GATEWAY
On Call. On Time. On Target.

THE GATEWAY ENGINEERS, INC.

400 HOLIDAY DRIVE, SUITE 300
PITTSBURGH, PA 15220-2727
412.921.4030 PHONE
412.921.9960 FAX

www.gatewayengineers.com

September 4, 2014
C-97027-0014

Allegheny County Conservation District
33 Terminal Way, Suite 325b
Pittsburgh, PA 15219

Attn: Lionel L. Harris, Sr., Assistant District Manager

RE: Wildcat Field Turf Project
PAG02000214061
Municipality of Mt. Lebanon
Allegheny County

Dear Mr. Harris:

We are in receipt of your letter dated August 27, 2014 for the above referenced project. After submitting the project for an expedited review on May 30, 2014, it has been very disappointing as to how long it has taken for the response to occur. Private funds were donated for completion of this project and bids were taken in anticipation of an early August start. Now both are in jeopardy and we respectfully request that all provisions be made to address the responses provided in this letter as quickly as possible.

We have addressed each of the comments on the response as follows:

1. **Comment:** Please provide justification for the use of a curve number of 86 for the artificial turf field in the post construction runoff calculations. If the proposed post construction designation for this project is changed as a result of your review in response to this comment, please revise your stormwater calculations using the appropriate curve number for the revised post construction determination.

   Response: The current version of the PA DEP manual does not provide guidelines for a curve number to use for artificial turf fields. During the design process, Jim Pillsbury from the Westmoreland County Conservation District was contacted because of his stormwater expertise. At that time, Jim recommended using a curve number between 80 and 85. We also researched regulations from Maryland and they provide for a range of curve numbers that can be used. We took an average of those and arrived at a value of 86. This curve number is more conservative than the 80-85 that was recommended by an expert from WCCD. It is my professional opinion that a conservative engineering judgment has been made to address the lack of criteria in the manual.

2. **Comment:** The calculations that you provided indicate an increase in runoff volume of 6,734 cfs. Chapter 102 of the regulations requires that post construction stormwater BMPs be utilized to manage the net change in stormwater volume. No post construction volume controls are proposed in your application. Please include volume control BMPs to reduce the volume of runoff to preconstruction levels, a sequence for their implementation or installation, a schedule for their inspection, and a long-term operation and maintenance schedule for the PCSM BMPs consistent with the requirements of Chapter 102 of the regulations. Also, please supplement your identification of the potential thermal impacts from post construction stormwater to surface waters of the Commonwealth within your PCSM plan as well as the post construction BMPs that will be implemented to avoid, minimize or mitigate potential pollution for thermal impacts. For all of your post construction BMPs, please submit the appropriate calculations to support your design.

   Response: There is an increase in the volume of runoff from the site. However, we conducted an infiltration test on the site and the infiltration rate was 0.1 inches/hour. This rate is considered "Slow" per DEP criteria. During DEP training sessions held earlier this year (see attached Exhibit 1 for information from the training), it was presented that in an area with limited infiltration, a treatment train can be used in lieu of volume reduction to reduce TSS by 85%, Phosphorus by 85%, and Nitrogen by 50%. We chose this option due to the measured infiltration rate (see Exhibit 2) and are using the DEP recommended treatment train. Furthermore, by installation of the turf and removal of grass, pollutants in the form of suspended solids, phosphorus and nitrates will no longer be an issue.

   Regarding the thermal impact, there will not be an impact. The water that falls on the field drains immediately through the turf and into the stone base. Due to the fact that the rainwater goes so quickly through the field it will not have time to heat on the surface. All stormwater travel is subsurface through pipes and there will be no thermal impact. The connection point is into a municipal storm sewer; the open water course to this system is located approximately 610 feet downstream (see Exhibit 3).

3. **Comment:** Please provide a copy of the municipal storm water consistency letter for this project.

   Response: A consistency letter has been provided by the Municipal Engineer (see Exhibit 4).

4. **Comment:** The proposed zinc treatment system may require an industrial waste NPDES permit and a Part II permit from DEP's Clean Water Program. Please contact Dana Drake, Clean Water Permitting Section Chief, at 412-442-4202 or via email at ddrake@pa.gov, regarding permitting requirements. Please note that, should these additional permits be required, the permitting decisions of each DEP program will be coordinated with contemporaneous determinations.

Response: Dana Drake has been contacted and provided with information requested. Zinc Levels in the stormwater effluent from the field are expected to be at a maximum of 0.022 mg/l per the Connecticut Study (see Exhibit 5). The DEP Threshold for Zinc control is 0.117 mg/l; therefore, we are well below this threshold. However, a zinc filtration system (see Exhibit 6) will be installed that will remove zinc by 96.9% taking the 0.022 mg/l to 0.000682 mg/l. Consequently, the zinc levels will be well below those regulated by the PADEP and as a result an industrial waste NPDES Permit is not required.

5. **Comment:** Section 102.8(f)(12) of the regulations, requires that the identification of naturally occurring geologic formations or soil conditions that may have the potential to cause pollution after earth disturbance activities are completed and PCSM BMPs are operational, as well as the development of a management plan to avoid or minimize potential pollution and its impacts. Your application contains conflicting statements regarding the presence of naturally occurring geologic formations or soil conditions at the site that may have the potential to cause pollution. In item number 6 of page 6 of your NOI (Potential Pollution Causing Materials), you state that "There are no known naturally occurring geologic formations or soil conditions that have the potential to cause pollution during earth disturbance activities." On page 10 of the PCSM Report, you state that "There are known naturally occurring geologic formations or soil conditions located on the site that have the potential to cause pollution during construction." Please resolve the discrepancy and include a management plan to avoid or minimize potential pollution and its impacts if appropriate.

   Response: There was a typo on page 10 of the PCSM Report (see Exhibit 7). It has been revised to say that "There are <u>no</u> known naturally occurring geologic formations or soil conditions that have the potential to cause pollution during earth disturbance activities."

6. **Comment:** The Department requests that a Cultural Resource Notice be submitted to the Pennsylvania Historical and Museum Commission (PHMC) so that they can provide comments on this application consistent with the Pennsylvania State History Code. Please provide proof of submission and a copy of any response received from PHMC.

   Response: The Notice to the PHMC has been filed. See attached copy Exhibit 8. We do not anticipate any comments and will forward their response upon receipt.

Again, we have lost precious time during this review process and are available to meet or discuss our response to the comments immediately. I can be reached at 412-921-4030 x110.

Sincerely,
THE GATEWAY ENGINEERS, INC.

Daniel S. Deiseroth, P.E.
Executive Vice President

Attachment

cc: Jan Lauer, ACCD (2 copies)
Chuck Colbert, P.E., DEP (2 copies)
Steve Feller, Municipal Manager (1 copy)
Phil Weis, Municipal Solicitor (by email)
David Donnellan, Mt. Lebanon (by email)
Matthew E. Bagaley, P.E. (by email)
Sean M. Donnelly, P.E. (by email)
Mt. Lebanon Commission (by email)
Senator Matt Smith (1 copy)
Representative Dan Miller (1 copy)

G:\Projects\97000 Mt Lebanon\97027 Wildcat Field\-0014 CA\Docs\Correspondence\Govt Agencies\2014-09-04 Response To Accd\2014-09-04 Response Letter To Accd.Docx

Exhibit

1

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Oil and Gas Management

Site Restoration Plan Design Standards – Limited Infiltration

1. Generally, soils with permeability of greater than 0.2 in/hr can be effective to infiltrate stormwater.

USDA-NRCS Permeability Classes.

Description	Permeability (in/hr)
Very slow	< 0.06
Slow	0.06 to 0.2
Moderately slow	0.2 to 0.6
Moderate	0.6 to 2.0
Moderately rapid	2.0 to 6.0
Rapid	6.0 to 20.0
Very rapid	> 20.0

GATEWAY

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Memorandum

March 20, 2014

C-97027-0012

TO: Dan Deiseroth, P.E.

FROM: Nathaniel Hayes, P.E.

RE: Summary of Test Pits and Infiltration Test Results

As requested, on March 18 and March 19, 2014, I observed material from test pits and performed infiltration tests at eight locations – shown on the enclosed Test Pit Location Plan - within the proposed Wildcat Turf Field site, located along Cedar Boulevard, in the Municipality of Mt. Lebanon, Allegheny County, PA. All test pits were excavated to prescribed depths of four feet, and infiltration tests were performed at the bottom of the test pits, except Test Pit 4 which was excavated to a depth of one foot. All materials encountered within the test pits were man-made fill - a mixture of silt, clay, and gravel, cobble and boulder-sized concrete, asphalt and rock fragments, with trace amounts of wood planks and #4- and #5-sized steel reinforcing bars in Test Pits 1 and 2.

The stabilized rate of infiltration at all locations was 0.1 inch per hour.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Oil and Gas Management

Site Restoration Plan Design Standards – Limited Infiltration

1. When site conditions do not accommodate infiltration, the recommend Control Guideline for Total Water Quality should be followed.
   A. 85% reduction in TSS
   B. 85% reduction in Phosphorus
   C. 50% Reduction in NO_3-N

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Oil and Gas Management

Water Quality Guidelines - Example

1. Determine total area and pollutant load from areas needing treatment.
2. Use Worksheet 12 (Stormwater Manual) to determine post development pollutant (TSS, TP, NO_3-N) loading.
3. Determine necessary mass loading reductions

Exhibit

2

GATEWAY

On Call. On Time. On Target

Memorandum

March 21, 2014

C-97027-0012

TO: Dan Deiseroth, P.E.

FROM: Nathaniel Hayes, P.E. NSH

RE: Summary of Test Pits and Infiltration Test Results

As requested, on March 18 and March 19, 2014, I observed material from test pits and performed infiltration tests at eight locations - shown on the enclosed Test Pit Location Plan - within the proposed Wildcat Turf Field site, located along Cedar Boulevard, in the Municipality of Mt. Lebanon, Allegheny County, PA. All test pits were excavated to prescribed depths of four feet, and infiltration tests were performed at the bottom of the test pits, except Test Pit 4 which was excavated to a depth of one foot. All materials encountered within the test pits were man-made fill - a mixture of silt, clay, and gravel, cobble and boulder-sized concrete, asphalt and rock fragments, with trace amounts of wood planks and #4- and #5-sized steel reinforcing bars in Test Pits 1 and 2.

The stabilized rate of infiltration at all locations was 0.1 inch per hour.

GATEWAY

Consulting Engineers & Surveyors
400 Holiday Drive, Suite 300 Pittsburgh, PA 15220
Phone (412) 921-4000 Fax (412) 921-8880

REVISION RECORD

WILDCAT TURF FIELD INFILTRATION TESTS
CEDAR BOULEVARD, MUNICIPALITY OF MT. LEBANON
ALLEGHENY COUNTY, PA

PREPARED FOR:
MUNICIPALITY OF MT. LEBANON
710 WASHINGTON ROAD
PITTSBURGH, PA 15228

TEST PIT
LOCATION PLAN

FIGURE 1

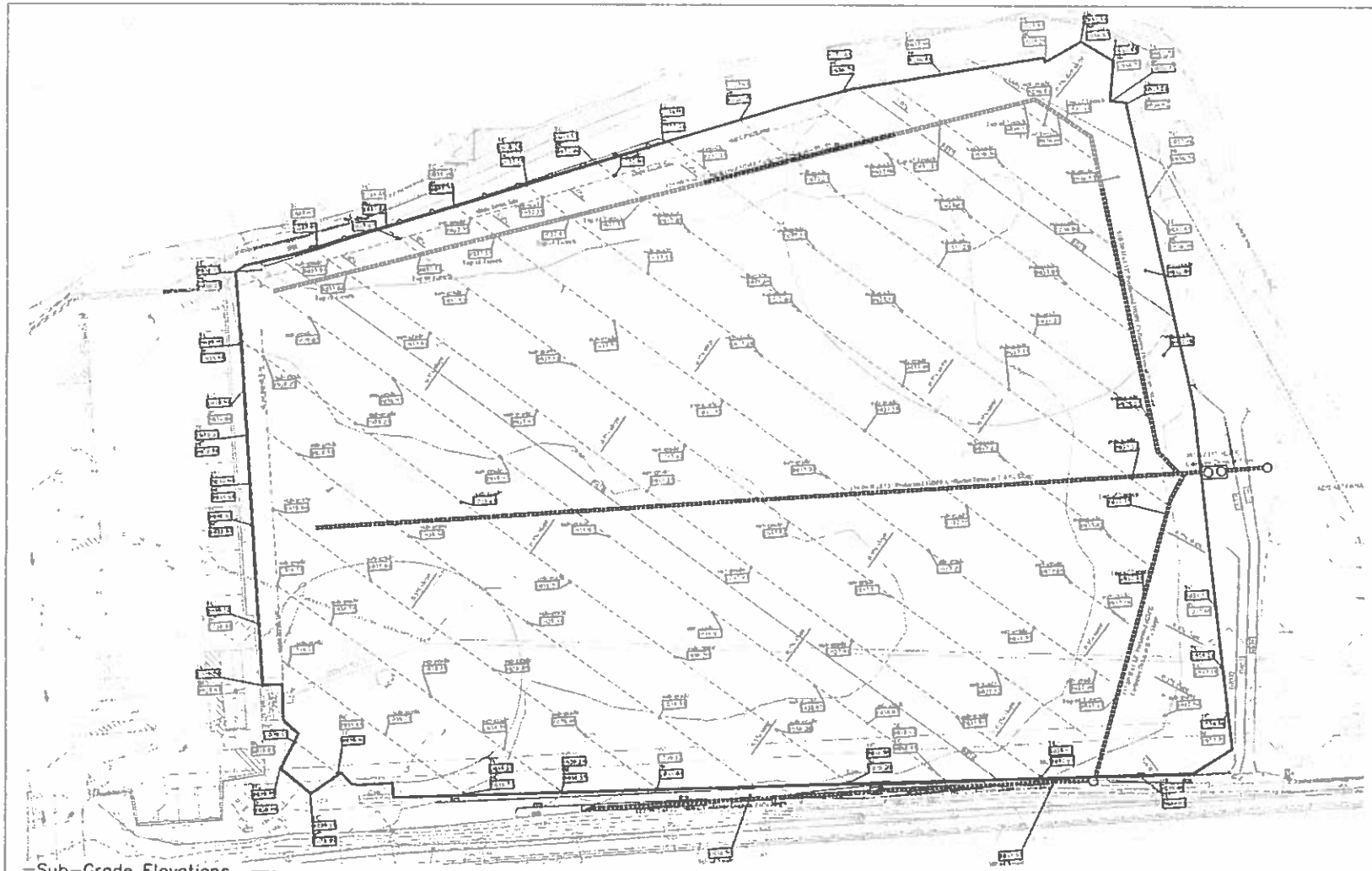
Exhibit

3

0 20 40 80 120 160 Feet

SCALE 1" = 100'

Mt. Lebanon G.I.S.



Sub-Grade Elevations

GRADING NOTES

1. A range of 6 inches of topsoil is provided on field. Contractor must contact topsoil to verify topsoil depth. No change orders shall be provided if topsoil exceeds depth. Contractor shall be responsible for hauling surplus grades.
2. Average 0.5 % cross slope to the playing field. Contractor is responsible for the removal of sub-base to meet finished sub-grade elevations and 0.5 % cross slope at sub-grade. NOTE: Baseball field sub-grade and finished grades are custom to meet the elevation as shown and required.
3. Contour and spot elevations shown graphically at 0.5 a drop of 0.05 are at finished grade elevation with topsoil and seeding.
4. Contractor shall meet appropriate section and include fees due to stricter entity target storm.
5. Contractor is responsible for provision of compaction testing to owner. In addition to provide disturbance testing, contractor must provide proof and plan with fully backed down sure with aggregate.
6. Contractor is responsible for verification that existing storm drain system and system that is low lined and fully reconstructed in to on site new system.
7. Contractor must provide as-built elevations on dark toning to site from and g elevations prior to permanent grant of sub-grade.
8. Contractor must provide topsoil elevations on flat or 25 LED grid to verify topsoil depth prior to installation of aggregate material.
9. Contractor must provide topsoil elevations on underlay mesh layers and provide mesh prior to installation of sand rubber over site.
10. Contractor's detailed indicators must have supplying in installation of an inverted curb plus weight greater than 150 linear feet or a price. Contractor shall provide sample with references.
11. Contractor is responsible for the removal of debris and any topsoil from site. Where rubber debris otherwise.

GENERAL NOTES

1. Base mapping was provided with a plan entitled "Mt. Lebanon High School Transportation Survey" prepared by Sarkovich Engineers Inc. and dated April 30, 2014.
2. The Pennsylvania Legislature Act 187 of 1996 requires notification to utility companies prior to any digging, drilling, blasting or excavation. Contractor shall contact PA ONE CALL SYSTEM at 1-800-242-1776 to make notifications. No activities can be performed until proof of one-call compliance has been confirmed by owner.
3. Any damage to curbs and property, signs and utilities shall be repaired immediately at their expense.
4. Contractor is responsible for obtaining all state and local permits for earth movement activities.
5. NO CHEMICALS OR HAZARDOUS MATERIALS WILL BE STORED ON SITE.
6. Contractor shall field verify location and depth of existing storm system prior to ordering of materials. Plans show an estimated depth of 4 to 6' for top of pipe system.
7. Contour interval is 1'.

Scale: 1" = 30'

LEGEND

	Existing	Proposed
Property Line		
Contour		
Spot Elevation		
Manhole		
Storm Drain		
Inlet		
Under Drain		

All offset along the grid the repeat

GATEWAY

ITSA SPORTS

ENGINEER:
THE GATEWAY ENGINEERS, INC.
416 McKEAN CHURCH, SUITE 200
MOON TOWNSHIP, PA 15108
412-262-2030

LANDSCAPE ARCHITECT:
J.T. SHEARER & ASSOCIATES, LLC
300 SOUTH MAIN STREET, SUITE 200
BLACK DIAMOND, PA 15221
412-767-1300

MT. LEBANON WILDCAT AND MIDDLE FIELD ARTIFICIAL TURF CONSTRUCTION PACKAGE

MARK	DATE	DESCRIPTION

PROJECT #: 14002
DATE: 10.17.2014
DRAWN BY: KRW
CHECKED BY: JAS
APPROVED BY: JT SHEARER & ASSOCIATES
SHEET TITLE:

GRADING PLAN SUBGRADE ELEVATIONS

G001

Exhibit

4

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THE GATEWAY ENGINEERS, INC.

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September 4, 2014
C-97027-0014

Allegheny County Conservation District
33 Terminal Way, Suite 325b
Pittsburgh, PA 15219

Attn: Lionel L. Harris, Sr., Assistant District Manager

Re: Wildcat Field Turf Project

Dear Mr. Harris,

Please be advised that I have reviewed the above referenced project on the behalf of the Municipality of Mt. Lebanon as the Municipal Engineer. With regards to the stormwater management plan as proposed, the plan is consistent with the Flood Plain and Stormwater Management Ordinances contained in Chapter 2 Part 1 Ordinance 2760 and Chapter XVI Section 809 of the Mt. Lebanon Code.

If you have any questions, please contact me.

Sincerely,
THE GATEWAY ENGINEERS, INC.

Daniel S. Deiseroth, P.E.
Township Engineer

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
DANIEL S. DEISEROTH
ENGINEER
038499-E

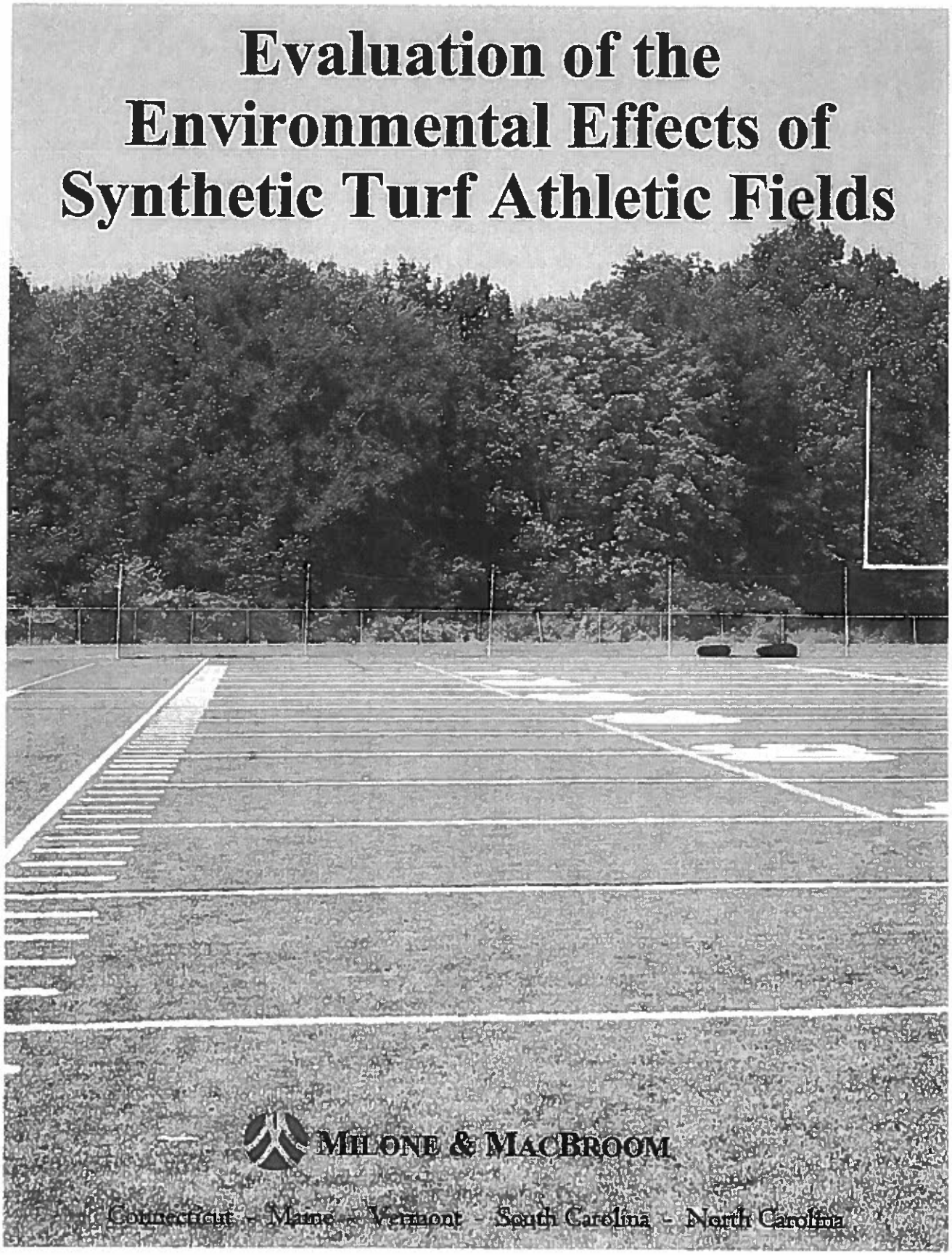
cc: Stephen Feller, Municipal Manager

G:\Projects\97000 Mt Lebanon\97027 Wildcat field\-0014 CA\Docs\Correspondence\Govt Agencies\2014-09-04 response to accd\2014-09-04 swm consistency letter.docx

Exhibit

5

Evaluation of the Environmental Effects of Synthetic Turf Athletic Fields



MILONE & MACBROOM

Connecticut - Maine - Vermont - South Carolina - North Carolina

PREFACE

Evaluation of the Environmental Effects of Synthetic Turf Athletic Fields

Over the past year or so, Milone & MacBroom, Inc. (MMI) conducted a variety of tests of synthetic athletic fields in Connecticut in an attempt to contribute to the discussion regarding potential risks to the environment and human health associated with such facilities. In 2007, laboratory tests at the Connecticut Agricultural Experiment Station (CAES) raised a number of questions concerning the safety of such fields. As a company that advises clients and designs athletic fields using both natural grass and synthetic surfaces, Milone & MacBroom, Inc. believed that it would be prudent to undertake some first-hand observations and to become more confident that published literature was applicable to synthetic surfaces in the northeast.

When reading these papers, there are two points that should be clearly understood. First, by undertaking these studies, we are not promoting the installation of synthetic fields but recognize that they are a legitimate alternative to natural grass in some instances. Second, the cost of the testing was totally paid by Milone & MacBroom, Inc. and that the synthetic turf industry has had no involvement whatsoever in our testing program. We did consult, however, with representatives of the Connecticut Department of Public Health regarding testing protocols to be sure that our methodologies and the results of our efforts would be useful to the regulatory community.

The three areas of concern that Milone & MacBroom, Inc. addressed were water quality from the runoff that passes through the synthetic turf, the temperature of the surface of the turf, and the air quality on and surrounding the synthetic field. The questions we sought to answer are:

- Does the temperature of the synthetic field become excessively hot in summer months?
- Does the crumb rubber infill material have an effect on air quality?
- Do metals leach from the crumb rubber infill material at a level that would adversely affect the quality of water?

To address these issues, Milone & MacBroom, Inc. conducted three separate studies at locations where synthetic fields had been recently installed. The sites were selected for two reasons. First, we were able to secure permission from the owner of the fields to conduct the necessary tests. Second, we were familiar with the sites and understood how the fields were constructed and the materials that were used in the construction. The water quality monitoring was initiated in late 2007 and continued into the fall of 2008. The testing and observation of the temperature and the sampling of the air were done in mid-summer 2008. The results of the testing are presented in three separate documents as follows:

- **Thermal Effects Associated with Crumb Rubber In-filled Synthetic Turf Athletic Fields**
- **Evaluation of Benzothiazole, 4-(tert-octyl) Phenol and Volatile Nitrosamines in Air at Synthetic Turf Athletic Fields**
- **Evaluation of Stormwater Drainage from Synthetic Turf Athletic Fields**

We hope that our efforts will be useful to public officials and the consumer when evaluating which type of playing surface best suits their athletic field program needs.

Please contact Vince McDermott with any questions or to request additional copies of the research conducted by Milone & MacBroom, Inc.

Milone & MacBroom, Inc.
99 Realty Drive
Cheshire, Connecticut 06410
T 203.271.1773
F 203.272.9733

About Milone & MacBroom, Inc.

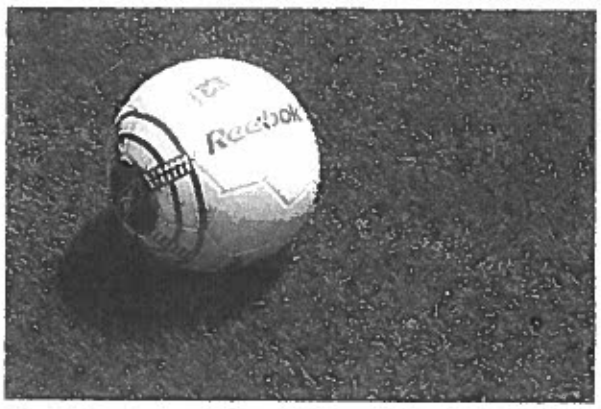
Milone & MacBroom, Inc. is a privately-owned, multidisciplinary consulting firm founded in 1984. The firm maintains a staff of over 145 technical and administrative personnel, with its main office located in Cheshire, Connecticut, and regional offices in Stamford and Branford, Connecticut; Greenville, South Carolina; Raleigh, North Carolina; Freeport, Maine; and South Burlington, Vermont. The team of professionals at Milone & MacBroom, Inc. is committed to building strong partnerships with our clients to deliver creative solutions that are technically sound, cost-effective, and environmentally sensitive. We strive to integrate the disciplines of engineering, landscape architecture, and environmental science in an exceptional work environment that is founded upon respect among ourselves, our clients, and our professional colleagues.

Thermal Effects Associated with Crumb Rubber In-filled Synthetic Turf Athletic Fields

Scott G. Bristol, LEP
Vincent C. McDermott, FASLA, AICP

Milone & MacBroom, Inc.
99 Realty Drive
Cheshire, Connecticut 06410

Substantial focus has been given to possible environmental effects associated with the installation of synthetic turf athletic fields. Questions concerning the potential health effects have been raised by several groups. Generally, these questions have been related to claims that insufficient data has been collected to reach a conclusion regarding possible detrimental health effects. One component of these claims is the question concerning the effect of solar heating on the fields and in particular upon the crumb rubber that is used as in-fill material (Figure 1). A temperature evaluation study was designed and conducted to determine the temperature rise of the synthetic materials under a number of conditions.



Two fields within Connecticut were selected for this study. Both fields were constructed by FieldTurf in 2007. One field, identified as Field F, is located in the northern portion of the state, while Field G is located in the southern portion of the state. Selection of the fields was based upon the ability to obtain permission to perform the testing and was not based upon manufacturer or geographic location. Temperature monitoring occurred on June 10 and July 11, 2008, at Field F and on June 17, 2008, at Field G.

During the testing procedure, the air temperature was monitored at two elevations directly over the synthetic playing surface and at a location adjacent to the synthetic surface but within an area of natural grass. Also measured during the testing were the temperatures of the crumb rubber

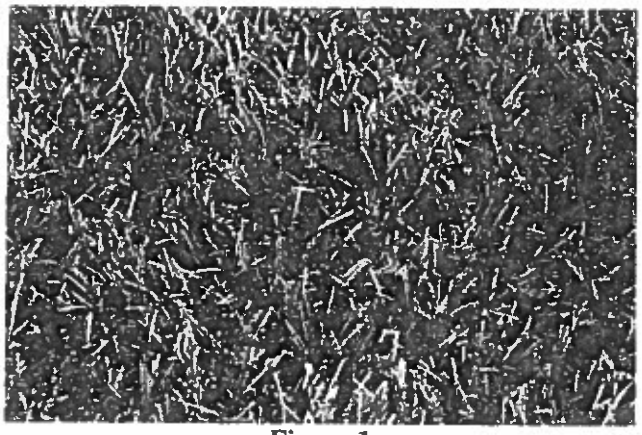


Figure 1

and the surface temperature of the polyethylene and polypropylene blended fibers used to simulate grass. Additional measurements were made of the soil at various depths in the area of the natural grass and the surface temperature of the natural grass itself. The air temperatures were measured using six-inch Enviro-Safe Easy Read Armor Case thermometers with a protective plastic jacket. These thermometers have a working temperature range of 0 degrees Fahrenheit (° F) to 220° F with two-degree graduations and are National Institute of Standards and Technology (NIST) certified. The thermometers were suspended within Styrofoam insulating cylinders. The inside dimensions of the cylinders were approximately $3^3/_8$ inches in diameter by 7¼ inches tall. Outside dimensions were approximately 4¼ inches in diameter by 7¾ inches tall. Twelve one-half inch holes were drilled into four sides of the cylinders to allow for airflow through the cylinder while still providing protection from the heating effect of the sunlight (Figures 2 and 3).

Figure 2

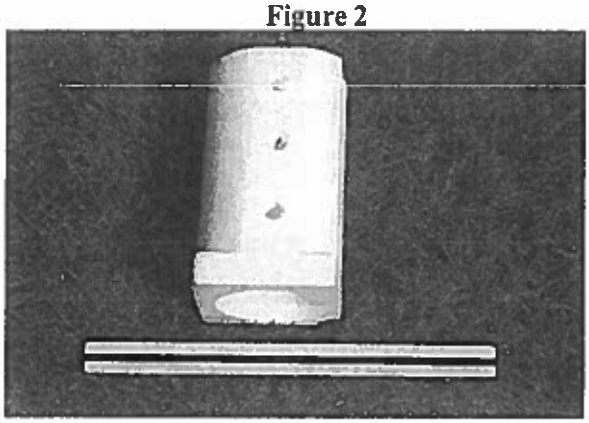
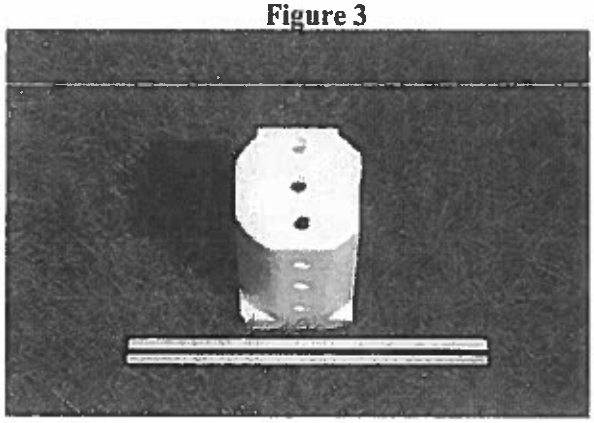


Figure 3



The Styrofoam cylinders were then mounted to a wooden pole measuring approximately 1¾ inch x 1¾ inch x 5½ feet tall using plastic wire ties (Figure 4). Each pole was then mounted to a metal and wooden surveyor's tripod (Figure 5).

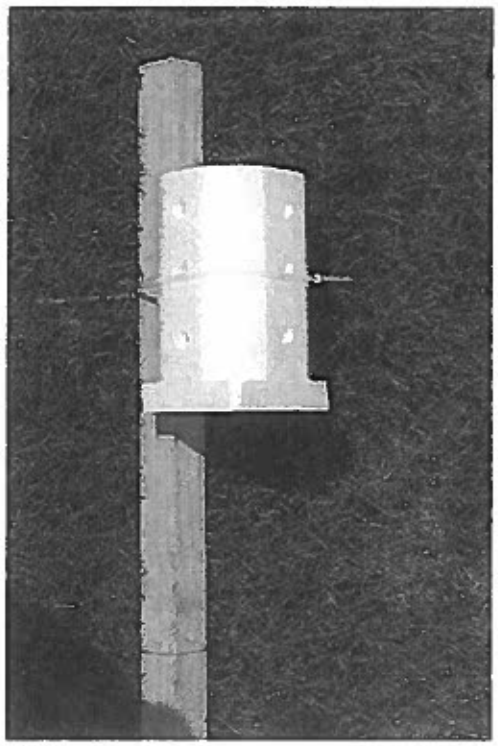


Figure 4

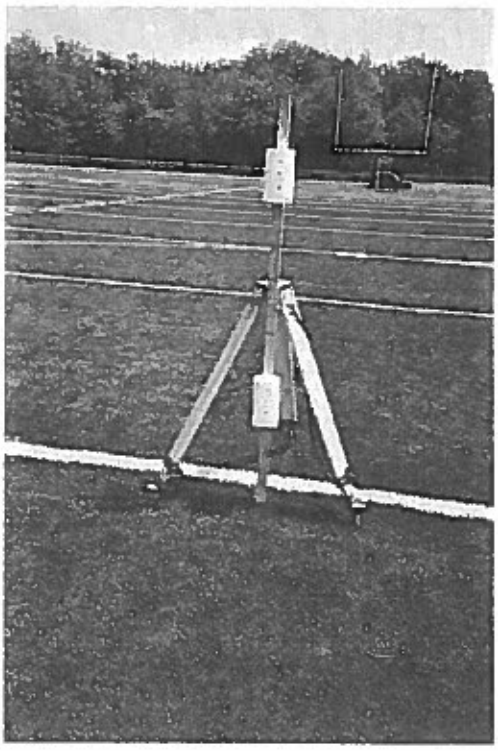


Figure 5

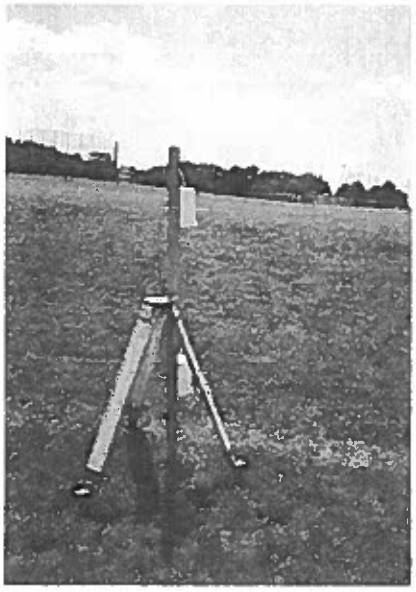
The surface temperatures of the natural grass and the synthetic fibers were measured using an infrared thermometer manufactured by EXTECH Instruments (EXTECH Pocket IR thermometer). The thermometer has a stated sensing range of -58° F to 518° F with an accuracy of +/- 2.5% of reading plus three degrees.

The temperature of the soil and the crumb rubber in-fill material was measured using a digital pen thermometer with a stated sensing range of -58° F to 536° F in 0.1-degree divisions with an accuracy of one degree. The sensing probe measured eight inches long and was constructed of stainless steel.

Methodology

The temperature monitoring stations were placed to allow a comparison of temperatures between the synthetic and natural turf surfaces. One station was placed in the center of the synthetic turf field, while the second station was placed approximately 50 feet (Field G) or 125 feet (Field F) away from the synthetic surface on natural turf. The natural turf monitoring station was located based upon the location of nearby structures (bleachers, parking lots, synthetic running track surfaces) that had the potential to affect the temperature readings (Figure 6).

Figure 6



Air temperatures were measured at two feet and five feet above the ground surface during the June 10 and June 17, 2008, monitoring events. The methodology was adjusted for the July 11, 2008, event, at which time the temperatures were measured at one foot and five feet.

Surface temperatures of both the synthetic "grass" fibers and the natural grass were measured using the infrared thermometer, while soil and crumb rubber temperatures were measured using the digital pen thermometer.

The air temperature measured at a distance of five feet above the natural turf was assumed to best approximate the actual ambient air temperature at the location of the monitored field.

Results

June 10, 2008

Temperature measurements were obtained at Field F on June 10, 2008. Official temperature data for this date was obtained from Weatherunderground.com for Bradley International Airport in Windsor Locks, Connecticut. The official high temperature was 98° F. Additional temperature and wind data was obtained from a private weather station associated with Weatherunderground.com. This weather station is located approximately 2.3 miles from Field F. A high temperature of 95.6° F and maximum winds of three miles per hour (mph) were recorded at this station during the study time period. Skies were clear throughout the study.

Collected data indicated that the air temperature as measured at a distance of two feet above the synthetic turf surface ranged from one to five degrees greater than the observed ambient air temperature, while the temperature at the same height above the natural turf ranged from 3° F lower to 1° F greater than the ambient air temperature (Figure 7).

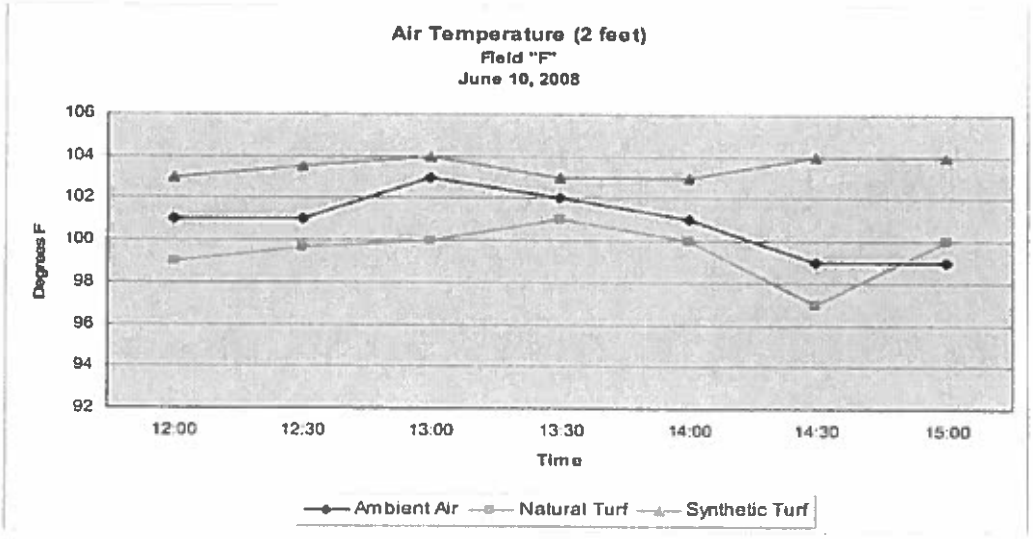


Figure 7

The measured air temperature at a height of five feet above the synthetic turf more closely approximated the ambient air temperature. Measured air temperatures ranged from 2° F lower to 2° F greater than the ambient air temperature (Figure 8).

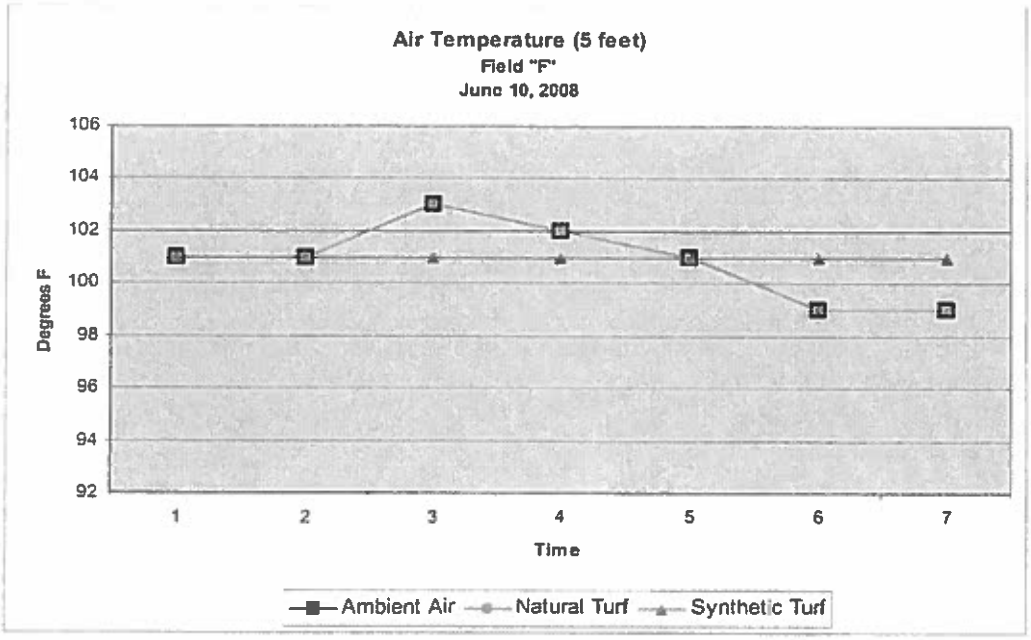


Figure 8

Note in Figure 8 the temperature identified as the ambient air temperature is the same as the temperature measured at a distance of five feet above the natural turf.

The temperature observed for the surface of the synthetic "grass" fibers was measured using an infrared thermometer and compared to the observed air temperatures and also the temperature of the crumb rubber in-fill material as measured at a depth of one inch. The surface of the synthetic fibers reached a maximum temperature of 156° F. The crumb rubber reached a maximum temperature of 111.5° F or approximately 44 degrees cooler than the surface temperature of the synthetic "grass" fibers. As noted above, the elevated temperature of the fibers did not result in a significant elevation of the air temperature above the synthetic field as compared to the air temperature over the natural grass field (Table 1 and Figure 9).

Table 1

Time of Day (hrs)	Ambient Temperature	Synthetic Turf Temperatures			
		Surface Temperature Synthetic "Grass" Fibers	Crumb Rubber Temperature (1 inch depth)	Air Temperature 2 feet above surface	Air Temperature 5 feet above surface
	°F	°F	°F	°F	°F
12:00	101	153	102.5	103	101
12:30	101	155	103	104	101
13:00	103	151	104.5	104	101
13:30	102	156	111.5	103	101
14:00	101	154	109.5	103	101
14:30	99	138	107.2	104	101
15:00	99	149	105.8	104	101

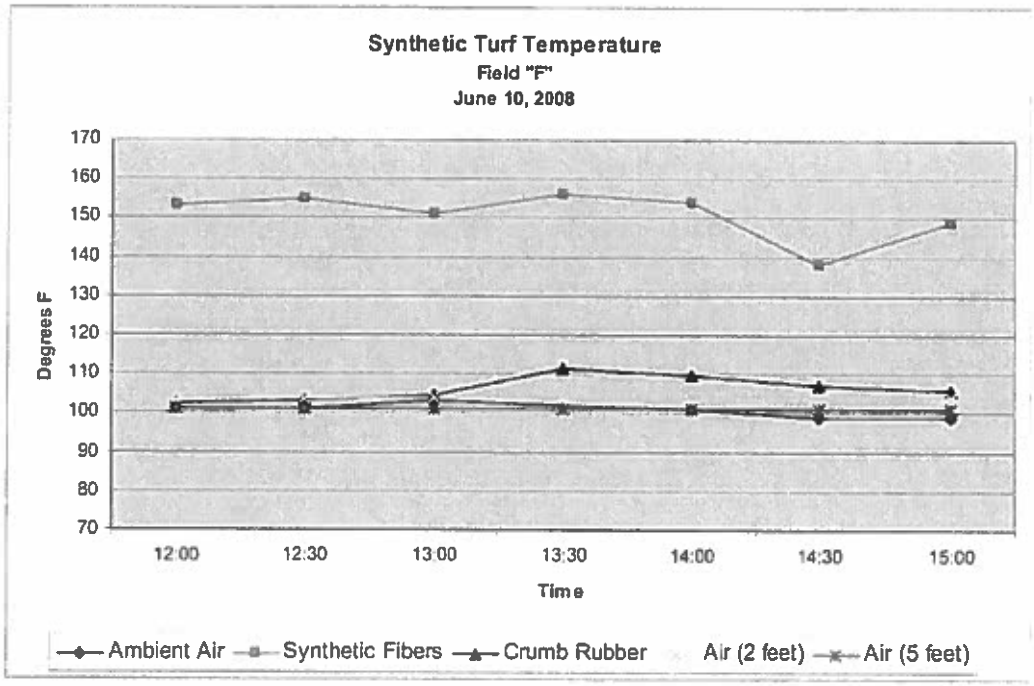


Figure 9

Temperatures measured in the area of the natural turf indicated that the surface of the natural grass blades closely approximated the ambient air temperature. The grass blades ranged from 3° F cooler to 5° F warmer than the measured ambient temperature. Soil temperatures were determined to decrease with increasing depth. The highest soil temperatures were noted at the end of the study period with a maximum temperature of 90.1° F being measured at 15:00 at a depth of one inch below the surface. The temperature of the soil at that depth increased approximately nine degrees over a span of three hours, while the temperature at a depth of six inches increased just two degrees.

Table 2

Time of Day (hrs)	Ambient Temperature	Natural Turf Temperatures					
		Surface Temperature Natural Grass	Soil Temperature			Air Temperature 2 feet above surface	Air Temperature 5 feet above surface
			1 inch depth	3 inch depth	6 inch depth		
	°F	°F	°F	°F	°F	°F	°F
12:00	101	100	81.5	78.8	77.3	99	101
12:30	101	101	86.5	79	77.3	99.7	101
13:00	103	102	89.2	79.8	77.3	100	103
13:30	102	99	86	81.6	78.2	101	102
14:00	101	101	89.4	82.5	79.5	100	101
14:30	99	104	87	81	78.9	97	99
15:00	99	100	90.1	85.1	79.3	100	99

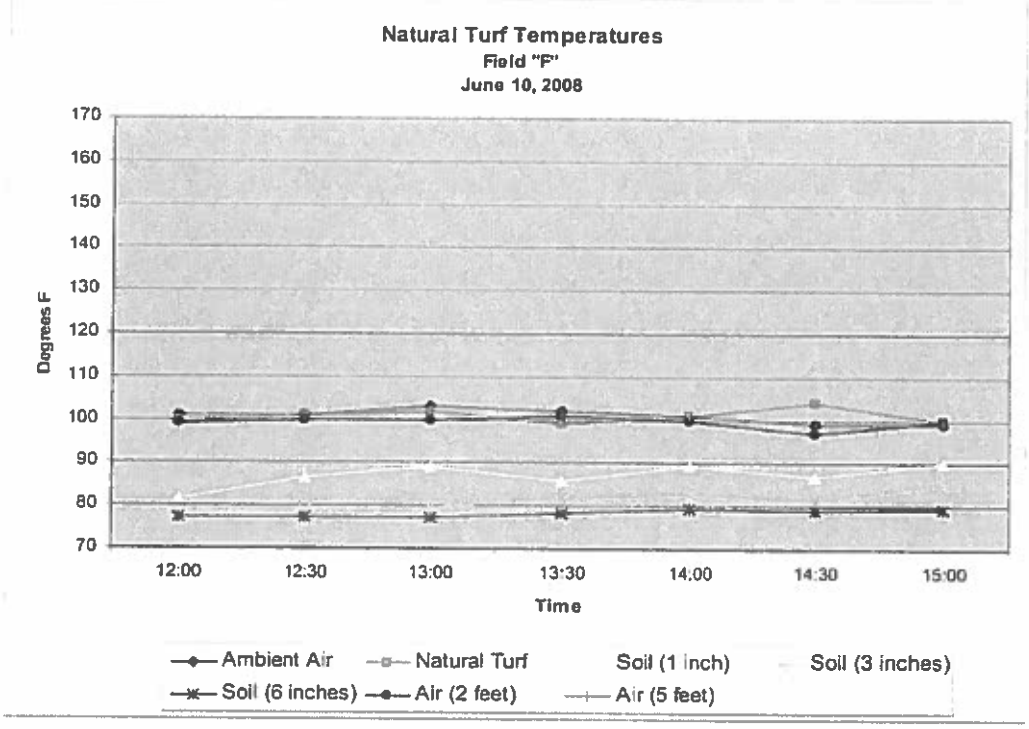


Figure 10

June 17, 2008

Temperature measurements were obtained at Field G on June 17, 2008. Field G is located in the southern portion of Connecticut and is believed by the authors to be susceptible to localized weather variations caused by Long Island Sound. Once again, temperature and wind data were obtained from a private weather station associated with Weatherunderground.com and located approximately 1.5 miles from Field G. A high temperature of 75.7° F and maximum winds of four mph were recorded at this station during the study time period. Intermittent clouds and sunshine were noted during the study period.

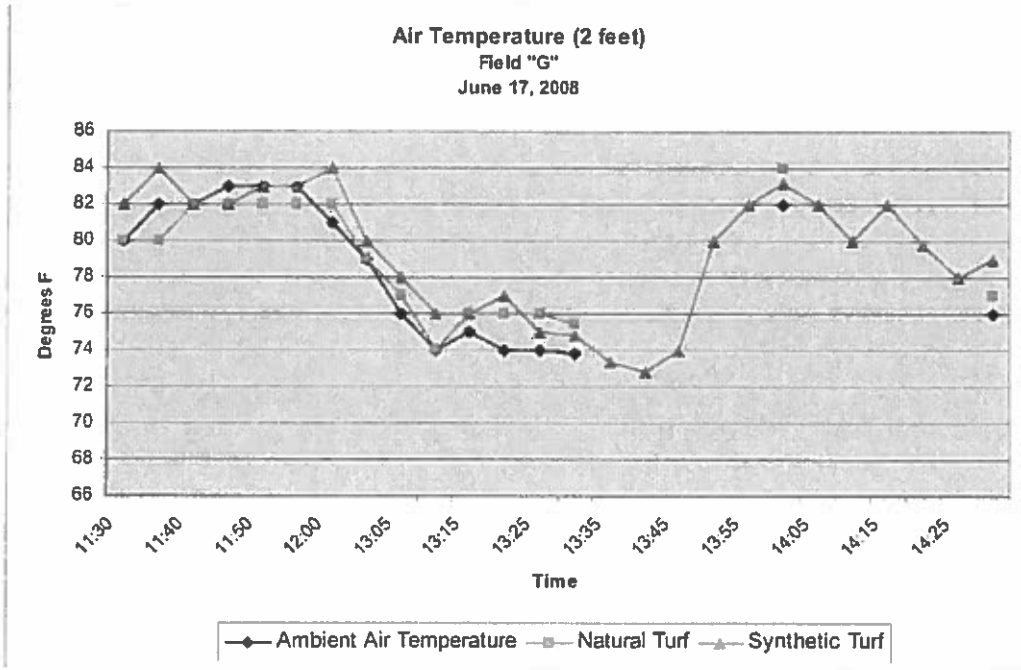


Figure 11

Collected data indicated that the air temperature as measured at a distance of two feet above the synthetic turf surface ranged from 0 degrees to three degrees greater than the observed ambient air temperature, while the temperature at the same height above the natural turf ranged from 2° F lower to 2° F greater than the ambient air temperature (Figure 11). The air temperature two feet above the synthetic turf field was generally two degrees to four degrees greater than the temperature above the natural turf.

The time period between approximately 13:00 and 13:45 was characterized by clouds. The cooling effect of the cloud cover can be clearly noted in the data. This effect is also noted in the graph of the air temperature at five feet above the fields. At this height, the air temperature above the synthetic turf was generally two to three degrees greater than the natural turf field.

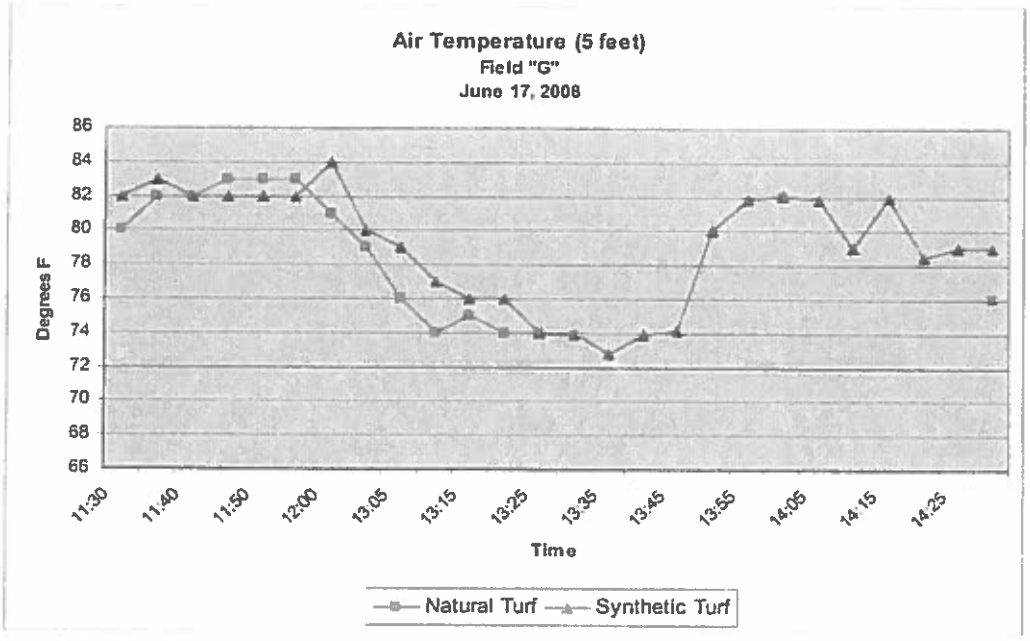


Figure 12

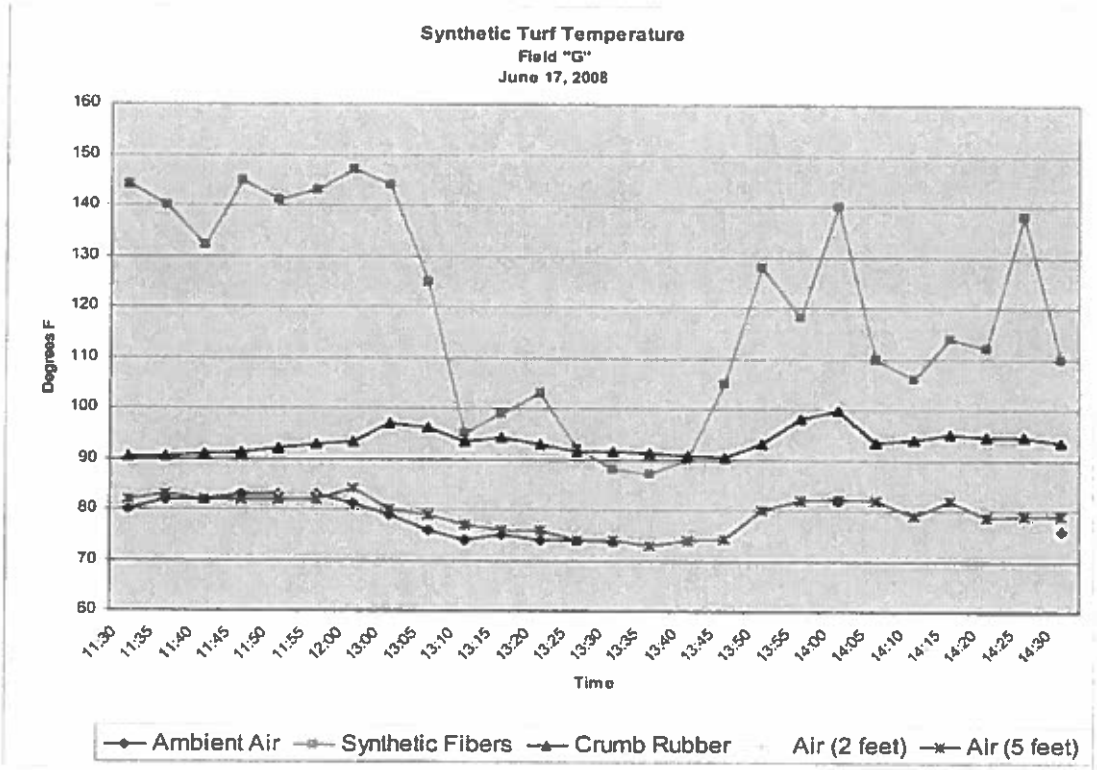


Figure 13

The results of the measurements of the temperature of surface of the synthetic "grass" fibers were similar to those obtained for Field F. A maximum temperature of 147° F was noted during periods of sunshine. The temperature dropped rapidly during cloudy periods and reached a minimum temperature of 87° F or approximately 15 degrees greater than the observed ambient air temperature. The crumb rubber in-fill material maintained a relatively steady temperature and averaged approximately 93° F or approximately 15 degrees greater than the average ambient air temperature (Figure 13). Once again, the elevated temperature of the fibers did not result in a significant elevation of the air temperature above the synthetic field as compared to the air temperature over the natural grass field.

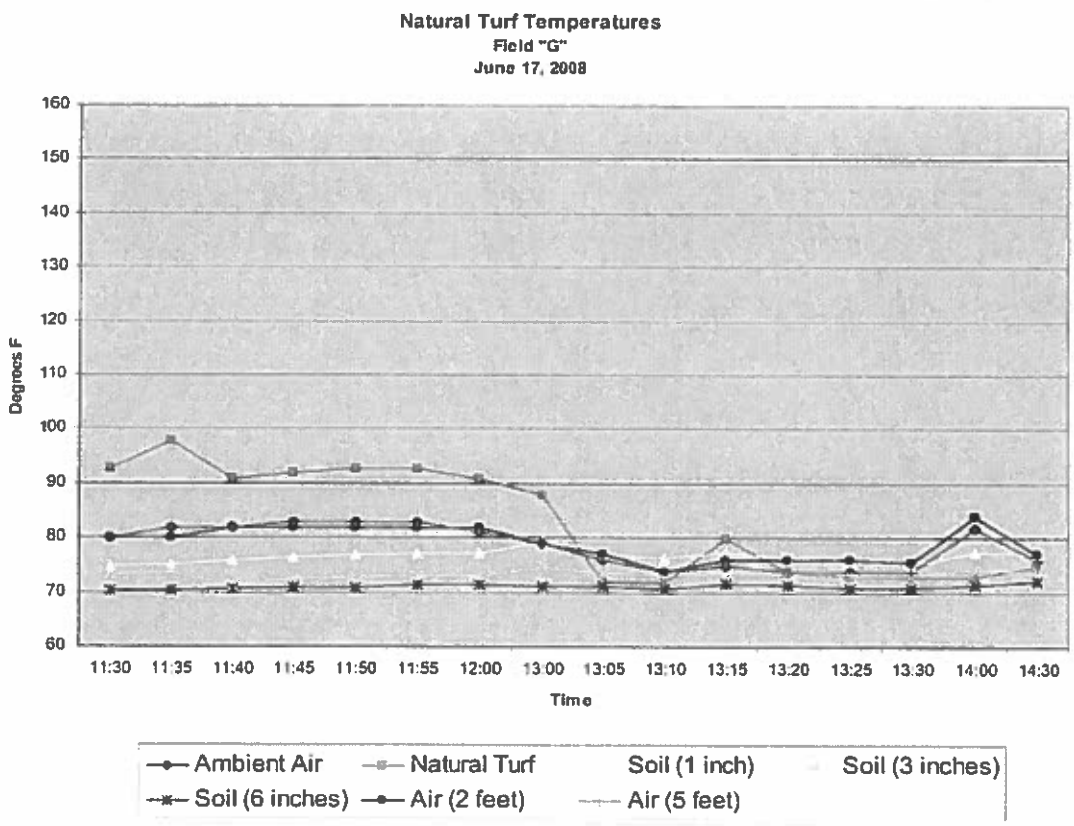


Figure 14

Measurements in the area of the natural turf near Field G indicated that the surface temperature of the natural grass blades was approximately 10 to 15 degrees greater than the ambient air

temperature during periods of sunshine. The temperature decreased quickly to nearly the ambient air temperature once cloud cover was present. The soil temperatures were nearly constant throughout the monitoring period and averaged approximately 74° F (Figure 14).

July 11, 2008

The temperature monitoring was repeated at Field F on July 11, 2008. The exception to the above procedures was that the air temperature was measured at heights of one foot and five feet above the synthetic turf and the natural turf fields. The results are detailed in Figures 15 through 19 below. As noted previously, the elevated surface temperature of the synthetic "grass" fibers appeared to have minimal effect on the air temperature directly over the synthetic turf field. Likewise, only a moderate rise in the temperature of the crumb rubber was noted. The temperature rise noted at one foot above the synthetic turf field was generally two to four degrees as compared to the measured ambient air temperature, although a maximum of a nine-degree rise was noted to occur over a short time period early in the study. The temperature rise noted at five feet above the synthetic turf surface was generally between one to five degrees, which is comparable to the previously observed measurements.

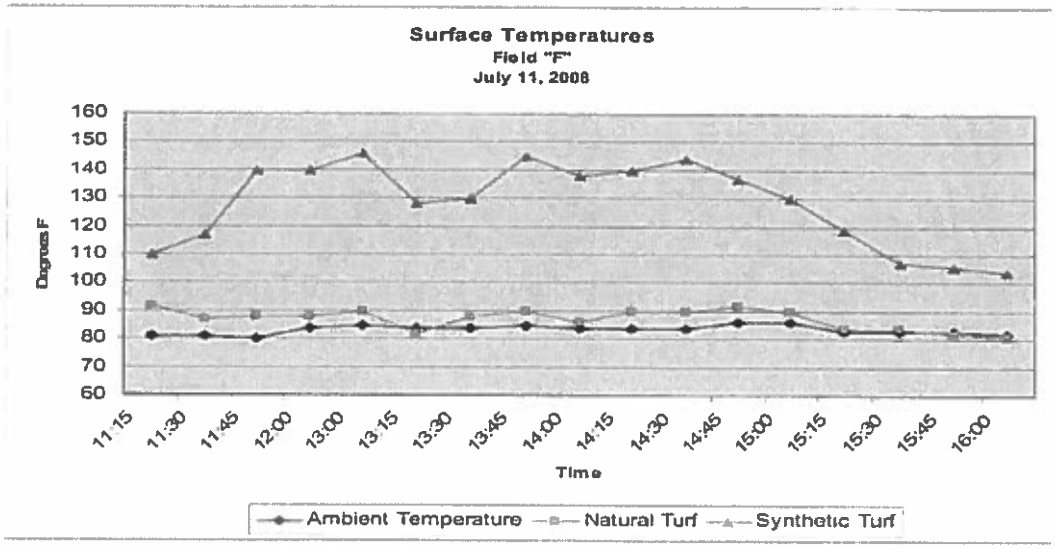


Figure 15

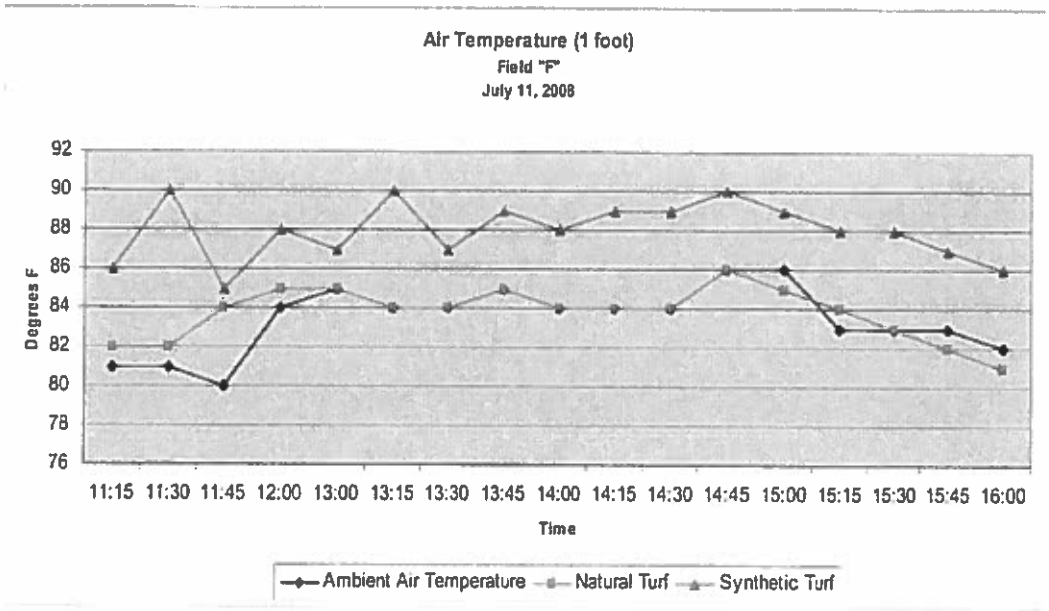


Figure 16

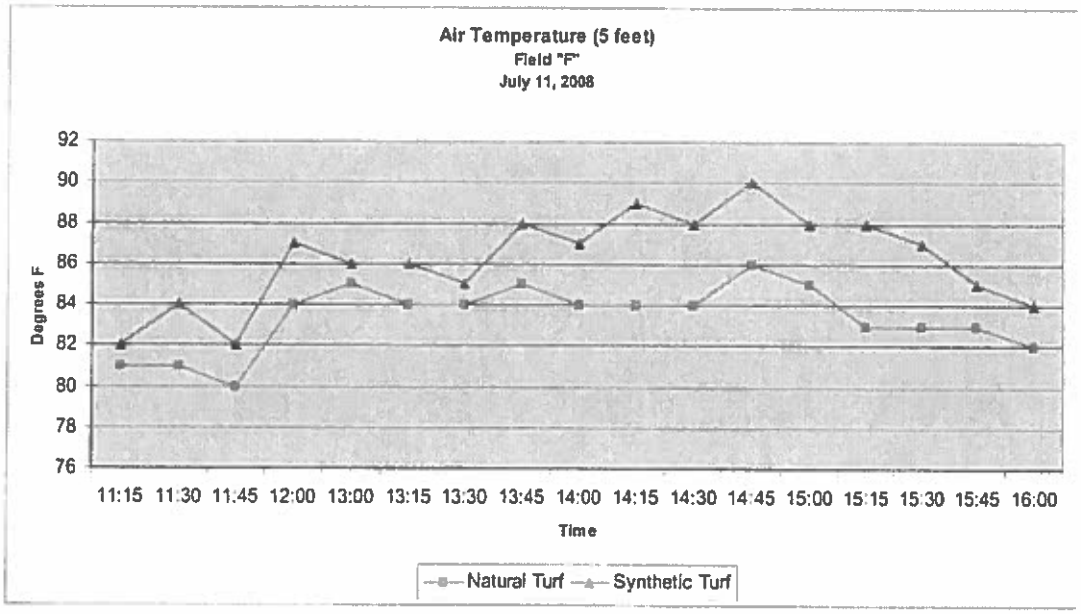


Figure 17

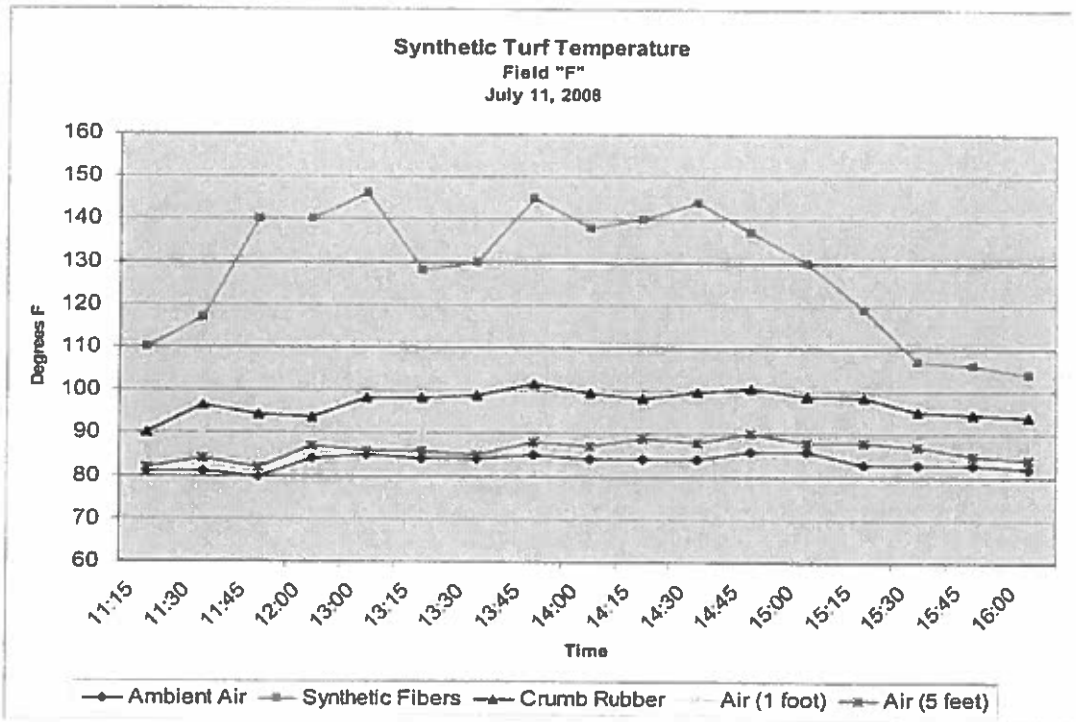


Figure 18

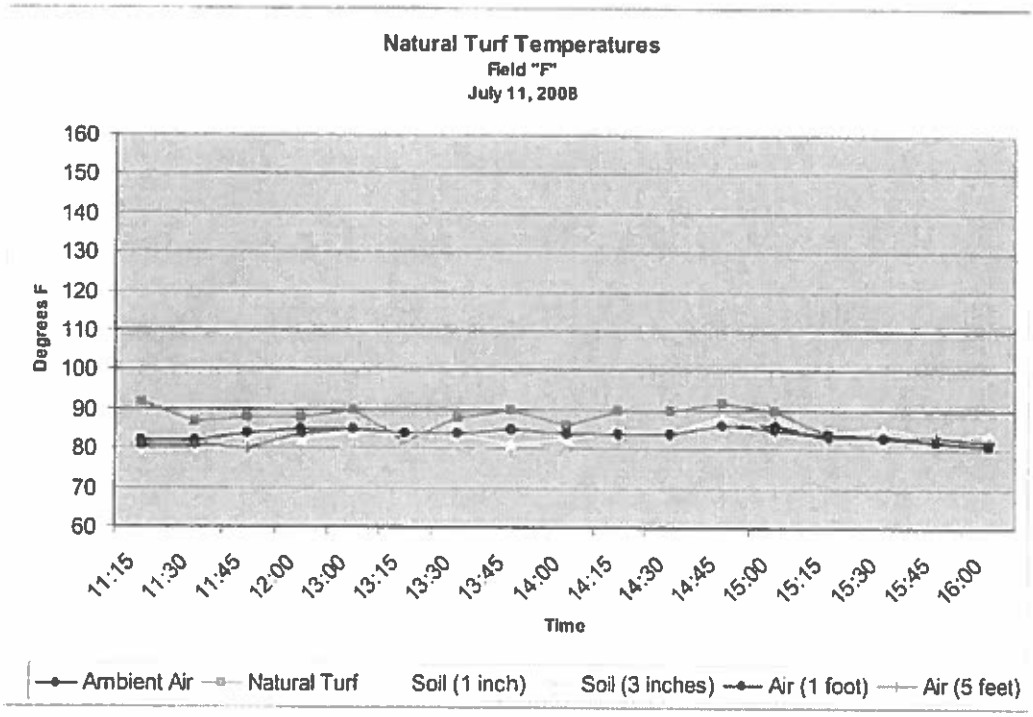


Figure 19

The sampling methodology on this date was also adjusted to evaluate the potential cooling effect due to the evaporation of water from the synthetic "grass" fibers. Two squares measuring one foot square were cut from a single sheet of white foam board (Figure 20). The surface temperature of the synthetic fibers was then measured using an infrared thermometer. One square was kept dry while the other side was wetted with one ounce of water using a spray bottle. The surface temperatures were measured and recorded over a period of 20 minutes. The foam board was then moved to a dry location, and the measurements were repeated using two ounces and then three ounces of water.

The results indicated that the applied water provided at least 20 minutes of effective cooling to the synthetic fibers. The amount of the cooling effect was generally between 10 and 20 degrees although slightly more of a cooling effect was noted when three ounces of water were used.

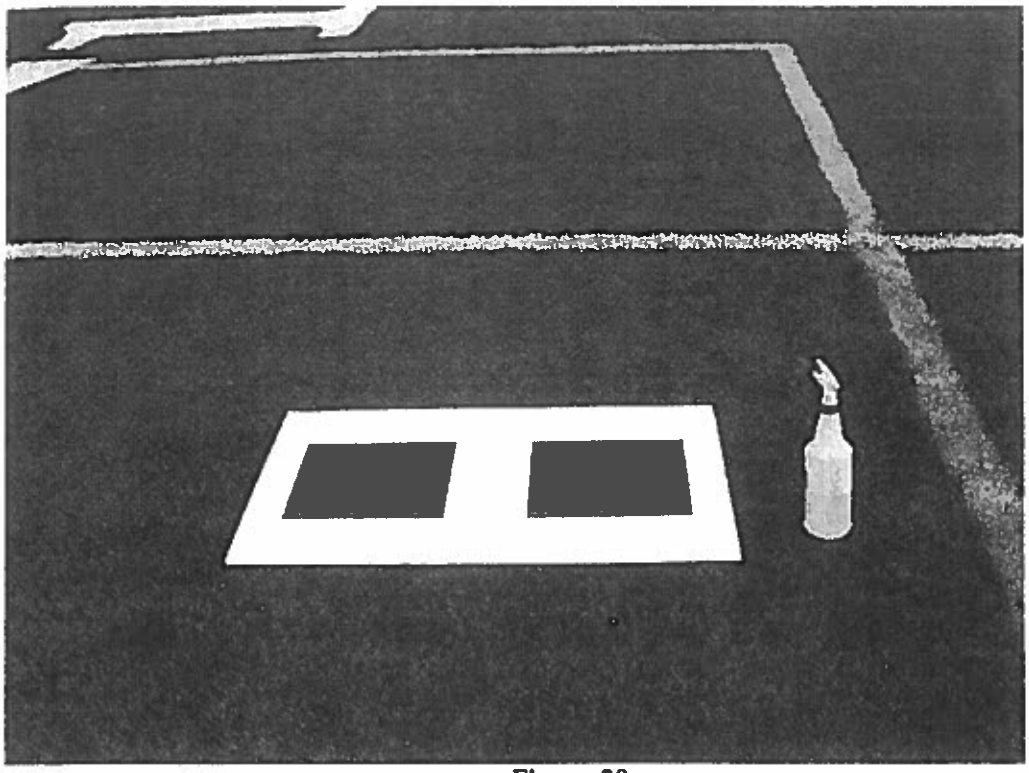


Figure 20

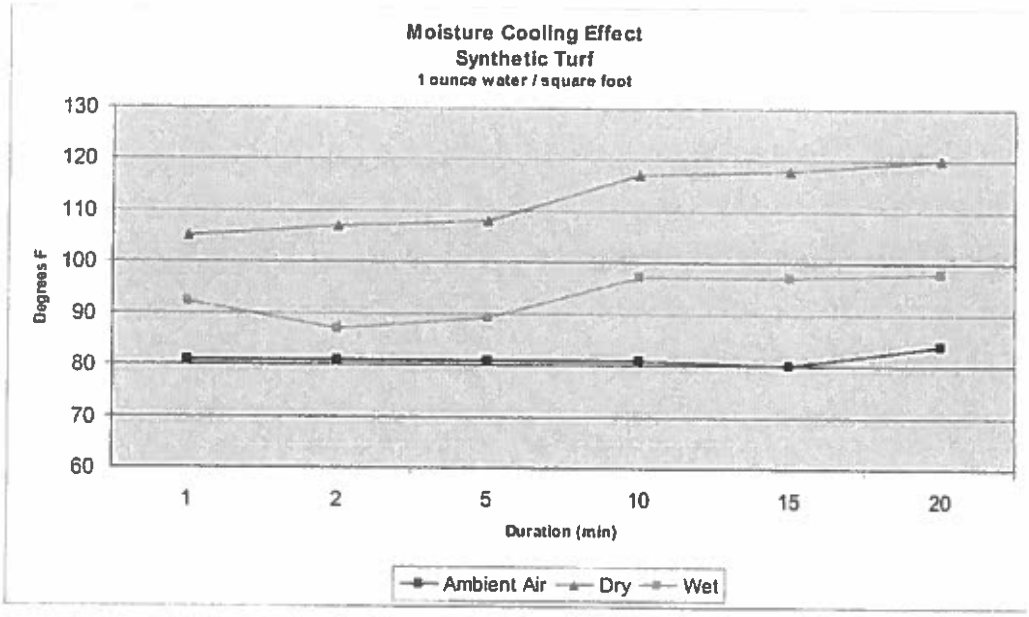


Figure 21

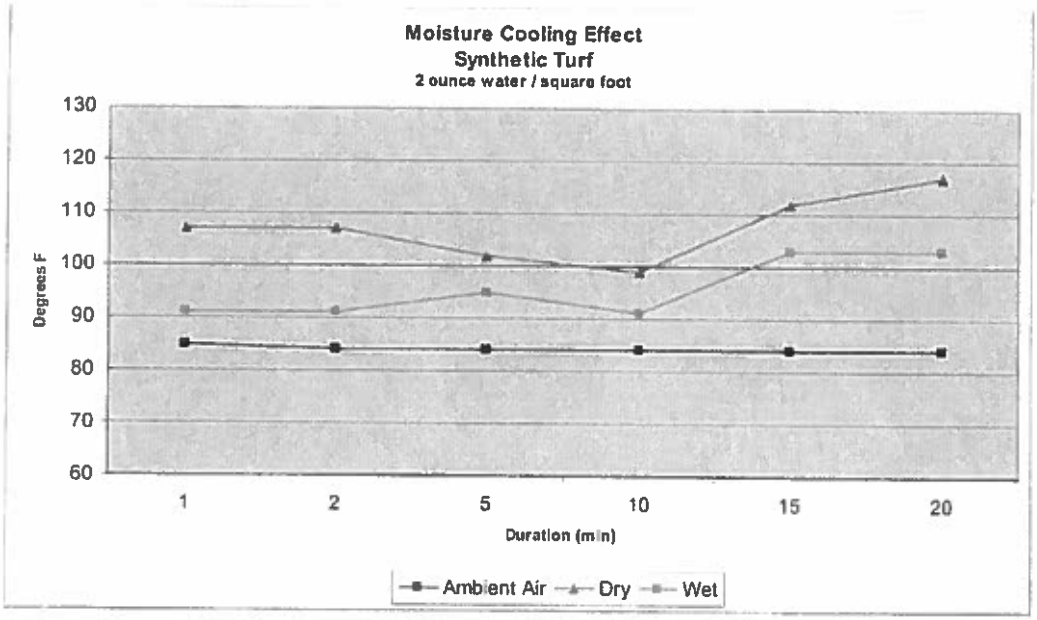


Figure 22

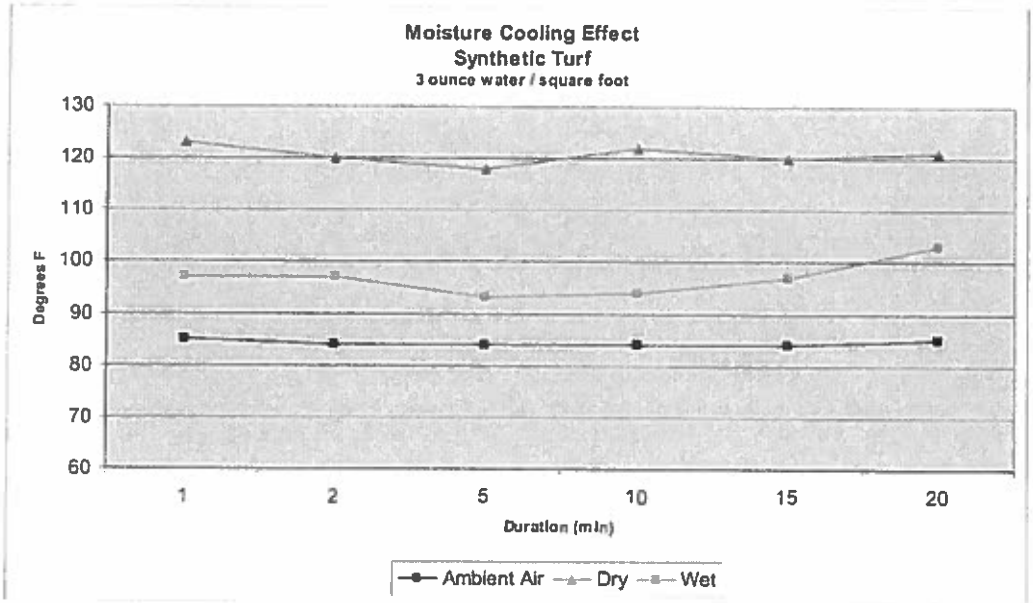


Figure 23

Summary

The results of the temperature measurements obtained from the fields studied in Connecticut indicate that solar heating of the materials used in the construction of synthetic turf playing surfaces does occur and is most pronounced in the polyethylene and polypropylene fibers used to replicate natural grass. Maximum temperatures of approximately 156° F were noted when the fields were exposed to direct sunlight for a prolonged period of time. Rapid cooling of the fibers was noted if the sunlight was interrupted or filtered by clouds. Significant cooling was also noted if water was applied to the synthetic fibers in quantities as low as one ounce per square foot. The elevated temperatures noted for the fibers generally resulted in an air temperature increase of less than five degrees even during periods of calm to low winds.

The rise in temperature of the synthetic fibers was significantly greater than the rise in temperature noted for the crumb rubber. Although a maximum temperature of 156° F was noted for the fibers, a maximum temperature of only 101° F, or approximately 16 degrees greater than the observed ambient air temperature, was noted for the crumb rubber.

Evaluation of Benzothiazole, 4-(tert-octyl) Phenol and Volatile Nitrosamines in Air at Synthetic Turf Athletic Fields

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The growing popularity of crumb rubber in-filled synthetic turf playing surfaces has resulted in questions concerning the potential resulting human health effects from the inhalation of volatile chemicals by users of those fields. A limited number of studies have attempted to identify and quantify these chemicals. One such study, conducted in 2007 by the Connecticut Agricultural Experiment Station[1] identified benzothiazole, butylated hydroxyanisole, n-hexadecane, and 4-(tert-octyl) phenol as potential chemicals of concerns. This study, however, was laboratory based and did not include collection and analysis of samples from installed fields. Another study, conducted by the Norwegian Institute for Air Research[2], evaluated the air quality at three different indoor fields.

A study was designed and conducted to specifically evaluate the possible presence of benzothiazole, 4-(tert-octyl)phenol, and volatile nitrosamines in air above recently installed outdoor, crumb rubber in-filled synthetic turf playing surfaces in Connecticut.

Field G

Methodology

Two fields in Connecticut were selected for this study. Both fields were constructed in 2007 by FieldTurf using polyethylene fiber with cryogenically produced rubber and silica sand infill. One field, identified as Field F, is located in the northern portion of the state, while Field G is

located in the southern portion of the state. Selection of the fields was based upon the ability to obtain permission to perform the testing and not based upon manufacturer or geographic location. Both fields are multipurpose fields used for sports such as football, soccer, field hockey, and/or lacrosse among others and are encircled by synthetic running track surfaces. These two fields were previously the subject of a separate study by the authors entitled "Thermal Effects Associated with Crumb Rubber In-filled Synthetic Turf Athletic Fields." The air sampling activities were conducted on August 15, 2008, at Field F and on August 18, 2008, at Field G.

Five sample locations were selected at each of the sampled fields. One location at each field was directly over the center portion of the playing surface, while the remaining four were located off the playing surface at either end or sides of the fields. These later locations were selected to provide "background" results to account for potential transport of vapors by wind and to evaluate the possible volatilization of target compounds from the running track surfaces.

A Davis Vantage Pro2 automated meteorological station was utilized to measure temperature, relative humidity, wind speed, and wind direction at the fields throughout the sampling period. The station was erected near the sampling location in the center portion of the field (Figure 1). The temperature sensor portion of the instrument was located approximately five feet above the synthetic turf surface.

Figure 1 - Meteorological Station

Additional measurements were made of the air temperature at heights of one foot and four feet above the synthetic turf surface using six-inch Enviro-Safe, Easy Read Armor Case thermometers with a protective plastic jacket. These thermometers have a working temperature range of 0 degrees Fahrenheit (° F) to 220° F with two-degree graduations and are National Institute of Standards and Technology (NIST) certified. The thermometers were suspended within Styrofoam insulating cylinders. The inside dimensions of the cylinders were approximately $3^3/_8$ inches diameter by 7¼ inches tall. Outside dimensions were approximately 4¼ inches diameter by 7¾ inches tall. Twelve one-half inch holes were drilled into four sides of the cylinders to allow for airflow through the cylinder while still providing protection from the heating effect of the sunlight (Figure 2).

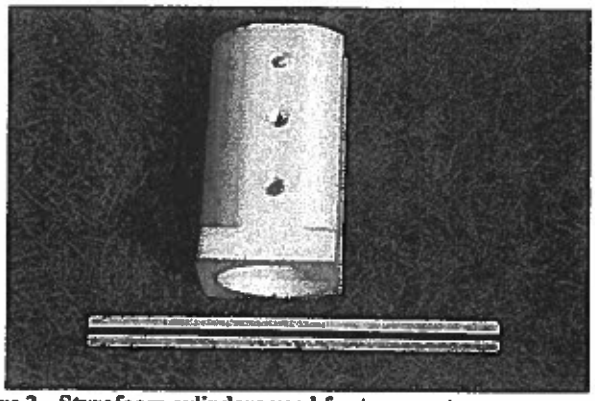

Figure 2 - Styrofoam cylinders used for temperature measurements

The Styrofoam cylinders were then mounted to the metal pole supporting the weather station. The mounted cylinders can be seen in Figure 1.

The temperature of crumb rubber in-fill material was measured using a digital pen thermometer with a stated sensing range of -58° F to 536° F in 0.1 degree divisions with accuracy of one degree. The sensing probe measured eight inches long and was constructed of stainless steel.

Air samples were collected through dedicated adsorbent media with the intakes set at approximately four feet above ground surface (Figures 2 through 5). The samples to be analyzed for benzothiazole and 4-(tert-octyl) phenol were collected using XAD-2 adsorbent media (Catalog #226-30, lot 4501, expiration date April 2012) produced by SKC Inc. of Eighty Four, Pennsylvania. A minimum of 480 liters of air was pumped through the adsorbent media at an approximate rate of two liters per minute using an SKC Airlite sampling pump. A 37 mm, 2 micron PTFE filter was placed inline before the adsorbent media tube.

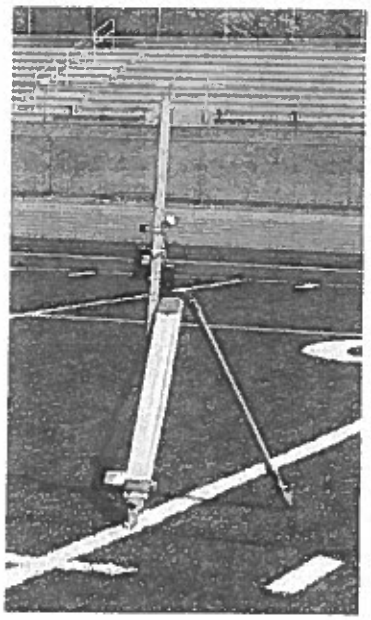

Figure 3 - Field Sample Location

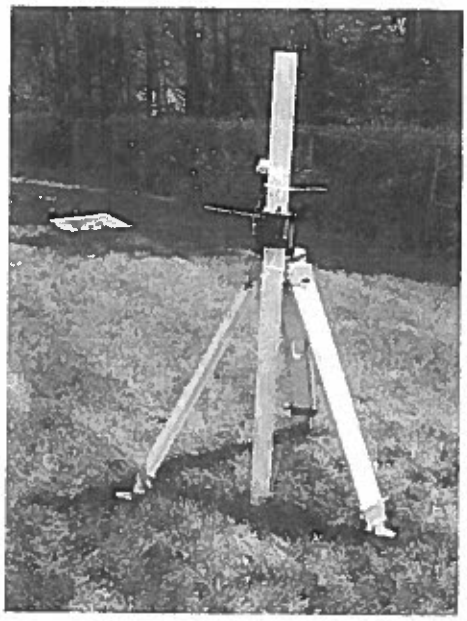

Figure 4 - "Background" Sample Location

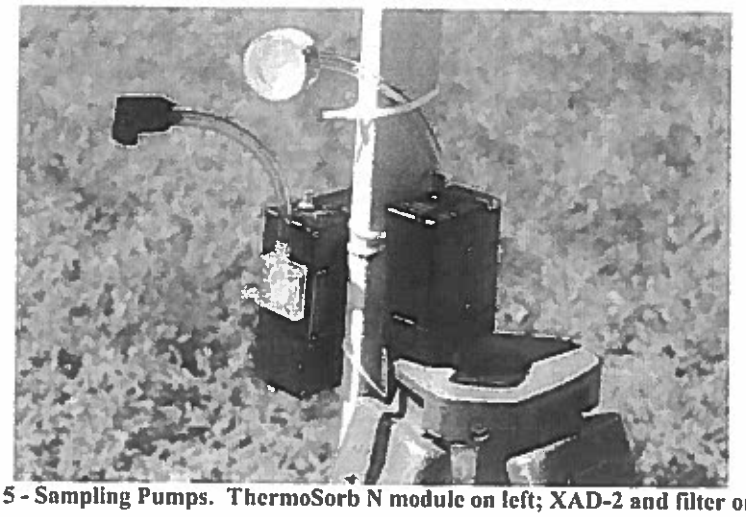

Figure 5 - Sampling Pumps. ThermoSorb N module on left; XAD-2 and filter on right

The samples to be analyzed for volatile nitrosamines were collected using ThermoSorb N adsorbent media produced by Advanced Chromatography Systems of Johns Island, South Carolina. A minimum of 75 liters of air was pumped through the adsorbent media at an

approximate rate of one liter per minute using an SKC Universal Pump 224-PCXR8 sampling pump.

Both models of sampling pumps have a manufacturer's stated flow rate accuracy of +/- 5%.

The intakes for all samples were set at approximately four feet above either the playing surface or the grass surface surrounding the playing field. The sampling media was connected to the sampling pumps using approximately six inches of ¼ I.D. x 3/8 OD poly tubing. The pump was calibrated prior to sampling utilizing a BIOS DryCal DC-Lite air pump calibrator. A sacrificial media tube and poly tubing was used during the pump calibration.

All samples were delivered to the Wisconsin Occupational Health Laboratory at the University of Wisconsin via overnight courier service for analysis. The analytical methods employed for benzothiazole and 4-(tert-octyl) phenol analysis were based upon NIOSH Method 2550. The samples were desorbed with 10 minutes of sonication performed three times with three milliliters (mL) of methanol. The combined methanol fractions were then evaporated to approximately 0.5 mL with nitrogen and brought to a final volume of 1.0 mL with methanol. The extracts were then analyzed by reversed phase high-performance liquid chromatography employing a 0.1 percent formic acid:methanol linear gradient program. Detection was achieved by triple quadruple mass spectrometry using multiple reaction monitoring. A reporting limit of 100 nanograms was established for the analytes based upon statistical data analysis.

The analytical methods employed for the nitrosamine analysis were based upon OSHA Method 27. The samples were with approximately three mL of methylene chloride:methanol (75:25 v/v). Extracts were analyzed by reversed phase high-performance liquid chromatography employing a 0.1 percent formic acid:methanol linear gradient program. Detection was achieved by turbo ion spray triple quadruple mass spectrometry using multiple reaction monitoring in positive ionization mode. A reporting limit of 100 nanograms was established for the analytes based upon statistical data analysis; however, any discernable peak for n-nitrosodimethylamine was reported with appropriate comment.

Results

Field F

Air sampling activities were conducted at Field F on August 15, 2008. Five discrete sample locations were chosen. One location (SF-1) was near the center to the playing surface while the remaining four locations (SF-2, SF-3, SF-4, and SF-5) were around the perimeter of the synthetic running track. The sample locations are graphically presented in Figure 6. Sampling activities were initiated at 11:40 and were completed at 16:07.

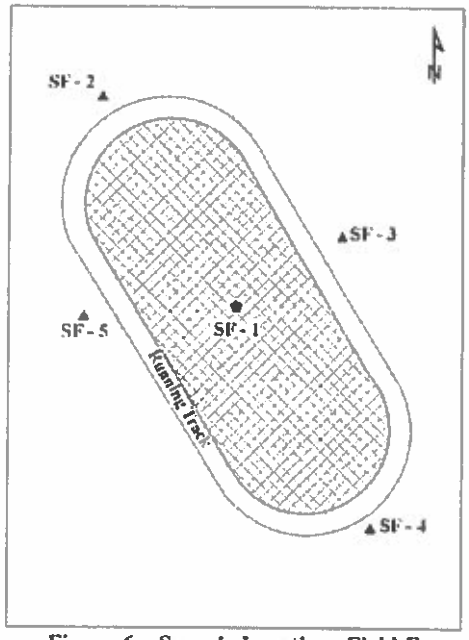

Figure 6 – Sample Locations Field F

Weather conditions on August 15, 2008, at the sample site were generally a mix of clear and partly cloudy skies with ambient air temperatures between 75° F and 80° F. Winds were generally light to calm. The late morning and early afternoon winds were measured

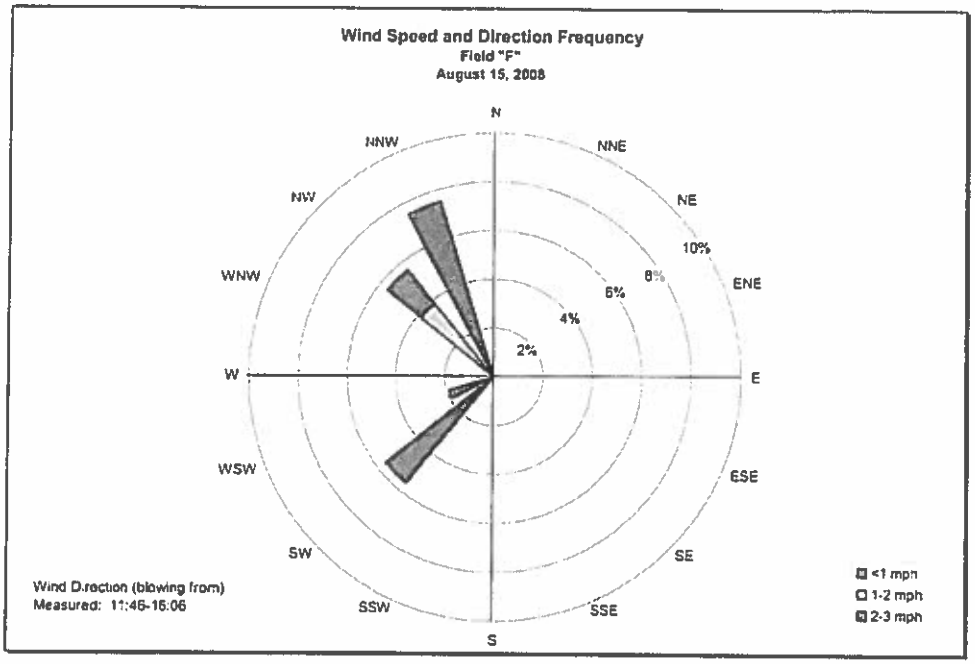

Figure 7 - Wind Speed and Direction

to be less than two miles per hour and were from the north and northwest. At approximately 15:30, the winds shifted to the southwest and increased to a maximum of three miles per hour. Figure 7 depicts the wind speed, direction, and frequency noted during the testing period. A brief rain shower occurred at approximately 14:45.

The air temperature was measured at three different heights (one foot, four feet, and five feet) directly over the playing surface near sample location SF-1. In addition, the temperature of the crumb rubber in-fill material was measured at a depth of approximately one inch. The measured temperatures are shown in Figure 8. The air temperature was noted to increase with decreasing height above the playing surface. The average air temperature measured at a height of five feet was 76.6° F, while the average temperatures at one foot and four feet were 85.7° F and 81.7° F, respectively. The average temperature of the crumb rubber was 91.7° F. Significant cooling of the crumb rubber and the air column at one foot and four feet above the surface was noted following the brief rain shower that occurred at 14:45.

Periodic measurements of the surface temperature of the synthetic "grass" fibers were measured using an infrared thermometer manufactured by EXTECH Instruments (EXTECH Pocket IR thermometer). A maximum temperature of 127° F was noted at 12:00.

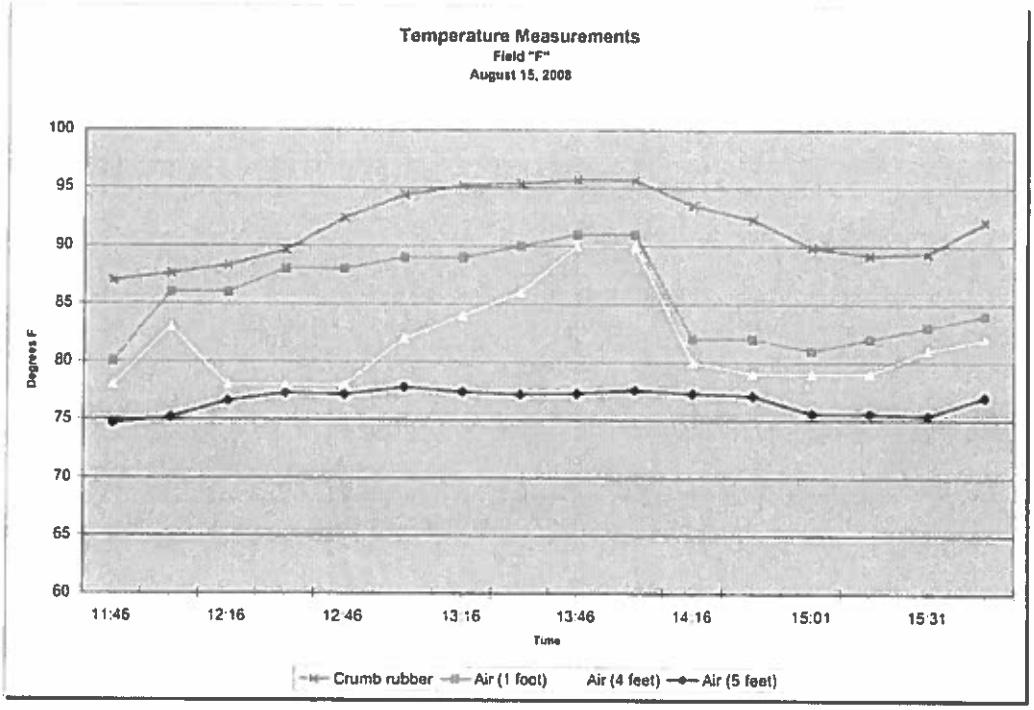

Figure 8 – Temperature Measurements Field F

All air sampling pumps were activated between 11:40 and 11:49. The pumps connected to the ThermoSorb N media were allowed to run at a flow rate of approximately one liter per minute for approximately 75 minutes. At the conclusion of the appropriate time interval, the SKC Universal Pump 224-PCXR8 was deactivated and the ThermoSorb N module was removed and sealed using the supplied caps. After approximately four hours, the SKC Airlite sampling pumps were also deactivated and the XAD-2 adsorbent tubes were removed and sealed using the supplied caps. The PTFE filters were capped and placed into plastic zip bags.

Table 1
Sampled Air Volumes - Field F
August 15, 2008

	ThermoSorb N Module			XAD-2 Module		
Sample ID	Start Time	End Time	Air Volume (L)	Start Time	End Time	Air Volume (L)
SF-1	11:49	13:04	76.13	11:49	16:08	519.04
SF-2	11:42	12:57	75.90	11:42	15:57	512.04
SF-3	11:45	13:00	75.98	11:45	16:04	519.55
SF-4	11:47	13:03	77.82	11:47	16:07	521.30
SF-5	11:40	12:55	78.75	11:40	15:46	493.23

The samples were packaged for delivery to the Wisconsin Occupational Health Laboratory at the University of Wisconsin. The analytical methods employed are described in the "Methodology" section above.

The volatile nitrosamine analysis indicated that there were no detectable concentrations of nitrosamines in the air directly above the synthetic turf playing surface (Table 2). The results also indicate that the air upwind and downwind of the playing surface lacked detectable concentrations of nitrosamines.

Table 2
Volatile Nitrosamines Results – Field F

	SF-1		SF-2		SF-3		SF-4		SF-5	
	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Nitrosodibutylamine (n-)	<1.1	< 0.18	<1.1	< 0.17	<1.4	< 0.22	<1.1	< 0.17	<1.0	< 0.16
Nitrosodiethylamine (n-)	<1.1	< 0.27	<1.1	< 0.26	<1.4	< 0.34	<1.1	< 0.27	<1.0	< 0.24
Nitrosodimethylamine (n-)	<1.1	< 0.38	<1.1	< 0.36	<1.4	< 0.46	<1.1	< 0.37	<1.0	< 0.34
Nitrosodipropylamine (n-)	<1.1	< 0.21	<1.1	< 0.20	<1.4	< 0.26	<1.1	< 0.20	<1.0	< 0.19
Nitrosomorpholine (n-)	<1.1	< 0.24	<1.1	< 0.23	<1.4	< 0.30	<1.1	< 0.23	<1.0	< 0.21
Nitrosopiperidine (n-)	<1.1	< 0.24	<1.1	< 0.24	<1.4	< 0.30	<1.1	< 0.24	<1.0	< 0.22
Nitrosopyrrolidine (n-)	<1.1	< 0.28	<1.1	< 0.27	<1.4	< 0.34	<1.1	< 0.27	<1.0	< 0.25

µg/m³ = mircograms per cubic meter
ppbv = parts per billion per volume

The laboratory analysis of the air directly above the synthetic turf playing surface also lacked detectable concentrations of benzothiazole and 4-(tert-octyl) phenol (Table 3). The upwind and downwind samples yielded similar results. No detectable concentrations of either compound were noted upon extraction of the two micron PTFE filters.

Table 3
Benzothiazole and 4-(tert-octyl) Phenol Results – Field F

	SF-1	SF-2	SF-3	SF-4	SF-5
	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Benzothiazole	<0.19	<0.20	<0.19	<0.19	<0.20
4-(tert-octyl)phenol	<0.19	<0.20	<0.19	<0.19	<0.20

µg/m³ = mircograms per cubic meter

Field G

Air sampling activities were conducted at Field G on August 18, 2008. The same procedures that were used in sampling at Field F were employed for the sampling at Field G. A potentially significant change in the sampling conditions was encountered during the activities at Field G. The owner of the field had groomed, or raked, the field three days prior to the air sampling activities. As a result of the grooming, the crumb rubber infill had not yet settled within the synthetic grass 'fibers" and was, therefore, more exposed at the surface.

As with the previous sampling, five discrete sample locations were chosen. The sample locations are graphically presented in Figure 9. Sampling activities were initiated at 11:17 and were completed at 15:33.

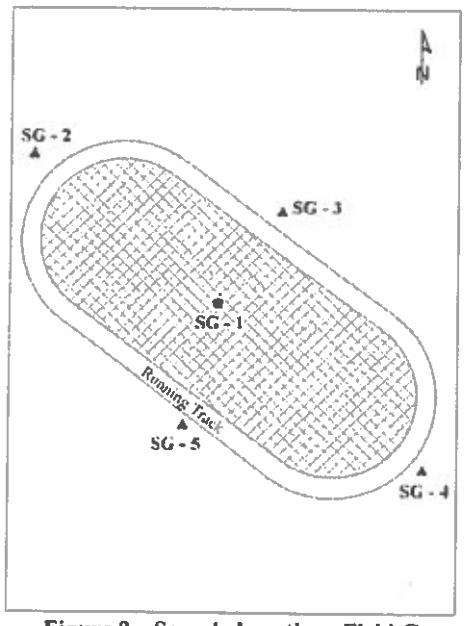

Figure 9 – Sample Locations Field G

Weather conditions on August 18, 2008, at the sample site were generally sunny with ambient air temperatures between 80° F and 85° F. Winds were generally light to calm and were variable in direction although were generally from a southerly direction. The maximum measured wind speed was three miles per hour. Figure 10 depicts the wind speed, direction, and frequency noted during the testing period.

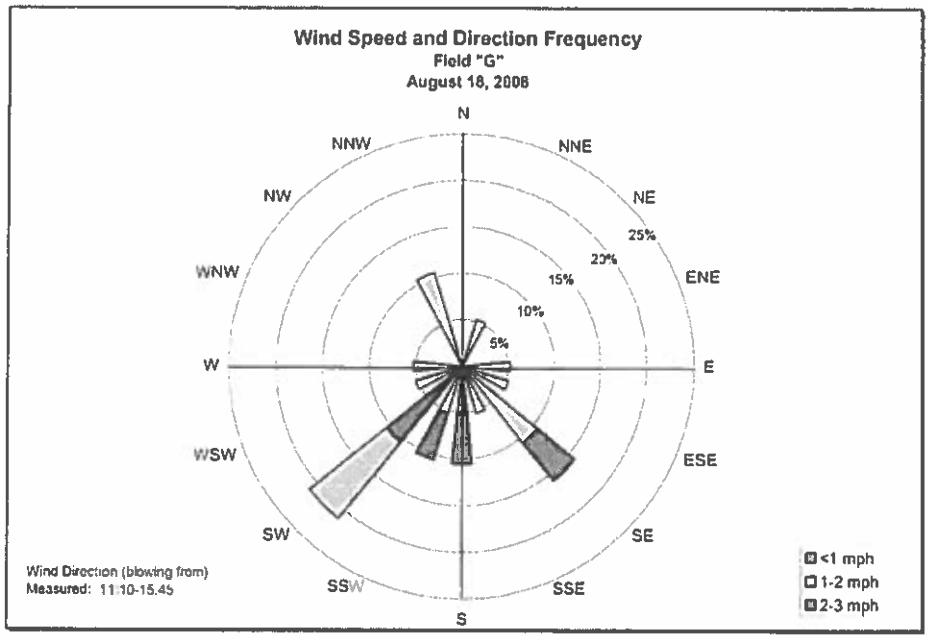

Figure 10 - Wind Speed and Direction

The air temperatures measured during the sampling at Field G are shown in Figure 11. As with Field F, the air temperature was noted to increase with decreasing height above the playing surface. The average air temperature measured at a height of five feet was 84.6° F while the average temperatures at one foot and four feet were 92.3° F and 88.4° F, respectively. The average temperature of the crumb rubber was 99.6° F. The surface temperature of the synthetic grass blades averaged 139° F.

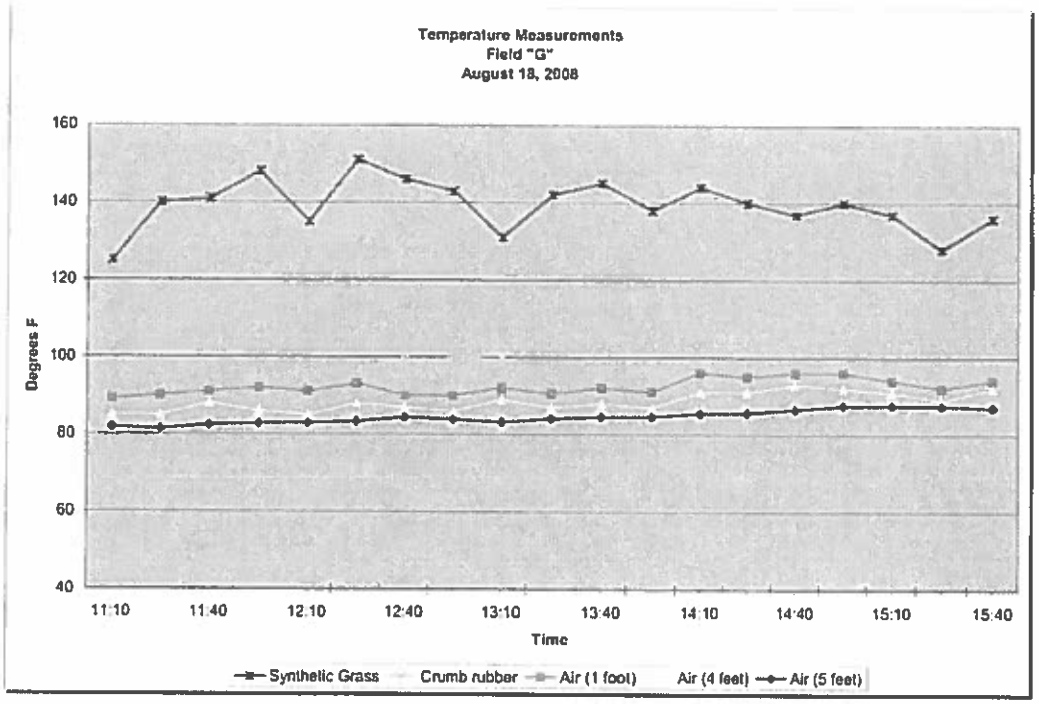

Figure 11 - Temperature Measurements Field G

All air sampling pumps were activated between 11:40 and 11:49. Table 4 details the start and stop times of the various sampling pumps and the volumes of air pumped during the sampling at Field G.

Table 4
Sampled Air Volumes - Field G
August 18, 2008

	ThermoSorb N Module			XAD-2 Module		
Sample ID	Start Time	End Time	Air Volume (L)	Start Time	End Time	Air Volume (L)
SG-1	11:22	12:37	75.75	11:22	15:23	480.96
SG-2	11:17	12:32	75.75	11:17	15:18	480.72
SG-3	11:25	12:40	75.15	11:25	15:25	481.44
SG-4	11:28	12:43	75.225	11:28	15:28	480.96
SG-5	11:33	12:48	75.525	11:33	15:33	481.20

The samples were packaged for delivery to the Wisconsin Occupational Health Laboratory at the University of Wisconsin. The analytical methods employed are described in the "Methodology" section above.

The volatile nitrosamine analysis indicated that there were no detectable concentrations of nitrosamines in the air directly above the synthetic turf playing surface (Table 5). The results also indicate that the air upwind and downwind of the playing surface lacked detectable concentrations of nitrosamines.

Table 5
Volatile Nitrosamines Results – Field G

	SG-1		SG-2		SG-3		SG-4		SG-5	
	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Nitrosodibutylamine (n-)	<1.3	< 0.20	<1.4	< 0.21	<1.4	< 0.21	<1.4	< 0.21	<1.4	< 0.21
Nitrosodiethylamine (n-)	<1.3	< 0.32	<1.4	< 0.33	<1.4	< 0.33	<1.4	< 0.33	<1.4	< 0.33
Nitrosodimethylamine (n-)	<1.3	< 0.44	<1.4	< 0.45	<1.4	< 0.45	<1.4	< 0.45	<1.4	< 0.45
Nitrosodipropylamine (n-)	<1.3	< 0.24	<1.4	< 0.25	<1.4	< 0.25	<1.4	< 0.25	<1.4	< 0.25
Nitrosomorpholine (n-)	<1.3	< 0.28	<1.4	< 0.29	<1.4	< 0.29	<1.4	< 0.29	<1.4	< 0.29
Nitrosopiperidine (n-)	<1.3	< 0.28	<1.4	< 0.29	<1.4	< 0.29	<1.4	< 0.29	<1.4	< 0.29
Nitrosopyrrolidine (n-)	<1.3	< 0.32	<1.4	< 0.33	<1.4	< 0.34	<1.4	< 0.34	<1.4	< 0.33

µg/m³ = mircograms per cubic meter
ppbv = parts per billion per volume

The laboratory analysis of the air directly above the synthetic turf playing surface indicated a concentration of benzothiazole of 0.39 micrograms per cubic meter of air. No 4-(tert-octyl) phenol was detected (Table 6). The upwind and downwind samples yielded similar results. No detectable concentrations of either compound were noted upon extraction of the two micron PTFE filters.

Table 6
Benzothiazole and 4-(tert-octyl) Phenol Results – Field G

	SG-1	SG-2	SG-3	SG-4	SG-5
	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Benzothiazole	0.39	<0.21	<0.21	<0.21	<0.21
4-(tert-octyl)phenol	<0.21	<0.21	<0.21	<0.21	<0.21

µg/m³ = mircograms per cubic meter

Although the concentration of benzothiazole was quantified at 0.39 $\mu g/m^3$, the three trip spikes that were used as quality control recovered low for benzothiazole. The average recovery was 39% of the known spiked concentration, indicating that some degradation of the sample may have occurred prior to laboratory extraction. Assuming a similar degradation occurred for sample SG-1, the actual concentration of benzothiazole in the air directly above the synthetic playing surface may have been as high as 1.00 $\mu g/m^3$.

Summary

Twenty air samples were collected above and around two synthetic turf playing surfaces in Connecticut. Ten of the samples were analyzed for volatile nitrosamine content and 10 were analyzed for benzothiazole and 4-(tert-octyl) phenol content. The samples were collected on warm, late summer days during periods of light to calm winds. In one case, the synthetic turf surface had been groomed three days prior to the sampling. The sampling was conducted during periods when the temperature of the crumb rubber in-fill material was elevated due to exposure to the sun. The average temperatures of the crumb rubber were 91.7° F and 99.6° F. The surface temperature of the synthetic grass blades was noted to climb as high as 151° F. The combination of air temperatures, surface temperatures, wind speed and, in the case of Field G, the recent maintenance, are believed to be conditions favorable for generating maximum concentrations of the analytes in the air column above and around the playing surfaces.

This study determined that under favorable conditions for vapor generation, no detectable concentrations of volatile nitrosamines or 4-(tert-octyl) phenol existed in the air column at a height of four feet above the tested synthetic playing surfaces or in the air either upwind or downwind of the fields. The study did not evaluate if any of these two compounds were off-gassed from the fields, but simply that if they did, sufficient dilution within the air column existed to render them undetectable using methods based upon accepted OSHA and NIOSH procedures. The study also determined that benzothiazole, a common compound used in the manufacturing of rubber and plastics, was present at a very low concentration directly above one of the two fields sampled. This compound was not detected at the second of the two fields sampled nor was it detected in any of the upwind or downwind locations at either field. The field where benzothiazole was detected had recently been groomed, thereby bringing significant

quantities of crumb rubber nearer to the surface of the field resulting in greater exposure to both the sunlight and air.

References

[1] Connecticut Agricultural Experiment Station (2007). Examination of Crumb Rubber Produced from Recycled Tires. AC005-8/07.

[2] Dye, C., Bjerke, A., Schmidbauer, N., and Mano, S. (2006). Measurement of Air Pollution in Indoor Artificial Turf Hall. Norwegian Institute for Air Research Report NILU OR 03/2006.

1001-22-1-n2408-rpt

Evaluation of Stormwater Drainage Quality From Synthetic Turf Athletic Fields

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Each year, millions of scrap tires are generated in the United States. The Rubber Manufacturers Association estimates that in 2005 seven-eighths of the scrap tires generated were ultimately consumed or recycled in end-use markets.[1] Approximately 290 million new scrap tires are generated each year.[2] Beneficial reuses of scrap tires include use as tire-derived fuel, landfill leachate collection systems, septic system drain fields, various civil engineering applications related to roadway and bridge construction, various stamped and punched rubber products, and use in athletic field and other recreational applications. The potential environmental effects resulting from the reuse of scrap tires in civil engineering applications have been evaluated by Humphrey[3, 4] and Brophy[5], among others. While these studies have concluded that the use of tire chip has a negligible effect upon ground water quality, few, if any, studies have been conducted concerning the effect on water quality resulting from the installation of synthetic turf athletic fields containing cryogenically treated crumb rubber produced from scrap tires.

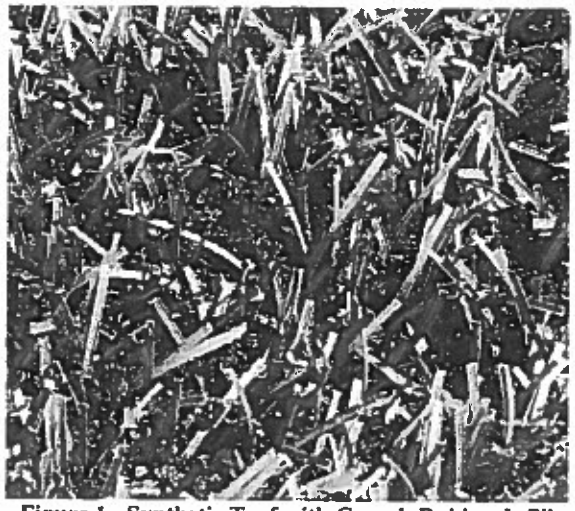

Figure 1 - Synthetic Turf with Crumb Rubber Infill

This paper presents the results of a study in which the stormwater drainage from crumb rubber and silica sand in-filled synthetic turf athletic fields was analyzed over a period of approximately one year.

Methodology

Three fields within Connecticut were selected for this study. Two of the fields are located in the northern portion of the state while the third is located in the southern portion of the state. Fields F and G were constructed by FieldTurf in 2007, and Field E was constructed in 2008. All fields are multipurpose fields used for sports such as football, soccer, field hockey, and lacrosse, among others, and are encircled by synthetic running track surfaces. In all cases, edge drains were present to capture the stormwater runoff from the running track surfaces (Figure 2).

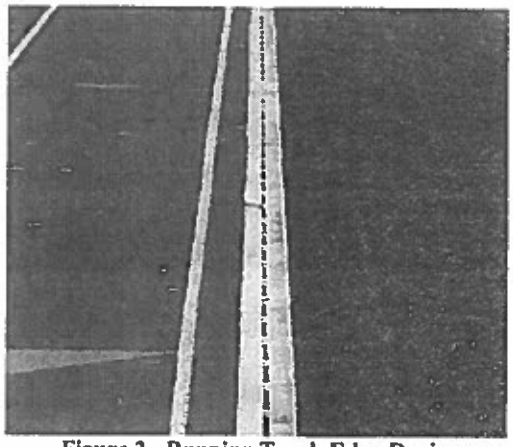

Figure 2 - Running Track Edge Drain

This allowed for sampling to be conducted of solely the stormwater that infiltrated the field surface and migrated downward through the in-fill material, through the polyethylene fiber backing, and into the underlying stone prior to entering the dedicated drainage piping. A typical cross section of a synthetic turf athletic field is shown in Figure 3.

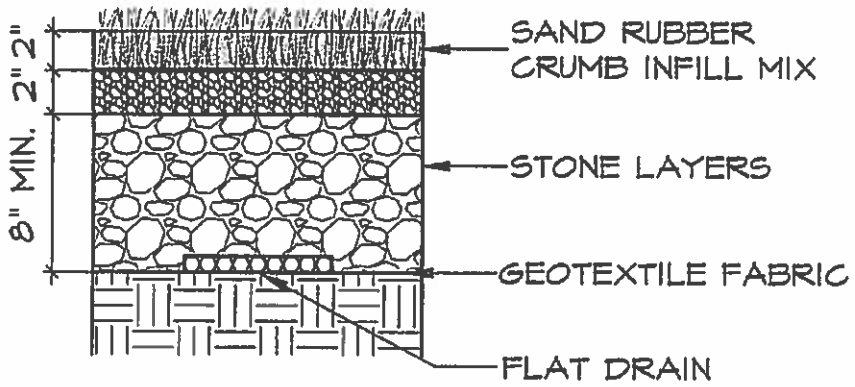

Figure 3 - Typical Field Cross Section

The use of the stone base and the flat drain systems is intended to drain stormwater out of and away from the playing surface as quickly as possible.

Each of the three sampled fields was constructed using nonmetallic underdrain systems that discharged directly to either a nearby catch basin or manhole. Grab samples of the discharge water were collected directly from the discharge pipe at the discharge location. Samples were generally collected on a calendar-quarter basis and were collected as soon as practical after the start of a rainfall event. The samples were collected using a high-density polyethylene dipper manufactured by Bel-Art and obtained from Forestry Suppliers, Inc. (catalog number 53915). The dipper was equipped with a six-foot polyethylene handle to allow for sampling without the need for entry into confined spaces. Tests performed included acute aquatic toxicity, dissolved metals (zinc, lead, selenium, and cadmium), and pH.

The aquatic toxicity monitoring was performed by GZA GeoEnvironmental, Inc. (GZA), of Bloomfield, Connecticut, in accordance with Method EPA-821-R-02-012. The water sample for this analysis was collected from Field F on October 12, 2007.

The analysis for dissolved metals content and pH was performed by Complete Environmental Testing (CET) of Stratford, Connecticut. The water samples for this analytical method were collected from Field F on October 12, 2007, October 20, 2007, November 6, 2007, February 5,

2008, April 28, 2008, and October 1, 2008. A single sampling event was conducted at Field G (April 29, 2008) and at Field E (July 24, 2008).

Subsequent to initiation of the study, the scope was expanded to include laboratory analysis of samples of the crumb rubber in-fill material. The laboratory analysis included the evaluation of metals content in an extract produced in accordance with EPA Method 1312. This methodology is referred to as the Synthetic Precipitation Leaching Procedure or SPLP. The purpose of the testing was to evaluate the potential to leach metals under acidic conditions in the controlled environment of a laboratory. The expectation was that the results would not be directly comparable to the actual in-place field conditions but would provide a useful check on the results of the drainage sampling. The analysis was performed by CET. Samples of the crumb rubber were collected from Field F on February 28, 2008, April 28, 2008, and October 1, 2008. A sample was collected from Field G on April 29, 2008, and from Field E on October 1, 2008. A sample of unused crumb rubber was also obtained from FieldTurf on October 23, 2007, and analyzed in accordance with the SPLP procedure.

Additional bench-scale testing was performed to evaluate the effect upon drainage water pH due to the stone layer that is installed under the synthetic surface materials. The tested fields were constructed using a stone layer consisting of broken basalt rock. A sample of basalt was obtained during the installation of Field E in order to perform the pH testing. The pH testing was conducted by first creating solutions of known pH. Five samples of stone, each having a mass of approximately 300 grams, were placed in separate glass jars. The known pH solution was then placed in contact with the stone samples, and the solution was monitored at five intervals up to 15 minutes. Separate control samples of tap water were prepared and served as quality control samples. Solutions of pH 4.2 and 5.2 were prepared for this evaluation.

Results

Aquatic Toxicity Evaluation

On October 12, 2007, a sample of stormwater was collected from the drainage system at Field F. The sample was placed into a container supplied by GZA and immediately delivered to GZA for an evaluation of the aquatic toxicity using *Daphnia pulex* as the test organism. The testing was conducted in accordance with EPA Method EPA-821-R-02-012. The results indicated >100% survival at both the 24- and 48-hour intervals at LC_{50} using copper nitrite as the reference toxicant.

Metals Content in Drainage Water

Samples of the stormwater were collected from Field F on October 12, 2007, October 20, 2007, November 6, 2007, February 5, 2008, April 28, 2008, and October 1, 2008. The samples were chilled and delivered to CET for analysis of the dissolved fraction of zinc, lead, selenium, and cadmium. The results were compared to the lowest aquatic life criterion for each element as established by the Connecticut Department of Environmental Protection. Table 1 summarizes the results of the laboratory analysis. The results of the laboratory analysis indicated that lead, selenium, and cadmium were not present in the drainage water. Zinc was determined to be present on three of the five sampling dates at a maximum concentration of 0.022 mg/L. The Water Quality Standard established by the Connecticut Department of Environmental Protection is 0.065 mg/L.

Table 1
Metals Content in Drainage Water - Field F

Constituent	Water Quality Standard[1]	Sample Date					
		10/12/2007	10/20/2007	11/6/2007	2/5/2008	4/28/2008	10/1/2008
metals (all units in mg/L)							
Zinc	0.065	<0.020	0.022	0.012	<0.002	0.019	0.031
Lead	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	0.005	<0.010	<0.005	<0.002	<0.002	<0.002	<0.002
Cadmium	0.00135	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
pH	--	7.30	7.41	7.34	7.48	7.85	7.83

[1] CT Department of Environmental Protection Standard for fresh water

A sample of stormwater was collected from the drainage system of Fields G and E on April 28, 2008, and July 24, 2008, respectively. The results, which are summarized in Tables 2 and 3, again indicated levels of dissolved zinc but at concentrations less than the applicable Water Quality Standard. Lead, selenium, and cadmium were not detected in the drainage from either Field E or Field G.

Table 2
Metals Content in Drainage Water - Field G

Constituent	Water Quality Standard[1]	Sample Date
		4/29/2008
metals analysis (all units in mg/L)		
Zinc	0.065	0.005
Lead	0.0012	<0.001
Selenium	0.005	<0.002
Cadmium	0.00135	<0.001
pH	--	8.7

[1]CT Department of Environmental Protection Standard for fresh water

Table 3
Metals Content in Drainage Water - Field E

Constituent	Water Quality Standard[1]	Sample Date
		7/24/2008
metals analysis (all units in mg/L)		
Zinc	0.065	0.036
Lead	0.0012	<0.001
Selenium	0.005	<0.002
Cadmium	0.00135	<0.001
pH	--	7.62

[1]CT Department of Environmental Protection Standard for fresh water

Laboratory Leaching Potential Evaluation

Samples of the crumb rubber and silica sand in-fill material were collected from Fields E, F, and G. The samples were collected on two different dates for Fields E and F and on just one occasion from Field G. Approximately 150 grams of the in-fill material were collected on each date and delivered to CET for metals analysis in accordance with the SPLP extraction protocols. The results were compared to the criteria established by the Connecticut Department of Environmental Protection for the evaluation of the leaching potential of environmentally contaminated soil. The results, which are summarized in Table 4, demonstrate that the crumb rubber has the potential to leach metals but at concentrations less than the criteria established by the CT DEP for geographic areas that rely upon ground water as the source of potable water.

Table 4
Synthetic Precipitation Leaching Procedure - Crumb Rubber In-fill

		Date					
		10/23/2007	2/8/2008	4/28/2008	4/29/2008	10/1/2008	10/1/2008
		Raw Crumb Rubber	Field F	Field F	Field G	Field F	Field E
Constituent	Approximate "Age"	0 month	4 months	6 months	6 months	1 year	4 months
	Connecticut Pollutant Mobility Criteria	all units in mg/l					
Mercury	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Lead	0.015	<0.013	<0.013	0.006	0.004	<0.013	<0.013
Selenium	0.05	<0.01	<0.01	<0.002	<0.002	<0.01	<0.01
Cadmium	0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.005
Chromium	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	0.05	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Barium	1.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.036	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	1.3	<0.04	<0.04	<0.04	<0.04	na	na
Nickel	0.1	<0.05	<0.05	<0.05	<0.05	na	na
Zinc	5	1.6	0.91	1.9	1.1	2.4	4.7

na: not analyzed

Bench-Scale pH Analysis

The measurements obtained as part of the sampling of the drainage water discharge indicated a pH that was higher than anticipated. Measurements obtained of the pH of rainfall in the town of Cheshire, Connecticut during the study period indicated a pH of rainfall that was generally between five and six units. It was theorized that the basaltic stone base used in the construction of the athletic fields had a neutralizing effect on the infiltrated rainfall at the field locations. A limited bench-scale test was developed and performed to evaluate the effect of the stone on the pH level of various prepared solutions. The stone used for the performance of these tests was obtained during the construction of Field E.

In the first test, approximately 300 grams of crushed basaltic stone were place in each of five nine-ounce glass jars. The glass jars were then filled with tap water, and the pH was measured as a function of time by sequentially pouring the water out of each sample jar and into a separate clean glass jar for evaluation. A parallel set of jars was used containing just tap water as a set of control samples. The crushed stone was determined to have minimal effect on the tap water.

Table 5
pH Evaluation - Tap Water

Jar #	Weight of Stone (g)	Duration (min.)	pH	Water	Duration (min.)	pH
1	318	1:00	7.2	Control	1:55	7.4
2	272	2:00	7.7		2:05	7.8
3	304	5:00	8		6:00	7.8
4	312	10:00	7.9		11:00	7.9
5	322	15:00	7.9		16:30	8

The test was then repeated using a solution with a pH of 5.2 units. This test determined that the stone tended to raise the pH of the slightly acidic solution by nearly one full unit within the first minute of the test and then by approximately one-half unit at the conclusion of the test.

Table 6
pH Evaluation - Prepared Solution of pH 5.2

Jar #	Weight of Stone (g)	Duration (min.)	pH	Water	Duration (min.)	pH
1	306	1:00	6.3	Control	3:00	5.4
2	326	2:00	6.4		6:00	5.6
3	308	5:00	6.2		13:00	5.8
4	286	10:00	6.4		18:00	5.8
5	286	15:00	6.4		22:00	5.9

The test was repeated once again using a solution with a pH of 4.2 units. The stone was once again determined to have a neutralizing effect on the pH of the solution. A rise of over two units was noted immediately. The final pH was similar to the end point of the test that was conducted using a starting solution of pH 5.2.

Table 7
pH Evaluation - Prepared Solution of pH 4.2

Jar #	Weight of Stone (g)	Duration (min.)	pH	Water	Duration (min.)	pH
1	312	1:00	6.6	Control	3:00	4.2
2	290	2:00	5.9		6:00	4.2
3	304	5:00	6.2		13:00	4.8
4	304	10:00	6.2		18:00	4.8
5	304	15:00	6.5		22:00	4.4

Summary

The evaluation of the stormwater drainage quality from synthetic turf athletic fields included the collection and analysis of eight water samples over a period of approximately one year from three different fields, the collection and analysis of samples of crumb rubber in-fill from the same three fields plus a sample of raw crumb rubber obtained from the manufacturer, and the evaluation of the effect of the stone base material on the pH of the drainage water. The results of the study indicate that the actual stormwater drainage from the fields allows for the complete survival of the test species *Daphnia pulex*. An analysis of the concentration of metals in the actual drainage water indicates that metals do not leach in amounts that would be considered a risk to aquatic life as compared to existing water quality standards. Analysis of the laboratory-

based leaching potential of metals in accordance with acceptable EPA methods indicates that metals will leach from the crumb rubber but in concentrations that are within ranges that could be expected to leach from native soil. Lastly, it can be concluded that the use of crushed basaltic stone as a base material in the construction of the athletic fields has a neutralizing effect on precipitation.

References

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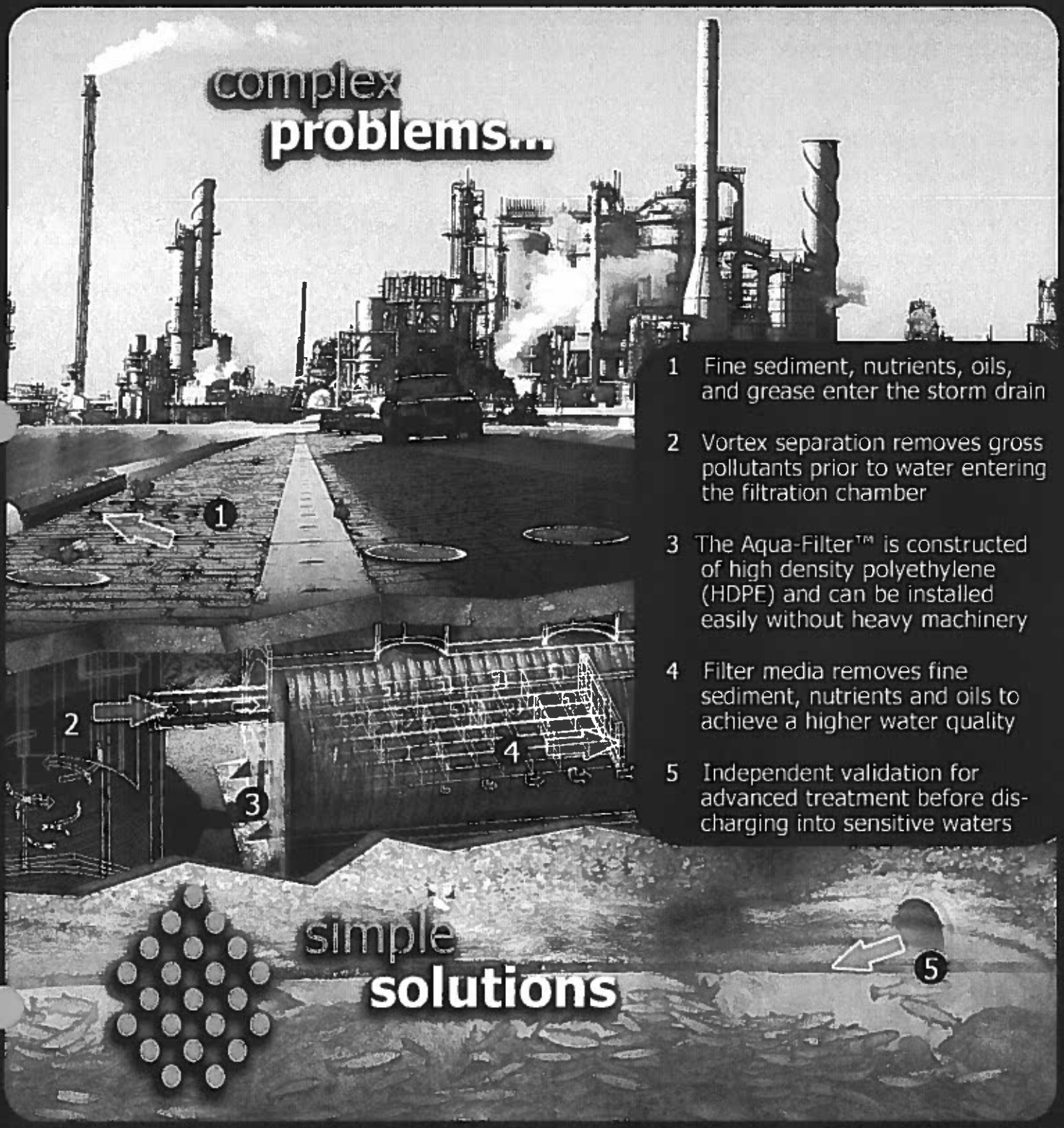
1001-22-n2608-1-rpt.doc

Exhibit

6

AquaShield™
STORMWATER TREATMENT SOLUTIONS

Aqua-Filter™ STORMWATER TREATMENT SYSTEM



1 Fine sediment, nutrients, oils, and grease enter the storm drain

2 Vortex separation removes gross pollutants prior to water entering the filtration chamber

3 The Aqua-Filter™ is constructed of high density polyethylene (HDPE) and can be installed easily without heavy machinery

4 Filter media removes fine sediment, nutrients and oils to achieve a higher water quality

5 Independent validation for advanced treatment before discharging into sensitive waters

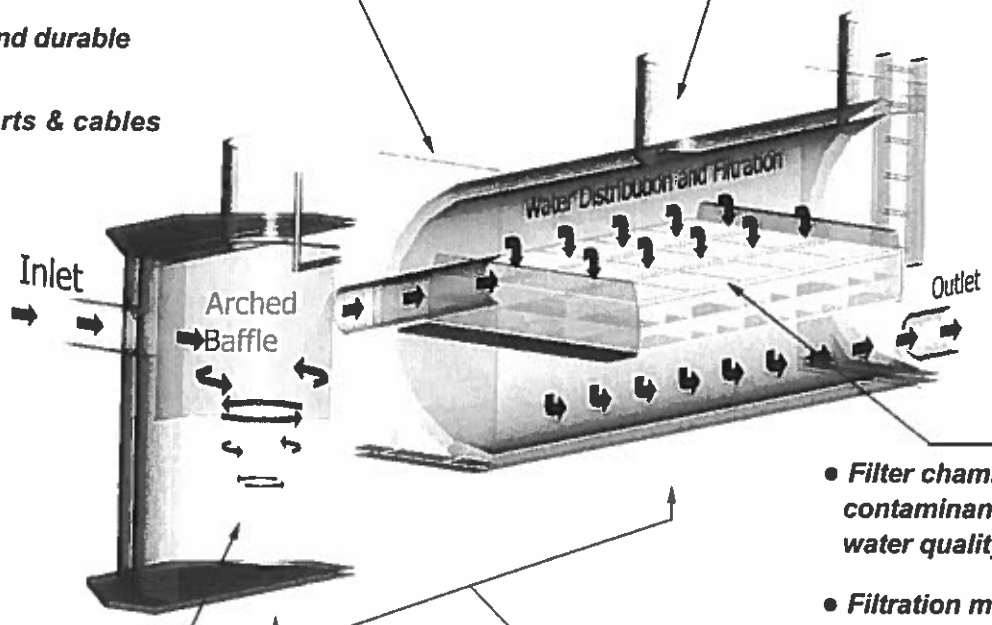
Aqua-Filter™ STORMWATER TREATMENT SYSTEM

Installation Benefits

- *Installs easily without the use of a crane, resulting in measurable project cost savings*
- *H20 loading capabilities*
- *Inlet / outlet stub-out connections*
- *Lightweight and durable construction*
- *Lifting supports & cables provided*

Inspection & Maintenance

- *AquaShield™ offers an extensive maintenance program that will keep the system at peak performance*
- *Download manuals from the on-line system catalog*



Filter Med

- *Filter chamber removes contaminants and improves water quality*
- *Filtration media captures stormwater pollutants through interstitial pores*
- *Wide range of filtration media available*

Swirl Concentrator

- *Utilizes hydrodynamic and gravitational forces to remove gross pollutants prior to filtration*
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- *Provides a treatment train solution tailored to site specific needs*
- *Systems designed to specific water quality filtration flows*
- *On-line project and system design tool at http://pda.aquashieldinc.com*

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AquaShield™ Bio-Filter™ Stormwater Biofiltration System

August 2012

PURPOSE

The AquaShield™ Bio-Filter™ Stormwater Biofiltration System is designed to provide innovative and sustainable green infrastructure solutions to meet the challenges presented by Low Impact Development (LID) practices. Selecting the proper LID technology involves a step by step selection process based on a series of preferred practices as illustrated in the technology selection pyramid below in Figure 1.

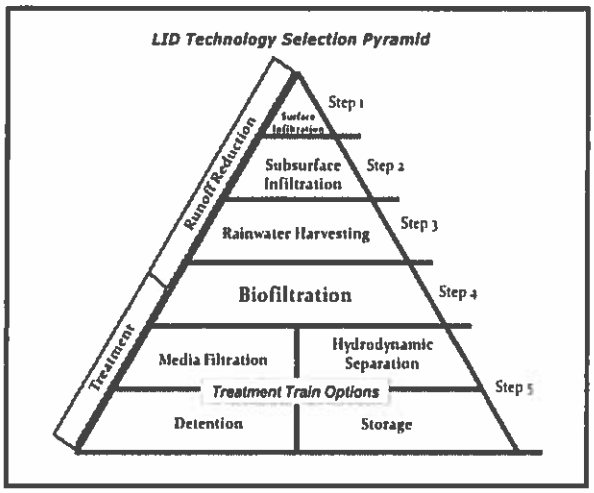


Figure 1. LID Technology Selection Pyramid.

Urban designs do not always allow for the use of surface or subsurface infiltration, nor is rainwater harvesting always feasible or acceptable (steps 1 through 3). The next step in the technology selection process includes the AquaShield™ Bio-Filter™ system which offers a modular bio-filtration approach that spans the fundamental LID goals of stormwater runoff reduction and treatment. The AquaShield™ Bio-Filter™ can be used as either a standalone technology to provide a conventional LID design approach; or, can also be utilized within a treatment train design to allow for a more unconventional design. Other LID technologies can be used in conjunction with the Bio-Filter™ system to provide unique site design innovations.

MODE of OPERATION

Elements of both pretreatment and biofiltration are incorporated into the Bio-Filter™ system. The design includes a trash shelf, pre-treatment chamber, biofiltration chamber, internal bypass, and outlet chamber (Figure 2).

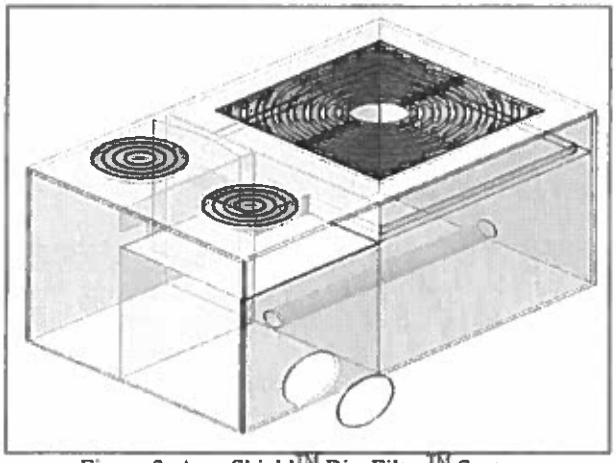


Figure 2. AquaShield™ Bio-Filter™ System.

Operation begins when water enters the device, commonly through a curb inlet, and flows onto the trash shelf. The water quality treatment flow (WQ_f) enters the pretreatment chamber where floatables and coarse sediment are captured and retained. The WQ_f then enters the biofiltration chamber and is evenly distributed across the top of the engineered soil filtration media. Water flows downward through the biomedia and plant root ball to remove fine sediment, metals, residual oil and phosphorus. The treated water then enters an underdrain pipe placed within a basal gravity bed. Water is conveyed via the underdrain pipe to the adjacent outlet chamber positioned underneath the trash shelf. The Bio-Filter™ also includes a unique internal bypass

mechanism designed not only to accommodate flows that exceed the WQ_f, but also to minimize the device's installation footprint by eliminating the need for any external bypass structures. Internal bypass occurs when the head level rises within the unit such that flows in excess of the WQ_f will spill across the overflow weir on the trash shelf and downward into the underlying outlet chamber.

DESIGN FEATURES

The modular Bio-Filter™ is constructed of durable polymer coated steel (PCS) to provide long term operations and structural functionality. Available model sizes range from 4 x 4 ft to 6 x 8 feet in area (16 to 48 ft^2). No heavy lifting equipment is needed for installation. AquaShield™ biofiltration soil media can be utilized with 18 or 24 inches of depth. Each unit also includes two 15-inch diameter access ports to the trash shelf, pretreatment chamber and underdrain area to facilitate inspection and maintenance activities. A non-skid surface material is also used for the system. Structural integrity of each unit is leak tested at the fabrication facility prior to shipping.

PERFORMANCE TESTING

A comprehensive testing program has been independently performed by a NELAP certified laboratory to demonstrate the performance capabilities of the engineered soil biofiltration media. Testing was designed to determine the removal efficiency of the bio-media against Total Suspended Solids (TSS) and insoluble (total) forms of copper and zinc. A PVC test cartridge measuring 36 inches long and 6 inches diameter contained the following components listed from top to bottom: (a) 6 inches freeboard space, (b) 3 inches mulch, (c) 24 inches biomedia, (d) permeable geotextile fabric layer, and (e) 3 inches washed stone. A nylon mesh was fixed at the base to retain the cartridge contents. The test sediment was ground silica SIL-CO-SIL® 106 having a reported median particle size (d_{50}) of 22 microns (0.022 mm). Following pre-flushing and collecting sample blanks, a 50 gallon stock solution containing the test sediment and metals was passed through the filter cartridge via gravity flow at an average loading rate of 1.4 gpm/ft^2, or 135 inches per hour.

Results of the laboratory testing program are summarized in Table 1. An average TSS influent concentration was 100 mg/L. Average copper and zinc influent concentrations were 0.029 and 0.162 mg/L. The biomedia demonstrates approximately 95% TSS removal efficiency. Additionally, total copper and total zinc removal efficiencies of 71 and 97%, respectively were achieved during comprehensive testing of the bio-filtration media. Phosphorus removal efficiency testing is enhanced through plant uptake processes.

Table 1. Bio-Filter™ Performance Testing Results

Contaminants	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Avg. RE (%)
TSS	100	5.5	94.5
Total Copper	0.029	0.008	71.4
Total Zinc	0.162	0.005	96.9

OPERATIONS & MAINTENANCE

AquaShield™ provides the media for the Bio-Filter™ system. Regional climatic conditions and site-specific design considerations should be understood to select the most suitable plant for the device. The system is activated on-site when the selected vegetation is planted by others within the bio-filtration chamber and the unit is connected to the conveyance piping network.

Maintenance frequency will ultimately be determined by site stormwater runoff conditions and plant growth. Inspections of the trash shelf, pretreatment chamber and underdrain area can be accomplished via the two access ports. Inspections of the filter media can be performed through the removable grates. AquaShield™ recommends periodic inspections following installation to determine a site-specific maintenance cycle both the device and plant structure. The biofiltration chamber only requires limited media replacement to include the top mulch layer and the top few inches of the soil filter media, being careful not to disturb the root ball or impair the plant's stability. Replacement biomedia is available from AquaShield™.

BENEFITS

- Provides green stormwater infrastructure in a sustainable water quality treatment device,
- Achieves high TSS and heavy metals removal at flow rates up to 135 in/hr,
- Modular installation provides for simple and quick installation,
- Internal bypass eliminates need for external bypass structure(s),
- Easy to maintain from the surface,
- Developed and backed by AquaShield™, a leader in stormwater treatment solutions.

For more information, contact your local AquaShield™ representative or call us at (888) 344-9044.

Performance Evaluation Using a Perlite Filter[1]

Aqua-Tech Report 7.3

Background Information

AquaShield™ utilizes various filter media for the treatment of stormwater and industrial runoff in the Aqua-Filter™ Stormwater Filtration System, the Go-Filter™ Mobile Treatment System, and the Aqua-Guardian™ Catch Basin Insert. The media is packaged in flexible cartridges that are fixed within the different patented technology devices. While each of these systems are custom-engineered facilities, the Aqua-Filter™ and Go-Filter™ systems utilize a two stage treatment train configuration. Treatment begins with the removal of gross pollutants and free-floating oil by the swirl concentrator (Aqua-Swirl™), followed by the removal of fine sediments and other waterborne pollutants by the filtration chamber. The Aqua-Guardian™ does not rely on a treatment train approach.

Perlite is the most common filter media used in the AquaShield™ stormwater treatment systems. Perlite (CAS: 93763-70-3) is an amorphous, hydrated glassy volcanic rock of rhyolitic composition, consisting primarily of fused sodium potassium aluminum silicate. Perlite has long been recognized as an effective filter medium for the removal of sediment and hydrocarbons contained in stormwater runoff.

Purpose of Performance Evaluation

In order to evaluate the performance level of a perlite filter medium, a laboratory simulation was performed using known concentrations of common contaminants associated with stormwater runoff.

Laboratory Methods

Independent laboratory testing was performed on behalf of AquaShield™ by Analytical Industrial Research Laboratories, Inc. (AIRL) of Cleveland, Tennessee.[2] AIRL is accredited with the National Environmental Laboratory Accreditation Program (NELAP).

A 50 gallon stock solution of laboratory reagent water containing known concentrations of total suspended solids (TSS) aluminum, copper, zinc and phosphorus was gravity fed from a 50-gallon sterile polypropylene holding tank. The container was gently stirred with an electric motor turning a paddle at approximately 25°C (77°F). The container was fitted at the base with a manually operated PVC flow discharge nozzle. An open ended, tube shaped, PVC filtration cartridge was held in place below the discharge nozzle by the use of standard laboratory clamp devices. A three inch (7.62 cm) head space was maintained between the discharge nozzle and the top of the filtration cartridge. The filtration cartridge dimensions were six inches (15.24 cm) in diameter and eight inches (20.32 cm) in length, and occupied a volume of 226 cubic inches (3,705 cubic cm). The cartridge contained 370 grams of consolidated (not packed) perlite. Both ends of the cartridge were covered with a thin flexible nylon screen having one millimeter (0.0394 inch) square openings to retain the perlite filter media.

Target influent concentrations were based on the maximum concentration from two years of sampling a commercial parking lot (Table 1).

Table 1: Target Influent Concentrations

Contaminant	Maximum Concentration
TSS	44 mg/L
Aluminum	786 µg/L
Copper	21.9 µg/L
Zinc	118 µg/L
Phosphorus	50 mg/L

All test constituents were insoluble forms. The simulation used sediment (TSS) particle sizes of 19, 45 and 75 microns, ranging from silt to very fine-grained sand. Particle sizes for the aluminum, phosphorus and zinc were <10 microns, while the copper particle size was <5 microns.

Water passed through the filtration cartridge at an assigned flow, or loading rate of approximately 17.8 gpm/ft^2 and at five gallon increments. One gallon effluent (filtered) water samples were collected in new, sterile polypropylene containers at the terminus of the filtration cartridge at pre-determined discharge volume intervals between the 4th and 5th, 24th and 25th gallon, and 49th and 50th gallon. Each effluent water sample was analyzed for the contaminant constituents and within their

Performance Evaluation Using a Perlite Filter[1]

Aqua-Tech Report 7.3

established holding times. Prior to testing, the filtration cartridge was rinsed with five gallons of reagent water to establish background levels for each constituent. The sampling for the "blanks" occurred between the 4th and 5th gallon.

Laboratory analytical methods for influent and effluent water samples followed EPA Method 160.2 for TSS and EPA Method 200.7 for the other contaminants.

Simulated Test Parameters

The use of simulated test parameters allows for the laboratory test parameters to be extrapolated in order to evaluate removal efficiency for a larger scale filtration cartridge. By using the laboratory test parameters of test gallons (50 gallons), test cartridge volume (226 in^3) and loading rate (17.8 gpm/ft^2), the extrapolated flow rate over a 24 hour period using a larger simulated filtration cartridge can be calculated.

Based on the laboratory test parameters cited above and a simulated filtration cartridge measuring 2 feet x 2 feet x 1 foot thick (4 ft^3, or 6,912 in^3), the laboratory test simulated approximately 102,400 gallons of contaminated water continuously passing through a 4 ft^3 filtration cartridge over a 24 hour period.

Analytical Results

Table 2 summarizes the average influent and effluent concentrations of the contaminants, and the calculated removal efficiencies that were achieved during the performance test. Removal efficiency (RE, %) is calculated as follows:

$$RE = 100 \times \frac{\text{Influent Concentration} - \text{Effluent Concentration}}{\text{Influent Concentration}}$$

A removal efficiency of 100% is not calculated for a recorded concentration that is below the method detection limit (MDL). While it is possible that a very small fraction of the contaminant could be contained in the effluent water below the MDL, the use of a reported effluent value of zero is not realistic. If the concentration is reported as less than the MDL, then one-half the MDL value is the reported concentration

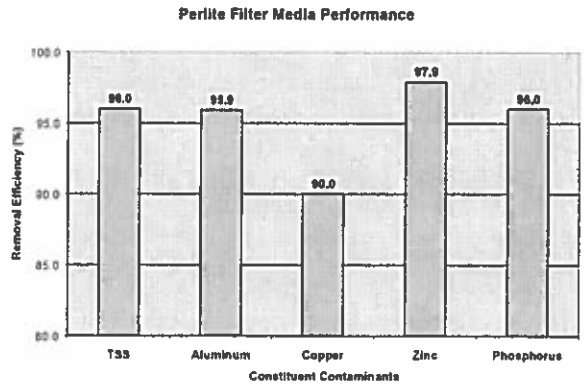
Table 2: Perlite Filter Performance Summary

Contaminant*	Average Influent	Average Effluent	Removal Efficiency (%)
TSS	50	2**	96.0
Aluminum	800	33	95.9
Copper	25	2.5**	90.0
Zinc	120	2.5**	97.9
Phosphorus	50	2	96.0

* TSS, P in mg/L; Al, Cu and Zn in µg/L
** Listed value = ½ MDL

It should be kept in mind that the average effluent concentrations for TSS, copper and zinc were recorded below their respective MDLs.

The following graph illustrates the high removal efficiencies achieved by the perlite filter medium during the performance evaluation:



Conclusion

Laboratory performance testing using approximately 100,000 gallons of simulated stormwater passing through a 4 ft^3 filtration cartridge in a 24 hour period demonstrates that the perlite filter medium provides outstanding water quality treatment against the tested contaminants. The TSS removal efficiency is calculated to be 96%, while excellent treatment was also achieved against aluminum, copper, zinc and phosphorus with removal efficiencies ranging from 90 to 97.9%.

[1] Jan. 2003, Updated Nov. 2007
[2] AIRL, 1550 37th Street, NE, Cleveland, TN 37312, (423) 476-7766.

Exhibit

7

GATEWAY

On Call. On Time. On Target.

C-97027-0013 May 2014

WILDCAT FIELD TURF PROJECT

Municipality of Mt. Lebanon
Allegheny County, Pennsylvania

PREPARED FOR

Municipality of Mt. Lebanon
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A FULL-SERVICE CIVIL ENGINEERING FIRM

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INTRODUCTION

The Municipality of Mt. Lebanon is proposing to renovate an existing multi-use ball field from a natural grass surface to an artificial synthetic turf surface, which will help improve drainage issues and playability of the existing fields. The project will include removal of existing topsoil, subgrade preparation, installation of the new synthetic turf with underdrain system, utility installation, new storm sewer inlets and piping, new edging curb along the field, fencing modifications, and grading along Cedar Boulevard in the Municipality of Mt. Lebanon, Allegheny County, PA. The construction of the proposed improvements will disturb approximately 2.7± acres. The project is located within the Chartiers Creek watershed, and is tributary to an Unnamed Tributary to Painters Run, located approximately 1,100 feet to the southwest. Construction is proposed to begin in the Summer of 2014 and be completed by Spring of 2015.

Per the Mt. Lebanon Subdivision and Land Development Ordinance (Chapter XVI, Part 8, Section 809), the allowable release rate for the proposed development is less than or equal to the peak runoff rate that existed prior to construction for the 25-year design storm. Per the stormwater water quality requirements of the Pennsylvania Department of Environmental Protection (Chapter 102), the 2-year volume increase from the proposed development should be stored on-site. However, due to slow infiltration through the existing ground, storage of the 2-year volume will not be possible on-site. Instead, stormwater water quality will be handled by reducing the pollutant load for total suspended solids, total phosphorous, and nitrates.

This report will demonstrate the methods used to compute the existing and proposed hydrographs, and the means by which the proposed stormwater discharge from the site will not exceed the allowable discharge. Also, the report will illustrate the pollutant load reduction from the proposed development versus pre-development conditions.

METHODOLOGY

The tie-in point to the existing downstream storm sewer was selected as the study point to analyze the pre- versus post-development conditions. The total area of the field is approximately 2.7 acres and was used as the study drainage area, as shown on the Pre-Development Drainage Area Map (PRE DA) in Appendix D. All hydrologic calculations for this study were performed utilizing the Soil Conservation Service's Technical Release 55 (TR-55) methodology. The soils within the tributary boundary are in soil group C, per the Soil Survey Map in Appendix B. The routing of the post-developed hydrographs through the synthetic turf field was performed using the Modified Puls method. These calculations were performed using Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2014. The 24 hour rainfall depths were obtained from Section 809.4 of the Mt. Lebanon Subdivision and Land Development Ordinance.

PRE-DEVELOPED CONDITIONS

The existing property is a multi-use ball field, consisting of grass areas and dirt infields. The site generally drains from the north towards the southwest corner of the property. The topography is gently sloping from the softball field towards the baseball field. Existing runoff from the site is collected in existing inlets and conveyed through culverts, where it eventually outfalls to an Unnamed Tributary to Painters Run.

For the purposes of this analysis, the entire drainage area of the field was taken into account. Conservatively, the entire area was assumed to be dirt and open space in good condition to estimate the pre-development peak rate flows. A breakdown of the estimated land coverage within the drainage area is summarized in the table below:

LAND USE DESCRIPTION	SCS CURVE NUMBER	AREA (ACRES)
OPEN SPACE ('C' SOILS)	74	2.04
DIRT ('C' SOILS)	87	0.66
TOTALS	**77**	**2.70**

The time of concentration for the pre-development watershed was estimated to be 17.7 minutes. The estimated land coverage and time of concentration path used in the calculations is shown on the Pre Development Drainage Area Map (PRE DA) in Appendix D.

The pre-development runoff for the 2-, 5-, 10-, 25-, and 100-year storm events with these conditions are summarized in the table below. Per the Mt. Lebanon Subdivision and Land Development Ordinance requirements, the allowable release rate is less than or equal to the pre-development release rate.

DESIGN STORM	PRE-DEVELOPMENT (CFS)	ALLOWABLE RELEASE RATE (CFS)
2-YEAR	1.86	1.86
5-YEAR	4.12	4.12
10-YEAR	5.63	5.63
25-YEAR	6.95	6.95
100-YEAR	9.14	9.14

POST-DEVELOPMENT CONDITIONS

The proposed renovations will alter the playing surface from a natural grass surface to an artificial synthetic turf surface. The site will continue to drain from the softball field to the baseball field, being conveyed through the subbase stone and underdrain system. This proposed system will tie into the existing storm system, where it eventually outfalls to an Unnamed Tributary to Painters Run.

For the purposes of this analysis, the entire drainage area of the field was once again taken into account. When stormwater hits the field, it will percolate through the stone surface and underdrain system until eventually reaching the outlet structure. To best describe this condition and after deliberation with local authorities versed in stormwater management, land coverage consisting of open space in poor condition was used. A breakdown of the estimated land coverage within the drainage area is summarized in the table below:

LAND USE DESCRIPTION	SCS CURVE NUMBER	AREA (ACRES)
OPEN SPACE, POOR CONDITION ('C' SOILS)	86	2.70
TOTAL	**86**	**2.70**

The time of concentration for the post-development watershed was estimated to be 24.1 minutes. Calculations summarizing the post development time of concentration are found in Appendix D. The estimated land coverage and time of concentration path used in the calculations is shown on the Post Development Drainage Area Map (POST DA) in Appendix D.

OUTLET STRUCTURE

The outlet structure for the system consists of a precast concrete manhole with weir plate and sump at the bottom. The weir plate contains two orifices that help attenuate the peak flow rates from the storm events and is set lower than the top of the structure, in order to provide an overflow for the larger storms. The outlet structure has a 15" diameter outlet pipe that ties into the existing storm system. The table below summarizes the controls of the outlet structure:

OUTLET STRUCTURE	ORIFICE #1 ELEV. (CIRCULAR)	ORIFICE #2 ELEV. (CIRCULAR)	OVERFLOW WEIR ELEV.	OUTLET PIPE INVERT (15" CPP)	TOP OF OUTLET STRUCTURE ELEV.
TYPE M INLET #1	1031.00 (1 - 6" Ø)	1034.75 (1 - 12" Ø)	1036.50	1030.90	1037.45

Using the aforementioned outlet structure data and the available volume in the stone trenches, the following detention routing was calculated:

DESIGN STORM	POND PEAK INFLOW (CFS)	POND STAGE (ELEV.)	POND PEAK OUTFLOW (CFS)	ALLOWABLE RELEASE RATE (CFS)	DIFFERENCE Δ
2-YEAR	2.96	1034.33	**1.59**	**1.86**	**-0.27**
5-YEAR	5.30	1035.62	**4.09**	**4.12**	**-0.03**
10-YEAR	6.75	1036.10	**5.32**	**5.63**	**-0.31**
25-YEAR	7.98	1036.50	**6.10**	**6.95**	**-0.85**
100-YEAR	9.95	1036.84	**8.98**	**9.14**	**-0.16**

Computer printouts for the hydrographs may be found in Appendix D of this report.

WATER QUALITY

The multi-purpose field as it currently exists infiltrates very little stormwater runoff into the ground, as shown in the summary of test pits and infiltration test results, completed by The Gateway Engineers, Inc. and dated March 21, 2014. Since there is little to no infiltration, storage of the 2-year storm, or "first flush", will not be possible and instead pollution prevention will be provided from the proposed BMPs, addressing water quality of the stormwater. Pollutants for total suspended solids and total phosphorus will be reduced to 85% of the existing load, and nitrate pollutants will be reduced to 50% of the existing load. The proposed BMPs that will act in series and aid in reducing the pollutant load include a subsurface infiltration bed and water quality filter (manhole sump). The subsurface infiltration bed under the entire field will act as a filter for stormwater that hits the field and percolates through the stone. Once conveyed through the stone, all stormwater exits the site via the outlet structure with sump, which helps collect total suspended solids and improve pollutant removal efficiency. In addition, the use of the artificial turf will eliminate any fertilizers or pesticides being used on a natural surface, from polluting the water entering the existing storm sewer system. The design calculations can be found in Appendix E of this report.

CONCLUSION

From the calculations and report as submitted, the proposed outlet structure and subbase stone and underdrain system for the Wildcat Field renovation project will not only improve existing field conditions, but will also reduce stormwater discharges to less than the allowable release rates as required by code. In addition, stormwater water quality will be addressed by the subsurface infiltration bed and water quality filter (manhole sump) that act in series to reduce pollutant loads from total suspended solids, total phosphorous, and nitrates. Therefore, the proposed plan will meet the stormwater requirements of the Mt. Lebanon Subdivision and Land Development Ordinance (Chapter XVI, Part 8, Section 809) and the Pennsylvania Department of Environmental Protection (Chapter 102).

CHAPTER 102 CRITERIA

The following narrative is in accordance with PA Title 25, Chapter 102, Section 102.8, Post Construction Stormwater Management Requirements:

102.8(b)(4) Minimize impervious areas.

There will be no impervious area added to the field.

102.8(b)(5) Maximize the protection of existing drainage features and existing vegetation.

The existing drainage features and vegetation will be protected by disturbing only those areas required for construction of the site.

102.8(b)(6) Minimize land clearing and grading.

Land clearing and grading will be minimized by clearing and grading only those areas required for construction of the site.

102.8(b)(7) Minimize soil compaction.

Contractors will be required to stay off or spend minimal time in areas that are not to be graded, in order to minimize soil compaction.

102.8(b)(8) Utilize other structural or nonstructural BMPs that prevent or minimize changes in stormwater runoff.

Refer to Section 102.8(f)(6) in the PCSM Report for other structural or nonstructural BMPs that will be utilized in order to prevent or minimize changes in stormwater runoff.

102.8(f) The PCSM Plan must contain drawings and a narrative consistent with the requirements of this chapter. The PCSM Plan shall be designed to minimize the threat to human health, safety and the environment to the greatest extent practicable. PCSM Plans must contain at a minimum the following:

102.8(f)(1) The existing topographic features of the project site and immediate surrounding area.

Existing contours are shown on the attached PCSM Plan at 2 foot intervals.

102.8(f)(2) The types, depth, slope, locations and limitations of the soils and geological formations.

Refer to Appendix B for soils information and possible limitations.

102.8(f)(3) The characteristics of the project site, including the past, present and proposed land uses and the proposed alteration to the project site.

The existing site consists of a multi-use ballfield with grass and dirt coverage, including dugouts, bleachers, backstops and fencing. The project proposes renovation of the field by removal of existing topsoil, subgrade preparation, installation of a new synthetic turf grass with an underdrain system, and grading. Additional improvements include utility service installation, new storm sewer inlets and piping, new edging curb along the field, and fencing modifications. Construction of the new facilities will require installation of temporary erosion and sediment control practices. The construction of the proposed improvements will disturb approximately 2.7+/- acres.

102.8(f)(4) An identification of the net change in volume and rate of stormwater from pre-construction hydrology to post construction hydrology for the entire project site and each drainage area.

Chapter XVI, Part 8, Section 809 of the Mt. Lebanon Subdivision and Land Development Ordinance requires that the post-development peak runoff rate be less than or equal to the pre-development condition for the 2-, 5-, 10-, 25-, and 100-year design storms. In addition, Chapter 102 of the Pennsylvania Department of Environmental Protection requires that the 2-year runoff volume increase must be stored on-site. In order to achieve these standards, an outlet structure has been designed to control the runoff rates to the existing condition. Refer to the summary table on Page 4 of this narrative or to the detailed hydraulic calculations in Appendix D. Since there is little to no infiltration on the existing site, the 2-year runoff volume increase will not be capable of being stored on-site. Instead, water quality BMP's are being proposed in order to reduce the pollutant loads of total suspended solids, total phosphorous, and nitrates. Refer to the BMP worksheets in Appendix E.

102.8(f)(5) An identification of the location of surface waters of this Commonwealth, which may receive runoff within or from the project site and their classification under Chapter 93 (relating to water quality standards).

The receiving stream is an unnamed tributary to Painters Run, which is classified as a Warm Water Fishery (WWF). Refer to Appendix A for the USGS mapping and stream location.

102.8(f)(6) A written description of the location and type of PCSM BMPs including construction details for permanent stormwater BMPs including permanent stabilization specifications and locations.

Permanent BMP's include the installation of stabilized synthetic turf grass field with sand and gravel subgrade for filtering, and permanent seeding in disturbed areas outside of the proposed turf field.

102.8(f)(7) A sequence of PCSM BMP implementation or installation in relation to earth disturbance activities of the project site and a schedule of inspections for critical stages of PCSM BMP installation.

Construction Sequence

The Wildcat Turf project will consist of the renovation of an existing multi-use field, utility installation, and PCSM BMP's. All PCSM facilities shall be installed in accordance with the approved SWM Plan and the DEP Erosion and Sediment Pollution Control Program Manual dated March, 2012 or latest version.

A generalized construction sequence is provided below. The construction sequence is intended to provide a general course of action in order to conform to the applicable regulatory agency requirements for temporary and permanent soil erosion and sediment pollution control. All necessary parts for proper and complete execution of work pertaining to this plan, whether specifically mentioned or not, are to be performed by the contractor. It is not intended that the drawings and this report show every detailed piece of material or equipment. The contractor shall comply with all requirements listed in this section. The contractor may be required to alter controls based on effectiveness of controls or differing conditions encountered.

- All disturbed areas which are at final grade and will not be further disturbed shall be seeded per the permanent seeding specifications.
- Disturbed areas left idle for more than 4 days should be temporarily seeded and mulched.
- Contact Allegheny County Conservation District for a pre-construction meeting prior to any earthwork.

1. Stake out limit of disturbance for grading operations.
2. Install rock construction entrance at site access from the adjacent parking lot, as shown on the plan according to construction detail.
3. Install inlet protection in existing inlets as indicated on the plan.
4. Install filter fabric fence 1 thru 7 in the locations shown on the plans, in accordance with the construction details.
5. Begin installation of the subsurface infiltration trenches. Stripped topsoil material from the trench installation shall be stockpiled in the location shown on the plan. Immediately surround topsoil stockpile area with 30" filter fabric fence and seed per the temporary seeding

specifications. Excavated subsoil material generated from the trench installations shall be stockpiled separately in the spoil removal stockpile location shown on the plan, and shall be hauled from the site. Immediately surround the spoil removal stockpile with 30" filter fabric fence and cover with tarp if the stockpile is to remain idle longer than 4 days.

6. Upon completion of the subsurface infiltration trench installation and removal of the topsoil and spoils stockpiles, begin earthmoving activities over the remaining limits of disturbance. Laser grade the site.
7. During grading operations, install concrete edging around the perimeter of the field as shown on the plan and in accordance with the details and specifications. Install concrete washout area prior to any concrete pours on site.
8. Begin installation of proposed storm sewers and service utilities. Refer to the utility line installation requirements below. As each new inlet is installed, immediately install inlet protection in the new structure, as indicated on the plans and in accordance with the construction detail.
9. Concurrent with storm sewer installation, install outlet structure #1. **(Critical Stage: A licensed professional or designee shall be on-site to oversee the installation of the structure, including the weir plate with orifices, outlet pipe, and connection to the existing drainage system.)**
10. Upon completion of fine grading, permanently stabilize the site with aggregate blanket. Seed and mulch all areas not permanently stabilized using the specified seeding requirements. All disturbed areas must be temporarily stabilized if remaining idle for more than 4 days. No more than 15,000 square feet of disturbed area may reach final grade before initiating seeding and mulching operations. In the absence of a soil test, lime should be added at a rate of 275 lbs / 1000 s.f. Likewise, the fertilizer rates should be increased to 1250 lbs / ac. of 8-16-16 and 2000 lbs / ac. of 5-10-10. Verify installation with the municipal engineer.
11. Upon completion of seeding and mulching, contractor shall install turf carpet and remove rock construction entrance.
12. Upon completion of turf installation, verify the site is permanently stabilized. Reseed all disturbed areas if 70% perennial vegetative cover is not established after 30 days.
13. When a minimum uniform 70% perennial vegetative cover with a density capable of resisting accelerated erosion and sedimentation is established, remove 30" filter fabric fence 1 thru 7, and remove inlet protection from all inlets. Coordinate final close out inspection with the Allegheny County Conservation District.

Utility Line Installation Requirements

1. Advanced clearing and grubbing operations for strip utility line installations shall be limited to a distance equal to two times the length of pipe installation that can be completed in one day.
2. Work crews and equipment for trenching, placement of pipe, plug installation and backfilling will be self-contained and separate from clearing and grubbing and site restoration and stabilization operations.
3. Daily trench excavation shall be limited to the length of pipe placement, plug installation and backfilling that can be completed the same day.

4. Water which accumulates in the open trench will be completely removed by pumping into a silt bag, prior to pipe placement or backfilling operations.
5. On the day following pipe placement and trench backfilling, the disturbed area shall be graded to final contours and appropriate temporary erosion and sediment pollution control measures/facilities will be installed. Seeding and mulching of all disturbed areas will be done at the end of each week.
6. In certain cases trenches cannot be backfilled until the pipe is hydrostatically tested, or anchors and other permanent features are installed. In these cases, Note 6 is modified as follows:
7. Daily backfilling of the trench may be delayed for six days. All pressure testing and the complete backfilling of the open trench must be completed by the seventh working day. If daily backfilling is delayed, the disturbed area will be graded to final contours, appropriate temporary erosion and sediment control measures/facilities will be installed, and the areas seeded and mulched within the next two calendar days.
8. Work through BMP's should be done during a dry period to protect downstream area.

102.8(f)(8) Supporting calculations.

Supporting calculations can be found in Appendices of this report.

102.8(f)(9) Plan drawings.

See attached Post Construction Stormwater Management Plan.

102.8(f)(10) A long-term operation and maintenance schedule, which provides for inspection of PCSM BMPs, including the repair, replacement, or other routine maintenance of the PCSM BMPs to ensure proper function and operation. The program must provide for completion of a written report documenting each inspection and all BMP repair and maintenance activities and how access to the PCSM BMPs will be provided.

Refer to Appendix F for a long-term operation and maintenance schedule.

102.8(f)(11) Procedures which ensure that the proper measures for the recycling or disposal of materials associated with or from the PCSM BMPs are in accordance with Department laws, regulations and requirements.

All construction wastes including, but not limited to, excess soil materials, concrete wash water, sanitary wastes, trash, debris, and any materials that could adversely impact water quality must be disposed of properly at an approved DEP disposal site and in accordance with state and federal guidelines.

102.8(f)(12) An identification of naturally occurring geologic formations or soil conditions that may have the potential to cause pollution after earth disturbance activities are completed and PCSM BMPs are operational and development of a management plan to avoid or minimize potential pollution and its impacts.

Refer to Appendix B for soil limitations and identification of potential resolutions to any limitations. There are no known naturally occurring geologic formations or soil conditions located on the site that have the potential to cause pollution during construction.

102.8(f)(13) An identification of potential thermal impacts from post construction stormwater to surface waters of this Commonwealth including BMPs to avoid, minimize or mitigate potential pollution from thermal impacts.

All stormwater on-site will enter the stone subbase before being conveyed to the existing storm sewer system, allowing it cool prior to entering any surface waters of the Commonwealth.

102.8(f)(14) A riparian forest buffer management plan when required under Chapter 102.14 (relating to riparian buffer requirements).

The proposed work is outside of existing riparian buffers.

102.8(g) PCSM Plan stormwater analysis.

Refer to Appendix D for pre- and post-development stormwater maps and calculations.

102.8(k) Licensed professional oversight of critical stages.

A licensed professional or designee shall oversee the installation of the outlet structure.

102.8(m) PCSM long-term operation and maintenance requirements.

Refer to Appendix F for PCSM long-term operation and maintenance requirements.

Appendix A

USGS SITE LOCATION MAP
BRIDGEVILLE QUAD
SCALE: 1" = 2,000'

NORTH

USGS SITE LOCATION MAP

USGS

WILDCAT FIELD TURF PROJECT

CEDAR BOULEVARD
MUNICIPALITY OF MT. LEBANON, ALLEGHENY COUNTY, PA

PREPARED FOR:

MUNICIPALITY OF MT. LEBANON
710 WASHINGTON ROAD
PITTSBURGH, PA 15228

Date	File	REVISION RECORD
-	01	-
-	02	-
-	03	-
-	04	
-	05	-
-	06	-
-	07	-
-	08	-

GATEWAY
Consulting Engineers & Surveyors
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• Butler PA (724) 287-1025 • Washington PA (724) 229-3962

Appendix B

Soil Map—Allegheny County, Pennsylvania
(Wildcat Field Turf Project)

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 1:15,800.

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: http://websoilsurvey.nrcs.usda.gov
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: Allegheny County, Pennsylvania
Survey Area Data: Version 6, Dec 16, 2013

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

Date(s) aerial images were photographed: Mar 27, 2011—Oct 9, 2011

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

Allegheny County, Pennsylvania (PA003)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
UB	Urban land	2.9	52.5%
UCD	Urban land-Culleoka complex, moderately steep	2.6	47.5%
Totals for Area of Interest		**5.6**	**100.0%**

Hydric Rating by Map Unit—Allegheny County, Pennsylvania
(Wildcat Field Turf Project)

Map Scale: 1:1,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Hydric (100%)
- Predominantly Hydric (66 to 99%)
- Partially hyrdic (33 to 65%)
- Predominatly nonhydric (1 to 32%)
- Nonhydric (0%)
- Not rated or not available

Soil Rating Lines

- Hydric (100%)
- Predominantly Hydric (66 to 99%)
- Partially hyrdic (33 to 65%)
- Predominatly nonhydric (1 to 32%)
- Nonhydric (0%)
- Not rated or not available

Soil Rating Points

- Hydric (100%)
- Predominantly Hydric (66 to 99%)
- Partially hyrdic (33 to 65%)
- Predominatly nonhydric (1 to 32%)
- Nonhydric (0%)
- Not rated or not available

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 1:15,800.

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: http://websoilsurvey.nrcs.usda.gov
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: Allegheny County, Pennsylvania
Survey Area Data: Version 6, Dec 16, 2013

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

Date(s) aerial images were photographed: Mar 27, 2011—Oct 9, 2011

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.

Hydric Rating by Map Unit

Hydric Rating by Map Unit— Summary by Map Unit — Allegheny County, Pennsylvania (PA003)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
UB	Urban land	0	2.9	52.5%
UCD	Urban land-Culleoka complex, moderately steep	0	2.6	47.5%
Totals for Area of Interest			**5.6**	**100.0%**

Description

This rating indicates the proportion of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is designated as "hydric," "predominantly hydric," "partially hydric," "predominantly nonhydric," or "nonhydric" depending on the rating of its respective components and the percentage of each component within the map unit.

"Hydric" means that all components listed for a given map unit are rated as being hydric. "Predominantly hydric" means components that comprise 66 to 99 percent of the map unit are rated as hydric. "Partially hydric" means components that comprise 33 to 66 percent of the map unit are rated as hydric. "Predominantly nonhydric" means components that comprise up to 33 percent of the map unit are rated as hydric. "Nonhydric" means that none of the components are rated as hydric. The assumption here is that all components of the map unit are rated as hydric or nonhydric in the underlying database. A "Not rated or not available" map unit rating is displayed when none of the components within a map unit have been rated.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as being hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

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.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

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.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Rating Options

Aggregation Method: Percent Present

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Map Unit Description (Brief, Generated)

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 in this report, 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.

The Map Unit Description (Brief, Generated) report displays a generated description of the major soils that occur in a map unit. Descriptions of non-soil (miscellaneous areas) and minor map unit components are not included. This description is generated from the underlying soil attribute data.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description (Brief, Generated)

Allegheny County, Pennsylvania

Map Unit: UB—Urban land

Component: Urban land (90%)

Generated brief soil descriptions are created for major soil components. The Urban land is a miscellaneous area.

Component: Steep areas (10%)

Generated brief soil descriptions are created for major components. The Steep areas soil is a minor component.

Map Unit: UCD—Urban land-Culleoka complex, moderately steep

Component: Urban land (60%)

Generated brief soil descriptions are created for major soil components. The Urban land is a miscellaneous area.

Component: Culleoka (40%)

The Culleoka component makes up 40 percent of the map unit. Slopes are 8 to 25 percent. This component is on uplands, hillslopes. The parent material consists of fine-loamy residuum weathered from sandstone and siltstone. Depth to a root restrictive layer, bedrock, lithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Data Source Information

Soil Survey Area: Allegheny County, Pennsylvania
Survey Area Data: Version 6, Dec 16, 2013

Limiting Soil Characteristics										
Map Symbol	Soil Name	Easily Erodible	Cut Banks Cave	Corrosive to Concrete or Steel	High Water Table	Low Strength	Piping	Poor Topsoil	Potentially Hydric	Slow Percolation
UB	Urban land	NR	NR	NR	NR	NR	NR	NR	NR	NR
UCD	Urban land-Culleoka complex, moderately steep	X	X	C		X	X	X		X
NR = NOT RATED										

RESOLUTIONS FOR SOIL USE LIMITATIONS

Soils susceptible to moderate or high erosion potential:

- Limit time of exposure
- Utilize erosion control blankets
- Select seed mixtures with rapidly germinating species
- Sodding
- Use of special stabilization products (cellular grids, interlocking concrete blocks, etc.)

Soils susceptible to cutbanks cave:

- Prevent saturation of slopes
- Provide anchoring or retaining systems
- Provide benching to catch falling debris
- Provide trench boxes for utility installation

Soils corrosive to concrete/steel:

- Minimize the amount of soil disturbance
- Provide protective coating to concrete and steel
- Provide extra concrete and steel thickness

Soils susceptible to high water tables and/or piping and seeping:

- Provide pumped water sediment removal facilities
- Use clay embankment cores
- Utilize anti-seep collars or gravel packs

Soils susceptible to slips and landslides:

- Prevent saturation of slopes
- Provide anchoring or retaining systems
- Provide benching to catch falling debris

Soils that are poor sources of topsoil:

- Perform soil tests to determine proper application of soil amendments and to determine the proper moisture content for proposed vegetative cover
- Import topsoil as needed

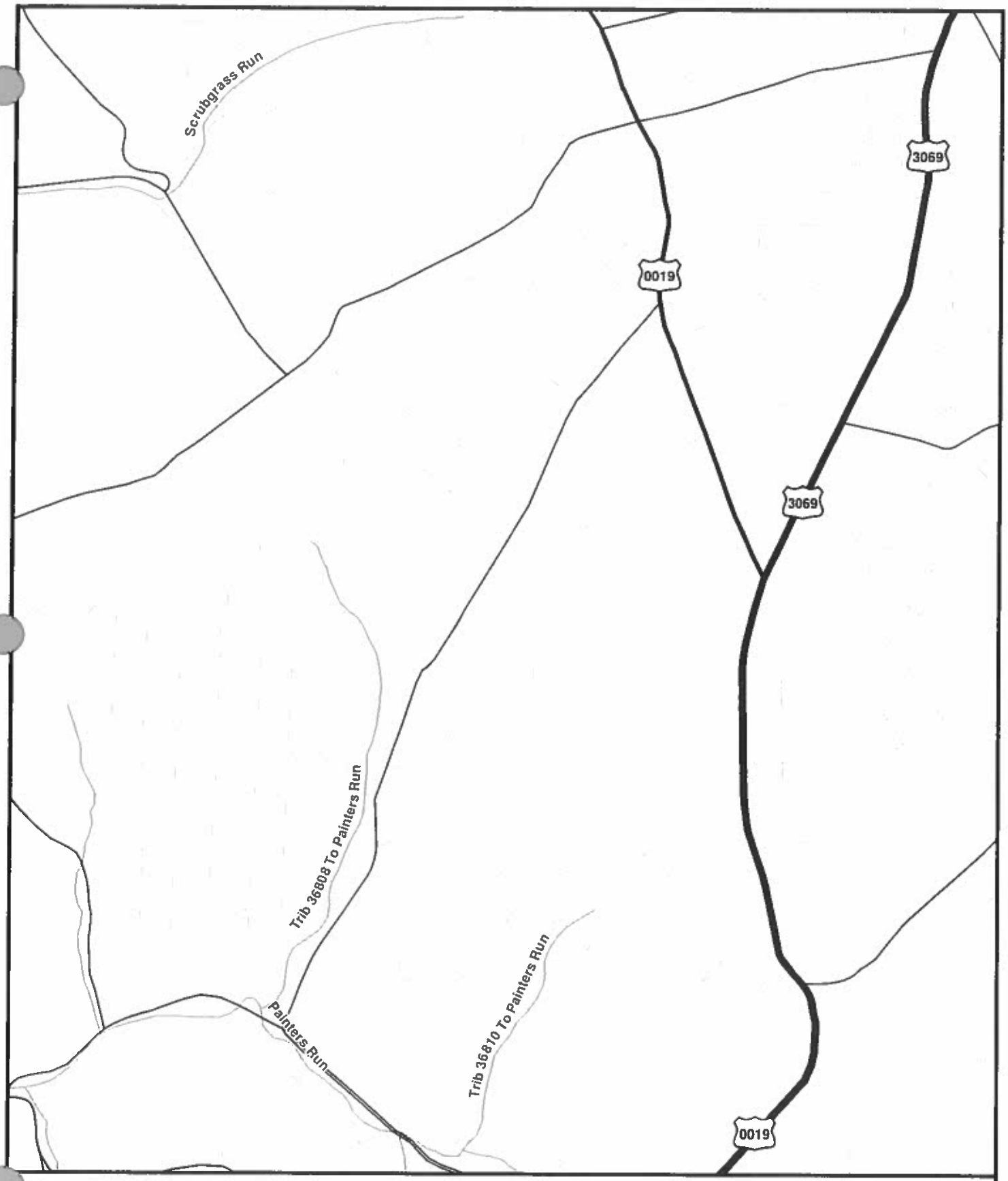
Soils that are hydric:

- Existing on-site wetlands and streams must be delineated
- No work shall be performed within 100 feet of any wetland area

Soils with slow percolation rates:

- Should infiltration facilities be used at the site, infiltration tests shall be performed to determine proper percolation rates
- Soil will be amended accordingly based on the results of the testing

Appendix C



GATEWAY

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Pittsburgh Pa 15220
www.gatewayengineers.com

Wildcat Field Turf Project

N
W E
S

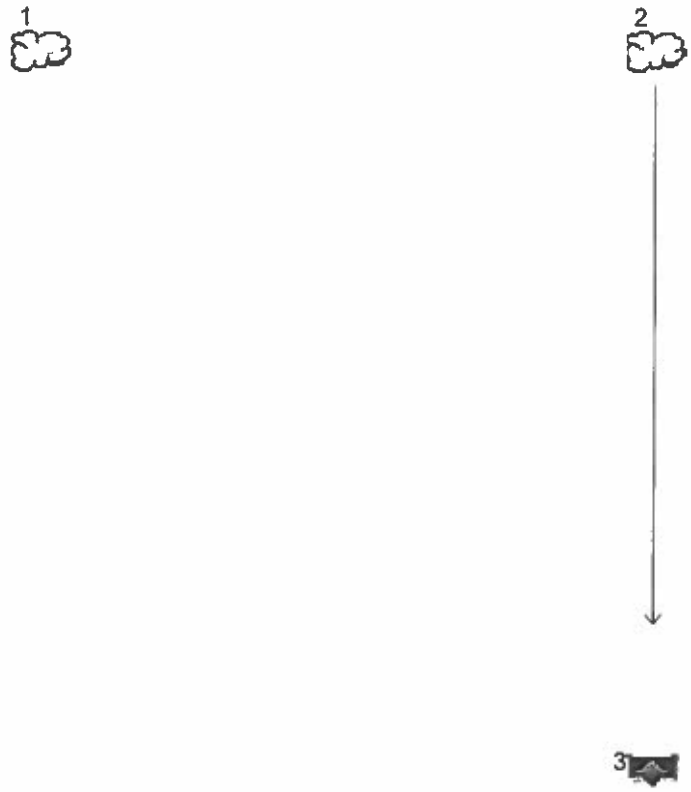
Stream Name / *Use Designation (Assessment ID)* / *Source*	*Cause*	*Date Listed*	*TMDL Date*
Montour Run Unnamed To (ID:99686656)			
HUC 05030101			
Aquatic Life (11408) - 4.72 miles			
Abandoned Mine Drainage	Metals	2004	2005
Montour Run Unnamed To (ID:99686778)			
HUC 05030101			
Aquatic Life (11408) - 0.4 miles			
Abandoned Mine Drainage	Metals	2004	2005
Moon Run			
HUC 05030101			
Aquatic Life (10068) - 2.28 miles			
Abandoned Mine Drainage	Metals	1996	2004
	pH	2002	2004
	Suspended Solids	1996	2004
Aquatic Life (10069) - 4.17 miles			
Abandoned Mine Drainage	Metals	2002	2004
	pH	2002	2004
	Suspended Solids	2002	2004
North Fork Montour Run			
HUC 05030101			
Aquatic Life (11407) - 2.31 miles			
Abandoned Mine Drainage	Metals	1998	2005
Ohio River			
HUC 05030101			
Fish Consumption (3161) - 10.9 miles			
Source Unknown	PCB	1996	2001
Fish Consumption (15919) - 39.52 miles			
Source Unknown	PCB	1996	2001
Painters Run			
HUC 05030101			
Fish Consumption (3164) - 1.37 miles			
Source Unknown	Chlordane	1998	2001
	PCB	1996	2001
Aquatic Life (8597) - 2.65 miles			
Habitat Modification	Suspended Solids	1998	2003
Aquatic Life (8762) - 1.37 miles			
Abandoned Mine Drainage	Metals	1996	2003
	Suspended Solids	2002	2003
Painters Run Unnamed To (ID:99689250)			
HUC 05030101			
Aquatic Life (8734) - 0.97 miles			
Abandoned Mine Drainage	Metals	2002	2003
	Suspended Solids	2002	2003
Painters Run Unnamed To (ID:99689280)			
HUC 05030101			
Aquatic Life (8597) - 0.6 miles			
Habitat Modification	Suspended Solids	1998	2003

Stream Name / *Use Designation (Assessment ID)* / *Source*	*Cause*	*Date Listed*	*TMDL Date*
Ohio River Unnamed To (ID:99684184)			
HUC 05030101			
Aquatic Life (5448) - 1.35 miles			
Removal of Vegetation	Siltation	2004	2017
Road Runoff		2004	2017
Urban Runoff/Storm Sewers	Organic Enrichment/Low D.O.	2004	2017
	Siltation	2004	2017
Ohio River Unnamed To (ID:99684770)			
HUC 05030101			
Aquatic Life (13788) - 0.32 miles			
Road Runoff	Siltation	2006	2019
Painters Run			
HUC 05030101			
Aquatic Life (8596) - 1.06 miles			
Habitat Modification	Siltation	1998	2011
	Turbidity	1998	2011
Aquatic Life (8597) - 2.65 miles			
Habitat Modification	Siltation	1998	2011
	Turbidity	1998	2011
Aquatic Life (8762) - 1.37 miles			
Abandoned Mine Drainage	Siltation	2002	2015
	TDS	2002	2015
Painters Run Unnamed To (ID:99689250)			
HUC 05030101			
Aquatic Life (8734) - 0.97 miles			
Abandoned Mine Drainage	Siltation	2002	2015
	TDS	2002	2015
Painters Run Unnamed To (ID:99689280)			
HUC 05030101			
Aquatic Life (8597) - 0.6 miles			
Habitat Modification	Siltation	1998	2011
	Turbidity	1998	2011
Painters Run Unnamed To (ID:99689284)			
HUC 05030101			
Aquatic Life (8597) - 0.45 miles			
Habitat Modification	Siltation	1998	2011
	Turbidity	1998	2011
Painters Run Unnamed To (ID:99689324)			
HUC 05030101			
Aquatic Life (8596) - 0.51 miles			
Habitat Modification	Siltation	1998	2011
	Turbidity	1998	2011
Painters Run Unnamed To (ID:99689400)			
HUC 05030101			
Aquatic Life (8597) - 0.28 miles			
Habitat Modification	Siltation	1998	2011
	Turbidity	1998	2011

Appendix D

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre Development
2	SCS Runoff	Post Development
3	Reservoir	Field and Trenches

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	------	1.858	------	4.116	5.634	6.953	------	9.135	Pre Development
2	SCS Runoff	------	------	2.957	------	5.297	6.753	7.978	------	9.950	Post Development
3	Reservoir	2	------	1.587	------	4.093	5.317	6.096	------	8.978	Field and Trenches

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.858	1	725	5,990	------	------	------	Pre Development
2	SCS Runoff	2.957	1	728	10,606	------	------	------	Post Development
3	Reservoir	1.587	1	743	10,605	2	1034.33	2,047	Field and Trenches

Hydrograph Report

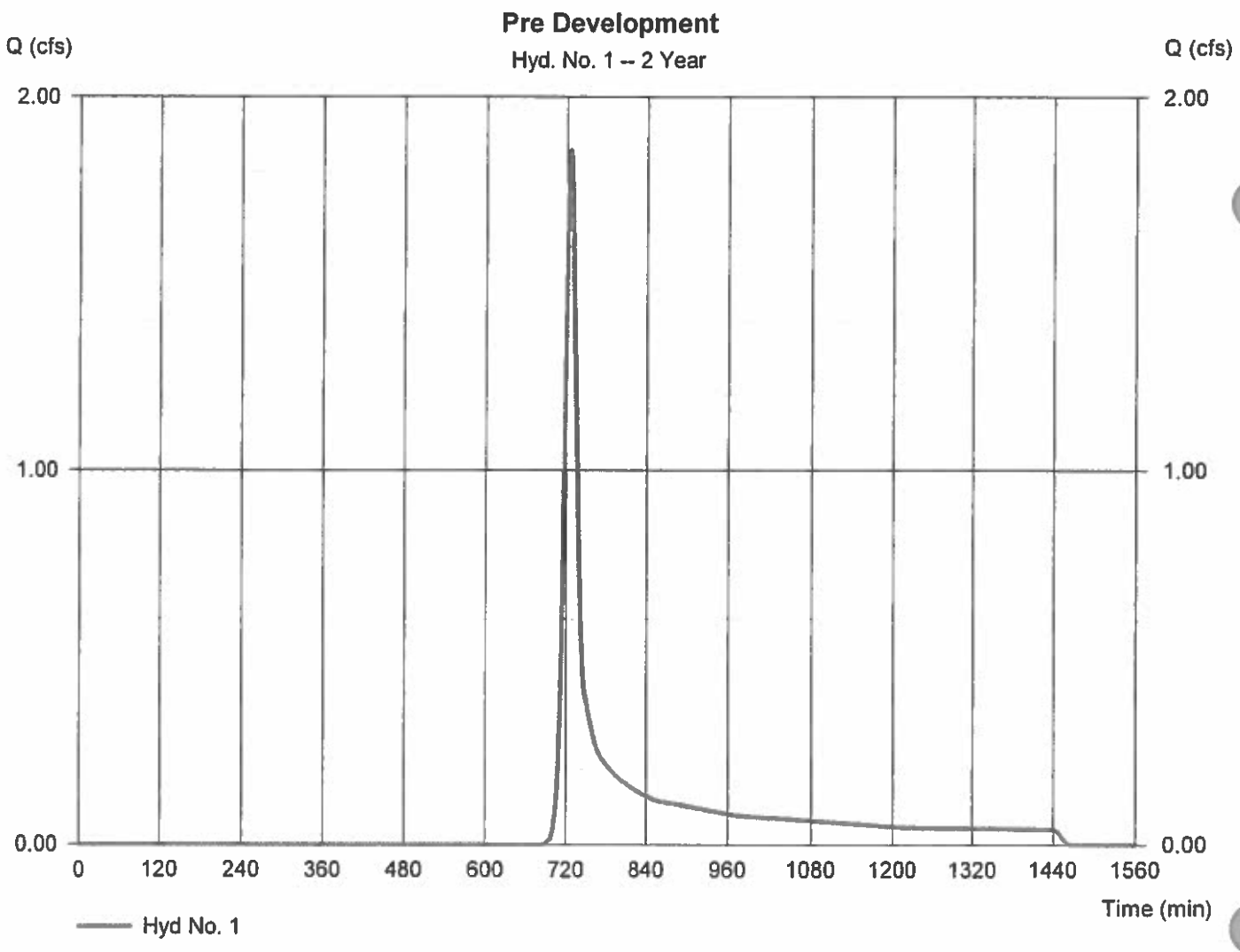
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 1.858 cfs
Storm frequency	= 2 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 5,990 cuft
Drainage area	= 2.700 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.70 min
Total precip.	= 2.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.040 x 74) + (0.660 x 87)] / 2.700



TR55 Tc Worksheet

Hyd. No. 1

Pre Development

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.37		0.00		0.00		
Land slope (%)	= 1.20		0.00		0.00		
Travel Time (min)	**= 13.97**	**+**	**0.00**	**+**	**0.00**	**=**	**13.97**
Shallow Concentrated Flow							
Flow length (ft)	= 200.00		0.00		0.00		
Watercourse slope (%)	= 1.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.77		0.00		0.00		
Travel Time (min)	**= 1.89**	**+**	**0.00**	**+**	**0.00**	**=**	**1.89**
Channel Flow							
X sectional flow area (sqft)	= 1.23		1.23		1.23		
Wetted perimeter (ft)	= 3.93		3.93		3.93		
Channel slope (%)	= 1.00		1.62		1.62		
Manning's n-value	= 0.023		0.012		0.012		
Velocity (ft/s)	=2.97						
			7.26				
					7.26		
Flow length (ft)	({0})203.0		105.0		185.0		
Travel Time (min)	**= 1.14**	**+**	**0.24**	**+**	**0.42**	**=**	**1.80**

Total Travel Time, Tc ..... 17.70 min

Hydrograph Report

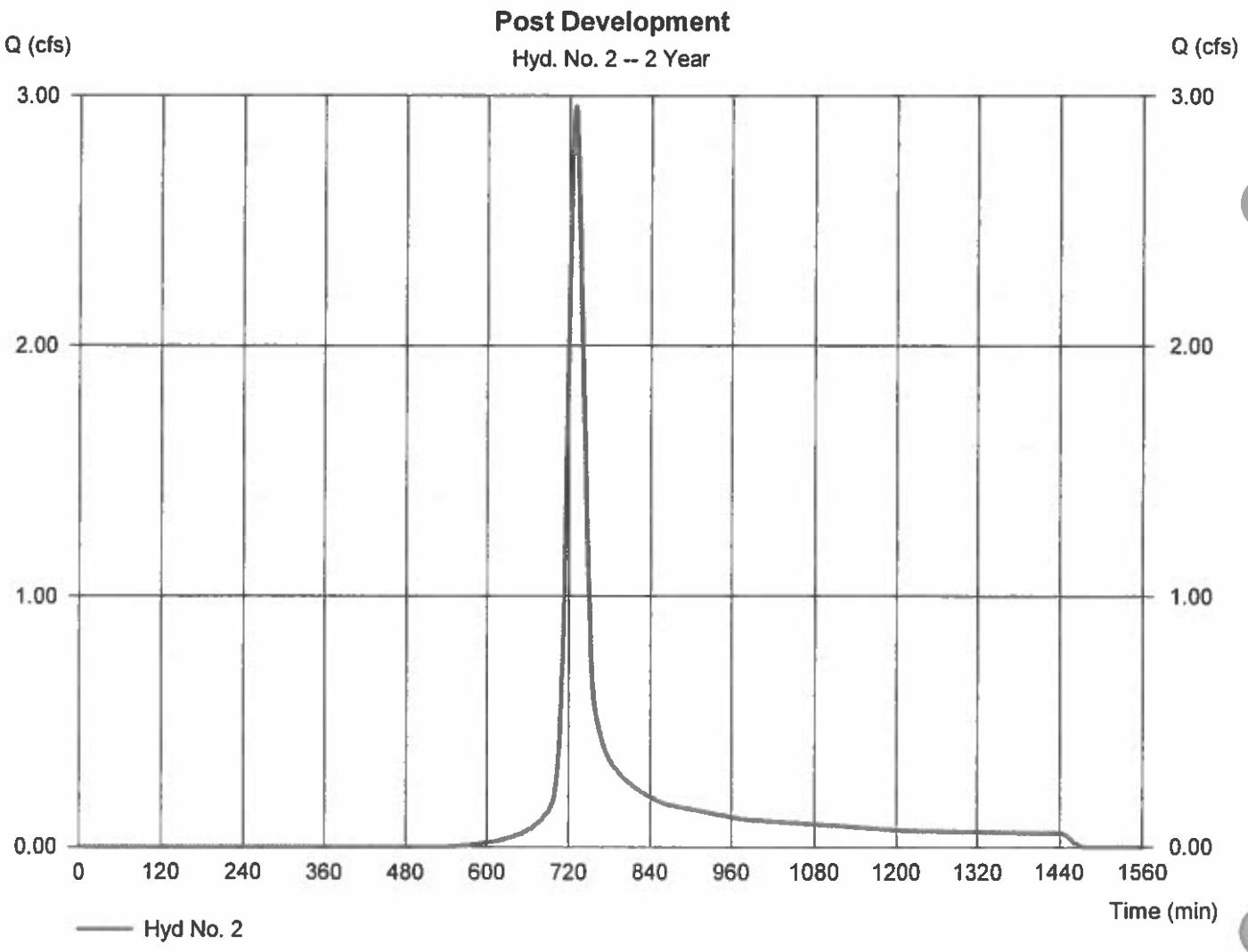
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 2

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 2.957 cfs
Storm frequency	= 2 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 10,606 cuft
Drainage area	= 2.700 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.10 min
Total precip.	= 2.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.700 x 86)] / 2.700



Hydrograph Report

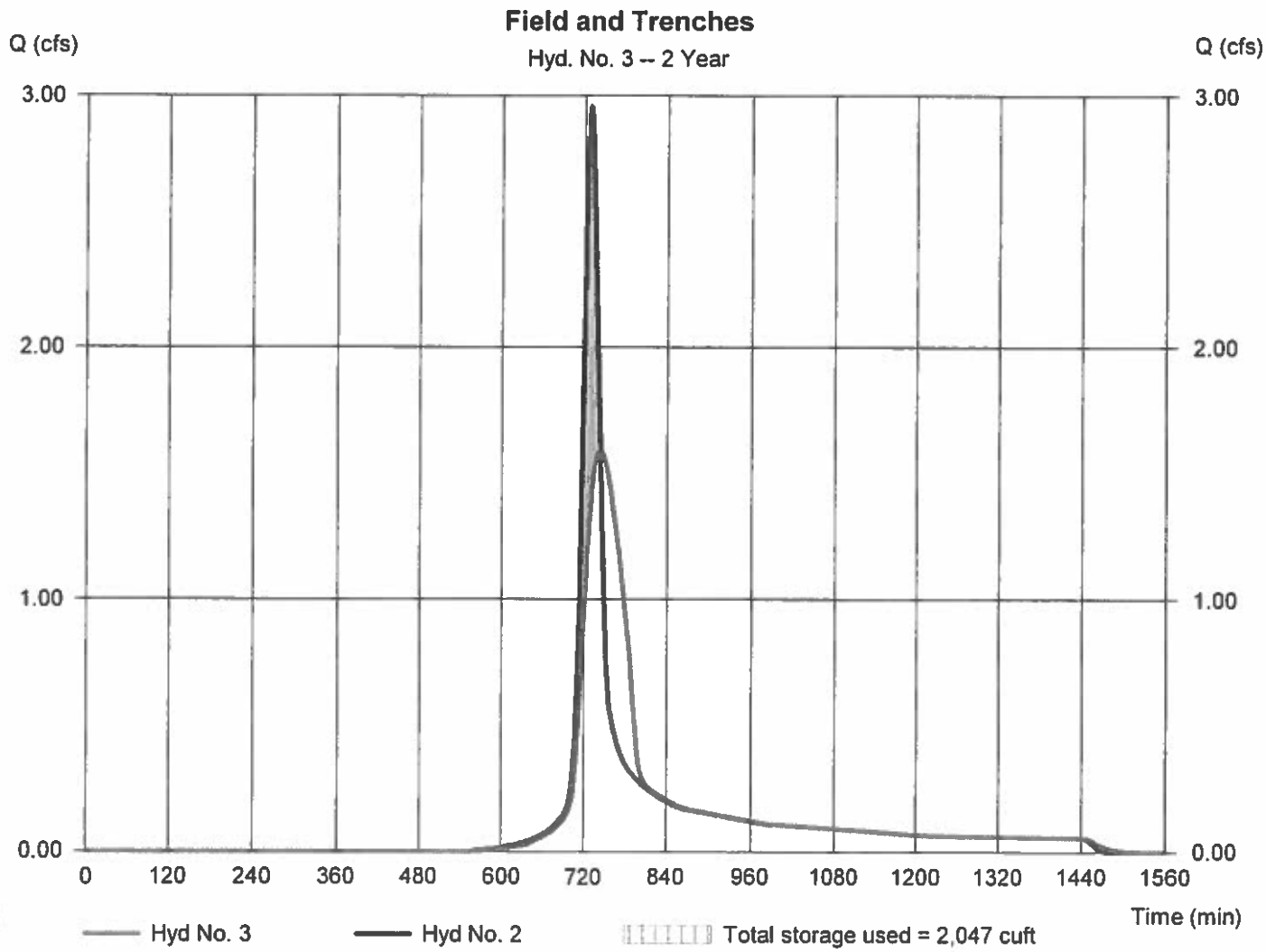
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 3

Field and Trenches

Hydrograph type	= Reservoir	Peak discharge	= 1.587 cfs
Storm frequency	= 2 yrs	Time to peak	= 743 min
Time interval	= 1 min	Hyd. volume	= 10,605 cuft
Inflow hyd. No.	= 2 - Post Development	Max. Elevation	= 1034.33 ft
Reservoir name	= Field and Trenches	Max. Storage	= 2,047 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Pond No. 1 - Field and Trenches

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1031.00	n/a	0	0
1.00	1032.00	n/a	316	316
2.00	1033.00	n/a	580	896
3.00	1034.00	n/a	812	1,708
4.00	1035.00	n/a	1,044	2,752
5.00	1036.00	n/a	1,206	3,958
6.00	1037.00	n/a	1,712	5,670
6.45	1037.45	n/a	3,331	9,001

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	6.00	12.00	0.00
Span (in)	= 15.00	6.00	12.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 1030.90	1031.00	1034.75	0.00
Length (ft)	= 38.00	0.50	0.50	0.00
Slope (%)	= 2.00	0.00	0.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.57	4.00	0.00	0.00
Crest El. (ft)	= 1037.45	1036.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1031.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.00	316	1032.00	0.80 ic	0.78 ic	0.00	---	0.00	0.00	---	---	---	---	0.783
2.00	896	1033.00	1.20 ic	1.19 ic	0.00	---	0.00	0.00	---	---	---	---	1.189
3.00	1,708	1034.00	1.50 ic	1.50 ic	0.00	---	0.00	0.00	---	---	---	---	1.499
4.00	2,752	1035.00	2.02 ic	1.74 ic	0.26 ic	---	0.00	0.00	---	---	---	---	2.009
5.00	3,958	1036.00	5.10 ic	1.83 ic	3.27 ic	---	0.00	0.00	---	---	---	---	5.100
6.00	5,670	1037.00	11.04 ic	1.33 ic	5.00 ic	---	0.00	4.71	---	---	---	---	11.04
6.45	9,001	1037.45	13.78 ic	0.66 ic	2.63 ic	---	0.00	10.49 s	---	---	---	---	13.78

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.116	1	724	12,439	------	------	------	Pre Development
2	SCS Runoff	5.297	1	728	18,841	------	------	------	Post Development
3	Reservoir	4.093	1	736	18,840	2	1035.62	3,496	Field and Trenches

Hydrograph Report

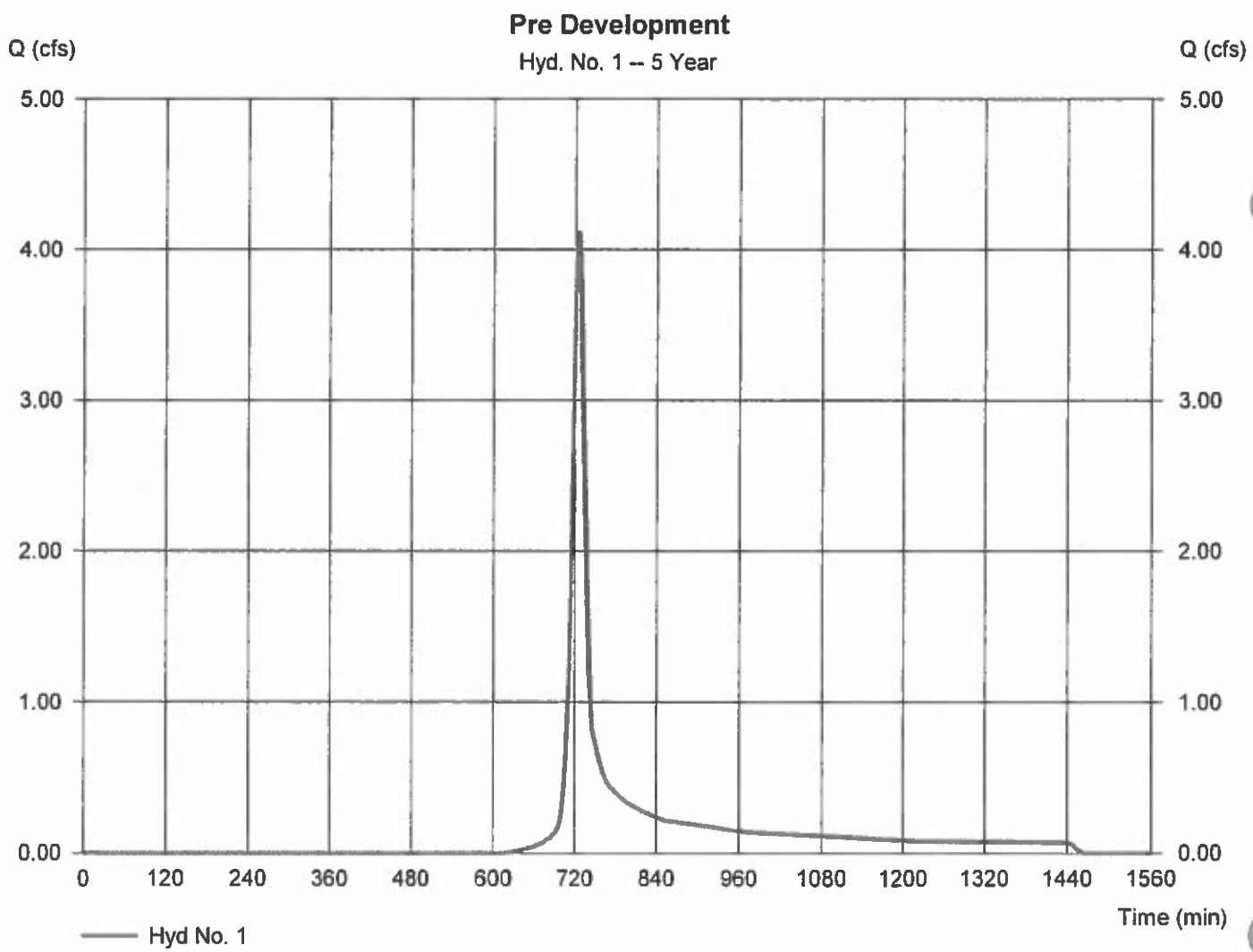
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 4.116 cfs
Storm frequency	= 5 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 12,439 cuft
Drainage area	= 2.700 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.70 min
Total precip.	= 3.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.040 x 74) + (0.660 x 87)] / 2.700



Hydrograph Report

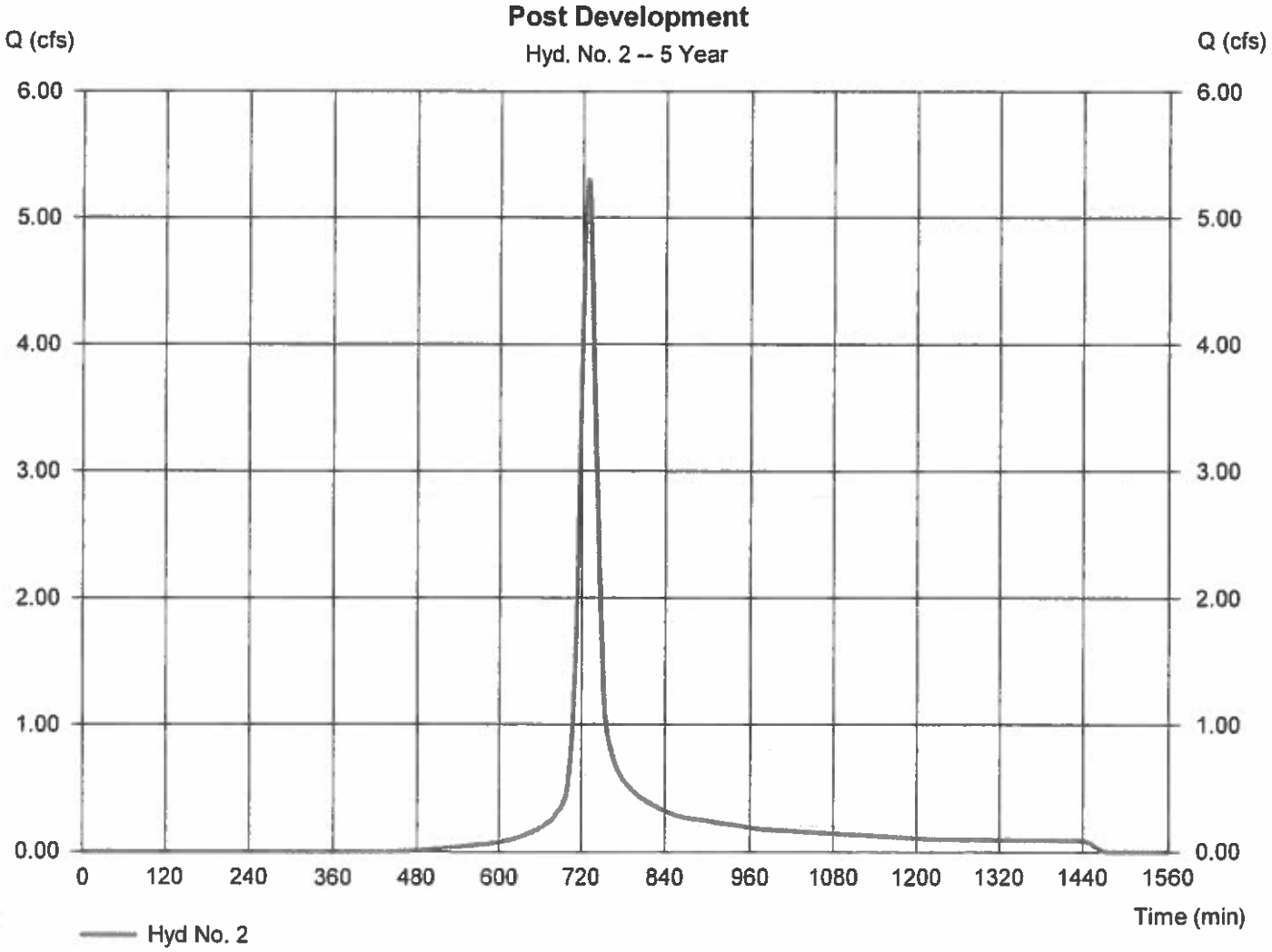
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 2

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 5.297 cfs
Storm frequency	= 5 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 18,841 cuft
Drainage area	= 2.700 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.10 min
Total precip.	= 3.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.700 x 86)] / 2.700



Hydrograph Report

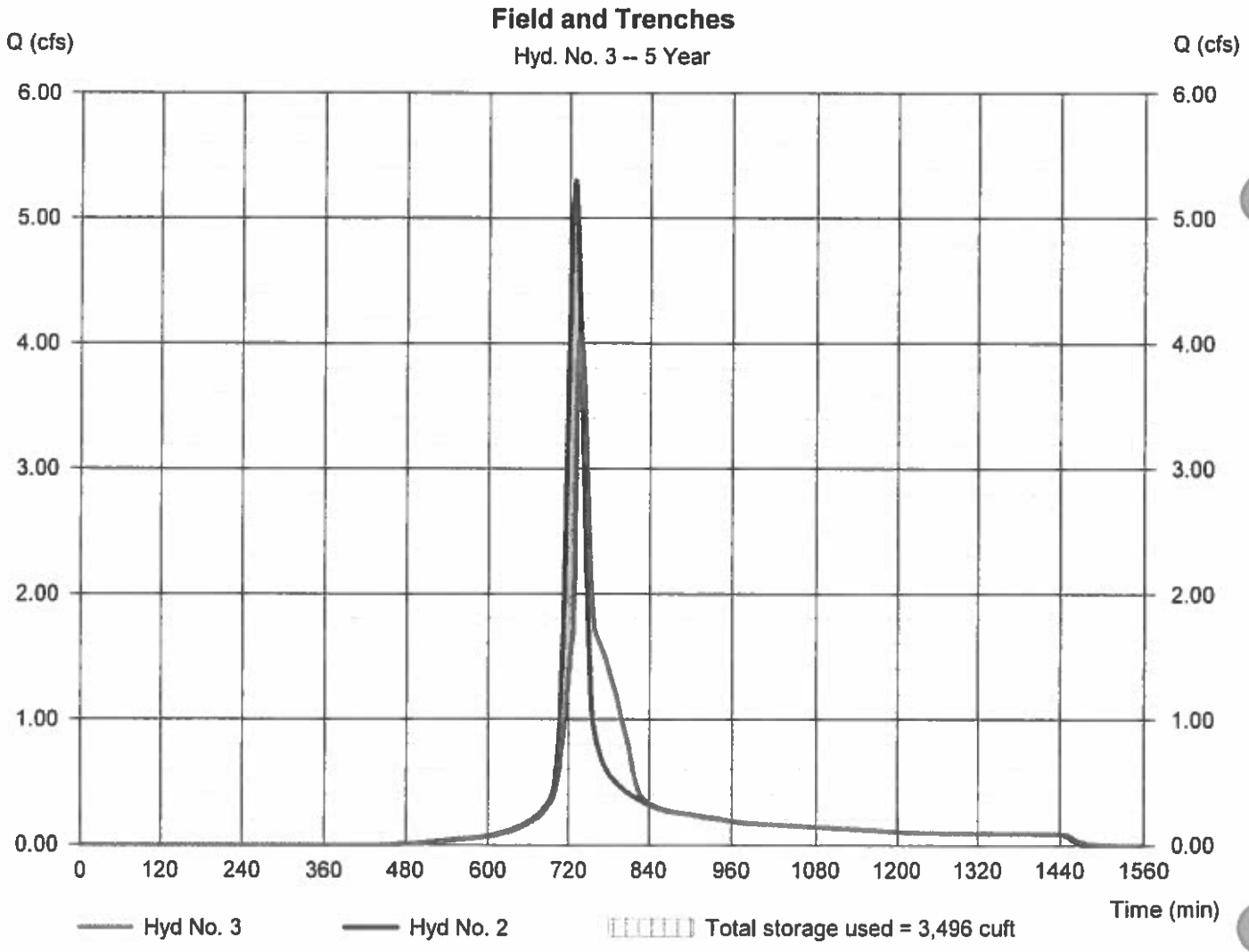
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 3

Field and Trenches

Hydrograph type	= Reservoir	Peak discharge	= 4.093 cfs
Storm frequency	= 5 yrs	Time to peak	= 736 min
Time interval	= 1 min	Hyd. volume	= 18,840 cuft
Inflow hyd. No.	= 2 - Post Development	Max. Elevation	= 1035.62 ft
Reservoir name	= Field and Trenches	Max. Storage	= 3,496 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.634	1	724	16,803	----	----	------	Pre Development
2	SCS Runoff	6.753	1	728	24,070	------	----	----	Post Development
3	Reservoir	5.317	1	736	24,069	2	1036.10	4,127	Field and Trenches

Hydrograph Report

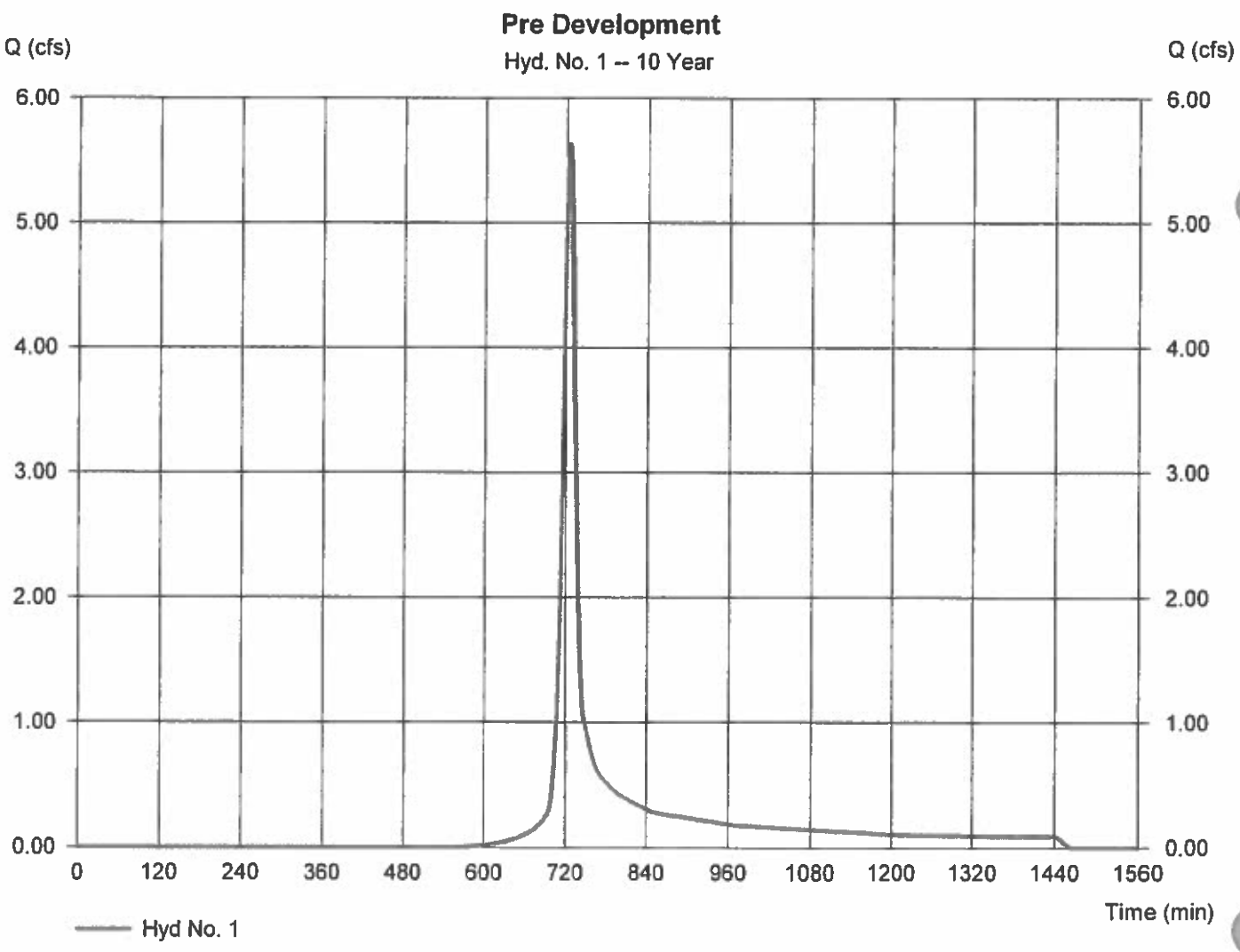
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 5.634 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 16,803 cuft
Drainage area	= 2.700 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.70 min
Total precip.	= 3.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.040 x 74) + (0.660 x 87)] / 2.700



Hydrograph Report

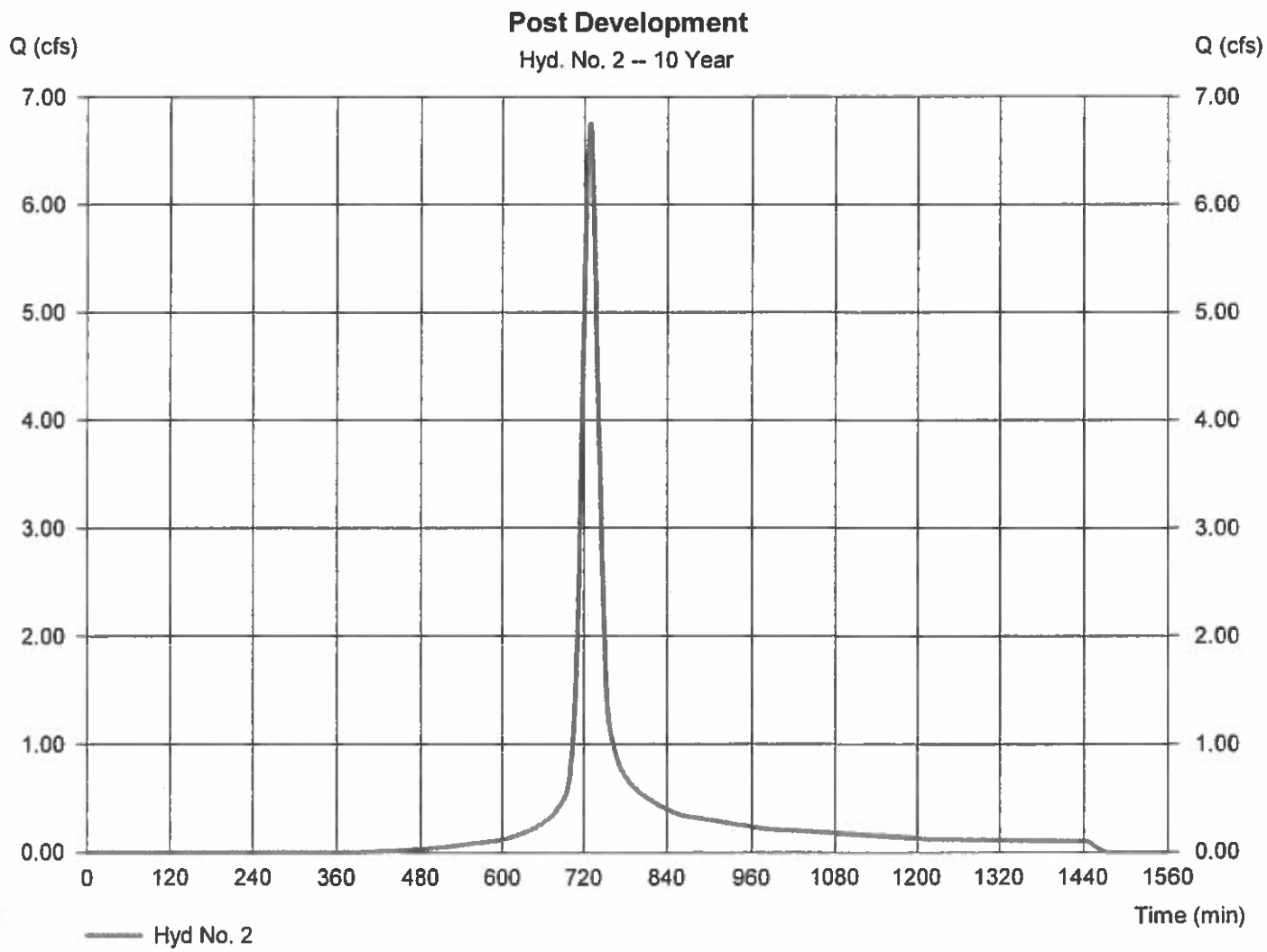
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 2

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 6.753 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 24,070 cuft
Drainage area	= 2.700 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.10 min
Total precip.	= 3.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.700 x 86)] / 2.700



Hydrograph Report

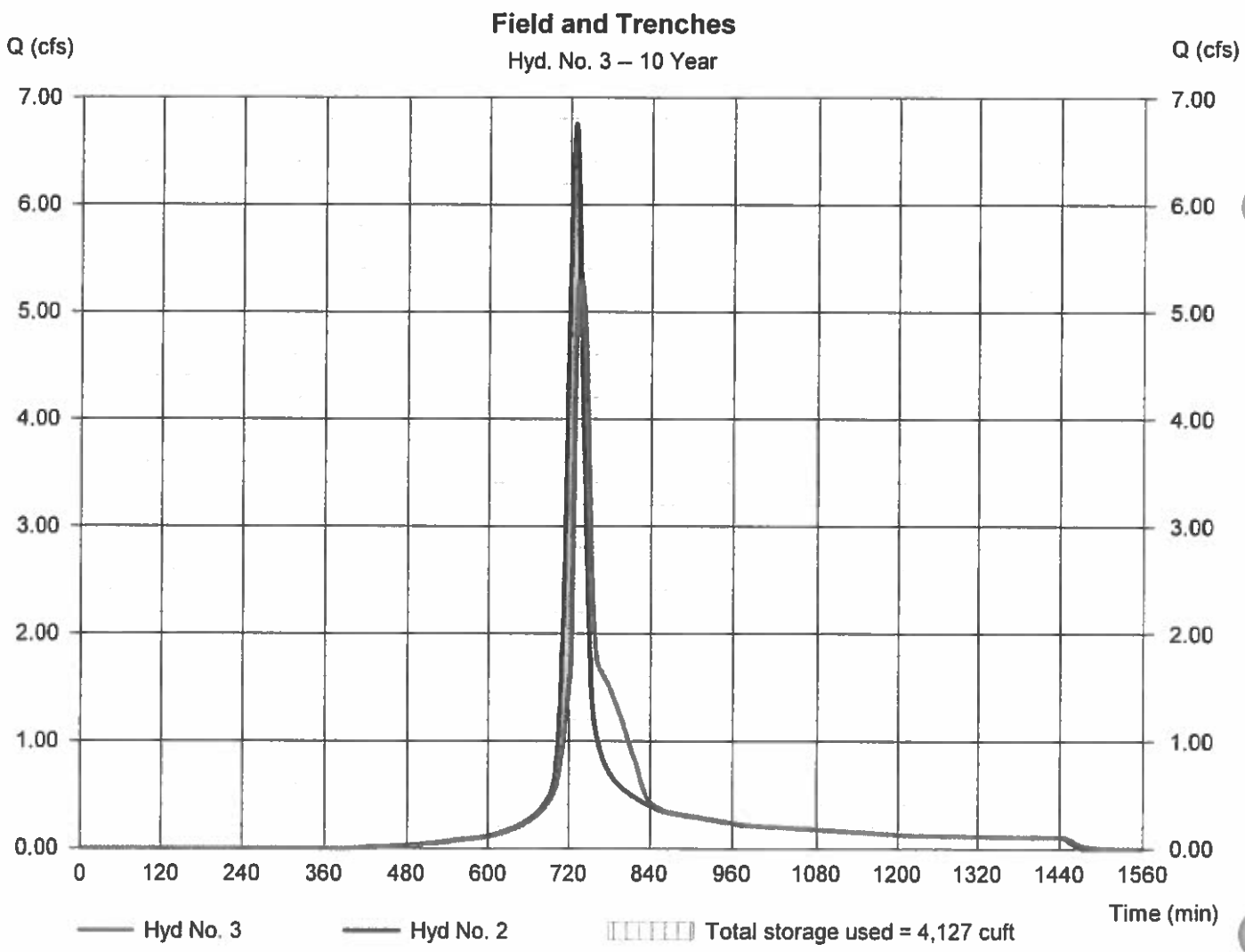
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 3

Field and Trenches

Hydrograph type	= Reservoir	Peak discharge	= 5.317 cfs
Storm frequency	= 10 yrs	Time to peak	= 736 min
Time interval	= 1 min	Hyd. volume	= 24,069 cuft
Inflow hyd. No.	= 2 - Post Development	Max. Elevation	= 1036.10 ft
Reservoir name	= Field and Trenches	Max. Storage	= 4,127 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.953	1	724	20,636	------	------	------	Pre Development
2	SCS Runoff	7.978	1	728	28,533	----	----	----	Post Development
3	Reservoir	6.096	1	736	28,532	2	1036.50	4,814	Field and Trenches

Hydrograph Report

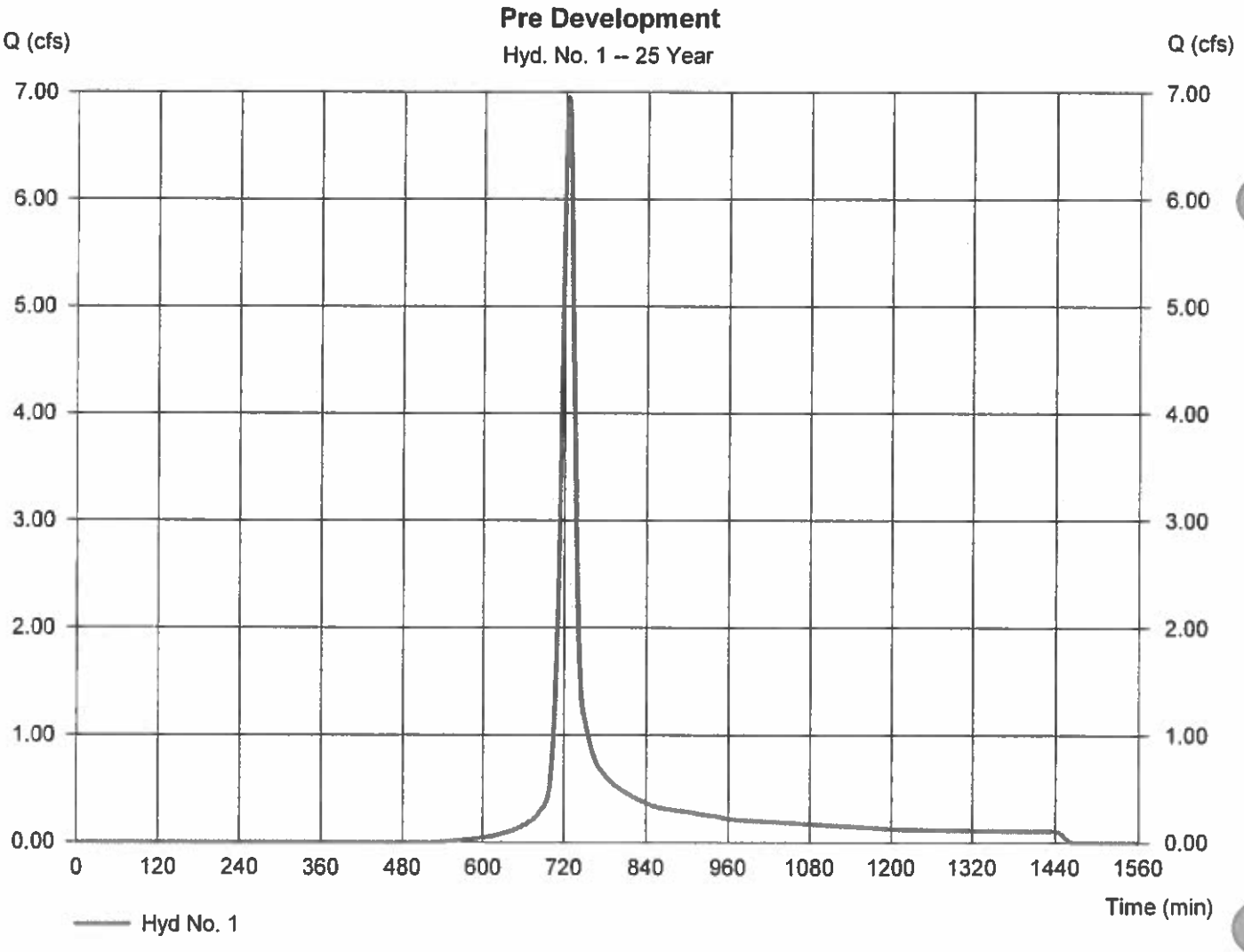
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 6.953 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 20,636 cuft
Drainage area	= 2.700 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.70 min
Total precip.	= 4.40 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.040 x 74) + (0.660 x 87)] / 2.700



Hydrograph Report

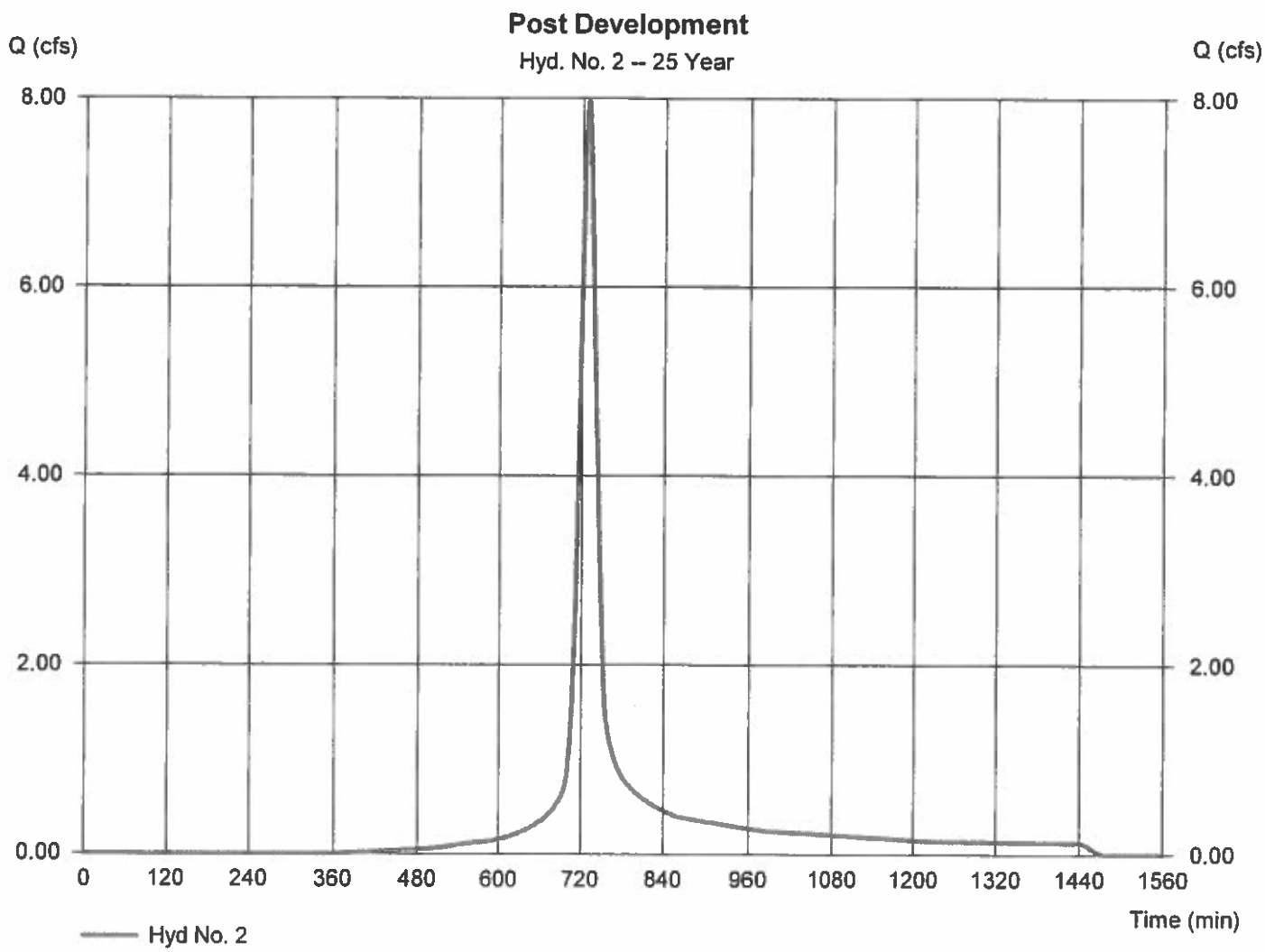
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 2

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 7.978 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 28,533 cuft
Drainage area	= 2.700 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.10 min
Total precip.	= 4.40 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.700 x 86)] / 2.700



Hydrograph Report

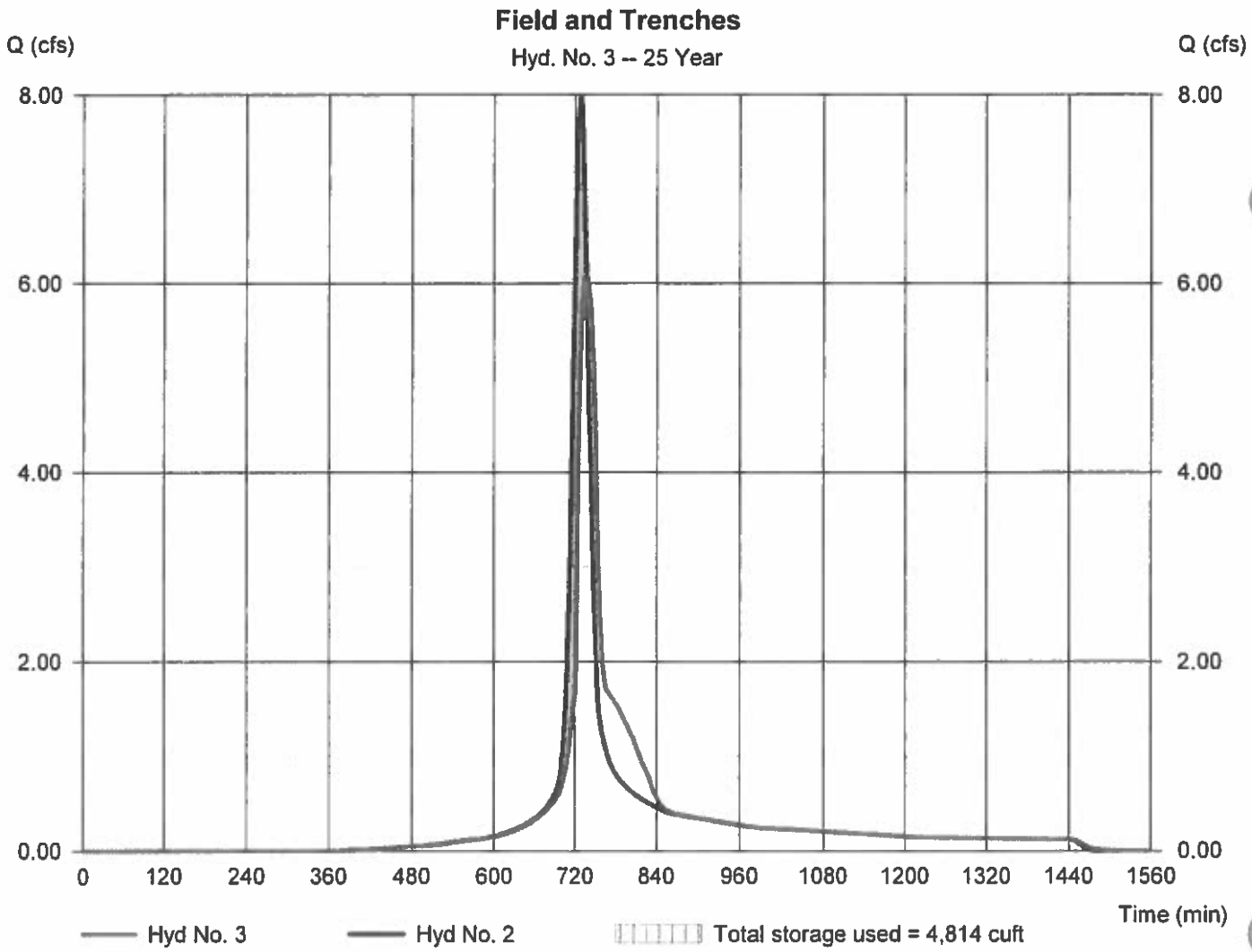
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 3

Field and Trenches

Hydrograph type	= Reservoir	Peak discharge	= 6.096 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 1 min	Hyd. volume	= 28,532 cuft
Inflow hyd. No.	= 2 - Post Development	Max. Elevation	= 1036.50 ft
Reservoir name	= Field and Trenches	Max. Storage	= 4,814 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	9.135	1	724	27,045	-----	-----	-----	Pre Development
2	SCS Runoff	9.950	1	728	35,814	-----	-----	-----	Post Development
3	Reservoir	8.978	1	732	35,813	2	1036.84	5,385	Field and Trenches

Hydrograph Report

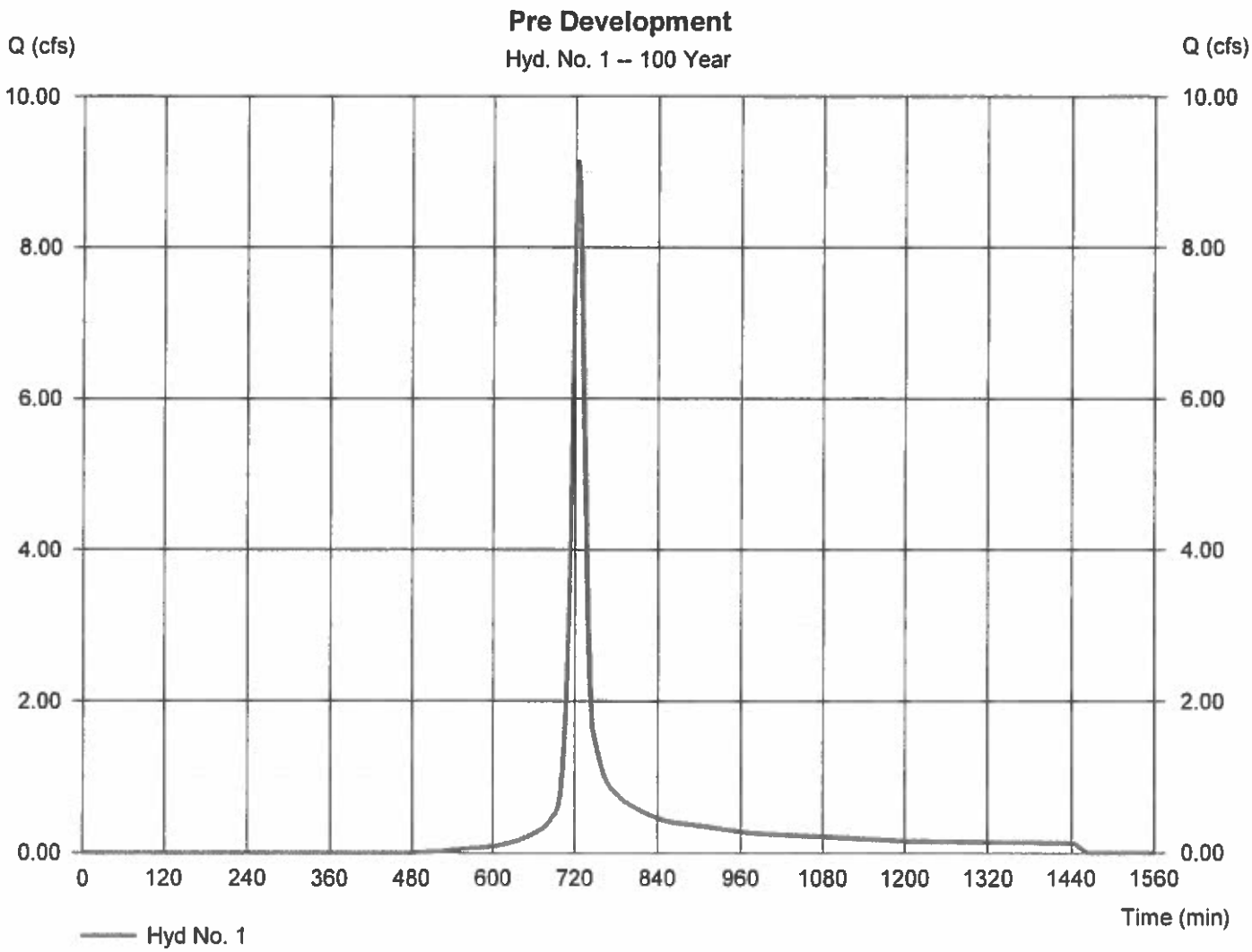
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 9.135 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 27,045 cuft
Drainage area	= 2.700 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.70 min
Total precip.	= 5.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.040 x 74) + (0.660 x 87)] / 2.700



Hydrograph Report

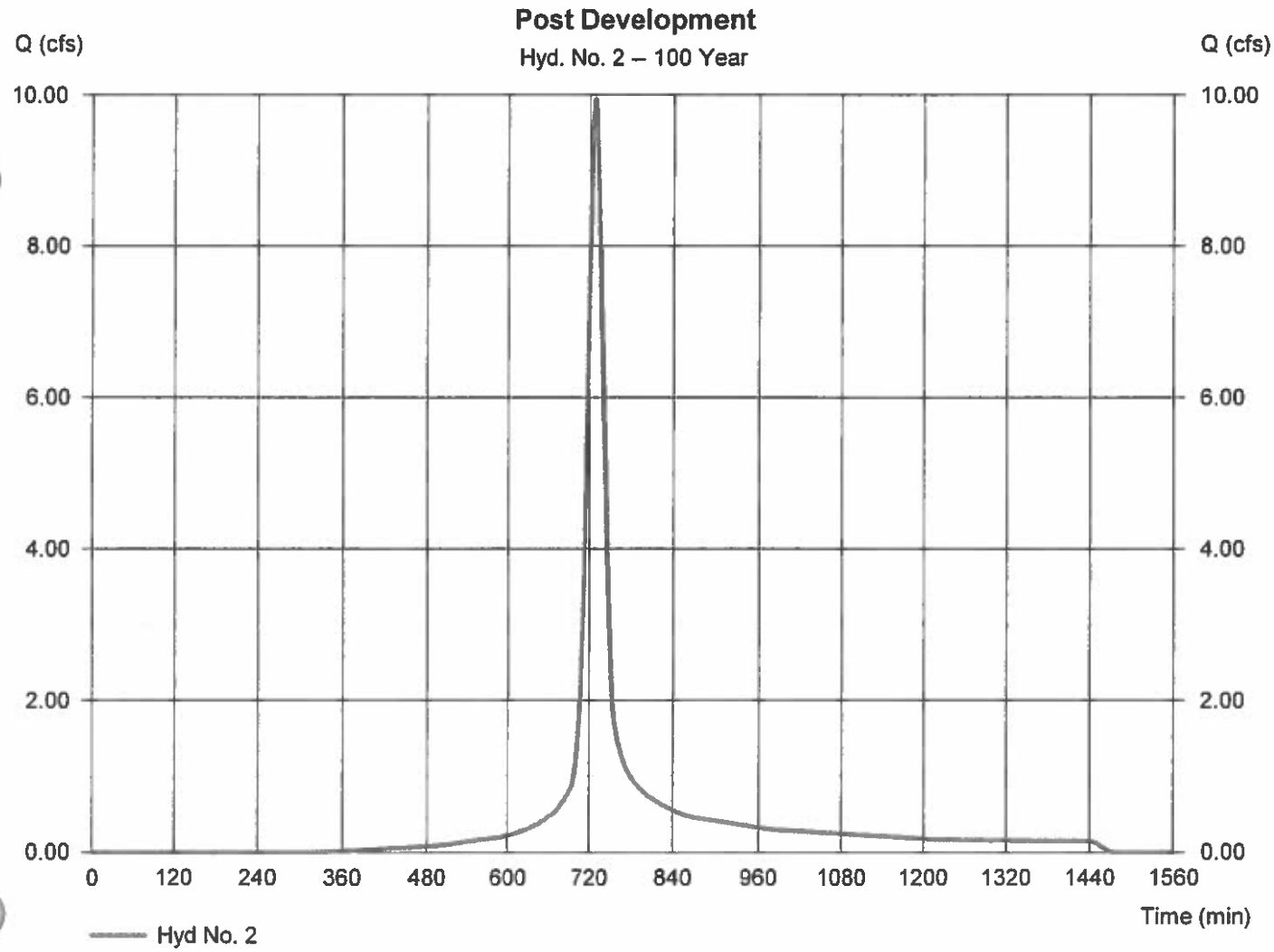
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 2

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 9.950 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 35,814 cuft
Drainage area	= 2.700 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.10 min
Total precip.	= 5.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.700 x 86)] / 2.700



Hydrograph Report

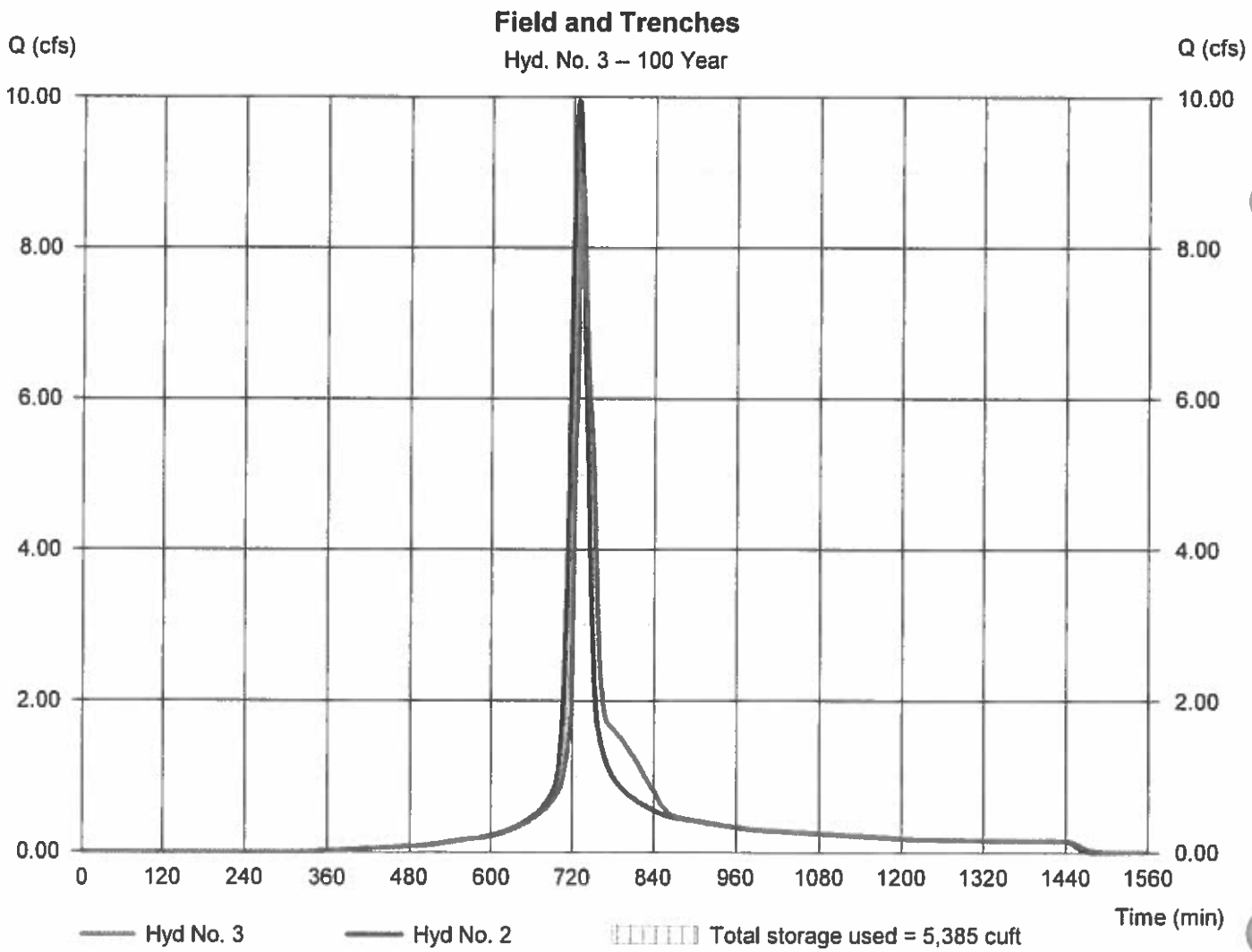
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Hyd. No. 3

Field and Trenches

Hydrograph type	= Reservoir	Peak discharge	= 8.978 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 35,813 cuft
Inflow hyd. No.	= 2 - Post Development	Max. Elevation	= 1036.84 ft
Reservoir name	= Field and Trenches	Max. Storage	= 5,385 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 05 / 19 / 2014

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	——
2	69.8703	13.1000	0.8658	——
3	0.0000	0.0000	0.0000	——
5	79.2597	14.6000	0.8369	——
10	88.2351	15.5000	0.8279	——
25	102.6072	16.5000	0.8217	——
50	114.8193	17.2000	0.8199	——
100	127.1596	17.8000	0.8186	——

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: F:\Storms\Aleppo Township Design Storm Frequency.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.30	0.00	3.30	3.90	4.40	0.00	5.20
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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2014-05-07_SWM.gpw

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- **Hydrograph Reports** 18
  - Hydrograph No. 1, SCS Runoff, Pre Development 18
  - Hydrograph No. 2, SCS Runoff, Post Development 19
  - Hydrograph No. 3, Reservoir, Field and Trenches 20

100 - Year

- **Summary Report** 21
- **Hydrograph Reports** 22
  - Hydrograph No. 1, SCS Runoff, Pre Development 22
  - Hydrograph No. 2, SCS Runoff, Post Development 23
  - Hydrograph No. 3, Reservoir, Field and Trenches 24

IDF Report 25

Project Number: C-97027 Date: 5/19/14

Prepared By: MGA Page Number:

Project Name: WILDCAT FIELD

GATEWAY
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Attendee(s):

Purpose / Goal: TIME OF CONCENTRATION – POST DEVELOPMENT

SHALLOW CONCENTRATED FLOW

FROM FIGURE 5.1 IN PA E&S MANUAL, $V = 0.175 \frac{FT}{SEC}$ (0.5 % SLOPE, FOREST W/ HEAVY GROUND LITTER AND MEADOW WATERCOURSE)

$L = 175'$; $175 \text{ FT} / 0.175 \frac{FT}{SEC} = 1000 \text{ SEC}$

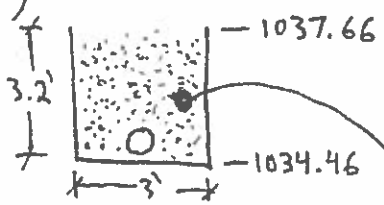
$1000 \text{ SEC} \left(\frac{1 \text{ MIN}}{60 \text{ SEC}}\right) = \boxed{16.67 \text{ MIN}} = t_c$

TRENCH / CHANNEL FLOW

1.) FLOW THROUGH TRENCH: $L = 415'$, $S = 0.8\%$

$n = 0.075$ (DENSE / HEAVY BRUSH)

$A = 3.84$ SF, $P = 9.4$ FT



$A = (3.2')(3')(0.4 \text{ VOID SPACE}) = 3.84 \text{ SF}$

BEGINNING OF TRENCH FLOW PATH AREA, MOST SHALLOW PART OF TRENCH

$t_c = \boxed{7.09 \text{ MIN}}$

2.) $L = 38'$ OF 15" Θ HDPE, $S = 2.0\%$, $n = 0.012$

$A = 1.23$ SF, $P = 3.93$ FT

$t_c = \boxed{0.08 \text{ MIN}}$

3.) $L = 106'$ OF 15" Θ CAP, $S = 1.62\%$, $n = 0.012$

$A = 1.23$ SF, $P = 3.93$ FT

$t_c = \boxed{0.24 \text{ MIN}}$

TOTAL $t_c = 16.67 + 7.09 + 0.08 + 0.24 = \boxed{24.1 \text{ MINUTES}}$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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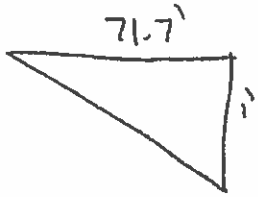
1031 – 1032

(A)

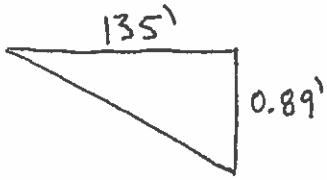


$A = 36$ SF $\quad A_{pipe} = 0.785$ SF

$V = 108$ CF $\quad V_{pipe} = 56.3$ CF

$V_T = 56.3 + (108 - 56.3)(0.4) = \underline{77 \text{ CF}}$

(B)

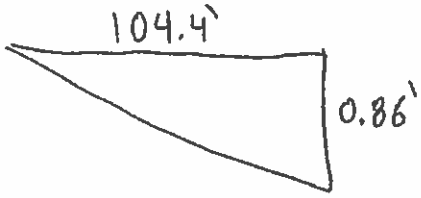


$A = 60$ SF $\quad A_{pipe} = 0.785$ SF

$V = 180$ CF $\quad V_{pipe} = 106$ CF

$V_T = 106 + (180 - 106)(0.4) = \underline{136 \text{ CF}}$

(C)



$A = 45$ SF $\quad A_{pipe} = 0.785$ SF

$V = 135$ CF $\quad V_{pipe} = 82$ CF

$V_T = 82 + (135 - 82)(0.4) = \underline{103 \text{ CF}}$

$V_{1031-1032} = 77 + 136 + 103 = \boxed{316 \text{ CF}}$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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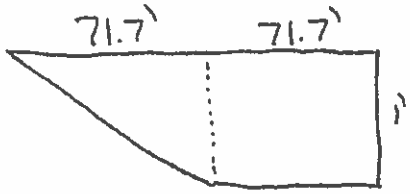
1032-1033

(A)

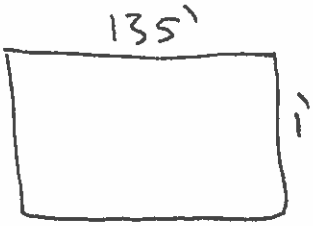


$A = 107.7\ SF$ $A_{pipe} = 0.785\ SF$

$V = 323\ CF$ $V_{pipe} = 56.3\ CF$

$V_T = 56.3 + (323 - 56.3)(0.4) = \underline{163\ CF}$

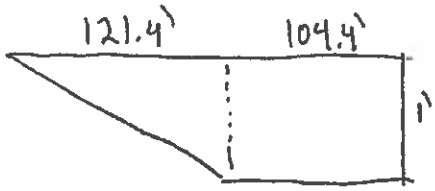
(B)



$A = 135\ SF$ $V = 405\ CF$

$V_T = (405)(0.4) = \underline{162\ CF}$

(C)



$A = 165\ SF$ $A_{pipe} = 0.785\ SF$

$V = 495\ CF$ $V_{pipe} = 95.3\ CF$

$V_T = 95.3 + (495 - 95.3)(0.4) = \underline{255\ CF}$

$V_{1032-1033} = 163 + 162 + 255 = \boxed{580\ CF}$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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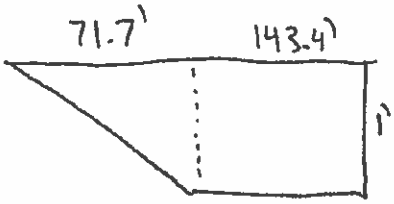
1033 – 1034

(A)

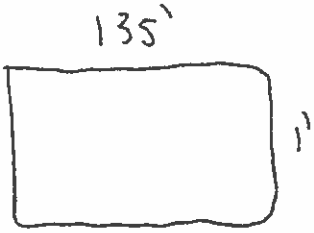


$A = 179.25\ SF$ $A_{Pipe} = 0.785\ SF$

$V = 538\ CF$ $V_{Pipe} = 56.3\ CF$

$V_T = 56.3 + (538 - 56.3)(0.4) = \underline{249\ CF}$

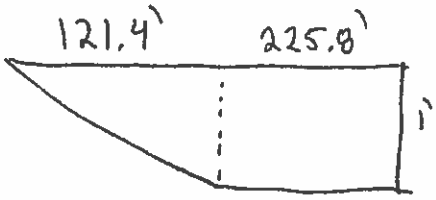
(B)



$A = 135\ SF$ $V = 405\ CF$

$V_T = (405)(0.4) = \underline{162\ CF}$

(C)



$A = 286.5\ SF$ $A_{Pipe} = 0.785\ SF$

$V = 860\ CF$ $V_{Pipe} = 95.3\ CF$

$V_T = 95.3 + (860 - 95.3)(0.4) = \underline{401\ CF}$

$V_{1033-1034} = 249 + 162 + 401 = \boxed{812\ CF}$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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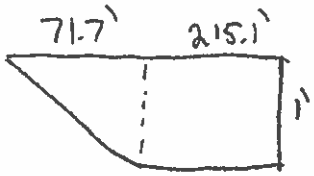
1034 – 1035

(A)

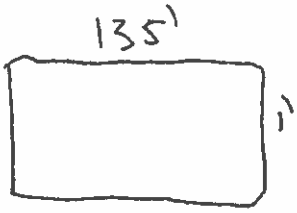


$A = 251$ SF $\quad A_{pipe} = 0.785$ SF

$V = 753$ CF $\quad V_{pipe} = 56.3$ CF

$V_T = 56.3 + (753 - 56.3)(0.4) = \underline{335 \text{ CF}}$

(B)

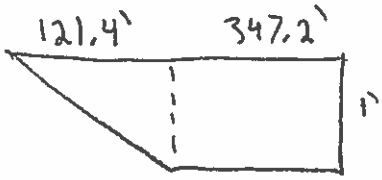


$A = 135$ SF

$V = 405$ CF

$V_T = (405)(0.4) = \underline{162 \text{ CF}}$

(C)



$A = 408$ SF $\quad A_{pipe} = 0.785$ SF

$V = 1224$ CF $\quad V_{pipe} = 95.3$ CF

$V_T = 95.3 + (1224 - 95.3)(0.4) = \underline{547 \text{ CF}}$

$$V_{1034-1035} = 335 + 162 + 547 = \boxed{1044 \text{ CF}}$$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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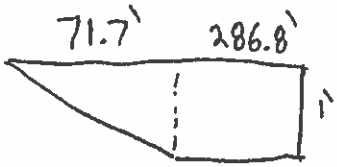
1035 – 1036

(A)

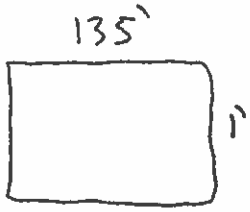


$A = 322.7$ SF $\quad A_{pipe} = 0.785$ SF

$V = 968$ CF $\quad V_{pipe} = 56.3$ CF

$V_T = 56.3 + (968 - 56.3)(0.4) = \underline{421 \text{ CF}}$

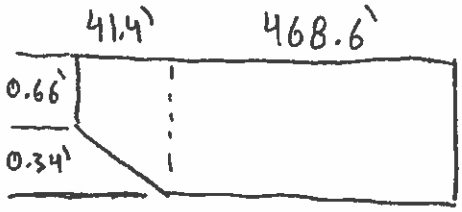
(B)



$A = 135$ SF $\quad V = 405$ CF

$V_T = (405)(0.4) = \underline{162 \text{ CF}}$

(C)



$A = 503$ SF $\quad A_{pipe} = 0.785$ SF

$V = 1509$ CF $\quad V_{pipe} = 32.5$ CF

$V_T = 32.5 + (1509 - 32.5)(0.4) = \underline{623 \text{ CF}}$

$V_{1035-1036} = 421 + 162 + 623 = \boxed{1206 \text{ CF}}$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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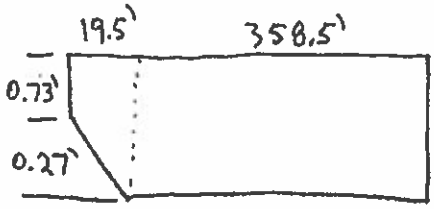
1036 -1037

(A)



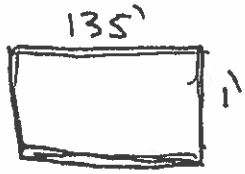
$A = 375.4\ SF$ $A_{pipe} = 0.785\ SF$

$V = 1126\ CF$ $V_{pipe} = 15.3\ CF$

$$V_T = 15.3 + (1126 - 15.3)(0.4) = 460\ CF - ((425\ CF)(0.4)) = \underline{290\ CF}$$

(SUBTRACTING TRENCH AREA NEAR HOMEPLATE SINCE ALREADY ACCOUNTED FOR)

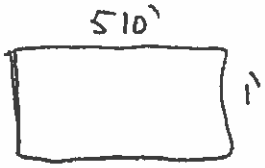
(B)



$A = 135\ SF$ $V = 405\ CF$

$V_T = (405)(0.4) = \underline{162\ CF}$

(C)



$A = 510\ SF$ $V = 1530\ CF$

$V_T = (1530)(0.4) = \underline{612\ CF}$

(FIELD) * FOUND BY COMPARING SURFACES IN AUTOCAD

$V = 1620\ CF$ $V_T = (1620)(0.4) = \underline{648\ CF}$

$$V_{1036-1037} = 290 + 162 + 612 + 648 = \boxed{1712\ CF}$$

Project Number: _____ Date: 5/14

Prepared By: MGA Page Number: _____

Project Name: WILDCAT FIELD

Attendee(s): _____

Purpose / Goal: STAGE-STORAGE

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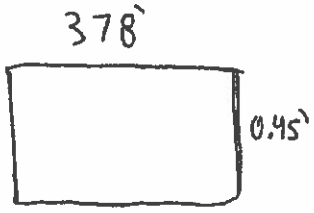
1037 – 1037.45 (LOWEST ELEVATION OF TOP OF TURF)

(A)

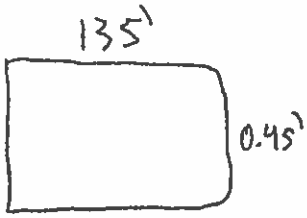


$A = (378')(3') = 1134\ SF - 206\ SF = 928\ SF$ (SUBTRACTING TRENCH AREA ALREADY ACCOUNTED FOR)

$V = (928\ SF)(0.45') = 418\ CF$

$V_T = (418)(0.4) = \underline{167\ CF}$

(B)

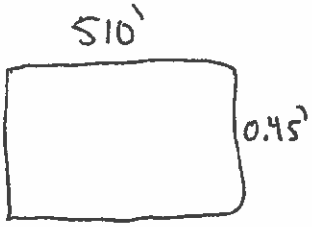


$A = (135')(3'\ WIDE) = 405\ SF - 119.6\ SF = 285.4\ SF$ (SUBTRACTING TRENCH AREA ALREADY ACCOUNTED FOR)

$V = (285.4\ SF)(0.45') = 128\ CF$

$V_T = (128)(0.4) = \underline{51\ CF}$

(C)



$A = (510')(3'\ WIDE) = 1530\ SF - 1034.3 = 495.7\ SF$ (SUBTRACTING TRENCH AREA ALREADY ACCOUNTED FOR)

$V = (495.7\ SF)(0.45') = 223\ CF$

$V_T = (223)(0.4) = \underline{89\ CF}$

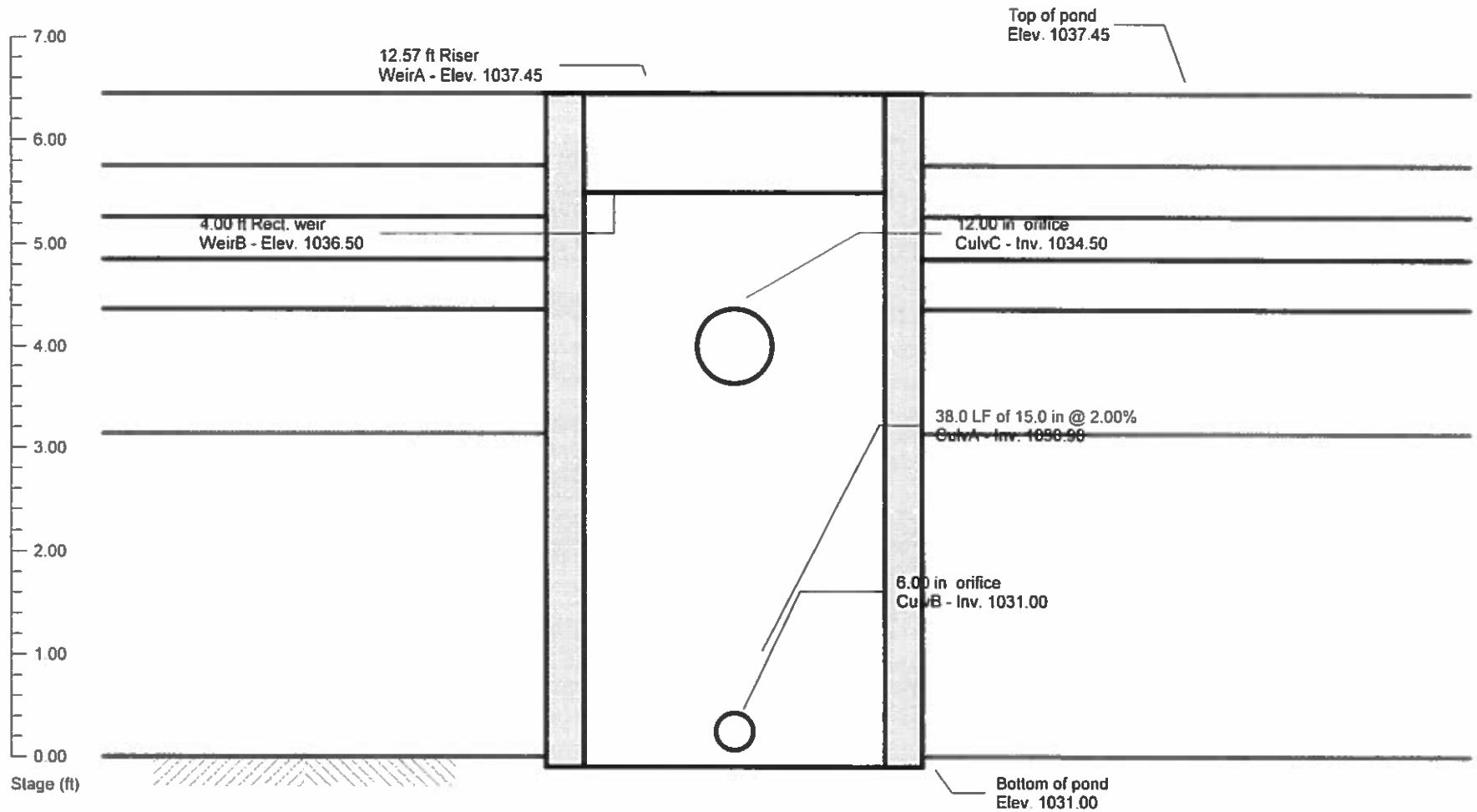
(FIELD) * FOUND BY COMPARING SURFACES IN AUTOCAD

$V = 7560\ CF$ $V_T = (7560)(0.4) = \underline{3024\ CF}$

$V_{1037-1037.45} = 167 + 51 + 89 + 3024 = \boxed{3331\ CF}$

Pond No. 1 - Field and Trenches

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3



Front View
NTS - Looking Downstream

25-yr
10-yr
5-yr
100-yr
2-yr

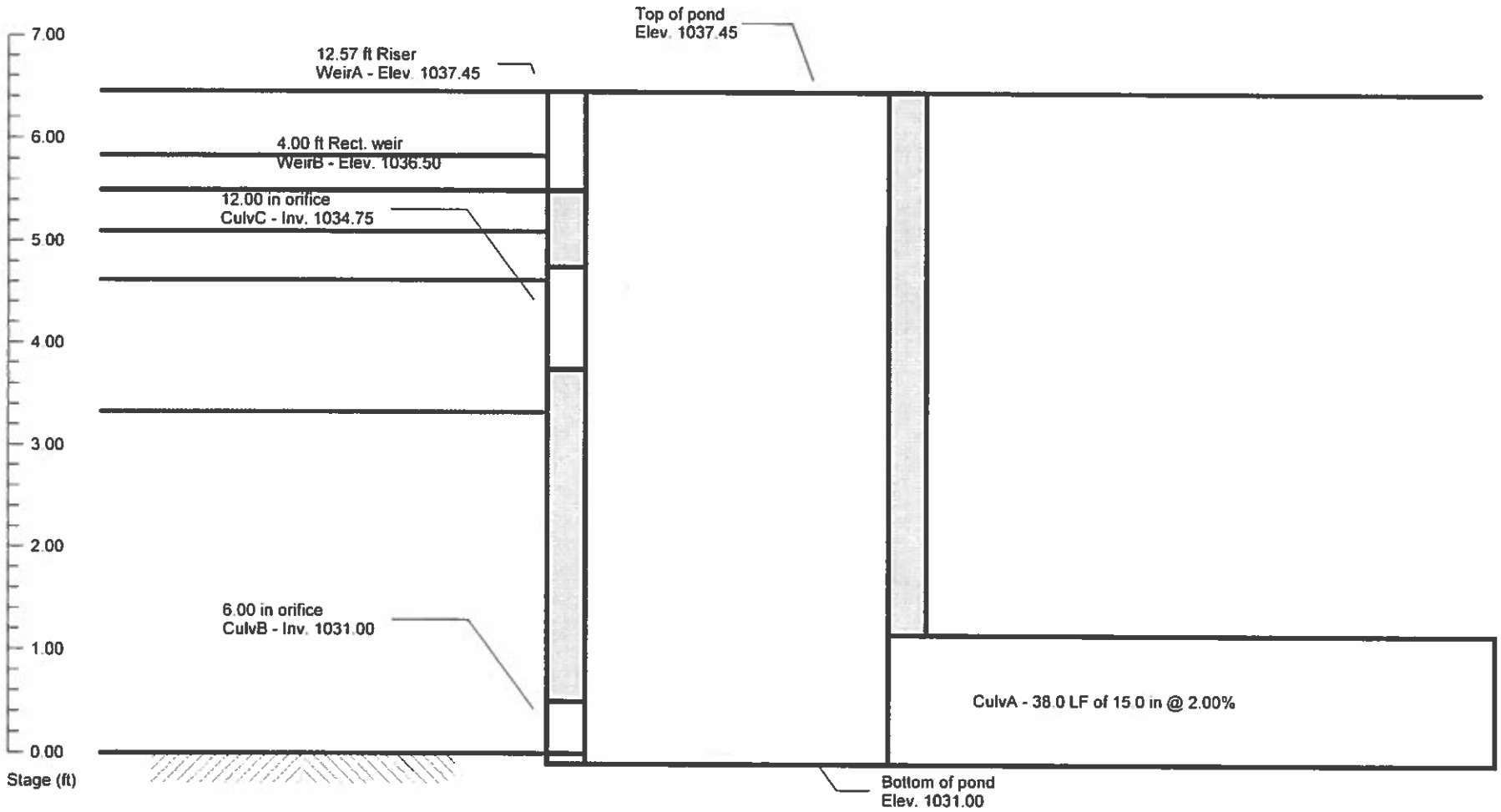
Inflow hydrograph = 2. SCS Runoff - Post Development

Project: 2014-05-07_SWM.gpw

Monday, 05 / 19 / 2014

Pond No. 1 - Field and Trenches

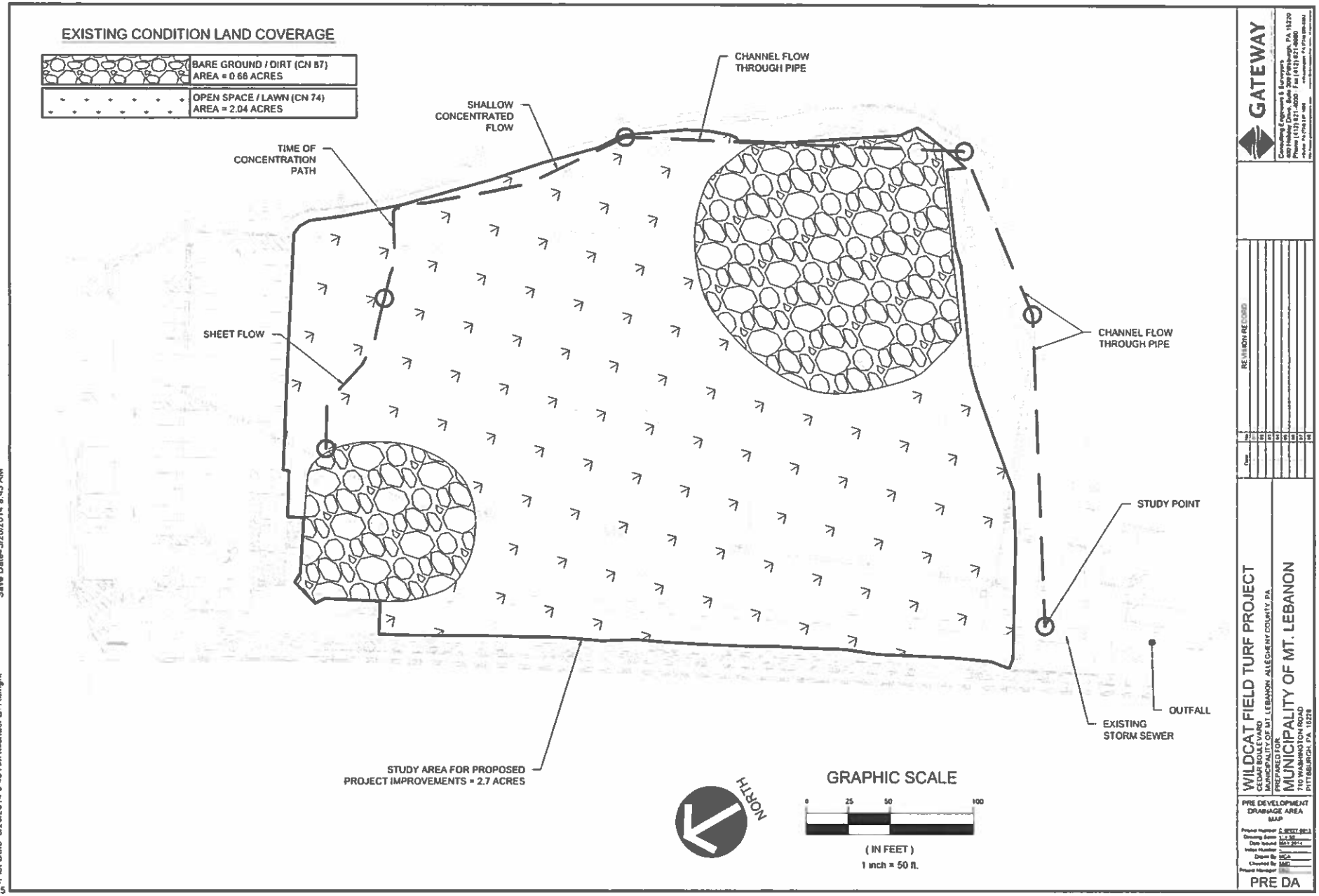
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3



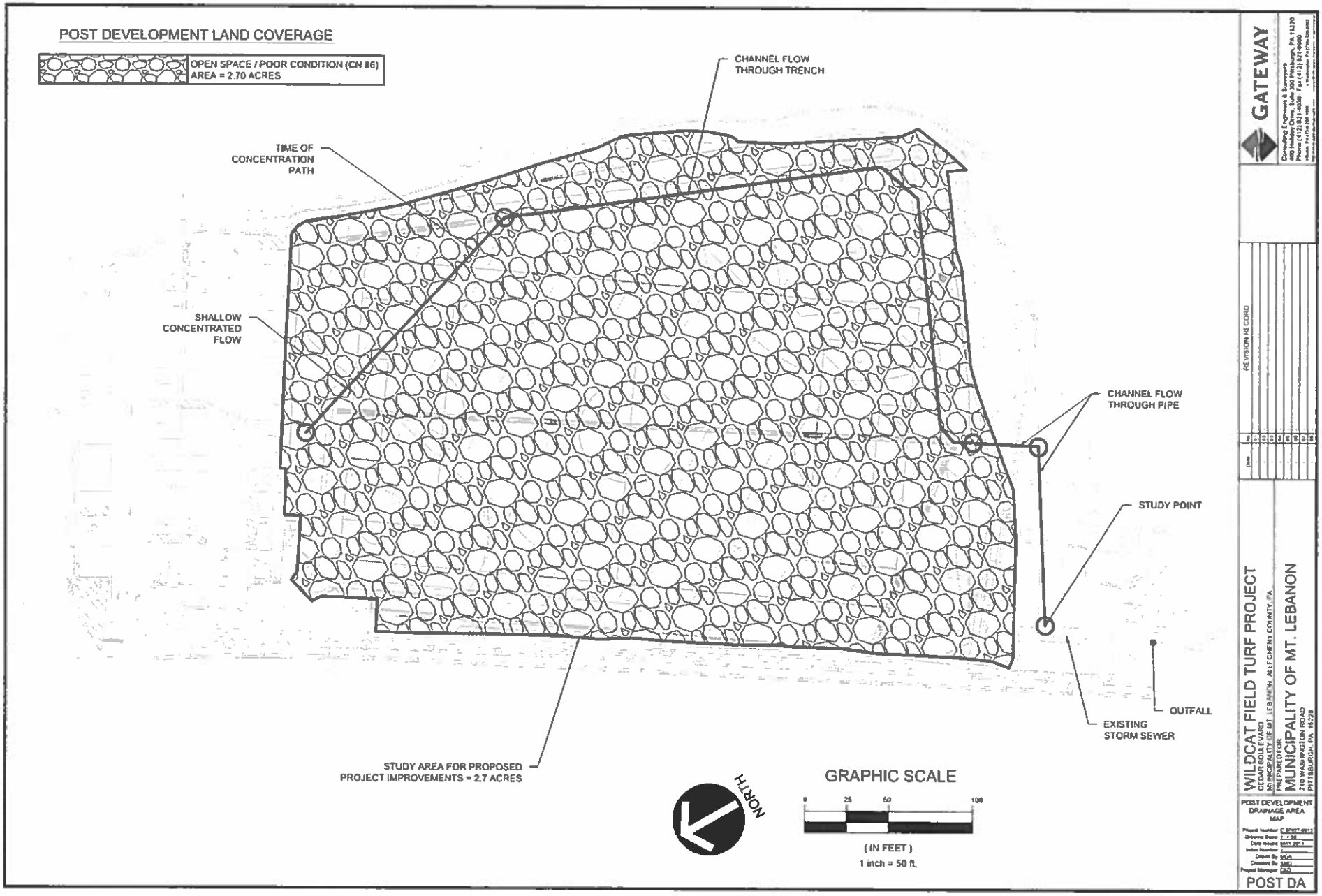
Section
NTS

25-yr
10-yr
5-yr
100-yr
2-yr

Inflow hydrograph = 2. SCS Runoff - Post Development



Path & Filename=G:\Projects\97000 Mt Lebanon\97027 Wildcat field\-0009 Wildcat Turf Field\Dwg\02-Sheet\PRE DA PRE DEVELOPMENT DRAINAGE AREA MAP.dwg
Plot Date=5/20/2014 9:45 AM Michael G. Albright
Save Date=5/20/2014 9:45 AM
14 05



Path & Filename=G:\Projects\97000 Mt Lebanon\97027 Wildcat field\-0009 Wildcat Turf Field\Dwg\02-Sheet\POST DA POST DEVELOPMENT DRAINAGE AREA MAP.dwg
Plot Date=5/20/2014 9:43 AM Michael G. Albright
Save Date=5/20/2014 9:14 AM
14 05

Appendix E

WORKSHEET 1. GENERAL SITE INFORMATION

INSTRUCTIONS: Fill out Worksheet 1 for each watershed

Date: May 2014

Project Name: Wildcat Field Turf Project

Municipality: Municipality of Mt. Lebanon

County: Allegheny

Total Area (acres): 2.7

Major River Basin: Ohio River
http://www.pawaterplan.dep.state.pa.us/StateWaterPlan/docroot/default.aspx

Watershed: Chartiers Creek

Sub-Basin: Painters Run

Nearest Surface Water(s) to Receive Runoff: UNT to Painters Run

Chapter 93 - Designated Water Use: WWF
http://pacode.com/secure/data/025/chapter93/chap93toc.html

Impaired according to Category 4 or 5 of the Integrated Water Quality Monitoring and Assessment Report? YES
http://www.portal.state.pa.us/portal/server.pt/community/water_quality_standards/10556/integrated_water_quality_report_-_2010/682562

List Causes of Impairment: Metals, Suspended Solids, Siltation, and TDS

Is there an established TMDL that applies: YES

Total Maximum Daily Loads (TMDLS)
http://www.dep.state.pa.us/watermanagement_apps/tmdl/
http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/index.htm

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? YES
http://www.portal.state.pa.us/portal/server.pt/community/stormwater_management/10628/npdes_ms4%C2%A0information/669119

Existing or planned drinking water supply?

If yes, distance from proposed discharge (miles): _____

Approved Act 167 Plan? NO
http://www.portal.state.pa.us/portal/server.pt?open=514&objID=554325&mode=2

Existing River Conservation Plan? YES
http://www.dcnr.state.pa.us/brc/rivers/riversconservation/registry/

WORKSHEET 2. NATURAL SENSITIVE RESOURSES

INSTRUCTIONS

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes and other sensitive natural areas.

2. Summarize the extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	n/a	-	-
Floodplains	n/a	-	-
Riprarian Areas	n/a	-	-
Wetlands	n/a	-	-
Woodlands	n/a	-	-
Natural Drainage Ways	n/a	-	-
Steep Slopes, 15% - 25%	n/a	-	-
Steep Slopes, over 25%	n/a	-	-
Other:			
Other:			
TOTAL EXISTING		0.00	0.00

WORKSHEET 3. NON-STRUCTURAL BMP CREDITS

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2)	0.00 Ac.
1.2 Area of Riprarian Forest Buffer Protection	0.00 Ac.
3.1 Area of Minimum Disturbance/Reduced Grading	0.00 Ac.
TOTAL	0.00 Ac.

Site Area	minus	Protected Area	=	Stormwater Management Area
2.70	-	0.00	=	2.70

This is the area that requires stormwater management

VOLUME CREDITS

3.1 Minimum Soil Compaction (See Chapter 8, page 22 - SW BMP Manual)

Lawn	0 ft^2	x 1/4" x 1/12	0 ft^3
Meadow	0 ft^2	x 1/3" x 1/12	0 ft^3

3.3 Protect Existing Trees (See Chapter 8, page 23 - SW BMP Manual)

For Trees within 100 feet of impervious area:

Tree Canopy	0 ft^2	x 1/2" x 1/12	0 ft^3

5.1 Disconnect Roof Leaders to Vegetated Areas (See Chapter 8, page 25 - SW BMP Manual)

For runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area	0 ft^2	x 1/3" x 1/12	0 ft^3

For all other disconnected roof areas

Roof Area	0 ft^2	x 1/4" x 1/12	0 ft^3

5.2 Disconnect Non-Roof impervious to Vegetated Areas (See Chapter 8, page 26 - SW BMP Manual)

For runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area	0 ft^2	x 1/3" x 1/12	0 ft^3

For all other disconnected non-roof areas

Impervious Area	0 ft^2	x 1/4" x 1/12	0 ft^3

TOTAL NON-STRUCTURAL VOLUME CREDIT* 0 ft^3

**For use on Worksheet 5*

WORKSHEET 4: CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Wildcat Field Turf Project
Drainage Area: 2.7
2-Year Rainfall: 2.3 in.

Total Site Area: 2.70 acres
Protected Site Area: 0.00 acres
Managed Area: 2.70 acres

Existing Conditions

Cover Type/Condition	Hydrologic Soil Group	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft3)
Woodland	C	0	0.00	70	4.29	0.86	0.36	0
Meadow	C	117,612	2.70	71	4.08	0.82	0.40	3,872
Meadow*	C	0	0.00	71	4.08	0.82	0.40	0
Impervious	N/A	0	0.00	98	0.20	0.04	2.07	0
TOTAL:			2.70					3,872

* 20% of Existing Impervious shall be analyzed as Meadow.

Developed Conditions

Cover Type/Condition	Hydrologic Soil Group	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft3)
Lawn	C	0	0.00	74	3.51	0.70	0.50	0
Meadow	C	0	0.00	71	4.08	0.82	0.40	0
Woodland	C	0	0.00	70	4.29	0.86	0.36	0
Synthetic Turf Field	C	117,612	2.70	86	1.63	0.33	1.08	10,606
TOTAL:			2.70					10,606

2-Year Volume Increase (ft^3): 6734

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = $Q = (P-0.2S)^2/(P+0.8S)$ where
   P = 2-Year Rainfall (in.)
   S = (1000/CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff
   Area = Land Use Area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI. The use of a weighted CN value for volume calculations is not acceptable.

WORKSHEET 12. WATER QUALITY ANALYSIS OF POLLUTANT LOADING FROM ALL DISTURBED AREAS

TOTAL SITE AREA (AC)	2.70
TOTAL DISTURBED AREA (AC)	2.70
DISTURBED AREA CONTROLLED BY BMPS (AC)	2.70

TOTAL DISTURBED AREAS:

		POLLUTANT					POLLUTANT LOAD		
	LAND COVER CLASSIFICATION	TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate - Nitrate EMC (mg/l)	COVER (ACRES)	RUNOFF VOLUME (AF)	TSS** (LBS)	TP** (LBS)	NO3 (LBS)
PERVIOUS SURFACES	Forest	39.00	0.15	0.17	0	0.00	0.00	0.00	0.00
	Meadow	47.00	0.19	0.30	0	0.00	0.00	0.00	0.00
	Fertilized Planting Area	55.00	1.34	0.73	0	0.00	0.00	0.00	0.00
	Native Planting Area	55.00	0.40	0.33	0	0.00	0.00	0.00	0.00
	Lawn, Low-Input	180.00	0.40	0.44	0	0.00	0.00	0.00	0.00
	Lawn, High-Input	180.00	2.22	1.46	0	0.00	0.00	0.00	0.00
	Golf Course Fairway/Green	305.00	1.07	1.84	0	0.00	0.00	0.00	0.00
	Grassed Athletic Field	200.00	1.07	1.01	2.7	0.52	279.45	1.50	1.41
IMPERVIOUS SURFACES	Rooftop	21.00	0.13	0.32	0	0.00	0.00	0.00	0.00
	High Traffic Street/Highway	261.00	0.40	0.83	0	0.00	0.00	0.00	0.00
	Medium Traffic Street	113.00	0.33	0.58	0	0.00	0.00	0.00	0.00
	Low Traffic/Residential Street	86.00	0.36	0.47	0	0.00	0.00	0.00	0.00
	Res. Driveway, Play Courts, etc.	60.00	0.46	0.47	0	0.00	0.00	0.00	0.00
	High Traffic Parking Lot	120.00	0.39	0.60	0	0.00	0.00	0.00	0.00
	Low Traffic Parking Lot	58.00	0.15	0.39	0	0.00	0.00	0.00	0.00
						TOTAL LOAD	279.45	1.50	1.41
						REQUIRED REDUCTION (%)	85	85	50
						REQUIRED REDUCTION (LBS)	237.53	1.27	0.71

* Pollutant Load = [EMC, mg/l] x [Volume, AF] x [2.7, Unit Conversion]

** TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area.

WORKSHEET 13. WATER QUALITY ANALYSIS OF POLLUTANT LOADING FROM ALL DISTURBED AREAS

* FILL THIS WORKSHEET OUT FOR EACH BMP TYPE WITH DIFFERENT POLLUTANT REMOVAL EFFICIENCIES. SUM POLLUTANT REDUCTION ACHIEVED FOR ALL BMP TYPES ON FINAL SHEET.

BMP TYPE: Subsurface Infiltration Bed

DISTURBED AREA CONTROLLED BY THIS BMP TYPE (AC)	2.70

DISTURBED ARAS CONTROLLED BY THIS BMP TYPE:

		POLLUTANT					POLLUTANT LOAD		
	LAND COVER CLASSIFICATION	TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate - Nitrate EMC (mg/l)	COVER (ACRES)	RUNOFF VOLUME (AF)	TSS** (LBS)	TP** (LBS)	NO3 (LBS)
PERVIOUS SURFACES	Forest	39.00	0.15	0.17	0.00	0.00	0.00	0.00	0.00
	Meadow	47.00	0.19	0.30	0.00	0.00	0.00	0.00	0.00
	Fertilized Planting Area	55.00	1.34	0.73	0.00	0.00	0.00	0.00	0.00
	Native Planting Area	55.00	0.40	0.33	0.00	0.00	0.00	0.00	0.00
	Lawn, Low-Input	180.00	0.40	0.44	0.00	0.00	0.00	0.00	0.00
	Lawn, High-Input	180.00	2.22	1.46	0.00	0.00	0.00	0.00	0.00
	Golf Course Fairway/Green	305.00	1.07	1.84	0.00	0.00	0.00	0.00	0.00
	Grassed Athletic Field	200.00	1.07	1.01	2.70	0.52	279.45	1.50	1.41
IMPERVIOUS SURFACES	Rooftop	21.00	0.13	0.32	0.00	0.00	0.00	0.00	0.00
	High Traffic Street/Highway	261.00	0.40	0.83	0.00	0.00	0.00	0.00	0.00
	Medium Traffic Street	113.00	0.33	0.58	0.00	0.00	0.00	0.00	0.00
	Low Traffic/Residential Street	86.00	0.36	0.47	0.00	0.00	0.00	0.00	0.00
	Res. Driveway, Play Courts, etc.	60.00	0.46	0.47	0.00	0.00	0.00	0.00	0.00
	High Traffic Parking Lot	120.00	0.39	0.60	0.00	0.00	0.00	0.00	0.00
	Low Traffic Parking Lot	58.00	0.15	0.39	0.00	0.00	0.00	0.00	0.00
						TOTAL LOAD TO THIS BMP TYPE	279.45	1.50	1.41
						POLLUTANT REMOVAL EFFICIENCIES FROM TABLE 9-3 (%)	85	85	30
						POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS)	237.53	1.27	0.42

POLLUTANT REDUCTION ACHIEVED BY ALL BMP TYPES (LBS)	237.53	1.27	0.42
REQUIRED REDUCTION FROM WS 12 (LBS)	237.53	1.27	0.71

* Pollutant Load = [EMC, mg/l] x [Volume, AF] x [2.7, Unit Conversion]

** TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area.

WORKSHEET 13. WATER QUALITY ANALYSIS OF POLLUTANT LOADING FROM ALL DISTURBED AREAS

* FILL THIS WORKSHEET OUT FOR EACH BMP TYPE WITH DIFFERENT POLLUTANT REMOVAL EFFICIENCIES. SUM POLLUTANT REDUCTION ACHIEVED FOR ALL BMP TYPES ON FINAL SHEET.

BMP TYPE: Water Quality Filter

DISTURBED AREA CONTROLLED BY THIS BMP TYPE (AC)	2.70

DISTURBED ARAS CONTROLLED BY THIS BMP TYPE:

		POLLUTANT					POLLUTANT LOAD		
	LAND COVER CLASSIFICATION	TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate - Nitrate EMC (mg/l)	COVER (ACRES)	RUNOFF VOLUME (AF)	TSS** (LBS)	TP** (LBS)	NO3 (LBS)
PERVIOUS SURFACES	Forest	39.00	0.15	0.17	0.00	0.00	0.00	0.00	0.00
	Meadow	47.00	0.19	0.30	0.00	0.00	0.00	0.00	0.00
	Fertilized Planting Area	55.00	1.34	0.73	0.00	0.00	0.00	0.00	0.00
	Native Planting Area	55.00	0.40	0.33	0.00	0.00	0.00	0.00	0.00
	Lawn, Low-Input	180.00	0.40	0.44	0.00	0.00	0.00	0.00	0.00
	Lawn, High-Input	180.00	2.22	1.46	0.00	0.00	0.00	0.00	0.00
	Golf Course Fairway/Green	305.00	1.07	1.84	0.00	0.00	0.00	0.00	0.00
	Grassed Athletic Field	200.00	1.07	1.01	2.70	0.52	279.45	1.50	1.41
IMPERVIOUS SURFACES	Rooftop	21.00	0.13	0.32	0.00	0.00	0.00	0.00	0.00
	High Traffic Street/Highway	261.00	0.40	0.83	0.00	0.00	0.00	0.00	0.00
	Medium Traffic Street	113.00	0.33	0.58	0.00	0.00	0.00	0.00	0.00
	Low Traffic/Residential Street	86.00	0.36	0.47	0.00	0.00	0.00	0.00	0.00
	Res. Driveway, Play Courts, etc.	60.00	0.46	0.47	0.00	0.00	0.00	0.00	0.00
	High Traffic Parking Lot	120.00	0.39	0.60	0.00	0.00	0.00	0.00	0.00
	Low Traffic Parking Lot	58.00	0.15	0.39	0.00	0.00	0.00	0.00	0.00
						TOTAL LOAD TO THIS BMP TYPE	279.45	1.50	1.41
						POLLUTANT REMOVAL EFFICIENCIES FROM TABLE 9-3 (%)	60	50	20
						POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS)	167.67	0.75	0.28

POLLUTANT REDUCTION ACHIEVED BY ALL BMP TYPES (LBS)	405.20	2.02	0.71
REQUIRED REDUCTION FROM WS 12 (LBS)	237.53	1.27	0.71

* Pollutant Load = [EMC, mg/l] x [Volume, AF] x [2.7, Unit Conversion]

** TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area.

Appendix F

Stormwater Management System
Maintenance Schedule

Owner and responsible maintenance party: Municipality of Mt. Lebanon

The stormwater management system, which includes inlets, storm sewers, and an outlet control structure, should be inspected April 15 and November 15 of each year, periodically, and after heavy rainfall events. The stormwater management system is a publicly owned system, and it is the responsibility of the municipality to perform these inspections, make all necessary repairs, and keep a record of the findings and results of the inspections available for review.

The following maintenance shall be performed as soon as practical, following an inspection:

Inlets – The inlets shall be maintained so as not to allow any sediment or debris to prevent the flow of water into the inlets. Any obstructions to the pipe should be removed.

Storm Sewer Pipes – All storm sewer piping should be inspected to make sure no sediment or debris build-up has occurred that might restrict the flow of water through them. If build-up has occurred, the pipes should be flushed and cleaned.

Outlet Control Structure – The outlet control structure should be inspected to make sure no obstructions are preventing the orifice opening(s) from passing water into the outlet pipe. Any obstructions preventing the primary spillways from functioning properly must be removed. The sump should be cleaned regularly or whenever build-up has occurred.

In addition to these measures, all maintenance requirements of the Mt. Lebanon Subdivision and Land Development Ordinance must be followed.

Appendix G

POST CONSTRUCTION STORMWATER MANAGEMENT PLAN

STANDARD WORKSHEET #2
RECORD OF TRAINING AND EXPERIENCE
IN EROSION AND SEDIMENT CONTROL
METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Michael G. Albright, E.I.T.

FORMAL EDUCATION:

Name of College or Technical Institute: The Pennsylvania State University
Curriculum or Program: Civil Engineering
Dates of Attendance: **From:** August, 2005 **To:** May, 2009
Degree Received: Bachelor of Science

EMPLOYMENT HISTORY:

Current Employer: The Gateway Engineers, Inc.
Telephone: (412) 921-4030
From: September 2009 **To:** Current

RECENT POST CONSTRUCTION STORMWATER MANAGEMENT PLANS PREPARED:

Al. Neyer, LLC
Warehouse and Showroom for Hillebrand Holdings, LLC
Post Construction Stormwater Management - NPDES Permit
Robinson Township, Allegheny County, PA
Permit #: PAG-02 00-02-12-078

Rugby Realty Co., Inc.
Penn Center West – Building 9
Post Construction Stormwater Management - NPDES Permit
Robinson Township, Allegheny County, PA
Permit #: PAG-02 00-02-13-107

Cool Springs Associates LP
Cool Springs Golf Center Re-Development
Post Construction Stormwater Management - NPDES Permit
Municipality of Bethel Park, Allegheny County, PA
Permit #: PAG-02 00-02-14-015

Al. Neyer, LLC
Grant Industrial Controls, Inc.
Post Construction Stormwater Management - NPDES Permit
Findlay Township, Allegheny County, PA
Permit #: PAG-02 00-02-14-041

Exhibit

8

Christine Davis Consultants
Archaeology and History
www.chrisdavis.net
Cider Mill of Pittsburgh • 560 Penn Street • Verona, Pennsylvania 15147 • 412.826.0443 • Fax 412.826-0458

September 4, 2014

Ms. Kira Heinrich
Pennsylvania Historical and Museum Commission
Bureau for Historic Preservation
Commonwealth Keystone Building, 2nd Floor
400 North Street
Harrisburg, PA 17120-0093

Re: Wildcat Field Turf Project
Municipality of Mt. Lebanon, Allegheny County, PA

Dear Ms. Heinrich:

Enclosed please find the **Cultural Resource Notice** form for the Wildcat Field Turf Project.

PLEASE DISREGARD THE CULTURAL RESOURCE NOTICE DATED SEPTEMBER 3, 2014 AND ONLY REVIEW THE ATTACHED.

Sincerely,

CHRISTINE DAVIS CONSULTANTS, INC.

Christine Davis
President

cc: 14051

0120-PM-PY0003 Rev. 5/2006
NOTICE

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CULTURAL RESOURCE NOTICE

DEP USE ONLY
Date Received

Read the instructions before completing this form.

SECTION A. APPLICANT IDENTIFIER

Applicant Name: Municipality of Mt. Lebananon

Street Address: 710 Washington Road

City: Pittsburgh State: PA Zip: 15228

Telephone Number: 412-921-4030

Project Title: Wildcat Field Turf Project

SECTION B. LOCATION OF PROJECT

Municipality: Municipality of Mt. Lebanon County Name: Allegheny DEP County Code: 02

SECTION C. PERMITS OR APPROVALS

Name of Specific DEP Permit or Approval Requested: General (PAG-02) NPDES Permit

Anticipated federal permits:

- ☐ Surface Mining
- ☐ Army Corps of Engineers
- ☐ 401 Water Quality Certification
- ☐ 404 Water Quality Permit
- ☐ Federal Energy Regulatory Commission
- ☐ Other: _____

SECTION D. GOVERNMENT FUNDING SOURCES

- ☐ State: (Name) _____
- ☐ Local: (Name) _____
- ☐ Federal: (Name) _____
- ☐ Other: (Name) _____

SECTION E. RESPONSIBLE DEP REGIONAL, CENTRAL, DISTRICT MINING or OIL & GAS MGMT OFFICE

DEP Regional Office Responsible for Review of Permit Application

- ☐ Central Office (Harrisburg)
- ☐ Southeast Regional Office (Norristown)
- ☐ Northeast Regional Office (Wilkes-Barre)
- ☐ Southcentral Regional Office (Harrisburg)
- ☐ Northcentral Regional Office (Williamsport)
- ☒ Southwest Regional Office (Pittsburgh)
- ☐ Northwest Regional Office (Meadville)
- ☐ District Mining Office: _____
- ☐ Oil & Gas Office: _____

SECTION F. RESPONSIBLE COUNTY CONSERVATION DISTRICT, if applicable.

County Conservation District _____ Telephone Number, if known _____

SECTION G. CONSULTANT

Consultant, if applicable: The Gateway Engineers, Inc.

Street Address: 400 Holiday Drive, Suite 300

City: Pittsburgh State: PA Zip: 15220

Telephone Number: 412-921-4030

SECTION H. PROJECT BOUNDARIES AND DESCRIPTION

REQUIRED

Indicate the total acres in the property under review. Of this acreage, indicate the total acres of earth disturbance for the proposed activity.

Attach a 7.5' U.S.G.S. Map indicating the defined boundary of the proposed activity.

Attach photographs of any building over 50 years old. Indicate what is to be done to all buildings in the project area.

Attach a narrative description of the proposed activity.

Attach the return receipt of delivery of this notice to the Pennsylvania Historical and Museum Commission.

REQUESTED

Attach photographs of any building over 40 years old.

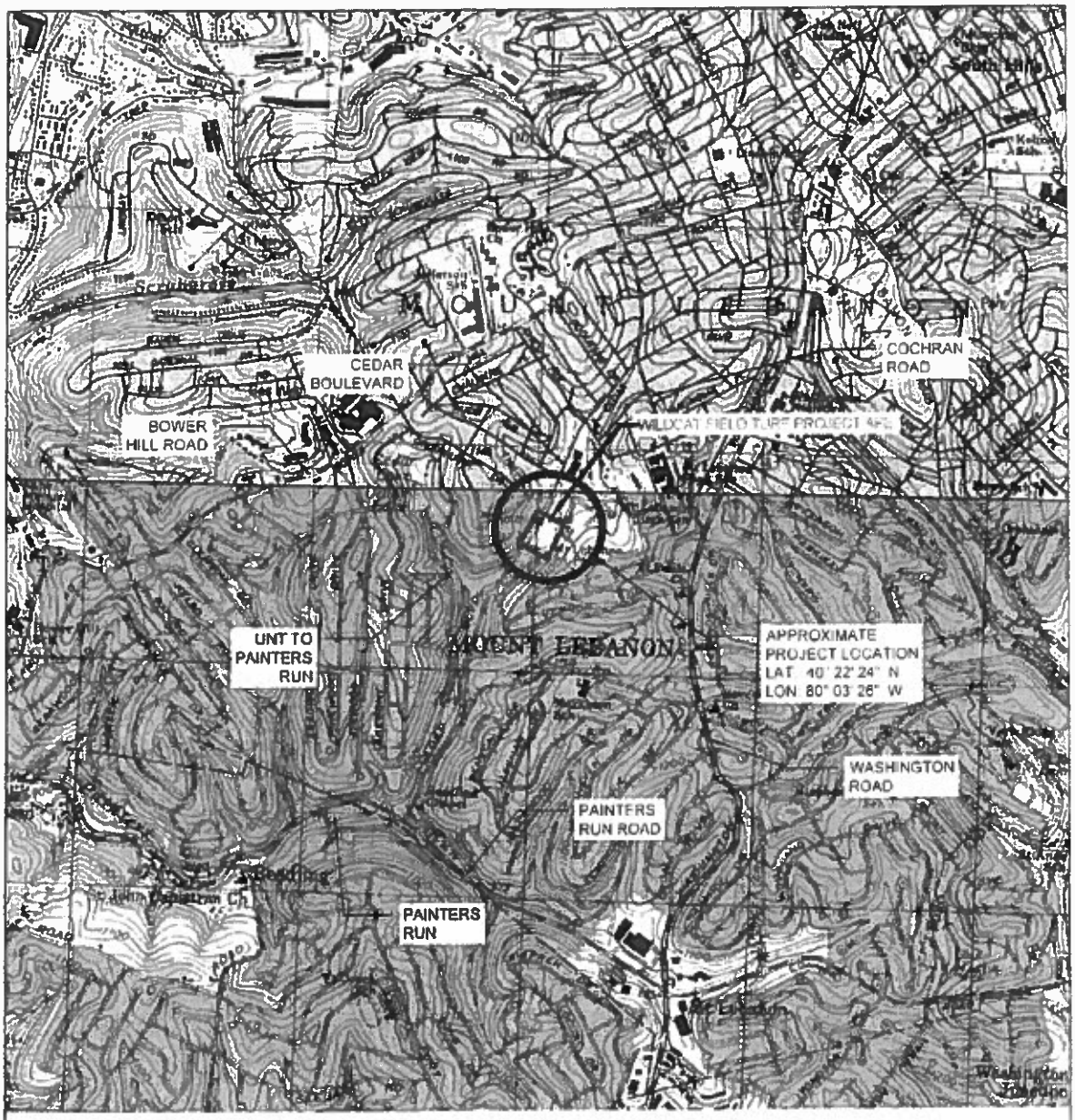
Attach site map, if available.

SECTION I. SIGNATURE BLOCK

Applicant's Signature	9/4/2014 Date of Submission of Notice to PHMC

Commonwealth of Pennsylvania
Department of Environmental Protection
CULTURAL RESOURCE NOTIFICATION

MAP OF PROJECT LOCATION: BRIDGEVILLE, PA, 7.5' USGS MAP



USGS SITE LOCATION MAP
BRIDGEVILLE QUAD
SCALE: 1" = 2,000'

NORTH

USGS

WILDCAT FIELD TURF PROJECT
CEDAR BOULEVARD
MUNICIPALITY OF MT. LEBANON, ALLEGHENY COUNTY, PA

PREPARED FOR
MUNICIPALITY OF MT. LEBANON
710 WASHINGTON ROAD
PITTSBURGH, PA 15228

GATEWAY

Commonwealth of Pennsylvania
Department of Environmental Protection
CULTURAL RESOURCE NOTIFICATION

PHOTOGRAPH LOCATION MAP: Google Earth

PHOTOGRAPHS:

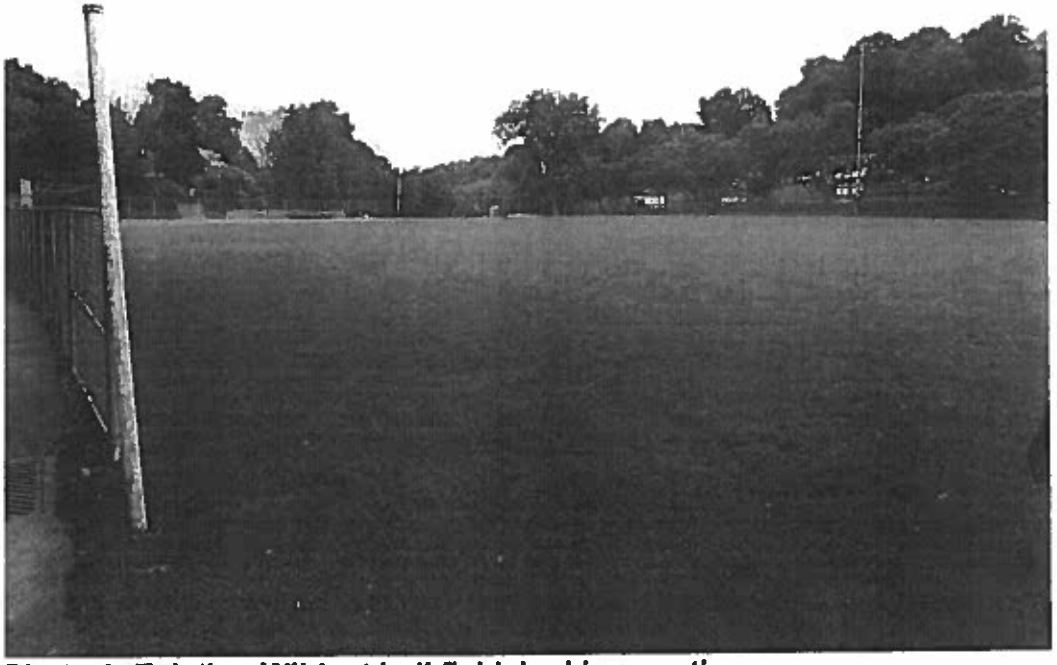


Photo 1: Existing Wildcat ball field, looking south

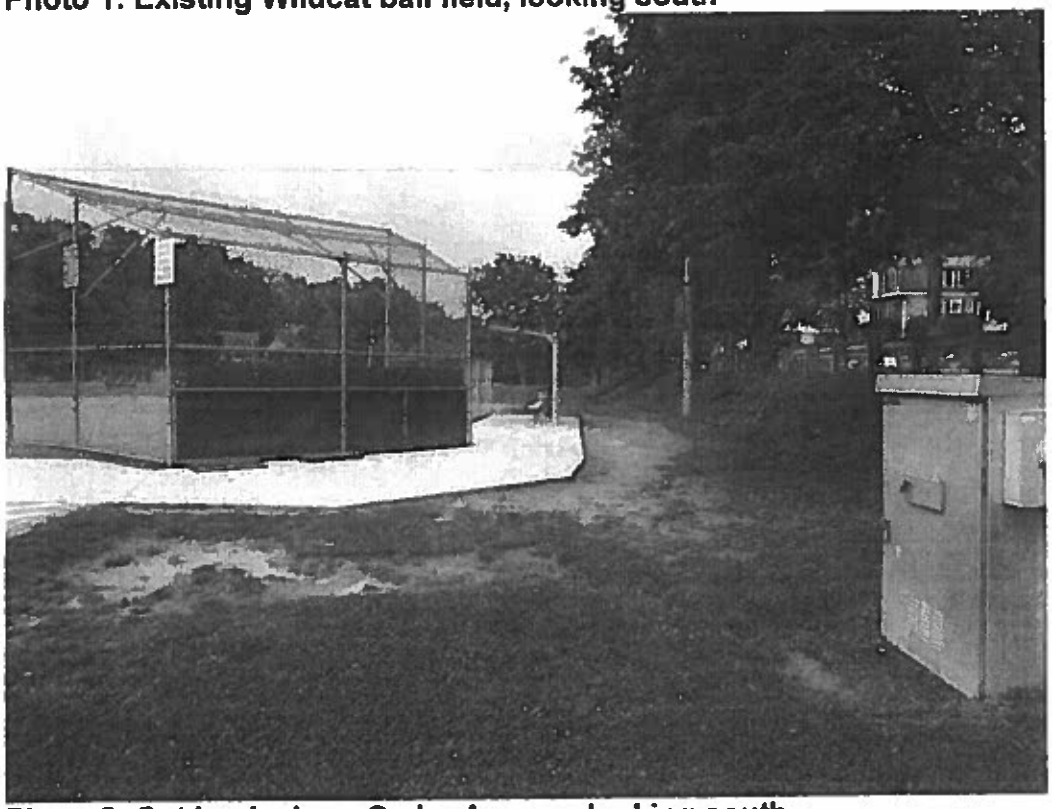


Photo 2: Cut bank along Cedar Avenue, looking south

PHOTOGRAPHS (CONTINUED):

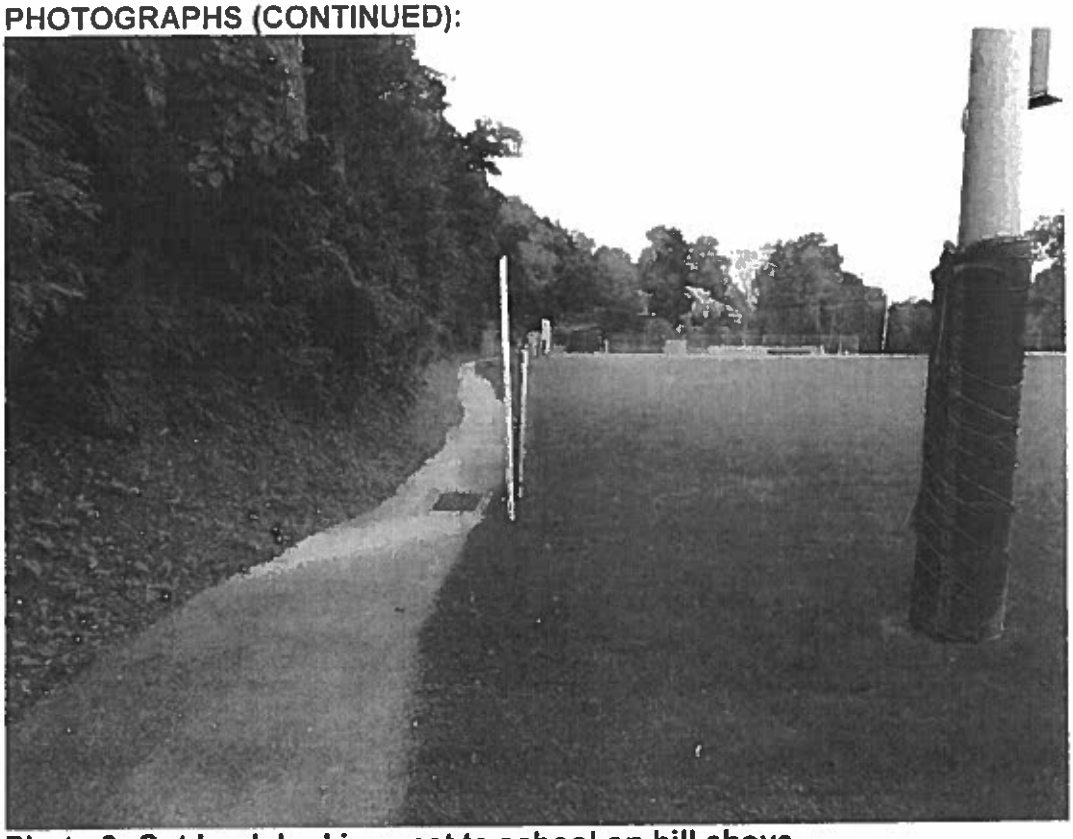


Photo 3: Cut bank looking east to school on hill above

Photo 4: Looking southeast on northern side of APE indicating graded parking lot

PHOTOGRAPHS (CONTINUED):

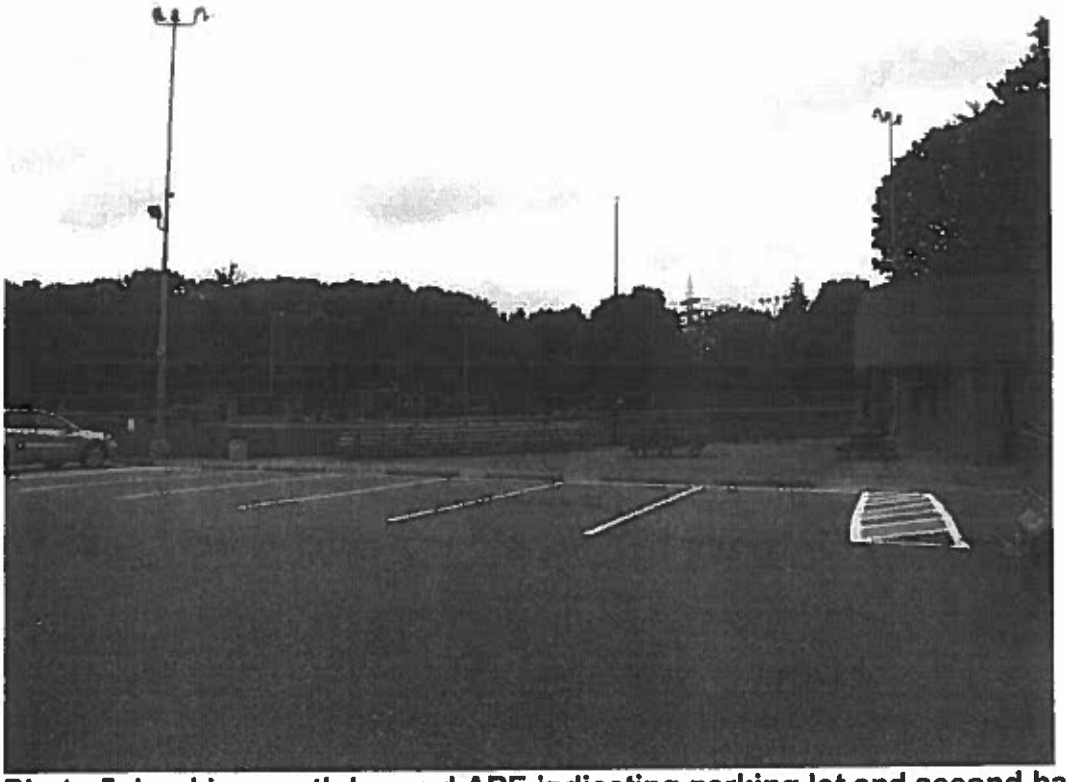


Photo 5: Looking north beyond APE indicating parking lot and second ball field

PROJECT DESCRIPTION NARRATIVE:

The proposed undertaking is known as the Wildcat Field Turf project located in the Municipality of Mt. Lebanon, Allegheny County, Pennsylvania. The sponsoring agency is the Department of Environmental Protection (DEP).

The Municipality of Mt. Lebanon is proposing to renovate an existing multi-use ball field from a natural grass surface to an artificial synthetic turf surface, which will help improve drainage issues and playability of the existing fields. The project will include removal of existing topsoil, subgrade preparation, installation of the new synthetic turf with underdrain system, utility installation, new storm sewer inlets and piping, new edging curb along the field, fencing modifications, and grading along Cedar Boulevard. The construction of the proposed improvements will disturb approximately 10,926 square (sq) m (117,612 sq feet (ft) or 2.7 acres (ac)). Soils within the project area are mapped as Urban Land (UB) and Urban Land-Culleoka complex, moderately steep (UCB).

There are no previously recorded prehistoric archaeological sites within a one-mile radius of the APE; however, the APE is located within the Mount Lebanon Historic District (MLHD) (Key #157646), which was listed on the National Register of Historic Places (NRHP) on March 3, 2014. This large historic district encompasses approximately 1,306 acres and is a primarily residential, early automobile suburb that includes commercial, cultural, and institutional resources. Within the boundaries are 38 historic residential subdivisions, two commercial areas, nine churches, six public schools, two large parks, and a major cemetery. The period of significance from 1874 to ca. 1945 coincides with the earliest extant resource, the Mt. Lebanon Cemetery, and the end of World War II. The period includes the transformation of Mt. Lebanon from a rural agricultural area to a trolley suburb ca. 1901 to an automobile suburb during the 1920s and 1930s.

Wildcat Field is located within Main Park, one of the two large parks contributing to the historic district. The original bath house and swimming pool within Main Park were extant during the district's period of significance but have since been removed. Today, the 51-acre park includes ball fields, playgrounds, and basketball and tennis courts and is considered a contributing element to the district, but the recreation center, tennis center, and current pool house, which were constructed after 1945, are considered non-contributing buildings.

The area of the proposed artificial turf application within Main Park is located along Cedar Boulevard, which creates one boundary for the District. This area of the Park includes a number of modern (1970's and later) outdoor recreation facilities which are specifically inventoried as non-

contributing resources within the MLHD, including the swimming pool, recreation center and tennis center.

In the same area of Main Park along Cedar Boulevard there are ball fields, a concession stand, dugouts, scoreboards, chain link fences and paved parking, all constructed after the MLHD's defined period of significance. These are all considered "minor resources" and are not counted in the MLHD inventory. Collectively, however, they add to the non-historic assemblage of outdoor recreation facilities located in Main Park along this boundary edge of the District. These modern facilities are not related to the development of the early automobile suburban design which defines the District's significance.

Adverse effects are defined as: "... *when an undertaking may alter, directly or indirectly, any of the characteristics...that qualify the property for inclusion in the National Register in a manner that would diminish the* (historic) *integrity of the property....*"

The proposed undertaking will not alter the use of the Main Park as a park, nor will it alter the use of the ball field as a ball field. The project will improve the drainage issues and playability of the ball field. Using the definition of adverse effect above, it does not appear that the application of artificial turf within an area dominated by non-historic recreational facilities on 2.7 acres of a 51-acre park within the 1306-acre MLHD would adversely affect the District.