6.50	0.62	0.0520	6.26
50-Year	7.70	0.73	0.0620	7.46
100-Year	8.90	0.84	0.0710	8.66
NJWQDS	1.25	0.29	0.0090	1.03

E1.2-1(4)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.08	0.0080	2.67
2-Year	3.30	0.09	0.0090	3.07
5-Year	4.40	0.13	0.0130	4.16
10-Year	5.20	0.15	0.0150	4.96
25-Year	6.50	0.19	0.0190	6.26
50-Year	7.70	0.22	0.0230	7.46
100-Year	8.90	0.26	0.0270	8.66
NJWQDS	1.25	0.09	0.0030	1.03

E1.2-1(5)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.04	0.0040	2.67
2-Year	3.30	0.05	0.0040	3.07
5-Year	4.40	0.07	0.0060	4.16
10-Year	5.20	0.08	0.0070	4.96
25-Year	6.50	0.10	0.0080	6.26
50-Year	7.70	0.12	0.0100	7.46
100-Year	8.90	0.14	0.0120	8.66
NJWQDS	1.25	0.05	0.0010	1.03

E1.2-5

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.04	0.0070	0.33
2-Year	3.30	0.07	0.0100	0.49
5-Year	4.40	0.18	0.0210	1.02
10-Year	5.20	0.28	0.0310	1.49
25-Year	6.50	0.46	0.0490	2.35
50-Year	7.70	0.64	0.0670	3.22
100-Year	8.90	0.84	0.0860	4.14
NJWQDS	1.25	0.00	0.0000	0.00

P1.2-2(1)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.00	0.0000	0.00
2-Year	3.30	0.00	0.0010	0.02
5-Year	4.40	0.01	0.0070	0.17
10-Year	5.20	0.04	0.0140	0.37
25-Year	6.50	0.20	0.0300	0.80
50-Year	7.70	0.43	0.0500	1.30
100-Year	8.90	0.71	0.0720	1.89
NJWQDS	1.25	0.00	0.0000	0.00

P1.2-2(2)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.00	0.0030	0.06
2-Year	3.30	0.01	0.0070	0.13
5-Year	4.40	0.15	0.0240	0.42
10-Year	5.20	0.41	0.0410	0.72
25-Year	6.50	0.93	0.0760	1.32
50-Year	7.70	1.50	0.1140	1.97
100-Year	8.90	2.12	0.1560	2.70
NJWQDS	1.25	0.00	0.0000	0.00

P1.2-2(3)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.05	0.0140	0.22
2-Year	3.30	0.12	0.0220	0.34
5-Year	4.40	0.47	0.0500	0.80
10-Year	5.20	0.80	0.0760	1.21
25-Year	6.50	1.40	0.1250	1.99
50-Year	7.70	2.03	0.1760	2.79
100-Year	8.90	2.69	0.2300	3.66
NJWQDS	1.25	0.00	0.0000	0.00

P1.2-3(1)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.09	0.0140	0.33
2-Year	3.30	0.18	0.0210	0.49
5-Year	4.40	0.48	0.0450	1.02
10-Year	5.20	0.75	0.0650	1.49
25-Year	6.50	1.22	0.1020	2.35
50-Year	7.70	1.70	0.1400	3.22
100-Year	8.90	2.20	0.1810	4.14
NJWQDS	1.25	0.00	0.0000	0.00

P1.2-3(2)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.07	0.0100	0.33
2-Year	3.30	0.13	0.0150	0.49
5-Year	4.40	0.34	0.0320	1.02
10-Year	5.20	0.53	0.0460	1.49
25-Year	6.50	0.86	0.0730	2.35
50-Year	7.70	1.20	0.1000	3.22
100-Year	8.90	1.56	0.1290	4.14
NJWQDS	1.25	0.00	0.0000	0.00

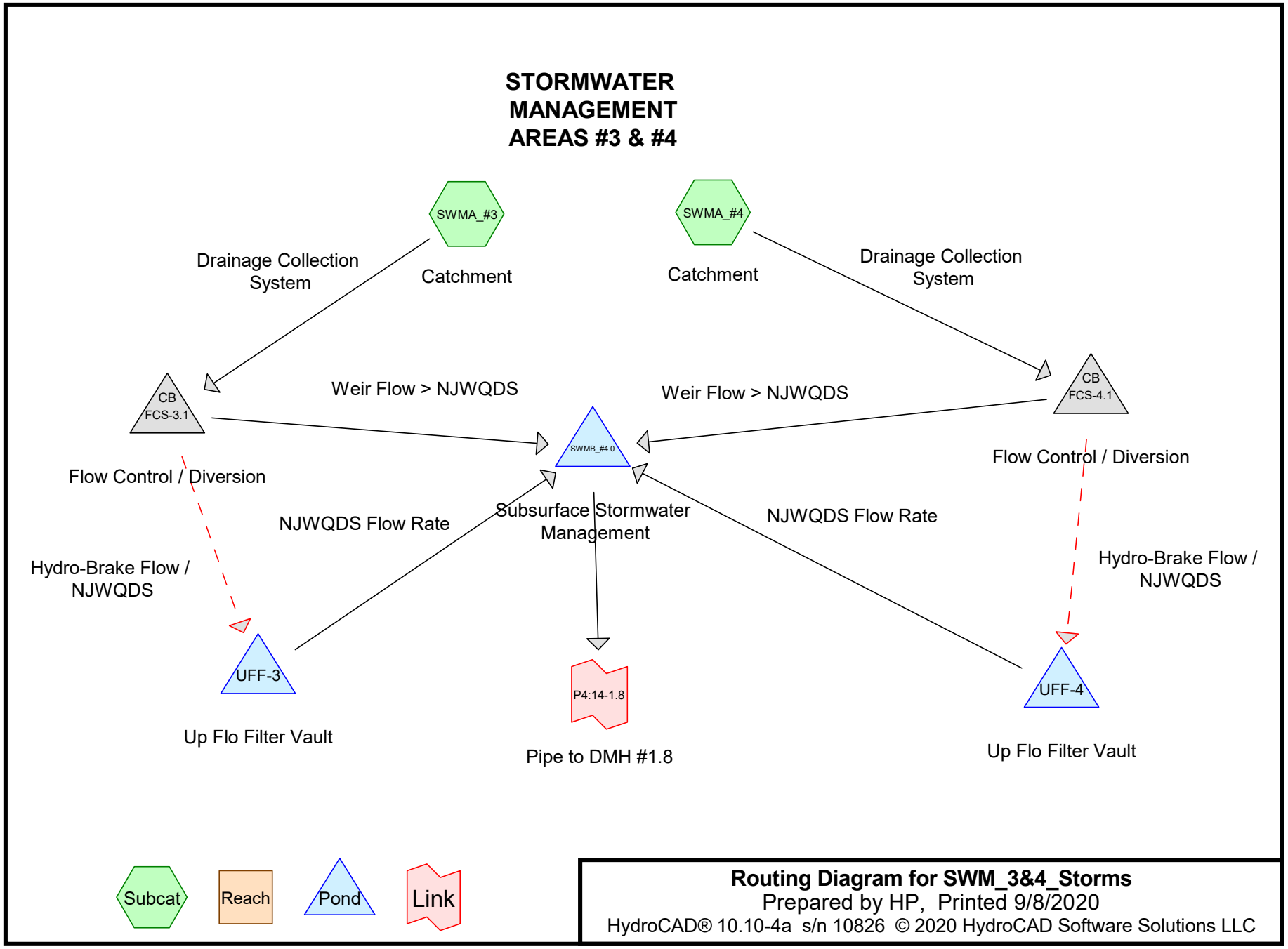
P1.2-3(3)

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
1-Year	2.90	0.03	0.0050	0.33
2-Year	3.30	0.05	0.0070	0.49
5-Year	4.40	0.14	0.0160	1.02
10-Year	5.20	0.22	0.0230	1.49
25-Year	6.50	0.37	0.0360	2.35
50-Year	7.70	0.51	0.0490	3.22
100-Year	8.90	0.67	0.0630	4.14
NJWQDS	1.25	0.00	0.0000	0.00

APPENDIX III.3

(Note: this appendix contains detailed hydrologic and hydraulic analyses, with supporting information, for post-development SWMA #3)

CONTENTS



Routing Diagram for SWM_3&4_Storms
Prepared by HP, Printed 9/8/2020

SWMA #3 Event Summary Tabulation					
	Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
	NJWQDS	1.25	1.51	0.0410	0.30
	1-Year	2.90	2.85	0.2020	1.50
	2-Year	3.30	3.48	0.2470	1.84
	5-Year	4.40	5.25	0.3780	2.82
	10-Year	5.20	6.55	0.4770	3.55
	25-Year	6.50	8.65	0.6410	4.78
	50-Year	7.70	10.59	0.7950	5.92
	100-Year	8.90	12.53	0.9500	7.08

Summary for Pond FCS-3.1: Flow Control / Diversion

[57] Hint: Peaked at 36.47' (Flood elevation advised)

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth = 7.08" for 100-Year event
Inflow = 12.53 cfs @ 12.13 hrs, Volume= 0.950 af
Outflow = 12.53 cfs @ 12.13 hrs, Volume= 0.950 af, Atten= 0%, Lag= 0.0 min
Primary = 10.97 cfs @ 12.13 hrs, Volume= 0.280 af
Secondary = 1.55 cfs @ 12.13 hrs, Volume= 0.671 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-150.00 hrs, dt= 0.02 hrs
Peak Elev= 36.47' @ 12.13 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	34.12'	**Q_HB_FCS_3.1** Head (feet) 0.00 0.09 0.17 0.26 0.34 0.43 0.52 0.60 0.69 0.78 0.86 0.95 1.03 1.12 1.21 1.29 1.38 1.47 1.55 1.64 1.72 1.81 1.90 1.98 2.07 2.15 2.24 2.33 2.41 2.50 Disch. (cfs) 0.000 0.024 0.091 0.198 0.339 0.507 0.695 0.894 1.095 1.285 1.451 1.477 1.493 1.503 1.508 1.509 1.506 1.499 1.489 1.475 1.458 1.436 1.409 1.431 1.461 1.490 1.518 1.546 1.573 1.600
#2	Primary	36.07'	**Custom Weir/Orifice, Cv= 3.10 (C= 3.88)** Head (feet) 0.00 1.00 Width (feet) 11.00 11.00

Primary OutFlow Max=10.87 cfs @ 12.13 hrs HW=36.47' TW=35.17' (Dynamic Tailwater)
↑—**2=Custom Weir/Orifice** (Weir Controls 10.87 cfs @ 2.46 fps)

Secondary OutFlow Max=1.55 cfs @ 12.13 hrs HW=36.47' TW=0.00' (Dynamic Tailwater)
↑—**1=Q_HB_FCS_3.1** (Custom Controls 1.55 cfs)

KEY DIMENSIONS

Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	2.500	1.600
Flush-Flo™	1.267	1.509
Kick-Flo®	1.907	1.405
Mean Flow		1.179

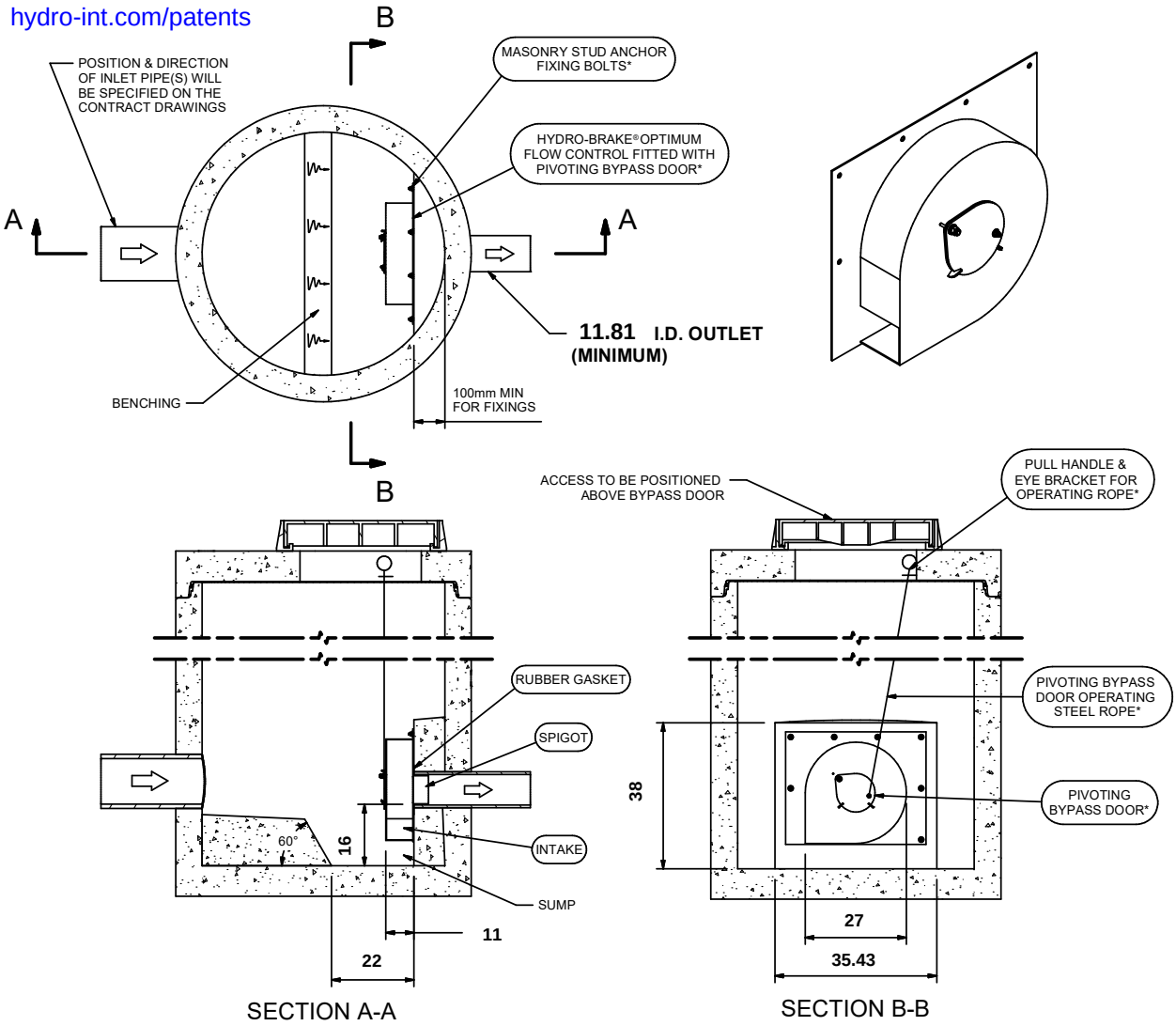
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0280-4530-0762-4275 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/7/2020 5:50 PM
SITE	MU SWMB #3.0
DESIGNER	**Bill Fitzgerald**
REF	**FCS_#3.1**

SFF-0280-4530-0762-4275

Hydro-Brake® Optimum

wfitz@wef-pe.com

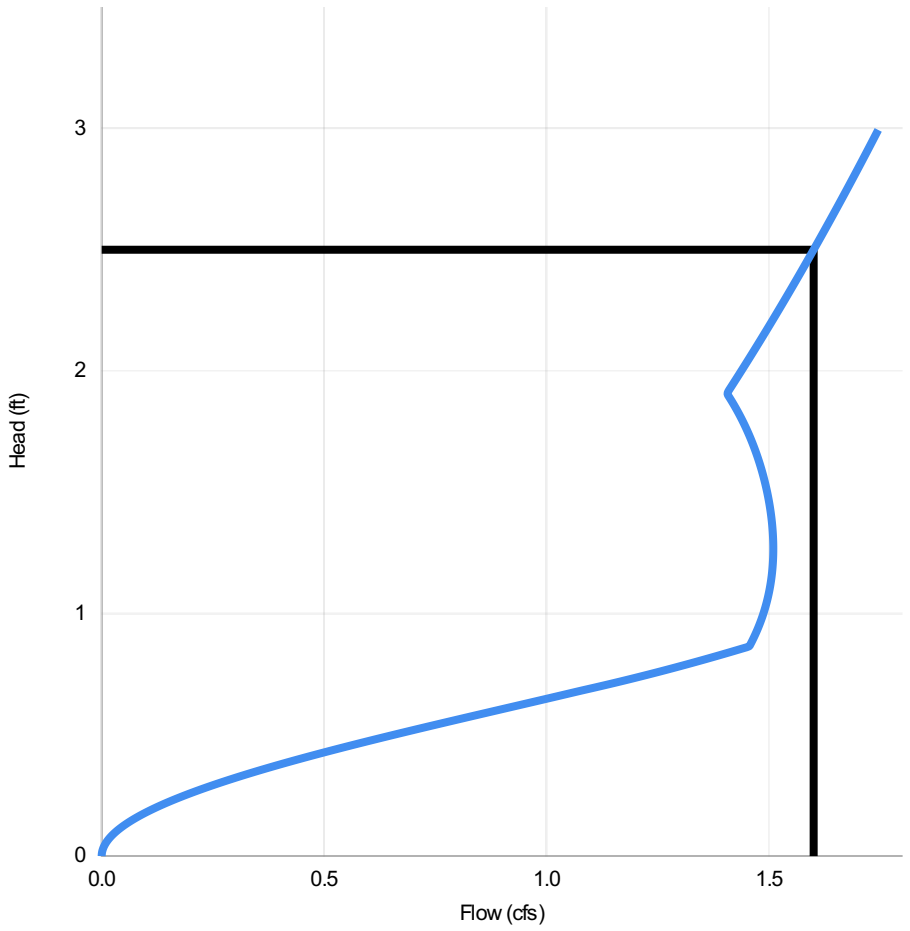
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	2.500	1.600
Flush-Flo	1.267	1.509
Kick-Flo®	1.907	1.405
Mean Flow		1.179

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.086	0.024
0.172	0.091
0.259	0.198
0.345	0.339
0.431	0.507
0.517	0.695
0.603	0.894
0.690	1.095
0.776	1.285
0.862	1.451
0.948	1.477
1.034	1.493
1.121	1.503
1.207	1.508
1.293	1.509
1.379	1.506
1.466	1.499
1.552	1.489
1.638	1.475
1.724	1.458
1.810	1.436
1.897	1.409
1.983	1.431
2.069	1.461
2.155	1.490
2.241	1.518
2.328	1.546
2.414	1.573
2.500	1.600

DESIGN ADVICE

The head/flow characteristics of this SFF-0280-4530-0762-4275 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/7/2020 5:50 PM
Site	MU SWMB #3.0
DESIGNER	Bill Fitzgerald
Ref	FCS_#3.1

SFF-0280-4530-0762-4275

Hydro-Brake Optimum®

FCS #3.1 Elevation-Discharge Tabulation

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
34.12	0.00	0.00	0.0000
34.22	0.03	0.00	0.0300
34.32	0.13	0.00	0.1300
34.42	0.27	0.00	0.2700
34.52	0.45	0.00	0.4500
34.62	0.65	0.00	0.6500
34.72	0.89	0.00	0.8900
34.82	1.12	0.00	1.1200
34.92	1.33	0.00	1.3300
35.02	1.46	0.00	1.4600
35.12	1.49	0.00	1.4900
35.22	1.50	0.00	1.5000
35.32	1.51	0.00	1.5100
35.42	1.51	0.00	1.5100
35.52	1.50	0.00	1.5000
35.62	1.50	0.00	1.5000
35.72	1.48	0.00	1.4800
35.82	1.46	0.00	1.4600
35.92	1.44	0.00	1.4400
36.02	1.41	0.00	1.4100
36.12	1.91	0.48	1.4400
36.22	3.95	2.48	1.4700
36.32	6.83	5.33	1.5100
36.42	10.36	8.83	1.5400

FCS #3.1 Event Summary Tabulation

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	1.51	1.51	0.00	1.51	35.18	0.0000
1-Year	2.85	2.85	1.39	1.46	36.17	0.0000
2-Year	3.48	3.48	2.01	1.46	36.20	0.0000
5-Year	5.25	5.25	3.76	1.49	36.27	0.0000
10-Year	6.55	6.55	5.05	1.50	36.31	0.0000
25-Year	8.65	8.65	7.13	1.52	36.37	0.0000
50-Year	10.59	10.59	9.05	1.54	36.43	0.0000
100-Year	12.53	12.53	10.97	1.55	36.47	0.0000

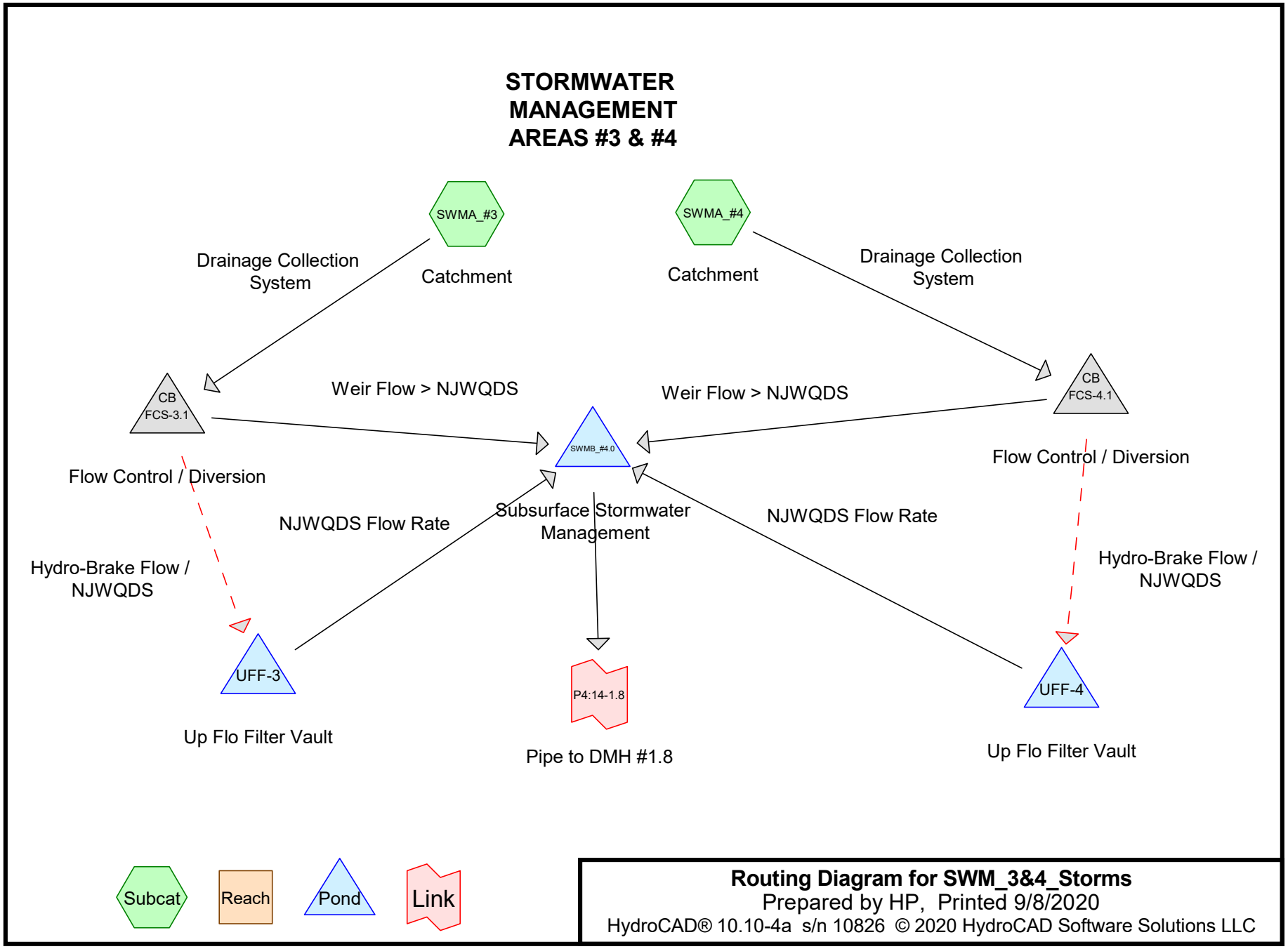
UFF #3 Event Summary Tabulation

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	1.51	1.51	0.00	0.0000
1-Year	1.46	1.46	0.00	0.0000
2-Year	1.46	1.46	0.00	0.0000
5-Year	1.49	1.49	0.00	0.0000
10-Year	1.50	1.50	0.00	0.0000
25-Year	1.52	1.52	0.00	0.0000
50-Year	1.54	1.54	0.00	0.0000
100-Year	1.55	1.55	0.00	0.0000

APPENDIX III.4

(Note: this appendix contains detailed hydrologic and hydraulic analyses, with supporting information, for post-development SWMA #4)

CONTENTS



Routing Diagram for SWM_3&4_Storms
Prepared by HP, Printed 9/8/2020

SWMA #4 Event Summary Tabulation					
	Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
	NJWQDS	1.25	2.75	0.0730	0.60
	1-Year	2.90	3.46	0.2540	2.07
	2-Year	3.30	4.05	0.3010	2.45
	5-Year	4.40	5.68	0.4310	3.50
	10-Year	5.20	6.86	0.5270	4.28
	25-Year	6.50	8.75	0.6840	5.56
	50-Year	7.70	10.49	0.8300	6.75
	100-Year	8.90	12.22	0.9760	7.94

Summary for Pond FCS-4.1: Flow Control / Diversion

[57] Hint: Peaked at 36.58' (Flood elevation advised)

Inflow Area = 1.476 ac, 0.00% Impervious, Inflow Depth = 7.94" for 100-Year event
Inflow = 12.22 cfs @ 12.13 hrs, Volume= 0.976 af
Outflow = 12.22 cfs @ 12.13 hrs, Volume= 0.976 af, Atten= 0%, Lag= 0.0 min
Primary = 9.51 cfs @ 12.13 hrs, Volume= 0.174 af
Secondary = 2.72 cfs @ 11.78 hrs, Volume= 0.802 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-150.00 hrs, dt= 0.02 hrs
Peak Elev= 36.58' @ 12.13 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	34.36'	**Q_HB_FCS_4-1** Head (feet) 0.00 0.08 0.16 0.24 0.32 0.40 0.48 0.56 0.63 0.71 0.79 0.87 0.95 1.03 1.11 1.19 1.27 1.35 1.43 1.51 1.59 1.67 1.75 1.82 1.90 1.98 2.06 2.14 2.22 2.30 Disch. (cfs) 0.000 0.023 0.090 0.198 0.342 0.520 0.727 0.959 1.210 1.474 1.746 2.017 2.285 2.527 2.670 2.700 2.723 2.740 2.751 2.756 2.757 2.752 2.743 2.730 2.712 2.689 2.662 2.665 2.712 2.758
#2	Primary	36.21'	**Custom Weir/Orifice, Cv= 3.10 (C= 3.88)** Head (feet) 0.00 10.00 Width (feet) 11.00 11.00

Primary OutFlow Max=9.41 cfs @ 12.13 hrs HW=36.58' TW=35.16' (Dynamic Tailwater)
↑—**2=Custom Weir/Orifice** (Weir Controls 9.41 cfs @ 2.34 fps)

Secondary OutFlow Max=2.72 cfs @ 11.78 hrs HW=36.22' TW=0.00' (Dynamic Tailwater)
↑—**1=Q_HB_FCS_4-1** (Custom Controls 2.72 cfs)

KEY DIMENSIONS

Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	2.300	2.760
Flush-Flo™	1.553	2.757
Kick-Flo®	2.107	2.644
Mean Flow		1.943

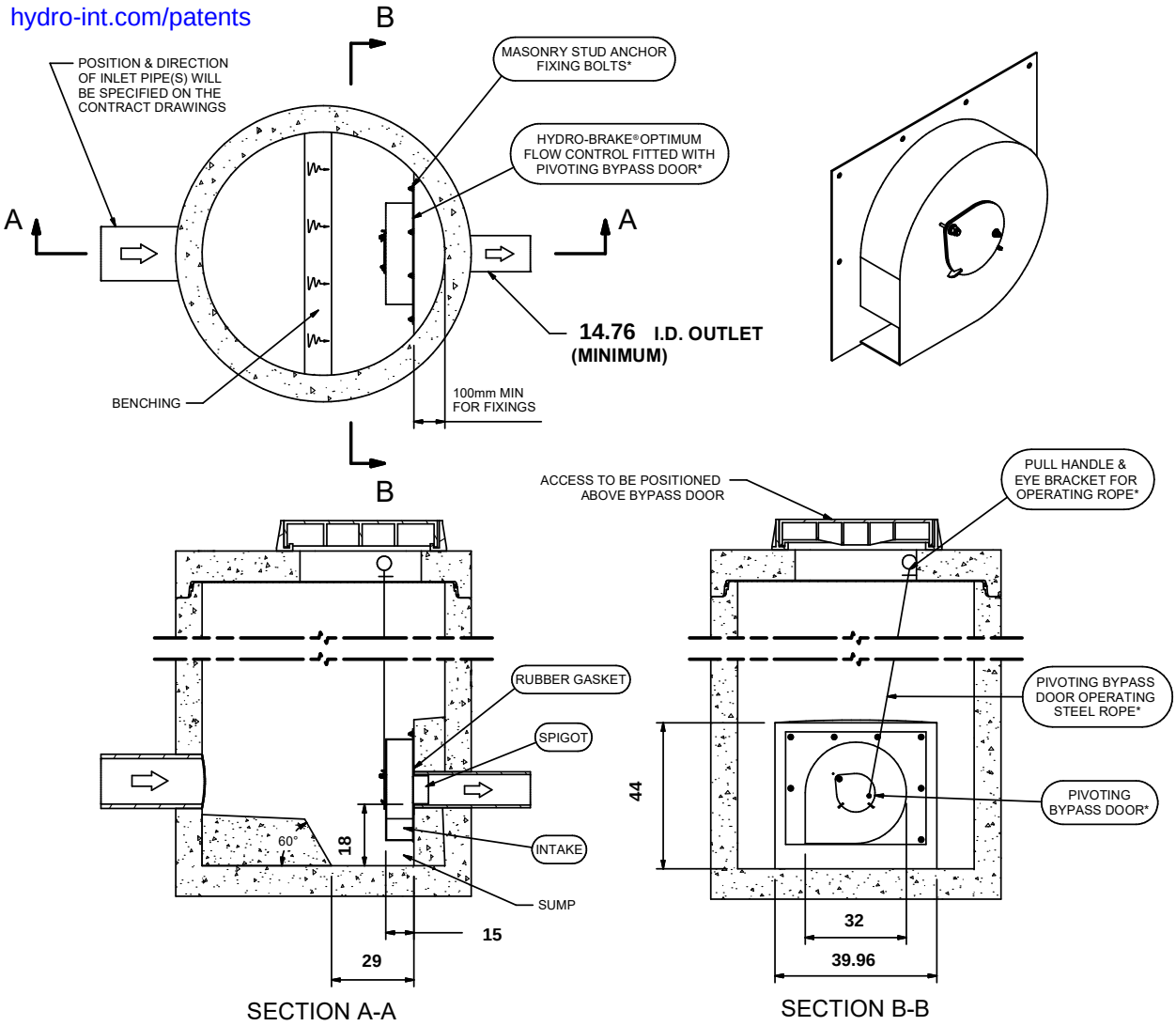
Hydro-Brake® Optimum Flow Control including:

- **0.196** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SHE-0361-7815-0701-7815 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/6/2020 12:23 PM
SITE	MU SWMA #$4
DESIGNER	**Bill Fitzgerald**
REF	**FCS #4.1**

SHE-0361-7815-0701-7815

Hydro-Brake® Optimum

 Hydro International Ltd, 94 Hutchins Drive, Portland, Maine, 04102-1930. Tel; +1 (207) 756 6200 Fax; +1 (207) 756 6212 Web; www.hydro-int.com Email; enquiries@hydro-int.com

wfitz@wef-pe.com

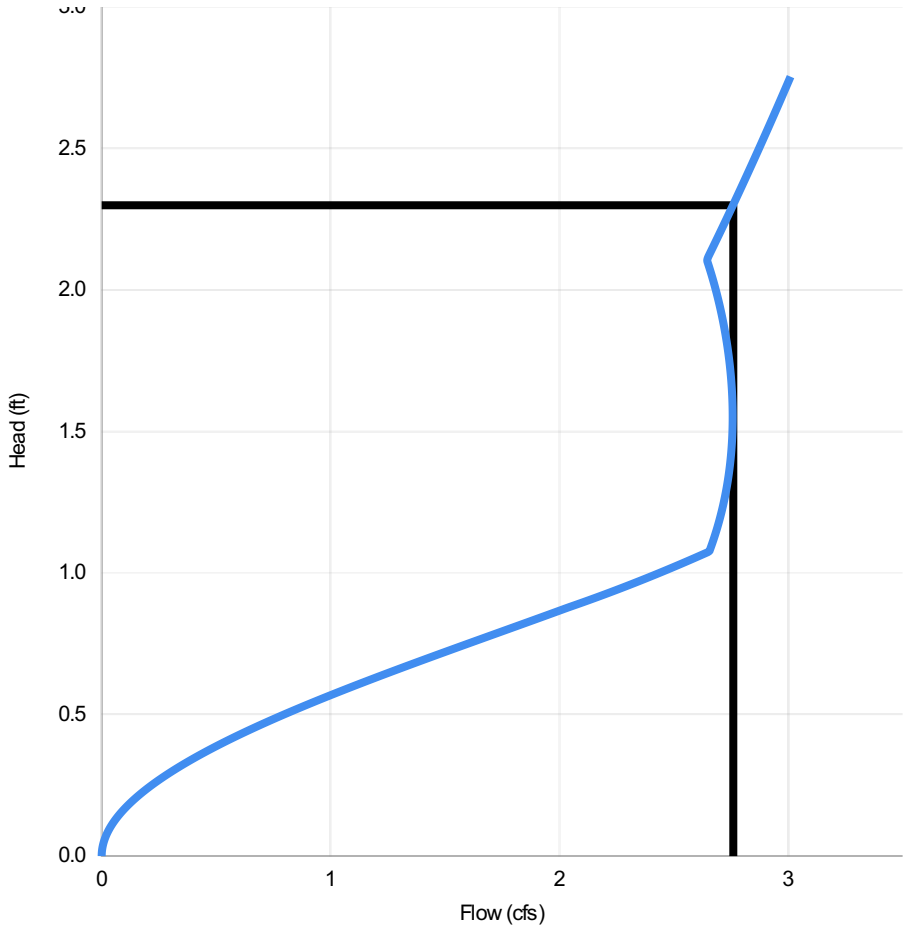
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	2.300	2.760
Flush-Flo	1.553	2.757
Kick-Flo®	2.107	2.644
Mean Flow		1.943

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.079	0.023
0.159	0.090
0.238	0.198
0.317	0.342
0.397	0.520
0.476	0.727
0.555	0.959
0.634	1.210
0.714	1.474
0.793	1.746
0.872	2.017
0.952	2.285
1.031	2.527
1.110	2.670
1.190	2.700
1.269	2.723
1.348	2.740
1.428	2.751
1.507	2.756
1.586	2.757
1.666	2.752
1.745	2.743
1.824	2.730
1.903	2.712
1.983	2.689
2.062	2.662
2.141	2.665
2.221	2.712
2.300	2.758

DESIGN ADVICE

The head/flow characteristics of this SHE-0361-7815-0701-7815 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/6/2020 12:23 PM
Site	MU SWMA #$4
DESIGNER	Bill Fitzgerald
Ref	FCS #4.1

SHE-0361-7815-0701-7815

Hydro-Brake Optimum®

FCS #4.1 Elevation-Discharge Tabulation

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
34.36	0.00	0.00	0.00
34.45	0.03	0.00	0.03
34.54	0.12	0.00	0.12
34.63	0.25	0.00	0.25
34.72	0.43	0.00	0.43
34.81	0.65	0.00	0.65
34.90	0.90	0.00	0.90
34.99	1.21	0.00	1.21
35.08	1.51	0.00	1.51
35.17	1.81	0.00	1.81
35.26	2.12	0.00	2.12
35.35	2.41	0.00	2.41
35.44	2.62	0.00	2.62
35.53	2.69	0.00	2.69
35.62	2.72	0.00	2.72
35.71	2.74	0.00	2.74
35.80	2.75	0.00	2.75
35.89	2.76	0.00	2.76
35.98	2.76	0.00	2.76
36.07	2.75	0.00	2.75
36.16	2.73	0.00	2.73
36.25	3.06	0.34	2.71
36.34	4.69	2.00	2.69
36.43	7.06	4.40	2.66
36.52	10.03	7.36	2.68
36.61	13.51	10.78	2.73
36.70	17.38	14.62	2.76
36.79	21.59	18.83	2.76

FCS #4.1 Event Summary Tabulation

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	2.75	2.75	0.0000	2.75	35.80	0.00
1-Year	3.46	3.46	0.7500	2.72	36.28	0.00
2-Year	4.05	4.05	1.3500	2.72	36.31	0.00
5-Year	5.68	5.68	3.0100	2.78	36.38	0.00
10-Year	6.86	6.86	4.1900	2.72	36.42	0.00
25-Year	8.75	8.75	6.0900	2.72	36.48	0.00
50-Year	10.49	10.49	7.8100	2.73	36.53	0.00
100-Year	12.22	12.22	9.5100	2.72	36.58	0.00

UFF #4 Event Summary Tabulation

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	2.75	2.75	0.00	0.0000
1-Year	2.72	2.72	0.00	0.0000
2-Year	2.72	2.72	0.00	0.0000
5-Year	2.78	2.78	0.00	0.0000
10-Year	2.72	2.72	0.00	0.0000
25-Year	2.72	2.72	0.00	0.0000
50-Year	2.73	2.73	0.00	0.0000
100-Year	2.72	2.72	0.00	0.0000

Summary for Pond SWMB_#4.0: Subsurface Stormwater Management

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 3.086 ac, 0.00% Impervious, Inflow Depth = 7.49" for 100-Year event
Inflow = 24.75 cfs @ 12.13 hrs, Volume= 1.927 af
Outflow = 4.51 cfs @ 12.56 hrs, Volume= 1.928 af, Atten= 82%, Lag= 26.1 min
Primary = 4.51 cfs @ 12.56 hrs, Volume= 1.928 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-150.00 hrs, dt= 0.02 hrs
Peak Elev= 35.71' @ 12.56 hrs Surf.Area= 0.401 ac Storage= 0.981 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 228.3 min (1,008.7 - 780.5)

Volume	Invert	Avail.Storage	Storage Description
#1	32.90'	0.000 af	**0.01'W x 5.00'L x 0.10'H Prismatoid**
#2A	33.00'	0.000 af	**7.87'W x 68.03'L x 2.95'H Field A** 0.036 af Overall - 0.036 af Embedded = 0.000 af x 0.0% Voids
#3A	33.00'	0.034 af	**ACF R-Tank SD 4** x 174 Inside #2 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 174 Chambers in 6 Rows
#4B	33.00'	0.000 af	**7.87'W x 105.56'L x 2.95'H Field B** 0.056 af Overall - 0.056 af Embedded = 0.000 af x 0.0% Voids
#5B	33.00'	0.054 af	**ACF R-Tank SD 4** x 270 Inside #4 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 270 Chambers in 6 Rows
#6C	33.00'	0.012 af	**11.00'W x 65.70'L x 2.95'H Field C** 0.049 af Overall - 0.019 af Embedded = 0.030 af x 40.0% Voids
#7C	33.00'	0.019 af	**ADS_StormTech SC-740 +Cap** x 18 Inside #6 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 18 Chambers in 2 Rows
#8D	33.00'	0.018 af	**11.00'W x 101.30'L x 2.95'H Field D** 0.075 af Overall - 0.030 af Embedded = 0.046 af x 40.0% Voids
#9D	33.00'	0.030 af	**ADS_StormTech SC-740 +Cap** x 28 Inside #8 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 28 Chambers in 2 Rows
#10E	33.00'	0.000 af	**44.62'W x 187.66'L x 2.95'H Field E** 0.568 af Overall - 0.568 af Embedded = 0.000 af x 0.0% Voids
#11E	33.00'	0.539 af	**ACF R-Tank SD 4** x 2720 Inside #10 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 2720 Chambers in 34 Rows
#12F	33.00'	0.016 af	**5.25'W x 186.74'L x 2.95'H Field F** 0.066 af Overall - 0.027 af Embedded = 0.039 af x 40.0% Voids
#13F	33.00'	0.027 af	**ADS_StormTech SC-740 +Cap** x 26 Inside #12 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

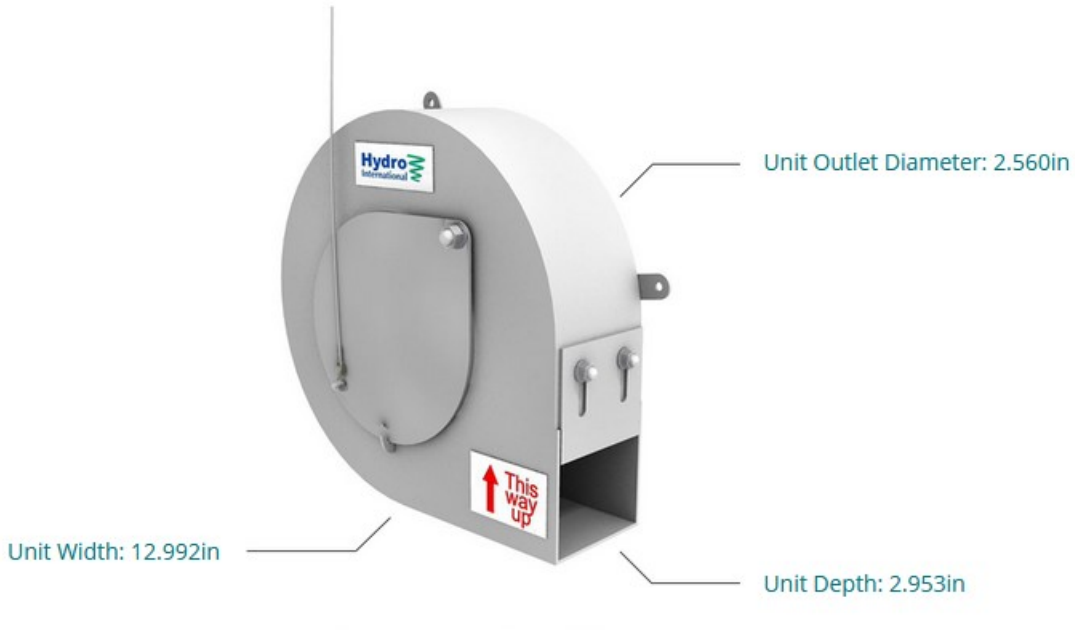
#14G	33.00'	0.000 af	**26.25'W x 187.66'L x 2.95'H Field G** 0.334 af Overall - 0.334 af Embedded = 0.000 af x 0.0% Voids
#15G	33.00'	0.317 af	**ACF R-Tank SD 4** x 1600 Inside #14 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 1600 Chambers in 20 Rows
#16	35.95'	0.004 af	**5.00'W x 10.00'L x 3.05'H Prismatoid**
		1.070 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard
Storage Group C created with Chamber Wizard
Storage Group D created with Chamber Wizard
Storage Group E created with Chamber Wizard
Storage Group F created with Chamber Wizard
Storage Group G created with Chamber Wizard

Device	Routing	Invert	Outlet Devices (Turned on 1 times)
#1	Primary	32.50'	**HB_Q060_090620** Head (feet) 0.00 0.12 0.23 0.35 0.47 0.59 0.70 0.82 0.94 1.05 1.17 1.29 1.41 1.52 1.64 1.76 1.88 1.99 2.11 2.23 2.35 2.46 2.58 2.70 2.81 2.93 3.05 3.17 3.28 3.40 Disch. (cfs) 0.000 0.017 0.043 0.053 0.056 0.057 0.057 0.056 0.056 0.055 0.053 0.051 0.047 0.049 0.050 0.052 0.054 0.055 0.056 0.058 0.059 0.060 0.062 0.063 0.064 0.065 0.067 0.068 0.069 0.070
#2	Primary	34.40'	**0.6' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	34.85'	**Pump** Discharges@36.00' Turns Off<32.95' 6.0" Diam. x 99.0' Long Discharge, Hazen-Williams C= 140 Flow (gpm)= 900.0 1,650.0 Head (feet)= 20.00 0.00 -Loss (feet)= 5.27 16.18 =Lift (feet)= 14.73 -16.18

Primary OutFlow Max=4.51 cfs @ 12.56 hrs HW=35.71' TW=0.00' (Dynamic Tailwater)
- **1=HB_Q060_090620** (Custom Controls 0.07 cfs)
- **2=Sharp-Crested Rectangular Weir** (Weir Controls 1.65 cfs @ 3.74 fps)
- **3=Pump** (Pump Controls 2.79 cfs)

KEY DIMENSIONS



Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo™	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

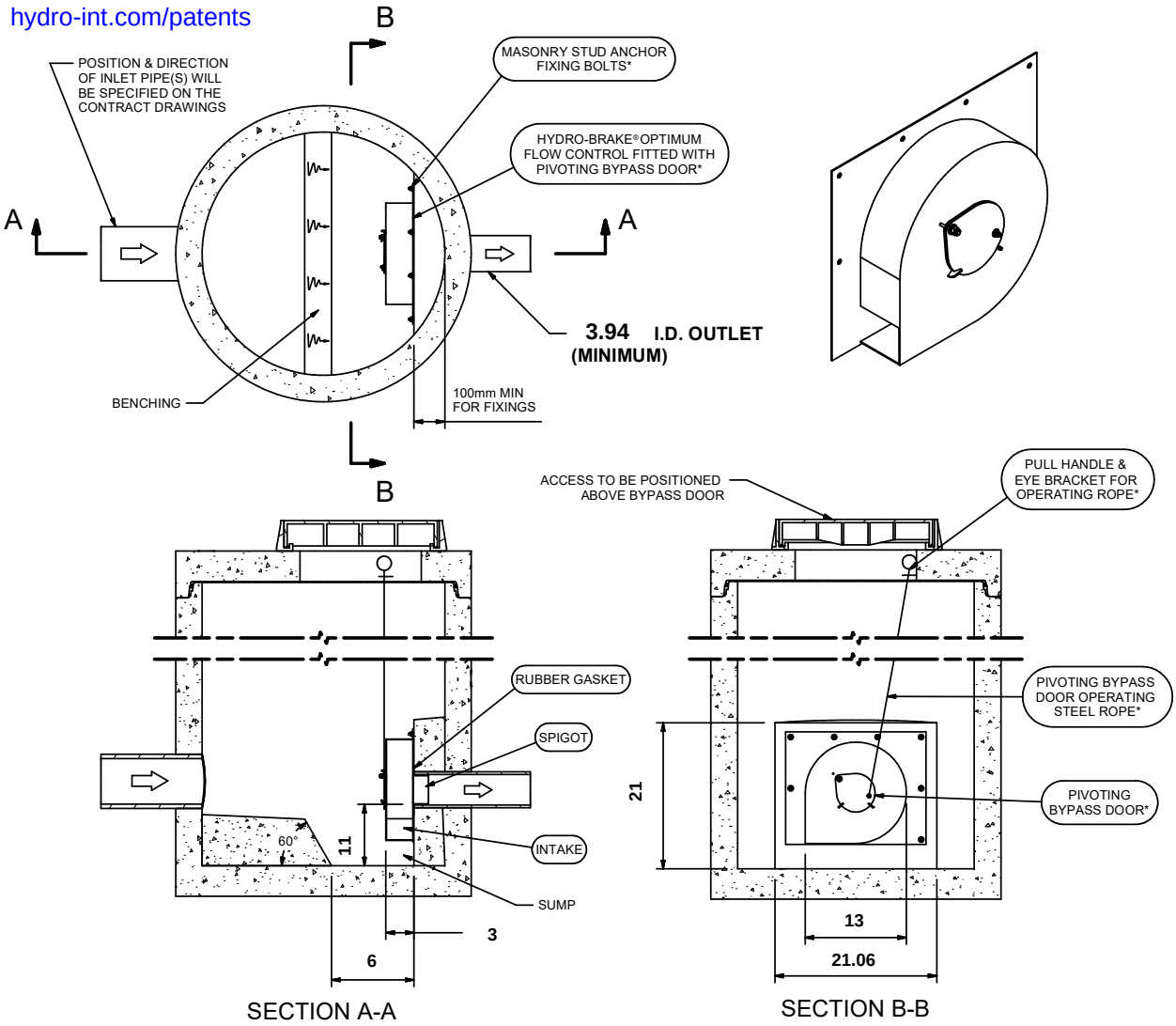
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/6/2020 10:29 PM
SITE	MU SWMB #6.0
DESIGNER	**Bill Fitzgerald**
REF	**ocs #6.7**

SFF-0065-1982-1036-1614

Hydro-Brake® Optimum

 Hydro International Ltd, 94 Hutchins Drive, Portland, Maine, 04102-1930. Tel; +1 (207) 756 6200 Fax; +1 (207) 756 6212 Web; www.hydro-int.com Email; enquiries@hydro-int.com

wfitz@wef-pe.com

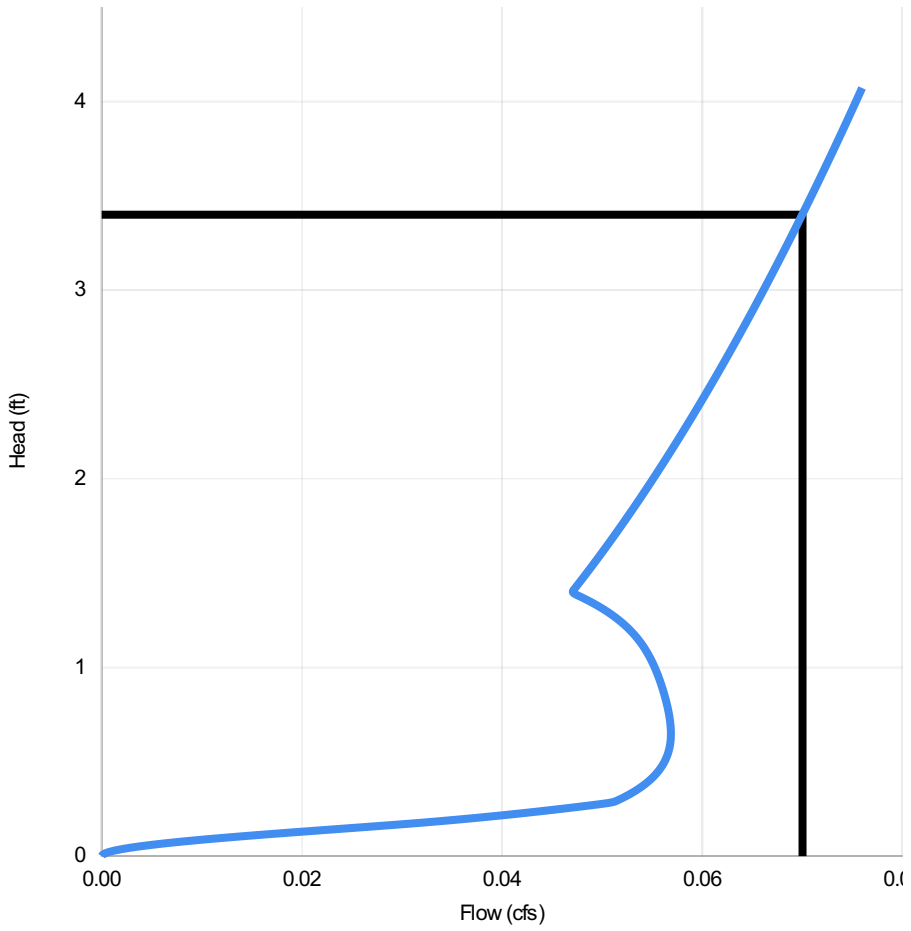
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.117	0.017
0.234	0.043
0.352	0.053
0.469	0.056
0.586	0.057
0.703	0.057
0.821	0.056
0.938	0.056
1.055	0.055
1.172	0.053
1.290	0.051
1.407	0.047
1.524	0.049
1.641	0.050
1.759	0.052
1.876	0.054
1.993	0.055
2.110	0.056
2.228	0.058
2.345	0.059
2.462	0.060
2.579	0.062
2.697	0.063
2.814	0.064
2.931	0.065
3.048	0.067
3.166	0.068
3.283	0.069
3.400	0.070

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/6/2020 10:29 PM
Site	MU SWMB #6.0
DESIGNER	Bill Fitzgerald
Ref	ocs #6.7

SFF-0065-1982-1036-1614

Hydro-Brake Optimum®

< View all Flygt N-Technology Water & Wastewater Pumps

Flygt N-Technology Pumps

N 3127

Overview

PRODUCT FEATURES

- State-of-the-art wastewater pump with N-technology
- Enhanced with Adaptive N™ hydraulic
- Sustained high efficiency with energy savings up to 25%

- Flexible and modular design
- Robust and reliable

WASTEWATER N-TECHNOLOGY PUMP WITH ADAPTIVE N-IMPELLER

Flygt N-pumps take on the toughest applications and get the job done. Every component is designed and manufactured to deliver sustained high efficiency. Thanks to patented N-technology with its innovative self-cleaning impeller, Flygt N-pumps deliver the highest total efficiency. They lower your energy bill and reduce unplanned maintenance costs. That adds up to total peace of mind – and big savings over the long term.

Most solid objects entering the pump will pass through the impeller between the impeller vanes. If an object gets caught on the leading edge of one of the vanes, it will slide along the backswept shape towards the perimeter of the inlet.

Due to the mechanical self-cleaning design, a sludge concentration up to 8% can easily be pumped.

FLEXIBLE AND MODULAR DESIGN

This self-cleaning pump features innovative functions that make it the best choice for a broad range of applications. The modular hydraulic design enables you to tailor the hydraulics to meet the requirements of virtually any application.

- Replaceable wear ring in two materials, gray iron or Hard Iron™, for different operation conditions
- Hardened gray iron impeller for typical wastewater applications
- Hard Iron™ impeller for abrasive and corrosive applications
- Chopper ring intended for tough wastewater applications where cutting is required due to long fibers and solids
- Stainless steel impeller for special applications that require duplex stainless steel
- Short shaft overhang reduces shaft deflection and increases seal and bearing life
- Motor designed for submersible use. Heat is concentrated to the stator core for improved cooling properties.
- The double mechanical seal system consists of two sets of mechanical shaft seals that work independently to provide double security. Available in Tungsten carbide (WCCR) or Silicone carbide (SiC) depending on pumped media.
- Griplock™ seal system secures locking to the shaft, no rubber friction, no grub screws and no shaft damage
- Motor cable SUBCAB ® specially developed for submersible use.

Wet Pit (P)

Semi permanent, submersible pump installation. Wet pit arrangement with the pump installed on twin guide bars with automatic connection to the discharge pipe.

Portable (S)

Portable, submersible pump installation. Portable pump with hose coupling or flange for connection to the discharge pipe.

Dry Installation vertical (T)

Vertical, permanent, dry pump installation. The submersible pump is installed in a dry pit, with flange connection to suction and discharge piping.

Dry Installation (Z)

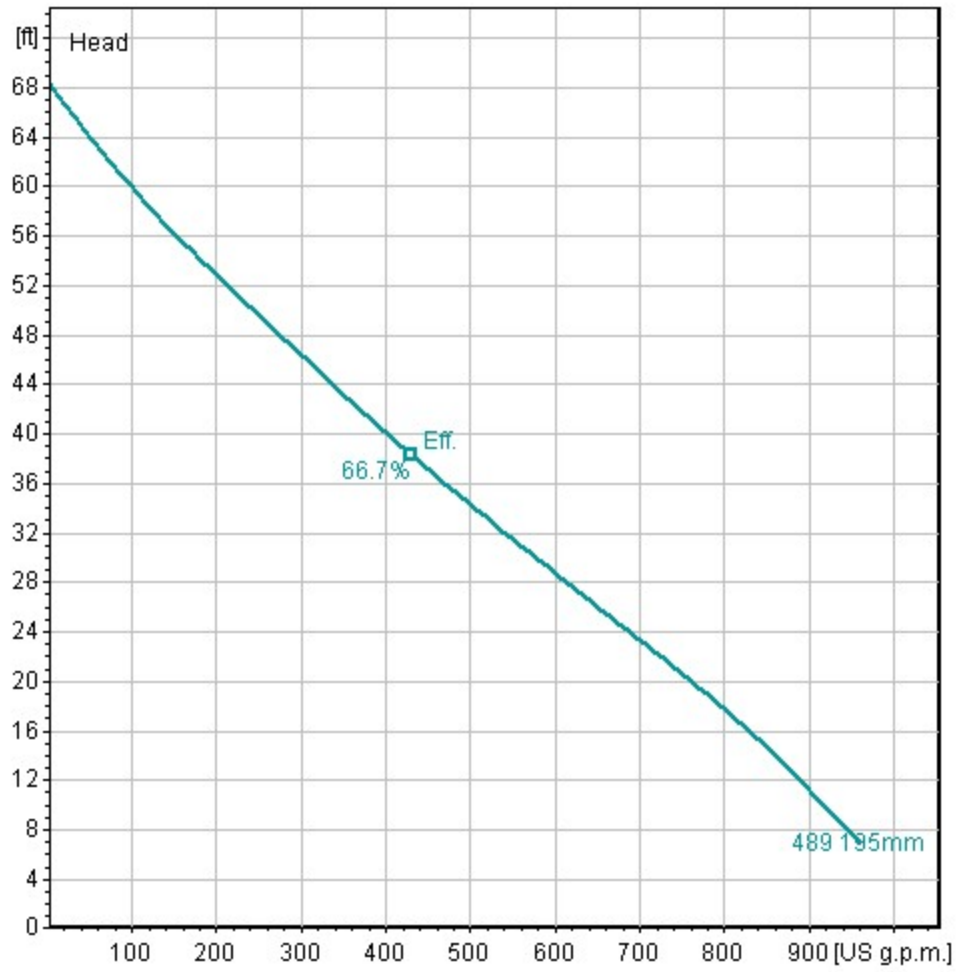
Horizontal, permanent, dry pump installation. The submersible pump is installed in a dry pit, with flange connection to suction and discharge piping.

Specifications

PUMP	N 3127 HT 3 PHASE 4 POLES 50HZ METRIC	N 3127 HT 3 PHASE ADAPTIVE 4 POLES 50HZ METRIC	N 3127 HT 3 PHASE 4 POLES SMARTRUN 50HZ METRIC
F) FREQUENCY	50 hz	50 hz	50 hz
G) NUMBER OF POLES	4	4	4
H) PHASE	3~	3~	3~
D) DISCHARGE OUTLET DIAMETER	100 mm	100 mm	100 mm
I) RATED POWER	4.7 kW - 5.9 kW	4.7 kW - 5.9 kW	4.7 kW
J) RATED CURRENTS @400V	9.6 A - 13 A	10 A - 13 A	9.6 A
A) IMPELLER MATERIAL	Standard, Premium efficiency (IE3)	Grey cast iron	Standard, Premium efficiency (IE3)
B) IMPELLER MATERIAL OPTION 1	Stainless steel	Standard, Premium efficiency (IE3)	Stainless steel
E) MOTOR EFFICIENCY CLASS	Standard, Premium efficiency (IE3)	Standard, Premium efficiency (IE3)	Standard, Premium efficiency (IE3)

Performance Curves

N 3127 HT 1 phase 4 poles 60hz US



N 3127 HT 1 phase Adaptive 4 poles 60hz US

SWMB #4.0 Elevation - Storage - Discharge			
	Elevation (feet)	Storage (acre-feet)	Discharge (cfs)
	32.90	0.0000	0.00
	33.00	0.0000	0.06
	33.10	0.0370	0.06
	33.20	0.0740	0.06
	33.30	0.1120	0.06
	33.40	0.1490	0.06
	33.50	0.1860	0.06
	33.60	0.2230	0.05
	33.70	0.2600	0.05
	33.80	0.2970	0.05
	33.90	0.3340	0.05
	34.00	0.3700	0.05
	34.10	0.4070	0.05
	34.20	0.4440	0.05
	34.30	0.4810	0.05
	34.40	0.5170	0.05
	34.50	0.5540	0.12
	34.60	0.5900	0.22
	34.70	0.6260	0.35
	34.80	0.6620	0.49
	34.90	0.6980	3.38
	35.00	0.7340	3.54
	35.10	0.7700	3.70
	35.20	0.8050	3.85
	35.30	0.8400	4.00
	35.40	0.8750	4.14
	35.50	0.9100	4.27
	35.60	0.9440	4.39
	35.70	0.9790	4.50
	35.80	1.0140	4.59
	35.90	1.0480	4.67
	36.00	1.0660	4.86
	36.10	1.0660	5.05
	36.20	1.0670	5.25
	36.30	1.0670	5.46
	36.40	1.0670	5.67
	36.50	1.0670	5.88
	36.60	1.0670	6.10
	36.70	1.0670	6.33
	36.80	1.0670	6.56

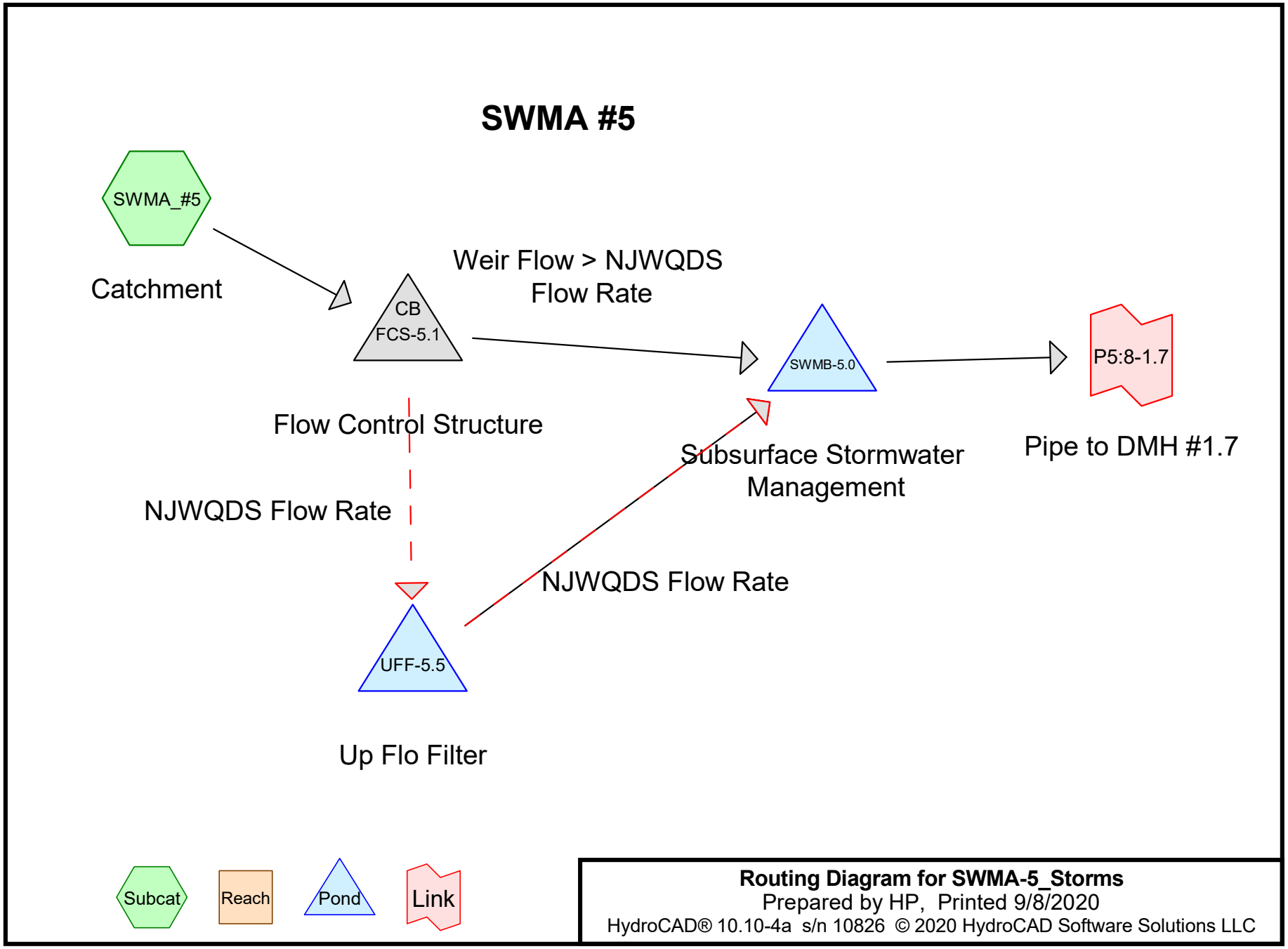
SWMB #4.0 Event Summary Tabulation

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	4.25	0.06	33.29	0.11	33.29	0.1070
1-Year	6.31	0.06	34.04	0.38	34.04	0.3840
2-Year	7.54	0.06	34.28	0.47	34.28	0.4720
5-Year	10.91	0.26	34.63	0.60	34.63	0.6020
10-Year	13.39	0.53	34.83	0.67	34.83	0.6730
25-Year	17.40	3.36	34.89	0.70	34.89	0.6950
50-Year	21.08	3.94	35.26	0.83	35.26	0.8270
100-Year	24.75	4.51	35.71	0.98	35.71	0.9810

APPENDIX III.5

(Note: this appendix contains detailed hydrologic and hydraulic analyses, with supporting information, for post-development SWMA #5)

CONTENTS


SWMA #5
SWMA_#5
Catchment
CB
FCS-5.1
Weir Flow > NJWQDS
Flow Rate
SWMB-5.0
P5:8-1.7
Pipe to DMH #1.7
Flow Control Structure
NJWQDS Flow Rate
Subsurface Stormwater
Management
NJWQDS Flow Rate
UFF-5.5
Up Flo Filter
Subcat
Reach
Pond
Link
Routing Diagram for SWMA-5_Storms
Prepared by HP, Printed 9/8/2020
HydroCAD® 10.10-4a s/n 10826 © 2020 HydroCAD Software Solutions LLC

SWMA #5 Event Summary Tabulation					
	Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
	NJWQDS	1.25	0.93	0.025	0.24
	1-Year	2.90	2.01	0.1420	1.37
	2-Year	3.30	2.49	0.1760	1.69
	5-Year	4.40	3.84	0.2740	2.64
	10-Year	5.20	4.85	0.3490	3.36
	25-Year	6.50	6.49	0.4740	4.56
	50-Year	7.70	8.01	0.5910	5.69
	100-Year	8.90	9.52	0.7110	6.84

Summary for Pond FCS-5.1: Flow Control Structure

[57] Hint: Peaked at 33.93' (Flood elevation advised)

Inflow Area = 1.252 ac, 0.00% Impervious, Inflow Depth = 0.24" for NJWQDS event
Inflow = 0.93 cfs @ 1.13 hrs, Volume= 0.026 af
Outflow = 0.93 cfs @ 1.13 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.93 cfs @ 1.13 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-75.00 hrs, dt= 0.01 hrs
Peak Elev= 33.93' @ 1.13 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	32.92'	**Q_HB_FCS_5.1** Head (feet) 0.00 0.11 0.23 0.34 0.46 0.57 0.68 0.80 0.91 1.02 1.14 1.25 1.37 1.48 1.59 1.71 1.82 1.93 2.05 2.16 2.28 2.39 2.50 2.62 2.73 2.85 2.96 3.07 3.19 3.30 Disch. (cfs) 0.000 0.036 0.137 0.288 0.471 0.666 0.839 0.912 0.925 0.932 0.933 0.930 0.923 0.913 0.900 0.882 0.857 0.852 0.876 0.899 0.921 0.943 0.964 0.984 1.005 1.024 1.044 1.063 1.082 1.100
#2	Primary	35.69'	**Custom Weir/Orifice, Cv= 3.10 (C= 3.88)** Head (feet) 0.00 10.00 Width (feet) 11.00 11.00

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=32.92' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=0.93 cfs @ 1.13 hrs HW=33.90' (Free Discharge)
↑—**1=Q_HB_FCS_5.1** (Custom Controls 0.93 cfs)

KEY DIMENSIONS

Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.300	1.100
Flush-Flo™	1.106	0.933
Kick-Flo®	1.879	0.840
Mean Flow		0.820

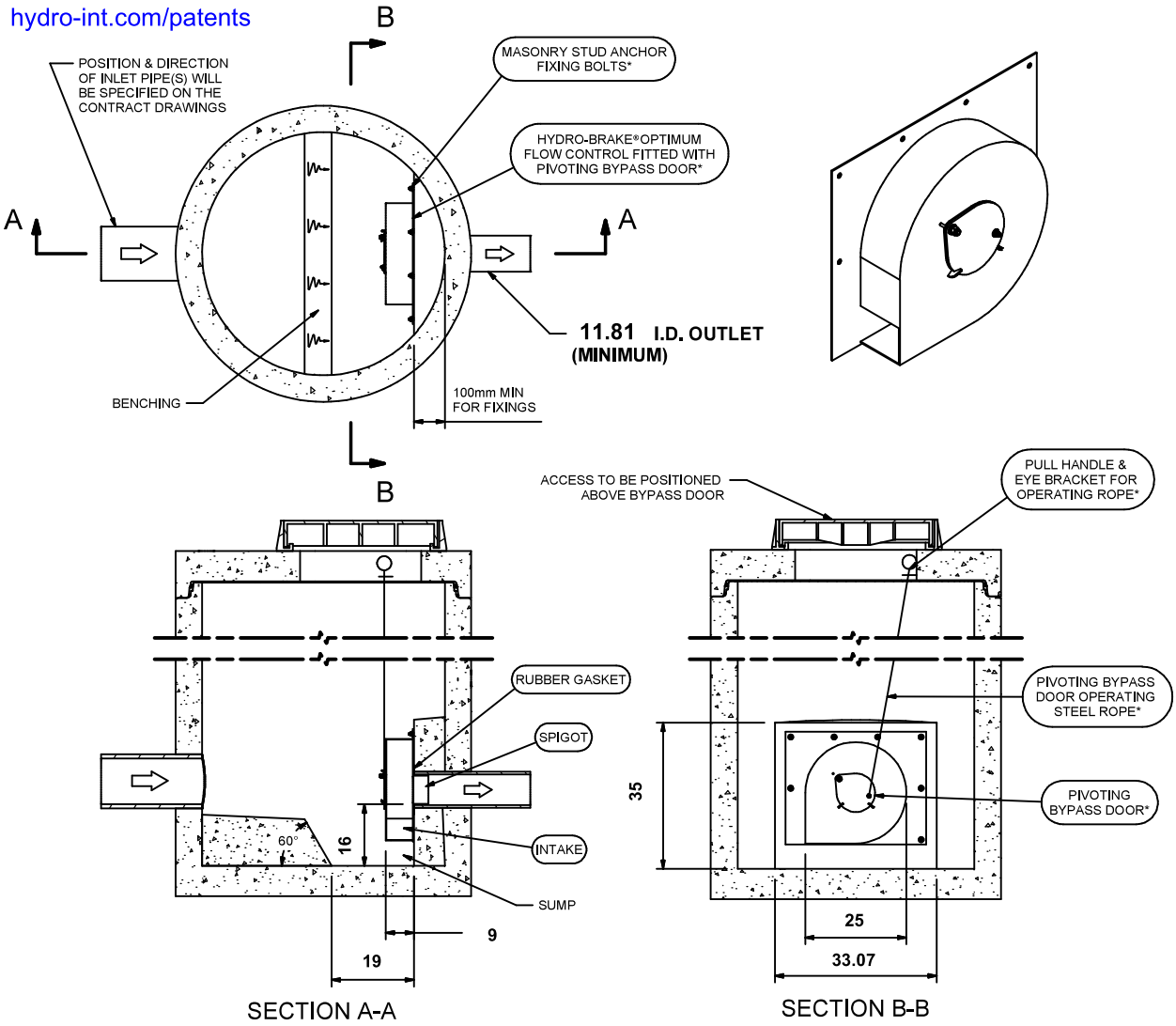
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0227-3114-1006-2644 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/7/2020 6:28 PM
SITE	MU SWMB #5.0
DESIGNER	**Bill Fitzgerald**
REF	**FCS_#5.1**

SFF-0227-3114-1006-2644

Hydro-Brake® Optimum

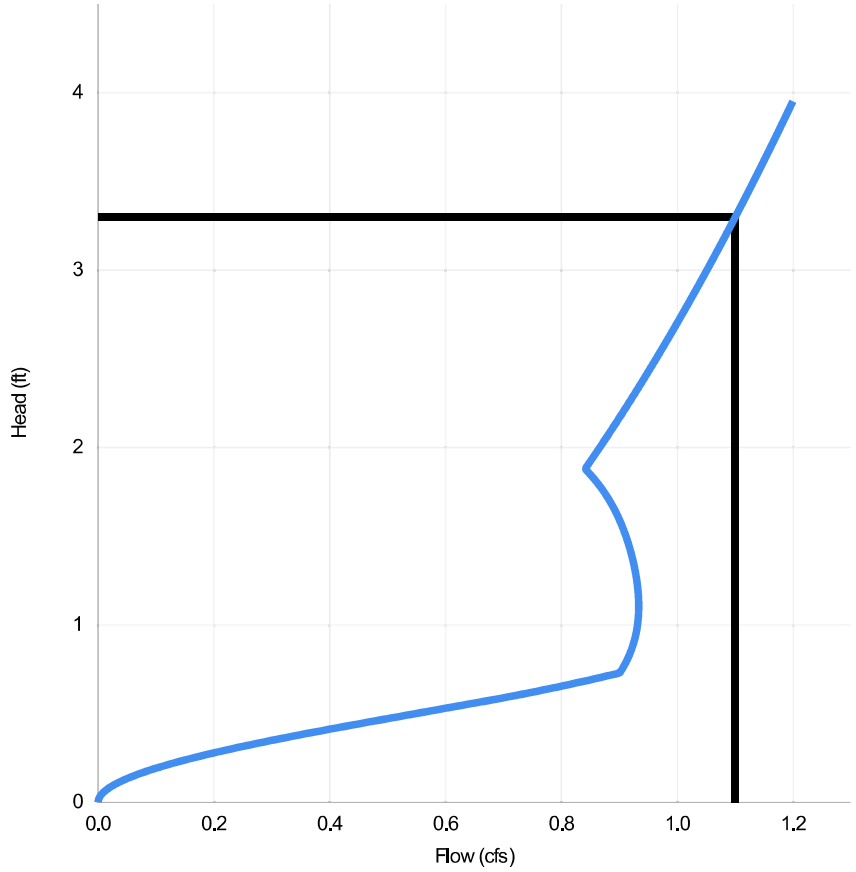
wfitz@wef-pe.com

Technical Specification		
Control Point	Head (ft)	Flow (cfs)
Primary Design	3.300	1.100
Flush-Flo	1.106	0.933
Kick-Flo®	1.879	0.840
Mean Flow		0.820

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.114	0.036
0.228	0.137
0.341	0.288
0.455	0.471
0.569	0.666
0.683	0.839
0.797	0.912
0.910	0.925
1.024	0.932
1.138	0.933
1.252	0.930
1.366	0.923
1.479	0.913
1.593	0.900
1.707	0.882
1.821	0.857
1.934	0.852
2.048	0.876
2.162	0.899
2.276	0.921
2.390	0.943
2.503	0.964
2.617	0.984
2.731	1.005
2.845	1.024
2.959	1.044
3.072	1.063
3.186	1.082
3.300	1.100

DESIGN ADVICE

The head/flow characteristics of this SFF-0227-3114-1006-2644 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/7/2020 6:28 PM
Site	MU SWMB #5.0
DESIGNER	Bill Fitzgerald
Ref	FCS_#5.1

SFF-0227-3114-1006-2644

Hydro-Brake Optimum®

FCS #5.1 Elevation-Discharge Tabulation

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
32.92	0.00	0.00	0.00
33.22	0.23	0.00	0.23
33.52	0.71	0.00	0.71
33.82	0.92	0.00	0.92
34.12	0.93	0.00	0.93
34.42	0.91	0.00	0.91
34.72	0.86	0.00	0.86
35.02	0.89	0.00	0.89
35.32	0.94	0.00	0.94
35.62	1.00	0.00	1.00
35.92	5.75	4.70	1.05
36.22	17.55	16.45	1.10
36.52	33.33	32.23	1.10

FCS #5.1 Event Summary Tabulation

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	0.93	0.93	0.0000	0.93	33.93	0.00
1-Year	2.02	2.02	0.9900	1.02	35.77	0.00
2-Year	2.50	2.50	1.4700	1.03	35.79	0.00
5-Year	3.86	3.86	2.8200	1.04	35.85	0.00
10-Year	4.87	4.87	3.8200	1.05	35.89	0.00
25-Year	6.51	6.51	5.4600	1.05	35.94	0.00
50-Year	8.04	8.04	6.9700	1.06	35.99	0.00
100-Year	9.56	9.56	8.4900	1.07	36.03	0.00

UFF #5 Event Summary Tabulation

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	0.93	0.93	0.00	0.0000
1-Year	1.02	1.02	0.00	0.0000
2-Year	1.03	1.03	0.00	0.0000
5-Year	1.04	1.04	0.00	0.0000
10-Year	1.05	1.05	0.00	0.0000
25-Year	1.05	1.05	0.00	0.0000
50-Year	1.06	1.06	0.00	0.0000
100-Year	1.07	1.07	0.00	0.0000

Summary for Pond SWMB-5.0: Subsurface Stormwater Management

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 1.252 ac, 0.00% Impervious, Inflow Depth = 0.24" for NJWQDS event
Inflow = 0.93 cfs @ 1.13 hrs, Volume= 0.026 af
Outflow = 0.04 cfs @ 2.06 hrs, Volume= 0.026 af, Atten= 95%, Lag= 55.9 min
Primary = 0.04 cfs @ 2.06 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-75.00 hrs, dt= 0.01 hrs
Peak Elev= 32.40' @ 2.06 hrs Surf.Area= 6,740 sf Storage= 964 cf

Plug-Flow detention time= 255.1 min calculated for 0.026 af (100% of inflow)
Center-of-Mass det. time= 255.2 min (336.0 - 80.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	32.25'	0 cf	**81.36'W x 72.72'L x 2.95'H Field A** 17,471 cf Overall - 17,471 cf Embedded = 0 cf x 40.0% Voids
#2A	32.25'	16,597 cf	**ACF R-Tank SD 4** x 1922 Inside #1 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 1922 Chambers in 62 Rows
#3B	32.25'	620 cf	**11.00'W x 74.82'L x 3.00'H Field B** 2,469 cf Overall - 919 cf Embedded = 1,550 cf x 40.0% Voids
#4B	32.25'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 2 Rows
		18,136 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	32.15'	**HB_Q060_090620** Head (feet) 0.00 0.12 0.23 0.35 0.47 0.59 0.70 0.82 0.94 1.05 1.17 1.29 1.41 1.52 1.64 1.76 1.88 1.99 2.11 2.23 2.35 2.46 2.58 2.70 2.81 2.93 3.05 3.17 3.28 3.40 Disch. (cfs) 0.000 0.017 0.043 0.053 0.056 0.057 0.057 0.056 0.056 0.055 0.053 0.051 0.047 0.049 0.050 0.052 0.054 0.055 0.056 0.058 0.059 0.060 0.062 0.063 0.064 0.065 0.067 0.068 0.069 0.070
#2	Primary	34.40'	**28.1 deg x 0.2' long Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.04 cfs @ 2.06 hrs HW=32.40' (Free Discharge)
└**1=HB_Q060_090620** (Custom Controls 0.04 cfs)
└**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

KEY DIMENSIONS

Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo™	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

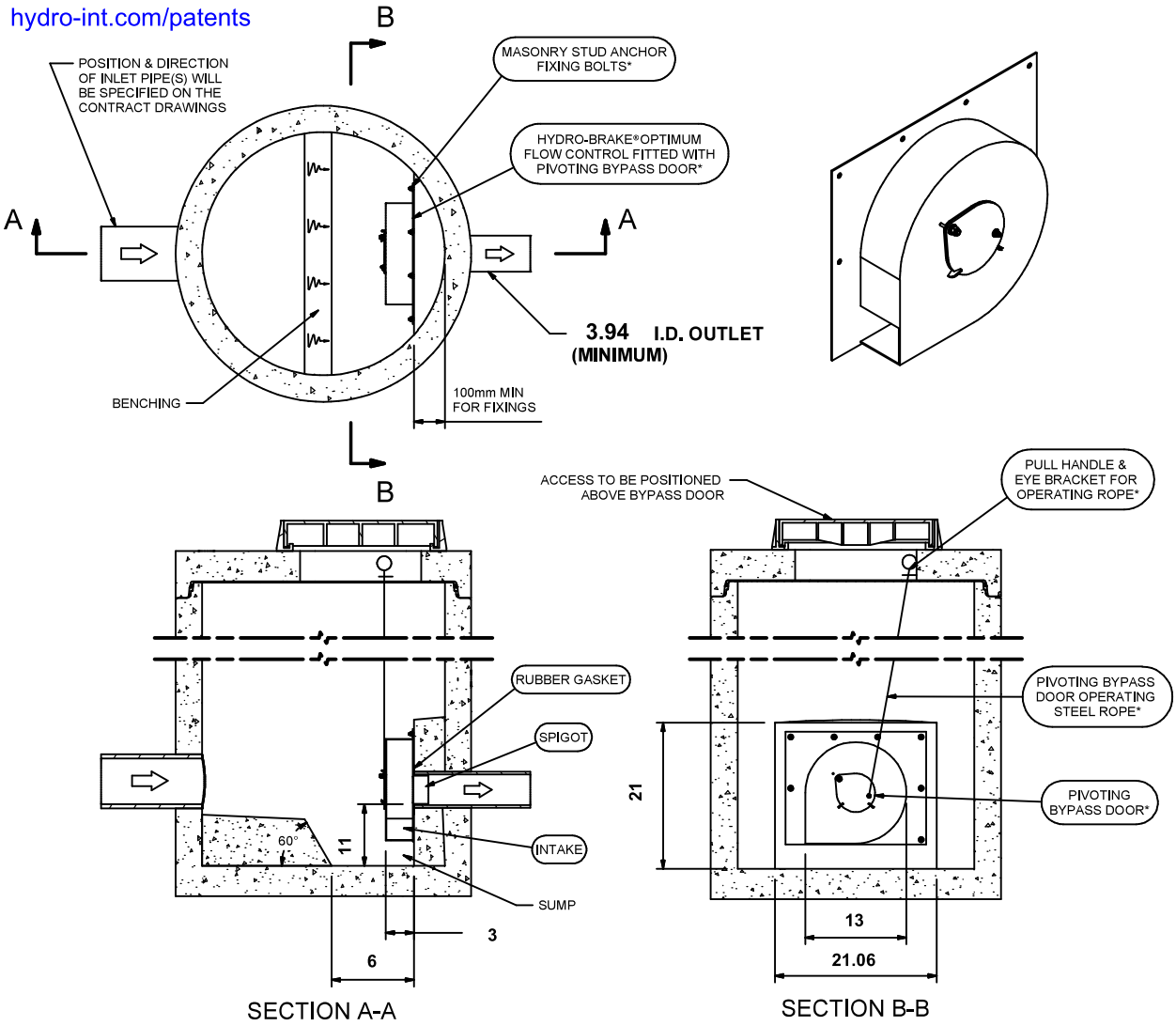
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



IMPORTANT: (oval) LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE !

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve. **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/6/2020 10:29 PM
SITE	MU SWMB #6.0
DESIGNER	**Bill Fitzgerald**
REF	**ocs #6.7**

SFF-0065-1982-1036-1614

Hydro-Brake® Optimum

 Hydro International Ltd, 94 Hutchins Drive, Portland, Maine, 04102-1930. Tel: +1 (207) 756 6200 Fax: +1 (207) 756 6212 Web: www.hydro-int.com Email: enquiries@hydro-int.com

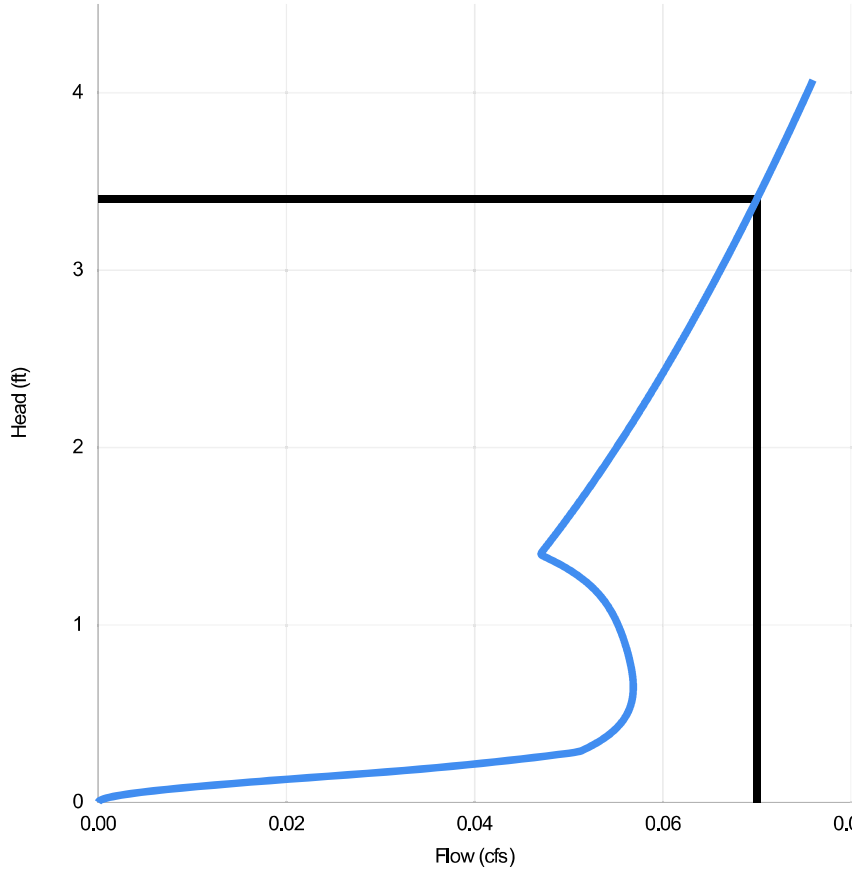
wfitz@wef-pe.com

Technical Specification		
Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.117	0.017
0.234	0.043
0.352	0.053
0.469	0.056
0.586	0.057
0.703	0.057
0.821	0.056
0.938	0.056
1.055	0.055
1.172	0.053
1.290	0.051
1.407	0.047
1.524	0.049
1.641	0.050
1.759	0.052
1.876	0.054
1.993	0.055
2.110	0.056
2.228	0.058
2.345	0.059
2.462	0.060
2.579	0.062
2.697	0.063
2.814	0.064
2.931	0.065
3.048	0.067
3.166	0.068
3.283	0.069
3.400	0.070

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/6/2020 10:29 PM
Site	MU SWMB #6.0
DESIGNER	Bill Fitzgerald
Ref	ocs #6.7

SFF-0065-1982-1036-1614

Hydro-Brake Optimum®

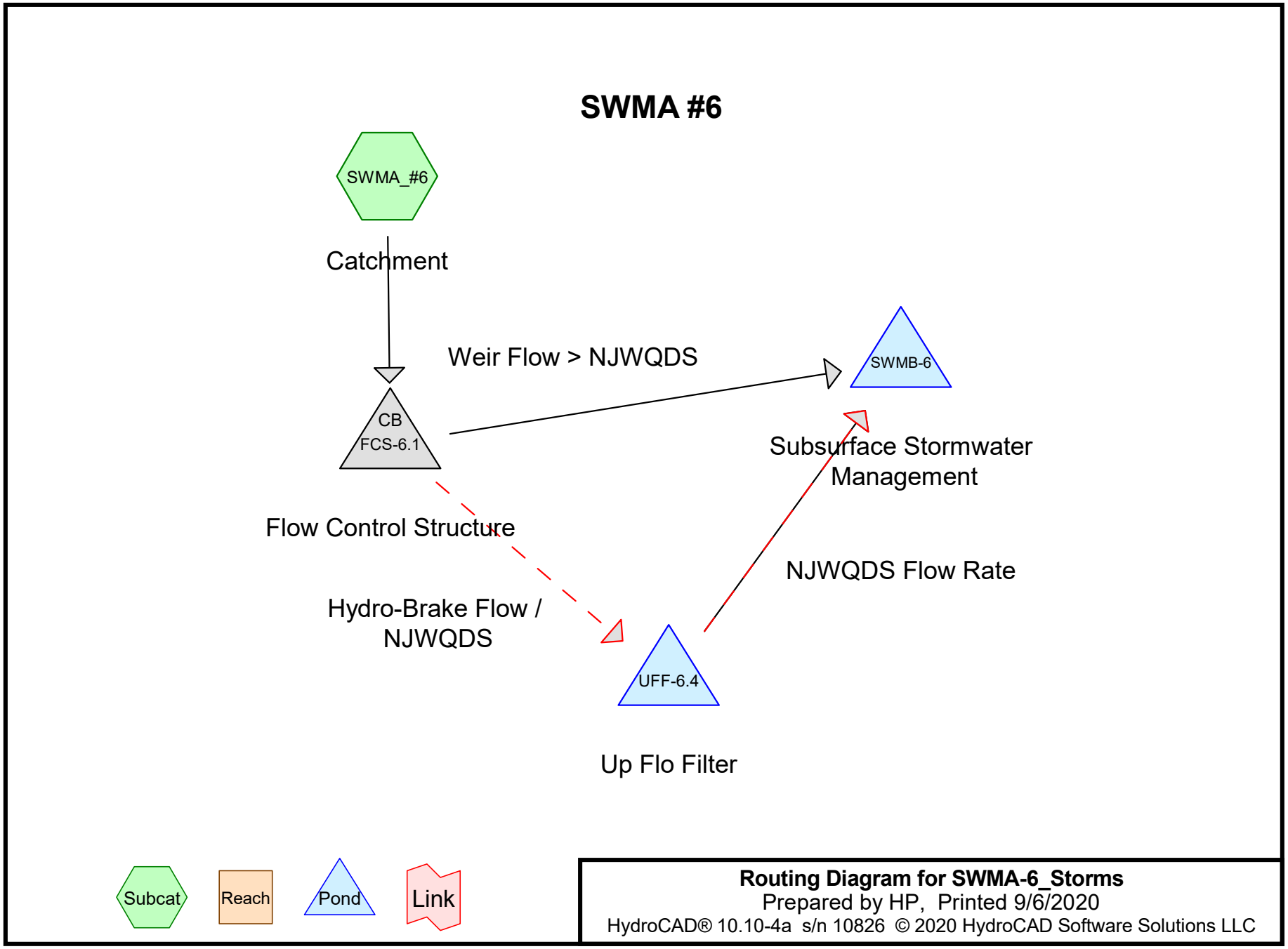
SWMB #5.0 Elevation - Storage - Discharge			
	Elevation (feet)	Storage (cubic-feet)	Discharge (cfs)
	32.25	0.0000	0.00
	32.35	627.0000	0.04
	32.45	1253.0000	0.05
	32.55	1880.0000	0.05
	32.65	2505.0000	0.06
	32.75	3131.0000	0.06
	32.85	3756.0000	0.06
	32.95	4380.0000	0.06
	33.05	5004.0000	0.06
	33.15	5627.0000	0.06
	33.25	6249.0000	0.05
	33.35	6871.0000	0.05
	33.45	7491.0000	0.05
	33.55	8111.0000	0.05
	33.65	8730.0000	0.05
	33.75	9348.0000	0.05
	33.85	9965.0000	0.05
	33.95	10580.0000	0.05
	34.05	11194.0000	0.05
	34.15	11807.0000	0.06
	34.25	12417.0000	0.06
	34.35	13026.0000	0.06
	34.45	13631.0000	0.07
	34.55	14233.0000	0.10
	34.65	14831.0000	0.16
	34.75	15427.0000	0.25
	34.85	16022.0000	0.35
	34.95	16617.0000	0.48
	35.05	17212.0000	0.63
	35.15	17807.0000	0.81
	35.25	18136.0000	1.02
	35.35	18136.0000	1.25

SWMB #5.0 Event Summary Tabulation					
	Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
	NJWQDS	0.93	0.04	32.40	964
	1-Year	2.02	0.06	32.88	3,948
	2-Year	2.50	0.06	33.08	5,214
	5-Year	3.86	0.06	33.77	9,444
	10-Year	4.87	0.06	34.25	12,393
	25-Year	6.51	0.18	34.67	14,966
	50-Year	8.04	0.44	34.92	16,446
	100-Year	9.56	0.89	35.19	18,043

APPENDIX III.6

(Note: this appendix contains detailed hydrologic and hydraulic analyses, with supporting information, for post-development SWMA #6)

CONTENTS


SWMA #6
SWMA_#6
Catchment
Weir Flow > NJWQDS
SWMB-6
CB
FCS-6.1
Subsurface Stormwater
Management
Flow Control Structure
NJWQDS Flow Rate
Hydro-Brake Flow /
NJWQDS
UFF-6.4
Up Flo Filter
Subcat
Reach
Pond
Link
Routing Diagram for SWMA-6_Storms
Prepared by HP, Printed 9/6/2020
HydroCAD® 10.10-4a s/n 10826 © 2020 HydroCAD Software Solutions LLC

SWMA #6 Event Summary Tabulation					
	Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
	NJWQDS	1.25	1.44	0.0420	1.03
	1-Year	2.90	1.35	0.1090	2.67
	2-Year	3.30	1.54	0.1250	3.07
	5-Year	4.40	2.06	0.1700	4.16
	10-Year	5.20	2.44	0.2030	4.96
	25-Year	6.50	3.05	0.2560	6.26
	50-Year	7.70	3.62	0.3050	7.46
	100-Year	8.90	4.19	0.3540	8.66

Summary for Pond FCS-6.1: Flow Control Structure

[57] Hint: Peaked at 34.54' (Flood elevation advised)

Inflow Area = 0.491 ac,100.00% Impervious, Inflow Depth = 1.03" for NJWQDS event
Inflow = 1.44 cfs @ 1.11 hrs, Volume= 0.042 af
Outflow = 1.44 cfs @ 1.11 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 1.44 cfs @ 1.11 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-75.00 hrs, dt= 0.01 hrs
Peak Elev= 34.54' @ 1.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	33.24'	**HB_Q1.44_090620** Head (feet) 0.00 0.12 0.24 0.36 0.48 0.60 0.72 0.84 0.97 1.09 1.21 1.33 1.45 1.57 1.69 1.81 1.93 2.05 2.17 2.29 2.41 2.53 2.65 2.78 2.90 3.02 3.14 3.26 3.38 3.50 Disch. (cfs) 0.000 0.045 0.170 0.362 0.601 0.865 1.128 1.351 1.404 1.423 1.433 1.437 1.437 1.432 1.424 1.414 1.401 1.384 1.363 1.335 1.299 1.285 1.314 1.342 1.370 1.397 1.423 1.449 1.475 1.500
#2	Primary	35.63'	**Custom Weir/Orifice, Cv= 3.10 (C= 3.88)** Head (feet) 0.00 10.00 Width (feet) 11.00 11.00

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=33.24' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=1.43 cfs @ 1.11 hrs HW=34.50' (Free Discharge)
↑—**1=HB_Q1.44_090620** (Custom Controls 1.43 cfs)

KEY DIMENSIONS

Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.500	1.500
Flush-Flo™	1.367	1.438
Kick-Flo®	2.483	1.272
Mean Flow		1.191

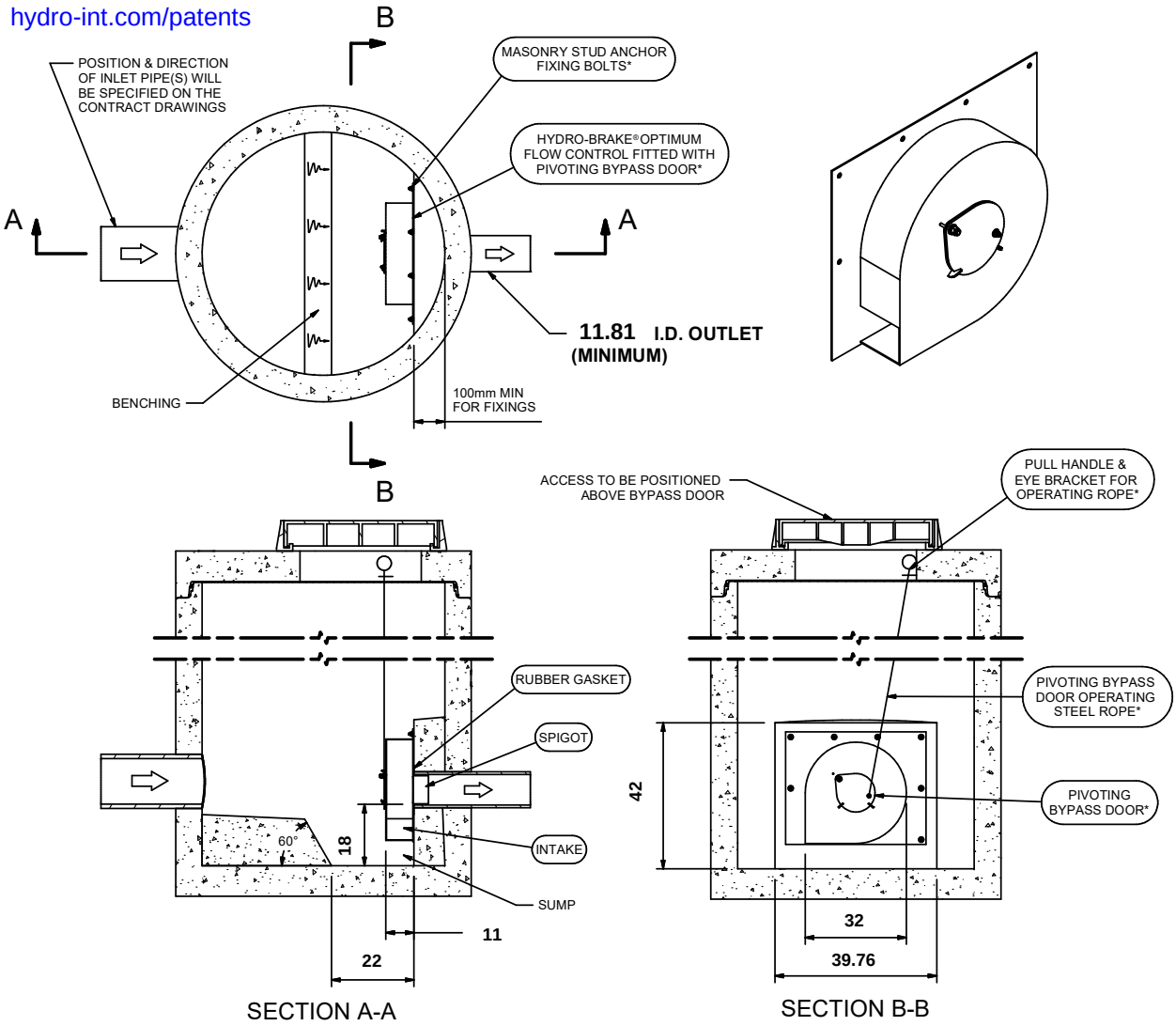
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0270-4247-1067-4077 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/6/2020 9:38 PM
SITE	MU SWMB #6.0
DESIGNER	**Bill Fitzgerald**
REF	**FCS #6.1**

SFF-0270-4247-1067-4077

Hydro-Brake® Optimum

wfitz@wef-pe.com

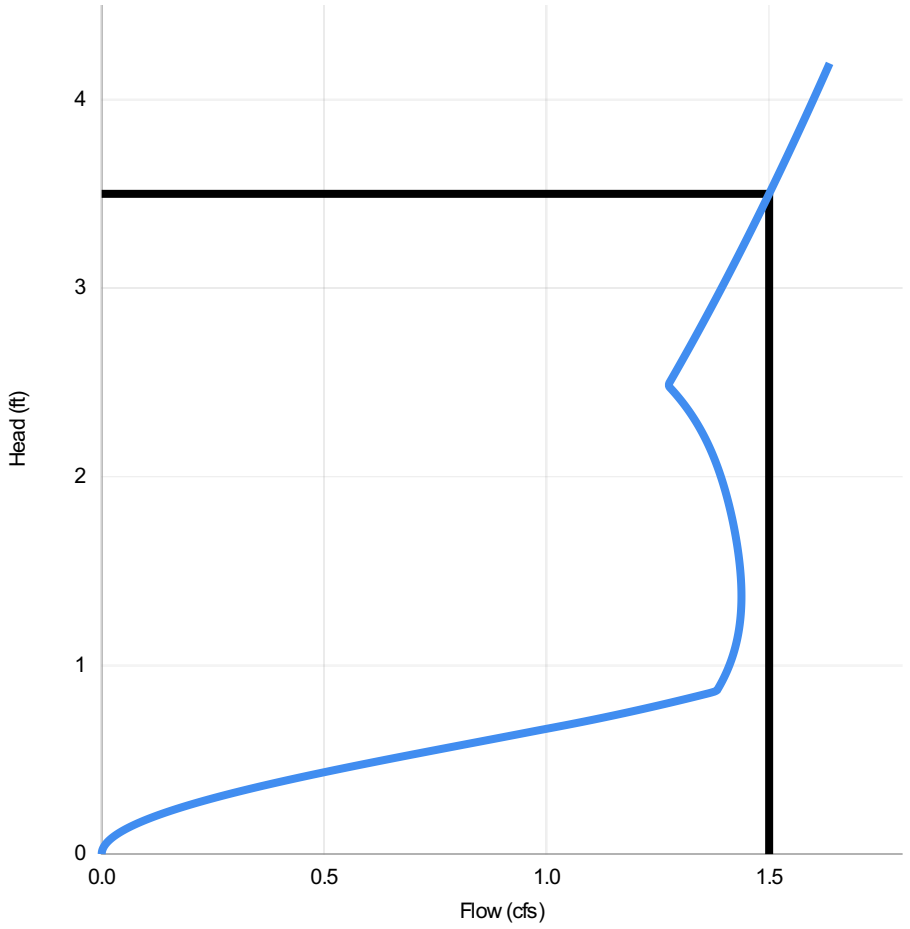
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.500	1.500
Flush-Flo	1.367	1.438
Kick-Flo®	2.483	1.272
Mean Flow		1.191

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.121	0.045
0.241	0.170
0.362	0.362
0.483	0.601
0.603	0.865
0.724	1.128
0.845	1.351
0.966	1.404
1.086	1.423
1.207	1.433
1.328	1.437
1.448	1.437
1.569	1.432
1.690	1.424
1.810	1.414
1.931	1.401
2.052	1.384
2.172	1.363
2.293	1.335
2.414	1.299
2.534	1.285
2.655	1.314
2.776	1.342
2.897	1.370
3.017	1.397
3.138	1.423
3.259	1.449
3.379	1.475
3.500	1.500

DESIGN ADVICE

The head/flow characteristics of this SFF-0270-4247-1067-4077 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/6/2020 9:38 PM
Site	MU SWMB #6.0
DESIGNER	Bill Fitzgerald
Ref	FCS #6.1

SFF-0270-4247-1067-4077

Hydro-Brake Optimum®

FCS #6.1 Elevation-Discharge Tabulation

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
33.24	0.00	0.00	0.00
33.54	0.27	0.00	0.27
33.84	0.87	0.00	0.87
34.14	1.38	0.00	1.38
34.44	1.43	0.00	1.43
34.74	1.43	0.00	1.43
35.04	1.41	0.00	1.41
35.34	1.38	0.00	1.38
35.64	1.34	0.04	1.30
35.94	8.68	7.36	1.32
36.24	21.70	20.31	1.39
36.54	38.46	37.00	1.46

FCS #6.1 Event Summary Tabulation

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	1.44	1.44	0.0000	1.44	34.54	0.00
1-Year	1.35	1.35	0.0000	1.35	34.08	0.00
2-Year	1.54	1.54	0.2400	1.44	35.66	0.00
5-Year	2.06	2.06	0.7700	1.41	35.69	0.00
10-Year	2.44	2.44	1.1500	1.41	35.72	0.00
25-Year	3.05	3.05	1.7700	1.42	35.75	0.00
50-Year	3.62	3.62	2.3300	1.41	35.77	0.00
100-Year	4.19	4.19	2.9000	1.43	35.79	0.00

UFF #6 Event Summary Tabulation

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	1.44	1.44	0.00	0.0000
1-Year	1.35	1.35	0.00	0.0000
2-Year	1.44	1.44	0.00	0.0000
5-Year	1.41	1.41	0.00	0.0000
10-Year	1.41	1.41	0.00	0.0000
25-Year	1.42	1.42	0.00	0.0000
50-Year	1.41	1.41	0.00	0.0000
100-Year	1.43	1.43	0.00	0.0000

Summary for Pond SWMB-6: Subsurface Stormwater Management

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 0.491 ac,100.00% Impervious, Inflow Depth = 1.03" for NJWQDS event
Inflow = 1.44 cfs @ 1.11 hrs, Volume= 0.042 af
Outflow = 0.06 cfs @ 1.18 hrs, Volume= 0.042 af, Atten= 96%, Lag= 4.4 min
Primary = 0.06 cfs @ 1.18 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-75.00 hrs, dt= 0.01 hrs
Peak Elev= 32.68' @ 1.91 hrs Surf.Area= 2,687 sf Storage= 1,589 cf

Plug-Flow detention time= 259.1 min calculated for 0.042 af (100% of inflow)
Center-of-Mass det. time= 259.0 min (329.3 - 70.3)

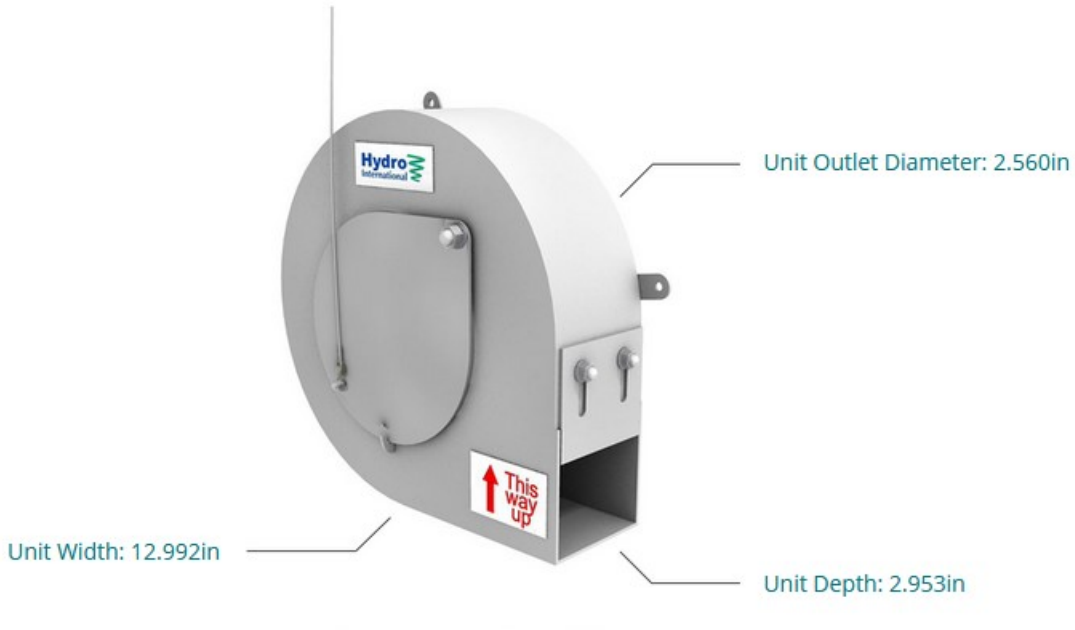
Volume	Invert	Avail.Storage	Storage Description
#1A	32.00'	0 cf	**39.37'W x 55.12'L x 3.28'H Field A** 7,119 cf Overall - 7,119 cf Embedded = 0 cf x 40.0% Voids
#2A	32.00'	6,407 cf	**ACF R-Tank XD 20** x 672 Inside #1 Inside= 19.7"W x 39.4"H => 4.84 sf x 1.97'L = 9.5 cf Outside= 19.7"W x 39.4"H => 5.38 sf x 1.97'L = 10.6 cf 672 Chambers in 24 Rows
#3B	32.00'	503 cf	**11.00'W x 47.00'L x 3.50'H Field B** 1,810 cf Overall - 551 cf Embedded = 1,258 cf x 40.0% Voids
#4B	32.00'	551 cf	**ADS_StormTech SC-740 +Cap** x 12 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 12 Chambers in 2 Rows
		7,462 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	31.88'	**HB_Q060_090620** Head (feet) 0.00 0.12 0.23 0.35 0.47 0.59 0.70 0.82 0.94 1.05 1.17 1.29 1.41 1.52 1.64 1.76 1.88 1.99 2.11 2.23 2.35 2.46 2.58 2.70 2.81 2.93 3.05 3.17 3.28 3.40 Disch. (cfs) 0.000 0.017 0.043 0.053 0.056 0.057 0.057 0.056 0.056 0.055 0.053 0.051 0.047 0.049 0.050 0.052 0.054 0.055 0.056 0.058 0.059 0.060 0.062 0.063 0.064 0.065 0.067 0.068 0.069 0.070
#2	Primary	34.08'	**28.1 deg Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.06 cfs @ 1.18 hrs HW=32.47' (Free Discharge)
1=HB_Q060_090620 (Custom Controls 0.06 cfs)
2=Sharp-Crested Vee/Trap Weir (Controls 0.00 cfs)

KEY DIMENSIONS



Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo™	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

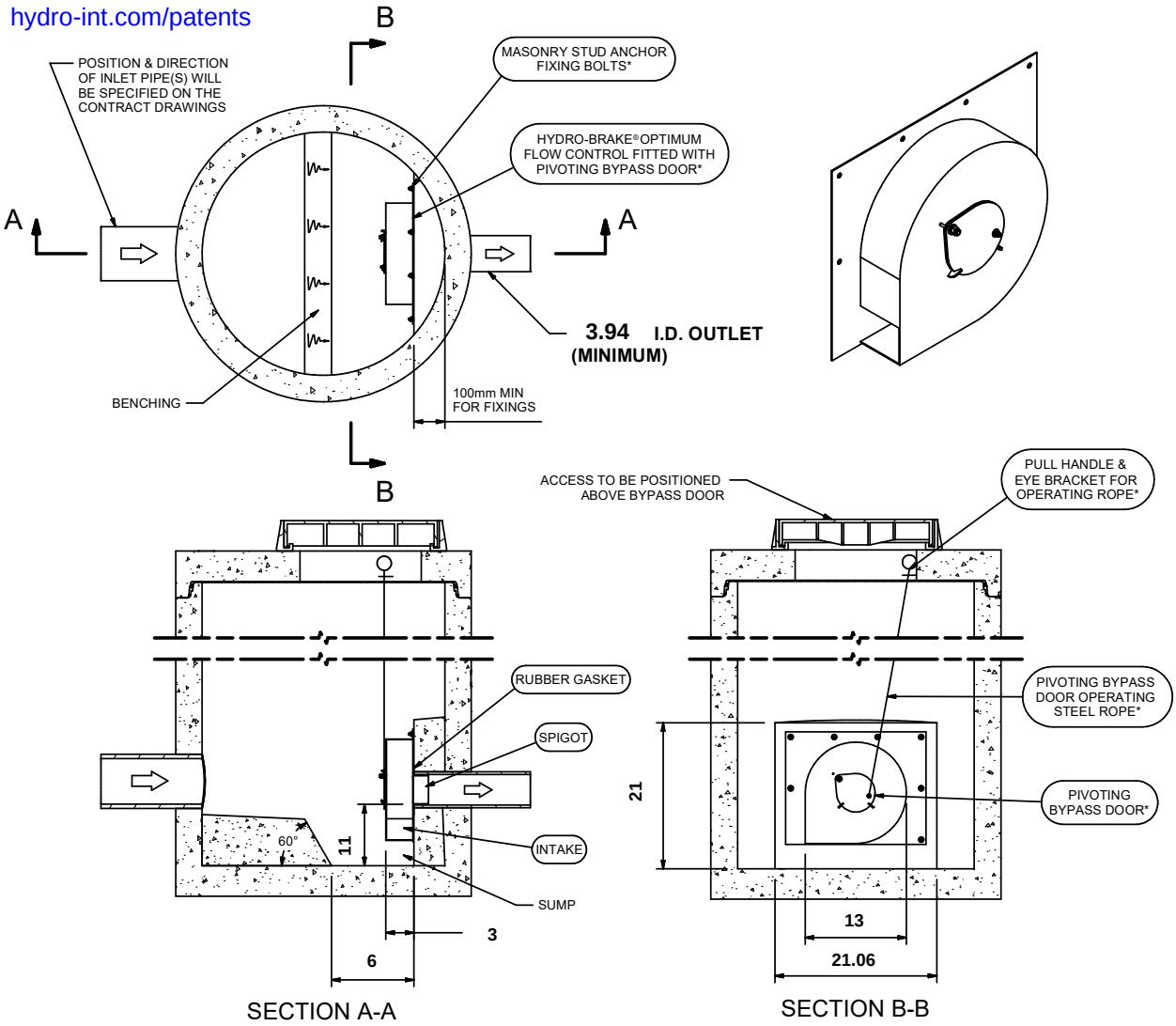
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/6/2020 10:29 PM
SITE	MU SWMB #6.0
DESIGNER	**Bill Fitzgerald**
REF	**ocs #6.7**

SFF-0065-1982-1036-1614

Hydro-Brake® Optimum

 Hydro International Ltd, 94 Hutchins Drive, Portland, Maine, 04102-1930. Tel; +1 (207) 756 6200 Fax; +1 (207) 756 6212 Web; www.hydro-int.com Email; enquiries@hydro-int.com

wfitz@wef-pe.com

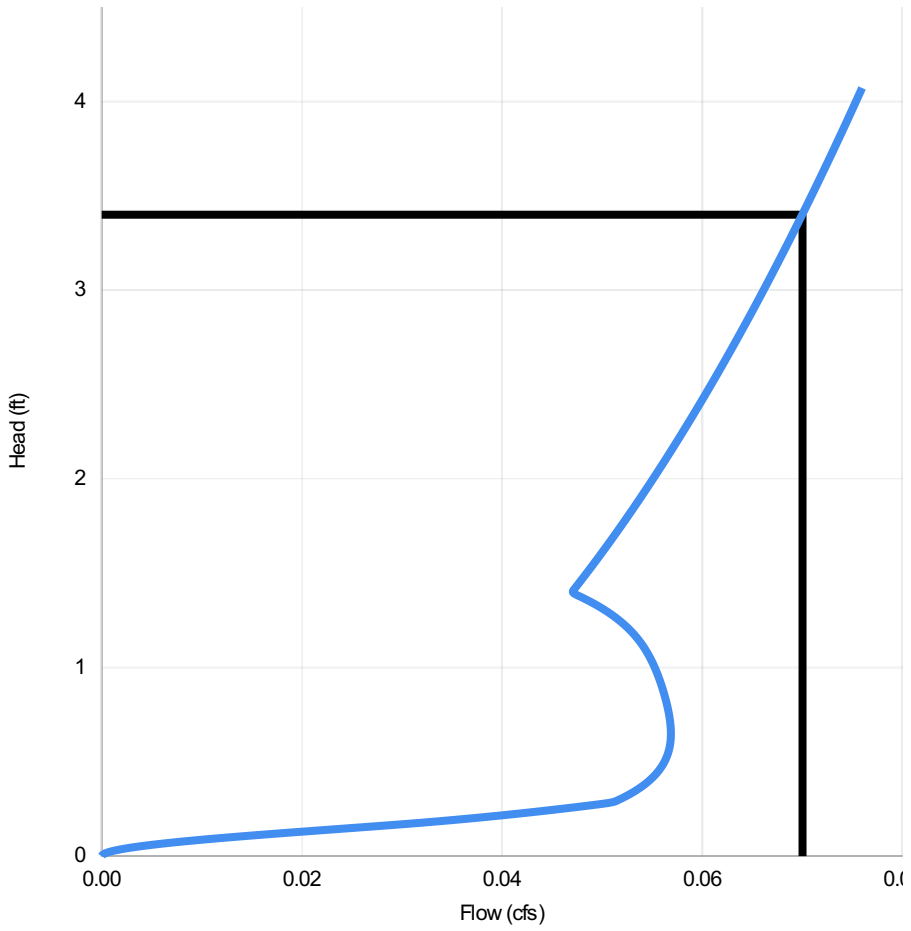
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.117	0.017
0.234	0.043
0.352	0.053
0.469	0.056
0.586	0.057
0.703	0.057
0.821	0.056
0.938	0.056
1.055	0.055
1.172	0.053
1.290	0.051
1.407	0.047
1.524	0.049
1.641	0.050
1.759	0.052
1.876	0.054
1.993	0.055
2.110	0.056
2.228	0.058
2.345	0.059
2.462	0.060
2.579	0.062
2.697	0.063
2.814	0.064
2.931	0.065
3.048	0.067
3.166	0.068
3.283	0.069
3.400	0.070

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/6/2020 10:29 PM
Site	MU SWMB #6.0
DESIGNER	Bill Fitzgerald
Ref	ocs #6.7

SFF-0065-1982-1036-1614

Hydro-Brake Optimum®

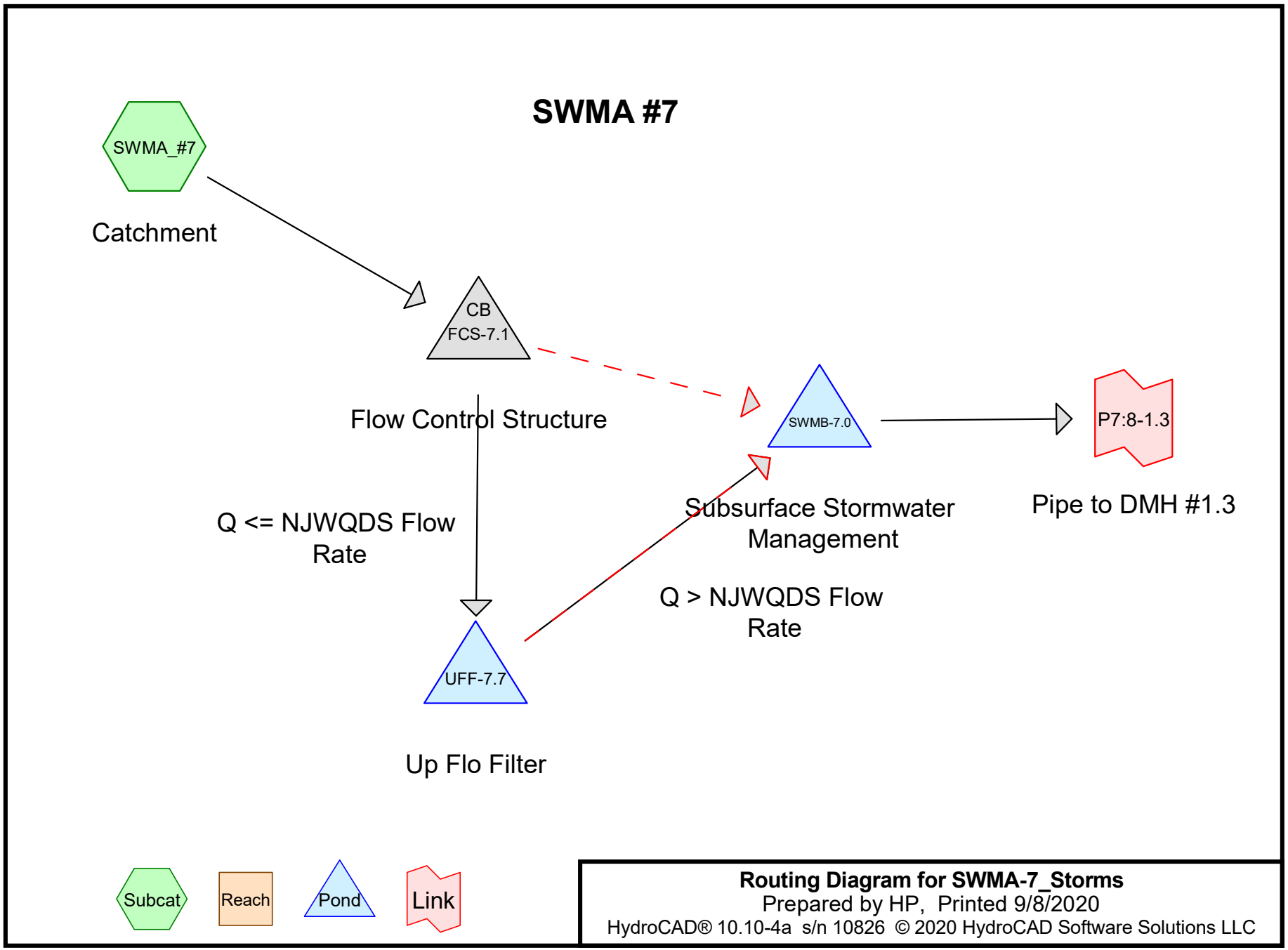
SWMB #5.0 Elevation - Storage - Discharge			
	Elevation (feet)	Storage (cubic-feet)	Discharge (cfs)
	32.00	0	0.00
	32.10	235	0.04
	32.20	470	0.05
	32.30	705	0.05
	32.40	939	0.06
	32.50	1,173	0.06
	32.60	1,407	0.06
	32.70	1,641	0.06
	32.80	1,874	0.06
	32.90	2,107	0.06
	33.00	2,339	0.05
	33.10	2,571	0.05
	33.20	2,802	0.05
	33.30	3,033	0.05
	33.40	3,264	0.05
	33.50	3,493	0.05
	33.60	3,722	0.05
	33.70	3,951	0.05
	33.80	4,178	0.05
	33.90	4,404	0.06
	34.00	4,630	0.06
	34.10	4,854	0.06
	34.20	5,076	0.06
	34.30	5,296	0.07
	34.40	5,514	0.10
	34.50	5,730	0.14
	34.60	5,946	0.19
	34.70	6,162	0.26
	34.80	6,378	0.35
	34.90	6,594	0.47
	35.00	6,810	0.60
	35.10	7,026	0.76
	35.20	7,242	0.94
	35.30	7,421	1.15
	35.40	7,441	1.38
	35.50	7,462	1.65

SWMB #6.0 Event Summary Tabulation					
	Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
	NJWQDS	1.44	0.06	32.68	1,589
	1-Year	1.35	0.06	33.08	2,533
	2-Year	1.54	0.06	33.32	3,069
	5-Year	2.06	0.06	33.92	4,445
	10-Year	2.44	0.08	34.32	5,342
	25-Year	3.05	0.24	34.68	6,109
	50-Year	3.62	0.52	34.94	6,690
	100-Year	4.19	0.98	35.22	7,290

APPENDIX III.7

(Note: this appendix contains detailed hydrologic and hydraulic analyses, with supporting information, for post-development SWMA #7)

CONTENTS


SWMA #7
SWMA_#7
Catchment
CB
FCS-7.1
Flow Control Structure
SWMB-7.0
P7:8-1.3
Pipe to DMH #1.3
Q <= NJWQDS Flow Rate
Subsurface Stormwater Management
Q > NJWQDS Flow Rate
UFF-7.7
Up Flo Filter
Subcat
Reach
Pond
Link
Routing Diagram for SWMA-7_Storms
Prepared by HP, Printed 9/8/2020
HydroCAD® 10.10-4a s/n 10826 © 2020 HydroCAD Software Solutions LLC

SWMA #7 Event Summary Tabulation					
	Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
	NJWQDS	1.25	0.64	0.0170	0.30
	1-Year	2.90	1.19	0.0845	1.50
	2-Year	3.30	1.46	0.1035	1.84
	5-Year	4.40	2.20	0.1583	2.82
	10-Year	5.20	2.75	0.1996	3.55
	25-Year	6.50	3.64	0.2683	4.78
	50-Year	7.70	4.45	0.3327	5.92
	100-Year	8.90	5.27	0.3979	7.08

Summary for Pond FCS-7.1: Flow Control Structure

[57] Hint: Peaked at 34.68' (Flood elevation advised)

Inflow Area = 0.674 ac, 0.00% Impervious, Inflow Depth = 0.30" for NJWQDS event
Inflow = 0.64 cfs @ 1.13 hrs, Volume= 0.017 af
Outflow = 0.64 cfs @ 1.13 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 1.13 hrs, Volume= 0.017 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-75.00 hrs, dt= 0.01 hrs
Peak Elev= 34.68' @ 1.13 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	33.16'	**Q_HB_FCS_7.1** Head (feet) 0.00 0.10 0.19 0.29 0.39 0.48 0.58 0.68 0.77 0.87 0.97 1.06 1.16 1.25 1.35 1.45 1.54 1.64 1.74 1.83 1.93 2.03 2.12 2.22 2.32 2.41 2.51 2.61 2.70 2.80 Disch. (cfs) 0.000 0.024 0.091 0.192 0.316 0.447 0.566 0.622 0.630 0.633 0.631 0.626 0.616 0.602 0.601 0.621 0.640 0.659 0.677 0.695 0.712 0.729 0.745 0.761 0.777 0.792 0.807 0.821 0.836 0.850
#2	Secondary	35.45'	**Custom Weir/Orifice, Cv= 3.10 (C= 3.88)** Head (feet) 0.00 10.00 Width (feet) 11.00 11.00

Primary OutFlow Max=0.62 cfs @ 1.13 hrs HW=34.63' (Free Discharge)
↑—**1=Q_HB_FCS_7.1** (Custom Controls 0.62 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=33.16' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Controls 0.00 cfs)

KEY DIMENSIONS

Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	2.800	0.850
Flush-Flo™	0.876	0.633
Kick-Flo®	1.307	0.592
Mean Flow		0.597

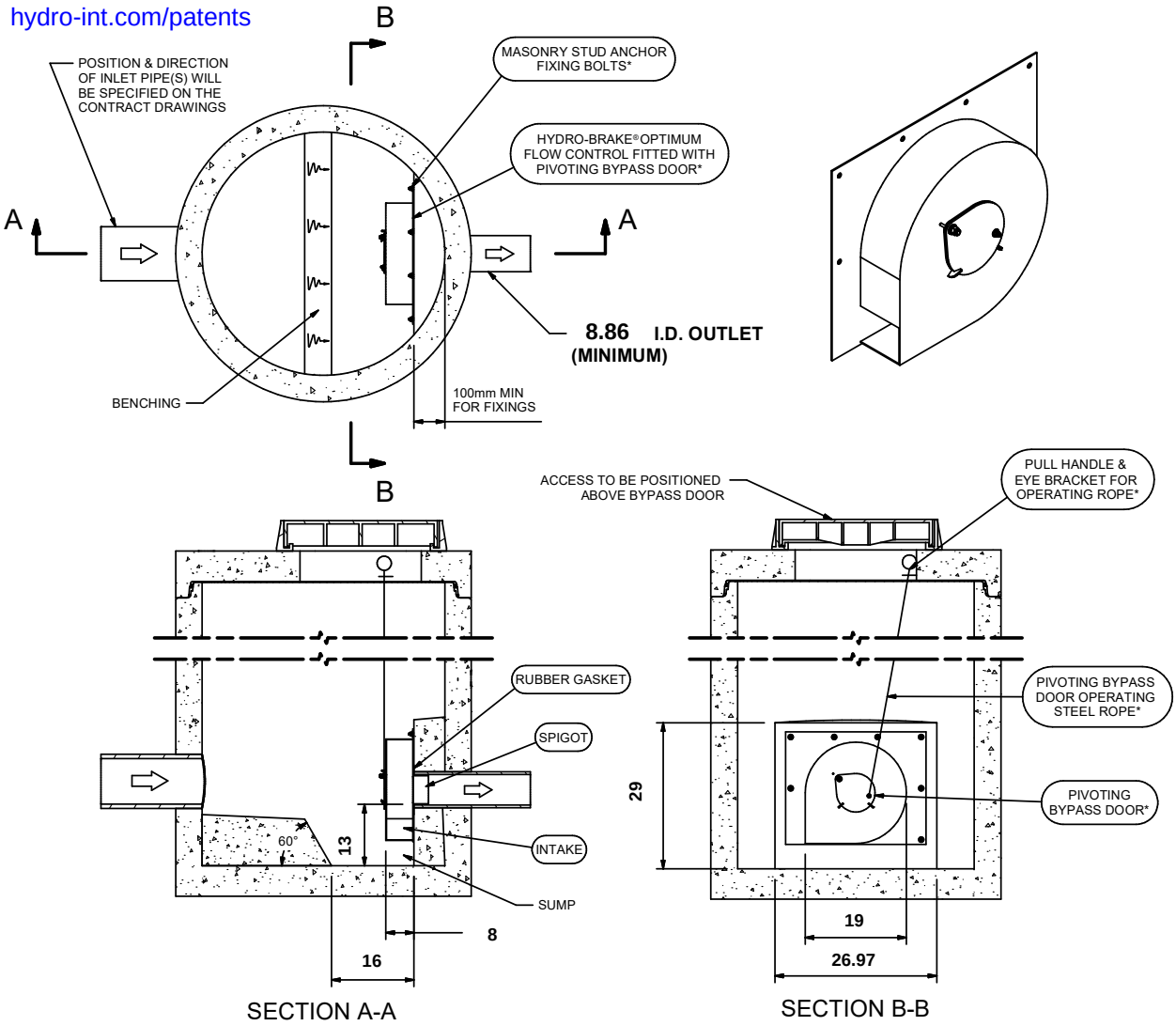
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0196-2406-0853-1795 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/7/2020 7:05 PM
SITE	MU SWMB #7.0
DESIGNER	**Bill Fitzgerald**
REF	**FCS #7.1**

SFF-0196-2406-0853-1795

Hydro-Brake® Optimum

wfitz@wef-pe.com

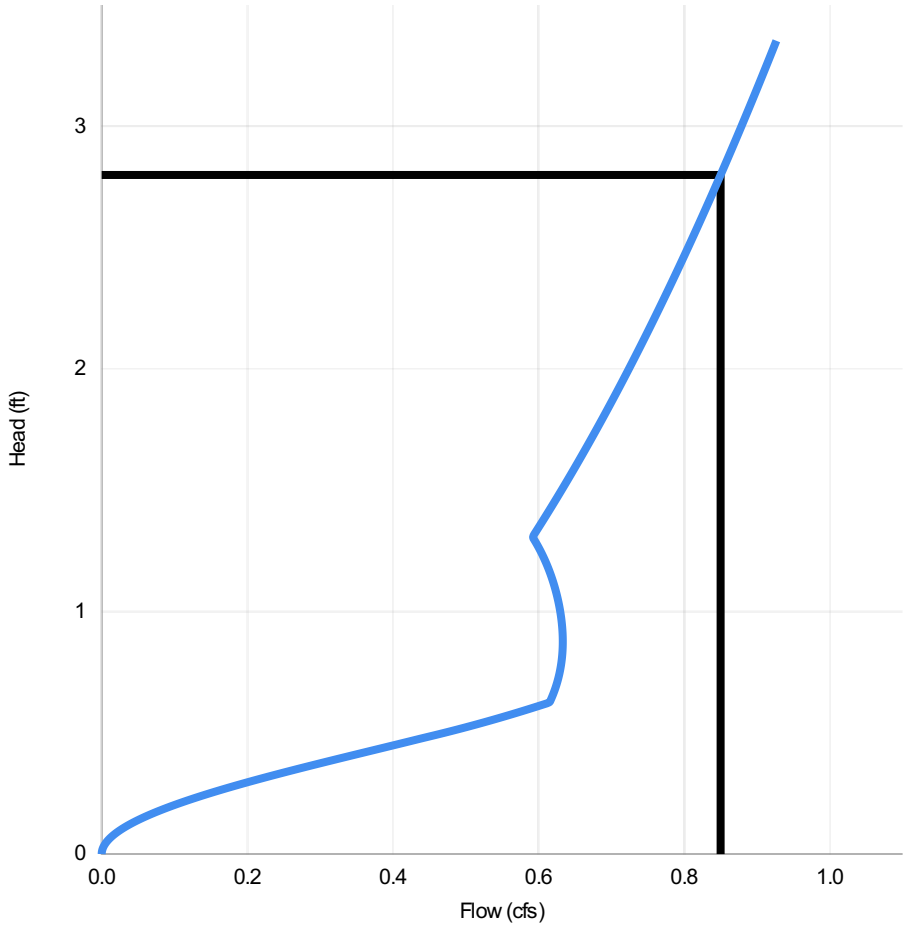
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	2.800	0.850
Flush-Flo	0.876	0.633
Kick-Flo®	1.307	0.592
Mean Flow		0.597

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.097	0.024
0.193	0.091
0.290	0.192
0.386	0.316
0.483	0.447
0.579	0.566
0.676	0.622
0.772	0.630
0.869	0.633
0.966	0.631
1.062	0.626
1.159	0.616
1.255	0.602
1.352	0.601
1.448	0.621
1.545	0.640
1.641	0.659
1.738	0.677
1.834	0.695
1.931	0.712
2.028	0.729
2.124	0.745
2.221	0.761
2.317	0.777
2.414	0.792
2.510	0.807
2.607	0.821
2.703	0.836
2.800	0.850

DESIGN ADVICE

The head/flow characteristics of this SFF-0196-2406-0853-1795 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

DATE	9/7/2020 7:05 PM
Site	MU SWMB #7.0
DESIGNER	Bill Fitzgerald
Ref	FCS #7.1

SFF-0196-2406-0853-1795

Hydro-Brake Optimum®

FCS #7.1 Elevation-Discharge Tabulation

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
33.17	0.00	0.00	0.00
33.47	0.20	0.20	0.00
33.77	0.58	0.58	0.00
34.07	0.63	0.63	0.00
34.37	0.61	0.61	0.00
34.67	0.63	0.63	0.00
34.97	0.69	0.69	0.00
35.27	0.74	0.74	0.00
35.57	2.56	0.79	1.77
35.87	12.44	0.84	11.60
36.17	26.89	0.85	26.04
36.47	44.76	0.85	43.91

FCS #7.1 Event Summary Tabulation

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	0.64	0.64	0.64	0.00	34.69	0.0000
1-Year	1.19	1.19	0.78	0.42	35.50	0.0000
2-Year	1.46	1.46	0.78	0.68	35.51	0.0000
5-Year	2.20	2.20	0.79	1.41	35.55	0.0000
10-Year	2.75	2.75	0.79	1.96	35.58	0.0000
25-Year	3.64	3.64	0.80	2.84	35.61	0.0000
50-Year	4.45	4.45	0.80	3.65	35.64	0.0000
100-Year	5.27	5.27	0.81	4.46	35.67	0.0000

UFF #7 Event Summary Tabulation

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
NJWQDS	0.64	0.64	0.0000	0.00
1-Year	0.78	0.78	0.00	0.0000
2-Year	0.78	0.78	0.00	0.0000
5-Year	0.79	0.79	0.00	0.0000
10-Year	0.79	0.79	0.00	0.0000
25-Year	0.80	0.80	0.00	0.0000
50-Year	0.80	0.80	0.00	0.0000
100-Year	0.81	0.81	0.00	0.0000

Summary for Pond SWMB-7.0: Subsurface Stormwater Management

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 0.674 ac, 0.00% Impervious, Inflow Depth = 0.30" for NJWQDS event
Inflow = 0.64 cfs @ 1.13 hrs, Volume= 0.017 af
Outflow = 0.05 cfs @ 1.87 hrs, Volume= 0.017 af, Atten= 91%, Lag= 44.3 min
Primary = 0.05 cfs @ 1.87 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 0.00-75.00 hrs, dt= 0.01 hrs
Peak Elev= 32.32' @ 1.87 hrs Surf.Area= 2,780 sf Storage= 551 cf

Plug-Flow detention time= 103.6 min calculated for 0.017 af (100% of inflow)
Center-of-Mass det. time= 103.5 min (183.1 - 79.6)

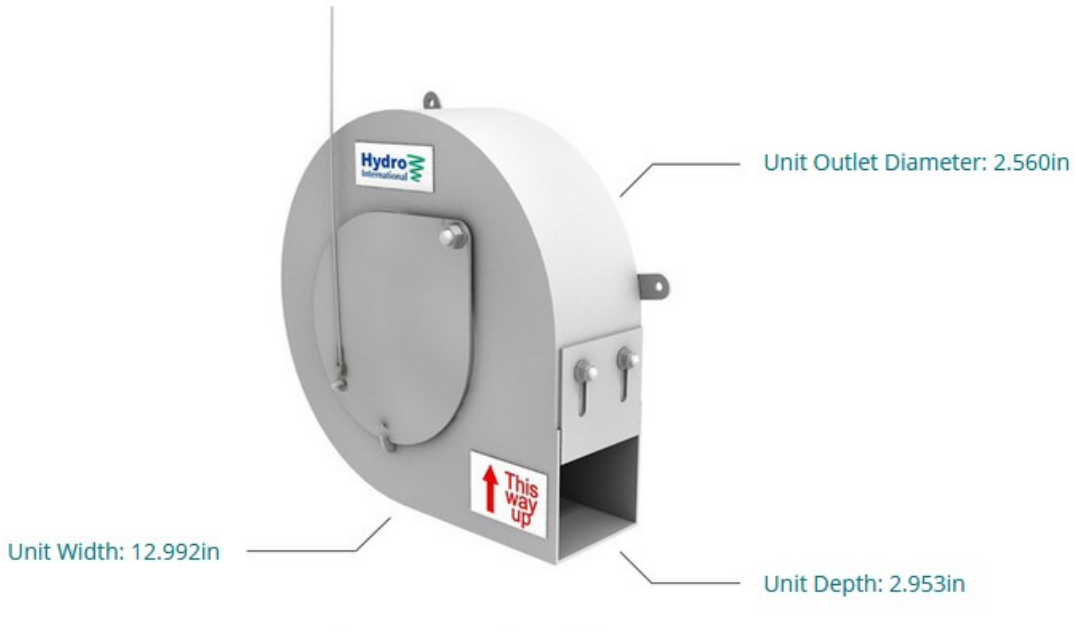
Volume	Invert	Avail.Storage	Storage Description
#1A	32.10'	0 cf	**11.81'W x 49.26'L x 2.95'H Field A** 1,718 cf Overall - 1,718 cf Embedded = 0 cf x 40.0% Voids
#2A	32.10'	1,632 cf	**ACF R-Tank SD 4** x 189 Inside #1 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 189 Chambers in 9 Rows
#3B	32.10'	400 cf	**11.00'W x 47.00'L x 3.00'H Field B** 1,551 cf Overall - 551 cf Embedded = 1,000 cf x 40.0% Voids
#4B	32.10'	551 cf	**ADS_StormTech SC-740 +Cap** x 12 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 12 Chambers in 2 Rows
#5C	32.10'	0 cf	**34.12'W x 49.26'L x 2.95'H Field C** 4,963 cf Overall - 4,963 cf Embedded = 0 cf x 40.0% Voids
#6C	32.10'	4,715 cf	**ACF R-Tank SD 4** x 546 Inside #5 Inside= 15.7"W x 35.4"H => 3.68 sf x 2.35'L = 8.6 cf Outside= 15.7"W x 35.4"H => 3.88 sf x 2.35'L = 9.1 cf 546 Chambers in 26 Rows
		7,298 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard
Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	31.90'	**HB_Q060_090620** Head (feet) 0.00 0.12 0.23 0.35 0.47 0.59 0.70 0.82 0.94 1.05 1.17 1.29 1.41 1.52 1.64 1.76 1.88 1.99 2.11 2.23 2.35 2.46 2.58 2.70 2.81 2.93 3.05 3.17 3.28 3.40 Disch. (cfs) 0.000 0.017 0.043 0.053 0.056 0.057 0.057 0.056 0.056 0.055 0.053 0.051 0.047 0.049 0.050 0.052 0.054 0.055 0.056 0.058 0.059 0.060 0.062 0.063 0.064 0.065 0.067 0.068 0.069 0.070
#2	Primary	33.47'	**28.1 deg Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=0.05 cfs @ 1.87 hrs HW=32.32' (Free Discharge)
└─**1=HB_Q060_090620** (Custom Controls 0.05 cfs)
└─**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

KEY DIMENSIONS



Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo™	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

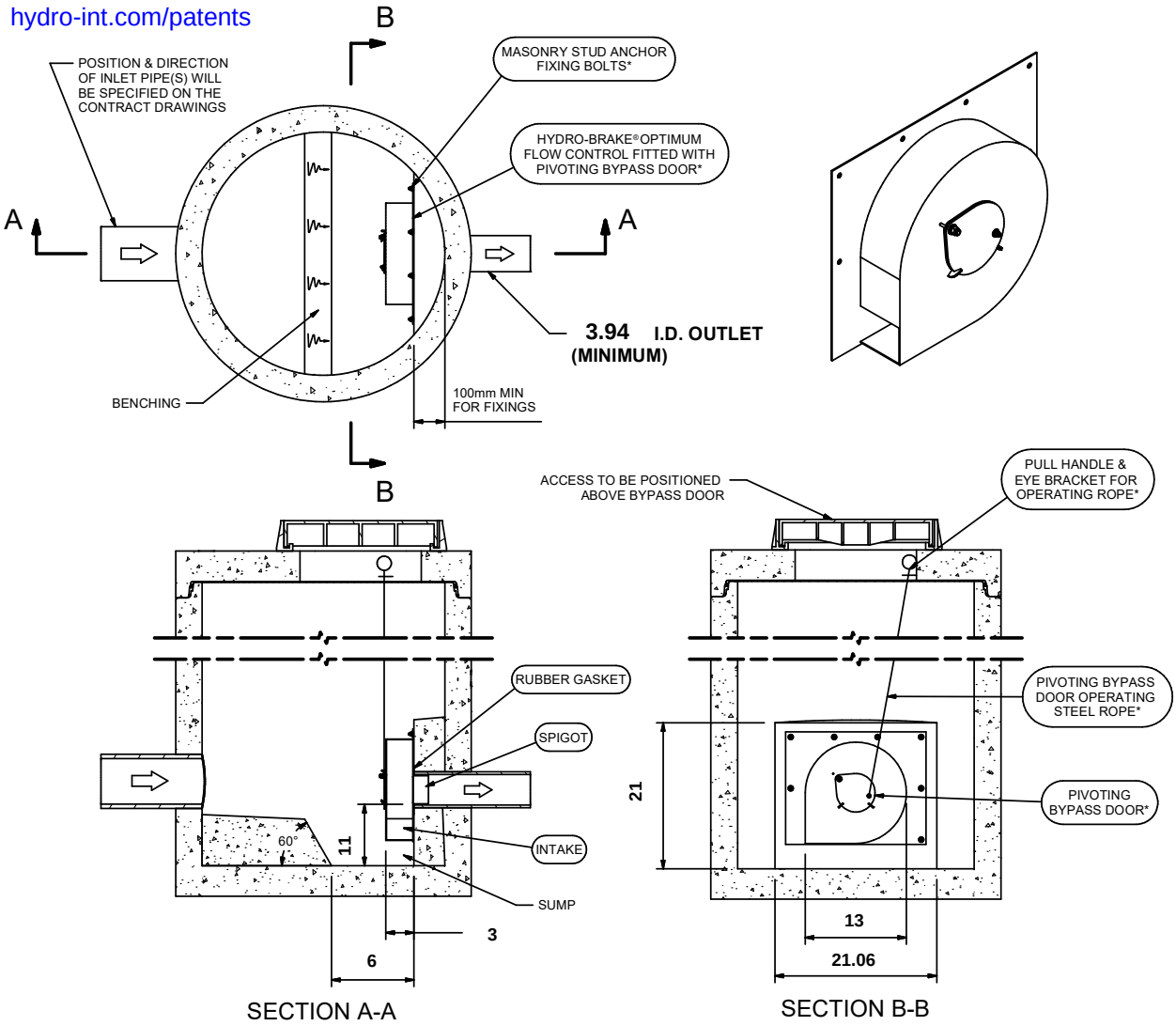
Hydro-Brake® Optimum Flow Control including:

- **0.118** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

hydro-int.com/patents



SECTION A-A

SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	9/6/2020 10:29 PM
SITE	MU SWMB #6.0
DESIGNER	**Bill Fitzgerald**
REF	**ocs #6.7**

SFF-0065-1982-1036-1614

Hydro-Brake® Optimum

 Hydro International Ltd, 94 Hutchins Drive, Portland, Maine, 04102-1930. Tel; +1 (207) 756 6200 Fax; +1 (207) 756 6212 Web; www.hydro-int.com Email; enquiries@hydro-int.com

wfitz@wef-pe.com

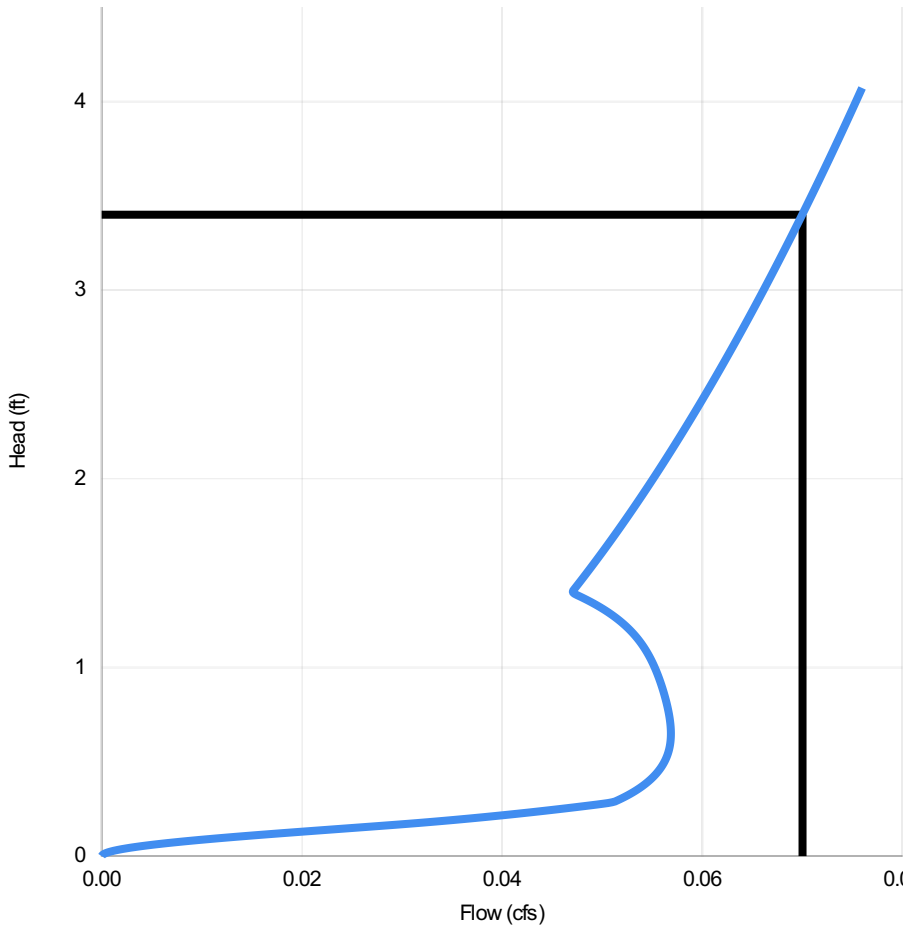
Technical Specification

Control Point	Head (ft)	Flow (cfs)
Primary Design	3.400	0.070
Flush-Flo	0.649	0.057
Kick-Flo®	1.395	0.047
Mean Flow		0.055

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412

hydro-int.com/patents



Head (ft)	Flow (cfs)
0.000	0.000
0.117	0.017
0.234	0.043
0.352	0.053
0.469	0.056
0.586	0.057
0.703	0.057
0.821	0.056
0.938	0.056
1.055	0.055
1.172	0.053
1.290	0.051
1.407	0.047
1.524	0.049
1.641	0.050
1.759	0.052
1.876	0.054
1.993	0.055
2.110	0.056
2.228	0.058
2.345	0.059
2.462	0.060
2.579	0.062
2.697	0.063
2.814	0.064
2.931	0.065
3.048	0.067
3.166	0.068
3.283	0.069
3.400	0.070

DESIGN ADVICE

The head/flow characteristics of this SFF-0065-1982-1036-1614 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International®

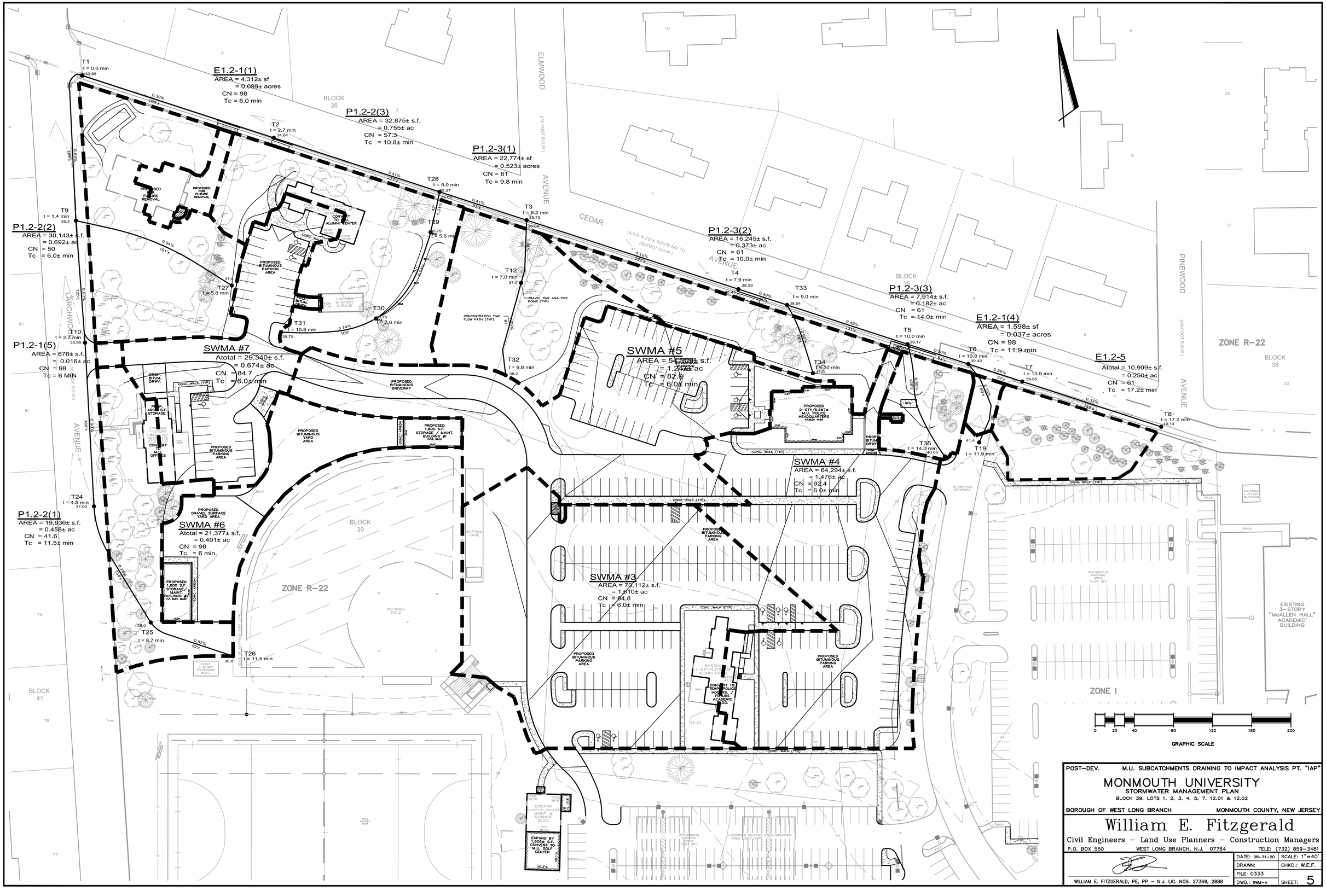
DATE	9/6/2020 10:29 PM
Site	MU SWMB #6.0
DESIGNER	Bill Fitzgerald
Ref	ocs #6.7

SFF-0065-1982-1036-1614

Hydro-Brake Optimum®

SWMB #7.0 Elevation - Storage - Discharge			
	Elevation (feet)	Storage (cubic-feet)	Discharge (cfs)
	32.10	0	0.00
	32.20	255	0.05
	32.30	509	0.05
	32.40	764	0.06
	32.50	1,018	0.06
	32.60	1,272	0.06
	32.70	1,525	0.06
	32.80	1,778	0.06
	32.90	2,031	0.06
	33.00	2,284	0.05
	33.10	2,536	0.05
	33.20	2,787	0.05
	33.30	3,038	0.05
	33.40	3,289	0.05
	33.50	3,539	0.05
	33.60	3,788	0.05
	33.70	4,037	0.07
	33.80	4,285	0.10
	33.90	4,532	0.13
	34.00	4,778	0.19
	34.10	5,023	0.26
	34.20	5,267	0.36
	34.30	5,508	0.47
	34.40	5,748	0.61
	34.50	5,985	0.77
	34.60	6,222	0.95
	34.70	6,457	1.16
	34.80	6,693	1.40
	34.90	6,929	1.67
	35.00	7,164	1.97
	35.10	7,298	2.29
	35.20	7,298	2.65
	35.30	7,298	3.04

SWMB #7.0 Event Summary Tabulation					
	Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
	NJWQDS	0.64	0.05	32.32	551
	1-Year	1.19	0.06	32.84	1,880
	2-Year	1.46	0.06	33.08	2,491
	5-Year	2.20	0.08	33.74	4,136
	10-Year	2.75	0.18	33.99	4,741
	25-Year	3.64	0.50	34.32	5,563
	50-Year	4.45	1.04	34.64	6,323
	100-Year	5.27	1.88	34.97	7,096



POST-DEV. M.U. SUBCATCHMENTS DRAINING TO IMPACT ANALYSIS PT. "IAP"

MONMOUTH UNIVERSITY

STORMWATER MANAGEMENT PLAN

BLOCK 39, LOTS 1, 2, 3, 4, 5, 7, 12.01 & 12.02

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald

Civil Engineers – Land Use Planners – Construction Managers

P.O. BOX 550 WEST LONG BRANCH, N.J. 07764 TELE: (732) 859-3481

WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 2888

DATE: 08-31-20	SCALE: 1"=40'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	
DWG.: SWM-4	SHEET: 5

APPENDIX IV

(Note: this appendix contains tabulations from which UpFlo Filter MTD's have been designed based upon post-development Stormwater Management Area peak flow rates and/or impervious coverages)

MTD / UP FLO FILTER : FILTER COUNT DETERMINATIONS						
		STORMWATER MANAGEMENT AREA NO.				
		#3	#4	#5	#6	#7
Impervious Area (ac)		1.190	1.254	0.863	0.491	0.517
FILTER COUNT / IMPERVIOUS	Standard Ribbon Certification	85	90	62	36	37
	Long Ribbon Certification	48	51	35	20	21
NJWQDS Flow Rate (cfs)		1.51	2.75	0.93	1.44	0.64
Max Flow Rate to MTD (cfs)		1.55	2.75	1.06	1.44	0.81
FILTER COUNT / FLOW RATE	Standard Ribbon Certification	47	83	32	44	25
	Long Ribbon Certification	70	124	48	65	37

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
Mail Code 401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

January 11, 2017

David Scott, CPSWQ
General Manager
Hydro International
94 Hutchins Drive
Portland, ME 04102

Re: MTD Laboratory Certification
Up-Flo® Filter by Hydro International
Off-line Installation

TSS Removal Rate 80%

Dear Mr. Scott:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7(c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Hydro International has requested a Laboratory Certification for the Up-Flo® Filter System.

This project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the afore-mentioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the Up-Flo® Filter by Hydro International at a TSS removal rate of 80%, when designed, operated and maintained in accordance with the information provided in the Verification Appendix and subject to the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5. The MTFR is calculated based on a verified loading rate of 1.264 gpm/sf of effective filtration treatment area.

2. The Up-Flo® Filter shall be installed using the same configuration as the unit verified by NJCAT, and sized in accordance with the criteria specified in item 6 below.

3. This device cannot be used in series with another MTD or a media filter (such as a sand filter), to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the Up-Flo® Filter, which is attached to this document. However, it is recommended to review the maintenance website at http://www.hydro-int.com/sites/default/files/nj_uff_inspection_and_maintnenance.pdf for any changes to the maintenance requirements.

6. Sizing Requirements:

   The example below demonstrates the sizing procedure for an Up-Flo® Filter.

   Example: A 0.25-acre impervious site is to be treated to 80% TSS removal using an Up-Flo® Filter. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs or 354.58 gpm.

   The selection of configuration for use in the Up-Flo® Filter is based upon both the MTFR and the maximum inflow drainage area. It is necessary to select the configuration using both methods and to rely on the method that results in the larger configuration determined by the two methods.

   Inflow Drainage Area Evaluation:

   The drainage area to the Up-Flo® Filter in this example is 0.25 acres. Based upon the information in Table 1 below, the following minimum configuration is required in an Up-Flo® Filter to treat the impervious area without exceeding the maximum drainage area:

Model Size UFF-ZV-19-285R with MTFR of 285 gpm and Maximum Allowable Inflow Drainage Area of 0.264 acre

Maximum Treatment Flow Rate (MTFR) Evaluation:

The site runoff (Q) was determined based on the following:

time of concentration = 10 minutes
i=3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
c=0.99 (runoff coefficient for impervious)
Q=ciA=0.99x3.2x0.25=0.79 cfs=0.79x448.83 gpm=354.58 gpm

Based on a flow rate of 354.58 gpm, the following minimum configurations are required in an Up-Flo® Filter System to treat the impervious area without exceeding the MTFR:

Model Size UFF-ZV-38-285R with MTFR of 570 gpm and Maximum Allowable Inflow Drainage Area of 0.528 acre

The MTFR Evaluation results will be used since that method results in the higher minimum configuration determined by the two methods.

The sizing table corresponding to the available system models are noted below:

Table 1 Up-Flo® Filter Configurations and NJDEP Sizing Table

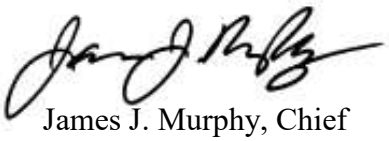
Configuration	Model Size	Number of Filter Modules	Max. Filtration Rate[1] (gpm)	Minimum Sedimentation Area [1,2] (sq.ft.)	Minimum Wet Volume [1,2] (cu.ft.)	Total Filtration Area [1] (sq.ft.)	Total Mass Capture [1] (lbs)	Maximum Allowable Inflow Area [1] (Acres)
Manhole	UFF-MH-285R	6	90	12.57	31.30	71.22	50.0	0.083
Vault	UFF-ZV-19-285R	19	285	39.79	99.12	225.5	158	0.264
Vault	UFF-ZV-38-285R	38	570	79.59	198.2	451.1	317	0.528
Vault	UF-ZV-57-285R	57	855	119.4	297.4	676.6	475	0.792

[1] Refer to Table A-1 of NJCAT Verification Report dated December 2016: UFF Design Specifications for the design parameters
[2] The precast structure housing the filter modules shall have at least the "Min. Sedimentation Area"

Be advised a detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Shashi Nayak of my office at (609) 633-7021.

Sincerely,



James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

cc: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP - DLUR
Ravi Patraju, NJDEP - BES
Gabriel Mahon, NJDEP - BNPC
Shashi Nayak, NJDEP – BNPC

Table A-1 Up-Flo® Filter Design Specifications

Ribbon Model	Filter Ribbon Length (in)	Filtration Area per Module	Max. Flow per Module	Max. Flow per Filtration Area	Minimum Sedimentation Area per Module	Min. Wet Volume per Module	Mass Capture Capacity per Module	Max Allowable Inflow Area[1] per Module	Min. Sump Depth	Max. Operating Head
	(in)	(ft^2)	(gpm/module)	(gpm/ft^2)	(ft^2/module)	(ft^3/module)	(lbs)	(acres)	(in.)	(in.)
285R	28.5	11.87	15	1.264	2.094	5.217	8.33	0.014	24	25.625

[1] Maximum Allowable Inflow Area = (8.33 lbs/module)/600 lbs per acre of drainage area annually

Table A-2 Up-Flo® Filter Configurations and NJDEP Sizing Table

Configuration	Model Size	Number of Filter Modules	Max. Filtration Rate[2]	Min. Sedimentation Area[2,3]	Min. Wet Volume[2,3]	Total Filtration Area[2]	Total Mass Capture[2]	Max. Allowable Inflow Area[2]
			(gpm)	(ft^2)	(ft^3)	(ft^2)	(lbs)	(acres)
MANHOLE	UFF-MH-285R	6	90	12.57	31.30	71.22	50.0	0.083
VAULT	UFF-ZV-19-285R	19	285	39.79	99.12	225.5	158	0.264
VAULT	UFF-ZV-38-285R	38	570	79.59	198.2	451.1	317	0.528
VAULT	UFF-ZV-57-285R	57	855	119.4	297.4	676.6	475	0.792

[2] Refer to Table A-1: UFF Design Specifications for the design parameters

[3] The precast structure housing the filter modules shall have at least the “Min. Sedimentation Area”

APPENDIX V

(Note: this appendix contains tabulations regarding design of storm drainage collection systems for post-development Stormwater Management Areas)

Design Storm: 100-Year, 24-Hour, NOAA Type 'D'

SWMA #3: Inlet Area/Flow Tabulation

To	Area		DA-perv		DA-imperv	CN	Q_{100}	A x CN
			HSG 'A'	HSG 'B'				
	(ft^2)	(acre)s	(ft^2)	(ft^2)	(ft^2)		(cfs)	
DI_3.6	24,495	0.562	0	14,165	10,330	76.6	3.19	43.1
DI_3.5	11,494	0.264	0	2,755	8,739	89.1	2.15	23.5
DI_3.4	13,266	0.305	0	2,800	10,466	90.2	2.50	27.5
DI_3.3	21,140	0.485	0	2,047	19,093	94.4	4.08	45.8
SWMA #3	70,395	1.616				86.6	12.85	139.9

SWMA #3: Collection System Conduit Tabulation

From	To	Pipe ID	L	Q_{des}	n	D		A	R	min S	design S	Q_{full}	$Q_{full} \geq Q_{des}$
			(ft)	(cfs)		(in)	(ft)	(ft^2)	(ft)	(ft/ft)	(ft/ft)	(cfs)	
DI_3.5	DI_3.4	P3:5-4	42	2.15	0.013	15	1.25	1.227	0.313	0.0011	0.0020	2.89	OK
DI_3.4	DI_3.3	P3:4-3	129	4.65	0.013	15	1.25	1.227	0.313	0.0052	0.0054	4.75	OK
DI_3.6	DI_3.3	P3:6-3	52	3.19	0.013	15	1.25	1.227	0.313	0.0024	0.0042	4.19	OK
DI_3.3	DI_3.2	P3:3-2	10	12.85	0.013	24	2.00	3.142	0.500	0.0032	0.0040	14.31	OK
DMH_3.2	FCS_3.1	P3:2-1	13	12.85	0.013	24	2.00	3.142	0.500	0.0032	0.0040	14.31	OK
DI_3.2	FCS_3.1	P3:1-7	8	0.00	0.013	15	1.25	1.227	0.313	0.0000	0.0052	4.66	OK
FCS_3.1	SWMB_4.0	P3:1-0	12	12.43	0.011	24	2.00	3.142	0.500	0.0022	0.0052	19.28	OK
FCS_3.1	UFF_3.7	P3:1-7	12	1.88	0.013	15	1.25	1.227	0.313	0.0008	0.0052	4.66	OK
UFF_3.7	UFF_3.8	P3:7-8	7	1.88	0.013	15	1.25	1.227	0.313	0.0008	0.0030	3.54	OK
UFF_3.8	DMH_3.9	P3:8-9	12	1.88	0.011	15	1.25	1.227	0.313	0.0006	0.0020	3.41	OK
DMH_3.9	SWMB_4.0	P3:9-0	19	1.88	0.013	24	2.00	3.142	0.500	0.0001	0.0020	10.12	OK

Design Storm: 100-Year, 24-Hour, NOAA Type 'D'

SWMA #4: Inlet Area Tabulation

To	Area		DA-perv		DA-imperv	CN	Q_{100}	A x CN
			HSG 'A'	HSG 'B'				
	(ft^2)	(acre)s	(ft^2)	(ft^2)	(ft^2)		(cfs)	
TD_4.13	6,072	0.139	0	0	6,072	98.0	1.19	13.7
DI_4.7	22,989	0.528	0	3,302	19,687	92.7	4.42	48.9
DI_4.6	3,793	0.087	0	297	3,496	95.1	0.74	8.3
DI_4.5	11,561	0.265		2,863	8,698	88.8	2.15	23.6
DI_4.4	20,133	0.462		3,222	16,911	92.1	92.10	42.6
	64,548	1.482				92.4		137.0

SWMA #4: Collection System Conduit Tabulation

From	To	Pipe ID	L	Q_{des}	n	D		A	R	min S	design S	Q_{full}	$Q_{full} \geq Q_{des}$
			(ft)	(cfs)		(in)	(ft)	(ft^2)	(ft)	(ft/ft)	(ft/ft)	(cfs)	
DI_4.7	DI_4.6	P4:7-6	51	4.42	0.013	15	1.25	1.227	0.313	0.0047	0.0048	4.48	OK
DI_4.6	DI_4.5	P4:6-5	52	5.16	0.013	18	1.50	1.767	0.375	0.0024	0.0025	5.25	OK
DI_4.5	DMH_4.2	P4:5-2	113	7.31	0.013	18	1.50	1.767	0.375	0.0048	0.0050	7.43	OK
DI_4.4	DMH_4.3	P4:4-3	133	3.84	0.013	15	1.25	1.227	0.313	0.0035	0.0038	3.98	OK
DMH_4.3	DMH_4.2	P4:3-2	24	3.84	0.013	15	1.25	1.227	0.313	0.0035	0.0050	4.57	OK
DMH_4.2	FCS_4.1	P4:2-1	18	12.24	0.013	21	1.75	2.405	0.438	0.0060	0.0060	12.27	OK
FCS_4.1	DMH_4.11	P4:1-11	21	12.34	0.011	24	2.00	3.142	0.500	0.0021	0.0067	21.88	OK
DMH_4.11	SWMB_4.0	P4:11-0	18	12.34	0.011	24	2.00	3.142	0.500	0.0021	0.0078	23.61	OK
FCS_4.1	UFF_4.8	P4:1-8	6	2.78	0.013	18	1.50	1.767	0.375	0.0007	0.0052	7.57	OK
UFF_4.8	UFF_4.9	P4:8-9	7	2.78	0.013	15	1.25	1.227	0.313	0.0019	0.0030	3.54	OK
UFF_4.9	DMH_4.10	P4:9-10	10	2.78	0.013	18	1.50	1.767	0.375	0.0007	0.0020	4.70	OK
DMH_4.10	SWMB_4.0	P4:10-0	14	2.78	0.011	24	2.00	3.142	0.500	0.0001	0.0020	11.96	OK

Design Storm: 100-Year, 24-Hour, NOAA Type 'D'

SWMA #5: Inlet Area Tabulation

To	Area		DA-perv		DA-imperv	CN	Q_{100}
			HSG 'A'	HSG 'B'			
	(ft^2)	(acre)s	(ft^2)	(ft^2)	(ft^2)		(cfs)
DI_5.2	22,253	0.511	0	1,849	20,404	94.9	4.18
DI_5.3	14,092	0.324	0	4,395	9,697	86.5	2.50
DI_5.4	4,356	0.100	2,032	595	1,729	65.4	0.53
DI_5.5	5,334	0.122	1689	664	2,981	74.7	0.80
DI_5.6	8,274	0.190	5420	86	2,768	59.0	0.84
SWMA #5	54,309	1.247	9,141	7,589	37,579	82.9	8.85
					0.863	ac	

SWMA #5: Stormwater Collection System Tabulation

From	To	Pipe ID	L	Q_{des}	n	D		A	R	min S	design S	Q_{full}	$Q_{full} \geq Q_{des}$	High End Inv	Low End Inv
			(ft)	(cfs)		(in)	(ft)	(ft^2)	(ft)	(ft/ft)	(ft/ft)	(cfs)		(ft)	(ft)
DI_5.6	DI_5.5	P5:6-5	24	0.84	0.013	12	1.00	0.785	0.250	0.0006	0.0060	2.76	OK	33.91	33.77
DI_5.5	DI_5.2	P5:5-2	174	1.64	0.013	15	1.25	1.227	0.313	0.0006	0.0020	2.89	OK	33.73	33.38
DI_5.4	DI_5.3	P5:4-3	28	0.53	0.013	12	1.00	0.785	0.250	0.0002	0.0020	1.59	OK	35.03	34.97
DI_5.3	DI_5.2	P5:6-2	60	3.03	0.013	15	1.25	1.227	0.313	0.0022	0.0025	3.23	OK	34.72	34.57
DI_5.2	FCS_5.1	P5:2-1	6	8.85	0.013	18	1.50	1.767	0.375	0.0071	0.0072	8.91	OK	33.03	32.99
FCS_5.1	DMH_5.9	P5:1-9	13	8.49	0.024	24	2.00	3.142	0.500	0.0048	0.0082	11.10	OK	32.35	32.24
FCS_5.1	UFF_5.7	P5:1-7	7	1.07	0.013	12	1.00	0.785	0.250	0.0009	0.0058	2.71	OK	32.88	32.84
UFF_5.7	OCS_5.8	P5:7-8	11	1.07	0.013	12	1.00	0.785	0.250	0.0009	0.0030	1.95	OK	32.74	32.71
DMH_5.10	SWMB_#5.0	P5:10-0	8	9.52	0.012	24	2.00	3.142	0.500	0.0015	0.0100	24.51	OK	32.33	32.25
SWMB_#5.0	DMH_5.9	P5:0-9	12	9.52	0.012	24	2.00	3.142	0.500	0.0015	0.0050	17.33	OK	32.25	32.19
DMH_5.9	OCS_5.8	P5:0-8	8	9.52	0.012	24	2.00	3.142	0.500	0.0015	0.0050	17.33	OK	32.19	32.15
OCS_5.8	DMH_1.7	P5:8-1.7	60	9.52	0.013	24	2.00	3.142	0.500	0.0018	0.0020	10.12	OK	31.98	31.86

Design Storm: 100-Year, 24-Hour, NOAA Type 'D'

SWMA #6: Inlet Area Tabulation

To	Area		DA-perv		DA-imperv	CN	Q_{100}	A x CN
			HSG 'A'	HSG 'B'				
	(ft^2)	(acre)s	(ft^2)	(ft^2)	(ft^2)		(cfs)	
DMH_6.5	2,625	0.060	0	0	2,625	98	0.49	5.9
DMH_6.4	9,161	0.210	0	0	9,161	98	1.73	20.6
DMH_6.3	1,998	0.046	0	0	1,998	98	0.38	4.5
DMH_6.2	7,593	0.174	0	0	7,593	98	1.43	17.1
	21,377	0.220			21,377	98.0	4.03	21.6
					0.491	ac		

SWMA #6: Stormwater Collection System Tabulation

From	To	Pipe ID	L	Q_{des}	n	D		A	R	min S	design S	Q_{full}	$Q_{full} \geq Q_{des}$	High End Inv	Low End Inv
			(ft)	(cfs)		(in)	(ft)	(ft^2)	(ft)	(ft/ft)	(ft/ft)	(cfs)		(ft)	(ft)
DMH_6.5	DMH_6.4	P6:5-4	59	0.49	0.013	15	1.25	1.227	0.313	0.0001	0.0020	2.89	OK	33.88	33.76
DMH_6.4	DMH_6.3	P6:4-3	117	2.22	0.013	15	1.25	1.227	0.313	0.0012	0.0020	2.89	OK	33.72	33.49
DMH_6.3	DMH_6.2	P6:3-2	65	2.60	0.013	15	1.25	1.227	0.313	0.0016	0.0020	2.89	OK	33.45	33.32
DMH_6.2	FCS_6.1	P6:2-1	7	4.33	0.013	15	1.25	1.227	0.313	0.0045	0.0058	4.92	OK	33.28	33.24
FCS_1.1	UFF_6.6	P6:1-6	6	1.44	0.013	12	1	0.785	0.250	0.0016	0.0067	2.92	OK	33.20	33.16
FCS_6.1	OCS_6.7	P6:1-7	10	2.90	0.024	24	2	3.142	0.500	0.0006	0.0250	19.37	OK	32.50	32.25
UFF_6.6	OCS_6.7	P6:6-7	7	1.44	0.013	12	1	0.785	0.250	0.0016	0.0500	7.97	OK	33.16	32.81
SWMB_#6.0	OCS_6.7	P6:0-7	6	4.33	0.011	24	2	3.142	0.500	0.0003	0.0133	30.83	OK	32.00	31.92
OCS_6.7	DMH_1.5	P6:7-1.5	40	4.33	0.013	18	1.5	1.767	0.375	0.0017	0.0020	4.70	OK	31.79	31.71

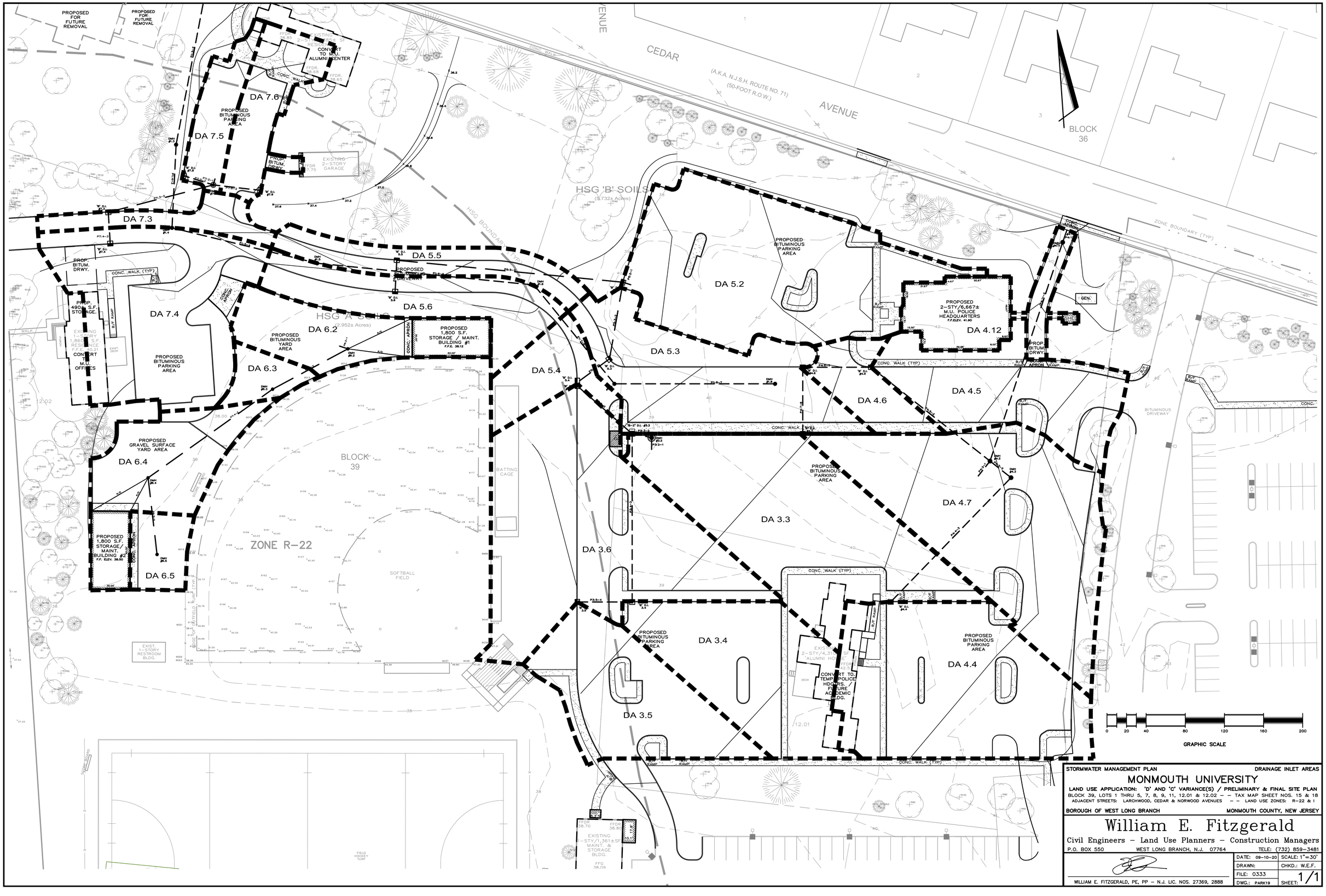
Design Storm: 100-Year, 24-Hour, NOAA Type 'D'

SWMA #7: Inlet Area Tabulation

To	Area		DA-perv		DA-imperv	CN	Q_{100}
			HSG 'A'	HSG 'B'			
	(ft^2)	(acre)s	(ft^2)	(ft^2)	(ft^2)		(cfs)
DI_7.4	17,430	0.400	5,951	0	11,479	77.9	2.75
DI_7.3	2,987	0.069	200	0	2,787	94.0	0.56
DI_7.5	3,499	0.080	0	86	3,413	97.1	0.66
DI_7.6	5,424	0.125	84	519	4,821	92.9	1.01
SWMA #7	29,340	0.674	6,235	605	22,500	84.6	4.98
					0.517	ac	

SWMA #7: Stormwater Collection System Tabulation

From	To	Pipe ID	L	Q_{des}	n	D		A	R	min S	design S	Q_{full}	$Q_{full} \geq Q_{des}$	High End Inv	Low End Inv
			(ft)	(cfs)		(in)	(ft)	(ft^2)	(ft)	(ft/ft)	(ft/ft)	(cfs)		(ft)	(ft)
DI_7.4	DI_7.3	P7:4-3	24	2.75	0.013	12	1	0.785	0.250	0.0060	0.0060	2.76	OK	33.84	33.70
DI_7.3	DMH_7.2	P7:3-2	83	3.31	0.013	15	1.25	1.227	0.313	0.0026	0.0027	3.36	OK	33.44	33.22
DI_7.5	DMH_7.2	P7:5-2	14	0.66	0.013	12	1	0.785	0.250	0.0003	0.0020	1.59	OK	34.25	34.22
DI_7.6	DMH_7.2	P7:6-2	36	1.01	0.013	15	1.25	1.227	0.313	0.0002	0.0022	3.03	OK	34.25	34.17
DMH_7.2	FCS_7.1	P7:2-1	5	5.27	0.013	15	1.25	1.227	0.313	0.0067	0.0080	5.78	OK	33.20	33.16
FCS_7.1	OCS_7.8	P7:1-8	13	4.46	0.024	24	2	3.142	0.500	0.0013	0.0025	6.13	OK	31.97	31.94
FCS_7.1	UFF_7.7	P7:1-7	7	0.81	0.013	12	1	0.785	0.250	0.0005	0.0300	6.17	OK	33.09	32.88
UFF_7.7	OCS_7.8	P7:7-8	7	0.81	0.013	12	1	0.785	0.250	0.0005	0.0036	2.14	OK	32.80	32.77
DMH_7.9	SWMB_#7.0	P7:9-0	8	5.27	0.011	24	2	3.142	0.500	0.0004	0.0075	23.15	OK	32.06	32.00
SWMB_#7.0	OCS_7.8	P7:0-8	10	5.27	0.011	24	2	3.142	0.500	0.0004	0.0060	20.71	OK	32.00	31.94
OCS_7.8	DMH_1.3	P7:8-1.3	18	5.27	0.013	15	1.25	1.227	0.313	0.0067	0.0100	6.46	OK	31.84	31.66



STORMWATER MANAGEMENT PLAN — DRAINAGE INLET AREAS

MONMOUTH UNIVERSITY

LAND USE APPLICATION: 'D' AND 'C' VARIANCE(S) / PRELIMINARY & FINAL SITE PLAN

BLOCK 39, LOTS 1 THRU 5, 7, 8, 9, 11, 12.01 & 12.02 – – TAX MAP SHEET NOS. 15 & 18

ADJACENT STREETS: LARCHWOOD, CEDAR & NORWOOD AVENUES – – LAND USE ZONES: R-22 & I

BOROUGH OF WEST LONG BRANCH — MONMOUTH COUNTY, NEW JERSEY

William E. Fitzgerald

Civil Engineers – Land Use Planners – Construction Managers

P.O. BOX 550 WEST LONG BRANCH, N.J. 07764 TELE: (732) 859-3481

WILLIAM E. FITZGERALD, PE, PP – N.J. LIC. NOS. 27369, 2888

DATE: 09-10-20	SCALE: 1"=30'
DRAWN:	CHKD.: W.E.F.
FILE: 0333	SHEET: 1/1
DWG.: PARK19	