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ALDI #98 WILMINGTON NC
STORMWATER MANAGEMENT REPORT
KLEINFELDER PROJECT #20170421.001A

October 19, 2016

Final SW Calcs
12/16/2016
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A Report Prepared for:

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ALDI #98 WILMINGTON NC
STORMWATER MANAGEMENT REPORT

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October 19, 2016
Kleinfelder Project No: 20170421.001A

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ALDI: WILMINGTON
STORMWATER MANAGEMENT REPORT

1 EXECUTIVE SUMMARY

Aldi, Inc. is proposing an 18,992 square foot retail building and associated site improvements at 3701 South College Road in Wilmington, North Carolina. This report represents the stormwater management design and hydrologic model results for the proposed project.

As part of the stormwater design, Kleinfelder is proposing the installation of a wet detention basin. The wet detention basin has been designed to control and treat the estimated runoff generated from the first one and one-half inches of rainfall per the requirements of the City of Wilmington.

The wet detention basin is anticipated to attenuate the peak flow rate for the 2-year, 10-year and 25-year, 24-hour storm events in accordance with the City of Wilmington requirements.

2 INTRODUCTION

2.1 SITE DESCRIPTION

The existing property is located at 3701 South College Road in Wilmington, North Carolina. The existing parcel is 2.89 acres and zoned CB (CD); however, after a fifteen foot right-of-way dedication along Waltmoor Road the total property area will be 2.79 acres. Three existing building are located on site, including a church building, trailer, and shed. Paved parking and gravel parking areas exist on site to the north and east of the church building and driveways extend from these parking areas north to Waltmoor Road and west to S. College Road. There is tree cover on the east side of the site while the rest of the site is predominately grass.

The site is bounded by South College Road to the west, Waltmoor Road to the north, residential lots to the east and a school to the south.

The area considered Subcatchment 1 drains from the west side of the site toward Waltmoor Road on the northeast side of the site. This water moves towards the street and into the curb and gutter where it is collected in the existing storm drainage system on Waltmoor Road. The area considered Subcatchment 2 drains from the west side of the site to a road-side ditch. The area considered Subcatchment 3 drains from the west side of the site to the southeast corner of the site towards the residential lots.

TABLE 2-1

PRE-DEVELOPMENT IMPERVIOUS AREAS

SUBCATCHMENT	IMPERVIOUS AREA	TOTAL AREA
SUBCATCHMENT 1	0.000 ACRES	1.771 ACRES
SUBCATCHMENT 2	0.000 ACRES	0.138 ACRES
SUBCATCHMENT 3	0.000 ACRES	0.878 ACRES

Based on a review of the Federal Emergency Management Act (FEMA) Flood Insurance Rate Map (FIRM) 3720313500J, dated April 3, 2006, no portion of the site is located within a flood

2.2 PROPOSED DEVELOPMENT

An 18,922 square foot building and associated parking are proposed for the site. The proposed impervious area of 1.70 acres increases the percentage of impervious area for the entire site to 60.9%.

The area considered Subcatchment 4 drains from the north side of the site toward Waltmoor Road. This water moves towards the street and into the curb and gutter where it is collected in the existing storm drainage system on Waltmoor Road. The area considered Subcatchment 5 drains from the north side of the parking lot to the southern side of the site, where the runoff is collected in the wet detention basin and then drained into the existing ditch on the western side of the site. The area considered Subcatchment 6 drains from the east side of the building to the southeast corner of the site. Sheets C-9 and C-10 of the Site Plans show the stormwater Grading and Drainage Plan and associated details.

TABLE 2-2

POST-DEVELOPMENT IMPERVIOUS AREAS

SUBCATCHMENT	IMPERVIOUS AREA	TOTAL AREA
SUBCATCHMENT 4	0.052 ACRES	0.337 ACRES
SUBCATCHMENT 5 TO POND	1.655 ACRES	2.187 ACRES
SUBCATCHMENT 5 BYPASS	0.011 ACRES	0.112 ACRES
SUBCATCHMENT 6	0.000 ACRES	0.151 ACRES

2.3 DESIGN DATA AND METHODOLOGIES

The design of the proposed stormwater facilities was performed in accordance with Chapter 10 of the North Carolina Department of Environmental Quality (NC DEQ) Stormwater BMP Manual and the City of Wilmington, NC Code of Ordinances.

HydroCAD, version 10.0, a computer modeling software package, was used for the analysis of stormwater routing and hydrology of the existing and proposed watersheds. The hydrology calculations were performed using the National Resource Conservation Service (NRCS) SCS and TR-55 methods. New Hanover County lies within the Type III rainfall distribution. The rainfall

depths for the site were obtained from the City of Wilmington Technical Standards and Specifications Manual and are included in Appendix B.

The stormwater analysis performed for this project include the 2-year, 10-year and 25-year, 24-hour storm events and the 1.5” rainfall (first flush). The proposed inlets and catch basins were analyzed for the 10-year, 24-hour storm event and analyzed in low points for the 50-year, 24-hour storm event to check for flooding. Refer to Appendix F of this report for the storm pipe drainage map, Appendix M of this report for the storm drainage calculations and Appendix O for the pump installation, maintenance and operation manuals.

The NRCS Soil Survey of New Hanover County, North Carolina was reviewed for general information on the soils within the site area. Refer to Appendix C of this report for the NRCS Soils Map.

3 PRE-DEVELOPMENT STORMWATER RUNOFF

The pre-development drainage area was determined using site visits, visual observations, and surveyed topographic data. The peak flow rate for the specified storm events are based on topography, land use cover (such as open space, grass, woods), and soil type. The land uses in each of the drainage areas were considered to be in a predevelopment state, which the City of Wilmington considers to be woods in good condition. The subject parcel was chosen as the limits of analysis since no off-site water is draining through the site.

The existing 2.787-acre watershed was modeled in HydroCAD as three subcatchments, as described below. Refer to Appendix D of this report for the Pre-Development Watershed Map.

- Subcatchment 1
  Subcatchment 1 is 1.771 acres and drains to the northeast of the property. A time of concentration was calculated and estimated to be 28.0 minutes.

- Subcatchment 2
  Subcatchment 2 is 0.138 acres and drains to the southwest corner of the property through the road-side ditch. A time of concentration was calculated and was found to be lower than 6 minutes. Therefore, 6 minutes was estimated as the time of concentration for this subcatchment.

- Subcatchment 3
  Subcatchment 3 is 0.878 acres and drains to the southeast corner of the property. A time of concentration was calculated and estimated to be 49.1 minutes.

The time of concentration calculations and HydroCAD analysis can be found in Appendix E. Table 3-1 summarizes the hydrologic model results for pre-development peak flow rates of the existing 2.787-acre watershed.

TABLE 3-1

PRE-DEVELOPMENT STORMWATER RUNOFF

STORM EVENT	PRE-DEVELOPMENT PEAK FLOW
2-YEAR	0.04 CFS
10-YEAR	0.59 CFS
25-YEAR	1.28 CFS

4 POST-DEVELOPMENT STORMWATER RUNOFF

An analysis of the post-development stormwater runoff was performed using similar methods, parameters, and assumptions as described in the pre-development analysis above. Based upon the calculations, the project does not create an increase in the peak runoff rate for the 2-year, 10-year and 25-year, 24-hour storm events. This will be achieved by constructing appropriate Best Management Practices (BMPs).

The structural BMP proposed for this project includes:

1. Wet Detention Basin:

   A wet detention basin is a stormwater management facility that includes a permanent pool of water for removing pollutants and additional capacity above the permanent pool for detaining stormwater runoff. The proposed wet detention basin has been designed in accordance with the NC DEQ Stormwater BMP Manual. It an anticipated that the basin will reduce the total suspended solids for the site by 90%.

The wet detention basin has been sized per the simple method. The simple method equation and calculations are listed below.

- A = Watershed area (acres)
  - A = 95,266 square feet = 2.19 acres
  - Total Impervious Area = 72,092 square feet = 1.66 acres
    - Buildings = 18,992 square feet
    - Impervious Pavements = 49,853 square feet
    - Impervious Sidewalks = 3,247 square feet
    - I_A = Impervious fraction (unitless) = 72,092 / 95,266 = 0.757
- R_D = Design storm rainfall depth (inches)
  - R_D = 1.5 inches
- R_V = Runoff coefficient (unitless) = 0.05 + 0.9 * I_A
  - R_V = 0.05 + 0.9 * 0.757
  - R_V = 0.73
- V = 3,630 * R_D * R_V * A

- V = 3,630 * 1.5 inches * 0.73 * 2.19 acres
- V = 8,706 ft^3

The required permanent pool surface area was calculated using the permanent pool average depth calculation and the SA/DA from the NC DEQ Stormwater BMP Manual. The calculation is listed below:

- $d_{av} = [0.25 * (1 + A_{bot\_shelf} / A_{perm\_pool})] + [(A_{bot\_shelf} + A_{bot\_pond} / 2) * (Depth / A_{bot\_shelf})]$
  - A_{bot_shelf} = 8,182 ft^2
  - A_{bot_pond} = 545 ft^2
  - A_{perm_pool} = 11,356 ft^2
  - Depth = 7 ft
- d_{av} = 4.2 ft (Rounded down to the nearest 0.5')
- From table 10-4 in the BMP Manual (90% TSS removal in the Coastal Region) with d_{av} = 4.0 ft and 80% impervious
  - SA/DA Ratio = 7.0
- $A_{req'd\_perm\_pool}$ = (SA/DA Ratio / 100) * Watershed Area
- $A_{req'd\_perm\_pool}$ = (7.0 / 100) * (95,266 sf) = 6,669 ft^2

Based upon the hydrologic calculations, the wet detention basin will control the water quality volume generated from all surfaces by 1.5" of rainfall (first flush) as required by the City of Wilmington, NC Code of Ordinances. The wet detention basin is anticipated to drain the water quality volume in 84 hours. The calculation is listed below:

- $Q = C_D * A * SQRT(2 * g * H_O)$
  - Time to drain = 84 hours = 302,400 seconds
  - Q = 8,706 ft^3 / 302,400 seconds = 0.029 cfs
  - C_D = Coefficient of discharge = 0.6
  - G = Acceleration of gravity = 32.2 ft/sec^2
  - H_O = Driving head = H_O / 3 = 2.25 ft / 3 = 0.75 ft
    - H_O / 3 was used to compute drawdown to reflect the fact that head is decreasing as the drawdown occurs.
- A = 0.0067 ft^2
- D = 1.1 in

The principal spillway of the wet detention basin is a 4' x 4' concrete riser structure with a 4' x 4' grate and a 1.1 inch diameter orifice set at the permanent pool elevation. The riser spillway was set 2.25 feet above the permanent pool elevation. From the riser structure, the runoff is then released through a 12" outlet pipe to an existing ditch on the western side of the site. The emergency spillway of the wet detention basin was set 2.40 feet above the permanent pool elevation. The 100-year, 24-hour storm event is anticipated to temporarily stage approximately 0.04 feet above the emergency spillway and 1.06 feet below the top of the wet detention basin.

The water table elevation at the site was approximated in a geotechnical report by ECS Carolinas, LLP. ECS's report is included in Appendix I of this report.

The proposed site was divided into three subcatchments for post-development analysis. The subcatchments are described below. Refer to Appendix G of this report for the Post-Development Watershed Map.

- Subcatchment 4

  Subcatchment 4 is 0.337 acres and drains offsite to the northeast of the property. A time of concentration was calculated and estimated to be 12.6 minutes.

- Subcatchment 5

  Subcatchment 5 is 2.299 acres and includes runoff treated by the wet detention basin and an area on the eastern side of the site that bypasses the wet detention basin. Runoff that is treated by the wet detention basin is collected and discharged into an existing ditch on the western side of the site. Runoff that bypasses the wet detention basin also drains in the existing ditch on the western side of the site. A time of concentration was calculated and was found to be lower than 6 minutes. Therefore, 6 minutes was estimated as the time of concentration for this subcatchment.

- Subcatchment 6

  Subcatchment 6 is 0.151 acres and drains toward the southeast corner of the site. A time of concentration was calculated and estimated to be 21.4 minutes.

The HydroCAD analysis can be found in Appendix H. Table 4-1 summarizes the hydrologic model results for post-development peak flow rates of the 2.787-acre watershed.

TABLE 4-1

POST-DEVELOPMENT STORMWATER RUNOFF

STORM EVENT	POST-DEVELOPMENT PEAK FLOW
2-YEAR	0.04 CFS
10-YEAR	0.28 CFS
25-YEAR	1.07 CFS

4.1 STORMWATER RUNOFF SUMMARY

The structural BMPs proposed provide peak flow attenuation and water quality treatment. This project will not increase peak flow rate for the 2-year, 10-year and 25-year, 24-hour storm events. Additionally, the water quality volume is treated within the basin and is anticipated to draw down within 48 to 120 hours.

Table 4-2 (below) compares the pre-development and post-development peak flow rates for the design storm events.

TABLE 4-2

COMPARISON OF PRE- AND POST-DEVELOPMENT PEAK FLOW RATES

STORM EVENT (24-HOUR)	PRE-DEVELOPMENT PEAK FLOW (CFS)	POST-DEVELOPMENT PEAK FLOW (CFS)	NET CHANGE (%)
2-YEAR	0.04 CFS	0.04 CFS	-0.00%
10-YEAR	0.59 CFS	0.28 CFS	-52.54%
25-YEAR	1.28 CFS	1.07 CFS	-16.41%

5 WET DETENTION BASIN OPERATIONS & MAINTENANCE AGREEMENT

Operations and Maintenance procedures for the proposed wet detention basin will be vital to ensuring that the basin functions as designed. Per the City of Wilmington Wet Detention Basin Operation and Maintenance Agreement, the owner of each engineered stormwater control shall keep records of inspections, maintenance, and repairs.

6 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions, and at the date the services are provided. Kleinfelder's conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

APPENDIX A

FLOOD INSURANCE RATE MAP

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://FRIS.NC.GOV/FRIS

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

OTHER AREAS
- Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

OTHER FEATURES
- BM5510 North Carolina Geodetic Survey bench mark
- BM5510 National Geodetic Survey bench mark
- BM5510 Contractor Est. NCFMP Survey bench mark
- 012 18.2 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- Limit of Study
- Jurisdiction Boundary
- Limit of Moderate Wave Action (LiMWA)

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at http://www.ncfloodmaps.com, or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the North Carolina Floodplain Mapping Program (NCFMP). The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fws.gov/habitatconservation/coastal_barrier.html, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

- CBRS Area
- Otherwise Protected Area

SCALE

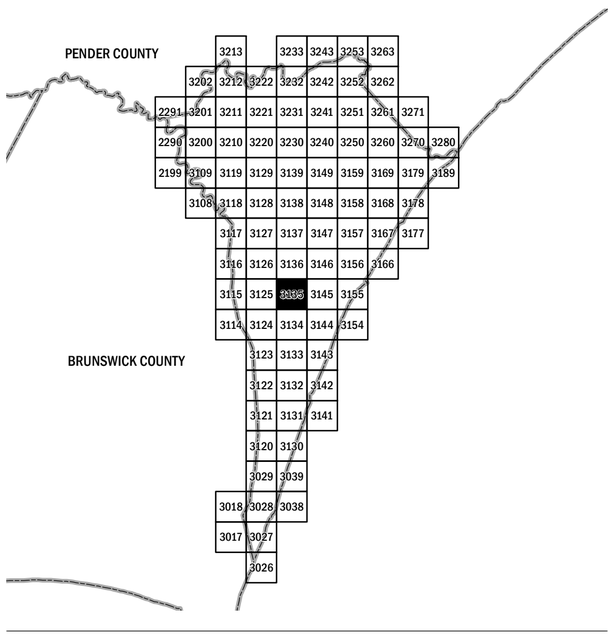
Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

PANEL LOCATOR



National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 3135

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
NEW HANOVER COUNTY	370168	3135	J
WILMINGTON, CITY OF	370171	3135	J

MAP NUMBER
3720313500J

MAP REVISED
04/03/06

APPENDIX B

RAINFALL DATA TABLE

CHART E-5

Depth .Duration .Frequency Table

Location: Wilmington, NC

Duration	Return Period 2-yr [in]	5-yr [in]	10-yr [in]	25-yr [in]	50-yr [in]	100-yr [in]
5 min	0.49	0.55	0.60	0.68	0.74	0.80
10 min	0.84	0.96	1.05	1.19	1.30	1.41
15 min	1.09	1.24	1.36	1.54	1.69	1.83
30 min	1.58	1.90	2.12	2.46	2.72	2.98
60 min	2.10	2.58	2.92	3.41	3.80	4.18
2 hr	2.36	2.93	3.34	3.92	4.37	4.82
3 hr	2.63	3.29	3.76	4.42	4.94	5.46
6 hr	3.30	4.20	4.82	5.71	6.40	7.09
l2hr	3.90	5.00	5.77	6.86	7.70	8.55
24hr	4.50	5.81	6.72	8.01	9.01	10.00

CHART E-6

Intensity - Duration - Frequency Table

Location: Wilmington, NC

Duration	Return Period 2-yr [inlhr]	5-yr [in/hr]	10-yr [in/hr]	25-yr [in/hr]	50-yr [in/hr]	100yr [in/hr]
5 min	5.88	6.63	7.23	8.15	8.87	9.60
10 min	5.06	5.76	6.30	7.13	7.79	8.45
15 min	4.36	4.97	5.45	6.17	6.75	7.32
30 min	3.17	3.79	4.25	4.92	5.44	5.96
60 min	2.10	2.58	2.92	3.41	3.80	4.18
2hr	1.18	1.47	1.67	1.96	2.19	2.41
3hr	0.88	1.10	1.25	1.47	1.65	1.82
6hr	0.55	0.70	0.80	0.95	1.07	1.18
12 hr	0.33	0.42	0.48	0.57	0.64	0.71
24 hr	0.19	0.24	0.28	0.33	0.38	0.42

*Source: Master Drainage Improvement and Stormwater Management Plan, Vol. 1, McKim & Creed, June 1988

APPENDIX C
NRCS SOILS DATA

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for New Hanover County, North Carolina

Aldi #98 Wilmington, NC Soil Report

May 20, 2016

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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


77° 53' 32" W
77° 53' 18" W
34° 10' 39" N
34° 10' 20" N
233460
233520
233580
233640
233700
233760
233400
3785600
3785540
3785480
3785420
3785360
3785300
3785240
3785180
3785120
3785060
S College Rd
Kirby Smith
Ramp
Le
Waltmoor Rd
S 17th St
17th
Waltmoor
Le
132
Mu
Rm
Shamrock Dr
S College Rd
Beechcliff Dr
Map Scale: 1:1,680 if printed on B portrait (11" x 17") sheet.
Meters
0 20 40 80 120
N
Feet
0 50 100 200 300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: New Hanover County, North Carolina
Survey Area Data: Version 16, Sep 29, 2015

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

Date(s) aerial images were photographed: Data not available.

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

New Hanover County, North Carolina (NC129)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Le	Leon sand	2.4	11.3%
Mu	Murville fine sand	0.5	2.4%
Rm	Rimini sand, 1 to 6 percent slopes	18.7	86.3%
Totals for Area of Interest		**21.7**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

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

New Hanover County, North Carolina

Le—Leon sand

Map Unit Setting

National map unit symbol: 3wrb
Elevation: 20 to 160 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 59 to 70 degrees F
Frost-free period: 200 to 280 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Leon and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Leon

Setting

Landform: Flats on marine terraces
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy fluviomarine deposits and/or eolian sands

Typical profile

A - 0 to 3 inches: sand
E - 3 to 15 inches: sand
Bh - 15 to 30 inches: fine sand
BE - 30 to 33 inches: fine sand
E' - 33 to 66 inches: fine sand
B'h - 66 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D

Mu—Murville fine sand

Map Unit Setting

National map unit symbol: 3wrh
Elevation: 20 to 160 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 59 to 70 degrees F
Frost-free period: 200 to 280 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Murville, undrained, and similar soils: 80 percent
Murville, drained, and similar soils: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Murville, Undrained

Setting

Landform: Depressions on marine terraces, flats on marine terraces
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy fluviomarine deposits and/or eolian sands

Typical profile

A - 0 to 8 inches: fine sand
Bh - 8 to 45 inches: fine sand
C - 45 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D

Description of Murville, Drained

Setting

Landform: Depressions on marine terraces, flats on marine terraces
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy fluviomarine deposits and/or eolian sands

Typical profile

A - 0 to 8 inches: fine sand
Bh - 8 to 45 inches: fine sand
C - 45 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D

Rm—Rimini sand, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: 3wrq
Elevation: 20 to 160 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 59 to 70 degrees F
Frost-free period: 200 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

Rimini and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rimini

Setting

Landform: Ridges on marine terraces, rims on carolina bays
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Eolian sands and/or sandy fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
E - 4 to 58 inches: sand
Bh - 58 to 80 inches: sand
C - 80 to 88 inches: sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Minor Components

Leon

Percent of map unit: 5 percent
Landform: Flats on marine terraces
Down-slope shape: Linear
Across-slope shape: Concave

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX D

PRE-DEVELOPMENT WATERSHED MAP

LEGEND

- EXISTING MAJOR CONTOUR (5')
- EXISTING MINOR CONTOUR (1')
- EXISTING PROPERTY LINE
- EXISTING ABUTTING PROPERTY LINE
- EXISTING SETBACK LINE
- EXISTING EASEMENT
- EX. CHAINLINK FENCE
- EX. WOOD FENCE
- EX. WATER LINE
- EXISTING OVERHEAD POWER LINE
- EXISTING SANITARY SEWER LINE
- EXISTING STORM SEWER LINE
- EXISTING GRAVEL AREA
- EXISTING CONCRETE AREA
- EXISTING PROTECTED TREE
- EXISTING TREE WITH NO PROTECTION REQUIREMENTS
- EXISTING SIGNIFICANT DOGWOOD, MAGNOLIA, AMERICAN HOLLY OR FLOWERING TREE >8" DBH TO BE REMOVED
- PRE-DEVELOPMENT DRAINAGE AREA
- PRE-DEVELOPMENT TIME OF CONCENTRATION

NOTES

SUBCATCHMENT 1: CN_{COMP} = 39
Q_{I-2YR} = 0.03
Q_{I-10YR} = 0.44
Q_{I-25YR} = 0.98

A TIME OF CONCENTRATION FOR SUBCATCHMENT 1 WAS CALCULATED TO BE 28.0 MINUTES.

SUBCATCHMENT 2: CN_{COMP} = 39
Q_{2-2YR} = 0.00
Q_{2-10YR} = 0.05
Q_{2-25YR} = 0.12

A TIME OF CONCENTRATION FOR SUBCATCHMENT 2 WAS CALCULATED AS LOWER THAN 6 MINUTES; THEREFORE, A TIME OF CONCENTRATION OF 6 MINUTES WAS USED.

SUBCATCHMENT 3: CN_{COMP} = 39
Q_{3-2YR} = 0.01
Q_{3-10YR} = 0.17
Q_{3-25YR} = 0.37

A TIME OF CONCENTRATION FOR SUBCATCHMENT 3 WAS CALCULATED TO BE 49.1 MINUTES.

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MORRISVILLE, NC 27560
PHONE: 919-755-5011
NC LICENSE # F-1143

REVISIONS

REV	DESCRIPTION	DSN DWN	CHK APP	DATE

SCALE VERIFICATION

THIS BAR IS 1 INCH IN LENGTH ON ORIGINAL DRAWING
0 1"
IF IT'S NOT 1 INCH ON THIS SHEET ADJUST YOUR SCALES ACCORDINGLY

0 20 40 60
SCALE: 1" = 20' SCALE IN FEET

ORIGINAL DRAWING SIZE IS 24 x 36

PRE-DEVELOPMENT WATERSHED MAP

ALDI #98 WILMINGTON, NC
3701 SOUTH COLLEGE ROAD
WILMINGTON, NC 28412

ALDI, INC. SALISBURY DIVISION
1985 OLD UNION CHURCH ROAD
SALISBURY, NORTH CAROLINA 28146
(919) 714-8111

APPENDIX

PROJECT NO.	20170421
ISSUE DATE	08-05-2016
CURRENT REVISION	0
DESIGNED BY	RAP
DRAWN BY	GLT
CHECKED BY	RAP
APPROVED BY	JBC

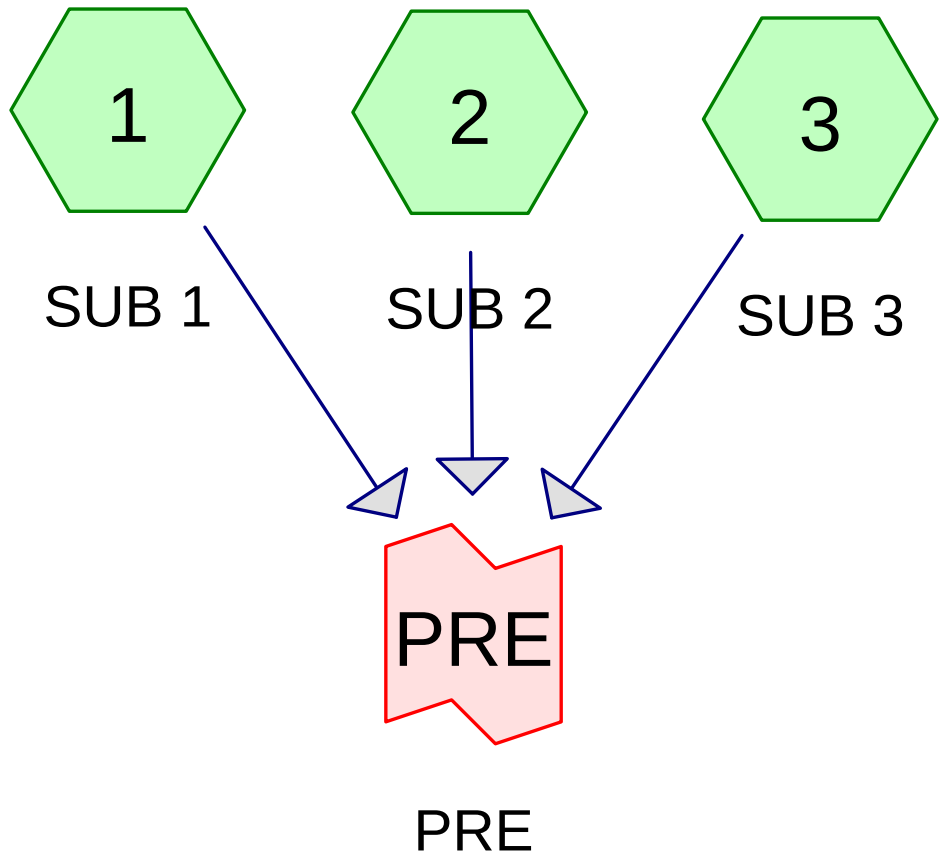
D

SHEET 1 of 1

CAD FILE: W:\Civil\Aldi\20170421.001A Wilmington (College Road)\CAD\Drawings\Exhibits\Aldi Wilmington (College Road) - Pre-Development Watershed Map.dwg LAYOUT: D PRE-DEVELOPMENT WATERSHED MAP PLOTTED: 10/7/2016 10:16 AM BY: ryan parker

APPENDIX E

PRE-DEVELOPMENT HYDROLOGIC MODEL AND RESULTS



Subcat Reach Pond Link

Routing Diagram for ALDI #98 Wilmington NC Stormwater
Prepared by Kleinfelder, Printed 10/13/2016

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.787	39	Woods, Good, HSG A (1, 2, 3)
2.787	**39**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.787	HSG A	1, 2, 3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.787		**TOTAL AREA**

Summary for Subcatchment 1: SUB 1

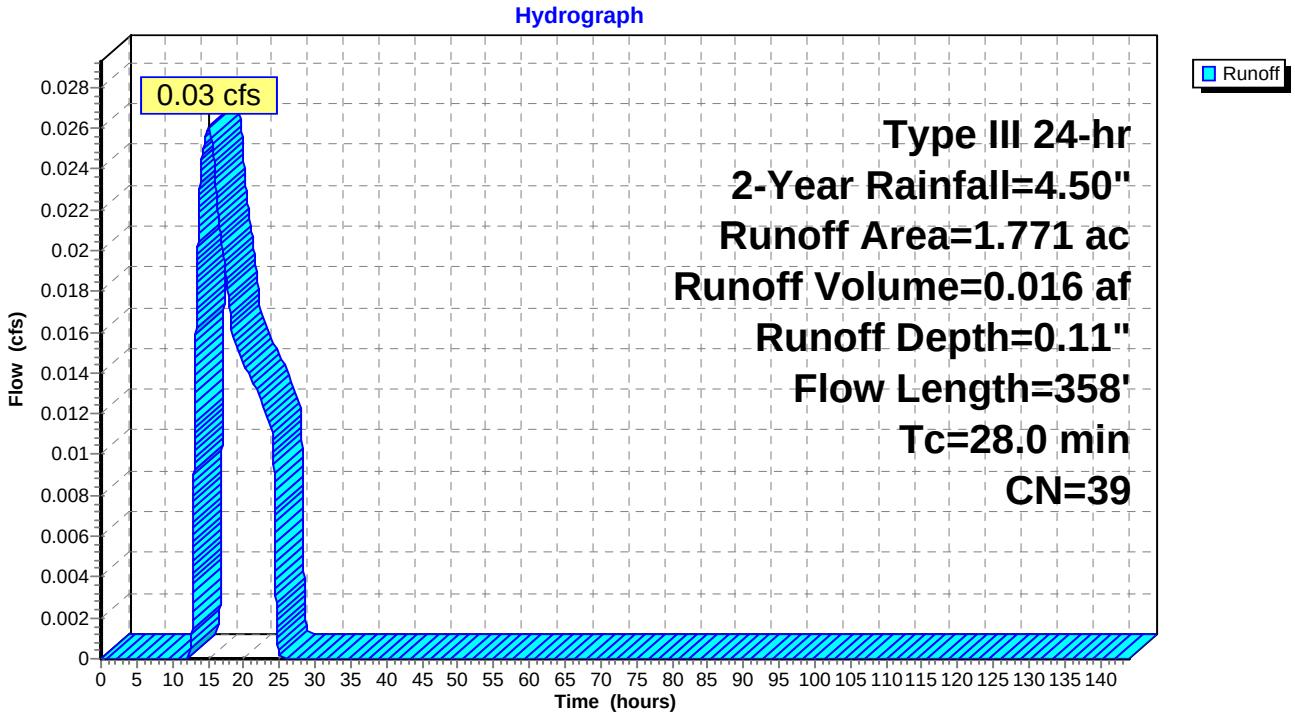
Runoff = 0.03 cfs @ 15.03 hrs, Volume= 0.016 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

	Area (ac)	CN	Description
*	1.771	39	Woods, Good, HSG A
	1.771		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.3	100	0.0100	0.07		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 4.74"
1.4	45	0.0111	0.53		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
2.6	147	0.0034	0.94		**Shallow Concentrated Flow, SCF on Gravel** Unpaved Kv= 16.1 fps
0.3	42	0.0119	2.21		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
0.4	24	0.0341	0.92		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
28.0	358	Total			

Subcatchment 1: SUB 1



Summary for Subcatchment 2: SUB 2

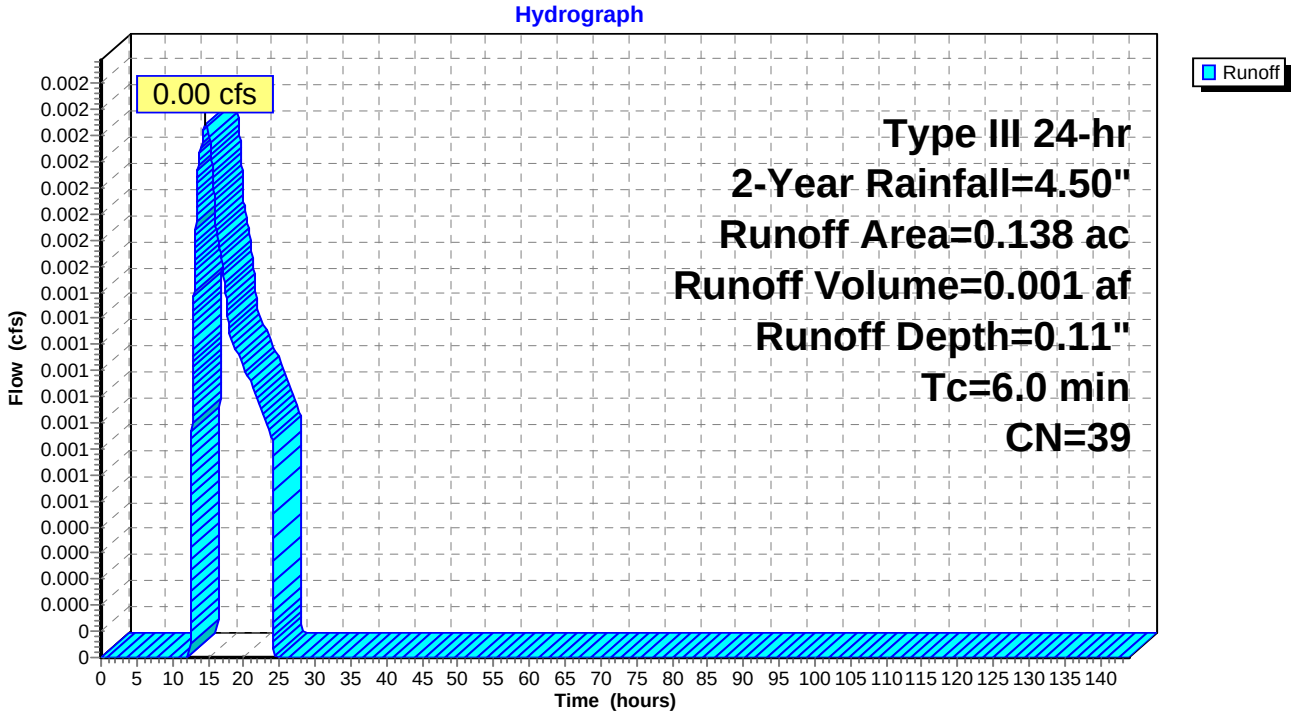
Runoff = 0.00 cfs @ 14.70 hrs, Volume= 0.001 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

	Area (ac)	CN	Description
*	0.138	39	Woods, Good, HSG A
	0.138		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Calced Tc = 2.1 Min**

Subcatchment 2: SUB 2



Summary for Subcatchment 3: SUB 3

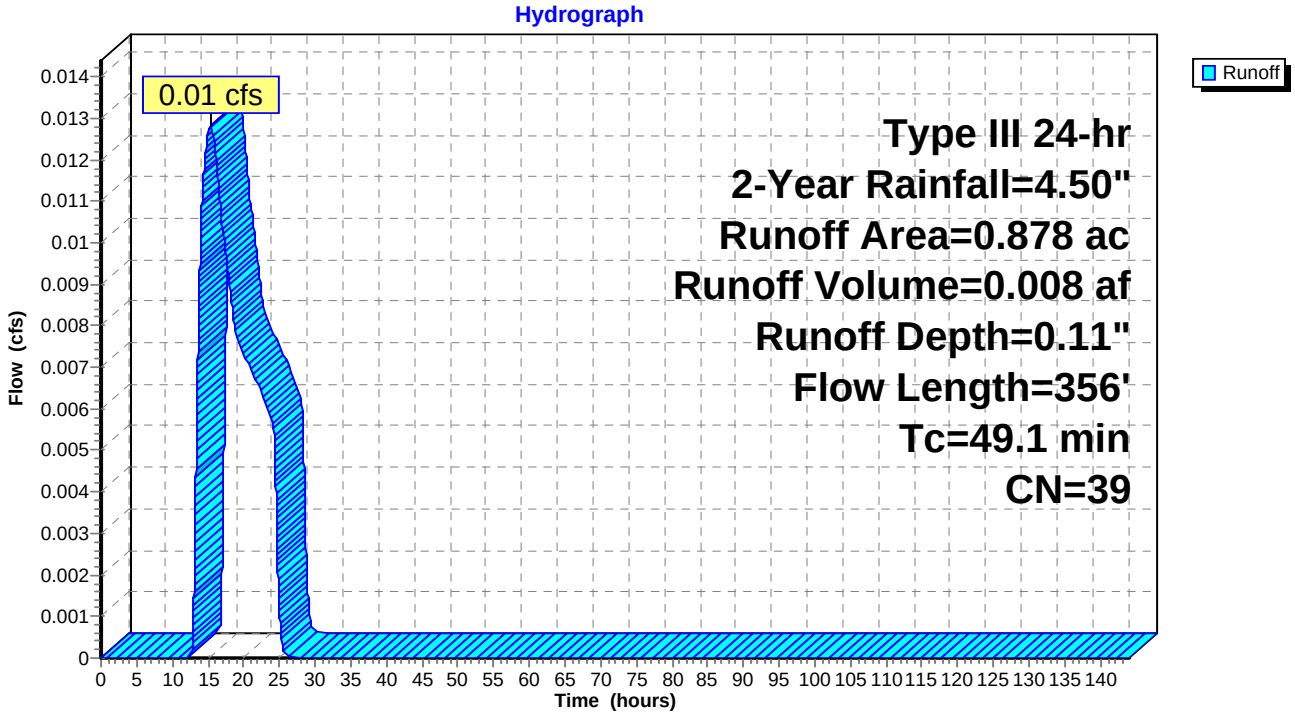
Runoff = 0.01 cfs @ 15.33 hrs, Volume= 0.008 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

	Area (ac)	CN	Description
*	0.878	39	Woods, Good, HSG A
	0.878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	100	0.0030	0.04		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 4.74"
3.0	54	0.0037	0.30		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
0.1	11	0.0045	1.36		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
4.3	55	0.0018	0.21		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
0.4	29	0.0034	1.18		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
3.6	107	0.0098	0.49		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
49.1	356	Total			

Subcatchment 3: SUB 3

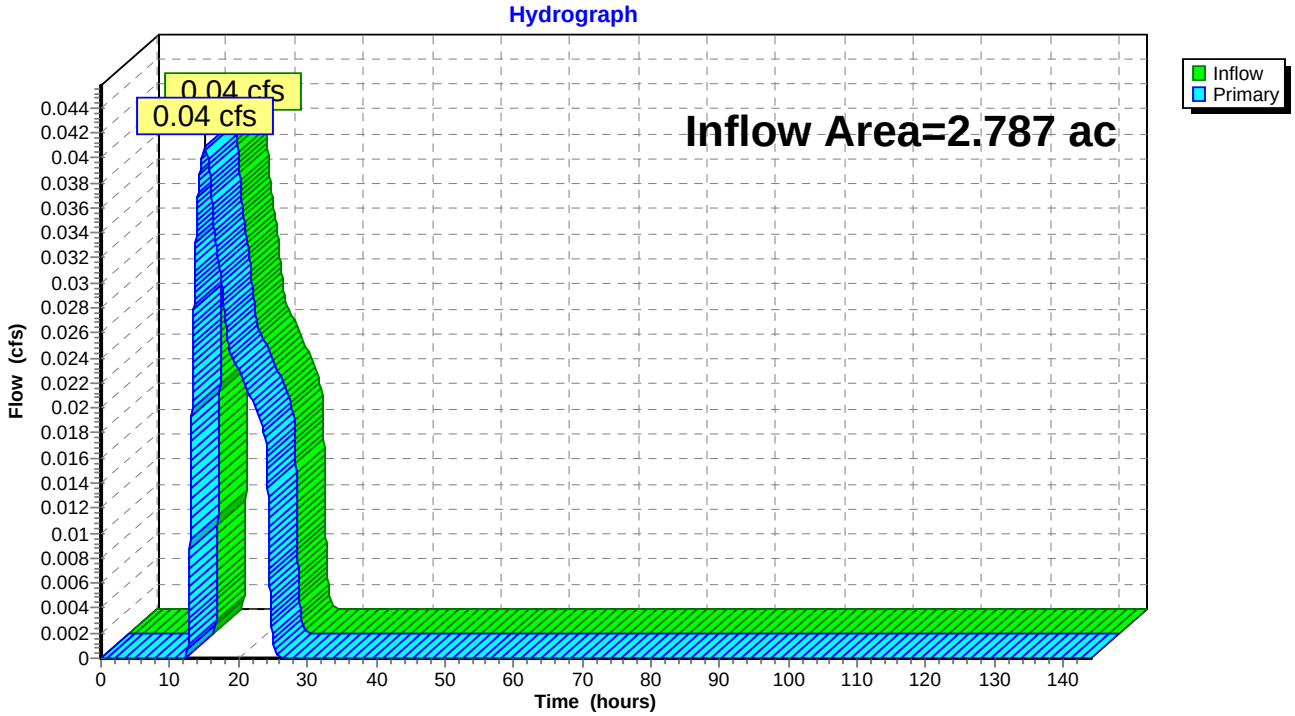


Summary for Link PRE: PRE

Inflow Area = 2.787 ac, 0.00% Impervious, Inflow Depth = 0.11" for 2-Year event
Inflow = 0.04 cfs @ 15.09 hrs, Volume= 0.026 af
Primary = 0.04 cfs @ 15.09 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link PRE: PRE



Summary for Subcatchment 1: SUB 1

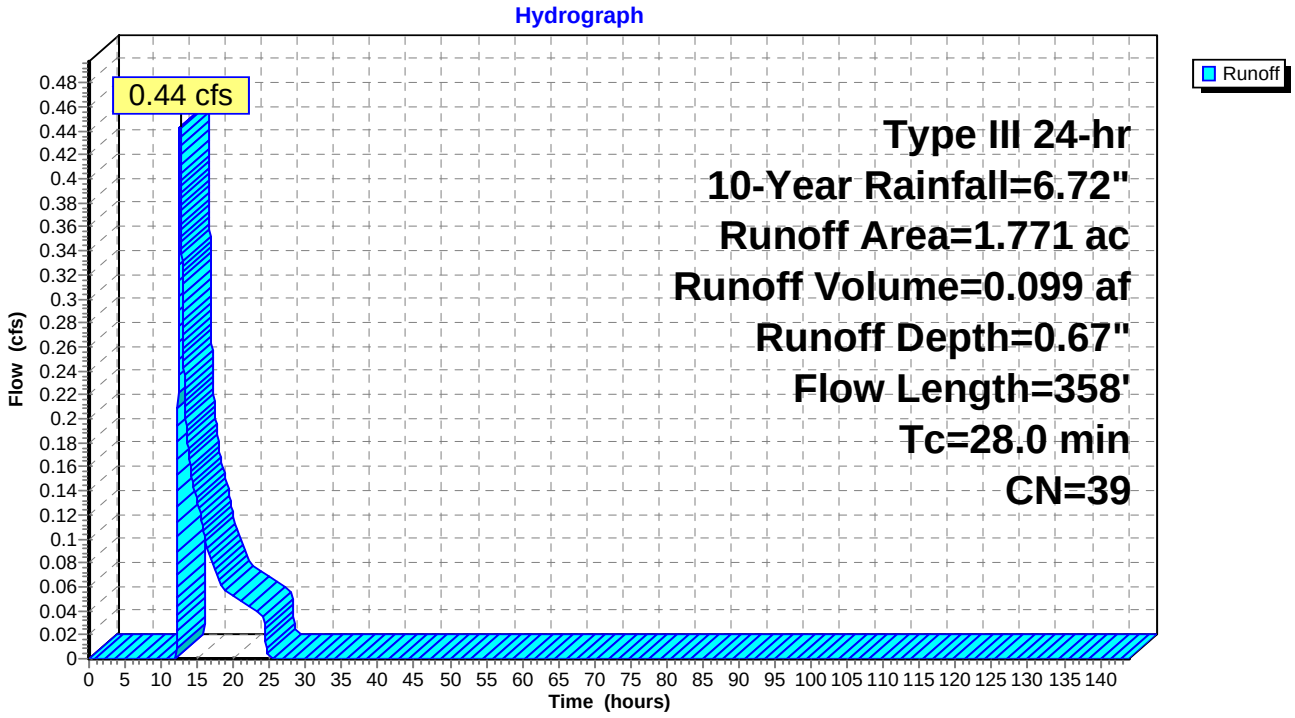
Runoff = 0.44 cfs @ 12.60 hrs, Volume= 0.099 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

	Area (ac)	CN	Description
*	1.771	39	Woods, Good, HSG A
	1.771		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.3	100	0.0100	0.07		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 4.74"
1.4	45	0.0111	0.53		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
2.6	147	0.0034	0.94		**Shallow Concentrated Flow, SCF on Gravel** Unpaved Kv= 16.1 fps
0.3	42	0.0119	2.21		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
0.4	24	0.0341	0.92		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
28.0	358	Total			

Subcatchment 1: SUB 1



Summary for Subcatchment 2: SUB 2

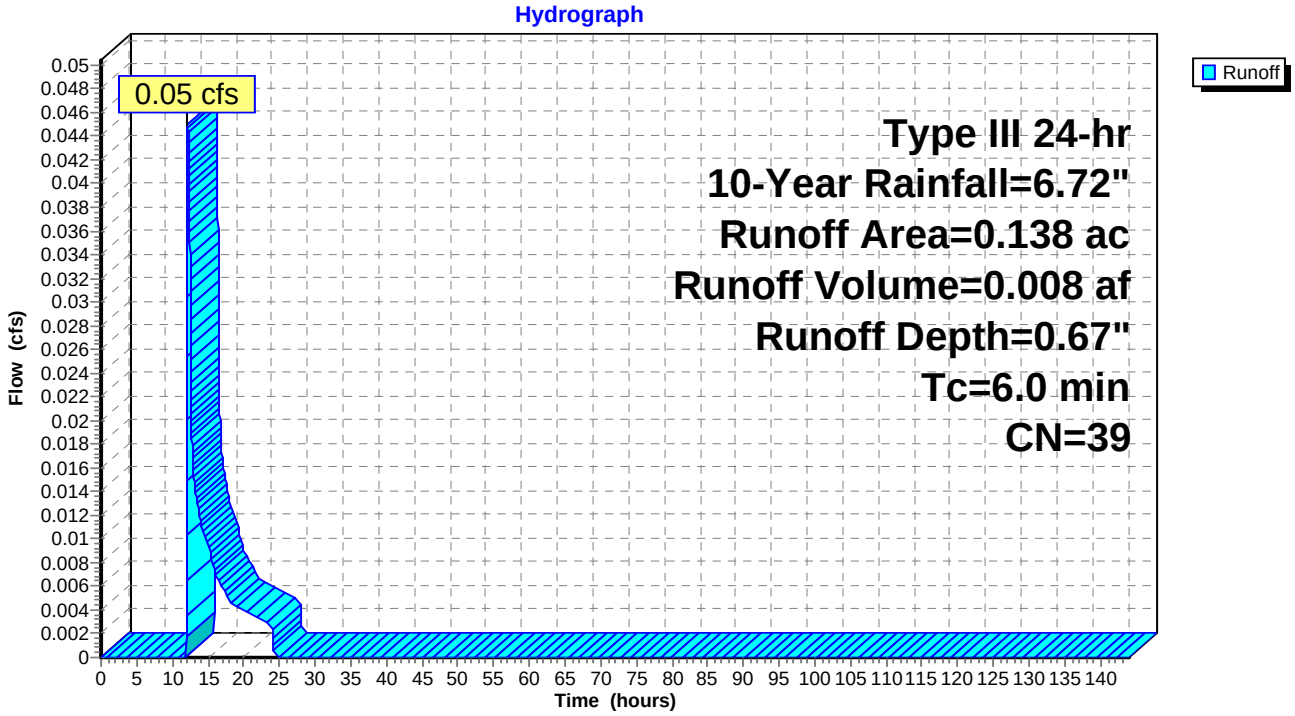
Runoff = 0.05 cfs @ 12.16 hrs, Volume= 0.008 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

	Area (ac)	CN	Description
*	0.138	39	Woods, Good, HSG A
	0.138		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Calced Tc = 2.1 Min**

Subcatchment 2: SUB 2



Summary for Subcatchment 3: SUB 3

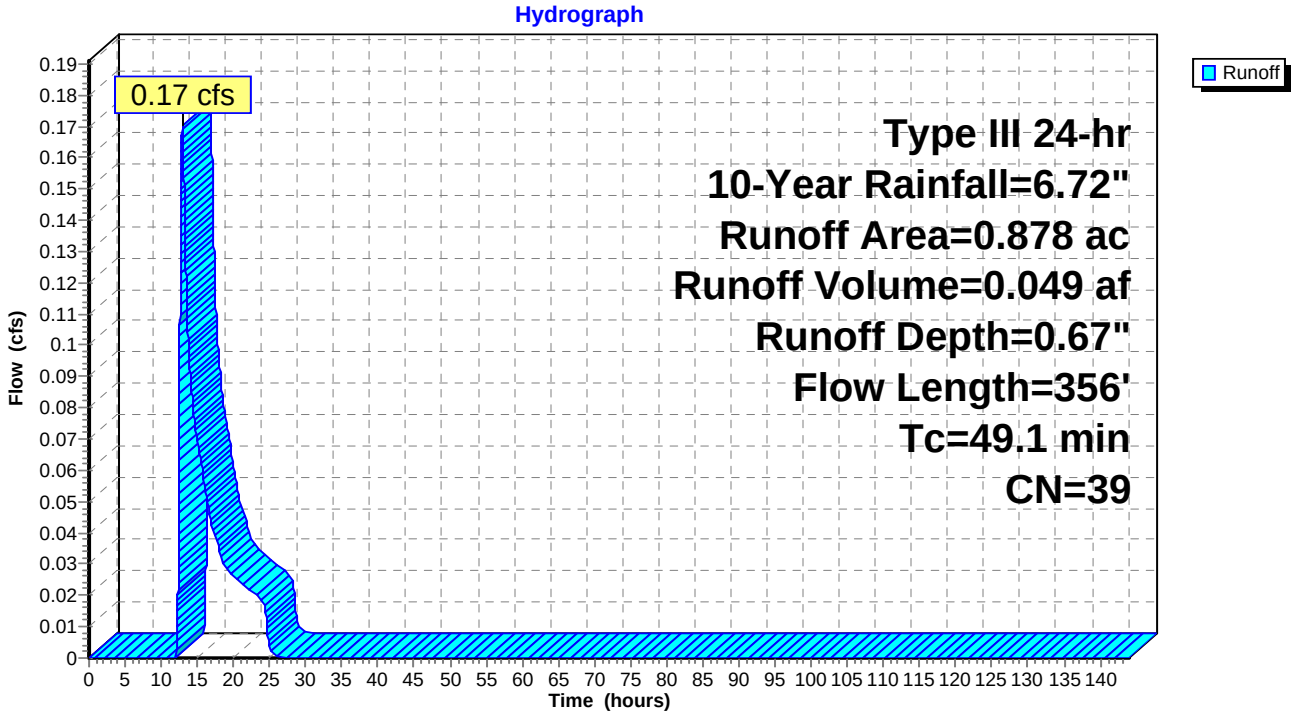
Runoff = 0.17 cfs @ 12.93 hrs, Volume= 0.049 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

	Area (ac)	CN	Description
*	0.878	39	Woods, Good, HSG A
	0.878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	100	0.0030	0.04		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 4.74"
3.0	54	0.0037	0.30		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
0.1	11	0.0045	1.36		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
4.3	55	0.0018	0.21		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
0.4	29	0.0034	1.18		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
3.6	107	0.0098	0.49		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
49.1	356	Total			

Subcatchment 3: SUB 3

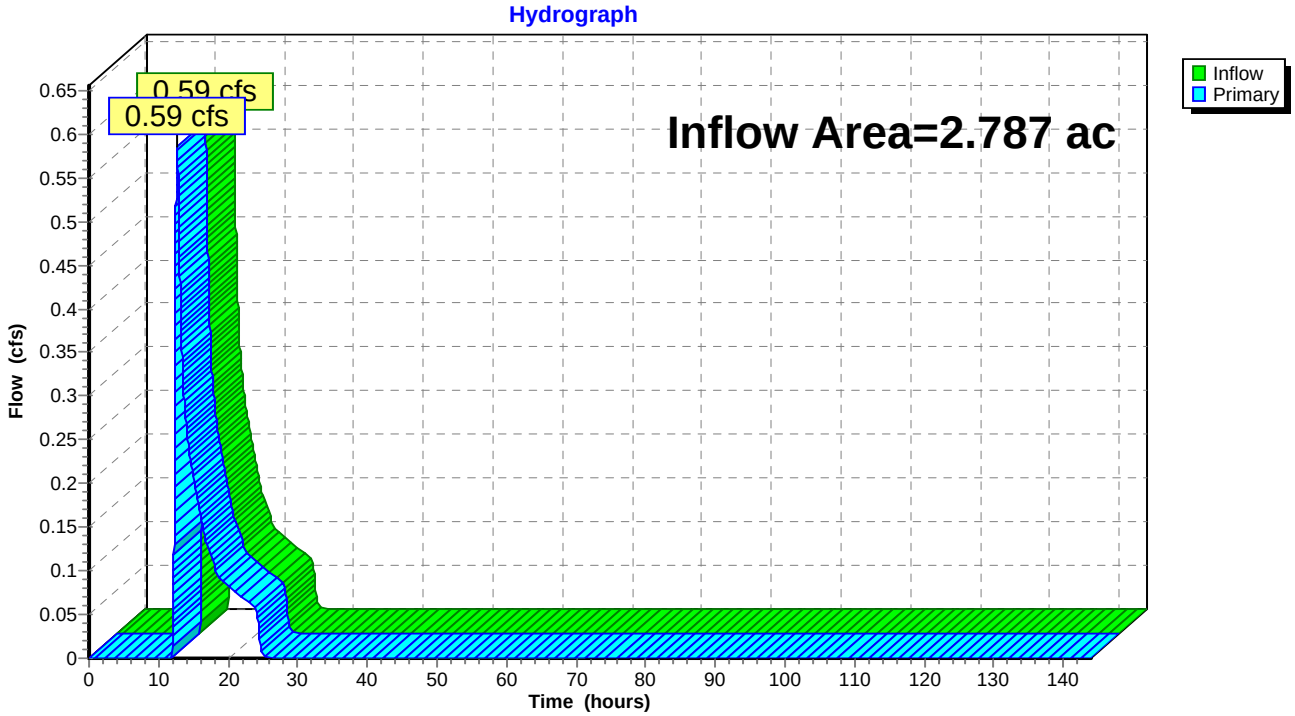


Summary for Link PRE: PRE

Inflow Area = 2.787 ac, 0.00% Impervious, Inflow Depth = 0.67" for 10-Year event
Inflow = 0.59 cfs @ 12.66 hrs, Volume= 0.156 af
Primary = 0.59 cfs @ 12.66 hrs, Volume= 0.156 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link PRE: PRE



Summary for Subcatchment 1: SUB 1

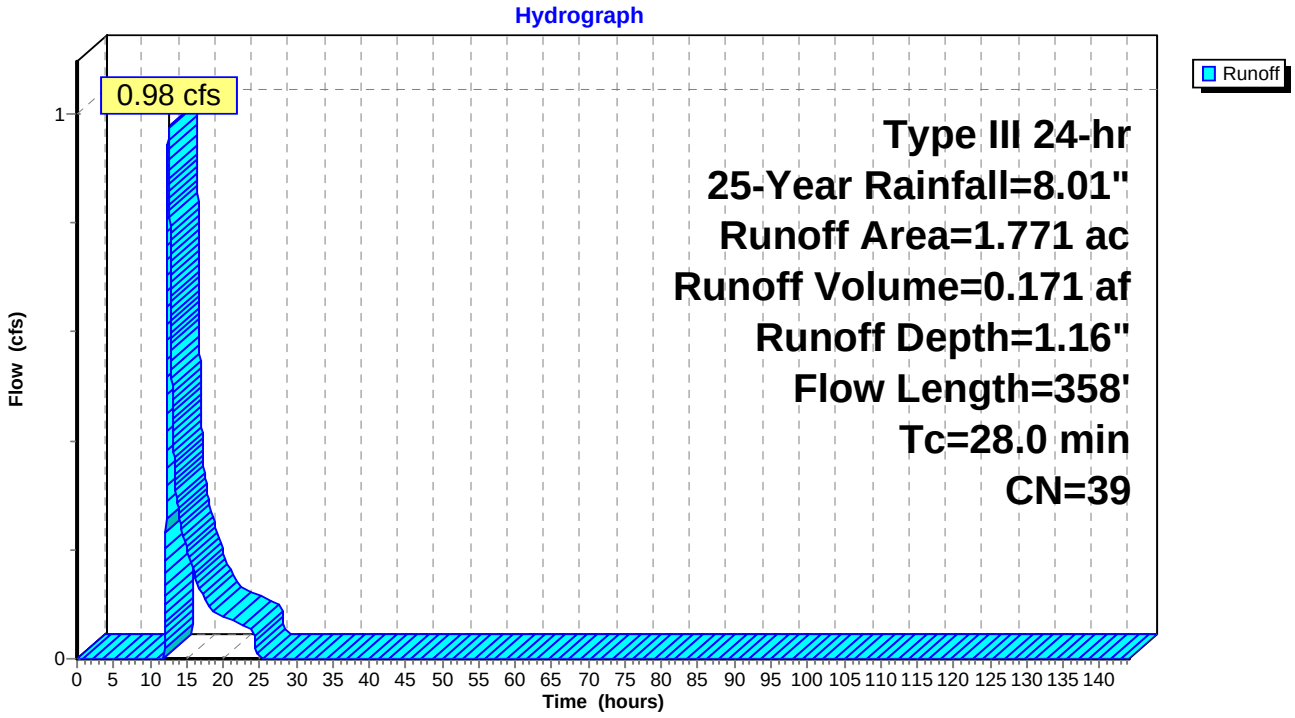
Runoff = 0.98 cfs @ 12.53 hrs, Volume= 0.171 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

	Area (ac)	CN	Description
*	1.771	39	Woods, Good, HSG A
	1.771		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.3	100	0.0100	0.07		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 4.74"
1.4	45	0.0111	0.53		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
2.6	147	0.0034	0.94		**Shallow Concentrated Flow, SCF on Gravel** Unpaved Kv= 16.1 fps
0.3	42	0.0119	2.21		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
0.4	24	0.0341	0.92		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
28.0	358	Total			

Subcatchment 1: SUB 1



Summary for Subcatchment 2: SUB 2

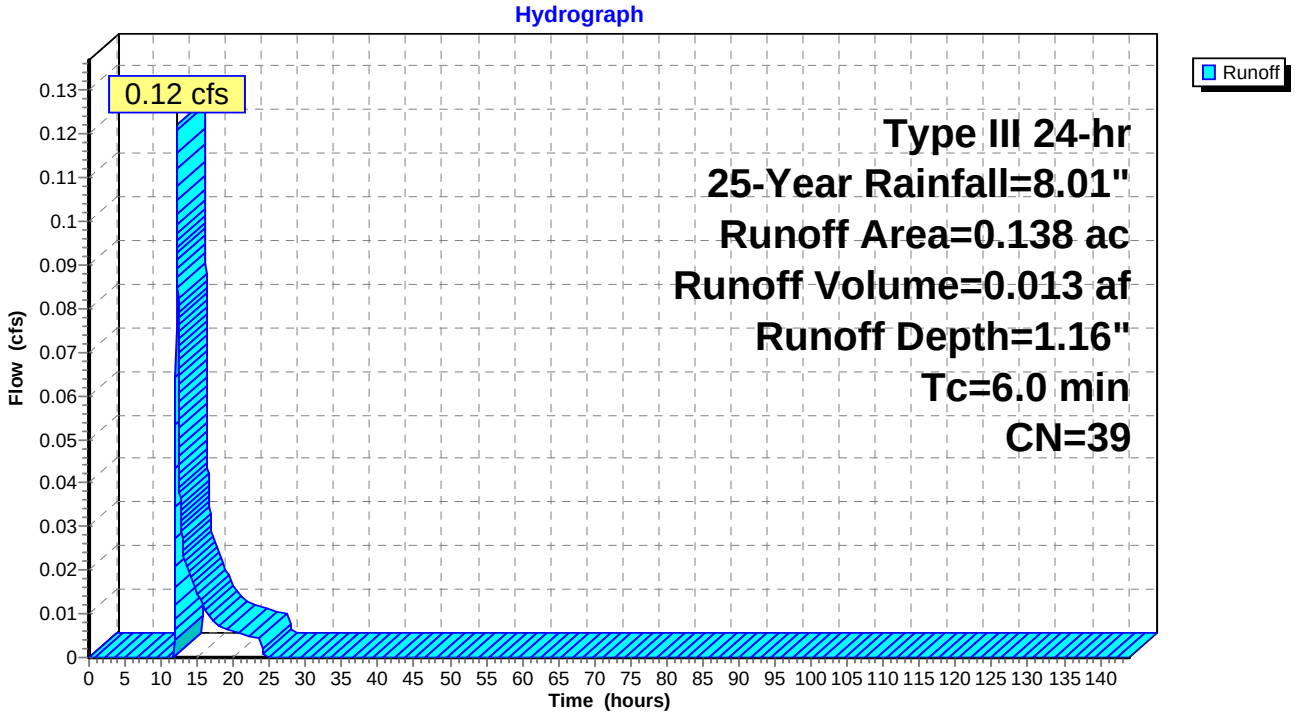
Runoff = 0.12 cfs @ 12.12 hrs, Volume= 0.013 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

	Area (ac)	CN	Description
*	0.138	39	Woods, Good, HSG A
	0.138		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Calced Tc = 2.1 Min**

Subcatchment 2: SUB 2



Summary for Subcatchment 3: SUB 3

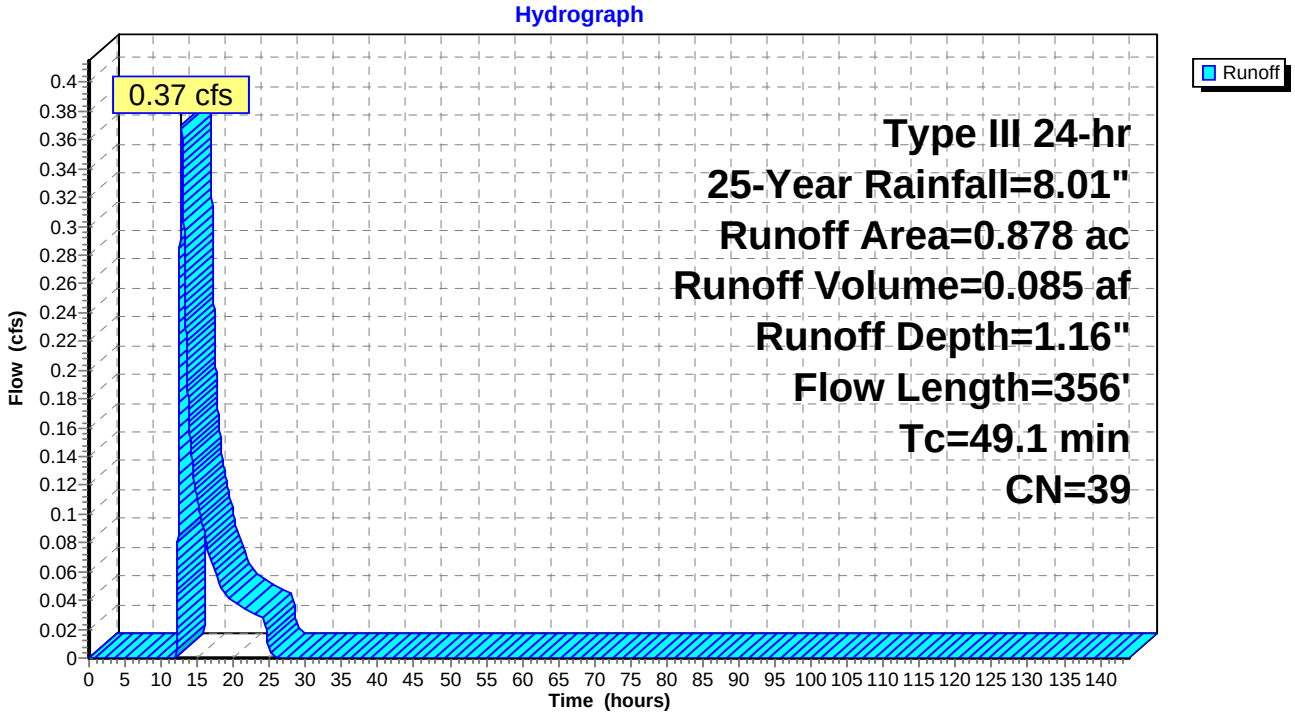
Runoff = 0.37 cfs @ 12.82 hrs, Volume= 0.085 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

	Area (ac)	CN	Description
*	0.878	39	Woods, Good, HSG A
	0.878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	100	0.0030	0.04		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 4.74"
3.0	54	0.0037	0.30		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
0.1	11	0.0045	1.36		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
4.3	55	0.0018	0.21		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
0.4	29	0.0034	1.18		**Shallow Concentrated Flow, SCF on Pavement** Paved Kv= 20.3 fps
3.6	107	0.0098	0.49		**Shallow Concentrated Flow, SCF on Grass (Woods)** Woodland Kv= 5.0 fps
49.1	356	Total			

Subcatchment 3: SUB 3

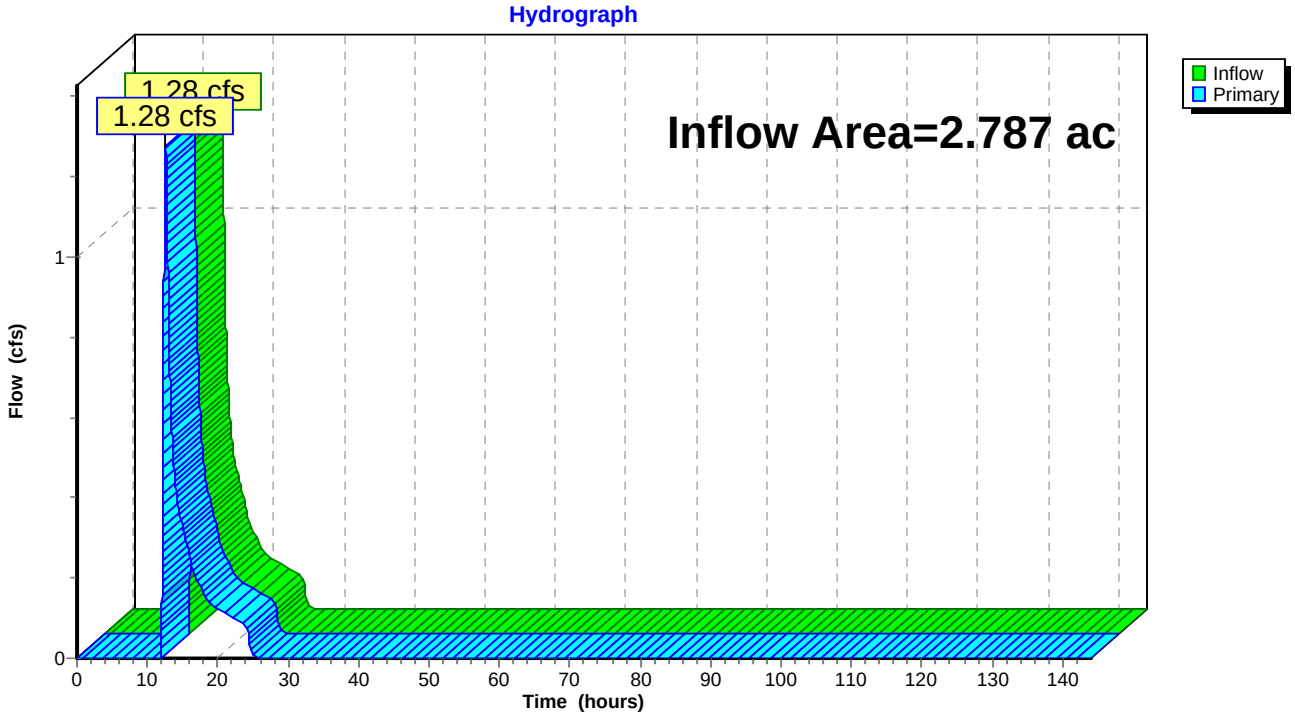


Summary for Link PRE: PRE

Inflow Area = 2.787 ac, 0.00% Impervious, Inflow Depth = 1.16" for 25-Year event
Inflow = 1.28 cfs @ 12.57 hrs, Volume= 0.270 af
Primary = 1.28 cfs @ 12.57 hrs, Volume= 0.270 af, Atten= 0%, Lag= 0.0 min

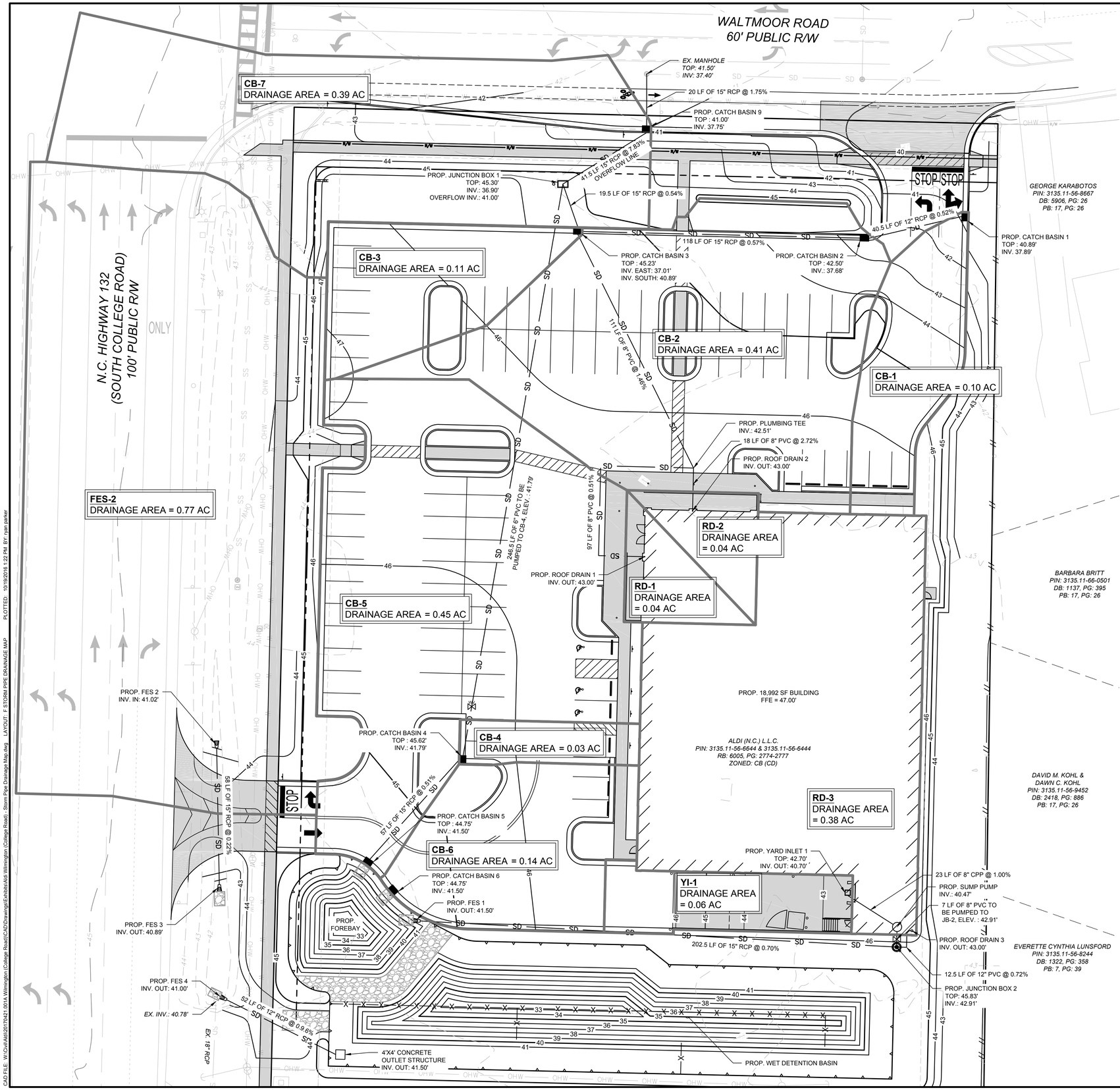
Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link PRE: PRE



APPENDIX F

STORM PIPE DRAINAGE MAP



LEGEND

- EXISTING MAJOR CONTOUR (5')
- EXISTING MINOR CONTOUR (1')
- EXISTING PROPERTY LINE
- EXISTING ABUTTING PROPERTY LINE
- EXISTING SETBACK LINE
- EXISTING EASEMENT
- EXISTING CHAINLINK FENCE
- EXISTING WOOD FENCE
- EX. WATER LINE
- EXISTING OVERHEAD POWER LINE
- EXISTING SANITARY SEWER LINE
- EXISTING STORM SEWER LINE
- PROPOSED RETAINING WALL
- PROPOSED WOOD FENCE
- PROPOSED MAJOR CONTOUR (5')
- PROPOSED MINOR CONTOUR (1')
- PROPOSED STORM SEWER LINE
- PROPOSED BAFFLE
- STORM PIPE DRAINAGE AREA

NOTES

1. A TIME OF CONCENTRATION FOR ALL STORM PIPE DRAINAGE AREAS WAS CALCULATED AS LOWER THAN 5 MINUTES; THEREFORE, A TIME OF CONCENTRATION OF 5 MINUTES WAS USED.
2. VALUES OF 0.15 FOR WOODLANDS, 0.20 FOR PASTURES, GRASS & FARMLAND AND 0.95 FOR ROOFTOPS AND PAVEMENT WERE USED IN THE CALCULATION OF RUNOFF COEFFICIENTS PER THE CITY OF WILMINGTON TECHNICAL STANDARDS AND SPECIFICATIONS MANUAL. THE CALCULATIONS FOR EACH DRAINAGE AREA ARE LISTED BELOW:

RUNOFF COEFFICIENT CALCULATION

DRAINAGE FROM	DRAINAGE TO	% WOODLANDS	% PASTURES, GRASS, & FARMLAND	% ROOFTOPS & PAVEMENT	RUNOFF COEFFICIENT, C
CB-1	CB-2	0	5	95	0.91
CB-2	CB-3	0	10	90	0.88
RD-1	PLUMBING TEE	0	0	100	0.95
RD-2	PLUMBING TEE	0	0	100	0.95
CB-3	JB-1	0	25	75	0.76
CB-4	CB-5	0	15	85	0.84
YI-1	SUMP PUMP	0	0	100	0.95
RD-3	JB-2	0	0	100	0.95
FES-2	FES-3	10	30	60	0.65
CB-7	EX. MH	10	40	50	0.57

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MORRISVILLE, NC 27560
PHONE: 919-755-5011
NC LICENSE # F-1143

REVISIONS

REV	DESCRIPTION	DSN DWN	CHK APP	DATE

SCALE VERIFICATION

THIS BAR IS 1 INCH IN LENGTH ON ORIGINAL DRAWING

0 1"

IF IT'S NOT 1 INCH ON THIS SHEET ADJUST YOUR SCALES ACCORDINGLY

0 20 40 60

SCALE: 1" = 20' SCALE IN FEET

ORIGINAL DRAWING SIZE IS 24 x 36

STORM PIPE DRAINAGE MAP

ALDI #98 WILMINGTON, NC
3701 SOUTH COLLEGE ROAD
WILMINGTON, NC 28412

ALDI, INC. SALISBURY DIVISION
1985 OLD UNION CHURCH ROAD
SALISBURY, NORTH CAROLINA 28146
(919) 714-8111

APPENDIX

PROJECT NO.	20170421
ISSUE DATE	10-13-2016
CURRENT REVISION	0
DESIGNED BY	RAP
DRAWN BY	GLT
CHECKED BY	RAP
APPROVED BY	JBC

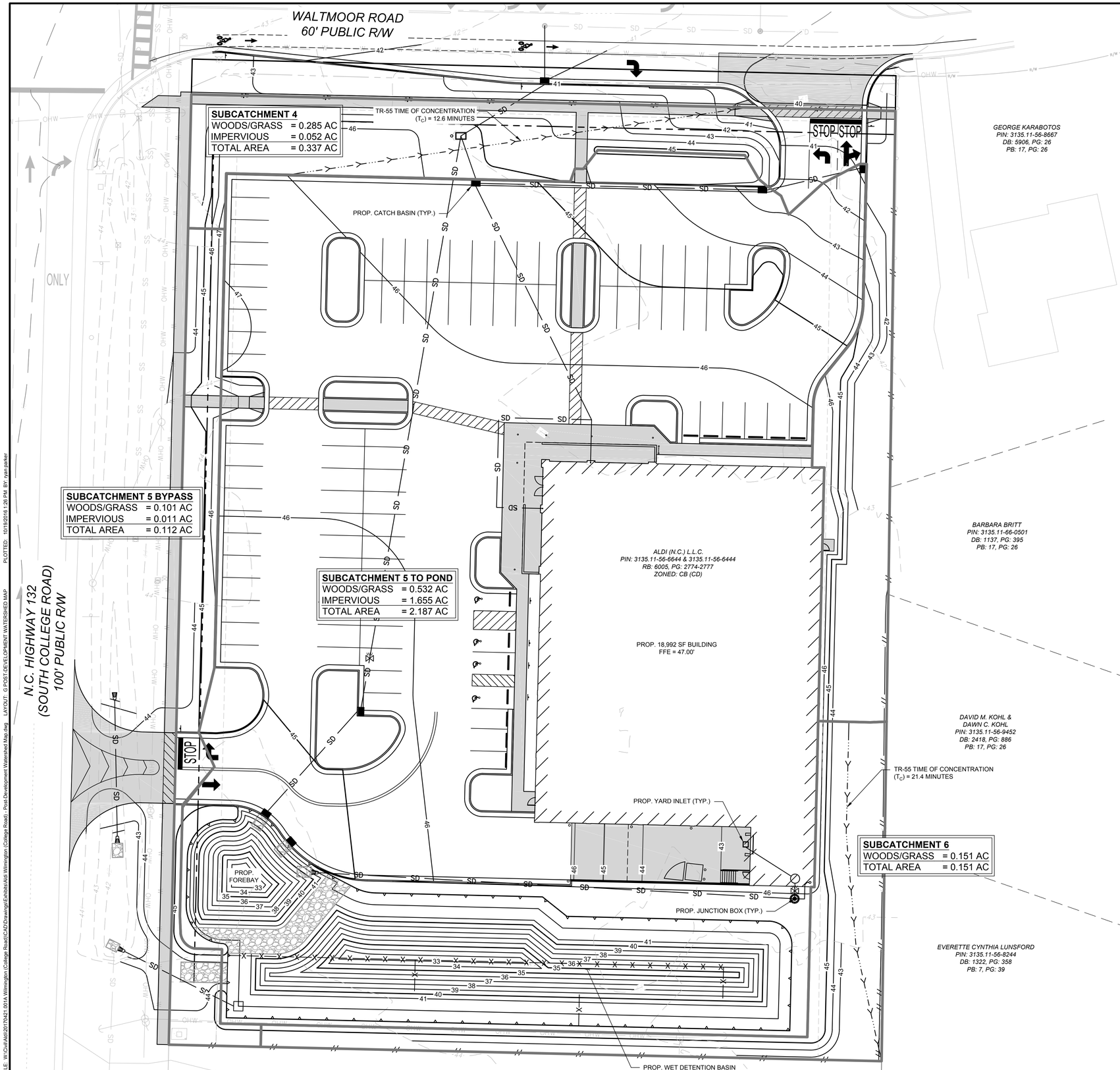
F

SHEET 1 of 1

CAD FILE: W:\Civil\Aldi\20170421.001A Wilmington (College Road)\CAD\Drawings\Exhibits\Aldi Wilmington (College Road) - Storm Pipe Drainage Map.dwg LAYOUT: F STORM PIPE DRAINAGE MAP PLOTTED: 10/19/2016 1:22 PM BY: ryan parker

APPENDIX G

POST-DEVELOPMENT WATERSHED MAP



LEGEND

- EXISTING MAJOR CONTOUR (5')
- EXISTING MINOR CONTOUR (1')
- EXISTING PROPERTY LINE
- EXISTING ABUTTING PROPERTY LINE
- EXISTING SETBACK LINE
- EXISTING EASEMENT
- EXISTING CHAINLINK FENCE
- EXISTING WOOD FENCE
- EX. WATER LINE
- EXISTING OVERHEAD POWER LINE
- EXISTING SANITARY SEWER LINE
- EXISTING STORM SEWER LINE
- PROPOSED RETAINING WALL
- PROPOSED WOOD FENCE
- PROPOSED MAJOR CONTOUR (5')
- PROPOSED MINOR CONTOUR (1')
- PROPOSED STORM SEWER LINE
- PROPOSED BAFFLE
- POST-DEVELOPMENT DRAINAGE AREA
- POST-DEVELOPMENT TIME OF CONCENTRATION

NOTES

SUBCATCHMENT 4:
CN_{COMP} = 42
$Q_{4\text{-}2YR}$ = 0.01
$Q_{4\text{-}10YR}$ = 0.17
$Q_{4\text{-}25YR}$ = 0.35

A TIME OF CONCENTRATION FOR SUBCATCHMENT 4 WAS CALCULATED TO BE 12.6 MINUTES.

SUBCATCHMENT 5 TO POND:
CN_{COMP} = 82
$Q_{5\text{-}2YR}$ = 0.04
$Q_{5\text{-}10YR}$ = 0.25
$Q_{5\text{-}25YR}$ = 0.98

A TIME OF CONCENTRATION FOR SUBCATCHMENT 5 TO POND WAS CALCULATED AS LOWER THAN 6 MINUTES; THEREFORE, A TIME OF CONCENTRATION OF 6 MINUTES WAS USED.

SUBCATCHMENT 5 BYPASS:
CN_{COMP} = 38
$Q_{5\text{-}2YR}$ = 0.00
$Q_{5\text{-}10YR}$ = 0.03
$Q_{5\text{-}25YR}$ = 0.08

A TIME OF CONCENTRATION FOR SUBCATCHMENT 5 BYPASS WAS CALCULATED AS LOWER THAN 6 MINUTES; THEREFORE, A TIME OF CONCENTRATION OF 6 MINUTES WAS USED.

SUBCATCHMENT 6:
CN_{COMP} = 32
$Q_{6\text{-}2YR}$ = 0.00
$Q_{6\text{-}10YR}$ = 0.01
$Q_{6\text{-}25YR}$ = 0.03

A TIME OF CONCENTRATION FOR SUBCATCHMENT 6 WAS CALCULATED TO BE 21.4 MINUTES.

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NC LICENSE # F-1143

REVISIONS

REV	DESCRIPTION	DSN DWN	CHK APP	DATE

SCALE VERIFICATION

THIS BAR IS 1 INCH IN LENGTH ON ORIGINAL DRAWING

0 1"

IF IT'S NOT 1 INCH ON THIS SHEET ADJUST YOUR SCALES ACCORDINGLY

0 20 40 60

SCALE: 1" = 20' SCALE IN FEET

ORIGINAL DRAWING SIZE IS 24 x 36

POST-DEVELOPMENT WATERSHED MAP

ALDI #98 WILMINGTON, NC
3701 SOUTH COLLEGE ROAD
WILMINGTON, NC 28412

ALDI, INC. SALISBURY DIVISION
1985 OLD UNION CHURCH ROAD
SALISBURY, NORTH CAROLINA 28146
(919) 714-8111

APPENDIX

PROJECT NO.	20170421
ISSUE DATE	10-13-2016
CURRENT REVISION	0
DESIGNED BY	RAP
DRAWN BY	GLT
CHECKED BY	RAP
APPROVED BY	JBC

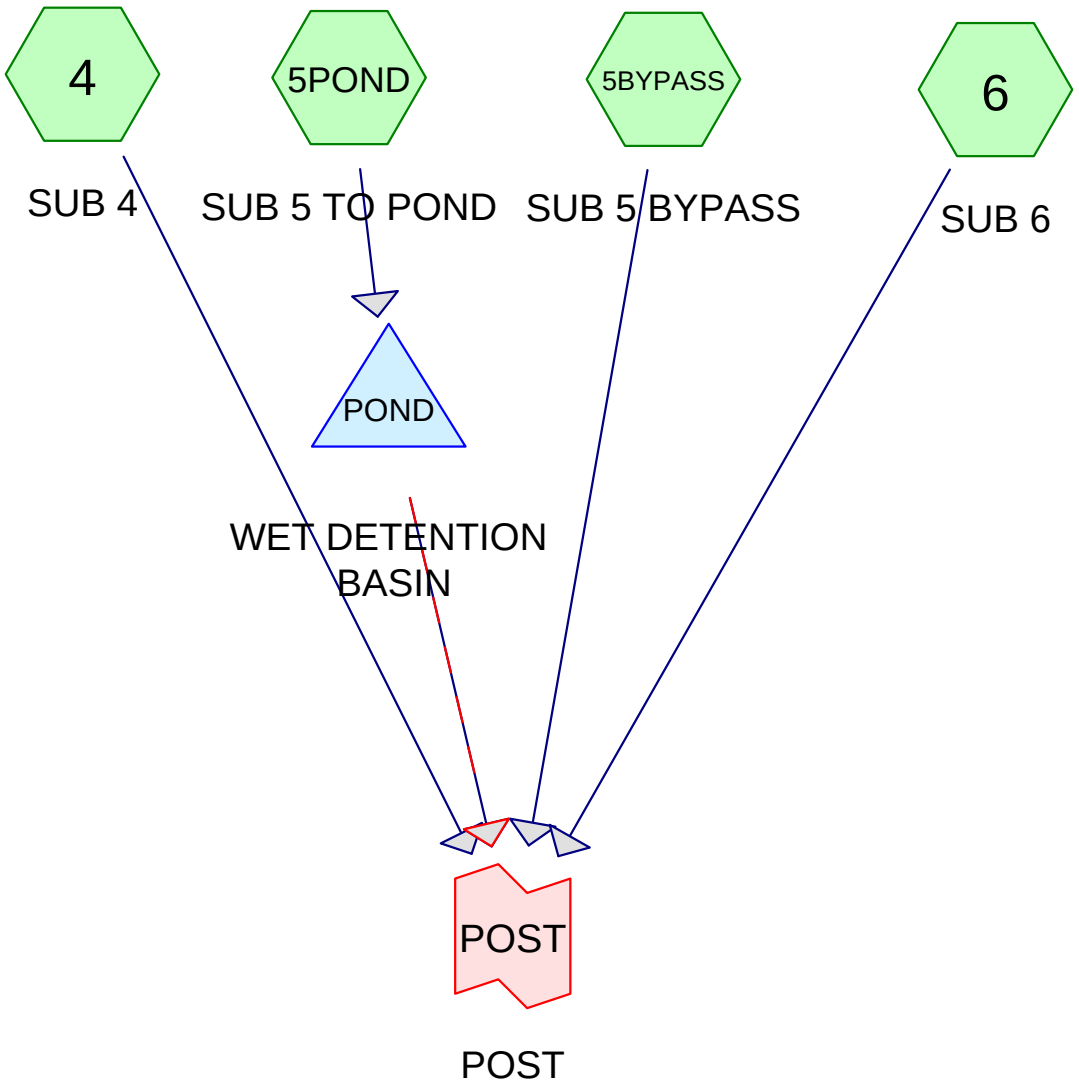
G

SHEET 1 of 1

CAD FILE: W:\Civil\Aldi\20170421.001A Wilmington (College Road)\CAD\Drawings\Exhibits\Aldi Wilmington (College Road) - Post-Development Watershed Map.dwg LAYOUT: G POST-DEVELOPMENT WATERSHED MAP PLOTTED: 10/19/2016 1:26 PM BY: ryan.parker

APPENDIX H

POST-DEVELOPMENT HYDROLOGIC MODEL AND RESULTS



Subcat Reach Pond Link

Routing Diagram for ALDI #98 Wilmington NC Stormwater
Prepared by Kleinfelder, Printed 10/13/2016

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.718	98	Paved parking, HSG A (4, 5BYPASS, 5POND)
1.069	32	Woods/grass comb., Good, HSG A (4, 5BYPASS, 5POND, 6)
2.787	**73**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.787	HSG A	4, 5BYPASS, 5POND, 6
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.787		**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	POND	41.50	41.00	52.0	0.0096	0.013	12.0	0.0	0.0

Summary for Subcatchment 4: SUB 4

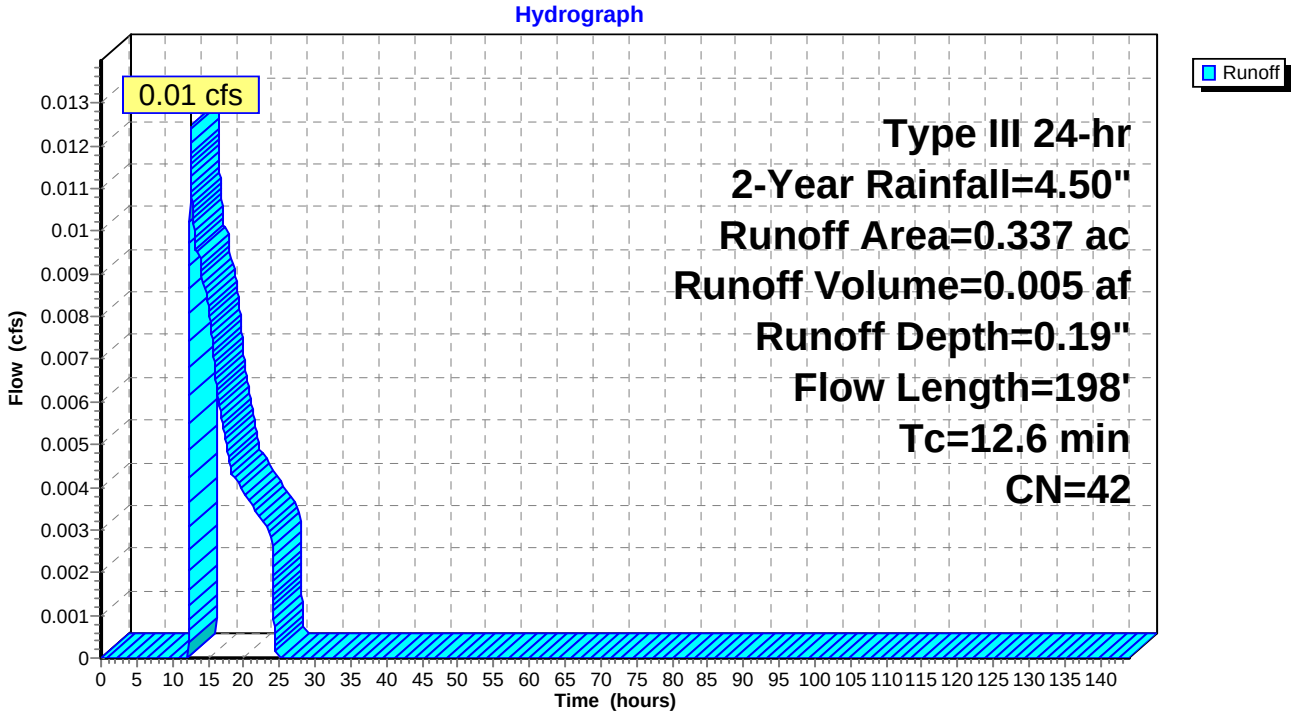
Runoff = 0.01 cfs @ 12.56 hrs, Volume= 0.005 af, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

Area (ac)	CN	Description
0.285	32	Woods/grass comb., Good, HSG A
0.052	98	Paved parking, HSG A
0.337	42	Weighted Average
0.285		84.57% Pervious Area
0.052		15.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	100	0.0200	0.14		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
0.3	24	0.0292	1.20		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
0.5	47	0.0468	1.51		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0545	4.74		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
12.6	198	Total			

Subcatchment 4: SUB 4



Summary for Subcatchment 5BYPASS: SUB 5 BYPASS

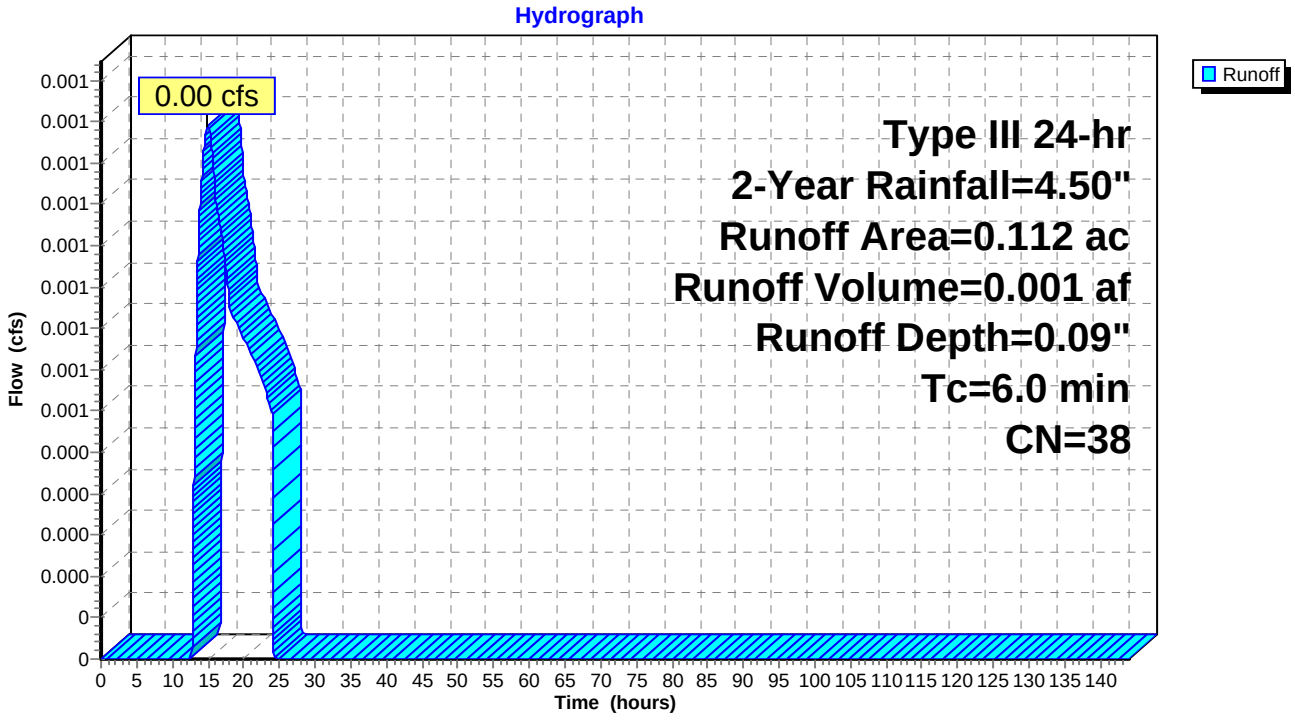
Runoff = 0.00 cfs @ 14.98 hrs, Volume= 0.001 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

Area (ac)	CN	Description
0.011	98	Paved parking, HSG A
0.101	32	Woods/grass comb., Good, HSG A
0.112	38	Weighted Average
0.101		90.18% Pervious Area
0.011		9.82% Impervious Area

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

Subcatchment 5BYPASS: SUB 5 BYPASS



Summary for Subcatchment 5POND: SUB 5 TO POND

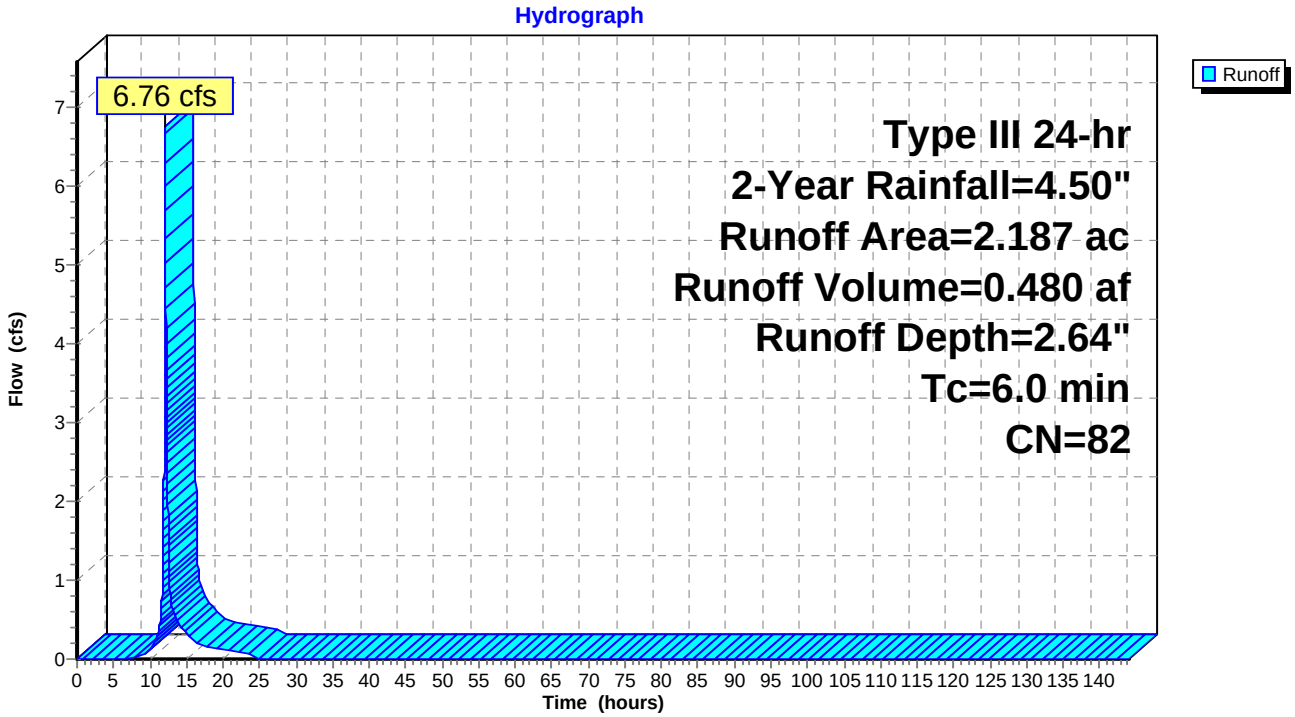
Runoff = 6.76 cfs @ 12.09 hrs, Volume= 0.480 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

Area (ac)	CN	Description
1.655	98	Paved parking, HSG A
0.532	32	Woods/grass comb., Good, HSG A
2.187	82	Weighted Average
0.532		24.33% Pervious Area
1.655		75.67% Impervious Area

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

Subcatchment 5POND: SUB 5 TO POND



Summary for Subcatchment 6: SUB 6

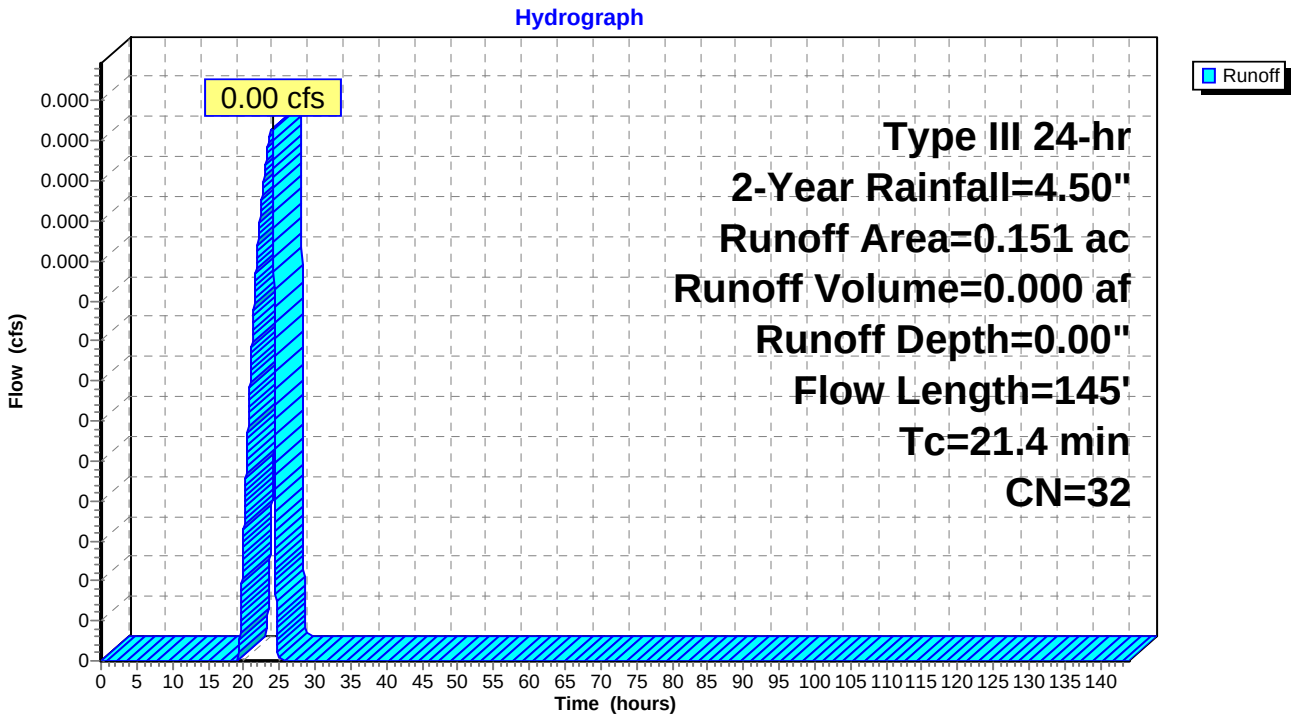
Runoff = 0.00 cfs @ 24.04 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.50"

Area (ac)	CN	Description
0.151	32	Woods/grass comb., Good, HSG A
0.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	100	0.0050	0.08		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
1.0	45	0.0111	0.74		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
21.4	145	Total			

Subcatchment 6: SUB 6



Summary for Pond POND: WET DETENTION BASIN

Inflow Area = 2.187 ac, 75.67% Impervious, Inflow Depth = 2.64" for 2-Year event
Inflow = 6.76 cfs @ 12.09 hrs, Volume= 0.480 af
Outflow = 0.04 cfs @ 24.08 hrs, Volume= 0.329 af, Atten= 99%, Lag= 719.8 min
Primary = 0.04 cfs @ 24.08 hrs, Volume= 0.329 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 42.92' @ 24.08 hrs Surf.Area= 0.323 ac Storage= 0.444 af

Plug-Flow detention time= 3,604.5 min calculated for 0.329 af (69% of inflow)
Center-of-Mass det. time= 3,506.8 min (4,327.5 - 820.7)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	1.115 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

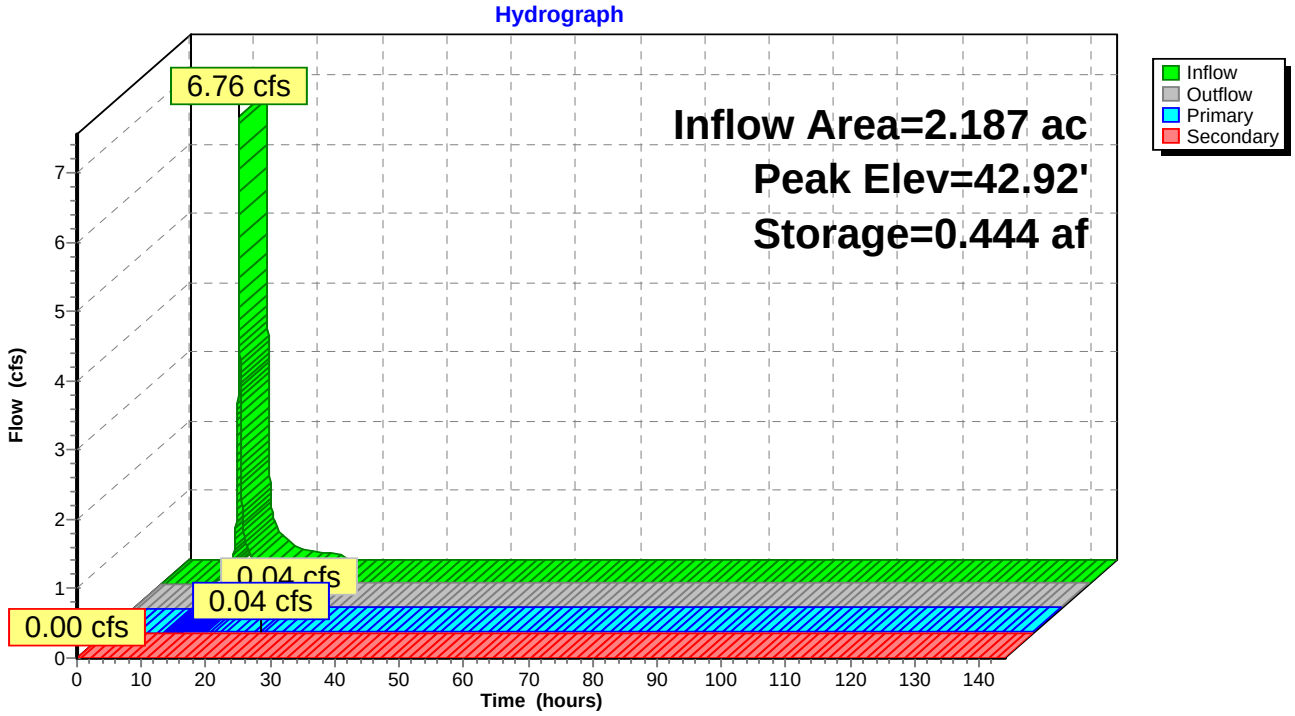
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
41.50	0.261	627.3	0.000	0.000	0.261
42.00	0.323	645.1	0.146	0.146	0.303
43.00	0.323	645.1	0.323	0.469	0.318
44.00	0.323	645.1	0.323	0.792	0.333
45.00	0.323	645.1	0.323	1.115	0.347

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**12.0" Round RCP_Round 12"** L= 52.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 41.50' / 41.00' S= 0.0096 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	43.75'	**48.0" x 48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	41.50'	**1.1" Vert. Orifice/Grate** C= 0.600
#4	Secondary	43.90'	**58.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.04 cfs @ 24.08 hrs HW=42.92' (Free Discharge)
└**1=RCP_Round 12"** (Passes 0.04 cfs of 3.60 cfs potential flow)
  └**2=Grate** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 0.04 cfs @ 5.65 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.50' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND: WET DETENTION BASIN



Stage-Discharge for Pond POND: WET DETENTION BASIN

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
41.50	0.00	0.00	0.00
41.55	0.00	0.00	0.00
41.60	0.01	0.01	0.00
41.65	0.01	0.01	0.00
41.70	0.01	0.01	0.00
41.75	0.01	0.01	0.00
41.80	0.02	0.02	0.00
41.85	0.02	0.02	0.00
41.90	0.02	0.02	0.00
41.95	0.02	0.02	0.00
42.00	0.02	0.02	0.00
42.05	0.02	0.02	0.00
42.10	0.02	0.02	0.00
42.15	0.02	0.02	0.00
42.20	0.03	0.03	0.00
42.25	0.03	0.03	0.00
42.30	0.03	0.03	0.00
42.35	0.03	0.03	0.00
42.40	0.03	0.03	0.00
42.45	0.03	0.03	0.00
42.50	0.03	0.03	0.00
42.55	0.03	0.03	0.00
42.60	0.03	0.03	0.00
42.65	0.03	0.03	0.00
42.70	0.03	0.03	0.00
42.75	0.03	0.03	0.00
42.80	0.04	0.04	0.00
42.85	0.04	0.04	0.00
42.90	0.04	0.04	0.00
42.95	0.04	0.04	0.00
43.00	0.04	0.04	0.00
43.05	0.04	0.04	0.00
43.10	0.04	0.04	0.00
43.15	0.04	0.04	0.00
43.20	0.04	0.04	0.00
43.25	0.04	0.04	0.00
43.30	0.04	0.04	0.00
43.35	0.04	0.04	0.00
43.40	0.04	0.04	0.00
43.45	0.04	0.04	0.00
43.50	0.04	0.04	0.00
43.55	0.04	0.04	0.00
43.60	0.05	0.05	0.00
43.65	0.05	0.05	0.00
43.70	0.05	0.05	0.00
43.75	0.05	0.05	0.00
43.80	0.63	0.63	0.00
43.85	1.70	1.70	0.00
43.90	3.09	3.09	0.00
43.95	6.25	4.73	1.52
44.00	9.59	5.30	4.29
44.05	13.25	5.36	7.88
44.10	17.57	5.43	12.14
44.15	22.75	5.49	17.25
44.20	28.62	5.55	23.06
44.25	35.16	5.62	29.54
44.30	42.36	5.68	36.68
44.35	50.39	5.74	44.65
44.40	59.12	5.80	53.32
44.45	68.55	5.86	62.69
44.50	78.70	5.92	72.78
44.55	87.89	5.98	81.91
44.60	97.41	6.04	91.37
44.65	107.25	6.10	101.15
44.70	117.38	6.15	111.22
44.75	128.02	6.21	121.81
44.80	138.98	6.27	132.72
44.85	150.25	6.32	143.93
44.90	161.82	6.38	155.44
44.95	173.36	6.43	166.93
45.00	**185.15**	**6.49**	**178.66**

Stage-Area-Storage for Pond POND: WET DETENTION BASIN

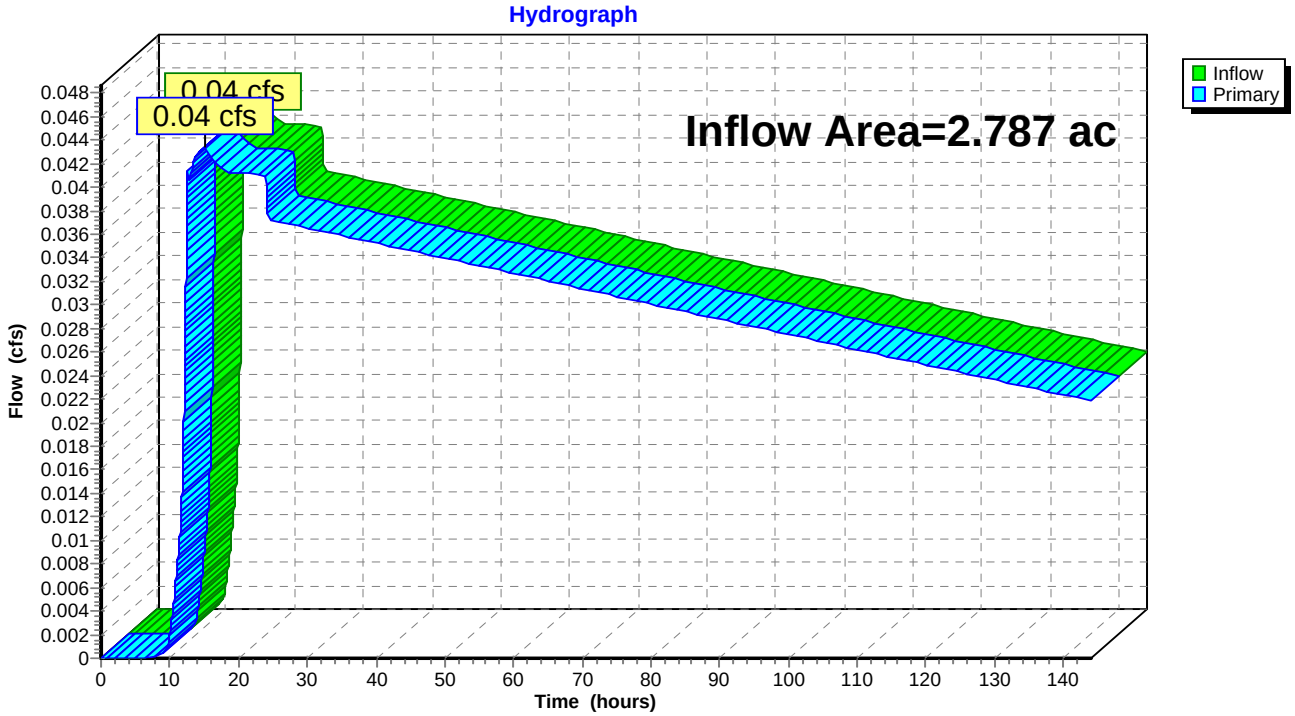
Elevation (feet)	Surface (acres)	Storage (acre-feet)
41.50	0.261	0.000
41.55	0.267	0.013
41.60	0.273	0.027
41.65	0.279	0.040
41.70	0.285	0.055
41.75	0.291	0.069
41.80	0.297	0.084
41.85	0.304	0.099
41.90	0.310	0.114
41.95	0.317	0.130
42.00	**0.323**	0.146
42.05	0.323	0.162
42.10	0.323	0.178
42.15	0.323	0.194
42.20	0.323	0.210
42.25	0.323	0.226
42.30	0.323	0.243
42.35	0.323	0.259
42.40	0.323	0.275
42.45	0.323	0.291
42.50	0.323	0.307
42.55	0.323	0.323
42.60	0.323	0.340
42.65	0.323	0.356
42.70	0.323	0.372
42.75	0.323	0.388
42.80	0.323	0.404
42.85	0.323	0.420
42.90	0.323	0.436
42.95	0.323	0.453
43.00	0.323	0.469
43.05	0.323	0.485
43.10	0.323	0.501
43.15	0.323	0.517
43.20	0.323	0.533
43.25	0.323	0.549
43.30	0.323	0.566
43.35	0.323	0.582
43.40	0.323	0.598
43.45	0.323	0.614
43.50	0.323	0.630
43.55	0.323	0.646
43.60	0.323	0.663
43.65	0.323	0.679
43.70	0.323	0.695
43.75	0.323	0.711
43.80	0.323	0.727
43.85	0.323	0.743
43.90	0.323	0.759
43.95	0.323	0.776
44.00	0.323	0.792
44.05	0.323	0.808
44.10	0.323	0.824
44.15	0.323	0.840
44.20	0.323	0.856
44.25	0.323	0.872
44.30	0.323	0.889
44.35	0.323	0.905
44.40	0.323	0.921
44.45	0.323	0.937
44.50	0.323	0.953
44.55	0.323	0.969
44.60	0.323	0.986
44.65	0.323	1.002
44.70	0.323	1.018
44.75	0.323	1.034
44.80	0.323	1.050
44.85	0.323	1.066
44.90	0.323	1.082
44.95	0.323	1.099
45.00	0.323	**1.115**

Summary for Link POST: POST

Inflow Area = 2.787 ac, 61.64% Impervious, Inflow Depth > 1.44" for 2-Year event
Inflow = 0.04 cfs @ 15.02 hrs, Volume= 0.335 af
Primary = 0.04 cfs @ 15.02 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link POST: POST



Summary for Subcatchment 4: SUB 4

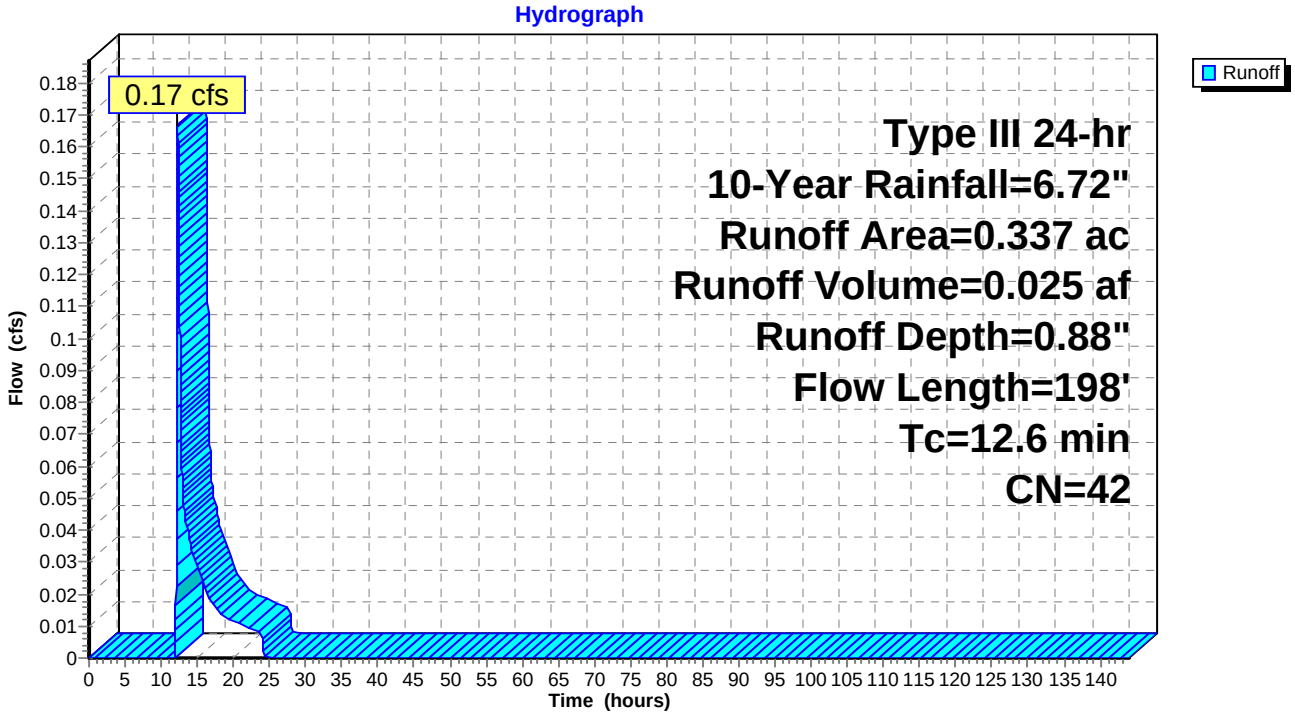
Runoff = 0.17 cfs @ 12.25 hrs, Volume= 0.025 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

Area (ac)	CN	Description
0.285	32	Woods/grass comb., Good, HSG A
0.052	98	Paved parking, HSG A
0.337	42	Weighted Average
0.285		84.57% Pervious Area
0.052		15.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	100	0.0200	0.14		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
0.3	24	0.0292	1.20		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
0.5	47	0.0468	1.51		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0545	4.74		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
12.6	198	Total			

Subcatchment 4: SUB 4



Summary for Subcatchment 5BYPASS: SUB 5 BYPASS

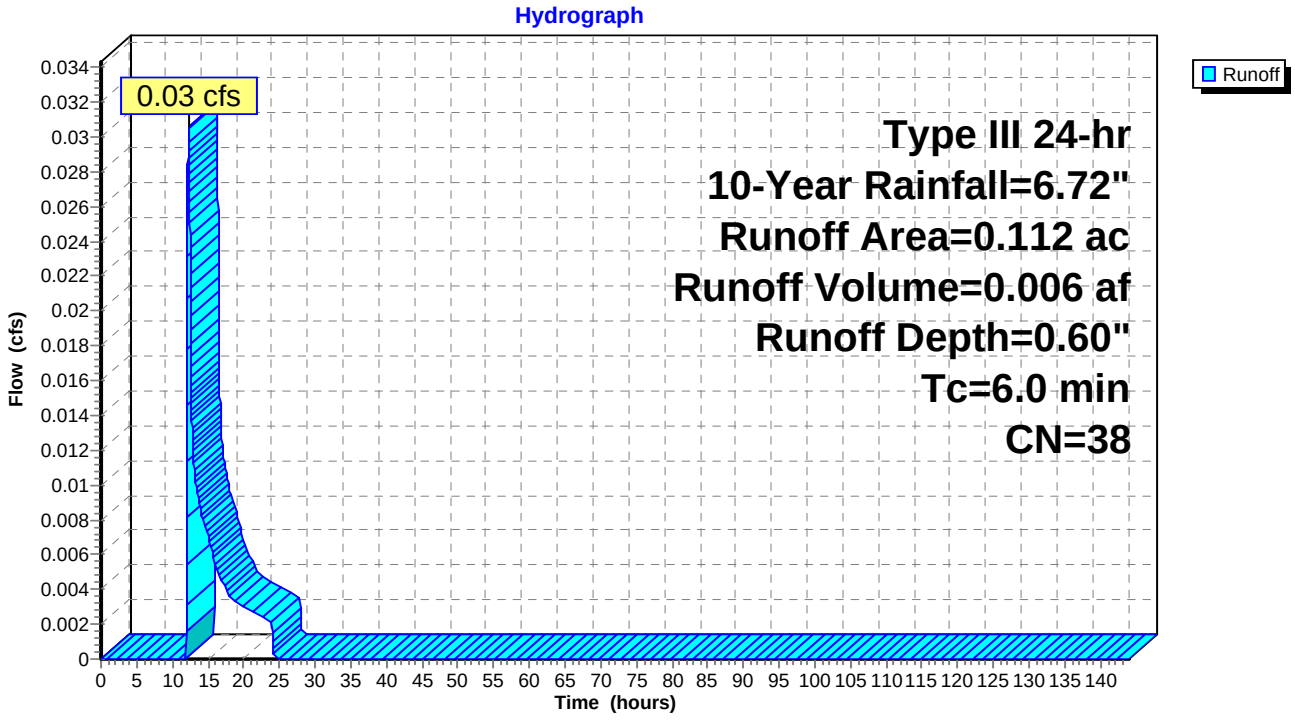
Runoff = 0.03 cfs @ 12.30 hrs, Volume= 0.006 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

Area (ac)	CN	Description
0.011	98	Paved parking, HSG A
0.101	32	Woods/grass comb., Good, HSG A
0.112	38	Weighted Average
0.101		90.18% Pervious Area
0.011		9.82% Impervious Area

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

Subcatchment 5BYPASS: SUB 5 BYPASS



Summary for Subcatchment 5POND: SUB 5 TO POND

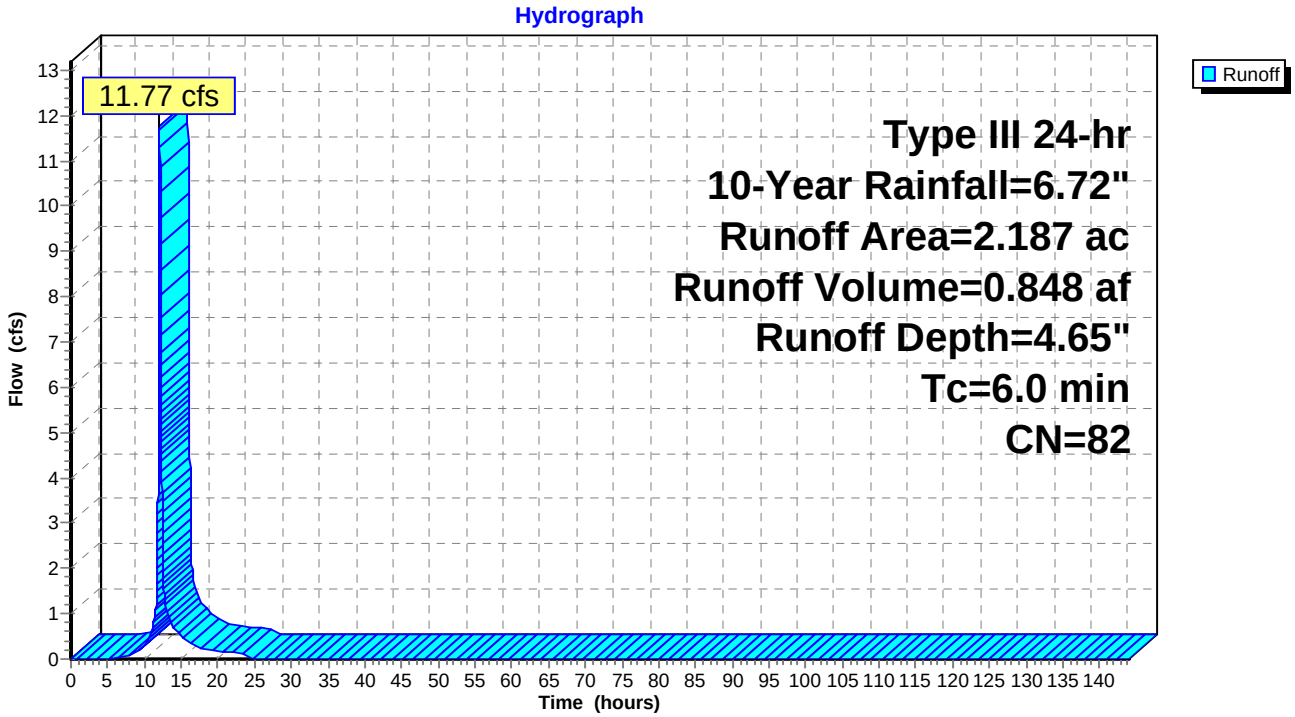
Runoff = 11.77 cfs @ 12.09 hrs, Volume= 0.848 af, Depth= 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

Area (ac)	CN	Description
1.655	98	Paved parking, HSG A
0.532	32	Woods/grass comb., Good, HSG A
2.187	82	Weighted Average
0.532		24.33% Pervious Area
1.655		75.67% Impervious Area

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

Subcatchment 5POND: SUB 5 TO POND



Summary for Subcatchment 6: SUB 6

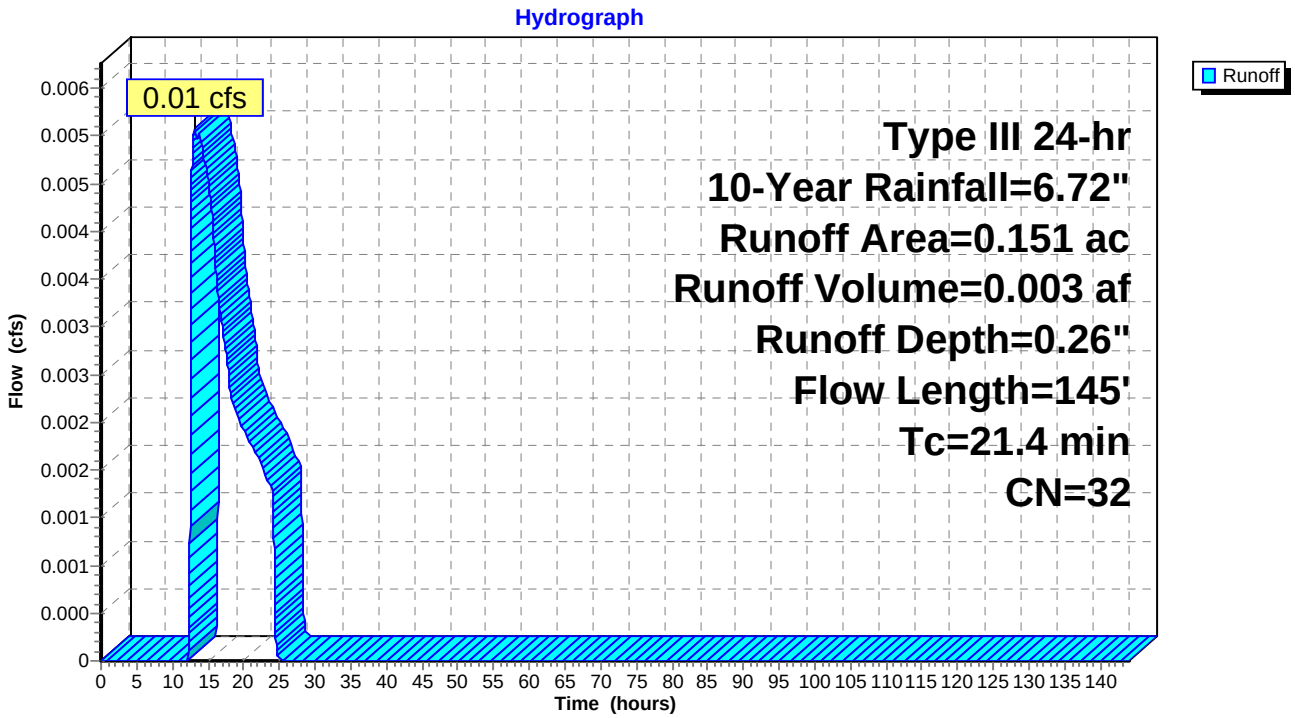
Runoff = 0.01 cfs @ 13.05 hrs, Volume= 0.003 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.72"

Area (ac)	CN	Description
0.151	32	Woods/grass comb., Good, HSG A
0.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	100	0.0050	0.08		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
1.0	45	0.0111	0.74		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
21.4	145	Total			

Subcatchment 6: SUB 6



Summary for Pond POND: WET DETENTION BASIN

Inflow Area = 2.187 ac, 75.67% Impervious, Inflow Depth = 4.65" for 10-Year event
Inflow = 11.77 cfs @ 12.09 hrs, Volume= 0.848 af
Outflow = 0.25 cfs @ 17.58 hrs, Volume= 0.527 af, Atten= 98%, Lag= 329.8 min
Primary = 0.25 cfs @ 17.58 hrs, Volume= 0.527 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 43.77' @ 17.58 hrs Surf.Area= 0.323 ac Storage= 0.719 af

Plug-Flow detention time= 3,163.1 min calculated for 0.527 af (62% of inflow)
Center-of-Mass det. time= 3,061.3 min (3,865.9 - 804.6)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	1.115 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

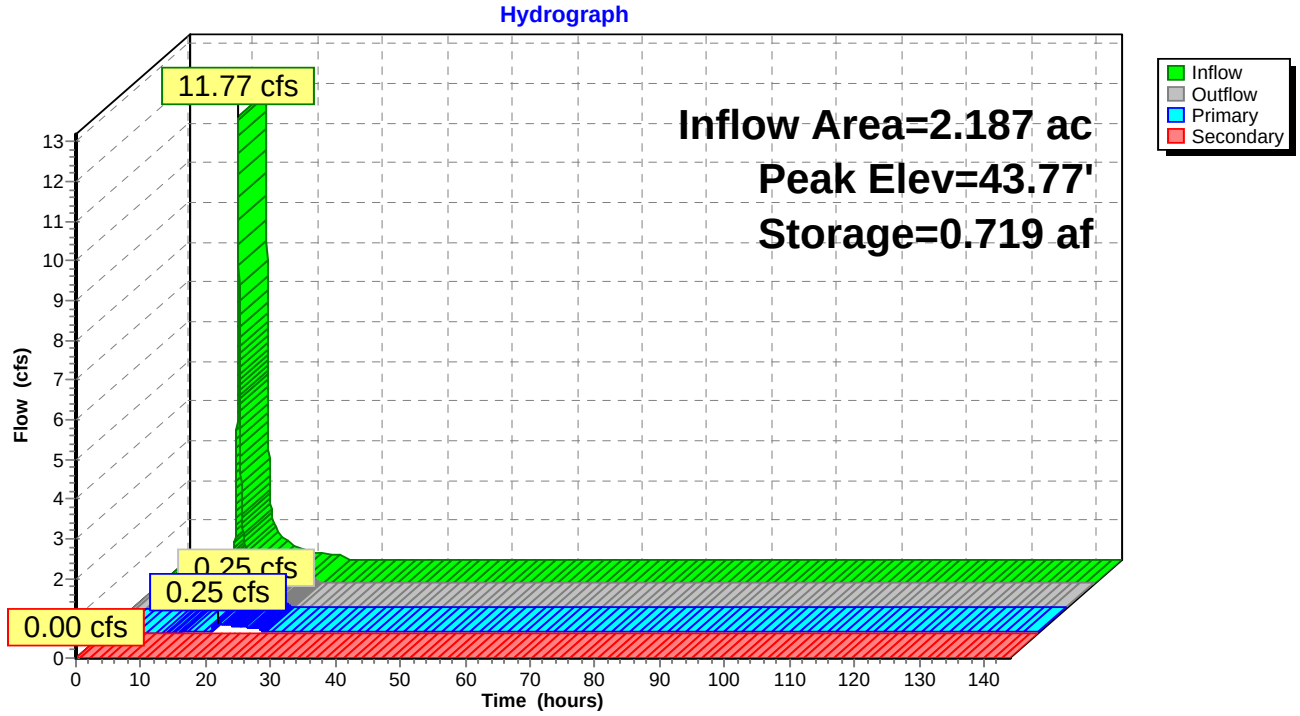
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
41.50	0.261	627.3	0.000	0.000	0.261
42.00	0.323	645.1	0.146	0.146	0.303
43.00	0.323	645.1	0.323	0.469	0.318
44.00	0.323	645.1	0.323	0.792	0.333
45.00	0.323	645.1	0.323	1.115	0.347

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**12.0" Round RCP_Round 12"** L= 52.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 41.50' / 41.00' S= 0.0096 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	43.75'	**48.0" x 48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	41.50'	**1.1" Vert. Orifice/Grate** C= 0.600
#4	Secondary	43.90'	**58.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.25 cfs @ 17.58 hrs HW=43.77' (Free Discharge)
└**1=RCP_Round 12"** (Passes 0.25 cfs of 4.99 cfs potential flow)
  └**2=Grate** (Weir Controls 0.21 cfs @ 0.52 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.05 cfs @ 7.19 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.50' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND: WET DETENTION BASIN



Stage-Discharge for Pond POND: WET DETENTION BASIN

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
41.50	0.00	0.00	0.00
41.55	0.00	0.00	0.00
41.60	0.01	0.01	0.00
41.65	0.01	0.01	0.00
41.70	0.01	0.01	0.00
41.75	0.01	0.01	0.00
41.80	0.02	0.02	0.00
41.85	0.02	0.02	0.00
41.90	0.02	0.02	0.00
41.95	0.02	0.02	0.00
42.00	0.02	0.02	0.00
42.05	0.02	0.02	0.00
42.10	0.02	0.02	0.00
42.15	0.02	0.02	0.00
42.20	0.03	0.03	0.00
42.25	0.03	0.03	0.00
42.30	0.03	0.03	0.00
42.35	0.03	0.03	0.00
42.40	0.03	0.03	0.00
42.45	0.03	0.03	0.00
42.50	0.03	0.03	0.00
42.55	0.03	0.03	0.00
42.60	0.03	0.03	0.00
42.65	0.03	0.03	0.00
42.70	0.03	0.03	0.00
42.75	0.03	0.03	0.00
42.80	0.04	0.04	0.00
42.85	0.04	0.04	0.00
42.90	0.04	0.04	0.00
42.95	0.04	0.04	0.00
43.00	0.04	0.04	0.00
43.05	0.04	0.04	0.00
43.10	0.04	0.04	0.00
43.15	0.04	0.04	0.00
43.20	0.04	0.04	0.00
43.25	0.04	0.04	0.00
43.30	0.04	0.04	0.00
43.35	0.04	0.04	0.00
43.40	0.04	0.04	0.00
43.45	0.04	0.04	0.00
43.50	0.04	0.04	0.00
43.55	0.04	0.04	0.00
43.60	0.05	0.05	0.00
43.65	0.05	0.05	0.00
43.70	0.05	0.05	0.00
43.75	0.05	0.05	0.00
43.80	0.63	0.63	0.00
43.85	1.70	1.70	0.00
43.90	3.09	3.09	0.00
43.95	6.25	4.73	1.52
44.00	9.59	5.30	4.29
44.05	13.25	5.36	7.88
44.10	17.57	5.43	12.14
44.15	22.75	5.49	17.25
44.20	28.62	5.55	23.06
44.25	35.16	5.62	29.54
44.30	42.36	5.68	36.68
44.35	50.39	5.74	44.65
44.40	59.12	5.80	53.32
44.45	68.55	5.86	62.69
44.50	78.70	5.92	72.78
44.55	87.89	5.98	81.91
44.60	97.41	6.04	91.37
44.65	107.25	6.10	101.15
44.70	117.38	6.15	111.22
44.75	128.02	6.21	121.81
44.80	138.98	6.27	132.72
44.85	150.25	6.32	143.93
44.90	161.82	6.38	155.44
44.95	173.36	6.43	166.93
45.00	**185.15**	**6.49**	**178.66**

Stage-Area-Storage for Pond POND: WET DETENTION BASIN

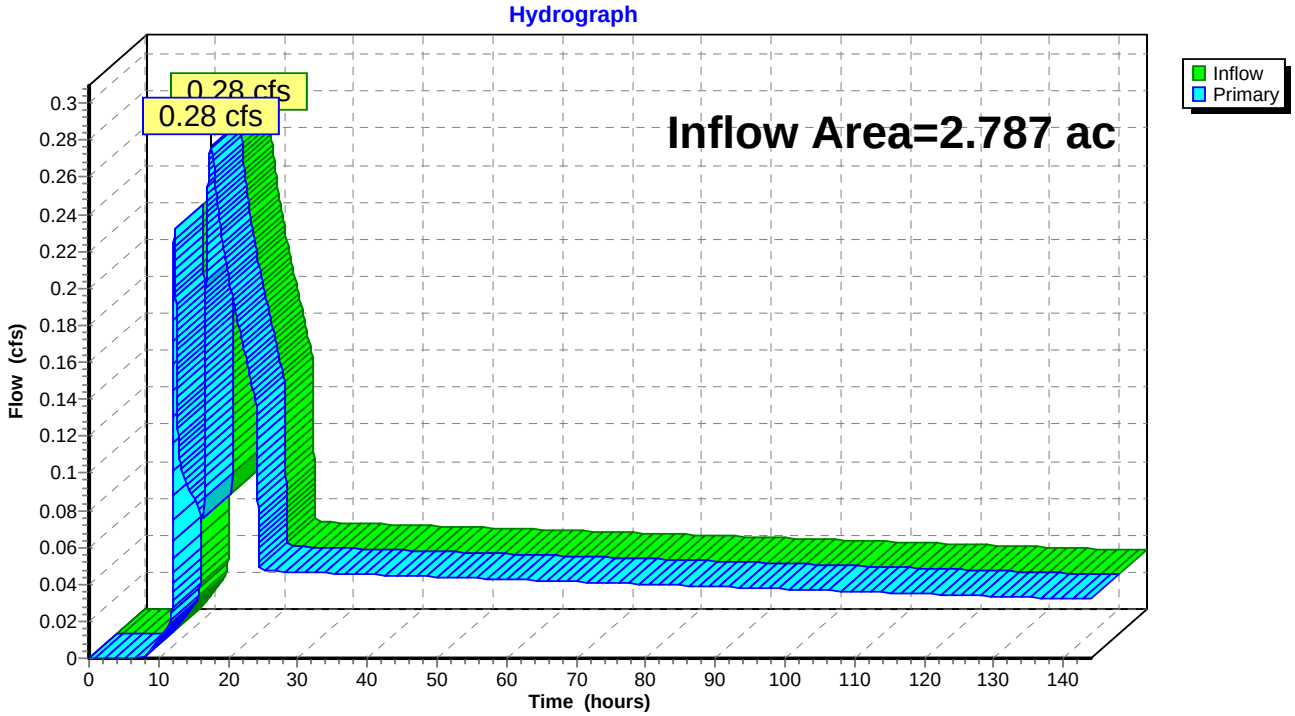
Elevation (feet)	Surface (acres)	Storage (acre-feet)
41.50	0.261	0.000
41.55	0.267	0.013
41.60	0.273	0.027
41.65	0.279	0.040
41.70	0.285	0.055
41.75	0.291	0.069
41.80	0.297	0.084
41.85	0.304	0.099
41.90	0.310	0.114
41.95	0.317	0.130
42.00	**0.323**	0.146
42.05	0.323	0.162
42.10	0.323	0.178
42.15	0.323	0.194
42.20	0.323	0.210
42.25	0.323	0.226
42.30	0.323	0.243
42.35	0.323	0.259
42.40	0.323	0.275
42.45	0.323	0.291
42.50	0.323	0.307
42.55	0.323	0.323
42.60	0.323	0.340
42.65	0.323	0.356
42.70	0.323	0.372
42.75	0.323	0.388
42.80	0.323	0.404
42.85	0.323	0.420
42.90	0.323	0.436
42.95	0.323	0.453
43.00	0.323	0.469
43.05	0.323	0.485
43.10	0.323	0.501
43.15	0.323	0.517
43.20	0.323	0.533
43.25	0.323	0.549
43.30	0.323	0.566
43.35	0.323	0.582
43.40	0.323	0.598
43.45	0.323	0.614
43.50	0.323	0.630
43.55	0.323	0.646
43.60	0.323	0.663
43.65	0.323	0.679
43.70	0.323	0.695
43.75	0.323	0.711
43.80	0.323	0.727
43.85	0.323	0.743
43.90	0.323	0.759
43.95	0.323	0.776
44.00	0.323	0.792
44.05	0.323	0.808
44.10	0.323	0.824
44.15	0.323	0.840
44.20	0.323	0.856
44.25	0.323	0.872
44.30	0.323	0.889
44.35	0.323	0.905
44.40	0.323	0.921
44.45	0.323	0.937
44.50	0.323	0.953
44.55	0.323	0.969
44.60	0.323	0.986
44.65	0.323	1.002
44.70	0.323	1.018
44.75	0.323	1.034
44.80	0.323	1.050
44.85	0.323	1.066
44.90	0.323	1.082
44.95	0.323	1.099
45.00	0.323	**1.115**

Summary for Link POST: POST

Inflow Area = 2.787 ac, 61.64% Impervious, Inflow Depth > 2.41" for 10-Year event
Inflow = 0.28 cfs @ 17.54 hrs, Volume= 0.560 af
Primary = 0.28 cfs @ 17.54 hrs, Volume= 0.560 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link POST: POST



Summary for Subcatchment 4: SUB 4

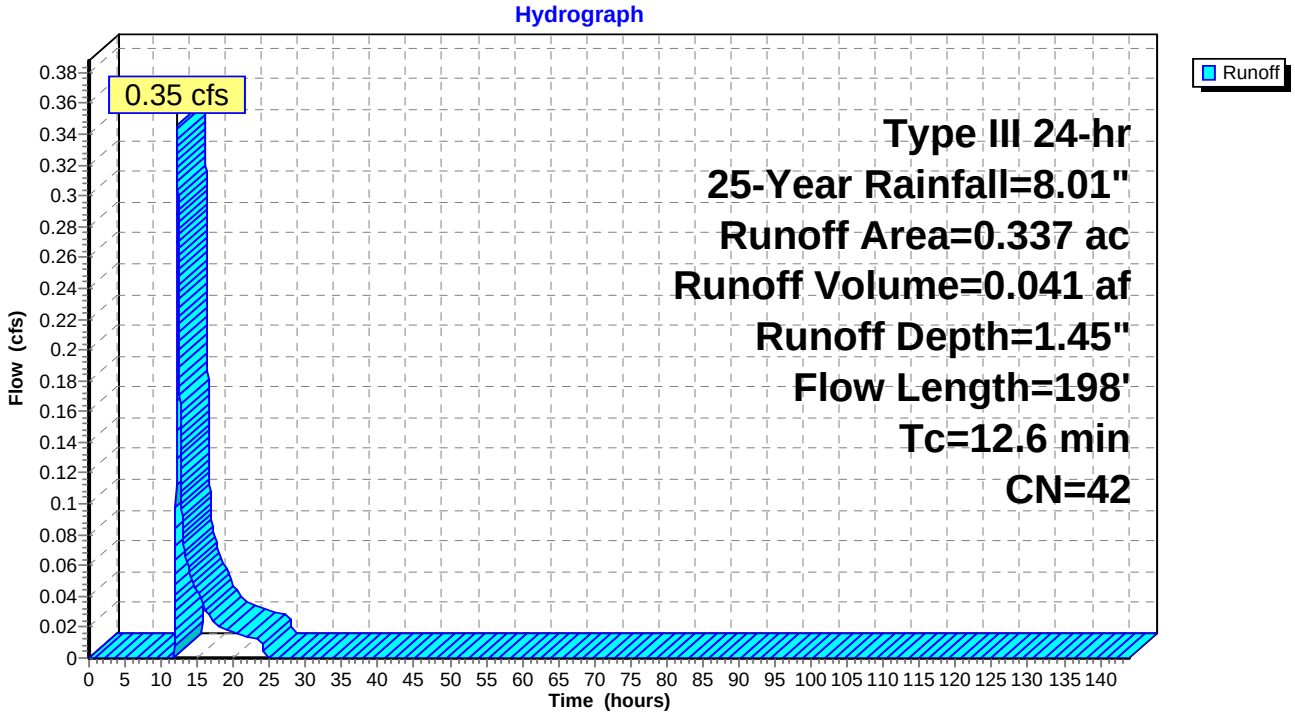
Runoff = 0.35 cfs @ 12.21 hrs, Volume= 0.041 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

Area (ac)	CN	Description
0.285	32	Woods/grass comb., Good, HSG A
0.052	98	Paved parking, HSG A
0.337	42	Weighted Average
0.285		84.57% Pervious Area
0.052		15.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	100	0.0200	0.14		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
0.3	24	0.0292	1.20		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
0.5	47	0.0468	1.51		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0545	4.74		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
12.6	198	Total			

Subcatchment 4: SUB 4



Summary for Subcatchment 5BYPASS: SUB 5 BYPASS

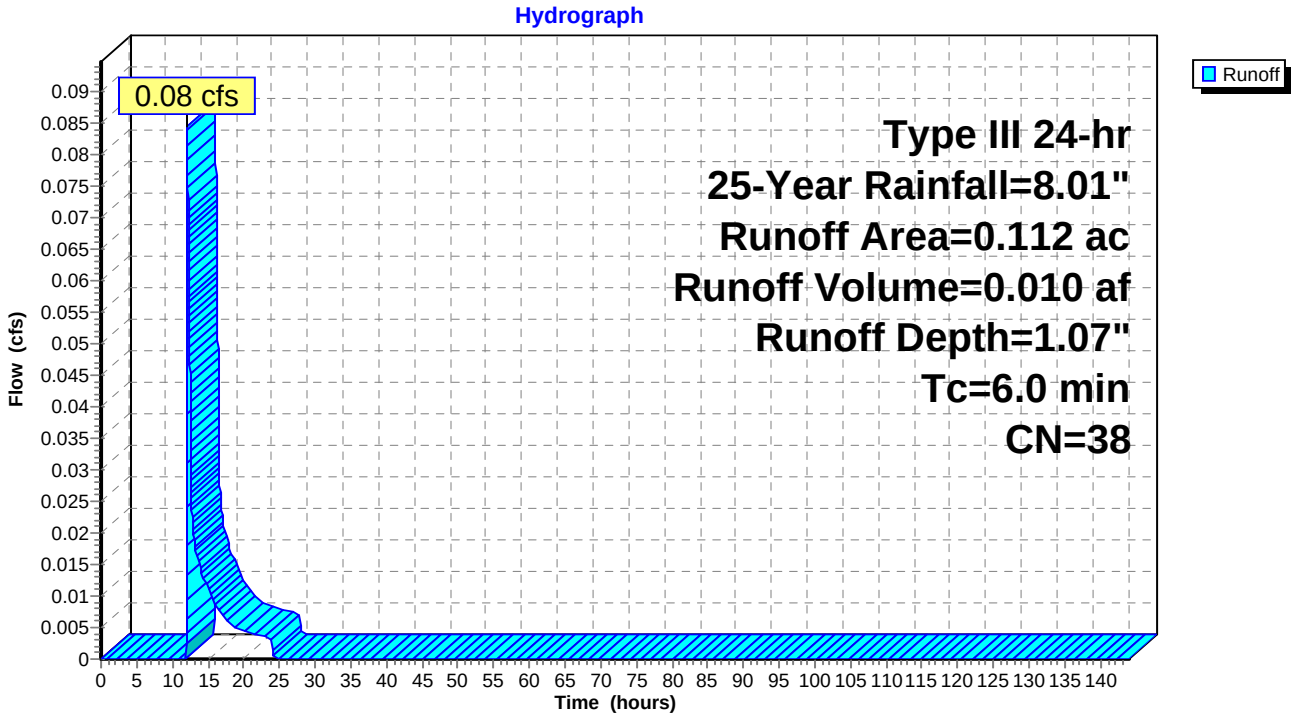
Runoff = 0.08 cfs @ 12.12 hrs, Volume= 0.010 af, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

Area (ac)	CN	Description
0.011	98	Paved parking, HSG A
0.101	32	Woods/grass comb., Good, HSG A
0.112	38	Weighted Average
0.101		90.18% Pervious Area
0.011		9.82% Impervious Area

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

Subcatchment 5BYPASS: SUB 5 BYPASS



Summary for Subcatchment 5POND: SUB 5 TO POND

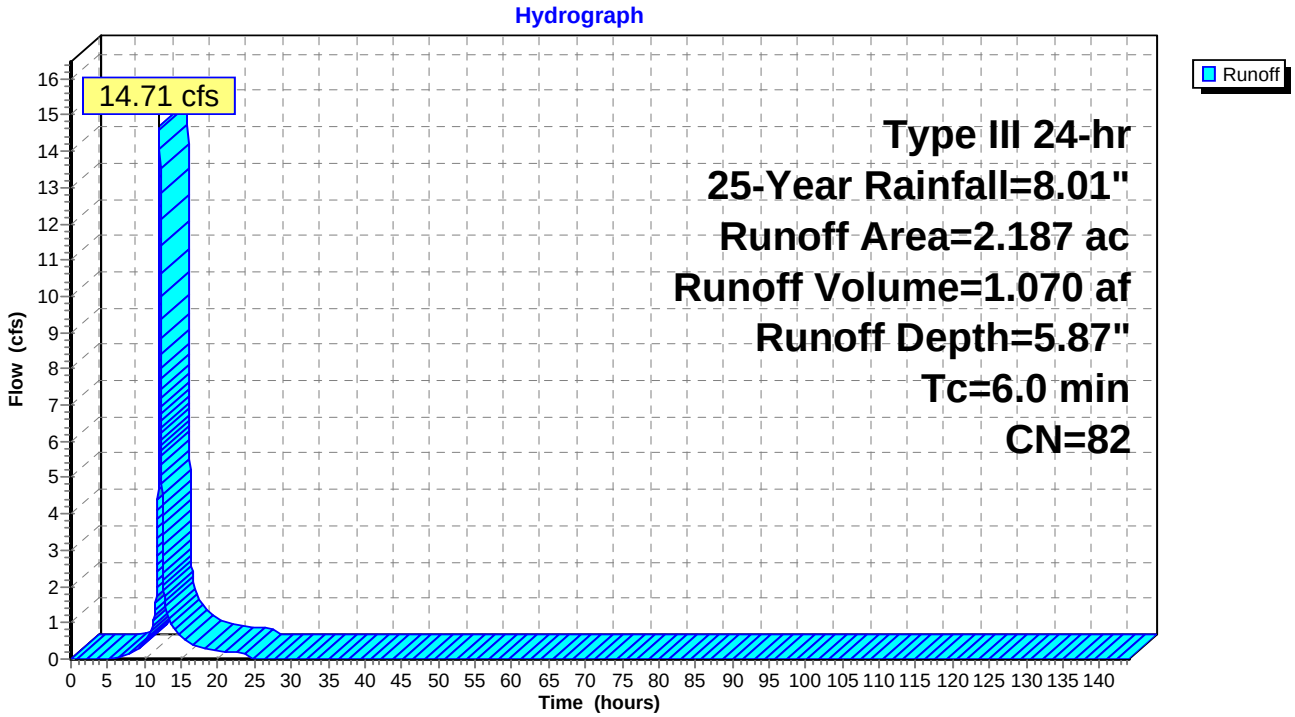
Runoff = 14.71 cfs @ 12.09 hrs, Volume= 1.070 af, Depth= 5.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

Area (ac)	CN	Description
1.655	98	Paved parking, HSG A
0.532	32	Woods/grass comb., Good, HSG A
2.187	82	Weighted Average
0.532		24.33% Pervious Area
1.655		75.67% Impervious Area

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

Subcatchment 5POND: SUB 5 TO POND



Summary for Subcatchment 6: SUB 6

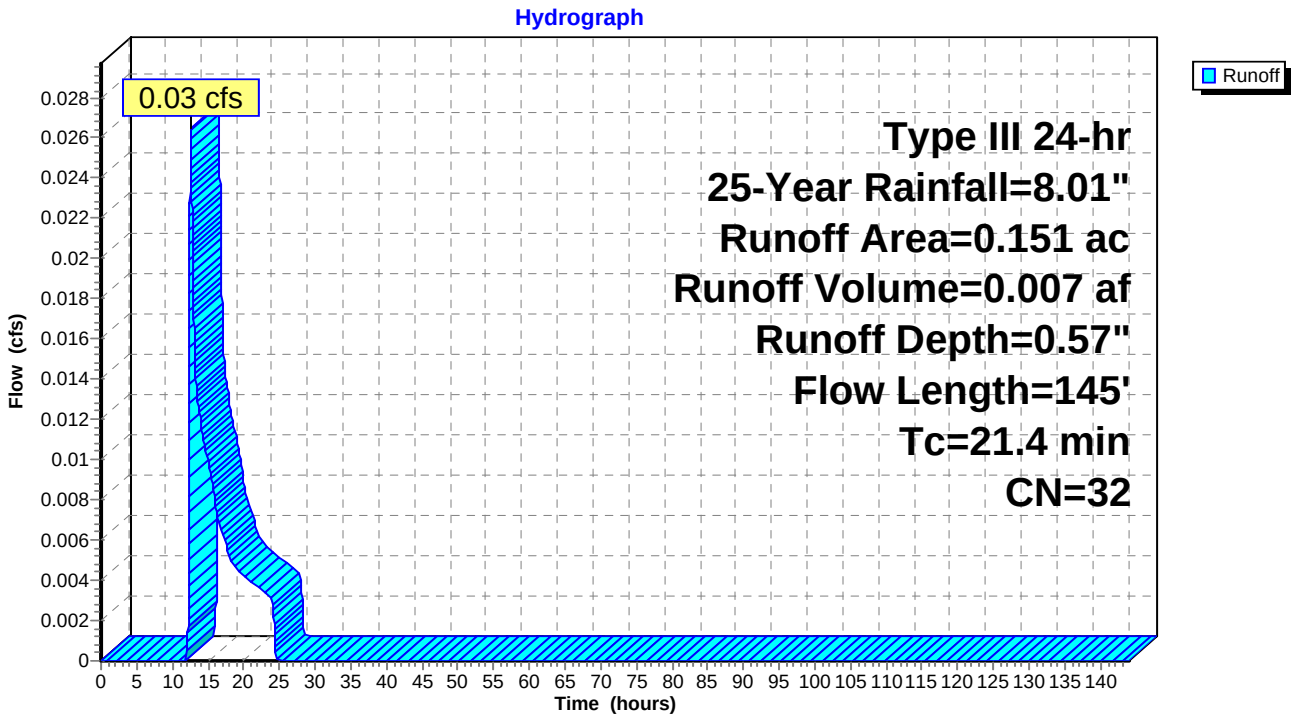
Runoff = 0.03 cfs @ 12.58 hrs, Volume= 0.007 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.01"

Area (ac)	CN	Description
0.151	32	Woods/grass comb., Good, HSG A
0.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	100	0.0050	0.08		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
1.0	45	0.0111	0.74		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
21.4	145	Total			

Subcatchment 6: SUB 6



Summary for Pond POND: WET DETENTION BASIN

Inflow Area = 2.187 ac, 75.67% Impervious, Inflow Depth = 5.87" for 25-Year event
Inflow = 14.71 cfs @ 12.09 hrs, Volume= 1.070 af
Outflow = 0.98 cfs @ 13.64 hrs, Volume= 0.748 af, Atten= 93%, Lag= 93.1 min
Primary = 0.98 cfs @ 13.64 hrs, Volume= 0.748 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 43.82' @ 13.64 hrs Surf.Area= 0.323 ac Storage= 0.733 af

Plug-Flow detention time= 2,289.3 min calculated for 0.748 af (70% of inflow)
Center-of-Mass det. time= 2,196.6 min (2,994.7 - 798.1)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	1.115 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

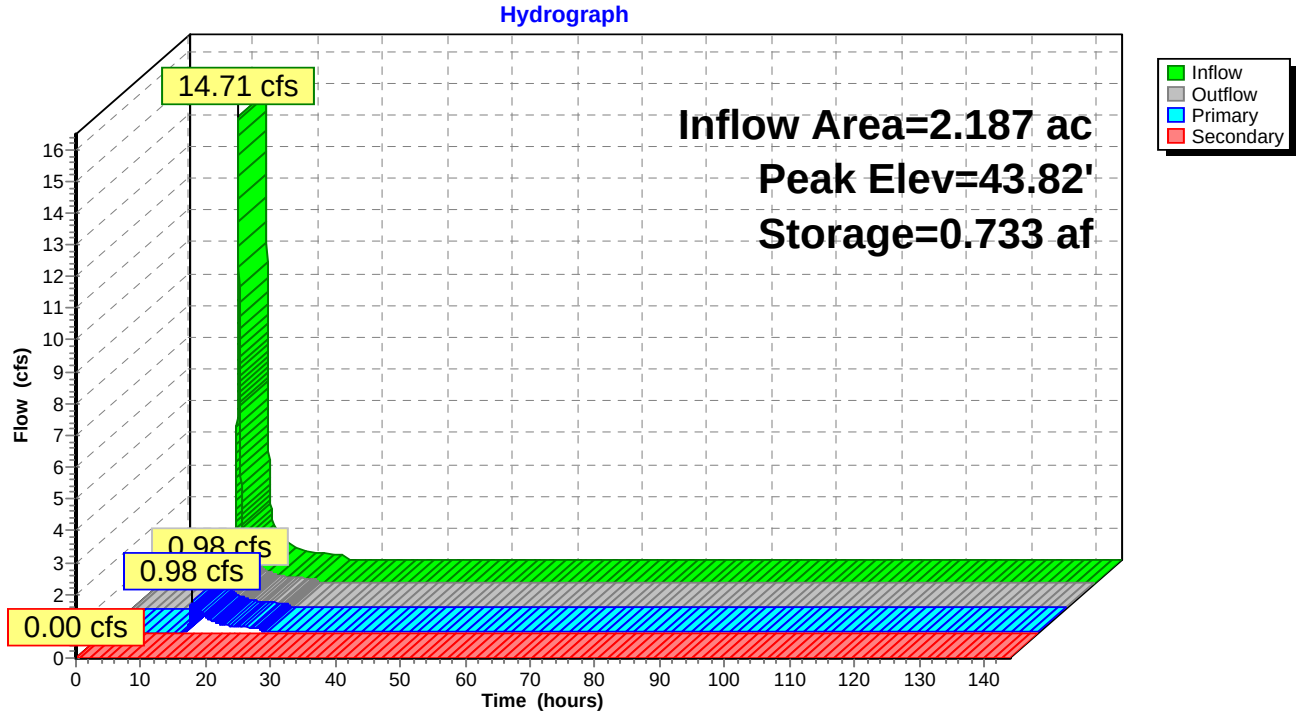
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
41.50	0.261	627.3	0.000	0.000	0.261
42.00	0.323	645.1	0.146	0.146	0.303
43.00	0.323	645.1	0.323	0.469	0.318
44.00	0.323	645.1	0.323	0.792	0.333
45.00	0.323	645.1	0.323	1.115	0.347

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**12.0" Round RCP_Round 12"** L= 52.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 41.50' / 41.00' S= 0.0096 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	43.75'	**48.0" x 48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	41.50'	**1.1" Vert. Orifice/Grate** C= 0.600
#4	Secondary	43.90'	**58.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.97 cfs @ 13.64 hrs HW=43.82' (Free Discharge)
└**1=RCP_Round 12"** (Passes 0.97 cfs of 5.05 cfs potential flow)
  └**2=Grate** (Weir Controls 0.92 cfs @ 0.85 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.05 cfs @ 7.26 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.50' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND: WET DETENTION BASIN



Stage-Discharge for Pond POND: WET DETENTION BASIN

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
41.50	0.00	0.00	0.00
41.55	0.00	0.00	0.00
41.60	0.01	0.01	0.00
41.65	0.01	0.01	0.00
41.70	0.01	0.01	0.00
41.75	0.01	0.01	0.00
41.80	0.02	0.02	0.00
41.85	0.02	0.02	0.00
41.90	0.02	0.02	0.00
41.95	0.02	0.02	0.00
42.00	0.02	0.02	0.00
42.05	0.02	0.02	0.00
42.10	0.02	0.02	0.00
42.15	0.02	0.02	0.00
42.20	0.03	0.03	0.00
42.25	0.03	0.03	0.00
42.30	0.03	0.03	0.00
42.35	0.03	0.03	0.00
42.40	0.03	0.03	0.00
42.45	0.03	0.03	0.00
42.50	0.03	0.03	0.00
42.55	0.03	0.03	0.00
42.60	0.03	0.03	0.00
42.65	0.03	0.03	0.00
42.70	0.03	0.03	0.00
42.75	0.03	0.03	0.00
42.80	0.04	0.04	0.00
42.85	0.04	0.04	0.00
42.90	0.04	0.04	0.00
42.95	0.04	0.04	0.00
43.00	0.04	0.04	0.00
43.05	0.04	0.04	0.00
43.10	0.04	0.04	0.00
43.15	0.04	0.04	0.00
43.20	0.04	0.04	0.00
43.25	0.04	0.04	0.00
43.30	0.04	0.04	0.00
43.35	0.04	0.04	0.00
43.40	0.04	0.04	0.00
43.45	0.04	0.04	0.00
43.50	0.04	0.04	0.00
43.55	0.04	0.04	0.00
43.60	0.05	0.05	0.00
43.65	0.05	0.05	0.00
43.70	0.05	0.05	0.00
43.75	0.05	0.05	0.00
43.80	0.63	0.63	0.00
43.85	1.70	1.70	0.00
43.90	3.09	3.09	0.00
43.95	6.25	4.73	1.52
44.00	9.59	5.30	4.29
44.05	13.25	5.36	7.88
44.10	17.57	5.43	12.14
44.15	22.75	5.49	17.25
44.20	28.62	5.55	23.06
44.25	35.16	5.62	29.54
44.30	42.36	5.68	36.68
44.35	50.39	5.74	44.65
44.40	59.12	5.80	53.32
44.45	68.55	5.86	62.69
44.50	78.70	5.92	72.78
44.55	87.89	5.98	81.91
44.60	97.41	6.04	91.37
44.65	107.25	6.10	101.15
44.70	117.38	6.15	111.22
44.75	128.02	6.21	121.81
44.80	138.98	6.27	132.72
44.85	150.25	6.32	143.93
44.90	161.82	6.38	155.44
44.95	173.36	6.43	166.93
45.00	**185.15**	**6.49**	**178.66**

Stage-Area-Storage for Pond POND: WET DETENTION BASIN

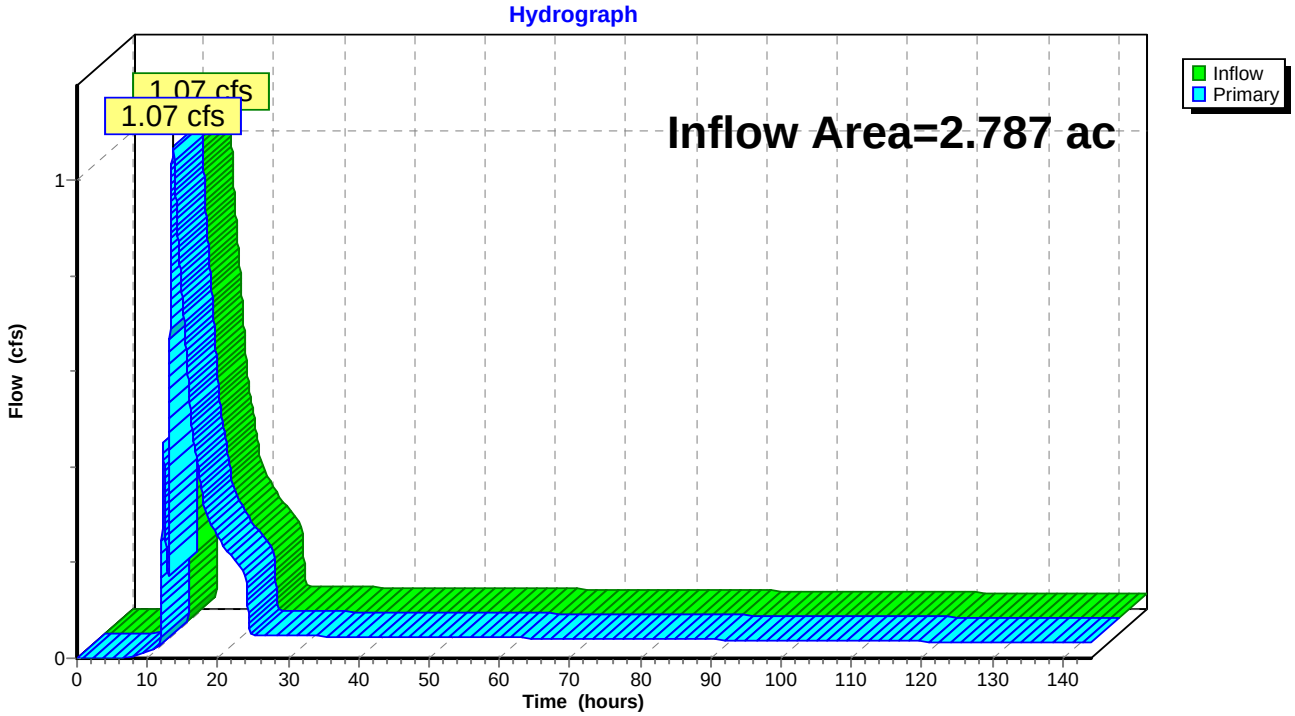
Elevation (feet)	Surface (acres)	Storage (acre-feet)
41.50	0.261	0.000
41.55	0.267	0.013
41.60	0.273	0.027
41.65	0.279	0.040
41.70	0.285	0.055
41.75	0.291	0.069
41.80	0.297	0.084
41.85	0.304	0.099
41.90	0.310	0.114
41.95	0.317	0.130
42.00	**0.323**	0.146
42.05	0.323	0.162
42.10	0.323	0.178
42.15	0.323	0.194
42.20	0.323	0.210
42.25	0.323	0.226
42.30	0.323	0.243
42.35	0.323	0.259
42.40	0.323	0.275
42.45	0.323	0.291
42.50	0.323	0.307
42.55	0.323	0.323
42.60	0.323	0.340
42.65	0.323	0.356
42.70	0.323	0.372
42.75	0.323	0.388
42.80	0.323	0.404
42.85	0.323	0.420
42.90	0.323	0.436
42.95	0.323	0.453
43.00	0.323	0.469
43.05	0.323	0.485
43.10	0.323	0.501
43.15	0.323	0.517
43.20	0.323	0.533
43.25	0.323	0.549
43.30	0.323	0.566
43.35	0.323	0.582
43.40	0.323	0.598
43.45	0.323	0.614
43.50	0.323	0.630
43.55	0.323	0.646
43.60	0.323	0.663
43.65	0.323	0.679
43.70	0.323	0.695
43.75	0.323	0.711
43.80	0.323	0.727
43.85	0.323	0.743
43.90	0.323	0.759
43.95	0.323	0.776
44.00	0.323	0.792
44.05	0.323	0.808
44.10	0.323	0.824
44.15	0.323	0.840
44.20	0.323	0.856
44.25	0.323	0.872
44.30	0.323	0.889
44.35	0.323	0.905
44.40	0.323	0.921
44.45	0.323	0.937
44.50	0.323	0.953
44.55	0.323	0.969
44.60	0.323	0.986
44.65	0.323	1.002
44.70	0.323	1.018
44.75	0.323	1.034
44.80	0.323	1.050
44.85	0.323	1.066
44.90	0.323	1.082
44.95	0.323	1.099
45.00	0.323	**1.115**

Summary for Link POST: POST

Inflow Area = 2.787 ac, 61.64% Impervious, Inflow Depth > 3.47" for 25-Year event
Inflow = 1.07 cfs @ 13.62 hrs, Volume= 0.806 af
Primary = 1.07 cfs @ 13.62 hrs, Volume= 0.806 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link POST: POST



Summary for Subcatchment 4: SUB 4

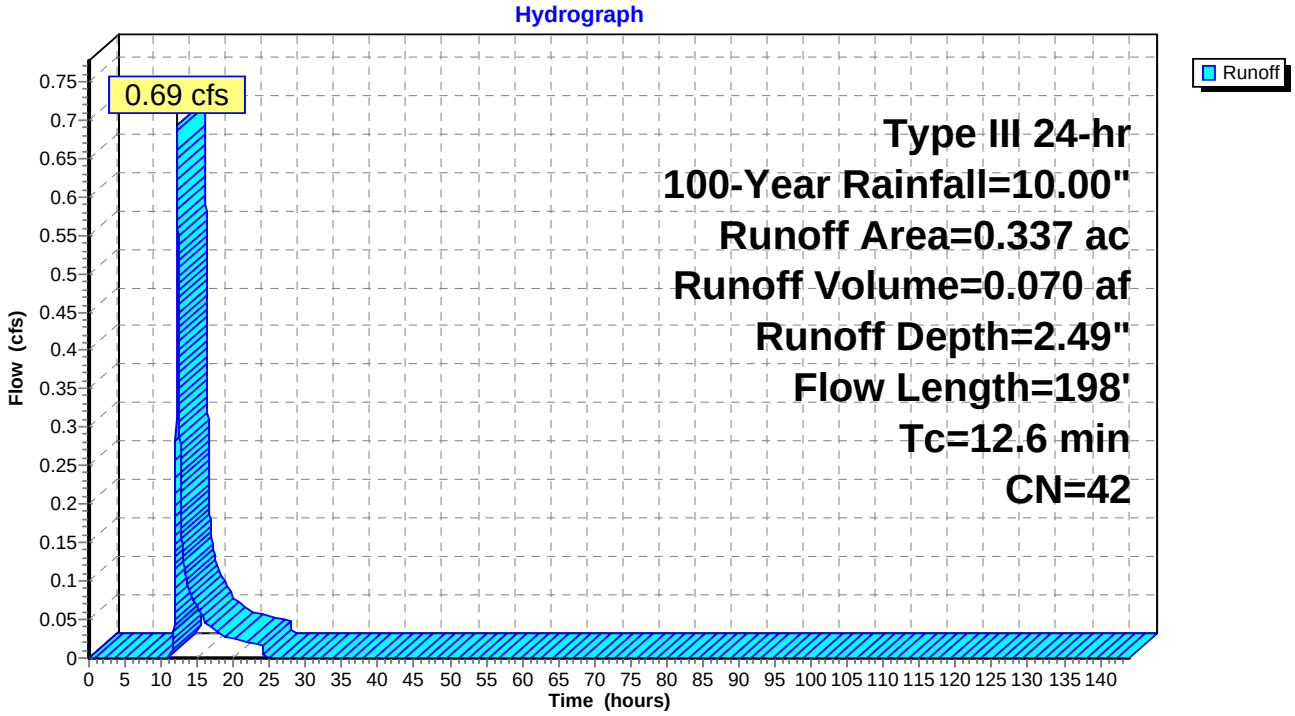
Runoff = 0.69 cfs @ 12.19 hrs, Volume= 0.070 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.00"

Area (ac)	CN	Description
0.285	32	Woods/grass comb., Good, HSG A
0.052	98	Paved parking, HSG A
0.337	42	Weighted Average
0.285		84.57% Pervious Area
0.052		15.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	100	0.0200	0.14		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
0.3	24	0.0292	1.20		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
0.5	47	0.0468	1.51		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0545	4.74		**Shallow Concentrated Flow, SCF on Sidewalk** Paved Kv= 20.3 fps
12.6	198	Total			

Subcatchment 4: SUB 4



Summary for Subcatchment 5BYPASS: SUB 5 BYPASS

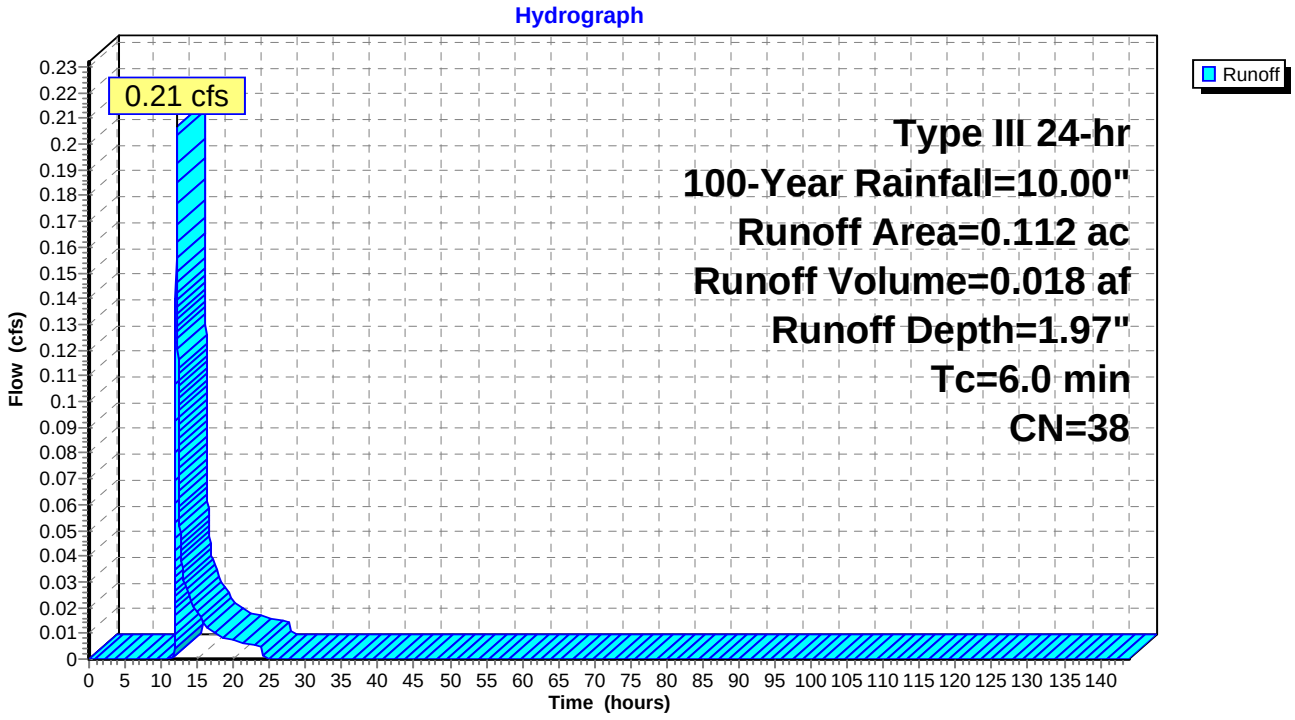
Runoff = 0.21 cfs @ 12.11 hrs, Volume= 0.018 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.00"

Area (ac)	CN	Description
0.011	98	Paved parking, HSG A
0.101	32	Woods/grass comb., Good, HSG A
0.112	38	Weighted Average
0.101		90.18% Pervious Area
0.011		9.82% Impervious Area

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

Subcatchment 5BYPASS: SUB 5 BYPASS



Summary for Subcatchment 5POND: SUB 5 TO POND

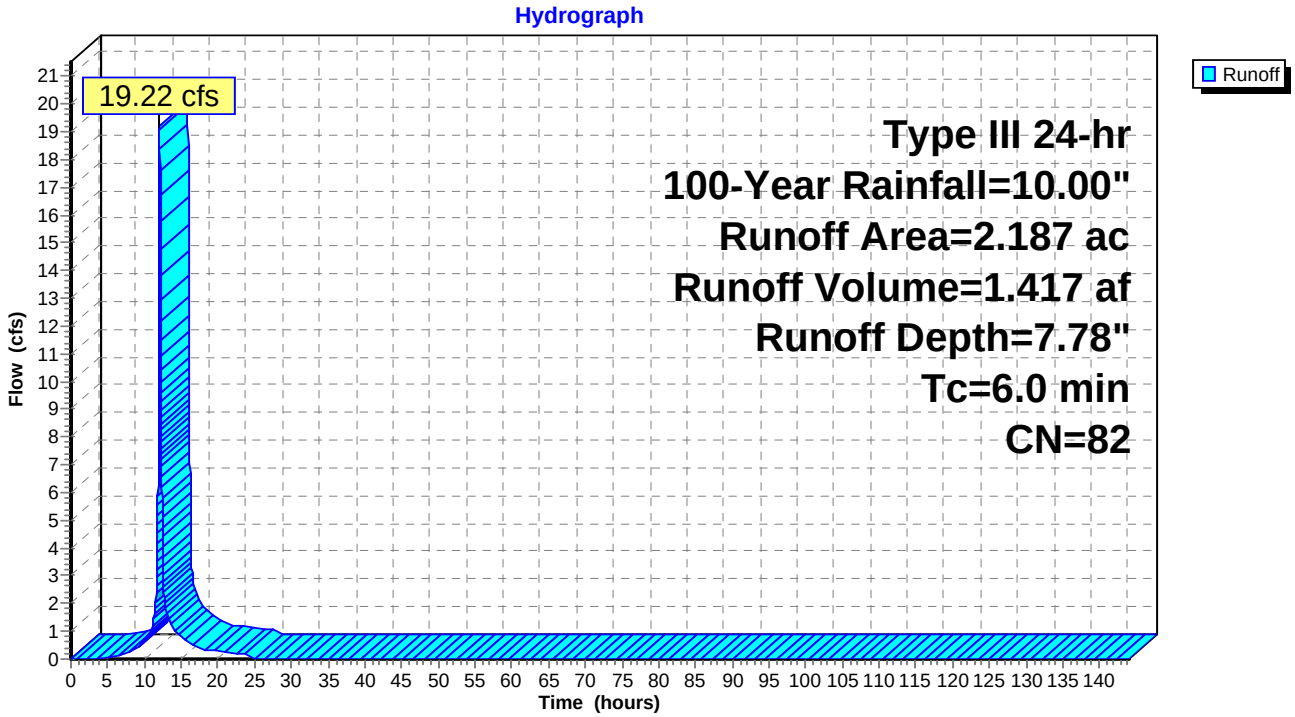
Runoff = 19.22 cfs @ 12.09 hrs, Volume= 1.417 af, Depth= 7.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.00"

Area (ac)	CN	Description
1.655	98	Paved parking, HSG A
0.532	32	Woods/grass comb., Good, HSG A
2.187	82	Weighted Average
0.532		24.33% Pervious Area
1.655		75.67% Impervious Area

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

Subcatchment 5POND: SUB 5 TO POND



Summary for Subcatchment 6: SUB 6

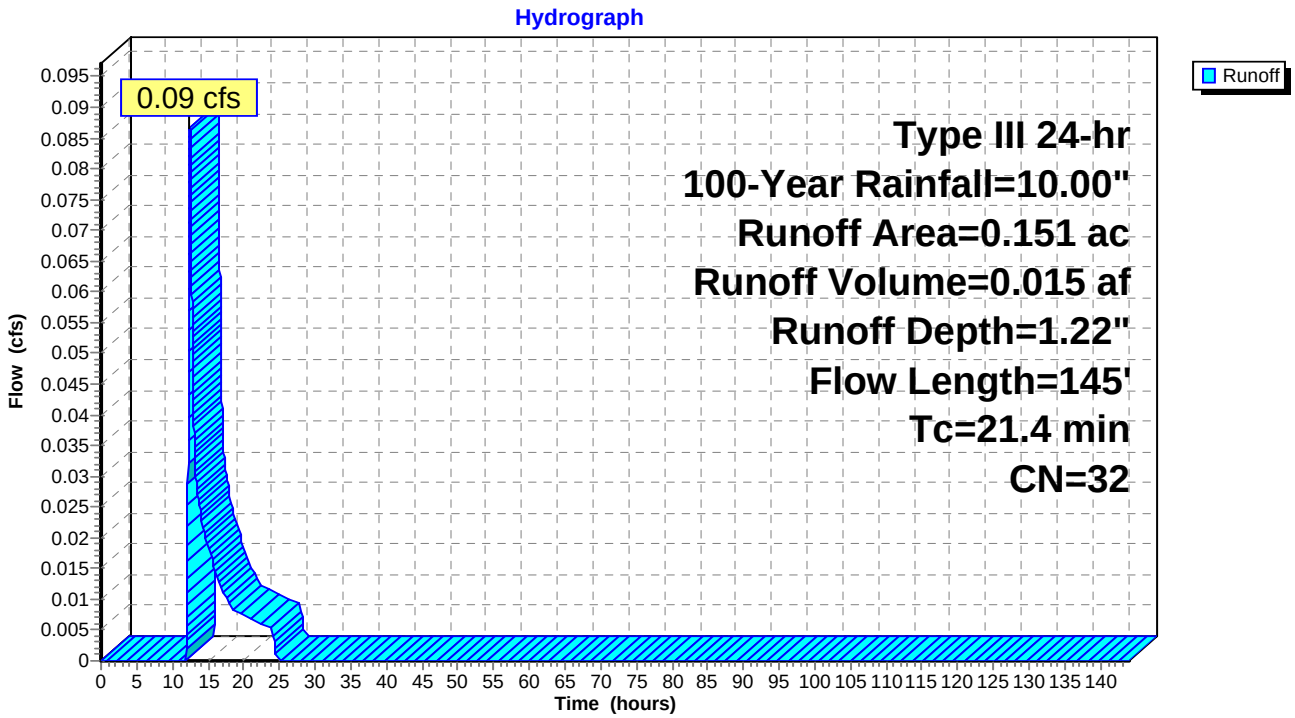
Runoff = 0.09 cfs @ 12.46 hrs, Volume= 0.015 af, Depth= 1.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.00"

Area (ac)	CN	Description
0.151	32	Woods/grass comb., Good, HSG A
0.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	100	0.0050	0.08		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 4.74"
1.0	45	0.0111	0.74		**Shallow Concentrated Flow, SCF on Grass** Short Grass Pasture Kv= 7.0 fps
21.4	145	Total			

Subcatchment 6: SUB 6



Summary for Pond POND: WET DETENTION BASIN

Inflow Area = 2.187 ac, 75.67% Impervious, Inflow Depth = 7.78" for 100-Year event
Inflow = 19.22 cfs @ 12.09 hrs, Volume= 1.417 af
Outflow = 5.88 cfs @ 12.40 hrs, Volume= 1.095 af, Atten= 69%, Lag= 19.1 min
Primary = 4.55 cfs @ 12.40 hrs, Volume= 1.075 af
Secondary = 1.33 cfs @ 12.40 hrs, Volume= 0.021 af

Routing by Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 43.94' @ 12.40 hrs Surf.Area= 0.323 ac Storage= 0.774 af

Plug-Flow detention time= 1,598.1 min calculated for 1.095 af (77% of inflow)
Center-of-Mass det. time= 1,517.7 min (2,308.1 - 790.3)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	1.115 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

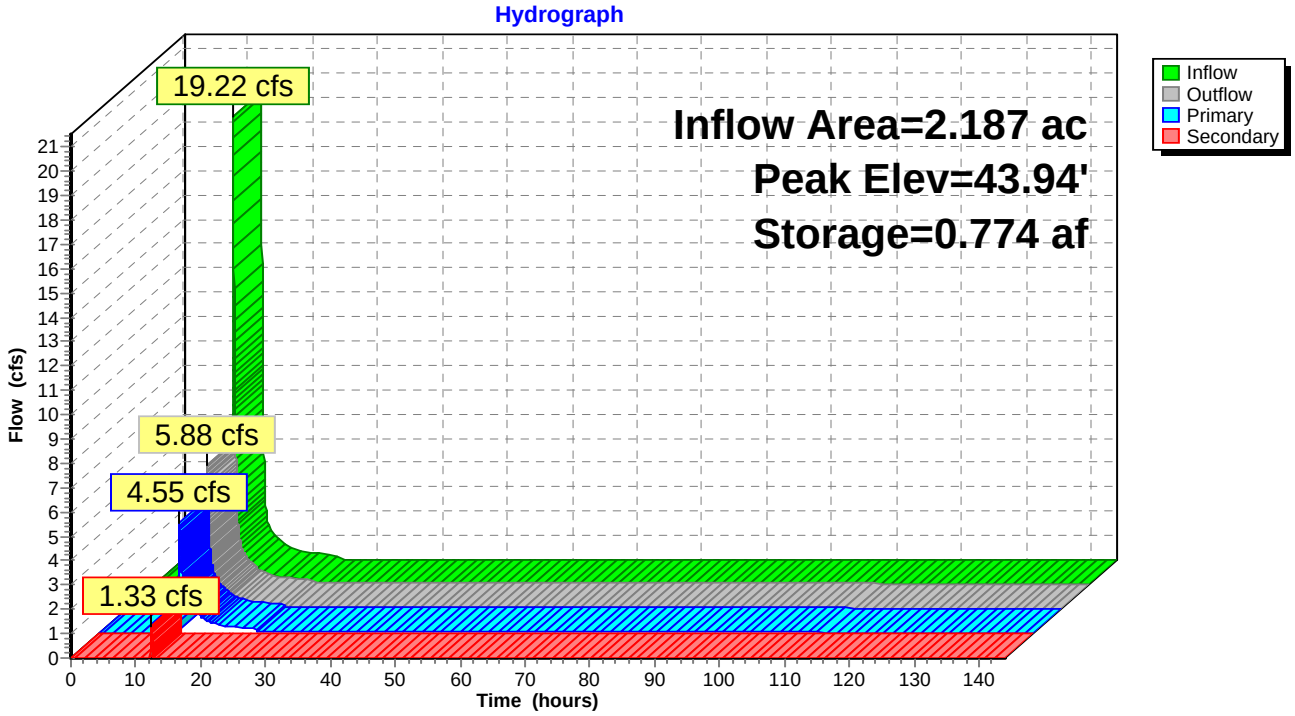
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
41.50	0.261	627.3	0.000	0.000	0.261
42.00	0.323	645.1	0.146	0.146	0.303
43.00	0.323	645.1	0.323	0.469	0.318
44.00	0.323	645.1	0.323	0.792	0.333
45.00	0.323	645.1	0.323	1.115	0.347

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**12.0" Round RCP_Round 12"** L= 52.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 41.50' / 41.00' S= 0.0096 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	43.75'	**48.0" x 48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	41.50'	**1.1" Vert. Orifice/Grate** C= 0.600
#4	Secondary	43.90'	**58.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=4.54 cfs @ 12.40 hrs HW=43.94' (Free Discharge)
└**1=RCP_Round 12"** (Passes 4.54 cfs of 5.22 cfs potential flow)
  └**2=Grate** (Weir Controls 4.50 cfs @ 1.44 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.05 cfs @ 7.46 fps)

Secondary OutFlow Max=1.28 cfs @ 12.40 hrs HW=43.94' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Weir Controls 1.28 cfs @ 0.49 fps)

Pond POND: WET DETENTION BASIN



Stage-Discharge for Pond POND: WET DETENTION BASIN

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
41.50	0.00	0.00	0.00
41.55	0.00	0.00	0.00
41.60	0.01	0.01	0.00
41.65	0.01	0.01	0.00
41.70	0.01	0.01	0.00
41.75	0.01	0.01	0.00
41.80	0.02	0.02	0.00
41.85	0.02	0.02	0.00
41.90	0.02	0.02	0.00
41.95	0.02	0.02	0.00
42.00	0.02	0.02	0.00
42.05	0.02	0.02	0.00
42.10	0.02	0.02	0.00
42.15	0.02	0.02	0.00
42.20	0.03	0.03	0.00
42.25	0.03	0.03	0.00
42.30	0.03	0.03	0.00
42.35	0.03	0.03	0.00
42.40	0.03	0.03	0.00
42.45	0.03	0.03	0.00
42.50	0.03	0.03	0.00
42.55	0.03	0.03	0.00
42.60	0.03	0.03	0.00
42.65	0.03	0.03	0.00
42.70	0.03	0.03	0.00
42.75	0.03	0.03	0.00
42.80	0.04	0.04	0.00
42.85	0.04	0.04	0.00
42.90	0.04	0.04	0.00
42.95	0.04	0.04	0.00
43.00	0.04	0.04	0.00
43.05	0.04	0.04	0.00
43.10	0.04	0.04	0.00
43.15	0.04	0.04	0.00
43.20	0.04	0.04	0.00
43.25	0.04	0.04	0.00
43.30	0.04	0.04	0.00
43.35	0.04	0.04	0.00
43.40	0.04	0.04	0.00
43.45	0.04	0.04	0.00
43.50	0.04	0.04	0.00
43.55	0.04	0.04	0.00
43.60	0.05	0.05	0.00
43.65	0.05	0.05	0.00
43.70	0.05	0.05	0.00
43.75	0.05	0.05	0.00
43.80	0.63	0.63	0.00
43.85	1.70	1.70	0.00
43.90	3.09	3.09	0.00
43.95	6.25	4.73	1.52
44.00	9.59	5.30	4.29
44.05	13.25	5.36	7.88
44.10	17.57	5.43	12.14
44.15	22.75	5.49	17.25
44.20	28.62	5.55	23.06
44.25	35.16	5.62	29.54
44.30	42.36	5.68	36.68
44.35	50.39	5.74	44.65
44.40	59.12	5.80	53.32
44.45	68.55	5.86	62.69
44.50	78.70	5.92	72.78
44.55	87.89	5.98	81.91
44.60	97.41	6.04	91.37
44.65	107.25	6.10	101.15
44.70	117.38	6.15	111.22
44.75	128.02	6.21	121.81
44.80	138.98	6.27	132.72
44.85	150.25	6.32	143.93
44.90	161.82	6.38	155.44
44.95	173.36	6.43	166.93
45.00	**185.15**	**6.49**	**178.66**

Stage-Area-Storage for Pond POND: WET DETENTION BASIN

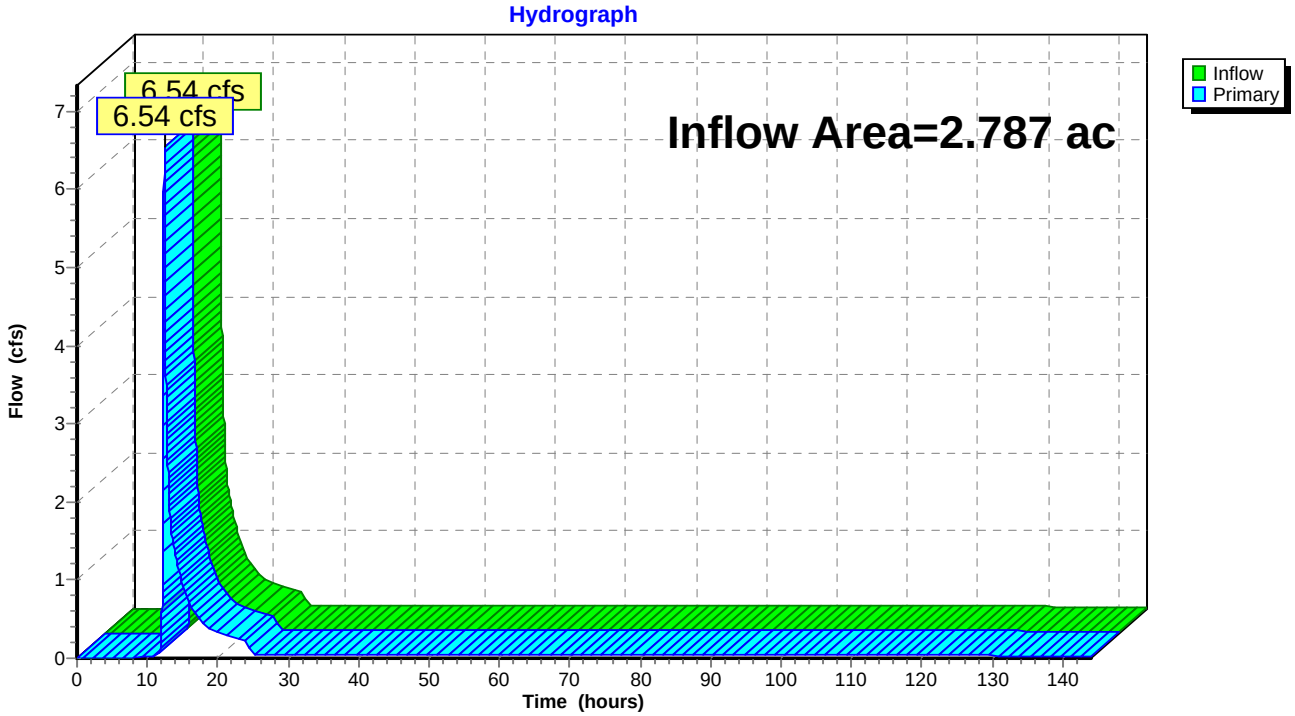
Elevation (feet)	Surface (acres)	Storage (acre-feet)
41.50	0.261	0.000
41.55	0.267	0.013
41.60	0.273	0.027
41.65	0.279	0.040
41.70	0.285	0.055
41.75	0.291	0.069
41.80	0.297	0.084
41.85	0.304	0.099
41.90	0.310	0.114
41.95	0.317	0.130
42.00	**0.323**	0.146
42.05	0.323	0.162
42.10	0.323	0.178
42.15	0.323	0.194
42.20	0.323	0.210
42.25	0.323	0.226
42.30	0.323	0.243
42.35	0.323	0.259
42.40	0.323	0.275
42.45	0.323	0.291
42.50	0.323	0.307
42.55	0.323	0.323
42.60	0.323	0.340
42.65	0.323	0.356
42.70	0.323	0.372
42.75	0.323	0.388
42.80	0.323	0.404
42.85	0.323	0.420
42.90	0.323	0.436
42.95	0.323	0.453
43.00	0.323	0.469
43.05	0.323	0.485
43.10	0.323	0.501
43.15	0.323	0.517
43.20	0.323	0.533
43.25	0.323	0.549
43.30	0.323	0.566
43.35	0.323	0.582
43.40	0.323	0.598
43.45	0.323	0.614
43.50	0.323	0.630
43.55	0.323	0.646
43.60	0.323	0.663
43.65	0.323	0.679
43.70	0.323	0.695
43.75	0.323	0.711
43.80	0.323	0.727
43.85	0.323	0.743
43.90	0.323	0.759
43.95	0.323	0.776
44.00	0.323	0.792
44.05	0.323	0.808
44.10	0.323	0.824
44.15	0.323	0.840
44.20	0.323	0.856
44.25	0.323	0.872
44.30	0.323	0.889
44.35	0.323	0.905
44.40	0.323	0.921
44.45	0.323	0.937
44.50	0.323	0.953
44.55	0.323	0.969
44.60	0.323	0.986
44.65	0.323	1.002
44.70	0.323	1.018
44.75	0.323	1.034
44.80	0.323	1.050
44.85	0.323	1.066
44.90	0.323	1.082
44.95	0.323	1.099
45.00	0.323	**1.115**

Summary for Link POST: POST

Inflow Area = 2.787 ac, 61.64% Impervious, Inflow Depth > 5.16" for 100-Year event
Inflow = 6.54 cfs @ 12.40 hrs, Volume= 1.199 af
Primary = 6.54 cfs @ 12.40 hrs, Volume= 1.199 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Link POST: POST



APPENDIX I

GEOTECHNICAL REPORT

REPORT OF SUBSURFACE EXPLORATION
AND
GEOTECHNICAL ENGINEERING EVALUATION

PROPOSED ALDI FOOD STORE #98
3701 SOUTH COLLEGE ROAD
WILMINGTON, NEW HANOVER COUNTY, NORTH CAROLINA
ECS PROJECT No: 22-23743

Prepared For

ALDI, INC.

Prepared By

FEBRUARY 5, 2016

February 5, 2016

Mr. Justin Spruill, Director of Real Estate
Aldi, Inc.
1985 Old Union Church Road
Salisbury, North Carolina 28146

Re: Report of Subsurface Exploration and Geotechnical Engineering Evaluation
Proposed Aldi Food Store #98
3701 South College Road
Wilmington, New Hanover County, North Carolina
ECS Project No. 22.23743

Dear Mr. Spruill:

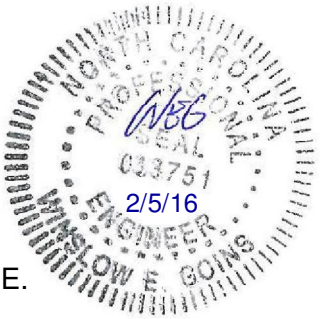
As authorized by your acceptance of our Proposal Number 22-20391-P, dated December 29, 2015, ECS Carolinas, LLP (ECS) has completed the subsurface exploration and geotechnical engineering evaluation for the above referenced project. This report contains the results of our subsurface exploration, as well as our recommendations concerning the geotechnical design and construction aspects of the project. Also included is a CD containing the Geotechnical Requirements and Design Pavement Sections sheet for inclusion with your project bid documents.

We appreciate the opportunity to be of continued service to Aldi and look forward to our continued involvement during the construction of this project. If you have any questions concerning the information and recommendations presented in this report, or if we can be of further assistance, please do not hesitate to contact us.

Sincerely,

ECS CAROLINAS, LLP represented by;

Micah F. Hatch, P.E.
Project Engineer



Winslow E. Goins, P.E.
Principal Engineer
North Carolina License No. 033571

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1.0 EXECUTIVE SUMMARY

This report contains the results of our subsurface exploration and geotechnical engineering evaluation for the proposed Aldi food store to be located at 3701 South College Road in Wilmington, New Hanover County, North Carolina. The Aldi food store will be an approximately 18,000 square foot single-story steel and masonry structure. ECS understands that the maximum anticipated column and wall loads for the store are expected to be on the order of 150 kips and 3 kips per linear foot, respectively. The maximum anticipated slab load is on the order of 150 pounds per square foot. Construction is also expected to include new underground utilities, paved parking, drive and loading areas and stormwater management areas.

Minimal to approximately 2 inches of organic topsoil and rootmat was reported by drillers at CPT sounding locations S-1, S-3 to S-4, S-7 to S-9 and S-11 to S-14. Paving materials ranging from approximately 2 to 6 inches thick were reported at sounding locations S-2, S-5 to S-6 and S-10. Beneath the surface materials, natural soils were encountered. The natural soils typically classify as intermittent layers of silty, slightly silty and clean sands (SM, SP-SM, SP) and sandy lean clays (CL). N*-values (equivalent corrected N-value) ranging from 3 to 100 bpf were recorded in the natural soils.

Groundwater was observed within the soundings at the time of our exploration at depths of about 4.1 to 9.0 feet below existing grades.

Even though the soundings did not detect apparent fill, the natural geology in developed portions of the site has been modified in the past and areas of undocumented fill may be present. We emphasize the importance of comprehensive subgrade evaluations prior to engineered fill placement and/or other construction activities. These evaluations may include proofrolling the subgrade soils, performing hand auger borings, and excavation of test pits within possible fill areas. The mentioned evaluations would help in identifying areas of soft, loose, or otherwise unsuitable fills, which would require remedial activities.

Provided the subgrade preparation and earthwork operations are completed in strict accordance with the recommendations of this report, the proposed construction can be supported on conventional shallow foundations bearing on approved natural soils or new engineered fill. Shallow foundations bearing on natural soils or new engineered fill may be designed for a net allowable bearing pressure of up to 3,000 pound per square foot (psf). Concrete slabs-on-grade can be designed using a modulus of subgrade reaction of 150 pounds per cubic inch (pci). Based on the soil test boring results, an IBC Seismic Site Class “D” is recommended for this site.

Specific information regarding the field and laboratory testing, the site and subsurface conditions at the time of our exploration, and our conclusions and recommendations concerning the geotechnical design and construction aspects of the project are discussed in detail in the subsequent sections of this report. Please note this Executive Summary is an important part of this report and may not be relied upon exclusive of the entire report. The subsequent sections of this report constitute our findings, conclusions, and recommendations in their entirety.

2.0 PROJECT INFORMATION

Our understanding of the proposed construction is based upon our conversations with the client and review of the provided site plan. We understand that the project site consists of two parcels totaling approximately 2.91-acres and is currently the site of Trinity Presbyterian Church at 3701 South College Road in Wilmington, New Hanover County, North Carolina, as shown on the Site Vicinity Map in Appendix I.

The site plan provided to ECS indicates that the proposed Aldi food store will be located on the southeastern portion of the site. The majority of the planned parking will be to the north and west of the structure. ECS understands that the Aldi food store will be an approximately 18,000 square foot, single-story steel and masonry structure. Maximum anticipated column and wall loads for the store are expected to be on the order of 150 kips and 3 kips per linear foot, respectively. The maximum anticipated slab load is expected to be on the order of 150 pounds per square foot. Construction is also expected to include new underground utilities; and paved, drives and loading areas. We expect that shallow to moderate cuts and fills will be needed to achieve the design grades based upon the prevailing site topography.

3.0 EXPLORATION PROCEDURES

3.1 Cone Penetration Test

Fourteen electronic cone penetration test soundings (S-1 through S-14) were performed during our field exploration. The cone penetration test soundings were performed in general conformance with ASTM D 5778. The soundings were performed with a track mounted rig. The approximate locations of the CPT soundings are indicated on the Sounding Location Diagram in Appendix I of this report.

The cone used in the soundings has a tip area of 10 cm^2 and a sleeve area of 150 cm^2. The CPT soundings recorded tip resistance and sleeve friction measurements to assist in determining pertinent index and engineering properties of the site soils. The ratio of the sleeve friction to tip resistance is then used to aid in assessing the soil types through which the tip is advanced. The results of the CPT soundings are presented in Appendix I.

3.2 Laboratory Testing

Representative soil samples obtained during our field exploration were selected and tested in our laboratory to check field classifications and to help determine pertinent engineering properties of the site soils. Laboratory testing included visual classifications in accordance with the Unified Soil Classification System (ASTM D 2488), moisture content testing (ASTM D 2216), and grain size testing (ASTM D 1140). A standard Proctor moisture-density relationship (ASTM D 698) was developed from a bulk soil sample obtained near sounding S-9 and a CBR (California Bearing Ratio) test (ASTM D 1883) was performed on a remolded specimen of the bulk sample. The laboratory testing was performed in general conformance with the referenced ASTM standards. The laboratory test results are included in Appendix II.

4.0 SITE AND SUBSURFACE CONDITIONS

4.1 Site Observations

The project site consists of an approximately 2.91-acre parcel at 3701 South College Road in Wilmington, New Hanover County, North Carolina. The site plan provided indicates that the Aldi Store will be located in the southeastern portion of the site.

The 2.91-acre site is currently the site of Trinity Presbyterian Church. The developed area consists of a single story building, trailer structure and asphalt paved parking and drive areas.

Topographically, the site is typically flat. Site elevations generally range from approximately 40 to 44 feet. Based on our observations, we expect that shallow to moderate cuts and fills will be required to establish finished elevations in planned building and pavement areas.

4.2 Regional Geology

The site is located in the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain is composed of seven terraces, each representing a former level of the Atlantic Ocean. Soils in this area generally consist of sedimentary materials transported from other areas by the ocean or rivers. These deposits vary in thickness from a thin veneer along the western edge of the region to more than 10,000 feet near the coast. The sedimentary deposits of the Coastal Plain rest upon consolidated rocks similar to those underlying the Sand Hills, Piedmont and Blue Ridge Physiographic Provinces. In general, shallow unconfined groundwater movement within the overlying soils is largely controlled by topographic gradients. Recharge occurs primarily by infiltration along higher elevations and typically discharges into streams or other surface water bodies. The elevation of the shallow water table is transient and can vary greatly with seasonal fluctuations in precipitation.

4.3 Subsurface Conditions

Minimal to approximately 2 inches of organic topsoil and rootmat was reported by drillers at CPT sounding locations S-1, S-3 to S-4, S-7 to S-9 and S-11 to S-14. Paving materials ranging from approximately 2 to 6 inches thick were reported at sounding locations S-2, S-5 to S-6 and S-10. Beneath the surface materials, natural soils were encountered. The natural soils typically classify as intermittent layers of silty, slightly silty and clean sands (SM, SP-SM, SP) and sandy lean clays (CL). N*-values (equivalent corrected N-value) ranging from 3 to 100 bpf were recorded in the natural soils.

Groundwater was observed within the soundings at the time of our exploration at depths of about 4.1 to 9.0 feet below existing grades.

The highest groundwater observations are normally encountered in the late winter and early spring. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration. If long term water levels are crucial to the development of this site, it would be prudent to verify water levels with the use of perforated pipes or piezometers.

The above paragraphs provide a general summary of the subsurface conditions encountered at the site at the time of our exploration. The CPT Sounding Logs included in Appendix I contain detailed information regarding the subsurface conditions encountered at each sounding location. Conditions intermediate of the actual sounding locations should be expected to vary.

4.4 Laboratory Test Results

Laboratory test results indicate the in-situ moisture contents of the tested samples range from approximately 3.1 to 22.0 percent. Grain size analyses performed on four samples indicated 5.2 and 13.4 percent material passing the No. 200 sieve. A bulk sample obtained from the upper 3 feet near sounding S-9 and consisting of silty fine to medium sand had a standard Proctor (ASTM D 698) maximum dry density of 108.2 pounds per cubic foot at an optimum moisture content of 12.4 percent. CBR values recorded for the bulk sample were 17.7 for 0.1 inch of penetration, respectively, for a specimen remolded to approximately 98.6 percent of the standard Proctor maximum dry density. The laboratory test results are included on the Laboratory Testing Summary and individual test data sheets in Appendix II.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the subsurface conditions encountered in the test borings, and our experience with similar soil conditions and construction, the planned construction can be supported on conventional shallow foundations bearing in natural soils or new engineered fill, provided that the recommendations provided herein are strictly followed. The Geotechnical Requirements and Pavement Design Section sheet in Appendix III summarizes pertinent information regarding site preparation, fill placement, drainage considerations and pavement construction for this project.

Existing asphalt, foundations or other buried structures from existing developments should be completely removed from the construction area and properly disposed of off-site.

Because the site has been previously developed, we emphasize the importance of comprehensive subgrade evaluations prior to engineered fill placement, foundation installation, pavement construction, and/or other construction activities. These evaluations may include proofrolling the subgrade soils, excavation of test pits, and performing hand auger borings in footing excavations. The mentioned evaluations would help in identifying areas of soft, loose, or otherwise unsuitable fills, which would require remedial activities.

5.1 Site and Subgrade Preparation

The first step in preparing the site for the proposed construction should be to demolish and properly dispose of the existing on-site above and below grade construction (e.g. foundations, subsurface utilities, slabs-on-grade, etc.). Excavations resulting from these activities should be filled with engineered fill as described in Section 5.3 of this report.

Existing asphaltic concrete should be removed, while any underlying base course aggregate may be left in place, if present. Any buried construction, existing utilities or temporary pavements that traverse the area of the planned construction site should also be removed. These operations should extend at least 10 feet beyond the planned limits of the proposed building and 5 feet beyond the planned pavement areas, where practical. Furthermore, these operations should be extended an additional one foot for each foot of fill required at the building's exterior perimeter.

After removal of all existing deleterious surface and subsurface materials, and prior to fill placement, the exposed subgrade soils should be evaluated by an experienced geotechnical engineer or his authorized representative to identify any localized loose, yielding, or otherwise unsuitable materials. After examining the exposed soils, loose and yielding areas can be identified by proofrolling with an approved piece of equipment, such as a loaded dump truck, having an axle weight of at least 10 tons. Unstable subgrade materials may require in-place densification, excavation and replacement with engineered fill or other suitable remedial repairs. The most appropriate remedial activity to repair unstable or unsuitable subgrades should be determined in the field by ECS at the time of proofrolling.

The preparation of all fill subgrades, as well as the proposed building or pavement subgrades, should be observed on a full-time basis by a representative of ECS. These observations should be performed by an experienced geotechnical engineer, or his representative, to help confirm that all unsuitable materials have been removed and that the prepared subgrade is suitable for support of the proposed construction. These observations are particularly important due to previous site development.

5.2 Excavation Considerations

The soils encountered within the test borings should generally be excavatable with conventional earth moving equipment such as pans/scrapers, loaders, bulldozers, rubber tired backhoes, etc. Areas of mass excavation, trenches and pits should meet the requirements of the most current Occupational Safety and Health Administration (OSHA) 29 CFR Part 1926, "Occupational Safety and Health Standards-Excavations". Based on the borings, the site soils appear to be OSHA Type C soils for the purpose of excavation support. Regardless, site safety shall be the sole responsibility of the contractor and his subcontractors.

5.3 Engineered Fill

Following the removal of all soft or otherwise unsuitable surface and subsurface features, and after achieving a competent subgrade, the contractor can place and compact approved, controlled engineered fill to achieve the desired site grades. All fill for support of the proposed construction and for backfill of utility lines within expanded building and pavement limits should consist of an approved material, free of organic matter and debris. The maximum nominal particle size of the engineered fill shall not exceed 3 inches. The engineered fill materials should have a plasticity index less than 20, a liquid limit less than 40 and contain less than 35 percent fines passing the #200 sieve. We also recommend that all fills within structural areas have a standard Proctor (ASTM D 698) maximum dry density of at least 100 pounds per cubic foot (pcf).

Prior to the commencement of fill operations and/or utilization of any off-site borrow materials, the contractor should provide representative samples of the soil materials to the geotechnical engineer. The geotechnical engineer will determine the material's suitability for use as an engineered fill and develop moisture-density relationships in accordance with the recommendations provided herein. Samples should be provided to the geotechnical engineer at least 3 days prior to their use in the field to allow for the appropriate laboratory testing to be performed.

Mass areas of engineered fill placed within the building and pavement areas should be placed in lifts not exceeding 8 inches in loose lift thickness and moisture conditioned to within their working range of optimum moisture content, and compacted to a minimum of 95 percent of their standard Proctor maximum dry density, as determined in accordance with ASTM D 698. Similarly, isolated areas of engineered fill, such as trench and retaining wall backfill, should be placed in lifts not exceeding 6 inches and moisture conditioned as mentioned above. The typical working range of optimum is typically within approximately 3 percent of the optimum moisture content. The upper 18 inches of soil supporting slabs-on-grade, pavements and sidewalks should be compacted to at least 98 percent of the standard Proctor maximum dry density.

The actual extent of the built-over portions of the site should be well defined during fill placement. Proper grade controls should also be maintained by the contractor throughout the filling operations. All filling operations should be observed on a full-time basis by an experienced soils engineering technician to determine that the required degrees of compaction are being achieved. We recommend at least one field density test be performed for every 2,500 square feet of fill placed per lift. We recommend at least one test per lift of fill for every 100 linear feet of utility trench backfill. The elevation and location of the tests should be accurately identified at the time of fill placement. Areas which fail to achieve the required degree of compaction should be

re-compacted and re-tested until the required compaction is achieved. Failing test areas may require moisture adjustments or other suitable remedial activities in order to achieve the required compaction.

Fill materials should not be placed on frozen soils or frost-heaved soils and/or soils which have been recently subjected to precipitation. Borrow fill materials should not contain wet or frozen materials at the time of placement. All wet or frost-heaved soils should be removed prior to placement of engineered fill, granular sub-base materials, foundation or slab concrete, and paving materials.

If problems are encountered during the site grading operations, or if the actual site conditions differ from those encountered during our subsurface exploration, the geotechnical engineer should be notified immediately.

5.4 Earth Slopes

Final engineered fill and cut slopes should be inclined no steeper than 3H:1V and 2.5H:1V, respectively, to maintain a suitable long-term factor of safety. Fill slopes should be over-built and cut back to the required inclination to help enhance their long-term stability. Satisfactory vegetative ground cover should be established on all permanent earth slopes to help reduce the potential for erosion.

5.5 Foundations

Provided the subgrade preparation and earthwork operations are completed in accordance with the “Site and Subgrade Preparation” and “Engineered Fill” sections of this report, the proposed construction can be supported on conventional shallow foundations bearing on approved natural soils or new engineered fill. Shallow foundations supported on approved natural soils and new engineered fill may be proportioned for a net allowable design bearing pressure of 3,000 psf. To help reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" failures, we recommend that continuous footings have a minimum width of 18 inches and that isolated column footings have a minimum lateral dimension of 30 inches. We recommend the bearing elevation for all foundations be a minimum depth of 18 inches below the finished exterior grade.

The settlement of a structure is a function of the compressibility of the bearing materials, bearing pressure, actual structural loads, fill depths, and the bearing elevation of footings with respect to the final ground surface elevation. Estimates of settlement for foundations bearing on engineered fills are strongly dependent on the quality of fill placed. Factors which may affect the quality of fill include maximum loose lift thickness of the fills placed and the amount of compactive effort placed on each lift. Provided the recommendations outlined in this report are strictly adhered to, we expect total settlements for the proposed construction to be in the range of 1 inch, while the differential settlement will be approximately 1/2 of the anticipated total settlement. This evaluation is based on our engineering experience and the anticipated loadings for this type of structure, and is intended to aid the structural engineer with his design.

Exposure to the environment may weaken the soils at the foundation bearing level if the foundation excavations remain exposed during periods of inclement weather. Therefore, foundation concrete should be placed the same day that proper excavation is achieved and the

design bearing pressure verified. If the bearing soils are softened by surface water absorption or exposure to the environment, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the foundation excavation must remain open overnight, or if inclement weather is expected while the bearing soils are exposed, we recommend that a 2 to 3-inch thick "mud mat" of "lean" concrete be placed over the exposed bearing soils before the placement of reinforcing steel.

The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. The final footing elevation should be evaluated by ECS personnel to verify that the bearing soils are capable of supporting the recommended net allowable bearing pressure and suitable for foundation construction. These evaluations should include visual observations, hand rod probing, and dynamic cone penetrometer (ASTM STP-399) testing in each column footing excavation and at intervals not greater than 25 feet in continuous footing excavations. The dynamic cone penetrometer testing should be conducted in hand auger boreholes at 1 foot intervals to a depth equal to at least ¾ B (where B equals the footing width) in isolated column footing excavations and to at least 1½ B in bearing wall footing excavations; or to a depth at least 4 feet below the bearing elevation of the planned footings, whichever is greater.

5.6 Concrete Slabs-On-Grade

For the design and construction of the slab-on-grade for the proposed building, a design modulus of subgrade reaction value of 100 pci is appropriate for design provided the subgrades are properly prepared. We also recommend the slabs-on-grade be underlain by a minimum of 4 inches of granular material having a maximum aggregate size of 1½ inches and no more than 2 percent fines. Prior to placing the granular material, the floor subgrade soil should be properly compacted, unyielding during a final proofroll, and free of standing water, mud, and frozen soil. A properly designed and constructed capillary break layer can often eliminate the need for a moisture retarder and can assist in more uniform curing of concrete. If a vapor retarder is considered to provide additional moisture protection, special attention should be given to the surface curing of the slabs to minimize uneven drying of the slabs and associated cracking and/or slab curling. The use of a blotter or cushion layer above the vapor retarder can also be considered for project specific reasons. Please refer to ACI 302.1R96 *Guide for Concrete Floor and Slab Construction* and ASTM E 1643 *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs* for additional guidance on this issue.

We recommend that the floor slab be isolated from the foundations so differential settlement of the structure will not induce shear stresses on the floor slab. Also, in order to help minimize the crack width of any shrinkage cracks that may develop near the surface of the slab, we recommend mesh reinforcement as a minimum be included in the design of the floor slab. For maximum effectiveness, temperature and shrinkage reinforcements in slabs on ground should be positioned in the upper third of the slab thickness. The Wire Reinforcement Institute recommends the mesh reinforcement be placed 2 inches below the slab surface or upper one-third of slab thickness, whichever is closer to the surface. Adequate construction joints, contraction joints and isolation joints should also be provided in the slab to reduce the impacts of cracking and shrinkage. Please refer to ACI 302.1R96 *Guide for Concrete Floor and Slab Construction* for additional information regarding concrete slab joint design.

5.7 Pavements

New pavements may be supported on approved natural soils, new engineered fill and evaluated and approved existing fill, provided that the recommendations provided herein are strictly followed. The pavement subgrades should be prepared in strict accordance with the recommendations in the "Site and Subgrade Preparation" and "Engineered Fill" sections of this report.

We have developed the pavement sections recommended below using AASHTO guidelines based on a design CBR value of 10 and an anticipated design life of 20 years. Anticipated traffic conditions used in the analysis include 20-year equivalent single axle loadings (ESAL's) of 100,000 and 10,000 for heavy duty and light duty pavements, respectively. Should the actual traffic conditions be different than those stated, ECS should be allowed to carefully review these recommendations and make appropriate revisions based upon the new traffic design criteria and/or determination of the engineering properties of the actual pavement subgrade soils. It is important to understand the recommended sections do not take into account construction traffic.

The recommended minimum pavement sections are included in the following table and the Geotechnical Requirements and Design Pavement Sections sheet in Appendix III.

Material Designation	Light Duty Asphalt Pavement	Heavy Duty Asphalt Pavement	Portland Cement Concrete Pavement
Asphalt Surface Course (SF 9.5A)	2.0 inches	3.0 inches	-
Portland Cement Concrete	-	-	6.0 inches
Graded Aggregate Base Course	6.0 inches	8.0 inches	6.0 inches

All base course materials beneath pavements should be compacted to at least 95 percent of their modified Proctor maximum dry density (ASTM D 1557). The asphalt concrete and all crushed stone materials should conform to the NC DOT Standard Specifications. Portland Cement Concrete (PCC) sections should consist of concrete having a minimum compressive strength of 4,000 psi. Appropriate jointing and reinforcing should be incorporated into the design of PCC pavements.

Front-loading trash dumpsters frequently impose concentrated front-wheel loads on pavements during loading. This type of loading typically results in rutting and shoving of bituminous pavements and ultimately pavement failures and costly repairs. Therefore, we recommend that the pavements in trash pickup areas utilize the PCC pavement section. The recommended PCC pavement section is also recommended within truck loading and ramp areas.

It should be noted that the design recommendations might not satisfy the North Carolina Department of Transportation traffic guidelines. Any roadways constructed for public use and to be dedicated to the State for repair and maintenance must be designed in accordance with the State requirements.

An important consideration with the design, construction and performance of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrades and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should help

reduce the possibility of the subgrade materials becoming saturated during the normal service period of the pavement.

5.8 Seismic Site Class

The North Carolina Building Code (IBC 2009 with State Amendments) requires that a seismic Site Class be assigned for new structures. The seismic Site Class for the site was determined by a calculating a weighted average of the N*-Values in the test soundings. Based on the CPT sounding data, a seismic Site Class of "D" is recommended for this site

5.9 Lateral Earth Pressures

For the design of below-grade and retaining walls to restrain compacted backfill or in-situ natural sandy soils, the equivalent fluid pressure parameters presented below can be used to determine lateral earth pressure loads. Please note that the values presented below are for on-site natural sandy soils.

Soil Parameter	Equivalent Fluid Pressure for Sands (SP, SP-SM, SM)
"At Rest" Earth Pressure (K_o)	55 pcf
"Active" Earth Pressure (K_a)	33 pcf
"Passive" Earth Pressure (K_p)	330 pcf

The lateral earth pressure values presented in the preceding table assume do not account for hydrostatic pressures against the walls or surcharge loads. Clays and elastic silts (CL, CH and MH) should not be utilized behind below-grade or retaining walls.

For wall conditions where wall movement cannot be tolerated or where the wall is restrained at the top, such as basement or loading dock walls, the "At Rest" earth pressure should be used. For wall conditions where outward wall movement on the order of 1/2 percent of the wall height can be tolerated, the "Active" earth pressure should be used.

Resistance to sliding can be provided by friction between the bottom of the wall foundation and the underlying soils and by passive resistance of soil adjacent to the wall foundation. The passive resistance should only be used in situations where the soil adjacent to the toe of the wall will not be eroded or otherwise removed in the future. A coefficient of friction of 0.35 for concrete bearing on approved natural soils or properly prepared engineered fill is recommended.

Drainage behind freestanding retaining walls is considered essential towards relieving hydrostatic pressures. Drainage can be established by providing a perimeter drainage system located just above the below grade/retaining wall footings which discharges by gravity flow to a suitable outlet. This system should consist of "perforated pipe" or "porous wall", closed-joint drain lines. These drain lines should be surrounded by a minimum 6 inches of free-draining, granular filter material having a gradation compatible with the size of the openings utilized in the drain lines and the surrounding soils to be retained, or by gravel wrapped in filter fabric. The space between the interior face of the wall and the earth fill should be backfilled with at least 12 inches of granular fill of porous quality or better extending from the perimeter drainage system to just below the top of the wall. The ground surface adjacent to the below-grade walls should be kept properly graded to prevent ponding of water adjacent to the walls.

As an alternative to the recommended granular porous backfill against the back of the wall, a suitable fabricated drainage board could be utilized. These materials should be covered with a filter fabric having an equivalent opening size (EOS) consistent with the size of the soil to be retained. The drainage board should be placed in accordance with the manufacturer's recommendations and connected to a drainage system that discharges beyond the wall.

Irrespective of the retaining wall system chosen, the design of the new retaining walls shall consider their global stability. We recommend that the global factor of safety should be at least 1.5. Other factors of safety shall be as follows:

Factor of Safety against Sliding > 1.5
Factor of Safety against Overturning > 2.0
Factor of Safety against Bearing Capacity Failure > 2.0

5.10 Site Drainage

Positive drainage should be provided around the perimeter of the building to minimize the potential for moisture infiltration into the foundation and/or subgrade soils. We recommend that landscaped areas adjacent to these structures be sloped away from the construction and maintain a fall of at least 6 inches for the first 10 feet outward from the structures. Similarly, all roof drains should release a sufficient distance from the building perimeter or discharge directly into underground stormwater piping. Sidewalks and paved areas should also be sloped to divert surface water away from the proposed building.

5.11 General Construction Considerations

It is imperative to maintain good site drainage during earthwork operations to help maintain the integrity of the surface soils. The surface of the site should be kept properly graded to enhance drainage of surface water away from the proposed construction areas during the earthwork phase of this project. We recommend that surface drainage be diverted away from the proposed building and pavements areas without significantly interrupting its flow. Other practices would involve crowning and sealing the exposed soils daily with a smooth-drum roller at the end of the day's work to reduce the potential for infiltration of surface water into the exposed soils.

The key to minimizing disturbance problems with the soils is to have proper control of the earthwork operations. Specifically, it should be the earthwork contractor's responsibility to maintain the site soils within a workable moisture content range to obtain the required in-place density and maintain a stable subgrade. Scarifying and drying operations should be included in the contractor's price and not be considered an extra to the contract. In addition, construction equipment cannot be permitted to randomly run across the site, especially once the desired final grades have been established. Construction equipment should be limited to designated lanes and areas, especially during wet periods to minimize disturbance of the site subgrades.

6.0 CLOSING

This report has been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty is expressed or implied. No third party may rely upon this report without prior written approval from ECS. The recommendations presented in this report are based on our understanding of the site and project information provided by the client, and the data obtained during our exploration. The general subsurface conditions utilized in our evaluations are based on interpolation of subsurface conditions between the borings. In evaluating the subsurface data, we have considered previous correlations between penetration resistance values and engineering properties for soil conditions similar to those at your site. The discovery of any site or subsurface conditions during construction which deviate from those described herein should be reported to us for our evaluation. Furthermore, ECS shall be provided with final project drawings and specifications to verify that our recommendations have been correctly interpreted. Any required revisions to the recommendations contained herein shall be made in writing by ECS prior to construction.

APPENDIX I

Site Vicinity Map

Sounding Location Diagram

Unified Soil Classification System

Reference Notes for Sounding Logs

Sounding Logs S-1 through S-14

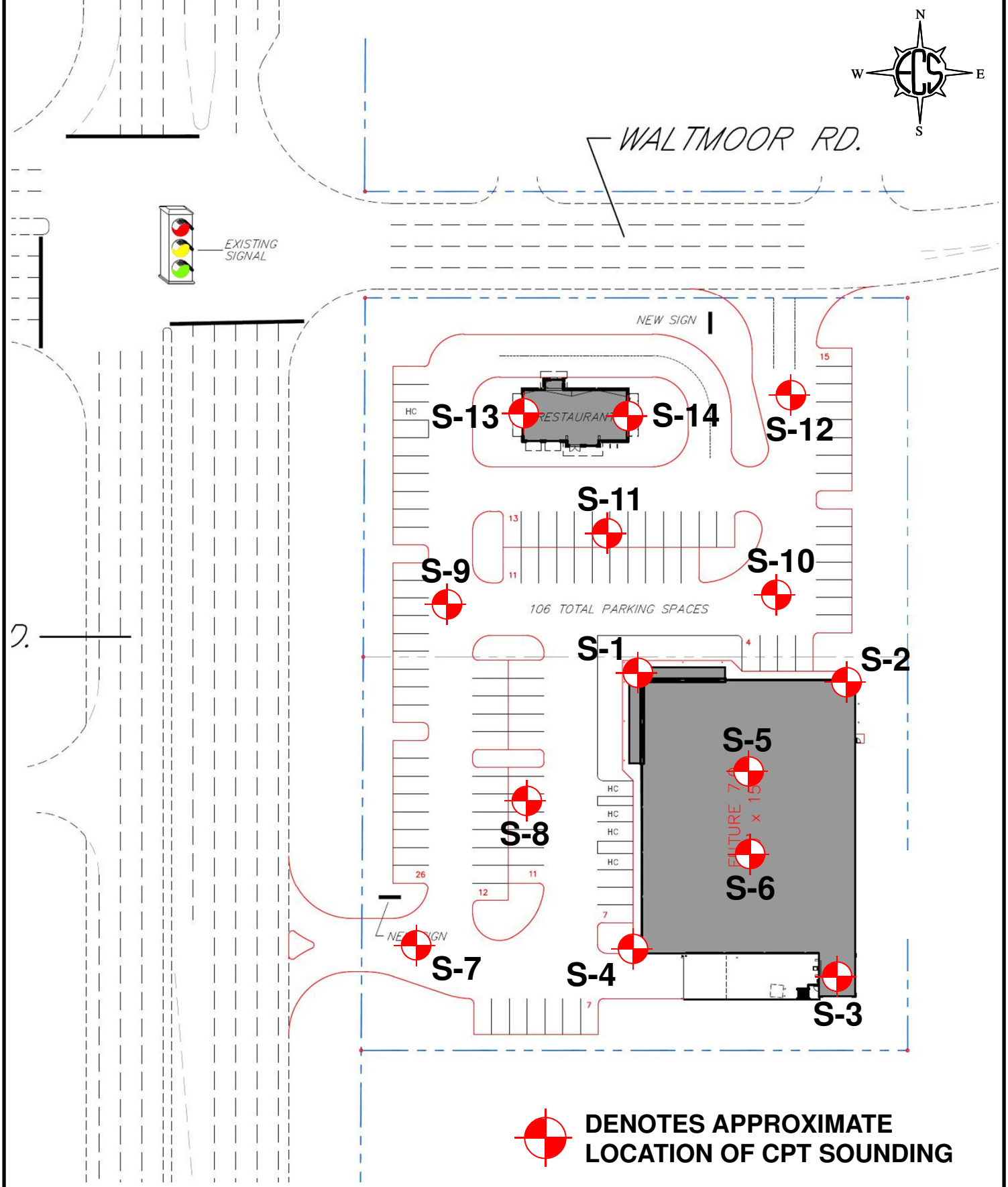
SITE VICINITY MAP

Source: Google Maps

Proposed Aldi Food Store #98 – S. College Road

Wilmington, North Carolina

ENGINEER WEG	SCALE NTS
DRAFTING FMW	PROJECT NO. 22.23743
REVISIONS	FIGURE 1
	DATE 2/2/2016

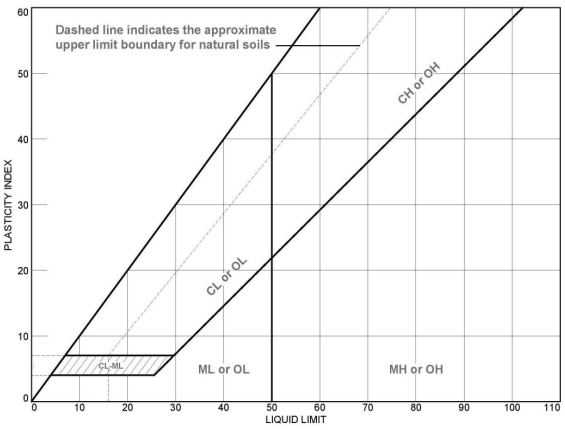


SOUNDING LOCATION DIAGRAM	ECS	**Proposed Aldi Food Store #98 - S. College Road** **Wilmington, North Carolina**	ENGINEER: WEG; DRAFTING: FMW SCALE: NTS; FIGURE: 2 PROJECT NO.: 22.23743 DATE: 2/2/2016

Unified Soil Classification System
(ASTM Designation D-2487)

Major Division		Group Symbol	Typical Names	Classification on basis of percentage of fines	Classification Criteria
Coarse-grained soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Less than 5% Pass No. 200 sieve: GW, GP, SW, SP	$C_u = D_{60}/D_{10}$ Greater than 4 $C_z = (D_{30})^2/(D_{10}xD_{60})$ Between 1 and 3
		GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW
		GM	Silty gravels, gravel-sand-silt mixtures	More than 12% Pass No. 200 sieve: GM, GC, SM, SC	Atterberg limits plot below "A" line or plasticity index less than 4
		GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
	Sands: More than 50% of coarse fraction passes No. 4 sieve	SW	Well-graded sands and gravelly sands, little or no fines	5% to 12% Pass No. 200 sieve: Borderline classification requiring use of dual symbol	$C_u = D_{60}/D_{10}$ Greater than 6 $C_z = (D_{30})^2/(D_{10}xD_{60})$ Between 1 and 3
		SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW
		SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
		SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
Fine-grained soils: 50% or more passing No. 200 sieve	Silts and Clays: Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
		OL	Organic silts and organic silty clays of low plasticity		
	Silts and Clays: Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
		CH	Inorganic clays of high plasticitiy, fat clays		
		OH	Organic clays of medium to high plasticity		
Highly organic soils		Pt	Peat, muck and other highly organic soils		Fibrous organic matter; will char, burn, or glow

Note: U-line represents approximate upper limit of LL and PI combinations for natural soils (empircally determined). ASTM-D2487.

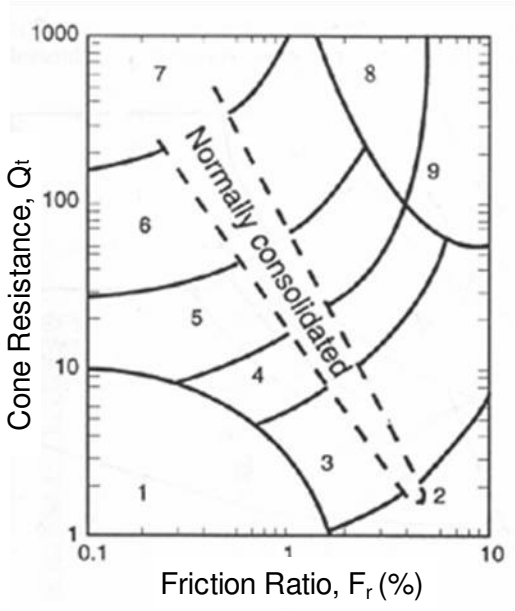


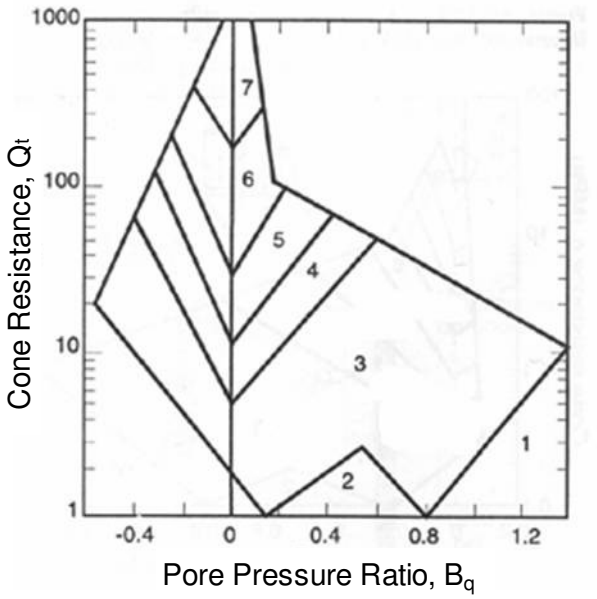
Plasticity chart for the classification of fine-grained soils.
Tests made on fraction finer than No. 40 sieve

UNIFIED SOIL CLASSIFICATION SYSTEM

REFERENCE NOTES FOR CONE PENETRATION TEST (CPT) SOUNDINGS

In the CPT sounding procedure (ASTM-D-5778), an electronically instrumented cone penetrometer is hydraulically advanced through soil to measure point resistance (q_c), pore water pressure (u_2), and sleeve friction (f_s). These values are recorded continuously as the cone is pushed to the desired depth. CPT data is corrected for depth and used to estimate soil classifications and intrinsic soil parameters such as angle of internal friction, preconsolidation pressure, and undrained shear strength. The graphs below represent one of the accepted methods of CPT soil behavior classification (Robertson, 1990).





1. Sensitive, Fine Grained
2. Organic Soils-Peats
3. Clays; Clay to Silty Clay
4. Clayey Silt to Silty Clay
5. Silty Sand to Sandy Silt
6. Clean Sands to Silty Sands
7. Gravelly Sand to Sand
8. Very Stiff Sand to Clayey Sand
9. Very Stiff Fine Grained

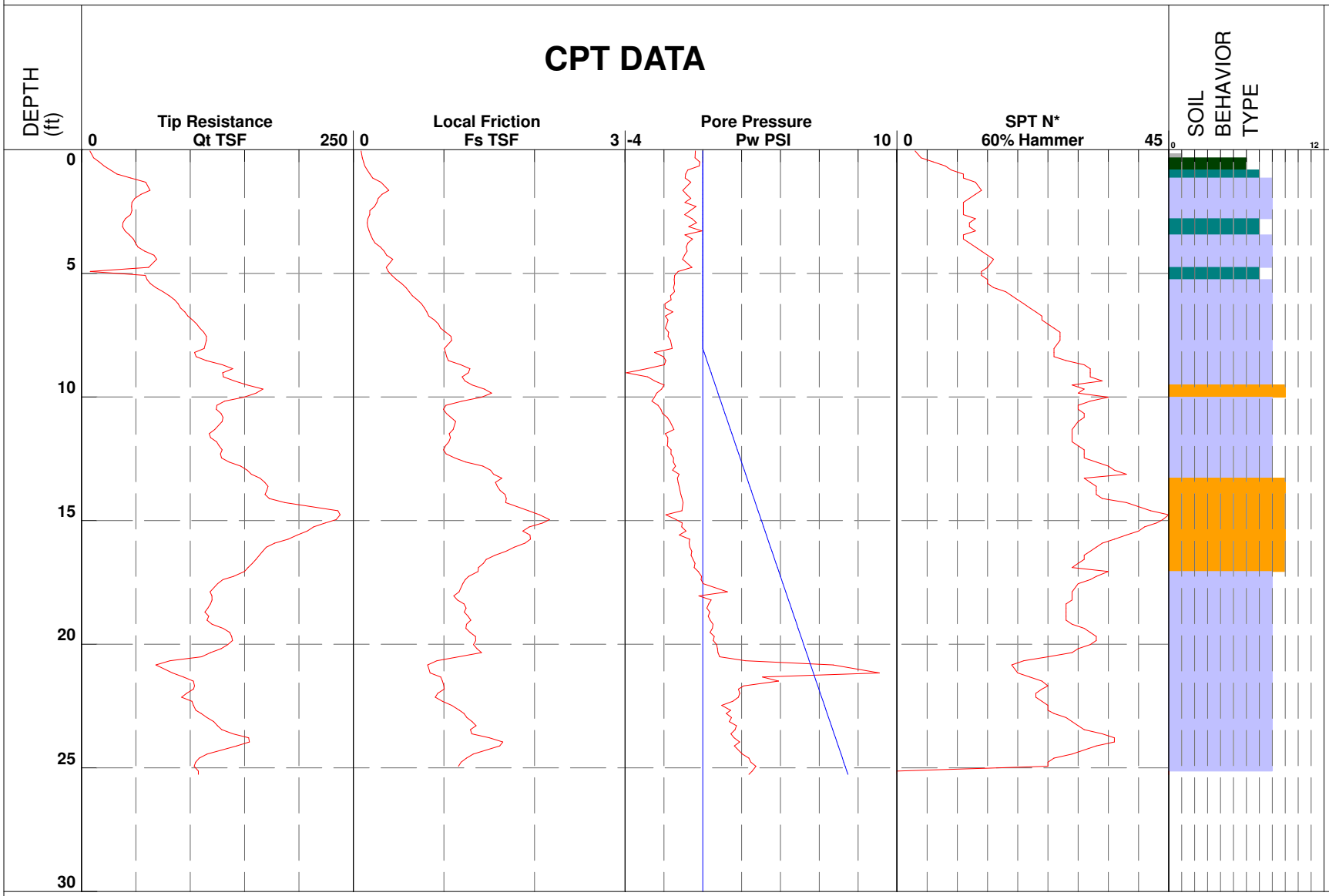
The following table presents a correlation of corrected cone tip resistance (q_c) to soil consistency or relative density:

SAND		SILT/CLAY	
Corrected Cone Tip Resistance (q_c) (tsf)	**Relative Density**	**Corrected Cone Tip Resistance (q_c) (tsf)**	**Relative Density**
<20	Very Loose	<5	Very Soft
20-40	Loose	5-10	Soft
40-120	Medium Dense	10-15	Medium Stiff
		15-30	Stiff
120-200	Dense	30-45	Very Stiff
>200	Very Dense	45-60	Hard
		>60	Very Hard

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 8:08:04 AM	Sounding Number	S-1
Water Table	8.04 ft			County	New Hanover

CPT DATA



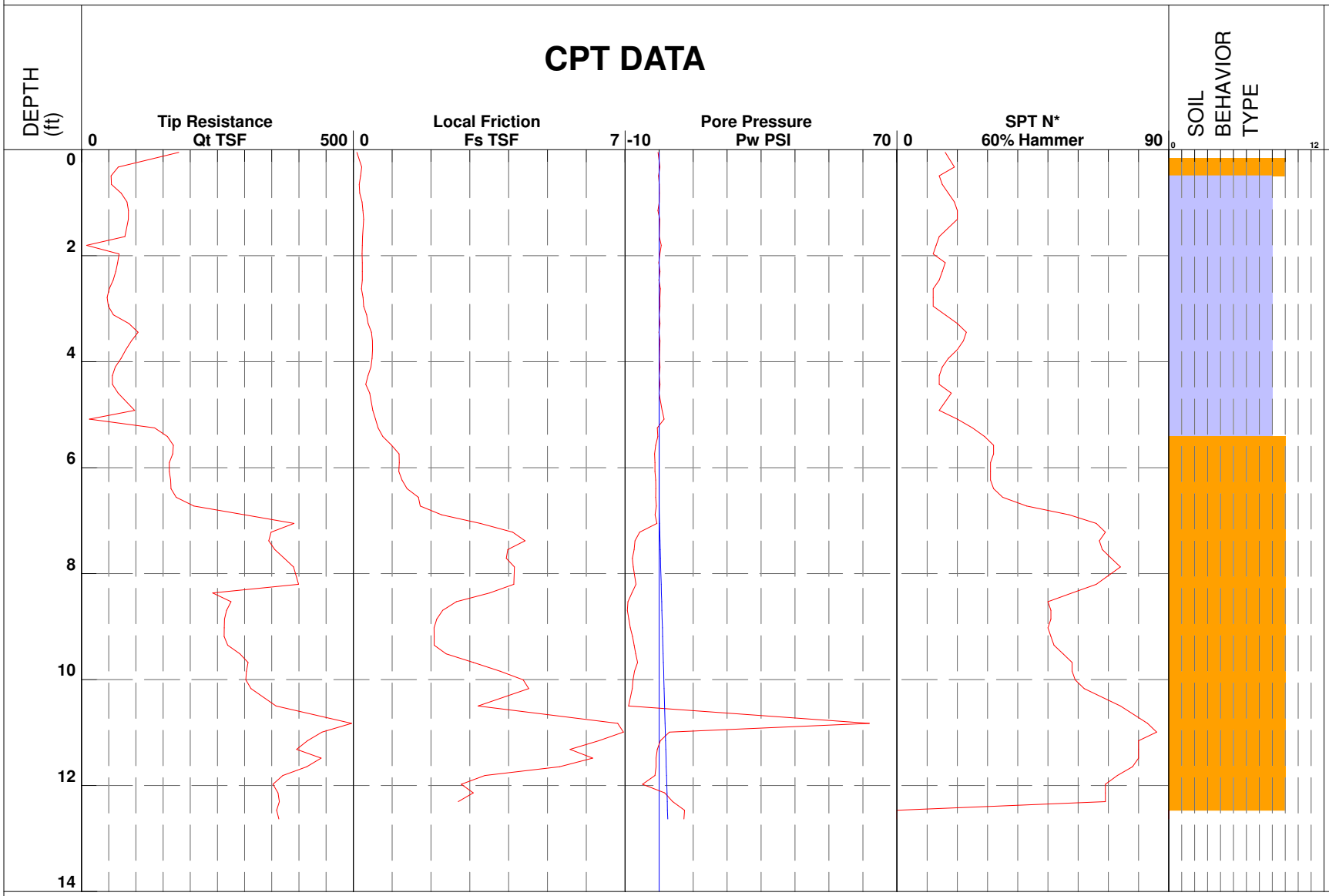
REMARKS

1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 8:31:51 AM	Sounding Number	S-2
Water Table	6.79 ft			County	New Hanover

CPT DATA

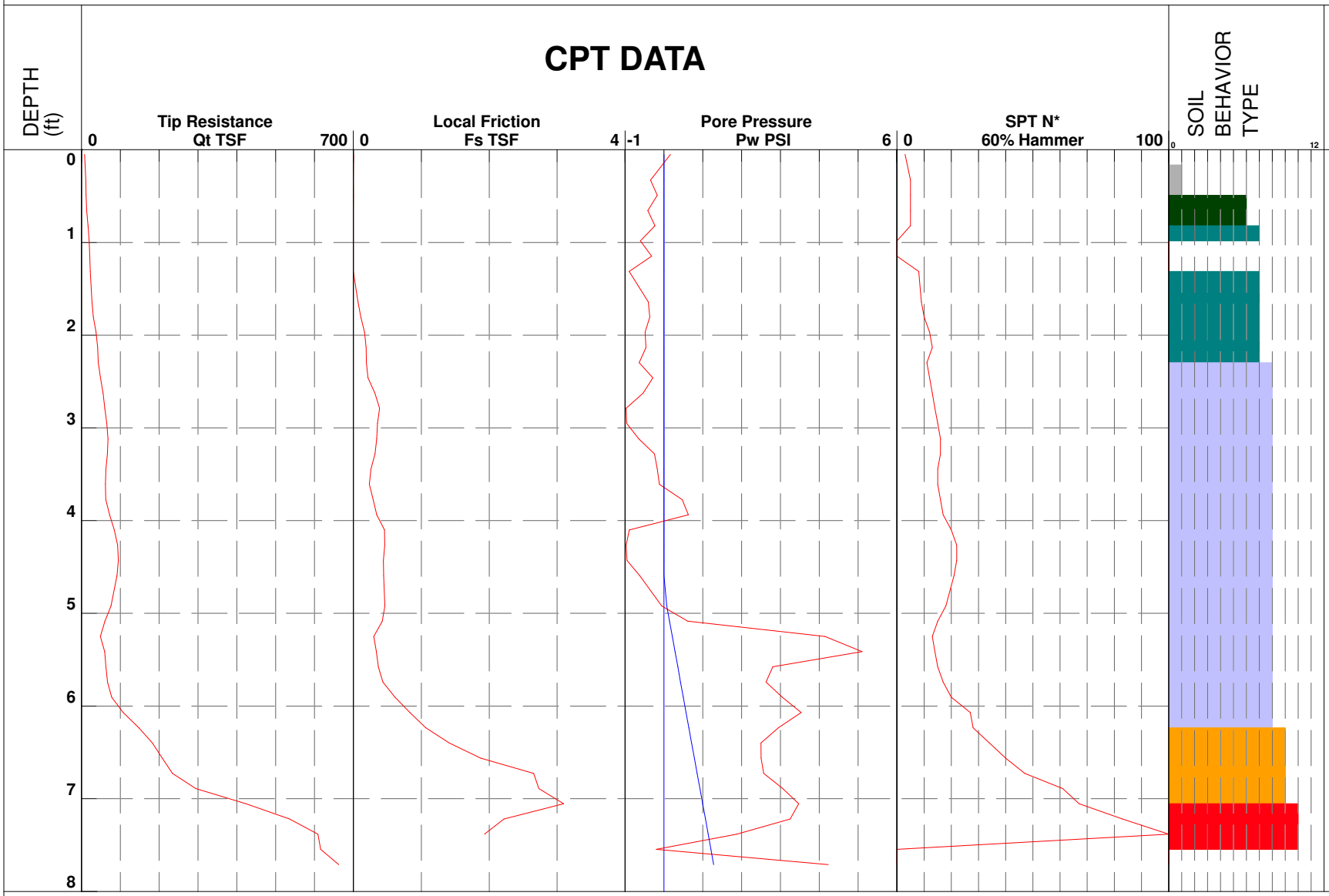


1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 10:15:57 AM	Sounding Number	S-3
Water Table	4.76 ft			County	New Hanover

CPT DATA

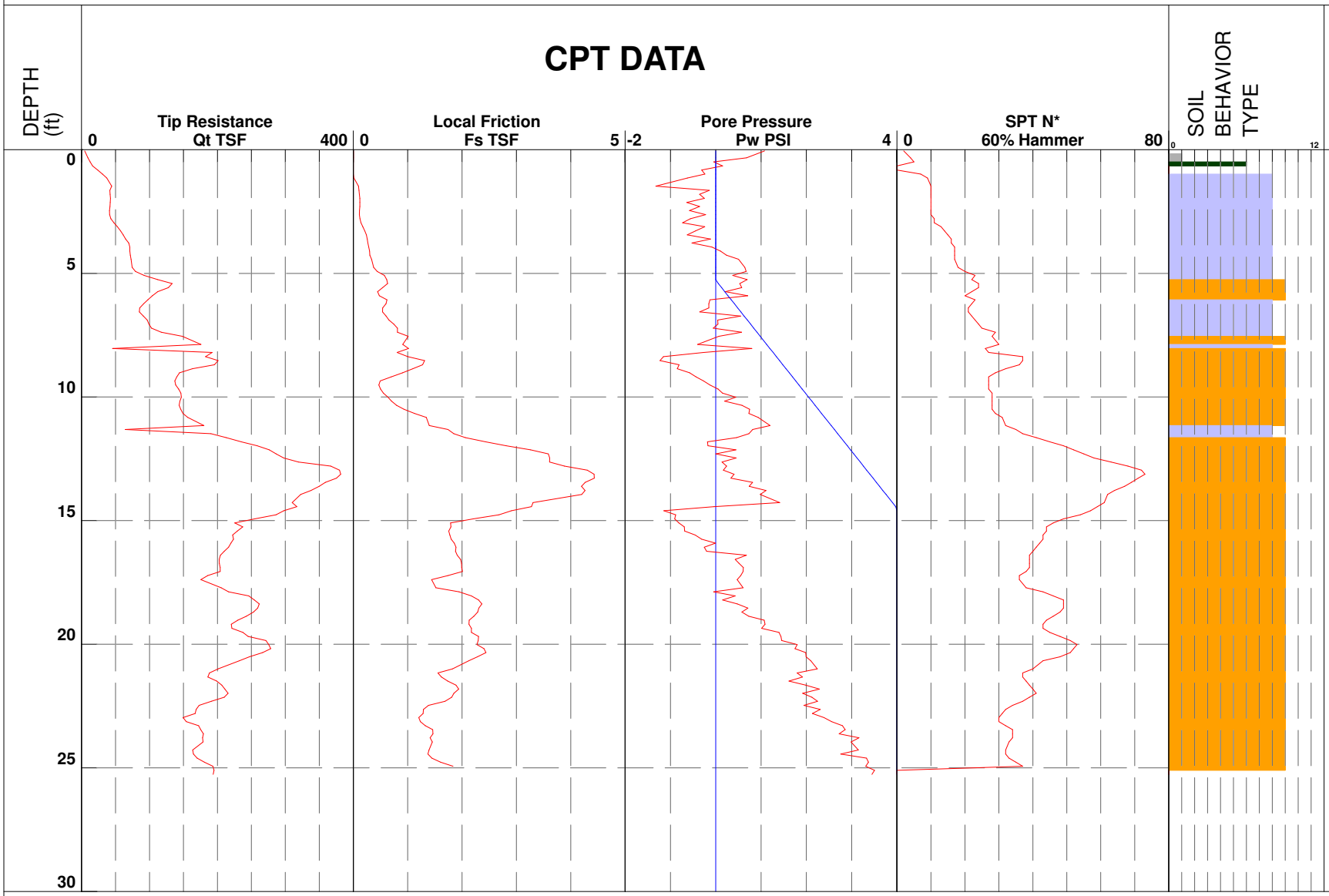


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 10:32:59 AM	Sounding Number	S-4
Water Table	5.28 ft			County	New Hanover

CPT DATA

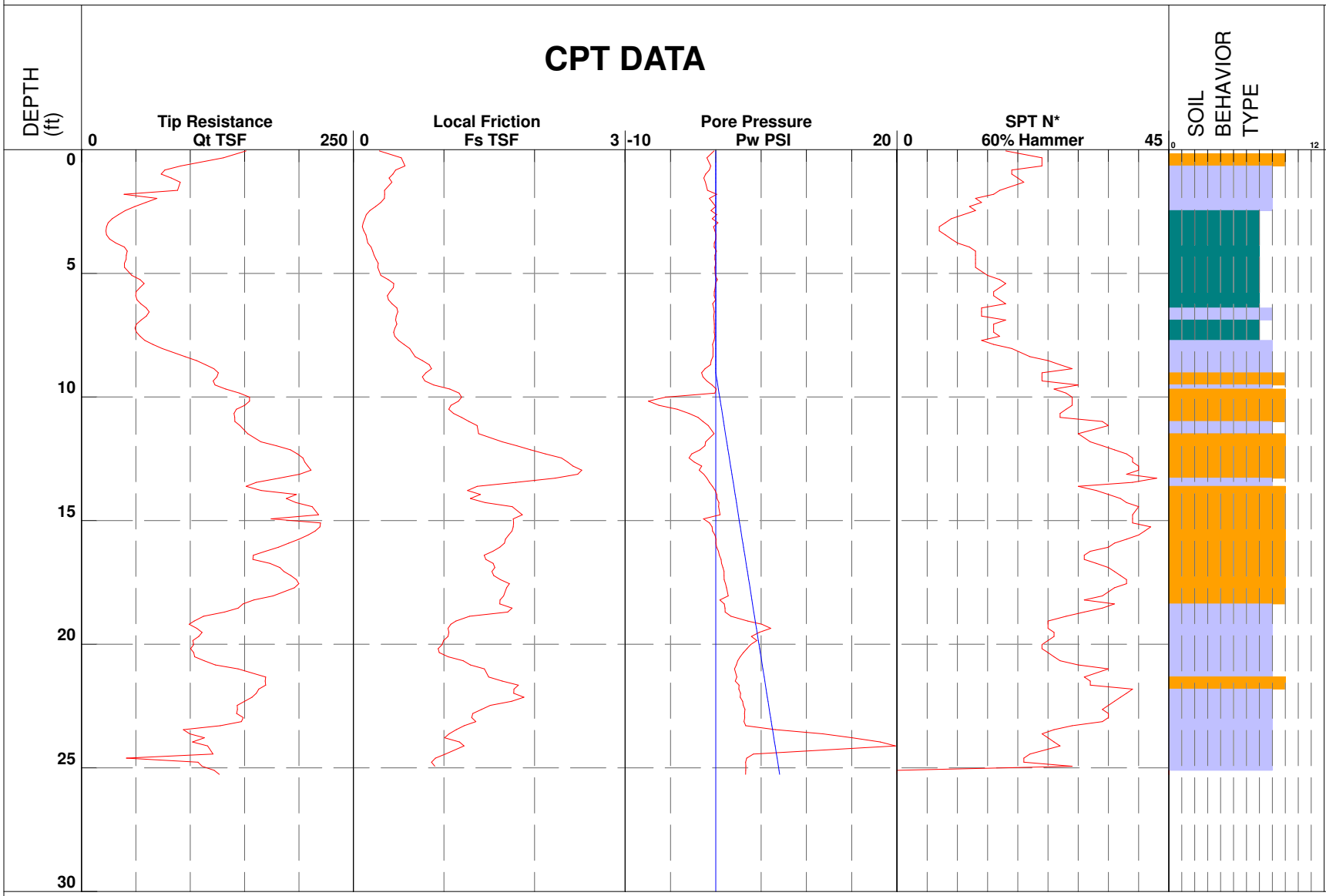


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 9:31:16 AM	Sounding Number	S-5
Water Table	9.02 ft			County	New Hanover

CPT DATA

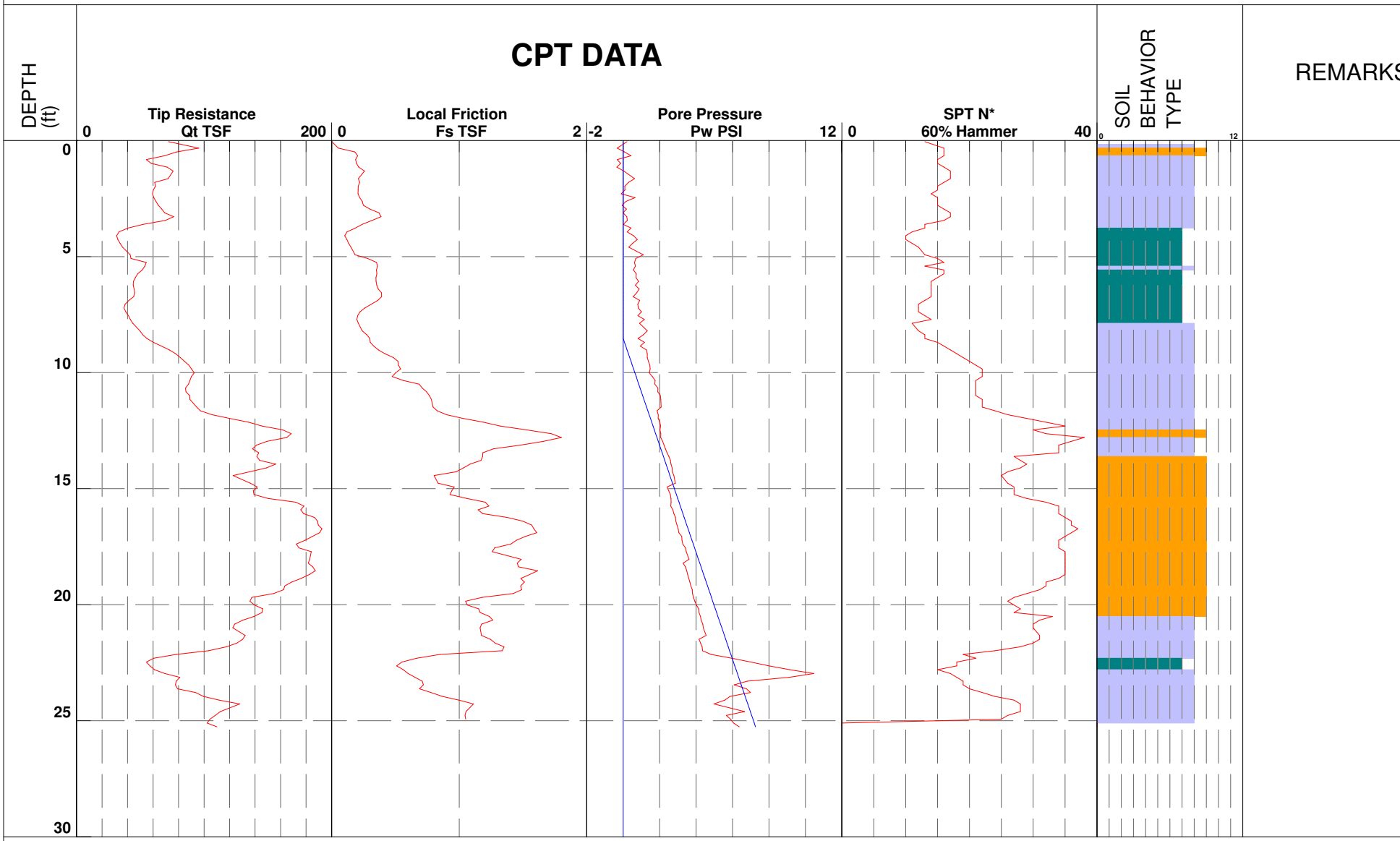


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 9:57:01 AM	Sounding Number	S-6
Water Table	8.53 ft			County	New Hanover

CPT DATA

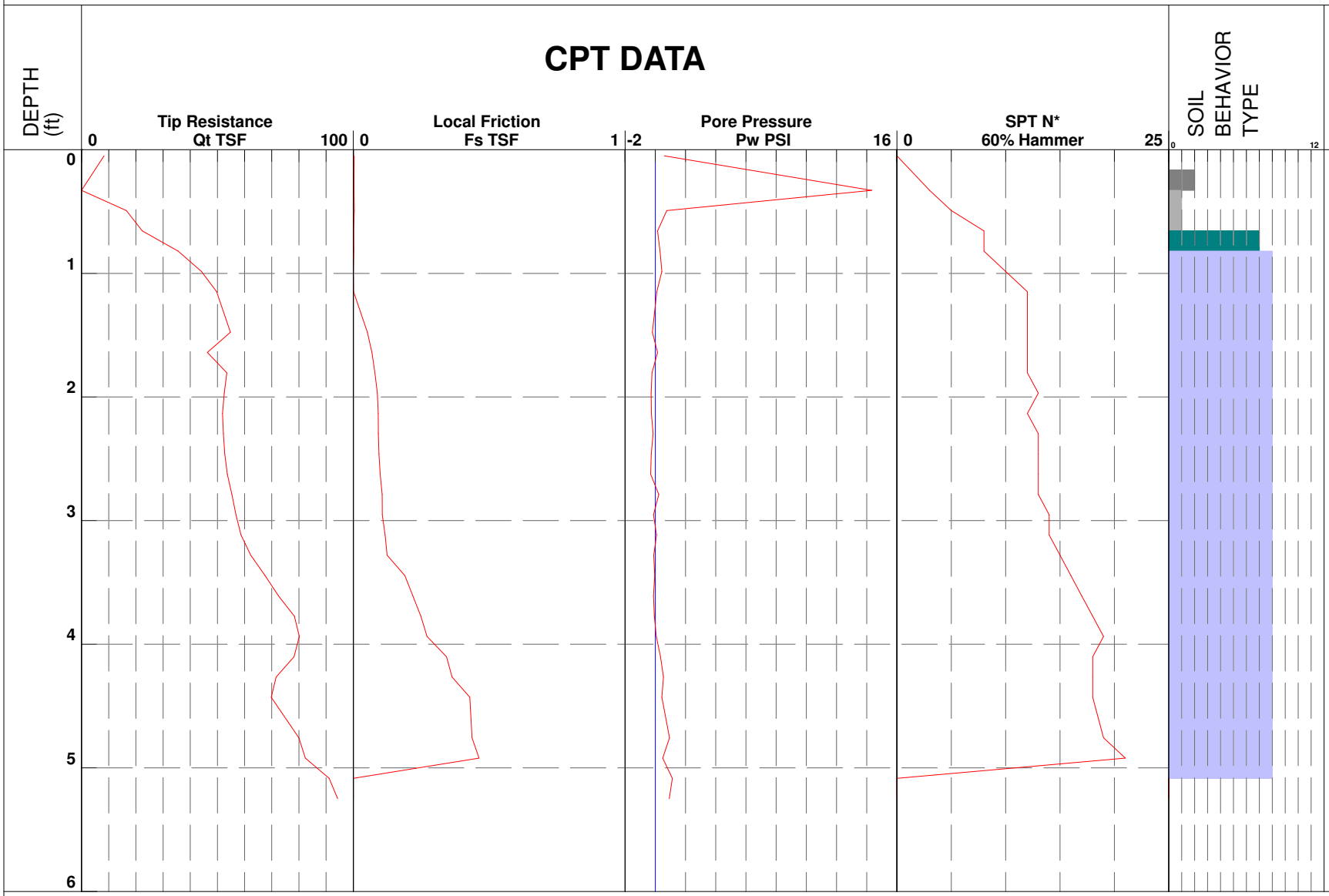


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 10:55:19 AM	Sounding Number	S-7
Water Table				County	New Hanover

CPT DATA



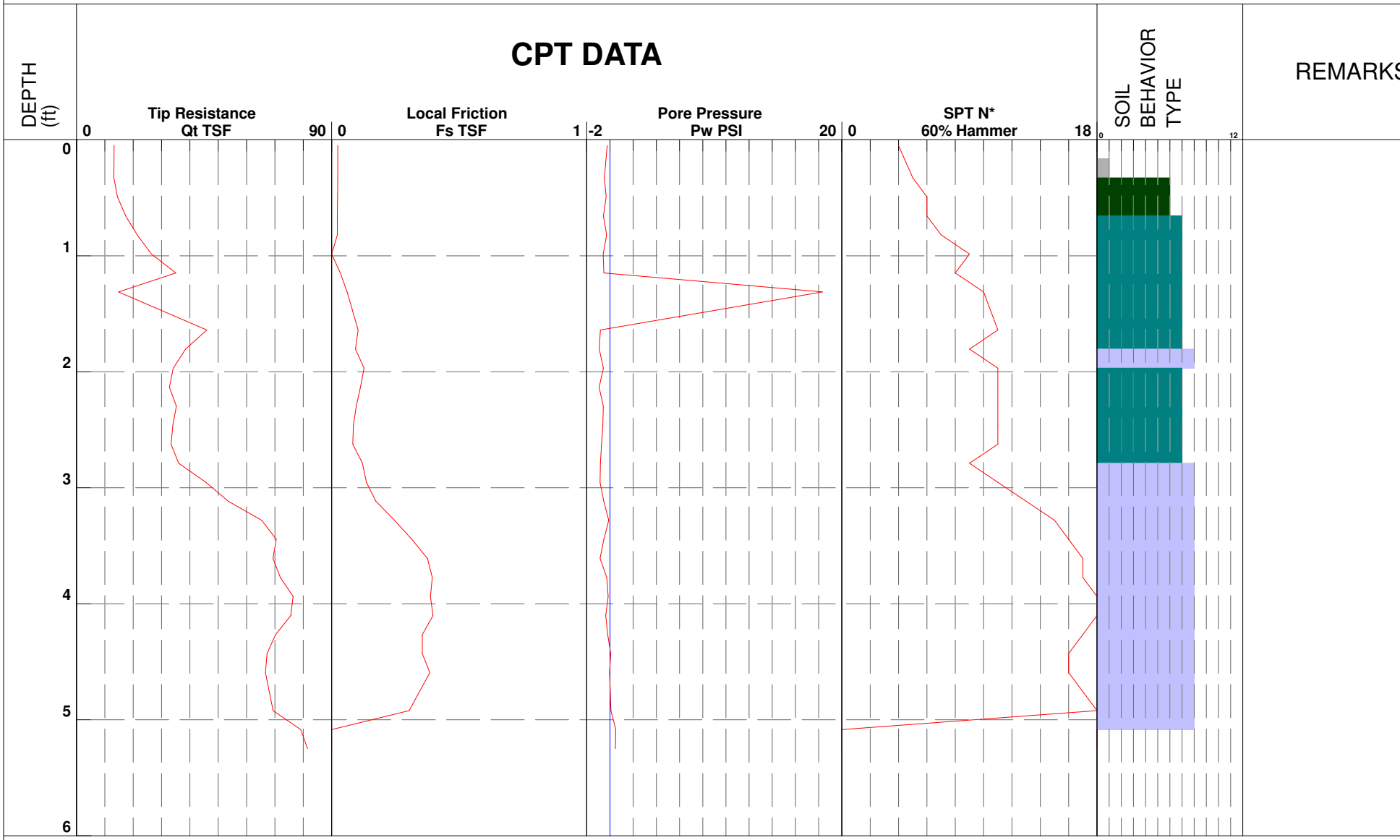
REMARKS

1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 11:02:09 AM	Sounding Number	S-8
Water Table				County	New Hanover

CPT DATA

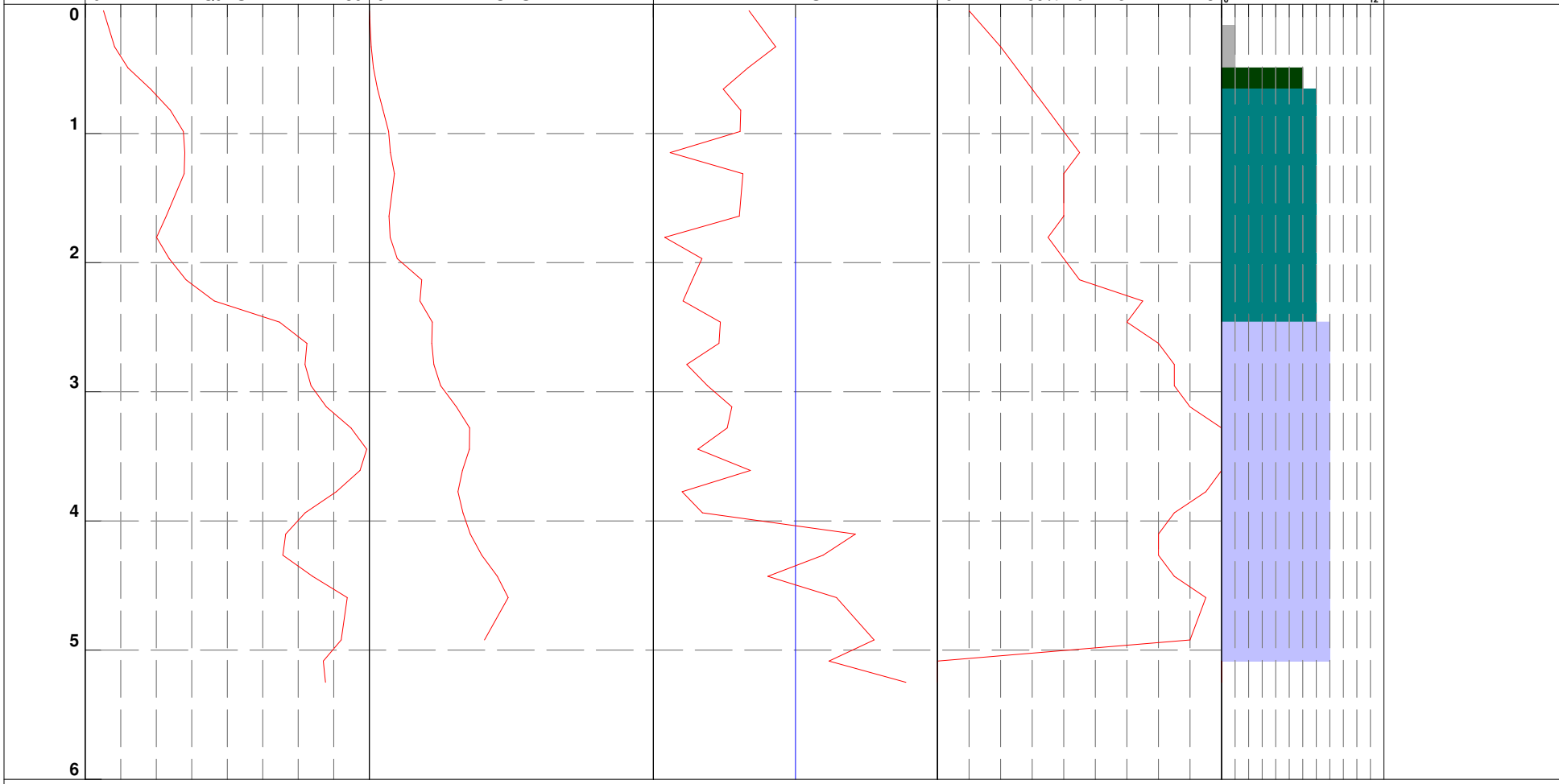


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 11:13:47 AM	Sounding Number	S-9
Water Table				County	New Hanover

CPT DATA

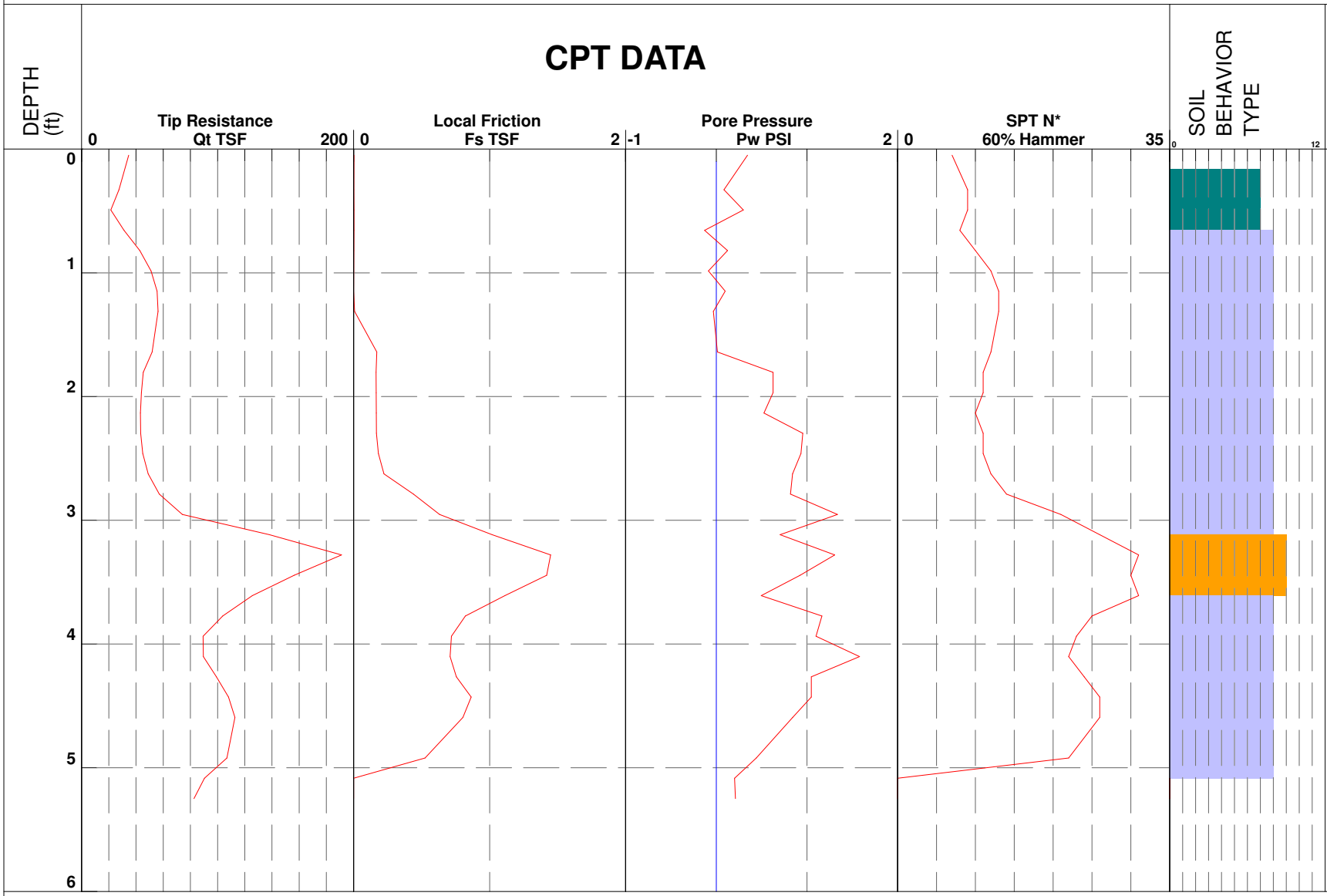


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 9:00:57 AM	Sounding Number	S-10
Water Table				County	New Hanover

CPT DATA



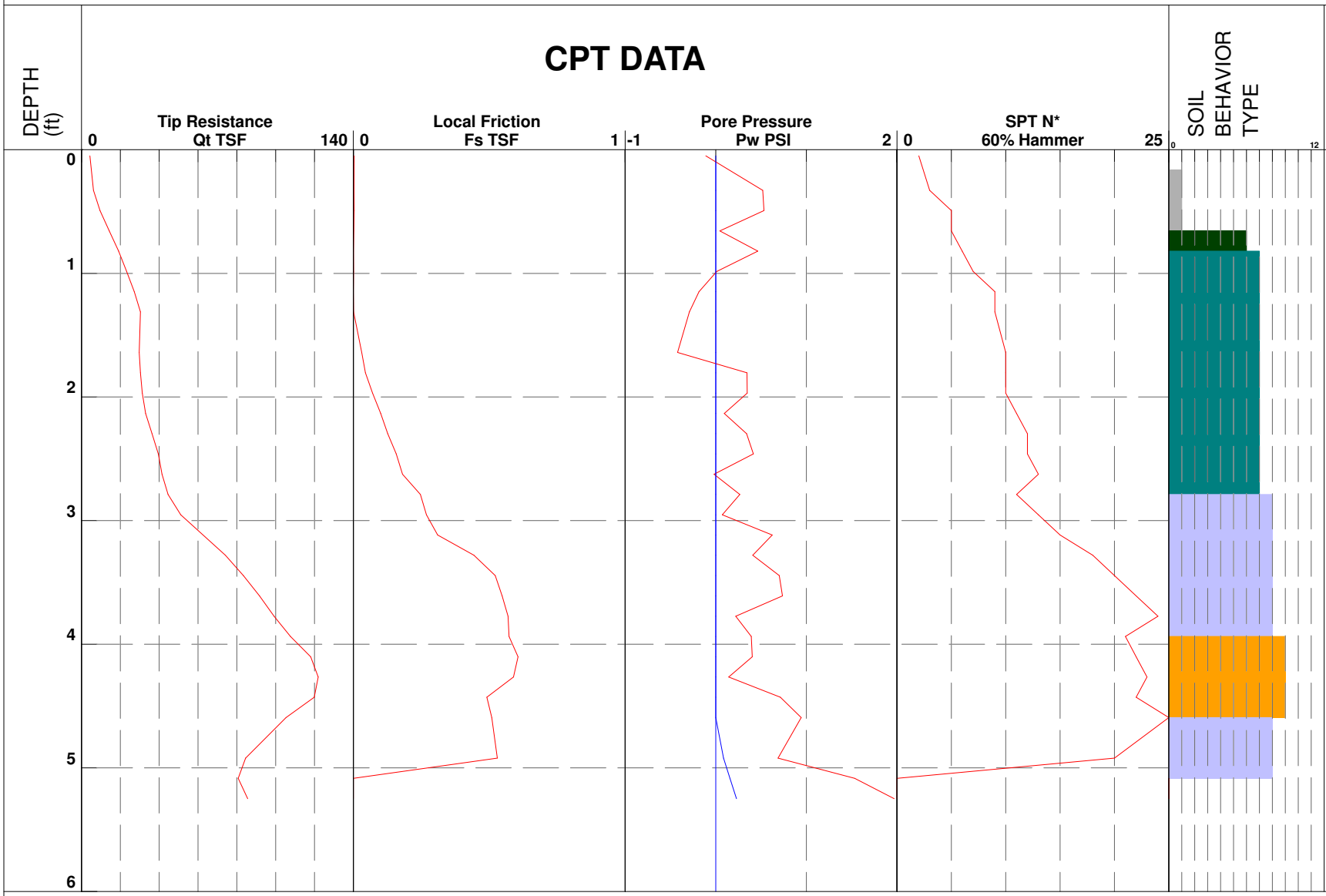
REMARKS

1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 11:33:44 AM	Sounding Number	S-11
Water Table	4.72 ft			County	New Hanover

CPT DATA

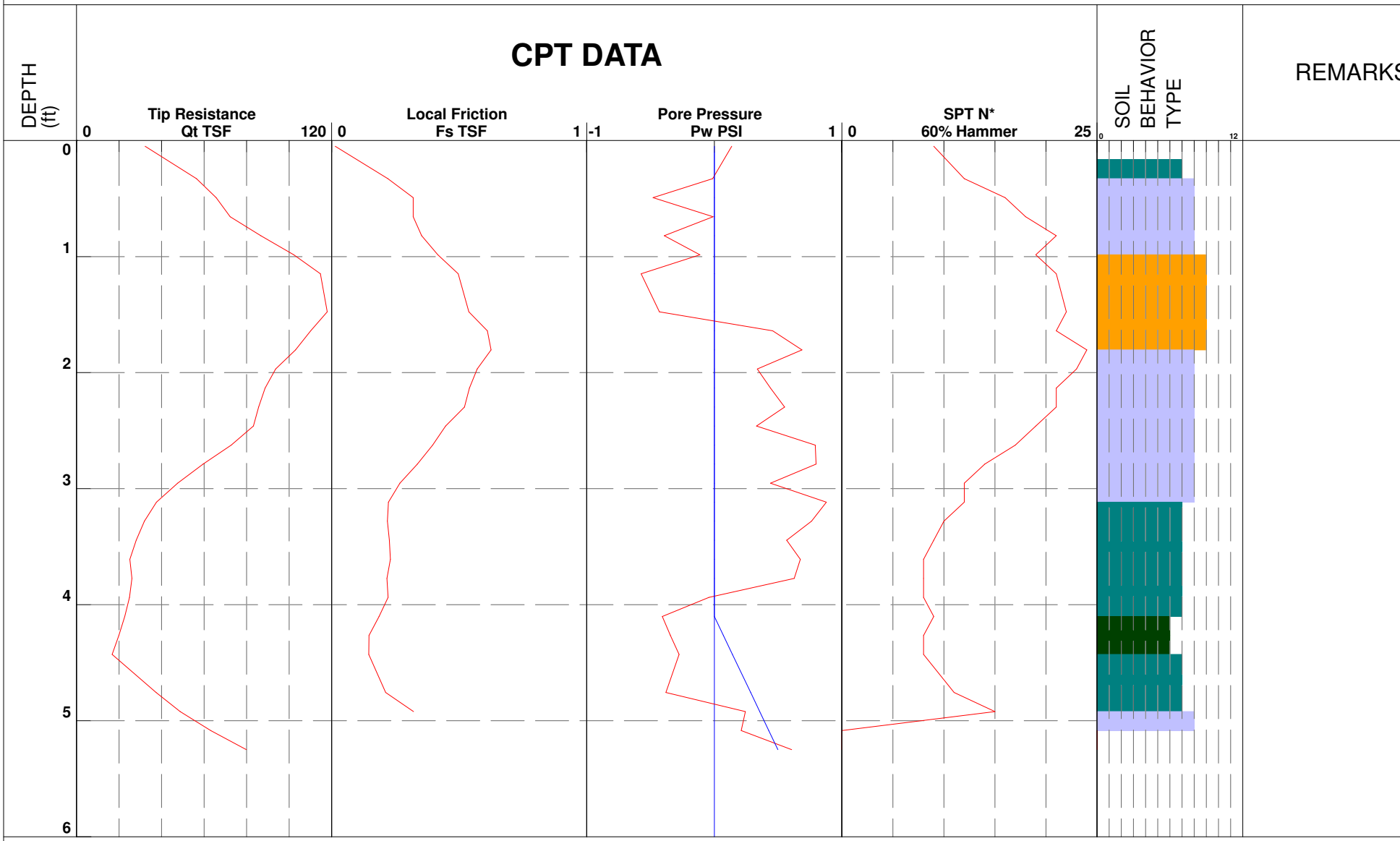


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 11:51:46 AM	Sounding Number	S-12
Water Table	4.10 ft			County	New Hanover

CPT DATA

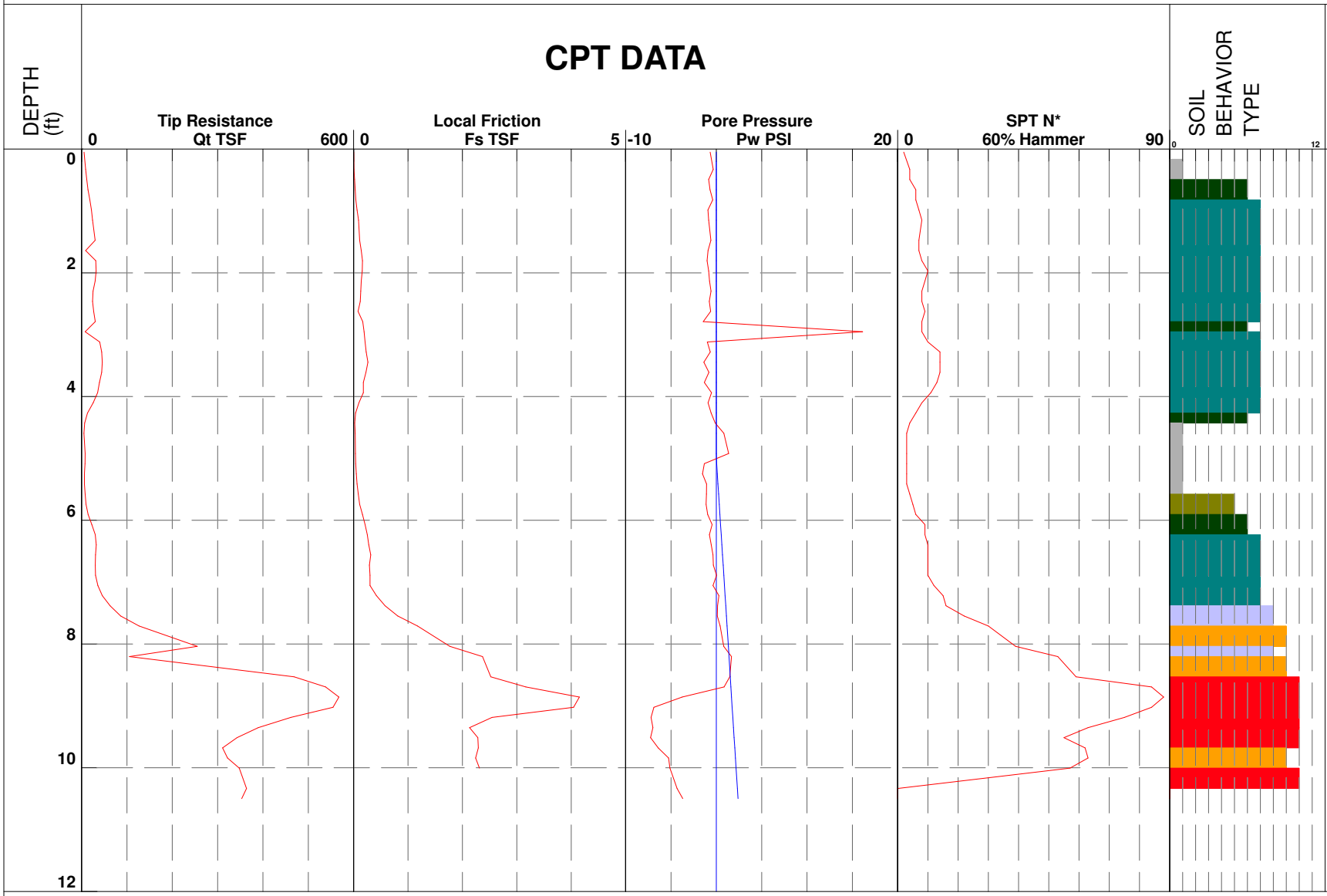


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 11:20:32 AM	Sounding Number	S-13
Water Table	4.99 ft			County	New Hanover

CPT DATA

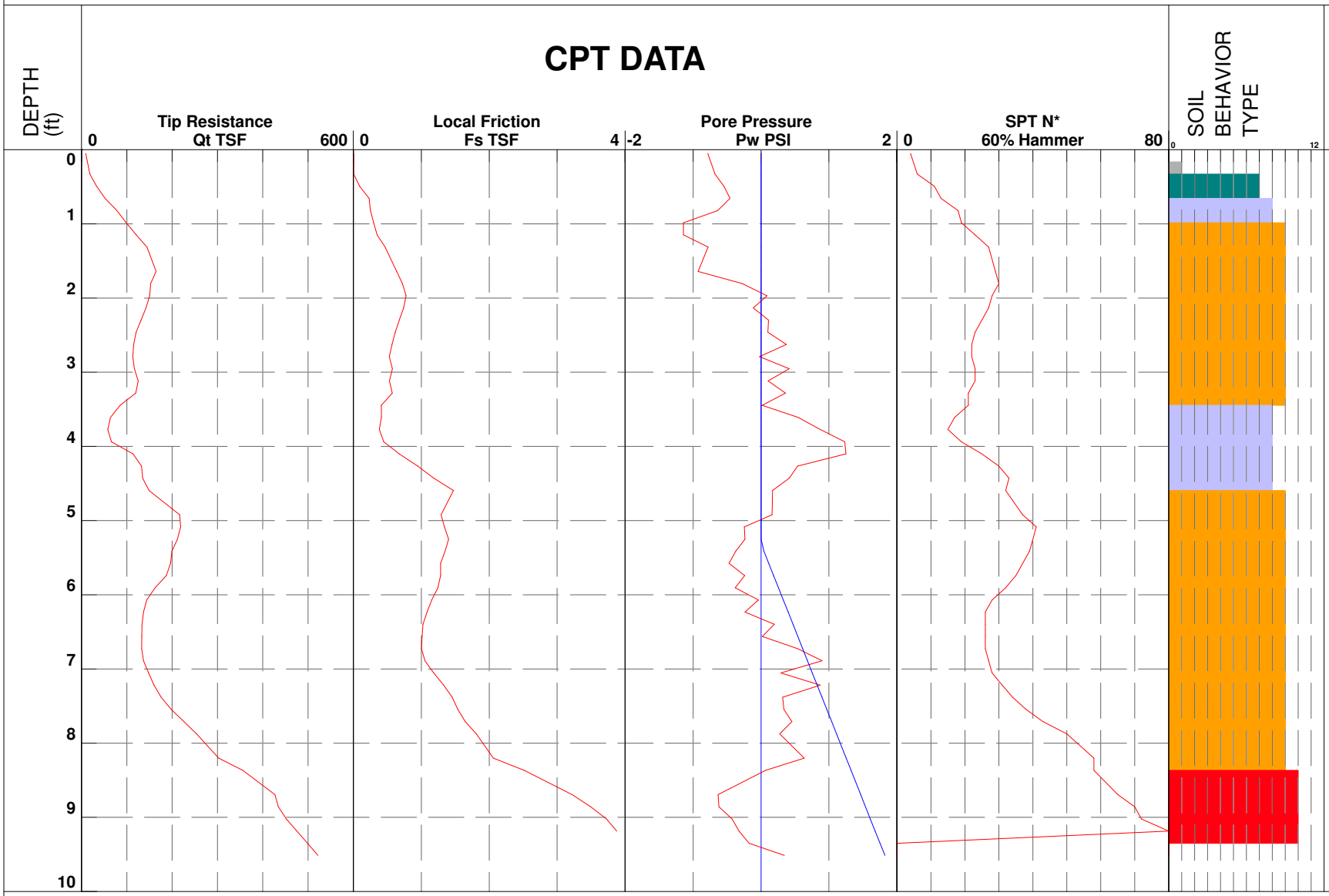


1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Proposed Aldi Food Store #98

Operator	Ron Stewart	Cone Number	DDG1299	Location	Wilmington, North Carolina
Project Number	22-23743	Date and Time	1/15/2016 11:40:55 AM	Sounding Number	S-14
Water Table	5.31 ft			County	New Hanover

CPT DATA



REMARKS

1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

APPENDIX II

Laboratory Testing Summary

Compaction Test Report

Bearing Ratio Test Report

ECS CAROLINAS, LLP

Wilmington, North Carolina

Laboratory Testing Summary

Project Number: 22.23743 **Project Engineer:** MFH **Date:** February 3, 2016

Project Name: Proposed Aldi Food Store #98 - Wilmington, NC **Principal Engineer:** WEG **Summary By:** MFH

Boring Number	Sample Number	Depth (feet)	Moisture Content (%)	USCS	Plastic Limit	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Compaction		CBR Value	Su Value	Other
									Maximum Density (pcf)	Optimum Moisture (%)			
S-1	1	1.0-2.0	4.7	SP-SM				6.7					
S-3	1	2.0-3.0	22.0	SP-SM				5.2					
S-4	1	1.0-2.0	3.7	SP									
S-7	1	2.0-3.0	4.9	SP-SM									
S-8	1	3.0-4.0	11.3	SP-SM				10.4					
S-9	Bulk-1	1.0-3.0		SM					108.2	12.4	17.7 @ 0.1"		
S-12	1	3.0-4.0	3.1	SP									
S-13	1	2.0-3.0	20.0	SM				13.4					

Summary Key:

SA = See Attached
S = Standard Proctor
M= Modified Proctor
OC = Organic Content

Hyd = Hydrometer
Con = Consolidation
DS = Direct Shear
GS = Specific Gravity

UCS = Unconfined Compression Soil
UCR = Unconfined Compression Rock
LS = Lime Stabilization
CS = Cement Staibilization

Su = Undrained Shear Strength

COMPACTION TEST REPORT

Curve No.: Bulk-1

Project No.: 22.23743 **Date:** 1/7/16

Project: Proposed Aldi Food Store #98 - Wilmington, NC

Client: ALDI, Inc.

Source of Sample: S-9 **Depth:** 1-3'

Sample Number: Bulk-1

Remarks:

MATERIAL DESCRIPTION

Description: Gray, Silty, Fine Sand

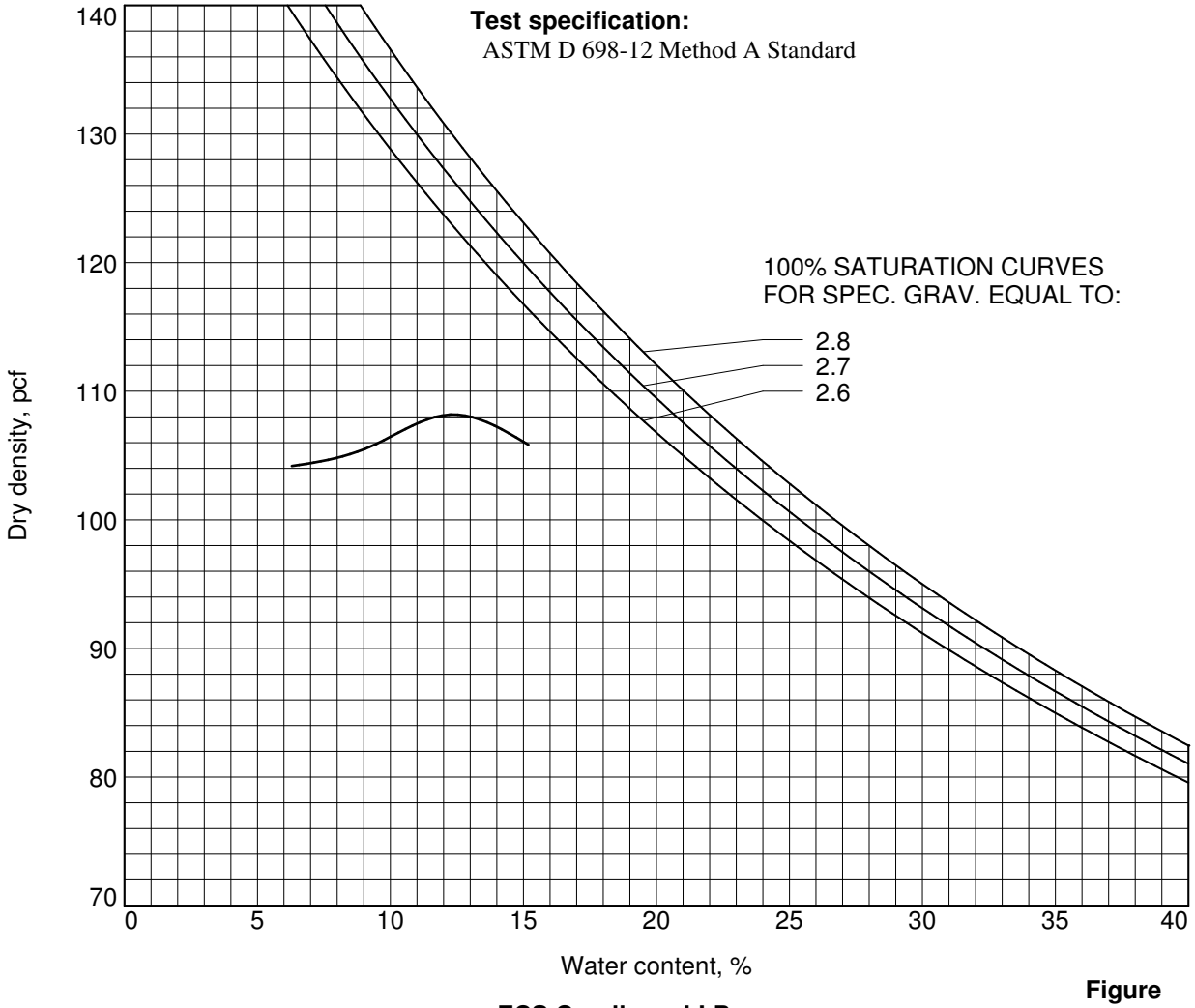
Classifications - **USCS:** SM **AASHTO:**

Nat. Moist. = **Sp.G. =** 2.60

Liquid Limit = **Plasticity Index =**

% < No.200 =

TEST RESULTS
Maximum dry density = 108.2 pcf
Optimum moisture = 12.4 %

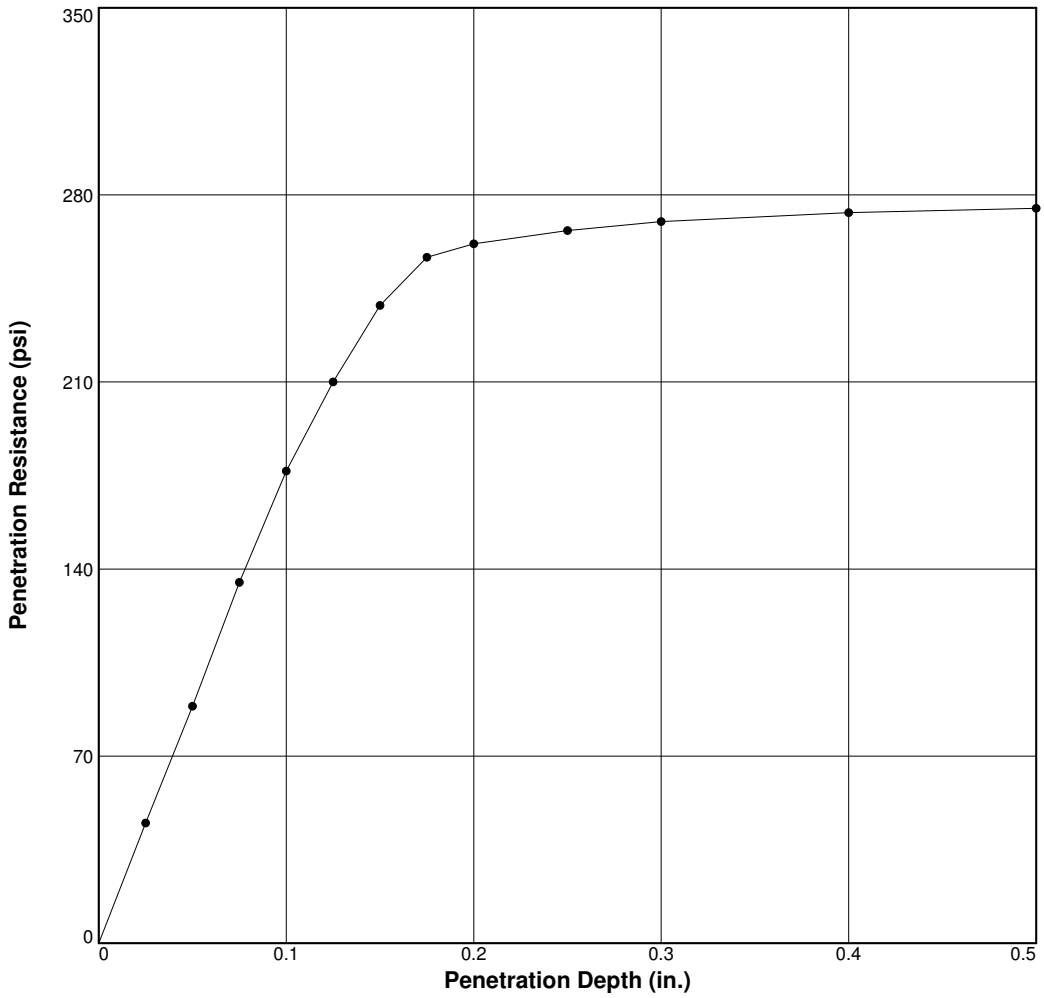


Figure

ECS Carolinas, LLP

Tested By: EG **Checked By:** KEL

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ●	106.7	98.6	12.5	106.7	98.6	14.9	17.7	17.4	0.000	10.0	0
2 ▲											
3 ■											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Gray, Silty, Fine Sand	SM	108.2	12.4		

Project No: 22.23743

Project: Proposed Aldi Food Store #98 - Wilmington, NC

Source of Sample: S-9 **Depth:** 1-3'

Sample Number: Bulk-1

Date: 1/15/16

ECS CAROLINAS, LLP
6714 Netherlands Drive
Wilmington, NC 28405
Phone: (910) 686-9114
Fax: (910) 686-9666

Test Description/Remarks:

Std. Proctor Comp.

Figure _____

Tested By: KEL **Checked By:** MFH

APPENDIX III

Geotechnical Requirements and Design Pavement Sections

GEOTECHNICAL REQUIREMENTS

These geotechnical grading requirements were taken from the Report of Subsurface Exploration and Geotechnical Engineering Evaluation (ECS Project No. 22-23743), which was prepared by ECS Carolinas, LLP and dated February 5, 2016. They are applicable to preparation of the building and pavement areas, as well as general site grading.

SITE AND SUBGRADE PREPARATION

Most of the site is currently developed with an existing building and associated asphalt paved parking and drive areas. No apparent fill was encountered in the soundings, but localized undocumented fill may be encountered in areas of the the site. Where encountered, undocumented fill should be removed. Site preparation should begin with demolishing and properly disposing of the existing on-site above and below grade construction (e.g. foundations, subsurface utilities, slabs-on-grade, etc.). Existing asphaltic concrete should be removed, while any underlying base course aggregate may be left in place. Any buried construction, existing utilities or temporary pavements that traverse the area of the planned construction site should also be removed. These operations should extend at least 10 feet beyond the planned limits of the proposed building and 5 feet beyond the planned pavement areas, where practical. These operations should be extended an additional one foot for each foot of fill required at the building's exterior perimeter.

After removal of all existing deleterious surface and subsurface materials, and prior to fill placement, the exposed subgrade soils should be evaluated by an experienced geotechnical engineer or his authorized representative to identify any localized loose, yielding, or otherwise unsuitable materials. After examining the exposed soils, loose and yielding areas can be identified by proofrolling with an approved piece of equipment, such as a loaded dump truck, having an axle weight of at least 10 tons. Unstable subgrade materials may require moisture conditioning, in-place densification, excavation and replacement with engineered fill, crushed stone (and Geogrid) stabilization or other suitable remedial repairs. The most appropriate remedial activity to repair unstable or unsuitable subgrades should be determined in the field by ECS at the time of proofrolling.

The preparation of all fill subgrades, as well as the proposed building or pavement subgrades, should be observed on a full-time basis by a representative of ECS. These observations should be performed by an experienced geotechnical engineer, or his representative, to help confirm that all unstable and/or unsuitable materials have been removed and that the prepared subgrade is suitable for support of the proposed construction.

ENGINEERED FILL

All fill for support of the proposed constructions and for backfill of utility lines within expanded building and pavement limits should consist of an approved material, free of organic matter and debris. The maximum nominal particle size within the engineered fill shall not exceed 3 inches. The engineered fill materials should have a plasticity index less than 20 and a liquid limit less than 40 and contain less than 35 percent fines. We also recommend that all fills within structural areas have a standard Proctor (ASTM D 698) maximum dry density of at least 100 pounds per cubic foot (pcf). Materials having USCS classifications of OH, OL, CL, MH, and CH shall not be used as fill beneath the building and pavements.

Mass areas of engineered fill placed within the building and pavement areas should be placed in lifts not exceeding 8 inches in loose lift thickness and moisture conditioned to within their working range of optimum moisture content, and compacted to a minimum of 95 percent of their standard Proctor maximum dry density, as determined in accordance with ASTM D 698. Similarly, isolated areas of engineered fill, such as trench and wall backfill, should be placed in lifts not exceeding 6 inches and moisture conditioned as mentioned above. The upper 18 inches of soil supporting slabs-on-grade, curb and gutter, pavements and sidewalks should be compacted to at least 98 percent of the standard Proctor maximum dry density. At least one field density test be performed for every 2,500 square feet of fill placed per lift and one test per lift of fill for every 100 linear feet of utility trench backfill. Areas which fail to achieve the required degree of compaction should be re-compacted and re-tested until the required compaction is achieved.

Fill materials should not be placed on frozen soils or frost-heaved soils and/or soils which have been recently subjected to precipitation. Borrow fill materials should not contain wet or frozen materials at the time of placement. All wet or frost-heaved soils should be removed prior to placement of engineered fill, granular sub-base materials, foundation or slab concrete, and paving materials.

SLAB-ON-GRADE SUBGRADES

Slab-on-grade areas shall be prepared in accordance with the "Site and Subgrade Preparation" and "Engineered Fill" sections of the referenced report. Prior to slab placement, the geotechnical engineer shall monitor proofrolling of the final slab subgrade with an appropriate piece of rubber-tired equipment. Any areas of unstable subgrade shall be repaired at the direction of ECS. Underslab aggregate may not be placed until ECS verifies that a stable and unyielding subgrade is indicated by the proofrolling.

SITE DRAINAGE

Positive drainage should be provided around the perimeter of the building to minimize the potential for moisture infiltration into the foundation and/or subgrade soils. We recommend that landscaped areas adjacent to the structure be sloped away from the construction and maintain a fall of at least 6 inches for the first 10 feet outward from the structures. All roof drains should release a sufficient distance from the building perimeter or discharge directly into underground stormwater piping. Sidewalks and paved areas should also be sloped to divert surface water away from the proposed building.

CONSTRUCTION CONSIDERATIONS

It is imperative to maintain good site drainage during earthwork operations to help maintain the integrity of the surface soils. The surface of the site should be kept properly graded to enhance drainage of surface water away from the proposed construction areas during the earthwork phase of this project. Surface water drainage must be diverted away from the proposed building and pavements areas without significantly interrupting its flow. Crowning and sealing the exposed soils daily with a smooth-drum roller at the end of the days work should help reduce the potential for infiltration of surface water into the exposed soils.

PAVEMENTS

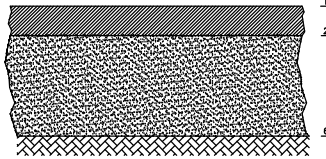
Pavement subgrades should be prepared in accordance with the recommendations in the "Site and Subgrade Preparation" and "Engineered Fill" sections of the geotechnical report and this specification. Prior to stone base placement, the geotechnical engineer shall monitor proofrolling of the subgrade with an appropriate piece of rubber-tired equipment. Any areas of unstable materials shall be repaired at the geotechnical engineer's direction. Base course aggregate shall not be placed until ECS verifies that a stable and unyielding final subgrade is indicated by the proofrolling.

All aggregate base course materials should be compacted to at least 95 percent of their modified Proctor (ASTM D 1557, AASHTO T-180) maximum dry density. Materials and placement procedures should be in accordance with the current edition of the North Carolina Department of Transportation (NCDOT) Standard Specifications.

PAVEMENT DESIGN SECTION

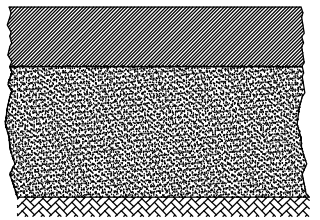
Design based on a CBR value of 10.0.

CUSTOMER PARKING/LIGHT DUTY ASPHALT PAVEMENT



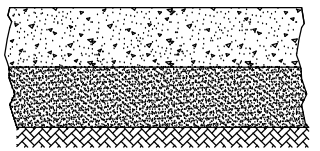
THICKNESS	MATERIAL
2.0"	SURFACE COURSE (TYPE SF9.5A)
6.0"	AGGREGATE BASE COURSE
	APPROVED SUBGRADE BY ECS AND FIELD VERIFIED CBR VALUE OF 10.0

TRAVEL LANE/HEAVY DUTY ASPHALT PAVEMENT



THICKNESS	MATERIAL
3.0"	SURFACE COURSE (TYPE SF9.5A)
8.0"	AGGREGATE BASE COURSE
	APPROVED SUBGRADE BY ECS AND FIELD VERIFIED CBR VALUE OF 10.0

PORTLAND CEMENT CONCRETE (PCC) PAVEMENT



THICKNESS	MATERIAL
6.0"	4,000 PSI COMPRESSIVEL STRENGTH CONCRETE
6.0"	AGGREGATE BASE COURSE
	APPROVED SUBGRADE BY ECS AND FIELD VERIFIED CBR VALUE OF 10.0

ECS CAROLINAS, LLP
5714 NETHERLANDS DRIVE
WILMINGTON, NORTH CAROLINA 28405
910.686.9114
910.686.9686 FAX

CLIENT:

ALDI, INC.
1985 OLD UNION CHURCH ROAD
SALISBURY, NORTH CAROLINA 28416

PROJECT:

ALDI FOOD STORE
3701 S. COLLEGE ROAD
WILMINGTON, NORTH CAROLINA 28412

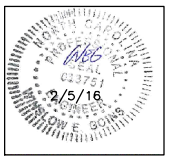
GEOTECHNICAL REQUIREMENTS AND DESIGN PAVEMENT SECTION

NOTES:

NO.	REVISION	DATE

PROJECT NUMBER	22-23743	
SCALE	NTS	
DRAWN BY	WEG	2/5/16
APPROVED BY	WEG	2/5/16

SEAL



ECS CAROLINAS, LLP
Geotechnical • Construction Materials • Environmental • Facilities

"Setting the Standard for Service"

February 12, 2016

#98

Mr. Justin Spruill
Director of Real Estate
Aldi, Inc.
1985 Old Union church Road
Salisbury, North Carolina 28146

Reference: Report of Seasonal High Water Table Estimation and Infiltration Testing
Aldi Store #98
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.1436

Dear Mr. Spruill:

ECS Carolinas, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing adjacent to the stormwater best management practice (BMP) areas at the corner of Waltmoor Road and College Road in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

Field Testing

On February 10, 2016, ECS conducted an exploration of the subsurface soil and groundwater conditions at two requested locations shown on the attached Test Location Plan (Figure 1). ECS located the borings based on a site plan provided by Design Solutions. The purpose of this exploration was to obtain subsurface information of the in situ soils for the stormwater BMP areas. ECS explored the subsurface soil and groundwater conditions by advancing one hand auger boring into the existing ground surface at the requested boring locations. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS also recorded the SHWT and groundwater elevation observed at the time of the hand auger borings. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring locations.

The SHWT and groundwater elevation was estimated at the boring locations below the existing grade elevation. A summary of the findings are as follows:

Location	SHWT	Groundwater
I-1	30 inches	42 inches
I-2	24 inches	36 inches

ECS has conducted three infiltration tests utilizing a compact constant head permeameter near the hand auger borings (two at boring I-1) in order to estimate the infiltration rate for the subsurface soils. Infiltration tests are typically conducted at two feet above the SHWT or in the most restrictive soil horizon. Tests in clayey or saturated conditions are conducted and calculated up to 30 minute intervals. If an exact hydraulic conductivity is necessary for these locations, then ECS recommends collecting samples by advancing Shelby tubes and performing laboratory permeability testing.

Field Test Results

Below is a summary of the infiltration test results:

Location	Description	Depth	Inches/ hour
I-1a	White fine to med. SAND	10 inches	14.1
I-1b	Black silty SAND	30 inches	0.09
I-2	Black silty SAND (wet)	24 inches	0.007

Infiltration rates and SHWT may vary within the proposed site due to changes in elevation and subsurface conditions.

Closure

ECS's analysis of the site has been based on our understanding of the site, the project information provided to us, and the data obtained during our exploration. If the project information provided to us is changed, please contact us so that our recommendations can be reviewed and appropriate revisions provided, if necessary. The discovery of any site or subsurface conditions during construction which deviate from the data outlined in this exploration should be reported to us for our review, analysis and revision of our recommendations, if necessary. The assessment of site environmental conditions for the presence of pollutants in the soil and groundwater of the site is beyond the scope of this geotechnical exploration.

ECS appreciates the opportunity to provide our services to you on this project. If you have any questions concerning this report or this project, please contact us at (910) 686-9114.

Respectfully,

ECS CAROLINAS, LLP

K. Brooks Wall
Project Geologist
bwall@ecslimited.com
910-686-9114

W. Brandon Fulton, PSC, PWS, LSS
Environmental Department Manager
bfulton@ecslimited.com
704-525-5152

Attachments: Figure 1 - Test Location Plan
Infiltration Testing Form
ASFE Document

⊗ **APPROXIMATE BORING LOCATIONS**

N
W E
S

SCALE SHOWN ABOVE

Aldi Store #98
Wilmington, New Hanover County, North Carolina

ECS Project # 49.1436
February 10, 2016
KBW

Figure 1– Boring Location Plan

Provided by: Google Maps

Infiltration Testing Form
Aldi Store #98
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.1436
February 10, 2016

Location	Depth	USCS	Soil Description
I-1	0-30"	SP	Gray fine to med. SAND
	30"-36"	SM	Black silty SAND (hardpan)
	36"-48"	SP	Gray fine SAND

Seasonal High Water Table was estimated to be at 30 inches below the existing grade elevation.
Groundwater was encountered at 42 inches below the existing grade elevation.
Test A was conducted at 10 inches below existing grade elevation
Test B was conducted at 30 inches below existing grade elevation
Infiltration Rate A: 14.1 per hour
Infiltration Rate B: 0.09 per hour

Location	Depth	USCS	Soil Description
I-2	0-24"	SP	Gray fine to med. SAND
	24"-42"	SM	Black silty SAND (hardpan)(wet)

Seasonal High Water Table was estimated to be at 24 inches below the existing grade elevation.
Groundwater was encountered at 36 inches below the existing grade elevation.
Test was conducted at 24 inches below existing grade elevation
Infiltration Rate: 0.007 per hour

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from alight industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ-sometimes significantly from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in-this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer For Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone:' 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

IIGER06045.0M

APPENDIX J

ENERGY DISSIPATER DESIGN CALCULATIONS

DESIGN OF RIPRAP OUTLET PROTECTION - SINGLE PIPE

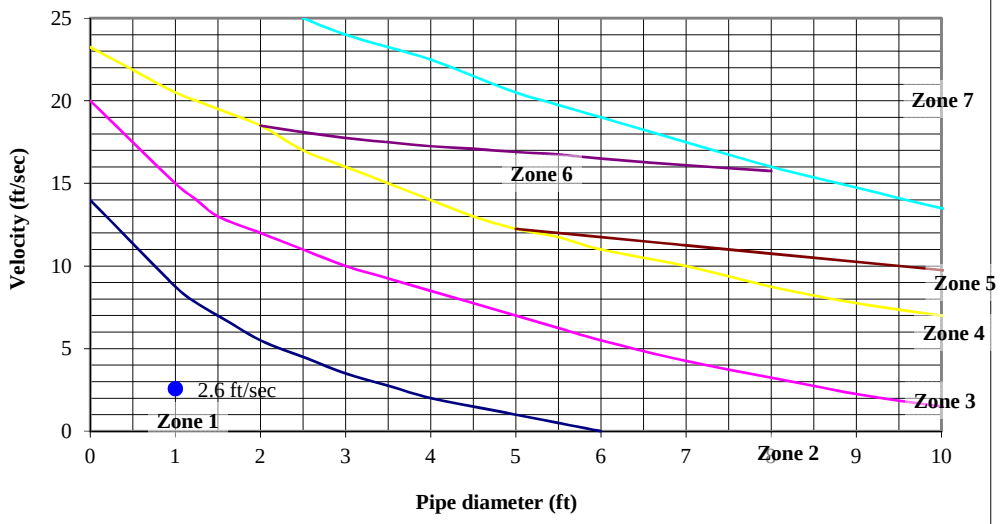
Single Pipe Outlet

Project	ALDI #98 Wilmington NC	Date	6-Oct-16
Project No.	20170421	Designer	RAP

Pipe and Flow Data

Outlet ID	POND OUTLET		
Pipe diameter	12 in.		
Pipe slope	0.96%		
Outlet flowrate	0.3 cfs	Source of flowrate data	HydroCAD
Outlet velocity	2.6 ft/sec	Source of velocity data	HydroCAD
Outlet pipe downstream inv.	41.00		
Tailwater elevation	41.18	Source of TW elev.	Hydraflow
Zone from graph below =	1		

Figure 8.06.b.1



NCDOT Class A Riprap - 4' L x 3' W x 9"Thick

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual

DESIGN OF RIPRAP OUTLET PROTECTION - SINGLE PIPE

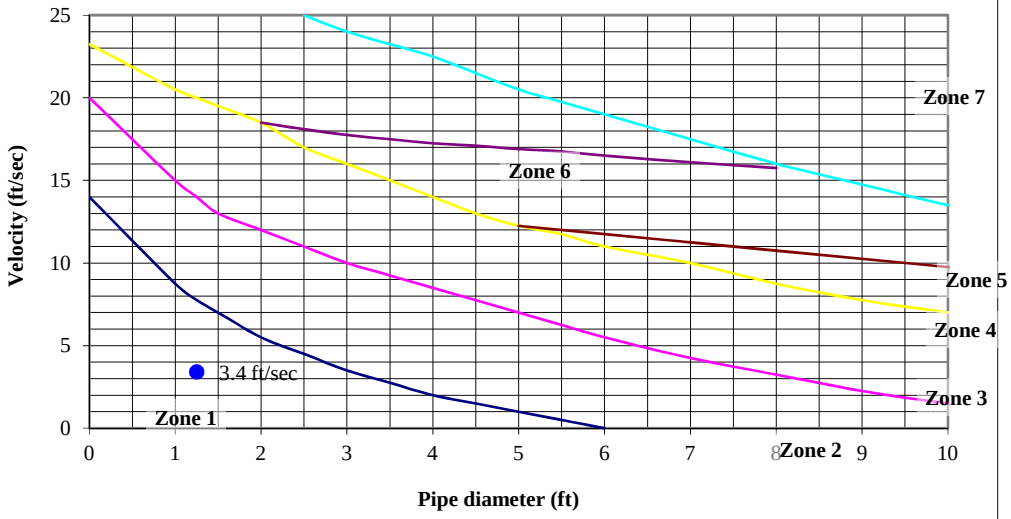
Single Pipe Outlet

Project	ALDI #98 Wilmington NC	Date	7-Oct-16
Project No.	20170421	Designer	RAP

Pipe and Flow Data

Outlet ID	DRIVEWAY CULVERT		
Pipe diameter	15 in.		
Pipe slope	0.22%		
Outlet flowrate	3.6 cfs	Source of flowrate data	Rational Method
Outlet velocity	3.4 ft/sec	Source of velocity data	Hydraflow
Outlet pipe downstream inv.	40.89		
Tailwater elevation	41.90	Source of TW elev.	Hydraflow
Zone from graph below =	1		

Figure 8.06.b.1



NCDOT Class A Riprap - 5' L x 3.75' W x 9"Thick

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual

DESIGN OF RIPRAP OUTLET PROTECTION - SINGLE PIPE

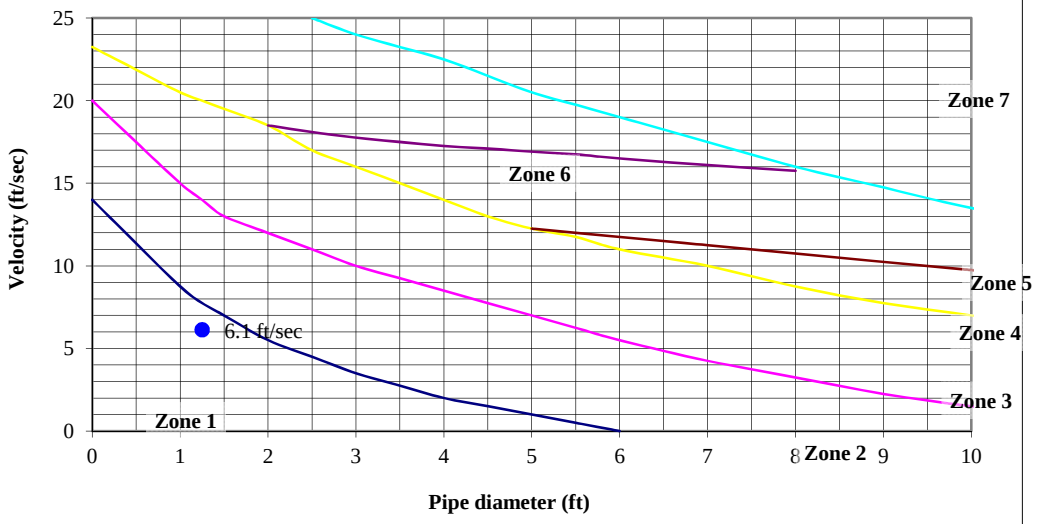
Single Pipe Outlet

Project	ALDI #98 Wilmington NC	Date	6-Oct-16
Project No.	20170421	Designer	RAP

Pipe and Flow Data

Outlet ID	CB-5		
Pipe diameter	15 in.		
Pipe slope	0.50%		
Outlet flowrate	7.3 cfs	Source of flowrate data	Rational Method
Outlet velocity	6.1 ft/sec	Source of velocity data	Hydraflow
Outlet pipe downstream inv.	41.50		
Tailwater elevation	42.66	Source of TW elev.	Hydraflow
Zone from graph below =	1		

Figure 8.06.b.1



NCDOT Class A Riprap - 5' L x 3.75' W x 9"Thick

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual

DESIGN OF RIPRAP OUTLET PROTECTION - SINGLE PIPE

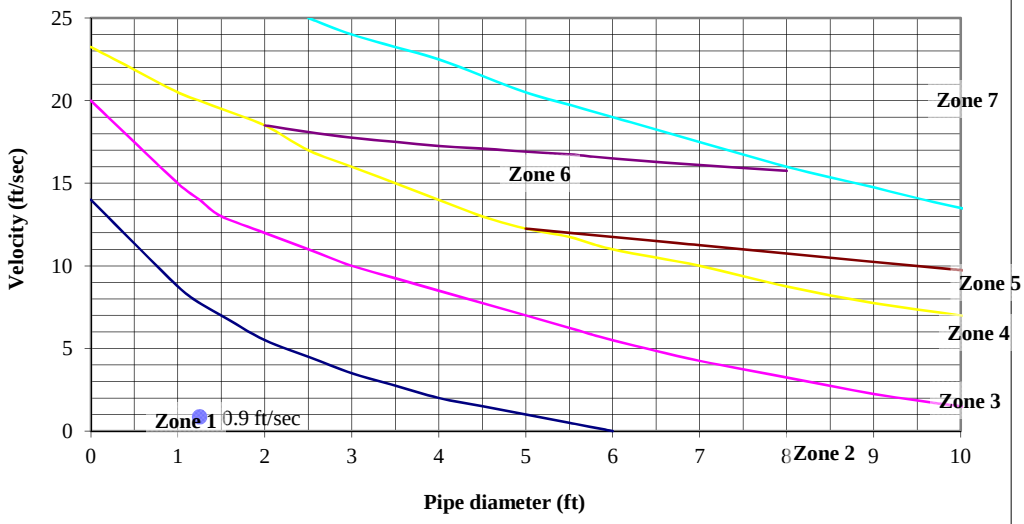
Single Pipe Outlet

Project	ALDI #98 Wilmington NC	Date	6-Oct-16
Project No.	20170421	Designer	RAP

Pipe and Flow Data

Outlet ID	CB-6		
Pipe diameter	15 in.		
Pipe slope	0.50%		
Outlet flowrate	0.7 cfs	Source of flowrate data	Rational Method
Outlet velocity	0.9 ft/sec	Source of velocity data	Hydraflow
Outlet pipe downstream inv.	41.50		
Tailwater elevation	42.29	Source of TW elev.	Hydraflow
Zone from graph below =	1		

Figure 8.06.b.1



NCDOT Class A Riprap - 5' L x 3.75' W x 9"Thick

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual

DESIGN OF RIPRAP OUTLET PROTECTION - SINGLE PIPE

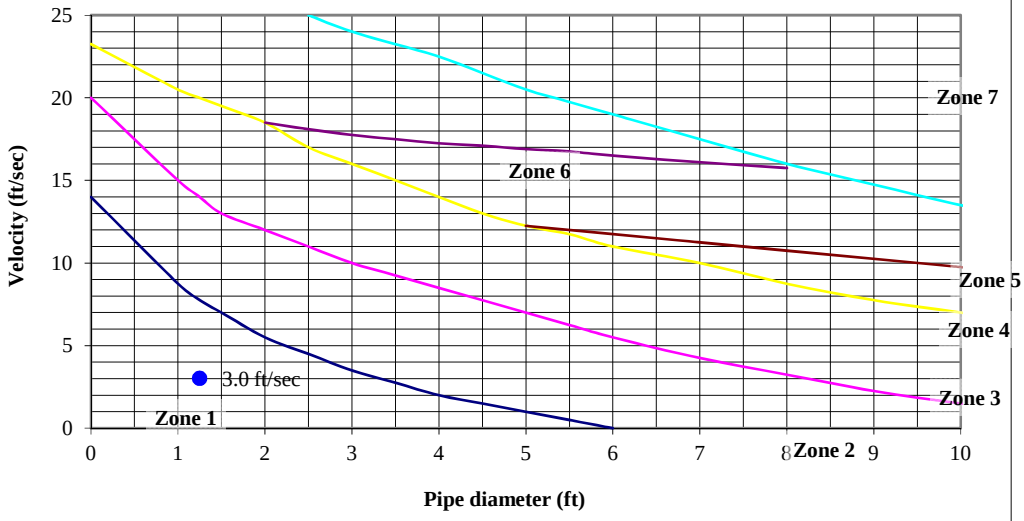
Single Pipe Outlet

Project	ALDI #98 Wilmington NC	Date	6-Oct-16
Project No.	20170421	Designer	RAP

Pipe and Flow Data

Outlet ID	FES-1		
Pipe diameter	15 in.		
Pipe slope	0.70%		
Outlet flowrate	3.1 cfs	Source of flowrate data	Rational Method
Outlet velocity	3.0 ft/sec	Source of velocity data	Hydraflow
Outlet pipe downstream inv.	41.50		
Tailwater elevation	42.48	Source of TW elev.	Hydraflow
Zone from graph below =	1		

Figure 8.06.b.1



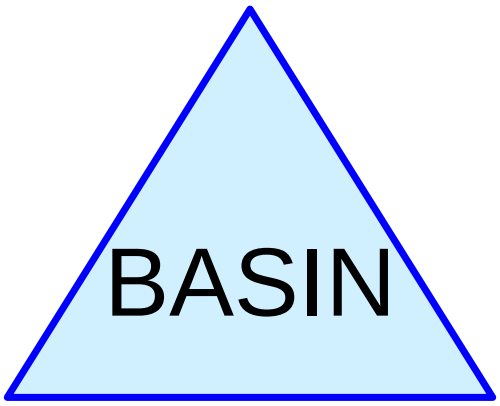
NCDOT Class A Riprap - 5' L x 3.75' W x 9"Thick

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

1. Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual

APPENDIX K

PRINCIPAL SPILLWAY OBSTRUCTED HYDROLOGIC MODEL AND RESULTS



WET DETENTION BASIN

Subcat Reach Pond Link

Routing Diagram for ALDI #98 Wilmington NC Stormwater
Prepared by Kleinfelder, Printed 10/28/2016

Summary for Pond BASIN: WET DETENTION BASIN

Inflow Area = 2.187 ac, 75.67% Impervious, Inflow Depth = 6.82" for 50-Year event
Inflow = 16.98 cfs @ 12.09 hrs, Volume= 1.244 af
Outflow = 1.11 cfs @ 13.64 hrs, Volume= 0.371 af, Atten= 93%, Lag= 93.5 min
Secondary = 1.11 cfs @ 13.64 hrs, Volume= 0.371 af

Routing by Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 44.29' @ 13.64 hrs Surf.Area= 0.323 ac Storage= 0.885 af

Plug-Flow detention time= 371.1 min calculated for 0.371 af (30% of inflow)
Center-of-Mass det. time= 227.4 min (1,021.3 - 793.9)

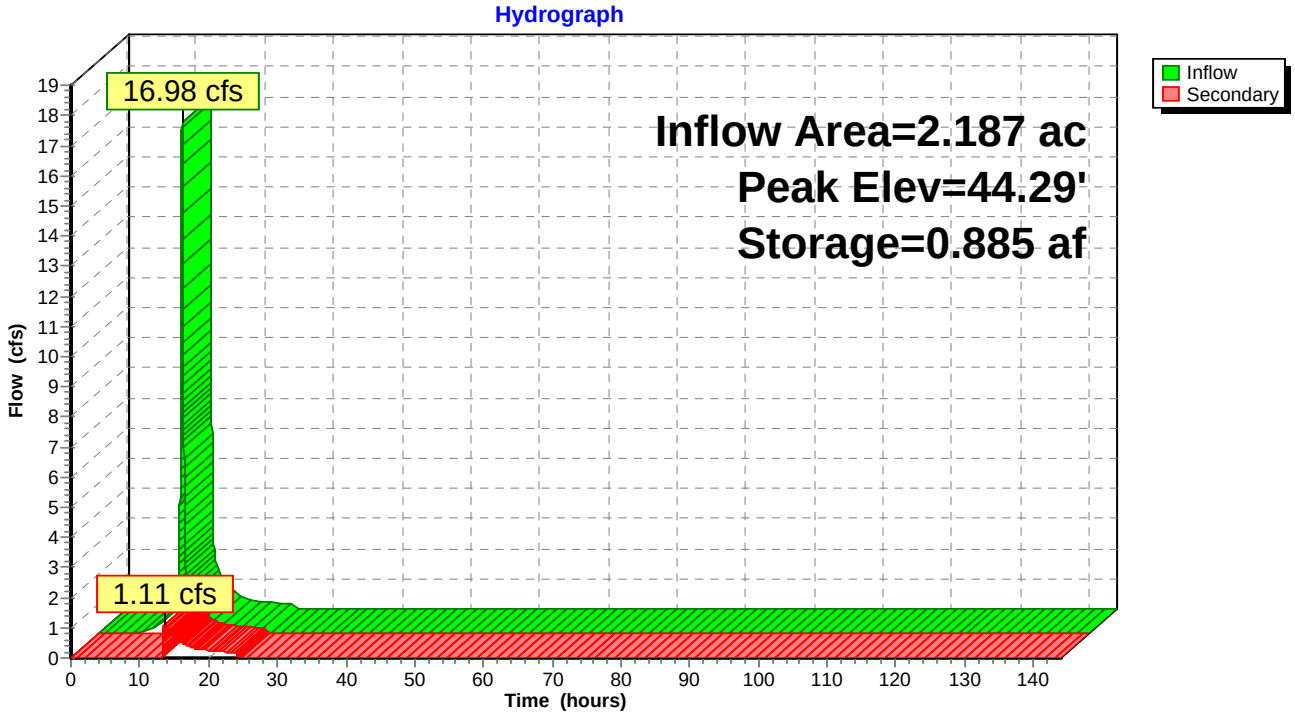
Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	1.115 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
41.50	0.261	627.3	0.000	0.000	0.261
42.00	0.323	645.1	0.146	0.146	0.303
43.00	0.323	645.1	0.323	0.469	0.318
44.00	0.323	645.1	0.323	0.792	0.333
45.00	0.323	645.1	0.323	1.115	0.347

Device	Routing	Invert	Outlet Devices
#1	Secondary	44.25'	**58.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Secondary OutFlow Max=1.04 cfs @ 13.64 hrs HW=44.29' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.04 cfs @ 0.46 fps)

Pond BASIN: WET DETENTION BASIN



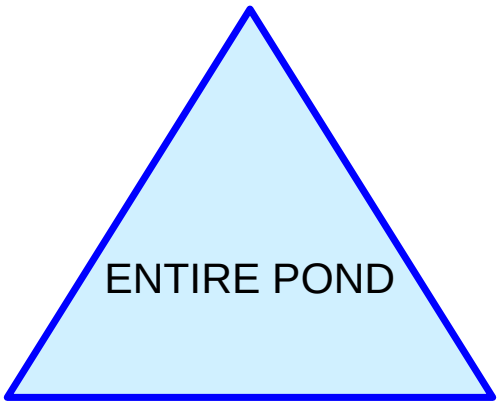
Stage-Discharge for Pond BASIN: WET DETENTION BASIN

Elevation (feet)	Secondary (cfs)	Elevation (feet)	Secondary (cfs)	Elevation (feet)	Secondary (cfs)	Elevation (feet)	Secondary (cfs)
41.50	0.00	42.54	0.00	43.58	0.00	44.62	32.32
41.52	0.00	42.56	0.00	43.60	0.00	44.64	35.20
41.54	0.00	42.58	0.00	43.62	0.00	44.66	38.22
41.56	0.00	42.60	0.00	43.64	0.00	44.68	41.38
41.58	0.00	42.62	0.00	43.66	0.00	44.70	44.65
41.60	0.00	42.64	0.00	43.68	0.00	44.72	48.03
41.62	0.00	42.66	0.00	43.70	0.00	44.74	51.53
41.64	0.00	42.68	0.00	43.72	0.00	44.76	55.13
41.66	0.00	42.70	0.00	43.74	0.00	44.78	58.86
41.68	0.00	42.72	0.00	43.76	0.00	44.80	62.69
41.70	0.00	42.74	0.00	43.78	0.00	44.82	66.64
41.72	0.00	42.76	0.00	43.80	0.00	44.84	70.71
41.74	0.00	42.78	0.00	43.82	0.00	44.86	74.58
41.76	0.00	42.80	0.00	43.84	0.00	44.88	78.22
41.78	0.00	42.82	0.00	43.86	0.00	44.90	81.91
41.80	0.00	42.84	0.00	43.88	0.00	44.92	85.66
41.82	0.00	42.86	0.00	43.90	0.00	44.94	89.46
41.84	0.00	42.88	0.00	43.92	0.00	44.96	93.31
41.86	0.00	42.90	0.00	43.94	0.00	44.98	97.20
41.88	0.00	42.92	0.00	43.96	0.00	45.00	**101.15**
41.90	0.00	42.94	0.00	43.98	0.00		
41.92	0.00	42.96	0.00	44.00	0.00		
41.94	0.00	42.98	0.00	44.02	0.00		
41.96	0.00	43.00	0.00	44.04	0.00		
41.98	0.00	43.02	0.00	44.06	0.00		
42.00	0.00	43.04	0.00	44.08	0.00		
42.02	0.00	43.06	0.00	44.10	0.00		
42.04	0.00	43.08	0.00	44.12	0.00		
42.06	0.00	43.10	0.00	44.14	0.00		
42.08	0.00	43.12	0.00	44.16	0.00		
42.10	0.00	43.14	0.00	44.18	0.00		
42.12	0.00	43.16	0.00	44.20	0.00		
42.14	0.00	43.18	0.00	44.22	0.00		
42.16	0.00	43.20	0.00	44.24	0.00		
42.18	0.00	43.22	0.00	44.26	0.14		
42.20	0.00	43.24	0.00	44.28	0.71		
42.22	0.00	43.26	0.00	44.30	1.52		
42.24	0.00	43.28	0.00	44.32	2.51		
42.26	0.00	43.30	0.00	44.34	3.66		
42.28	0.00	43.32	0.00	44.36	4.95		
42.30	0.00	43.34	0.00	44.38	6.36		
42.32	0.00	43.36	0.00	44.40	7.88		
42.34	0.00	43.38	0.00	44.42	9.51		
42.36	0.00	43.40	0.00	44.44	11.24		
42.38	0.00	43.42	0.00	44.46	13.11		
42.40	0.00	43.44	0.00	44.48	15.12		
42.42	0.00	43.46	0.00	44.50	17.25		
42.44	0.00	43.48	0.00	44.52	19.50		
42.46	0.00	43.50	0.00	44.54	21.85		
42.48	0.00	43.52	0.00	44.56	24.31		
42.50	0.00	43.54	0.00	44.58	26.87		
42.52	0.00	43.56	0.00	44.60	29.54		

Stage-Area-Storage for Pond BASIN: WET DETENTION BASIN

Elevation (feet)	Surface (acres)	Storage (acre-feet)
41.50	0.261	0.000
41.55	0.267	0.013
41.60	0.273	0.027
41.65	0.279	0.040
41.70	0.285	0.055
41.75	0.291	0.069
41.80	0.297	0.084
41.85	0.304	0.099
41.90	0.310	0.114
41.95	0.317	0.130
42.00	**0.323**	0.146
42.05	0.323	0.162
42.10	0.323	0.178
42.15	0.323	0.194
42.20	0.323	0.210
42.25	0.323	0.226
42.30	0.323	0.243
42.35	0.323	0.259
42.40	0.323	0.275
42.45	0.323	0.291
42.50	0.323	0.307
42.55	0.323	0.323
42.60	0.323	0.340
42.65	0.323	0.356
42.70	0.323	0.372
42.75	0.323	0.388
42.80	0.323	0.404
42.85	0.323	0.420
42.90	0.323	0.436
42.95	0.323	0.453
43.00	0.323	0.469
43.05	0.323	0.485
43.10	0.323	0.501
43.15	0.323	0.517
43.20	0.323	0.533
43.25	0.323	0.549
43.30	0.323	0.566
43.35	0.323	0.582
43.40	0.323	0.598
43.45	0.323	0.614
43.50	0.323	0.630
43.55	0.323	0.646
43.60	0.323	0.663
43.65	0.323	0.679
43.70	0.323	0.695
43.75	0.323	0.711
43.80	0.323	0.727
43.85	0.323	0.743
43.90	0.323	0.759
43.95	0.323	0.776
44.00	0.323	0.792
44.05	0.323	0.808
44.10	0.323	0.824
44.15	0.323	0.840
44.20	0.323	0.856
44.25	0.323	0.872
44.30	0.323	0.889
44.35	0.323	0.905
44.40	0.323	0.921
44.45	0.323	0.937
44.50	0.323	0.953
44.55	0.323	0.969
44.60	0.323	0.986
44.65	0.323	1.002
44.70	0.323	1.018
44.75	0.323	1.034
44.80	0.323	1.050
44.85	0.323	1.066
44.90	0.323	1.082
44.95	0.323	1.099
45.00	0.323	**1.115**

APPENDIX L
POND VOLUMES



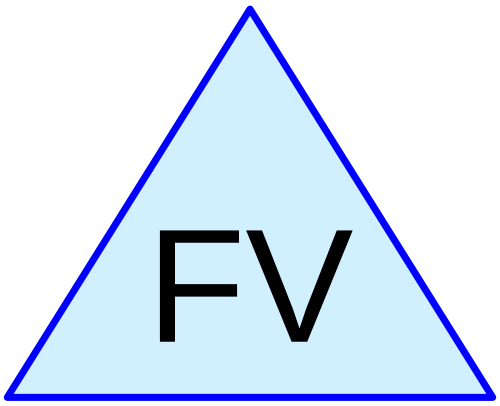
WET DETENTION BASIN (ENTIRE POND)

Subcat Reach Pond Link

Routing Diagram for ALDI #98 Wilmington NC Stormwater
Prepared by Kleinfelder, Printed 8/5/2016

Stage-Area-Storage for Pond ENTIRE POND: WET DETENTION BASIN (ENTIRE POND)

Elevation (feet)	Surface (acres)	Storage (acre-feet)
34.00	0.017	0.000
34.15	0.019	0.003
34.30	0.021	0.006
34.45	0.024	0.009
34.60	0.026	0.013
34.75	0.029	0.017
34.90	0.032	0.022
35.05	0.035	0.027
35.20	0.038	0.032
35.35	0.041	0.038
35.50	0.044	0.044
35.65	0.047	0.051
35.80	0.050	0.059
35.95	0.054	0.066
36.10	0.057	0.075
36.25	0.060	0.084
36.40	0.064	0.093
36.55	0.067	0.103
36.70	0.071	0.113
36.85	0.074	0.124
37.00	0.078	0.135
37.15	0.082	0.147
37.30	0.085	0.160
37.45	0.089	0.173
37.60	0.093	0.187
37.75	0.097	0.201
37.90	0.101	0.216
38.05	0.105	0.231
38.20	0.109	0.247
38.35	0.113	0.264
38.50	0.117	0.281
38.65	0.121	0.299
38.80	0.125	0.317
38.95	0.129	0.336
39.10	0.133	0.356
39.25	0.137	0.376
39.40	0.141	0.397
39.55	0.145	0.418
39.70	0.149	0.440
39.85	0.154	0.463
40.00	0.158	0.486
40.15	0.162	0.511
40.30	0.167	0.535
40.45	0.171	0.561
40.60	0.176	0.587
40.75	0.180	0.613
40.90	0.185	0.641
41.05	0.195	0.669
41.20	0.216	0.700
41.35	0.238	0.734
41.50	0.261	0.771
41.65	0.279	0.812
41.80	0.297	0.855
41.95	**0.317**	0.901
42.10	**0.323**	0.949
42.25	0.323	0.997
42.40	0.323	1.046
42.55	0.323	1.094
42.70	0.323	1.143
42.85	0.323	1.191
43.00	0.323	1.240
43.15	0.323	1.288
43.30	0.323	1.337
43.45	0.323	1.385
43.60	0.323	1.434
43.75	0.323	1.482
43.90	0.323	1.530
44.05	0.323	1.579
44.20	0.323	1.627
44.35	0.323	1.676
44.50	0.323	1.724
44.65	0.323	1.773
44.80	0.323	1.821
44.95	0.323	**1.870**



FOREBAY VOLUME

Subcat Reach Pond Link

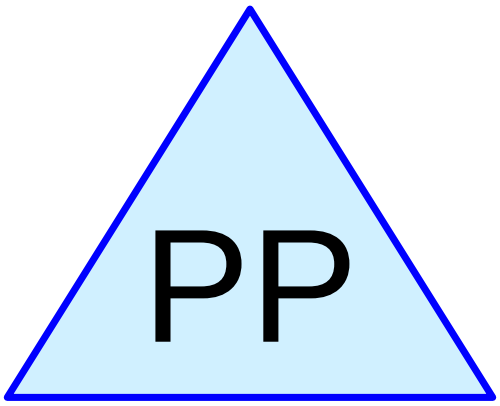
Routing Diagram for ALDI #98 Wilmington NC Stormwater
Prepared by Kleinfelder, Printed 8/5/2016

Summary for Pond FV: FOREBAY VOLUME

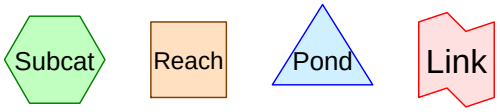
[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	7,011 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	208	58.8	0	0	208
35.00	341	74.2	272	272	384
36.00	504	89.2	420	692	595
37.00	698	104.2	598	1,290	846
38.00	921	119.1	807	2,097	1,133
39.00	1,174	133.7	1,045	3,142	1,453
40.00	1,456	148.4	1,312	4,454	1,812
41.00	1,768	163.6	1,609	6,064	2,220
41.50	2,022	175.3	947	7,011	2,547



PERMANENT POOL VOLUME



Routing Diagram for ALDI #98 Wilmington NC Stormwater
Prepared by Kleinfelder, Printed 8/5/2016

Summary for Pond PP: PERMANENT POOL VOLUME

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	33,594 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	752	245.9	0	0	752
35.00	1,471	443.8	1,092	1,092	11,619
36.00	2,396	482.2	1,915	3,006	14,486
37.00	3,413	533.6	2,890	5,896	18,672
38.00	4,512	564.9	3,950	9,846	21,463
39.00	5,673	595.9	5,081	14,927	24,385
40.00	6,896	627.1	6,275	21,202	27,482
41.00	8,182	658.9	7,530	28,731	30,799
41.50	11,356	625.2	4,863	33,594	34,258

APPENDIX M

STORM DRAINAGE CALCULATIONS

ALDI #98 WILMINGTON NC 10-YEAR STORM DRAINAGE COMPUTATIONS																	
DRAINAGE FROM	DRAINAGE TO	DRAINAGE AREA (ac)	tc TIME OF CONC. (min)	I INTENSITY (in/hr)	RUNOFF COEFFICIENT, C	Q FLOW (cfs)	Q TOTAL FLOW (cfs)	SLOPE (ft/ft)	Dtheo (in)	SIZE (in)	Vfull (ft/sec)	LENGTH (ft)	UPPER INVERT (ft)	LOWER INVERT (ft)	TOP EL (ft)	HGL	PIPE MATERIAL
CB-1	CB-2	0.10	5.0	7.23	0.91	0.7	0.7	0.0052	7.2	12	3.3	40.50	37.89	37.68	40.89	38.37	RCP
CB-2	CB-3	0.41	5.0	7.23	0.88	2.6	3.3	0.0057	12.9	15	4.0	118.00	37.68	37.01	42.50	38.74	RCP
RD-1	PLUMBING TEE	0.04	5.0	7.23	0.95	0.2	0.2	0.0051	4.4	8	3.5	97.00	43.00	42.51	-	-	PVC
RD-2	PLUMBING TEE	0.04	5.0	7.23	0.95	0.2	0.2	0.0272	3.2	8	8.2	18.00	43.00	42.51	-	-	PVC
PLUMBING TEE	CB-3	0.00	5.0	7.23	0.95	0.0	0.5	0.0146	4.6	8	6.0	111.00	42.51	40.89	-	-	PVC
CB-3	JB-1	0.11	5.0	7.23	0.76	0.6	4.4	0.0054	14.5	15	3.9	19.50	37.01	36.90	45.23	38.30	RCP
JB-1	CB-4	0.00	5.0	7.23	0.95	0.0	4.4	**PUMPED	14.9	6	3.7	246.50	36.90	41.79	45.30	-	PVC
*JB-1	*CB-7	0.00	5.0	7.23	0.95	0.0	4.4	0.0783	8.8	15	14.7	41.50	41.00	37.75	45.30	42.24	RCP
CB-4	CB-5	0.03	5.0	7.23	0.84	0.2	4.5	0.0051	14.9	15	3.7	57.00	41.79	41.50	45.62	43.10	RCP
YI-1	SUMP PUMP	0.06	5.0	7.23	0.95	0.4	0.4	0.0100	4.9	8	3.2	23.00	40.70	40.47	42.70	41.13	CPP
SUMP PUMP	JB-2	0.00	5.0	7.23	0.95	0.0	0.4	**PUMPED	5.3	8	3.5	7.00	40.47	42.91	-	-	PVC
RD-3	JB-2	0.38	5.0	7.23	0.95	2.6	2.6	0.0072	9.9	12	5.6	12.50	43.00	42.91	-	-	PVC
JB-2	FES-1	0.00	5.0	7.23	0.95	0.0	3.1	0.0070	12.1	15	4.4	202.50	42.91	41.50	45.83	43.94	RCP
FES-2	FES-3	0.77	5.0	7.23	0.65	3.6	3.6	0.0022	15.9	15	2.5	58.00	41.02	40.89	-	-	RCP
CB-7	EX. MH	0.39	5.0	7.23	0.57	1.6	6.0	0.0159	13.3	15	6.6	22.00	37.75	37.40	41.00	39.36	RCP

ALDI #98 WILMINGTON NC 50-YEAR STORM DRAINAGE COMPUTATIONS																	
DRAINAGE FROM	DRAINAGE TO	DRAINAGE AREA (ac)	tc TIME OF CONC. (min)	I INTENSITY (in/hr)	RUNOFF COEFFICIENT, C	Q FLOW (cfs)	Q TOTAL FLOW (cfs)	SLOPE (ft/ft)	Dtheo (in)	SIZE (in)	Vfull (ft/sec)	LENGTH (ft)	UPPER INVERT (ft)	LOWER INVERT (ft)	TOP EL (ft)	HGL	PIPE MATERIAL
CB-1	CB-2	0.10	5.0	8.87	0.91	0.8	0.8	0.0052	7.8	12.00	3.3	40.50	37.89	37.68	40.89	38.40	RCP
CB-2	CB-3	0.41	5.0	8.87	0.88	3.2	4.0	0.0057	13.9	15.00	4.0	118.00	37.68	37.01	42.50	38.89	RCP
RD-1	PLUMBING TEE	0.04	5.0	8.87	0.95	0.3	0.3	0.0051	4.7	8.00	3.5	97.00	43.00	42.51	-	-	PVC
RD-2	PLUMBING TEE	0.04	5.0	8.87	0.95	0.3	0.3	0.0272	3.4	8.00	8.2	18.00	43.00	42.51	-	-	PVC
PLUMBING TEE	CB-3	0.00	5.0	8.87	0.95	0.0	0.6	0.0146	5.0	8.00	6.0	111.00	42.51	40.89	-	-	PVC
CB-3	JB-1	0.11	5.0	8.87	0.76	0.7	5.3	0.0054	15.7	15.00	3.9	19.50	37.01	36.90	45.23	38.48	RCP
JB-1	CB-4	0.00	5.0	8.87	0.95	0.0	5.3	**PUMPED	13.8	6.00	3.7	246.50	36.90	41.79	45.30	-	PVC
*JB-1	*CB-7	0.00	5.0	8.87	0.95	0.0	5.3	0.0783	9.5	15.00	14.7	41.50	41.00	37.75	45.30	42.42	RCP
CB-4	CB-5	0.03	5.0	8.87	0.84	0.2	5.6	0.0051	16.1	15.00	3.7	57.00	41.79	41.50	45.62	43.32	RCP
YI-1	SUMP PUMP	0.06	5.0	8.87	0.95	0.5	0.5	0.0100	5.3	8.00	3.2	23.00	40.70	40.47	42.70	41.19	CPP
SUMP PUMP	JB-2	0.00	5.0	8.87	0.95	0.0	0.5	**PUMPED	5.8	8.00	3.5	7.00	40.47	42.91	-	-	PVC
RD-3	JB-2	0.38	5.0	8.87	0.95	3.2	3.2	0.0072	10.7	12.00	5.6	12.50	43.00	42.91	-	-	PVC
JB-2	FES-1	0.00	5.0	8.87	0.95	0.0	3.7	0.0070	13.1	15.00	4.4	202.50	42.91	41.50	45.83	44.06	RCP
FES-2	FES-3	0.77	5.0	8.87	0.65	4.4	4.4	0.0022	17.2	15.00	2.5	58.00	41.02	40.89	-	-	RCP
CB-7	EX. MH	0.39	5.0	8.87	0.57	2.0	7.3	0.0159	14.4	15.00	6.6	22.00	37.75	37.40	41.00	39.72	RCP

*PROPOSED PIPE TO MATCH SIZE OF EXISTING PIPE, AND TO HAVE SLOPE GREATER THAN OR EQUAL TO EXISTING PIPE.

APPENDIX N

DRIVEWAY CULVERT ANALYSIS

Culvert Report

FES-2 to FES-3, 25-Year

Invert Elev Dn (ft)	=	40.89
Pipe Length (ft)	=	58.00
Slope (%)	=	0.22
Invert Elev Up (ft)	=	41.02
Rise (in)	=	15.0
Shape	=	Circular
Span (in)	=	15.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

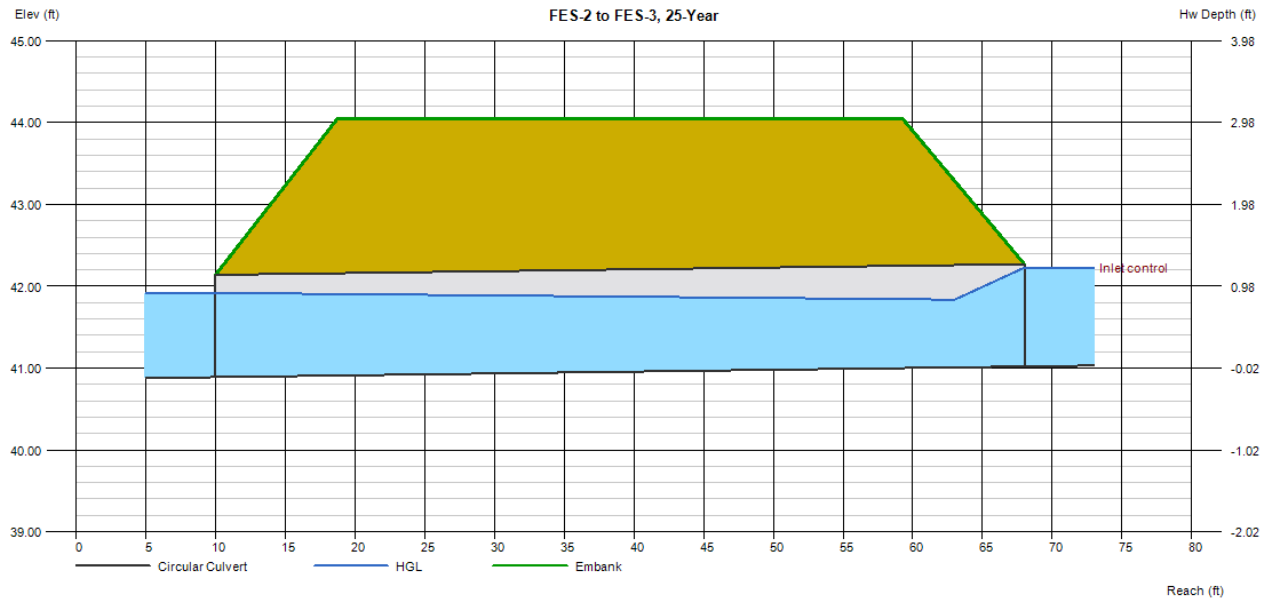
Top Elevation (ft)	=	44.05
Top Width (ft)	=	40.50
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	4.00
Qmax (cfs)	=	4.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	4.00
Qpipe (cfs)	=	4.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.70
Veloc Up (ft/s)	=	4.76
HGL Dn (ft)	=	41.92
HGL Up (ft)	=	41.83
Hw Elev (ft)	=	42.23
Hw/D (ft)	=	0.97
Flow Regime	=	Inlet Control



Culvert Report

FES-2 to FES-3, 50-Year

Invert Elev Dn (ft)	=	40.89
Pipe Length (ft)	=	58.00
Slope (%)	=	0.22
Invert Elev Up (ft)	=	41.02
Rise (in)	=	15.0
Shape	=	Circular
Span (in)	=	15.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

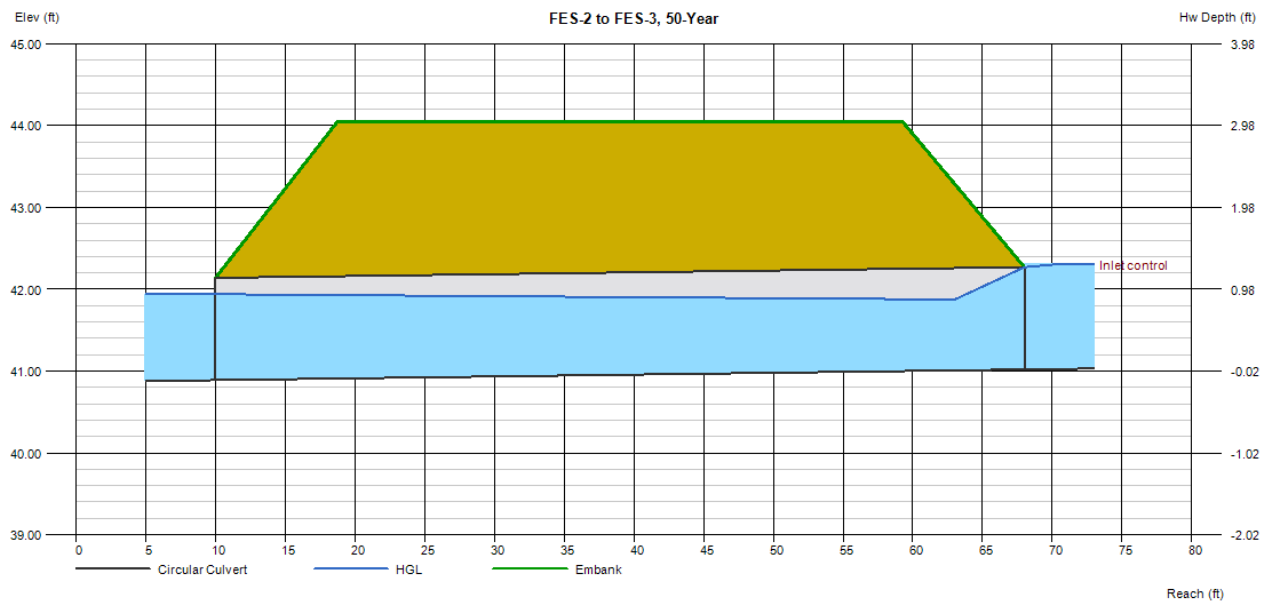
Top Elevation (ft)	=	44.05
Top Width (ft)	=	40.50
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	4.40
Qmax (cfs)	=	4.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	4.40
Qpipe (cfs)	=	4.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.00
Veloc Up (ft/s)	=	4.96
HGL Dn (ft)	=	41.94
HGL Up (ft)	=	41.87
Hw Elev (ft)	=	42.31
Hw/D (ft)	=	1.03
Flow Regime	=	Inlet Control



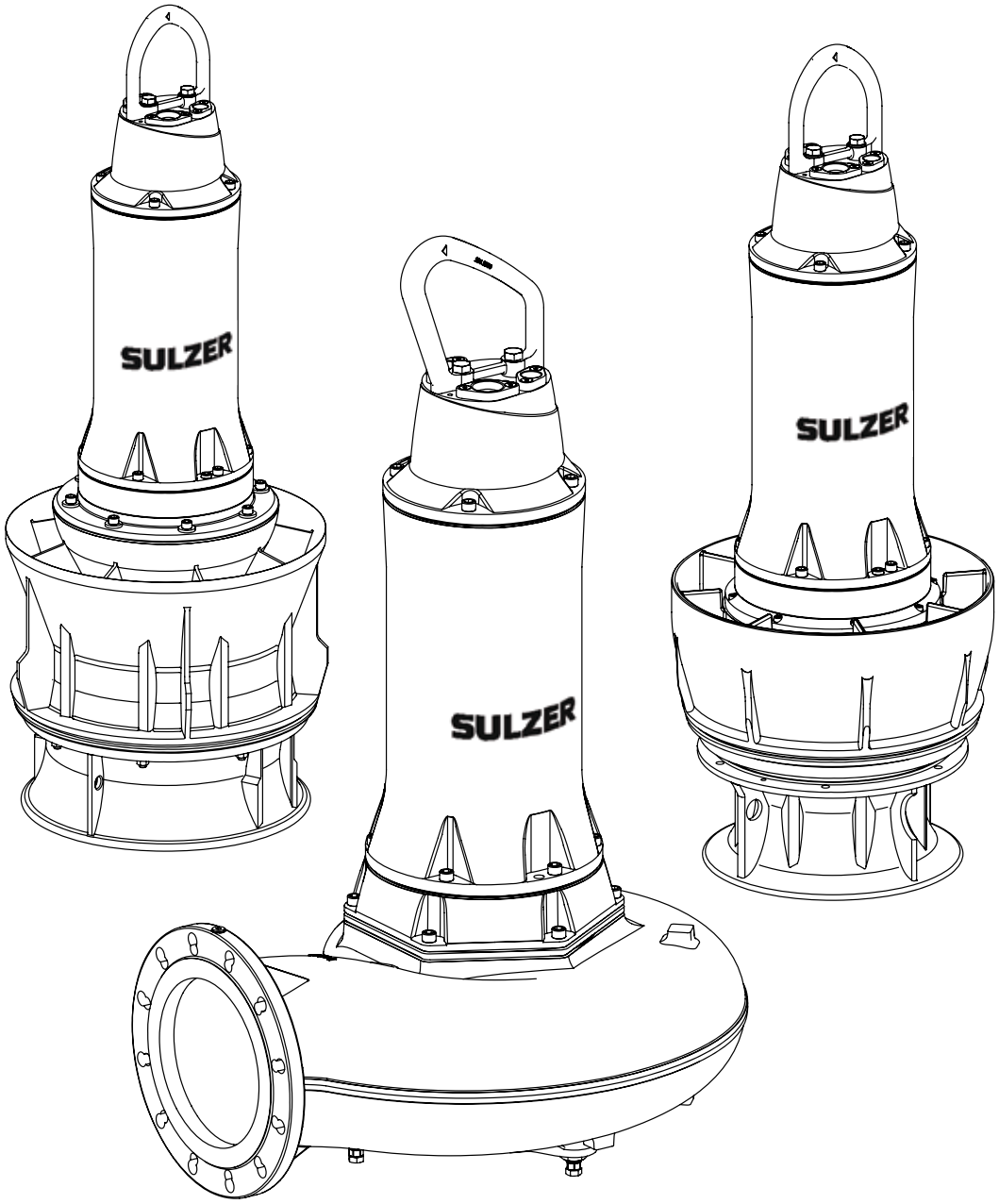
APPENDIX O

PUMP INSTALLATION, OPERATION & MAINTENANCE MANUALS

SULZER

Submersible Sewage Pump Type ABS XFP-PE4 to PE6
Submersible Mixed Flow Column Pump Type ABS AFLX-PE4 to PE6
Submersible Propeller Pump Type ABS VUPX-PE4 to PE6

2500-0001



en

Installation and Operating Instructions

translation of original instruction

www.sulzer.com

1 597 2500 GB 11.2015

GB 2500-J

Installation and Operating Instructions

For submersible sewage pumps

XFP CB - Hydraulics

XFP 105J	XFP 150M	XFP 200J	XFP 250J	XFP 300J	XFP 356M	XFP 405M
	XFP 155J	XFP 201J	XFP 255J	XFP 305J		
		XFP 205J		XFP 305M		
		XFP 206J		XFP 306M		

XFP CH; SK - Hydraulics

XFP 100J	XFP 150J	XFP 200J	XFP 250M	XFP 300J	XFP 350M	XFP 400M	XFP 500U	XFP 600V
		XFP 200M		XFP 300M	XFP 351M	XFP 400R	XFP 501U	XFP 600X
				XFP 301M				

AFLX-Hydraulics

AFLX 0601	AFLX 0701	AFLX 0801	
		AFLX 0802	AFLX 1202
		AFLX 0803	AFLX 1203
			AFLX 1207

VUPX-Hydraulics

	VUPX 0501	VUPX 0601	VUPX 0801	VUPX 1001	VUPX 1201
VUPX 0402	VUPX 0502	VUPX 0602	VUPX 0802	VUPX 1002	VUPX 1202
VUPX 0403	VUPX 0503				

Table of contents

1 General

These **Installation and Operating Instructions** and the separate booklet **Safety Hints** contain basic instructions and safety hints which must be observed during transport, installation and commissioning. For this reason it is essential that they are read by the installing technician as well as by relevant skilled operators or users. They should also be always available where the unit is installed.

Safety Instructions which might cause danger to life in case of non-observance have been specifically highlighted with the general danger symbol.

The presence of a dangerous voltage is identified with this safety symbol.

This symbol indicates the danger of an explosion occurring.

ATTENTION ***Appears at safety hints, the non-observance of which could damage the unit or affect its functioning.***

NOTE ***Used for important pieces of information.***

1.1 Correct usage of the products

In the case of any faults arising, the Sulzer units should immediately be taken out of use and secured. The fault should be immediately rectified or, if necessary, contact your **Sulzer Pump Solutions Germany** (in the following called Sulzer). service centre.

The submersible pumps with PE motor can be supplied both as standard versions and in explosion-proof execution with (ATEX II 2Gk Ex d IIB T4) for 50 Hz or FM execution (NEC 500, Class I, Division 1, Group C&D, T3C) for 60 Hz in isolation class H (140).

Temperatur limiter in the winding = 140 °C/284 °F (bimetallic or thermistor (PTC) as an option).

Special version Class H

A special version with temperature limiter in the winding = 160 °C/320 °F (bimetallic, temperature sensor (PTC) as an option or PT100) is also available. This version is only available without explosion-proof or NEC 500 approval with isolation class H (160) components.

For both versions an EMV-execution is available as an option.

ATTENTION ***Repair work on explosion-proof motors may only be carried out in authorized workshops by qualified personnel using original parts supplied by the manufacturer. Otherwise the ex-approvals are no longer valid. All Ex-relevant components and dimensions can be found in the modular workshop manual and the spare parts list.***

ATTENTION ***After repair work in not authorized workshops by not qualified personnel the ex-approvals are no longer valid. After such repair the unit must not be operated in hazardous areas. The ex-nameplate (see figure 2, 3) has to be removed.***

ATTENTION ***All regulations and guidelines, which may vary from country to country must be followed without exception.***

Limitations: Fluid temperature maximum 40 °C (104 °F)

Immersion depth maximum 20 m (65 ft)

For the operation of units as explosion-proof execution the following applies:

In hazardous areas care must be taken that during switching on and operation of the pumps the pump section is filled with water (dry installation) or alternatively is submerged or under water (wet installation with cooling jacket. Other types of operation e.g. snore operation or dry running are not allowed!

For the operation of explosion-proof submersible pumps in wet-well installation without cooling jacket applies:

It must be ensured that the motor of the ex-submersible pump is always fully submerged during start-up and operation!

For the operation of explosion-proof submersible pumps applies:

The temperature monitoring of the explosion-proof submersible pumps has to be carried out by **bimetallic temperature limiters** or thermistors according to DIN 44 081-150 connected to a suitable release device which is certified in accordance with EC directive 94/9/EC.

For the operation of explosion-proof submersible pumps with frequency inverter in hazardous areas (ATEX Zone 1 and 2) applies:

Motors must have direct thermal protection devices fitted. These consist of temperature sensors (PTC DIN 44081 -150) embedded in the windings. These must be connected to a suitable release device which is certified in accordance with EC directive 94/9/EC.

Machines designated as Ex machines may never, without exception, be operated using a mains frequency that is greater than the maximum of 50 or 60 Hz as indicated on the nameplate.

Operation with frequency inverters

See chapter 4.6

1.2 Application areas for the series XFP

The submersible sewage pumps type ABS **XFP series** have been designed for the economical and reliable pumping of commercial, industrial and municipal sewage and can be installed dry or wet.

They are suitable for pumping of the following liquids:

- Clear and wastewater, for sewage containing solids and fibrous material
- Faecal matter
- Sludge
- Fresh and process water pumping
- Raw water for drinking water supply
- Surface and rain water
- Sewage

1.3 Application areas for the series AFLX

The mixed flow column pump type ABS **AFLX series** have been developed for environmental protection, water supply, municipal sewage treatment and dewatering of polders.

They are suitable for the following liquids:

- Raw water with solid or fibrous material.
- Sewage
- Surface water, rain water, drainage water
- Sludge

The AFLX pumps are installed in a **concrete sump** or in a **steel pressure pipe** using a suitable coupling ring

1.4 Application areas for the series VUPX

The submersible propeller pumps type ABS **VUPX series** are designed for those applications where large water volumes must be pumped at low heads (up to 10 m/33 ft).

They are suitable for the following liquids

- Fresh and process water pumping
- Raw water for drinking water supply
- Surface and rain water

The VUPX pumps are installed in a **concrete sump** or in a **steel pressure pipe** using a suitable coupling ring.

1.5 Technical data

Please take the technical data and the weight from the nameplate. Please take the dimensions of the units from the resp. dimension drawing.

The maximum noise level of the units of this series is ≤ 70 dB(A).

HINT ***The resp. dimension drawings can be found in downloads „dimension drawing“ by the following link: www.sulzer.com.***

The maximum noise level of the units of this series is ≤ 70 dB(A).

The weights in the dimension sheets refer to a cable length of 10 m. In the case of cable lengths exceeding 10 m, the additional weight must be determined using the following table and added.

TECWATER EMV-FC S1BC4N8-F	Cable type	Weight kg/m
	3x6/6KON	0,4
	3x10/10KON	0,7
	3x16/16KON	1
	3x6/6KON +3x1,5ST	0,6
	3x25 +3G16/3	1,5
	3x35 +3G16/3	1,9
	3x50 +3G25/3	2,6
	3x70 +3G35/3	3,6
	3x95 +3G50/3	4,7
	3x120 + 3G70/3	6
	3x150 + 3G70/3	7,1
	3x185 +3G95/3	8,8
	3x240 +3G120/3	11
	3x300 +3G150/3	13,5
	1x185	2,2
	1x240	2,7
	1x300	3,4

TECWATER S1BN8-F / OZOFLEX (PLUS) H07RN8-F	Kabelart	Weight kg/m TECWATER S1BN8-F	Weight kg/m OZOFLEX (PLUS) H07RN8-F
	4 G 6	0,4	0,5
	4 G 10	0,5	0,8
	4 G 16	1	1,25
	4 G 25	1,5	1,8
	4 G 35	1,9	2,3
	4 G 50	2,6	3,0
	4 G 70	3,7	4,2
	4 G 95	4,7	5,5
	4 G 120	5,9	6,7
	4 G 1,5	0,2	0,17
	8 G 1,5	0,3	0,45
	10 G 1,5	0,4	0,47
	12 G 1,5	0,5	0,48
	1x150	1,6	1,8
	1x185	2	2,2
	1x300	3,2	3,4
	1x400	4,1	

	Cable type	Weight kg/m	Weight lb/1000ft
G-GC	AWG 8-3	0,9	597
	AWG 6-3	1,2	764
	AWG 4-3	1,6	1070
	AWG 2-3	2,3	1533
	AWG 1-3	2,8	1865
	AWG 1/0-3	3,5	2315
	AWG 2/0-3	4,1	2750
	AWG 3/0-3	5	3330
	AWG 4/0-3	6,1	4095
DLO	AWG 1/0	0,7	480
	AWG 2/0	0,8	558
	AWG 3/0	1,1	742
	AWG 4/0	1,3	872
	262 MCM	1,6	1068
	313 MCM	1,9	1258
	373 MCM	2,2	1462
	444 MCM	2,6	1726
	535 MCM	3,1	2047
	646 MCM	3,6	2416
SOOW	AWG 16/4	0,3	144
	AWG 16/8	0,4	222
	AWG 16/10	0,5	278
	AWG 16/12	0,5	305

1.6 Nameplate

We recommend that you record the data from the original nameplate *Figure 1* so that you can refer to the data at any time.

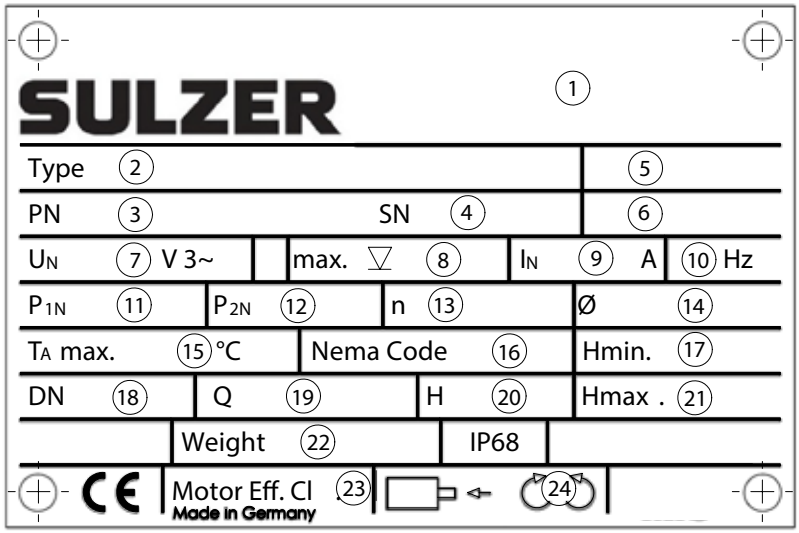


Figure 1 Nameplate 42242501

Legend

1 Address
2 Type designation
3 Art. no.
4 Serial number
5 Order number
6 Year of manufacture [month/year]
7 Nominal voltage
8 Max. immersion depth [flexible unit]
9 Nominal current
10 Frequency
11 Power (consumption) [flexible unit]
12 Power (output) [flexible unit]
13 Rotation speed [flexible unit]
14 Impeller/Propeller ø [flexible unit]
15 Max. ambient temperature [flexible unit]
16 Nema Code Letter (only at 60 Hz, e.g., H)
17 Min. pumping height [flexible unit]
18 Nominal width [flexible unit]
19 Pumping quantity [flexible unit]
20 Pumping height [flexible unit]
21 Max. pumping height [flexible height]
22 Weight (without attached parts) [flexible unit]
23 Motor efficiency class
24 Motor shaft direction of rotation

Figure 2 Nameplate ATEX

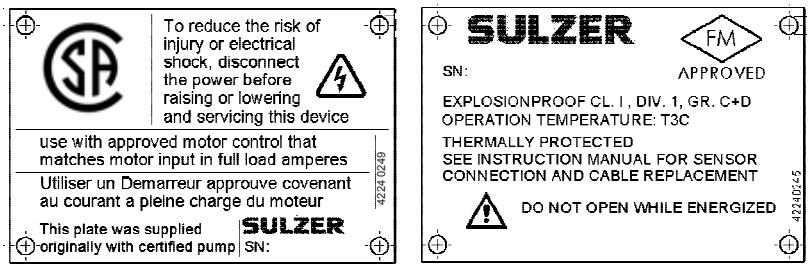


Figure 3 Nameplate FM / CSA

2 Safety

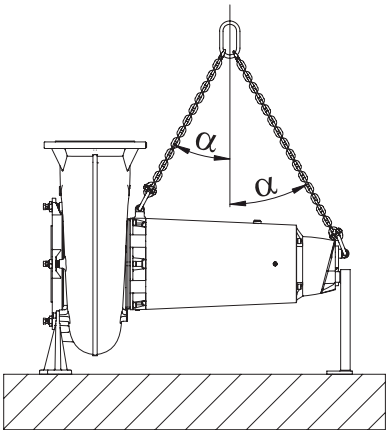
The general and specific health and safety hints are described in detail in the separate booklet **Safety Hints**. If anything is not clear or you have any questions as to safety make certain to contact the manufacturer Sulzer.

3 Transport and storage

Depending on model and mode of installation, the units are prepared at the factory for vertical or horizontal transportation.

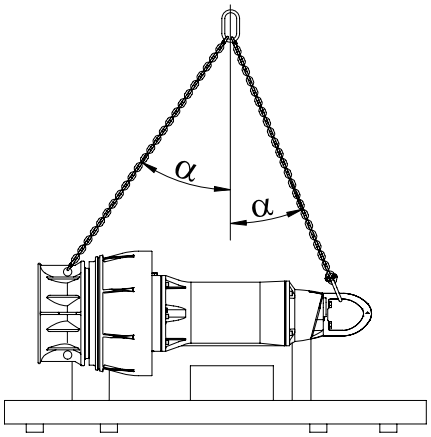
The units are equipped with a safety shackles (series for vertical setup) or swivel ring bolt (horizontal setup), which allow fixing chains for transporting or for installing or removing. We recommend using chains from the Sulzer list of accessories.

ATTENTION ***In the case of pumps set up vertically, sealing plugs are mounted for protecting the thread holes instead of swivel ring bolt. These seals may only be replaced by a swivel ring bolt for maintenance work but must be screwed on again before startup!***



0838-0005

Figure 4 Transport in a horizontal manner XFP



0838-0004

Figure 5 Transport in a horizontal manner AFLX/VUPX

ATTENTION ***α max. ≤ 45°. The angle α between the centre line of the unit and the lifting tools should not exceed 45°.***

3.1 Transport securing devices

The motor connection cables are protected against the ingress of moisture along the cable by having the ends sealed at the works with protective covers.

These protective covers should only be removed immediately prior to connecting the pumps electrically.

ATTENTION ***These protective covers only provide protection against water spray or similar and are not a water tight seal. The ends of the cables should not be immersed in water, otherwise moisture could enter the connection chamber of the motor.***

NOTE ***If there is a possibility of water ingress then the cables should be secured so that the ends are above the maximum possible flood level.***

ATTENTION ***Take care not to damage the cable or its insulation when doing this!***

In order to avoid damage to the pump shaft or the bearings during horizontal transport, the shaft is clamped in an axial direction when leaving the works.

ATTENTION ***The motor shaft transport lock must be removed before startup!***

3.2 Storage of the units

ATTENTION ***The Sulzer products must be protected from weather influences such as UV from direct sunlight, high humidity, aggressive dust emissions, mechanical damage, frost etc. The Sulzer original packaging with the relevant transport securing devices***

(where used) ensures optimum protection of the unit. If the units are exposed to temperatures under 0 °C/32 °F check that there is no water in the hydraulics, cooling system, or other spaces. In the case of heavy frosts, the units and cable should not be moved if possible. When storing under extreme conditions, e.g. in tropical or desert conditions suitable additional protective steps should be taken. We would be glad to advise you further

NOTE ***The Sulzer units normally require no maintenance during storage. During longer storage times, (after approx. one year) the transport locks on the motor shaft (not all versions) must be dismantled. Coolant is applied to the sealing surfaces by manually turning the shaft several times (also for the purpose of cooling or lubricating so that trouble-free function of the sliding ring seal is ensured. No maintenance is required when storing the motor shaft.***

4 Monitoring system

4.1 Motor monitoring system

Motor equipment:

Motors		**PE4/PE5**	**PE6**	**PE4/PE5**	**PE6**
Monitoring		**non Ex / Ex**	**non Ex / Ex**	**non FM / FM**	**non FM / FM**
Seal monitor	Separation chamber	●	●	●	●
	Motor chamber	○	●	○	●
	Connection chamber	○	○	○	●
Stator temperature	Bimetallic	●	●	●	●
	Thermistors (PTC)	○	○	○	○
	PT 100	○	○	○	○
Bearing temperature Upper/lower	Bimetallic	○	●	○	●
	Thermistors (PTC)	○	○	○	○
	PT 100	○	○	○	○
● = Standard ○ = Option					

4.2 DI-Electrode

The DI-electrodes carry out the seal monitoring function and signal the ingress of moisture into the motor by means of a special electronic device. Connection *see chapter 5.6*

4.3 Temperature monitoring of the stator

Thermal limiters protect the stator from overheating in the case of asymmetric phase loading or voltage, continuous dry running or excessive temperatures in the medium itself. The stator is equipped with three bimetallic thermal limiters (optional PTC, PT100) which are connected in series.

4.4 Temperature monitoring of the bearings (Option)

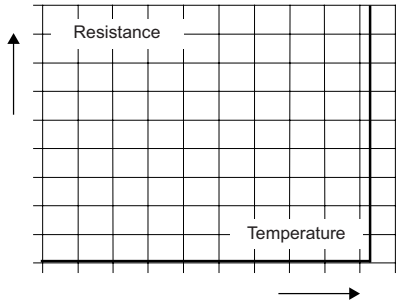
In the case of existing bearing monitoring, a bimetal temperature limiter is built into the bearing flanges of the standard version. This enables premature switching off of the submersible motor (e.g., due to wear-related increase in storage temperature).

Switching temperature: Upper bearing= 140 °C/284 °F Lower bearing = 130 °C/269 °F

4.5 Temperature densor indication

A continuous indication of the temperature in the stator and the bearings is not possible using bimetallic thermal limiters or thermistors. For this application it is necessary to fit thermal sensors of the type PT 100 with linear characteristics into the stator and bearing blocks. This type of resistor has a linear characteristic, i.e. the resistance rise is proportional to the temperature rise.

4.5.1 Temperature sensor bimetall



0562-0017

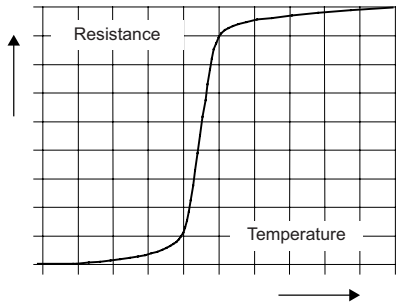
Application	Option
Function	Temperature switch using the bimetallic principle, which opens at a rated temperature
Switching	Taking care not to exceed the allowable switching current, these can be fitted directly into the control circuit

Figure 6 Curve showing principle of operation of bimetallic temperature limiter

Operating voltage **...AC**	**100 V to 500 V ~**
Rated voltage **AC**	**250 V**
Rated current **AC cos φ = 1,0**	**2.5 A**
Rated current **AC cos φ = 0,6**	**1.6 A**
max. switching current at I_N	**5.0 A**

ATTENTION ***The maximum switching ability of the thermal sensors is 5 A, the rated voltage 250 V. Explosion-proof motors which are connected to static frequency inverters must be fitted with thermistors. Activation must be by means of a thermistor protective relay device with PTB-Approval number.***

4.5.2 Temperature sensor PTC

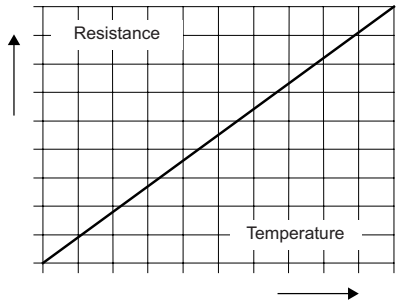


0562-0018

Application	Option
Function	Temperature dependent resistance (no switch) curve with stepwise behaviour
Switching	Cannot be installed direct into the control circuit. Evaluation of the signal must be carried out by suitable electronic equipment

Figure 7 Curve showing principle of operation of thermistor

4.5.3 Temperature sensor PT 100



0562-0019

Application	Option (not for Ex)
Function	Function temperature dependent resistance (no switch). The linear curve allows continuous measurement and indication of the temperature
Switching	Cannot be installed direct into the control circuit. Evaluation of the signal must be carried out by suitable electronic equipment

Figure 8 Curve showing principle of operation of PT 100

ATTENTION ***Thermistors or PT 100 devices must never be directly connected into the control or power system. They must always be connected to a suitable evaluation device.***

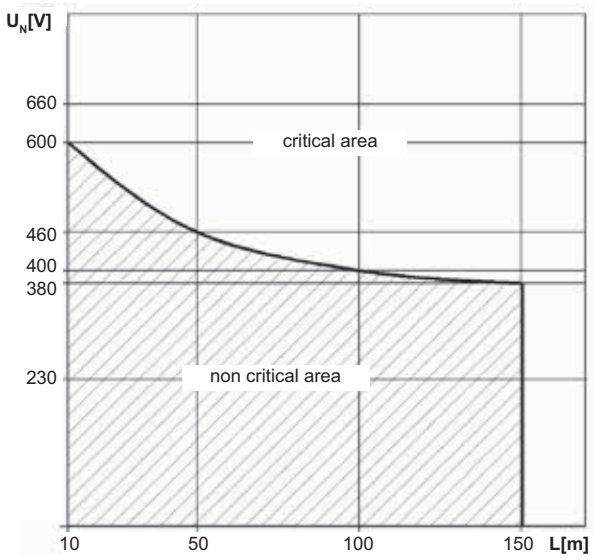
The thermal monitoring circuit must be wired into the motor contactors in such a manner that a manual reset is required.

4.6 Operation with frequency inverters

The stator design and the insulation grade of the motors from Sulzer means that they suitable for usage with fre-quency inverters. It is however essential that the following conditions are met when the motors are used with frequency inverters:

- The guidelines for EMC (electromagnetic compatibility) are complied with.
- Explosion-proof motors must be equipped with thermistors (PTC temperature sensors) if operated in hazardous areas (ATEX Zone 1 and 2).
- Machines designated as Ex machines may never, without exception, be operated using a mains frequency that is greater than the maximum of 50 or 60 Hz as indicated on the type plate.
- Machines that are not designated as Ex machines may only be operated using the mains frequency indicated on the type plate. Greater frequencies can be used but only after consulting with and receiving permission from the Sulzer manufacturing plant.
- For operation of ex-motors on frequency inverters special requirements in relation to the tripping times of the thermo control elements, must be observed.
- The lowest frequency must be set so that the minimum fluid velocity of 1 m/s is present in the volute.
- The maximum frequency must be set so the rated power of the motor is not exceeded.

Modern frequency inverters are using higher wave frequencies and a steeper rise on the flanks of the voltage wave. This means that motors losses and motor noise is reduced. Unfortunately these inverter output signals cause higher voltage spikes in the stator. Experience has shown that, depending on rated voltage and the length of the cable between the inverter and the motor, these voltage spikes can adversely affect the life of the motor. In order to avoid this, inverters of this type must equipped with sinus filters when used in the critical zone *(see fig 9)*. The sinus filter chosen must be suitable for the inverter with regard to rated voltage, inverter wave frequency, rated current of the inverter and maximum inverter output frequency.



L = total length (from frequency inverter to motor)

Figure 9 Critical / non critical area

5 Installation

5.1 Installation of the XFP submersible sewage pumps

5.1.1 Installation options for the XFP submersible sewage pumps

There are three main installation options for the submersible pumps.

1. Wet installation vertical with ABS automatic coupling system
2. Dry installation with ground support ring (with closed cooling system)
3. Dry installation horizontal (with closed cooling system)

Wet installation:

NOTE ***The dimensional sheets and foundation plans for each type of installation are supplied either with the planning documents or your order confirmation.***

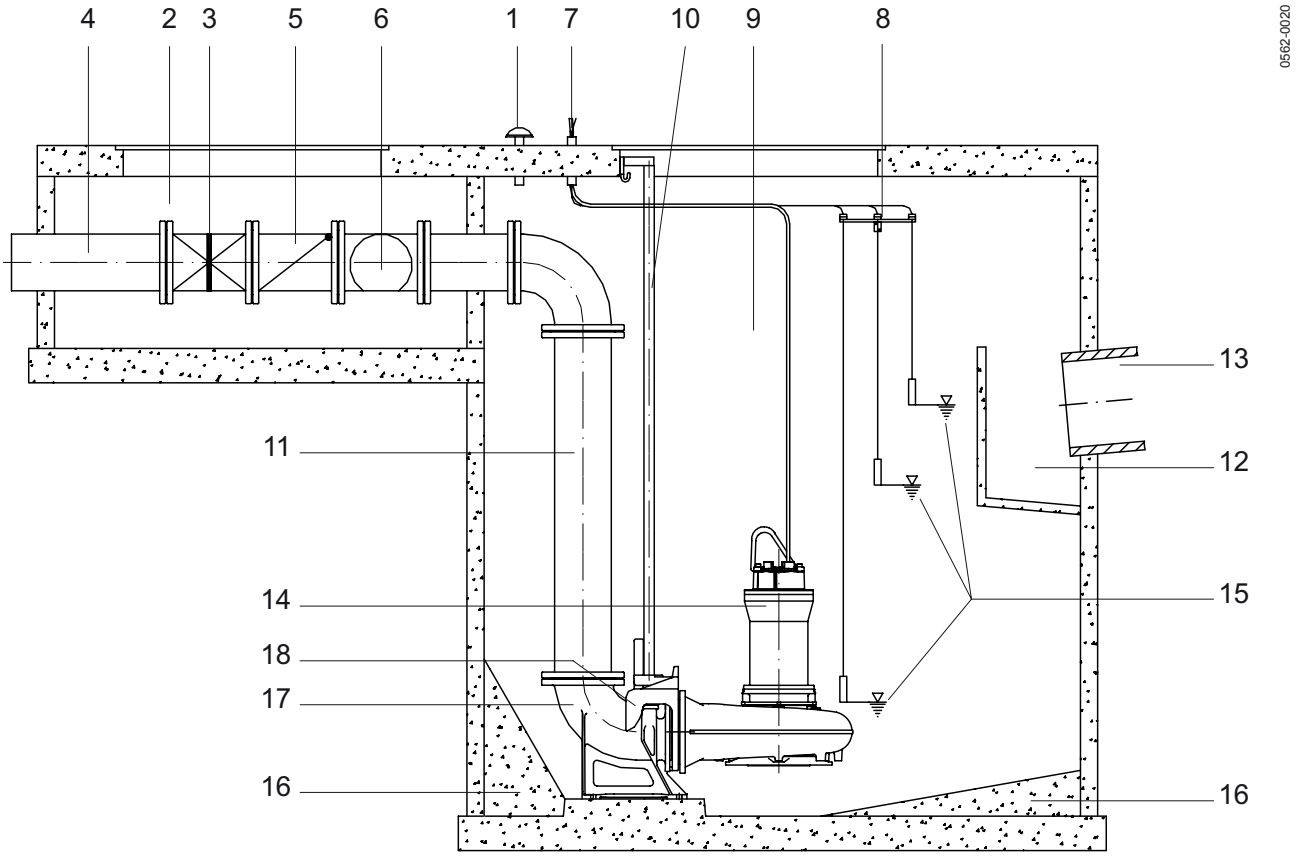


Figure 10 Wet installation vertical with ABS automatic coupling system

Legend

1 Venting
2 Valve chamber
3 Shut-off valve
4 Outflow line
5 Non-return valve
6 Fitting for valve removal
7 Cable duct
8 Bracket for float switches
9 Collection sump
10 Guide tube
11 Discharge line
12 Inflow chamber with impact wall
13 Inflow line
14 Sulzer submersible sewage pump
15 Automatic level control
16 Concrete benching
17 Pedestal
18 Bracket

ATTENTION ***The power cables should be handled carefully during installation and removal of the pumps in order to avoid damage to the insulation. When raising the submersible pump out of the concrete sump or the steel discharge pipe with the hoist ensure that the connection cables are lifted out simultaneously as the pump itself is being raised.***

- Fit a hoist to the submersible sewage pump.
- The Sulzer submersible sewage pump is suspended on the guide tube by means of the pedestal bracket on the pressure connection and carefully lowered vertically, or at a slight inclination (max. 3°). It couples automatically at the pedestal and seals the pressure connection at the pedestal leak-tight by means of its own weight and a seal.

Dry sump installation:

- Fit a hoist to the submersible pump.

- With the aid of the hoist place the submersible pump carefully into the prepared mounting frame and fasten.
- Mount suction and pressure nozzles on the pump housing.
- If required, fit the vent line to the volute.
- Open the gate valves on the suction and discharge side.

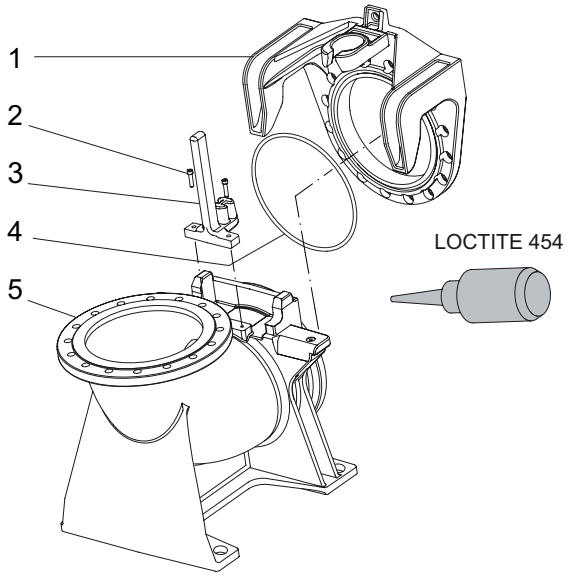
5.1.2 HD- pedestal fitting of O-ring and guide piece

Care, ensure that adhesive does not come into contact with skin or eyes! Wear goggle and gloves!

The groove of the guide piece and O-ring must be clean and free of grease. The instant adhesive LOCTITE type 454 (supplied with the unit) is spread evenly on the base of the groove in the bracket (11/1) and the O-ring inserted immediately.

NOTE ***The hardening time of the adhesive is only about 10 seconds!***

The guide piece (11/3) must be screwed on as shown in the drawing! Fasten the guide piece (11/3) with the two M12 screws (11/2). Tighten the screws with a torque of 56 Nm.



0562-0027

Legend

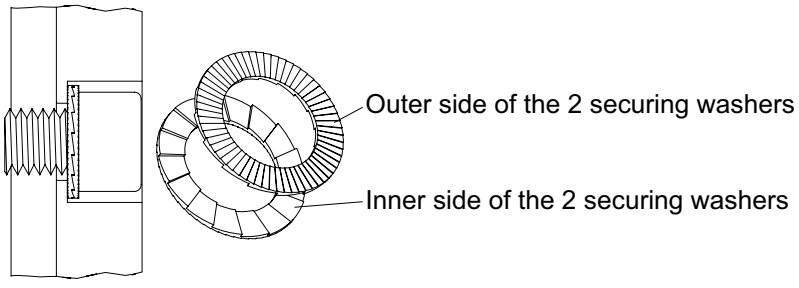
1 Bracket (is fitted to the pump)
2 Screws (2 off)
3 Guide piece
4 O-ring
5 Pedestal

Figure 11 HD-Pedestal DN 100 - 800

5.1.3 Tightening torque

Tightening torque for ABS stainless steel screws A4-70:								
Thread	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tightening torque	17 Nm	33 Nm	56 Nm	136 Nm	267 Nm	460 Nm	500 Nm	600 Nm

5.1.4 Fitting position of the Nord-Lock® securing washers



0562-0009

Figure 12 Correct fitting position of the Nord-Lock® securing washers

5.2 Installation of the AFLX and VUPX submersible pumps

A rake must be attached to the inlet of the **AFLX submersible mixed flow column pump**. The maximum bar spacing depends on the type of hydraulics fitted to the pump and can be obtained from the table below.

Type of hydraulics	Clean water	Runoff water, river water, used water, rain water, pre-screened liquid, recirculation
	Bar spacing in mm	Bar spacing in mm
AFLX 0600/0700	≤ 40	≤ 20
AFLX 0800	≤ 60	≤ 30
AFLX 1200	≤ 100	≤ 50
If larger bar spacings are required, please contact Sulzer		

A rake must be attached to the inlet of the **VUPX submersible propeller pump**. The maximum bar spacing depends on the type of hydraulics fitted to the pump and can be obtained from the table below.

Type of hydraulics	Clean water	Runoff water, river water, used water, rain water	pre-screened liquid, recirculation
	Bar spacing in mm	Bar spacing in mm	Bar spacing in mm
VUPX 0400	≤ 30	≤ 25	≤ 6
VUPX 0500	≤ 40		
VUPX 0600	≤ 50		
VUPX 0800	≤ 60		
VUPX 1000	≤ 80		
VUPX 1200	≤ 80		
If larger bar spacings are required, please contact Sulzer			

ATTENTION ***When setting the switching off level the minimum cover as given in the installation documents must be adhered to.***

5.2.1 Installations examples with AFLX and VUPX submersible pumps

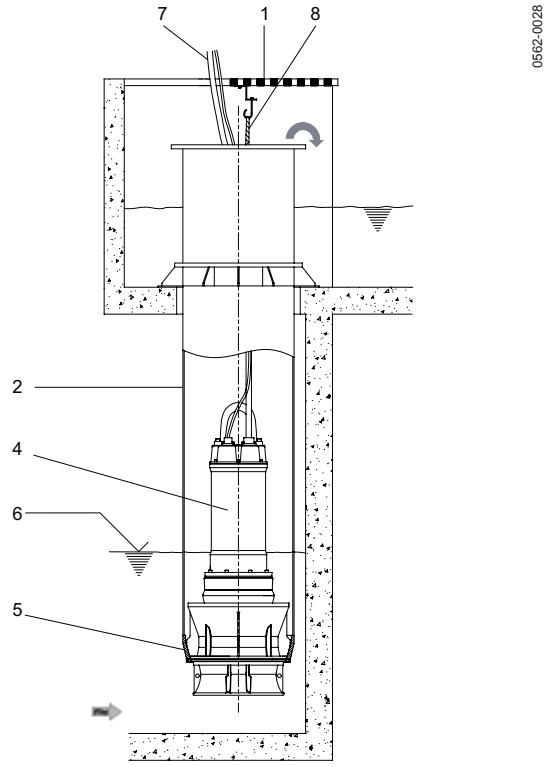


Figure 13a AFLX/VUPX in a steel discharge pipe

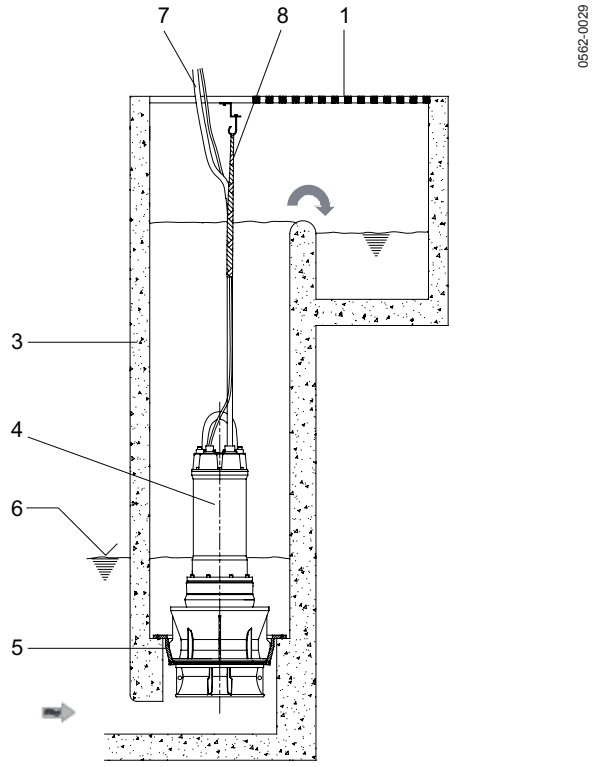


Figure 13b AFLX/VUPX in a concrete sump

Legend

1 Tank cover
2 Discharge pipe (riser pipe)
3 Concrete sump
4 AFLX/VUPX submersible pump
5 Coupling ring
6 Minimum water level (see installation drawings)
7 Connection cable
8 Cable support (for fixing the power cable)

ATTENTION ***The power cables should be handled carefully during installation and removal of the pumps in order to avoid damage to the insulation.***

- Fit a hoist to the submersible pump.

The coupling ring required for installation of the AFLX/VUPX submersible pump must already be installed as shown in *Figure 12 and 13.* Before installation of the pump a suitable support (hook) for the chain, as well as an opening and suspension (cable sock) for the cable must be provided in the sump or riser pipe.

Before or during the installation the motor connection cables should be fitted on site with suitable strain relief (e.g. cable socks). Particular care should be taken that the cable insulation is not crushed or damaged by the weight of the hanging cable especially in the area of the cable inlet.

ATTENTION ***When raising the submersible pump out of the concrete sump or the steel discharge pipe with the hoist ensure that the connection cables are lifted out simultaneously as the pump itself is being raised.***

Lowering of the AFLX and VUPX submersible pump into the coupling ring

ATTENTION ***Before lowering the pump a direction of rotation check should be carried out.***

- Draw the cable hose over the end of the connection cable.

2500-0009

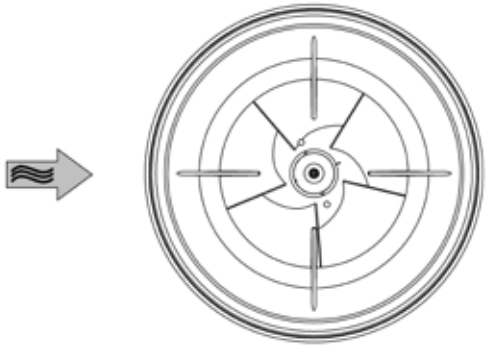


Figure 14 adjustment Bellmouth AFLX

2500-0010

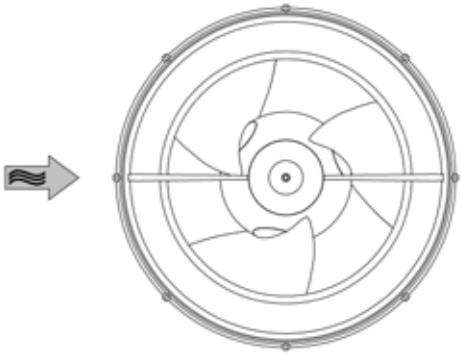


Figure 15 adjustment Bellmouth VUPX

ATTENTION ***The steel riser pipe, or concrete sump must be cleaned thoroughly (builder‘s rubble, etc.). To optimise the inflow and to reduce the noise level it is important that one pair of fins of the suction pipe are in line with the main flow direction of the inflow chamber. This must be observed when fitting the pump into a sump or into a steel discharge pipe.***

- Use lifting equipment to slowly lower the submersible mixed flow column/propeller pump into the shaft up to the coupling ring; feed in the motor connecting cable at the same time. The submersible mixed flow column/ propeller pump centres itself automatically and leakage free in the coupling ring.
- Attach the lifting chain to the hook provided so that it cannot strike either the pump cable or the sump wall.

- Tension the pump cable and fasten to the hook provided with the aid of the cable sock. Where a steel pressure pipe is used the connection cable should be brought through the connection cable inlet and sealed off in a watertight manner.

The connection cable should only be tightened sufficiently so that no tension acts at the cable inlet in the head of the pump. The connection cable should not strike the chain or the sump wall.

- If necessary, the steel riser pipe is sealed off in a watertight manner.

5.3 Electrical connection

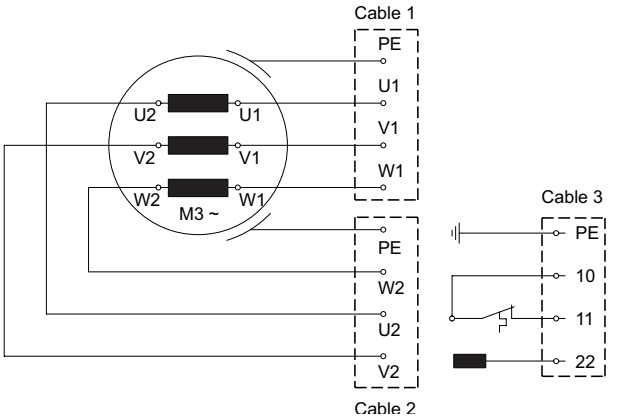


Figure 16 Two power cables and one control cable

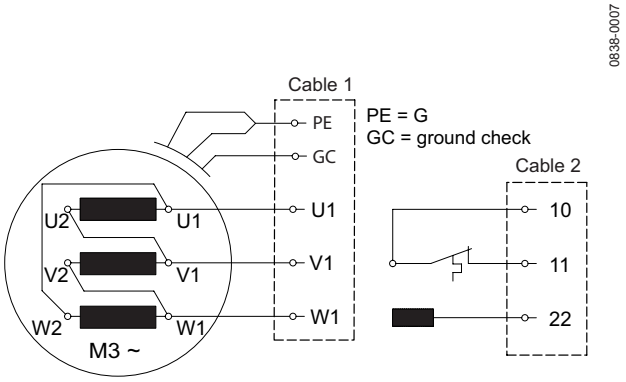


Figure 17 60 Hz version: One power cable and one control cable

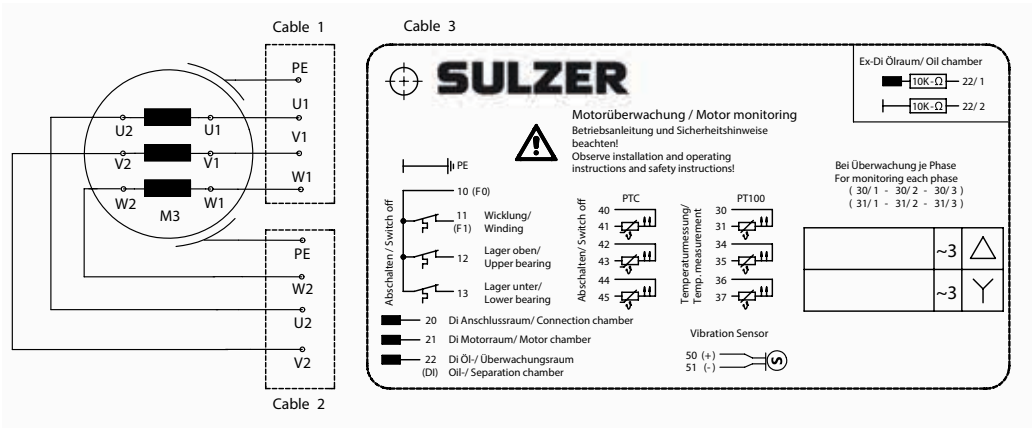


Figure 18 Special versions: two power cables and one control cable - for optional motor monitoring features

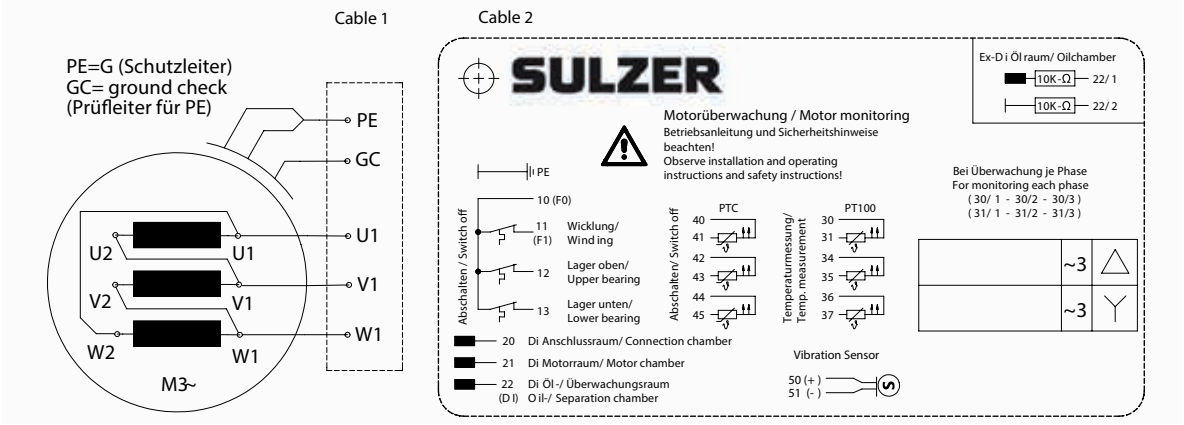


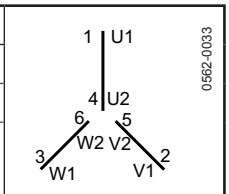
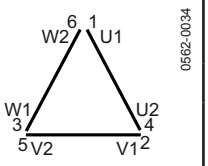
Figure 19 60 Hz version: one power cable and one control cable - for optional motor monitoring features

ATTENTION ***The cable leads are routed out of the motor. No switching takes place in the motor! (Exception US-version). Any switching required (use of bridges) must be carried out in the control panel.***

NOTE ***Information on the type of starting can be obtained from the nameplate of the pump.***

ATTENTION ***The unit should only be operated with the overload relay and thermal sensors/limiters connected.***

5.3.1 Lead designations

Direct starting in star					
	L1	L2	L3	Join	
North America	1	2	3	4 & 5 & 6	
Sulzer/Germany	U1	V1	W1	U2 & V2 & W2	
Direct starting in delta					
	L1	L2	L3	-	
North America	1; 6	2; 4	3; 5	-	
Sulzer/Germany	U1; W2	V1; U2	W1; V2	-	

5.4 Checking direction of rotation

ATTENTION
The **direction of rotation** is correct if the imeller/propeller rotates in a **clockwise** manner when viewing down from the top of the placed unit

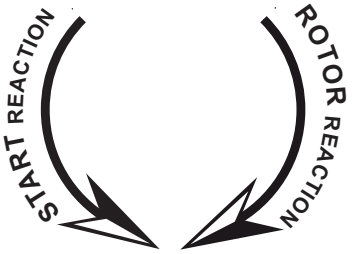


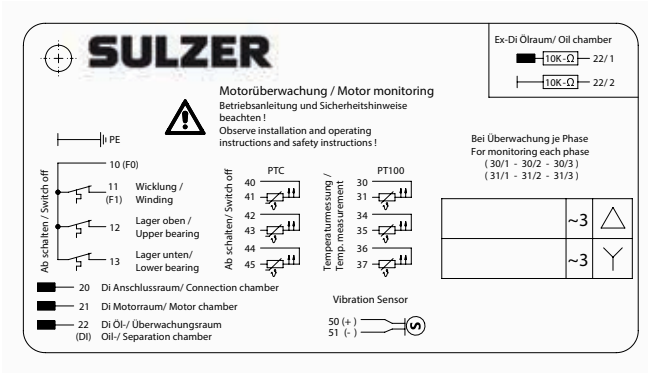
Figure 20 Rotor rotation

ATTENTION
The **start reaction** is **anti clockwise**

NOTE ***If a number of pumps are connected to a single control panel then each unit must be individually checked.***

ATTENTION ***The mains supply to the control panel should have a clockwise rotation. If the leads are connected in accordance with the circuit diagram and lead designations, the direction of rotation will be correct.***

5.5 Connection of the control circuit leads



Control circuit leads for submersible pumps

10 = Common lead
11 = Stator upper
12 = Bearing upper
13 = Bearing lower
20 = DI-connection chamber
21 = DI-Motor chamber
22 = DI-Oil chamber

= PE (green/yellow)

Figure 21 Designation of control circuit leads

5.6 Connection of the seal monitoring unit to the control panel

The submersible pumps, depending on execution, are supplied as standard with one or more DI-probes for seal monitoring. In order to integrate this seal monitoring function into the control panel of the pump it is necessary to fit an Sulzer DI-module and connect this in accordance with the circuit diagrams below.

ATTENTION ***If the DI-seal monitoring is activated the unit must be immediately taken out of service. Please contact your Sulzer service centre.***

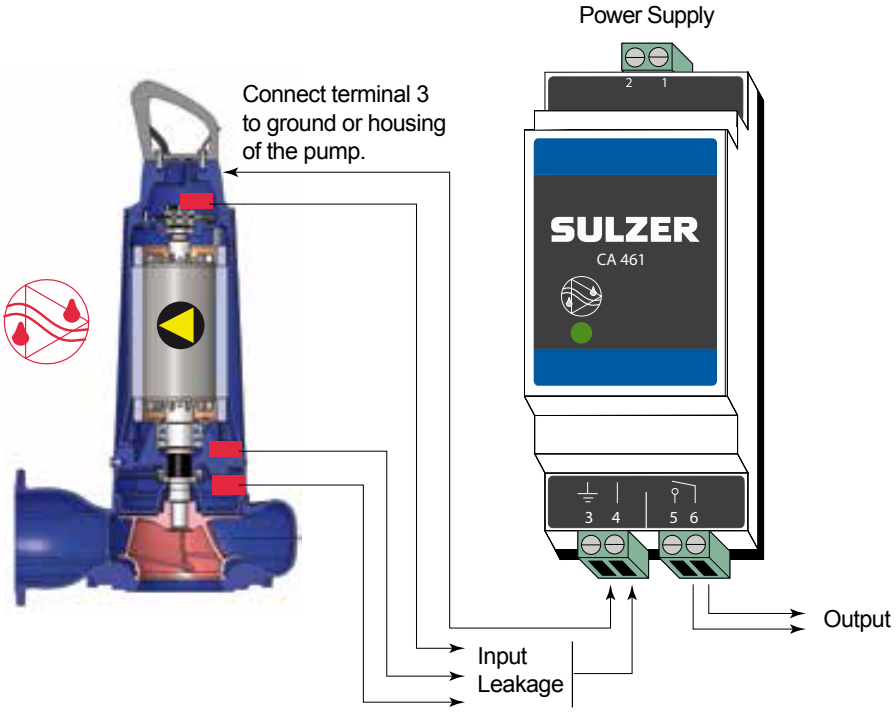


Figure 22 Sulzer leakage relay CA 461

Electronic amplifier for 50/60 Hz
110 - 230 V AC (CSA) (Part No.: 1 690 7010)
18 - 36 V DC (CSA) (Part No.: 1 690 7011)

ATTENTION ***Maximum relay contact loading:*** ***2 Ampere***

6 Commissioning

Before commissioning the pump/pump station should be checked and a functional test carried out. Particular attention should be paid to the following:

In explosive zones care must be taken that during switching on and operation of the pumps the pump section is filled with water (dry running) or alternatively is submerged or under water (wet installation). Ensure in this case that the minimum submergence given in the data sheet is observed, Other types of operation e.g. snore operation or dry running are not allowed.

- Have the electrical connections been carried out in accordance with regulations?
- Have the thermal sensors been connected?
- Is the seal monitoring device (where fitted) correctly installed?
- Is the motor overload switch correctly set?
- Have the power and control circuit cables been correctly fitted?
- Was the sump cleaned out?
- Have the inflow and outflows of the pump station been cleaned and checked?

- Is the direction of rotation of the pump correct - even if run via an emergency generator?
- Are the level controls functioning correctly?
- Are the required gates valves (where fitted) open?

XFP

- Do the non-return valves (where fitted) function easily?
- Have the hydraulics been vented in the case of dry installed pumps?

AFLX/VUPX

- Have the steel riser pipe, or concrete sump be cleaned thoroughly (builder's rubble, etc.)?

7 Maintenance

General maintenance hints

NOTE ***The maintenance hints given here are not designed for "do-it-yourself" repairs as special technical knowledge is required.***

Sulzer submersible pumps are reliable quality products each being subjected to careful final inspection. Lubricated-for-life ball bearings together with monitoring devices ensure optimum pump reliability provided that the pump has been connected and operated in accordance with the operating instructions.

Should, nevertheless, a malfunction occur, do not improvise but ask your Sulzer customer service department for assistance.

This applies particularly if the pump is continually switched off by the current overload in the control panel, by the thermal sensors/limiters of the thermo-control system or by the seal monitoring system (DI).

ATTENTION ***The lifting tools like chains and shackles should be visually checked in regular intervals (approx. every 3-month) for wear and corrosion. These parts should be replaced if required!***

The Sulzer service organisation would be pleased to advise you on any applications you may have and to assist you in solving your pumping problems.

NOTE ***The Sulzer warranty conditions are only valid provided that any repair work has been carried out in Sulzer approved workshops and where original ABS spare parts have been used.***

Maintenance hints if the submersible pump is out of use for a considerable period

NOTE ***If the pumps have remained idle for more than 12 months then we recommend that you ask Sulzer or an approved distributor for advice.***

Before installation:

The covers giving moisture protection of the cables should be only removed immediately before actual installation of the pump. After the removal of the transport securing devices and before connecting up the pump electrically the motor shaft should be rotated a number of times by turning the impeller or propeller by hand.

After installation:

If, after installation of the submersible pump, it remains out of use for prolonged periods (for example in storm water holding tanks) then we recommend that the pump be run for a maximum of 1 minute every 3 months in order to check both its functioning and availability.

7.1 Coolant filling

ATTENTION ***Only use products that are approved by the manufacturer!***

7.1.1 Coolant filling / Oil filling XFP

2500-0016

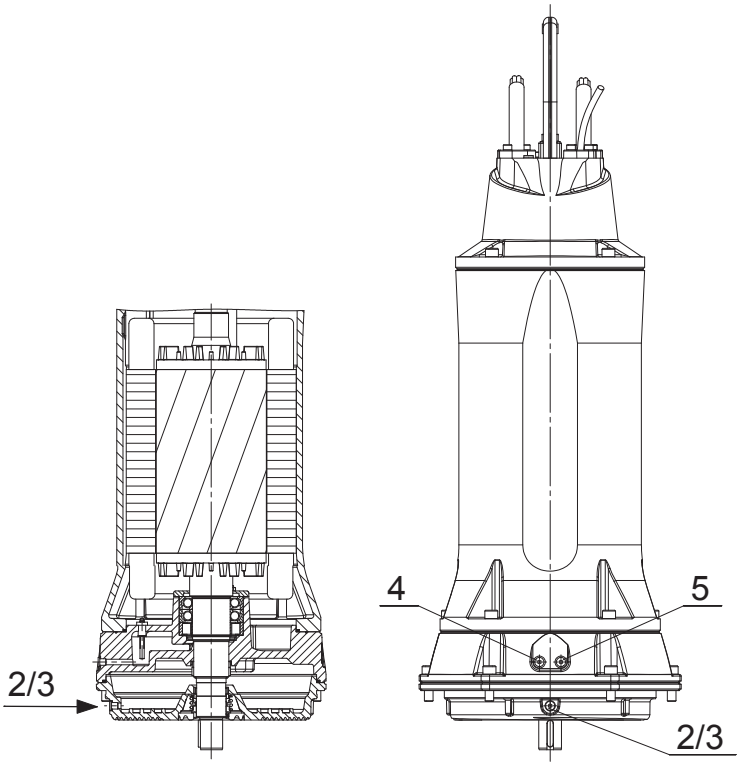


Figure 23 Cooling liquid / Oil filling and emptying XFP PE4 - PE5 without cooling jacket

2500-0017

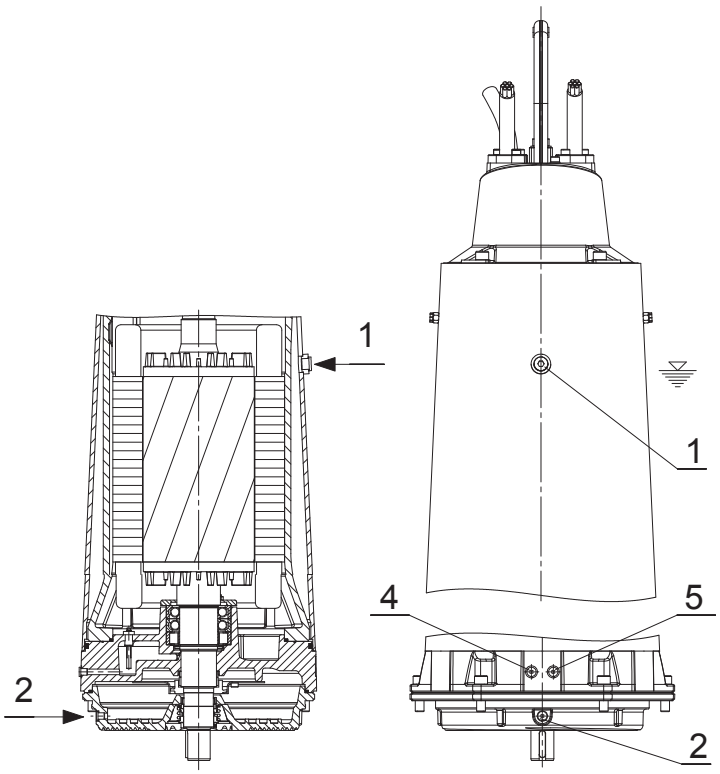


Figure 24 Cooling liquid / Oil filling and emptying XFP PE4 - PE5 with cooling jacket

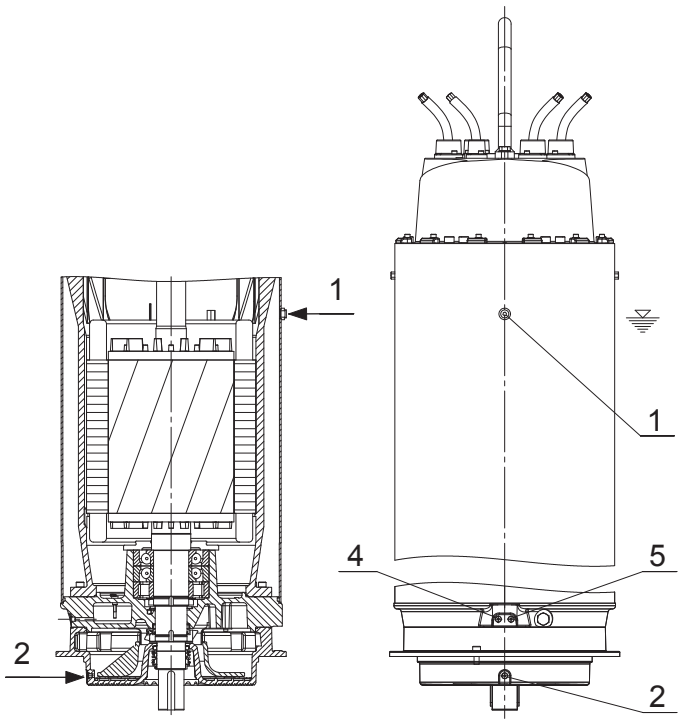


Figure 25 Cooling liquid / Oil filling and emptying XFP PE6 with cooling jacket

Legend (Figure 23 - 25) XFP

1 Cooling liquid filling (with cooling jacket)
2 Cooling liquid emptying
3 Cooling liquid filling (without cooling jacket) pump should be in horizontal position!
4 Inspection hole dry chamber
5 Inspection hole engine bay

7.1.2 Coolant filling / Oil filling VUPX / AFLX

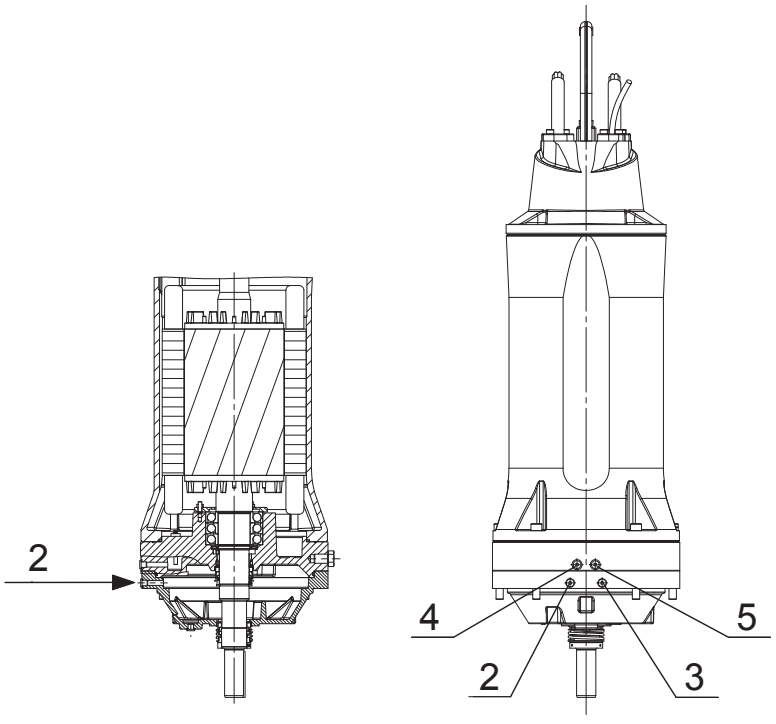


Figure 26 Cooling liquid / Oil filling and emptying VUPX / AFLX PE4 - PE5

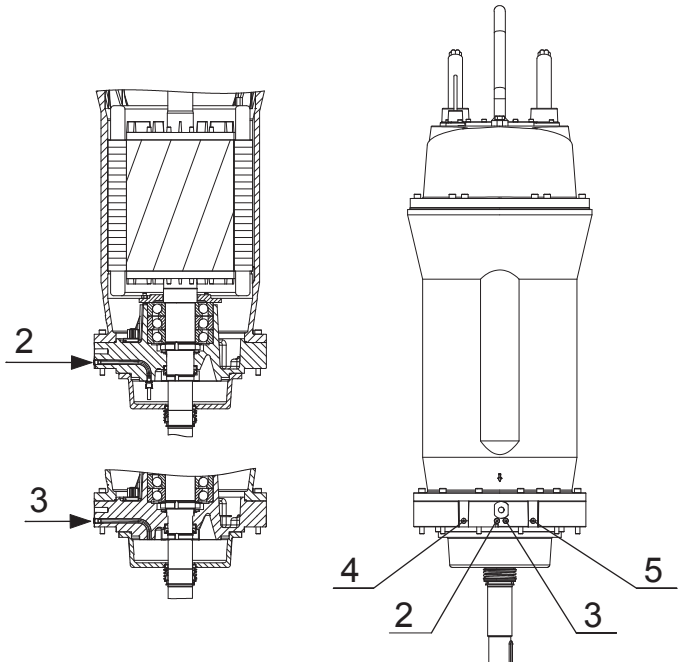


Figure 27 Cooling liquid / Oil filling and emptying VUPX / AFLX PE6

Legend (Figure 26 / 27) VUPX / AFLX

2 Cooling liquid emptying (to exhaust)
3 Drill hole venting (Cooling liquid filling), pump should be in horizontal position!
4 Inspection hole dry chamber
5 Inspection hole engine bay

Initial filling ex works:

Fill or drain collant at position 1/2/3

Glycol Frostox WS (Partnr.: 11030083) (TYFOROP Chemie GmbH)

Alternative coolant released by Sulzer:

Propylenglykol Code 27
(Houghton Deutschland GmbH)
DOWCAL 20-G HEAT TRANSFER FLUID
(Dow Deutschland GmbH & Co. OHG)
DOWCAL brand of - The Dow Chemical Companyy

Data is only valid for coolant used ex works. (Additional product information and safety data sheet are available on request).

Coolant filling quantities see chapter 7.1.4

When dealing with Frostox WS the general protective measures for chemicals must be observed. The information and hints in the safety data sheets covering this must be observed!

Fill or drain the lubricant at position 4

ATTENTION Only starting with mechanical seal MG1

PE4	0,6 *
PE5	1,5 *
PE6	2,0 *
* Filling volumes in Litres.	

HYDRAULIKÖL HLP-D (Art.nr.: 11030021)

7.1.3 Reference values for antifreeze behaviour

Concentration (vol.%)		Antifreeze in C°
Frostox WS	Water	
10	90	bis -3
20	80	bis -8
30	70	bis -13
40	60	bis -23
50	50	bis -35
60	40	bis -52
33*	67*	bis -16*

* default

7.1.4 Coolant filling quantities

Motor PE4		XFP 105J, 155J, 200J, 201J, 206J, 250J, 255J, 300J, 305J		XFP 100J, 150J, 200J, 300J, 350M		VUPX 0400, 0500, 0600, AFLX 0600, 0700
		CB-hydraulics		CH-Hydraulik		Axial hydraulics
50 Hz	60 Hz	A *	B *	A *	B *	
PE 75/8						6,9
PE 90/6						6,9
PE 90/8						6,9
PE 110/6						6,9
PE 110/8						6,9
PE 150/6						6,9
PE 150/8	PE 170/8	19.9	8.5	23.3	11.9	6.9
PE 185/6	PE 210/6	19.9	8.5	23.3	11.9	6.9
PE 185/8	PE 210/8	21.2	8.5	24.6	11.9	6.9
PE 220/4	PE 250/4	19.9	8.5	23.3	11.9	6.9
PE 220/6	PE 250/6	19.9	8.5	23.3	11.9	6.9
PE 220/8	PE 250/8	21.2	8.5	24.6	11.9	6.9
PE 300/4	PE 350/4	19.9	8.5	23.3	11.9	6.9
PE 300/6	PE 350/6	21.2	8.5	24.6	11.9	6.9
PE 300/8	PE 350/8	21.2	8.5	24.6	11.9	6.9
PE 370/4	PE 430/4	21.2	8.5	24.6	11.9	6.9
PE 370/6	PE 430/6	21.2	8.5	24.6	11.9	6.9
PE 450/4	PE 520/4	21.2	8.5	24.6	11.9	6.9
* A = Version **with** cooling jacket * B = Version **without** cooling jacket. Filling volumes in Litres.						**only version B**

Motor PE5		XFP 100J, 105J, 150J, 155J, 200J, 201J, 205J, 250J, 255J, 300J, 305J		XFP 150M, 200M, 250M, 300M, 301M, 305M, 306M, 351M, 356M, 400M, 405M		XFP Special version		XFP 501U		VUPX 0500 0600, AFLX 0700, 0800	VUPX 0800
50 Hz	**60 Hz**	**A ***	**B ***	**A ***	**B ***	**A ***	**B ***	**A ***	**B ***		
PE 300/10	PE 350/10	-	-	-	-	-	-	59.5	30.5	7.7	-
PE 370/8	PE 430/8	-	-	48	24	46.5	22.5	54.5	30.5	7.7	-
PE 370/10	PE 430/10	-	-	-	-	-	-	54.5	30.5	7.7	-
PE 450/6	PE 520/6	42.5	18.5	48	24	46.5	22.5	-	-	7.7	-
PE 450/8	PE 520/8	-	-	53	24	51,5	22.5	59.5	30.5	7.7	-
PE 450/10	PE 520/10	-	-	-	-	-	-	54.5	30.5	7.7	9.4
PE 550/4	PE 630/4	42.5	18.5	48	24	46.5	22.5	-	-	-	-
PE 550/6	PE 630/6	47.5	18.5	53	24	51.5	22.5	-	-	7.7	-
PE 550/8	PE 630/8	-	-	53	24	51.5	22.5	59.5	30.5	7.7	-
PE 550/10	PE 630/10	-	-	-	-	-	-	59.5	30.5	7.7	9.4
PE 750/4	PE 860/4	42.5	18.5	48	24	46.5	22.5	-	-	-	-
PE 750/6	PE 860/6	47.5	18.5	53	24	51.5	22.5	-	-	7.7	-
PE 750/8	PE 860/8	-	-	53	24	51.5	22.5	59.5	30.5	7.7	9.4
PE 900/4	PE 1040/4	47.5	18.5	53	24	51.5	22.5	-	-	-	-
PE 900/6	PE 1040/6	47.5	18.5	53	24	51.5	22.5	-	-	7.7	-
PE 1100/4	PE 1250/4	47.5	18.5	53	24	51.5	22.5	-	-	-	-
* A = Version with cooling jacket * B = Version without cooling jacket. Filling volumes in Litres.										only version B	

Motor PE6		Radial hydraulics					Axial hydraulics	
50 Hz	**60 Hz**	**XFP200M, 250M, 300M, 301M, 305J, 306M, 356M, 400M, 405M**	**XFP400R XFP501U**	**XFP500**	**XFP600V**	**XFP600X**	**VUPX 0500 VUPX 0600**	**VUPX 0800 VUPX 1000 AFLX 0800 AFLX 1200**
PE 750/12	PE 860/12				144	155		9,6
PE 750/10	PE 860/10		120				8,1	9,6
PE 900/12	PE 1040/12				144	155		9,6
PE 900/10	PE 1040/10		120			140		9,6
PE 900/8	PE 1040/8	114	120				8,1	9,6
PE 1100/12	PE 1250/12				153	164		9,6
PE 1100/10	PE 1250/10					155		9,6
PE 1100/8	PE 1250/8	114	120				8,1	9,6
PE 1100/6	PE 1250/6	114	120				8,1	9,6
PE 1320/12	PE 1500/12				153	164		9,6
PE 1320/10	PE 1500/10					155		9,6
PE 1320/8	PE 1500/8	114	120	135		140	8,1	9,6
PE 1320/6	PE 1500/6	114	120				8,1	9,6
PE 1320/4	PE 1500/4	114						
PE 1600/10	PE 1700/10				153	164		
	PE 1850/10				153	164		
PE 1600/8	PE 1700/8		135	150		155		9,6
	PE 1850/8		135	150		155		9,6
PE 1600/6	PE 1850/6	130	135				8,1	9,6
PE 1600/4	PE 1850/4	114						9,6
PE 2000/10	PE 2000/10				153	164		9,6

Motor PE6		Radial hydraulics					Axial hydraulics	
50 Hz	60 Hz	XFP200M, 250M, 300M, 301M, 305J, 306M, 356M, 400M, 405M	XFP400R XFP501U	XFP500	XFP600V	XFP600X	VUPX 0500 VUPX 0600	VUPX 0800 VUPX 1000 AFLX 0800 AFLX 1200
	PE 2250/10				153	164		9,6
PE 2000/8	PE 2000/8			150	144	155		
	PE 2250/8			150	144	155		
PE 2000/6	PE 2200/6	138	143	160			8,1	9,6
	PE 2250/6	138	143	160			8,1	9,6
PE 2000/4	PE 2200/4	130						
	PE 2250/4	130						
PE 2250/6	PE 2500/6		143					
PE 2500/8	PE 2800/8			160	153	164		9,6
PE 2500/4	PE 2800/4	130						
PE 3000/4	PE 3350/4	138						
PE 3500/4	PE 4000/4	138						
Filling volumes in Litres.								

Motor PE6	Axial hydraulics with gear unit	
Hydraulik	Gear unit filling quantity	Filling quantity
VUPX1000G	51	7
VUPX1200G		
AFLX1200G		
Filling volumes in Litres		

Starting frequency of the motors

The allowable starting frequency per hour can be read from the table below (where not otherwise specified from the works).

Motor power	maximum starts per hour	at interval in minutes
15 ≥ 160 kW	10	6

ATTENTION ***The allowable starting frequency for any starting devices should be obtained from manufacturer of these devices.***

7.2 Removal of the submersible sewage pump

The safety hints in the previous sections must be observed!

7.2.1 Removal of the XFP submersible sewage pump from a wet sump

Before removal of the unit the motor connection cables at the control panel should be completely disconnected by a qualified person from mains and care should be taken that it cannot be inadvertently switched back on.

Before removal of units in hazardous areas the sump and surrounding area must be adequately vented to avoid the danger of a spark causing an explosion!

- Fit a hoist to the pump.
- Raise the submersible pump out of the sump with the hoist. While doing this the connection cables should be simultaneously drawn out of the sump as the pump itself is being raised.

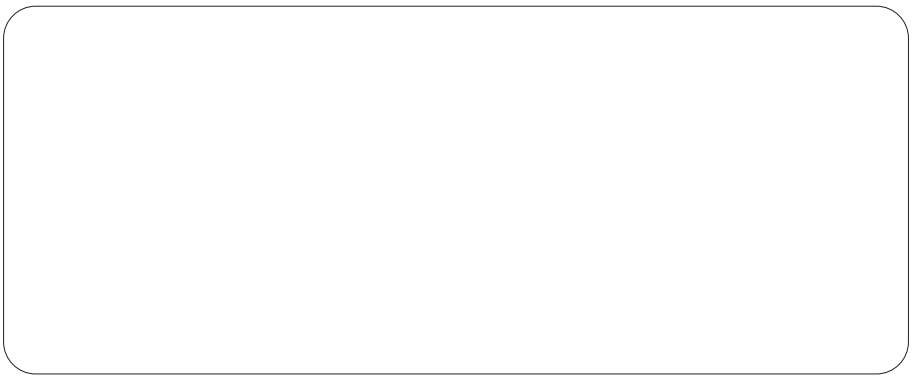
- Place the submersible sewage pump vertically onto a firm surface and secure against tipping.

7.2.2 Removal of the XFP submersible sewage pump when dry installed

- Close off the gate valves on the inlet and discharge sides.
- Empty the volute and, if necessary, the discharge line.
- If fitted, dismantle the venting line above the discharge.
- Install lifting gear on the submersible pump.
- Disconnect the suction inlet by opening the bolts on the bottom plate of the hydraulics (or at the pump housing).
- Dismantle the pressure hose by loosening the screws on the pressure flange of the pump housing.
- If necessary, remove the fastening bolts at the ground support ring and carefully lift off the pump with the hoist.
- Place the pump on an even, firm, flat surface.

7.2.3 Removal of the AFLX and VUPX submersible pump

- If present, the discharge pipe cover should be removed and the water pressure-tight cable inlet opened.
- Raise the submersible pump out of the concrete sump or the steel discharge pipe with the hoist. While doing this the connection cables should be drawn out as the pump itself is being raised.
- Place the submersible pump with propeller housing vertically on a solid surface, taking care that it cannot tip over.



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GB 2500-J

INSTALLATION, OPERATION & MAINTENANCE MANUAL

SKG SERIES
SHREDDER PUMPS
Electric Submersible Pumps

Three Phase
208V, 230V, 460V & 575V

CAST IRON

THREE PHASE

SKG15C
SKG22C
SKG37C

Read this manual carefully before installing, operating or servicing these pump models. Observe all safety information. Failure to comply with instructions may result in personal injury and/or property damage. Please retain these instructions.

Version 6/22/2016

TABLE OF CONTENTS

INTRODUCTION

This Installation, Operation and Maintenance manual provides important information on safety and the proper inspection, disassembly, assembly and testing of the BJM Pumps® SKG Series submersible pump. This manual also contains information to optimize performance and longevity of your **BJM Pumps** submersible pump.

The submersible SKG Series pumps are designed to pump wastewater and industrial wastewater that includes up to 10% by volume of solids. The SKG Series pumps are not explosion-proof. They are not designed to pump volatile or flammable liquids.

Note: Consult chemical resistance chart for compatibility between pump materials and liquid before operating pump.

If you have any questions regarding the inspection, disassembly, and assembly or testing please contact your **BJM Pumps** distributor, or BJM Pumps, LLC.

BJM Pumps, LLC
123 Spencer Plain Rd.
Old Saybrook, CT 06475, USA

Phone: 877-256-7867
Phone: 860-399-5937
Fax: 860-399-7784

Information, including pump data sheets and performance curves, is also available on our web site: www.bjmpumps.com

For assistance with your electric power source, please contact a certified electrician.

Please pay attention to the following alert notifications. They are used to notify operators and maintenance personnel to pay special attention to procedures, to avoid causing damage to the equipment, and to avoid situations that could be dangerous to personnel.

NOTE: Instructions to aid in installation, operation, and maintenance or which clarify a procedure.

⚠ DANGER Immediate hazards that WILL result in severe personal injury or death. These instructions describe the procedure required and the injury which will result from failure to follow the procedure.

⚠ WARNING Hazards or unsafe practices that COULD result in severe personal injury or death. These instructions describe the procedure required, and the injury which could result from failure to follow the procedure.

⚠ CAUTION Hazards or unsafe practices which COULD result in personal injury or product or property damage. These instructions describe the procedure required and the possible damage which could result from failure to follow the procedure.

SAFETY

Pump installations are seldom identical. Each installation and application can vary due to many different factors. It is the owner/service mechanics responsibility to repair, service, and test to ensure that the pump integrity is not compromised according to this manual.

⚠ WARNING Risk of electric shock – this pump has not been investigated for use in swimming pool areas.

⚠ DANGER **Do not pump flammable, inflammable or volatile liquids. <u>Death or serious injury will result.</u>**

⚠ WARNING Before attempting to open or service the pump:

1) Familiarize yourself with this manual.
2) Unplug or disconnect the pump power cable to ensure that the pump will remain inoperative.
3) Allow the pump to cool if overheated.

⚠ WARNING Do not operate the pump with a worn or damaged electric power cable. Death or serious injury could occur.

⚠ WARNING Never attempt to alter the length or repair any power cable with a splice. The pump motor and pump motor and cable must be completely waterproof. Damage to the pump or personal injury may result from alterations.

⚠ WARNING After the pump has been installed, make sure that the pump and all piping are secure before operation.

⚠ WARNING Do not lift the pump by the power cable piping or discharge hose. Attach proper lifting equipment to the lifting handle (or lifting rings) fitted to the pump. Do not suspend the pump by the power cable.

⚠ WARNING Obtain the services of a qualified electrician to troubleshoot, test and/or service the electrical components of this pump.

⚠ CAUTION Pumps and related equipment must be installed and operated according to all national, local and industry standards.

INSPECTION

Review all safety information before servicing pump.

The following are recommended installation practices/procedures for the pump. If there are questions in regards to your specific application, contact your local **BJM Pumps** distributor or BJM Pumps, LLC.

PRE-INSTALLATION INSPECTION

1) Check the pump for damage that may have occurred during shipment.
2) Inspect the pump for any cracks, dents, damaged threads, etc.
3) Check power cable (and Seal Minder® cable, if installed) for any cuts or damage.
4) Check for, and tighten any hardware that appears loose.
5) Carefully read all tags, decals and markings on the pump.
6) Important: Always verify that the pump nameplate amps, voltage, phase, and HP ratings match your control panel and power supply.

Warranty does not cover damage caused by connecting pumps and controls to an incorrect power source (voltage/phase supply).

Record the model numbers and serial numbers from the pumps and control panel on the front of this instruction manual for future reference. Give it to the owner or affix it to the control panel when finished with the installation.

If anything appears to be abnormal, contact your **BJM Pumps** distributor or BJM Pumps, LLC. If damaged, the pump may need to be repaired before use. Do not install or use the pump until appropriate action has been taken.

BJM Pumps Recommended Storage Procedures

Storage Environment

- The storage environment must be between 40°F - 120°F. DO NOT allow the pump to freeze.
- The pump must be stored in a dry location
- Avoid storing the pump in direct sunlight

For Storage Periods of 3 Years or Less

- Rotate the impeller shaft by hand every 6 months and again prior to start up
    - Keeps seal faces from sticking
    - Keeps bearing grease from settling

- Check the oil in seal chambers prior to startup to ensure oil is moisture free and has not broken down.
- Megger the motor prior to startup. The reading should be above 100 MΩ.
- Remove the air check screw on the motor housing. Using an air compressor, pressurize the motor chamber to 13 psi and check for leaks using a spray bottle. Repeat this procedure to check the seal chamber for leaks.
- Inspect the power cable for any damage.

For Storage Periods longer than 3 Years

- Disassemble the pump and replace all of the O-rings, the Mechanical Seal, Seal Chamber Oil, and the Lip Seal. Repack the Bearings.
- Remove the air check screw on the motor housing. Using an air compressor, pressurize the motor chamber to 13 psi and check for leaks using a spray bottle. Repeat this procedure to check the seal chamber for leaks.
- Rotate the impeller shaft by hand prior to startup.

Lubrication:

The shaft seal and bearings are fully lubricated from the factory. Seal oil should be checked once per year. See table: Oil Fill Quantity / Type. Prior to a dry run check, the shredder elements should be coated with a spray lubrication oil or a heavy soapy water solution. Do not run dry! Running dry can damage the shredder cutting elements.

OIL FILL QUANTITY/TYPE

	OIL IN SEAL CHAMBER		
MODEL	**U.S. FL. OZ.**	**CC.**	**TYPE OF OIL**
SKG15	25.0	750	ISO 32 NSF Food Grade Mineral Oil
SKG22	25.0	750	ISO 32 NSF Food Grade Mineral Oil
SKG37	28.3	850	ISO 32 NSF Food Grade Mineral Oil

Note: EPDM seals will use Propylene glycol instead of Shell FM32 oil

PUMP INSTALLATION

SKG Series pumps have been evaluated for use with water or water based solutions with solids. Please contact the manufacturer for additional information.

Lifting:

Attach a rope or lifting chain (not included) to the handle (or lifting rings) on the top of the pump.

⚠ CAUTION Do not lift the pump by the power cable or discharge hose/piping. Proper lifting equipment (rope/chain) must be used.

POSITIONING THE PUMP

BJM Pumps, SKG Series pumps are designed to operate fully or partially submerged. Avoid running the pump dry. Refer to data sheet for minimum submersion depth for your particular model. Data sheets can be obtained online at www.bjmpumps.com or by calling BJM Pumps, LLC at 860-399-5937. As a general rule, SKG Series SIDE discharge pumps can pump down to the center of the volute case. Pumping lower will permit air to enter the pump and cavitate, lose prime or become air bound, and may also damage the shredder cutting elements.

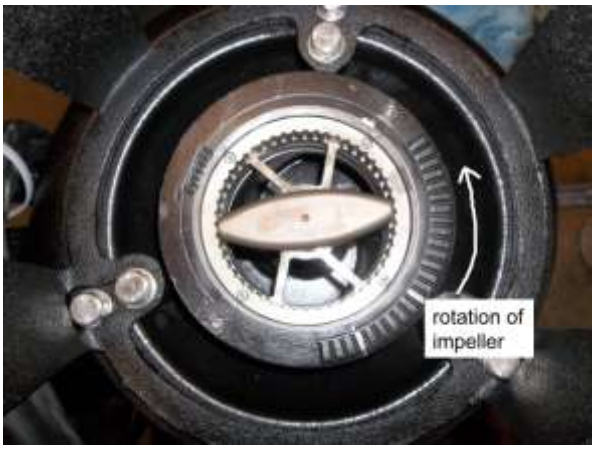
⚠ CAUTION

- Do not run pump dry.
- Pump liquid should not exceed a maximum temperature of 104°F.
- Never place the pump on loose or soft ground. The pump may sink, preventing water from reaching the impeller. Place on a solid surface or suspend the pump with a lifting rope/chain.
- For maximum pumping capacity, use the proper size non-collapsible hose or rigid piping. A check valve may be installed after the discharge to prevent back flow when the pump is shut off.
- Take stand off of pump when using slide rail. Keep stand and reattach when transporting or handling the pump.

PUMP ROTATION

See lubrication requirements prior to checking pump rotation. There are two ways to check the correct pump rotation:

1. By looking at the shredder cutting bar or the pump impeller; the rotation of the impeller should be counter clockwise as shown in the picture below.



2. Since the impeller cannot be seen, the best way to check the rotation is to check the kick back motion of the pump when the pump just starts. The kick back motions should be viewed from the top. The kick back motion of the pump should be counter clockwise as shown in the picture above. When viewed from the suction side (bottom) the impeller rotation is counter clockwise.

PUMP OPERATION

⚠WARNING This pump is designed to handle dirty water that contains some solids. It is not designed to pump volatile or flammable liquids. Do not attempt to pump any liquids which may damage the pump or endanger personnel as a result of pump failure.

⚠ DANGER **Do not operate this pump where explosive vapors or flammable material exist. Death or Serious injury will result.**

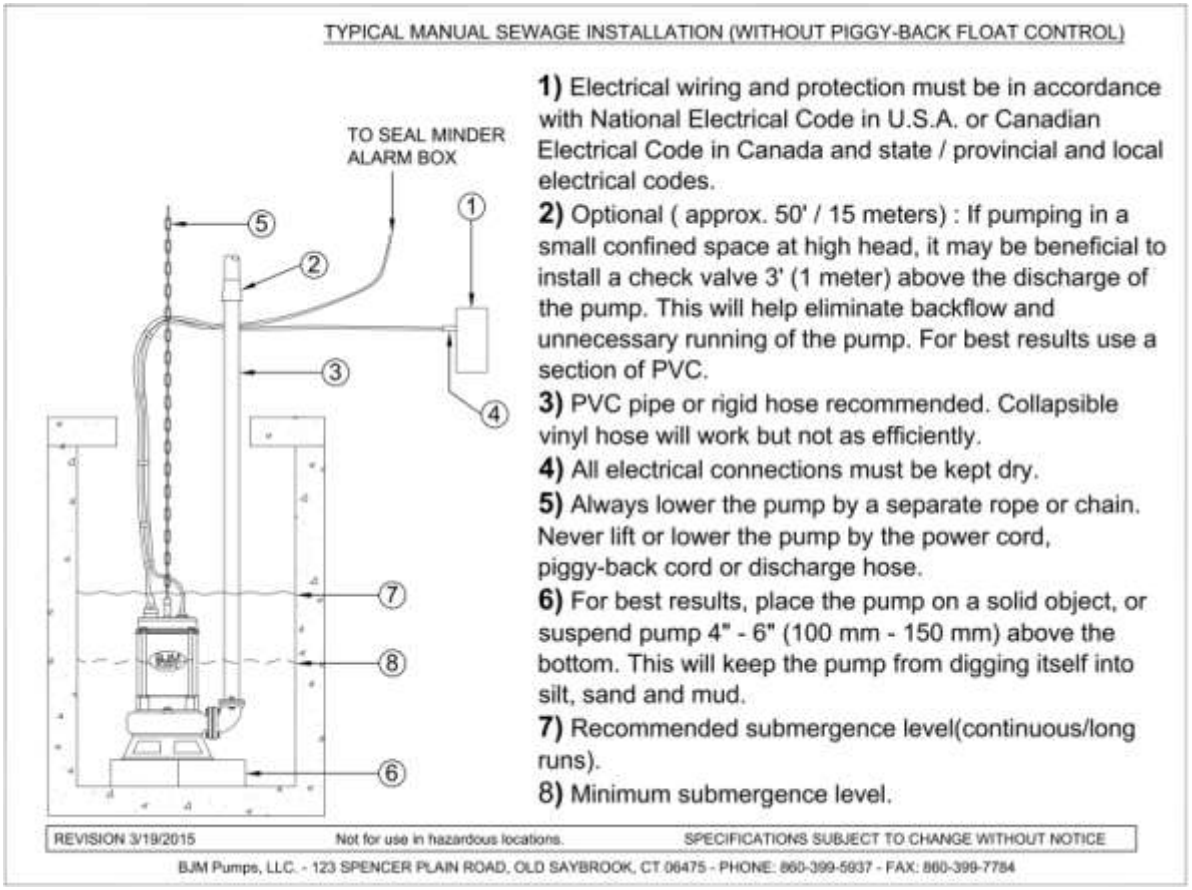
TYPICAL MUNICIPAL AND INDUSTRIAL WASTEWATER INTALLATION

NOTE: Maximum recommended starts should not exceed 10 times per hour.

MANUAL OPERATION

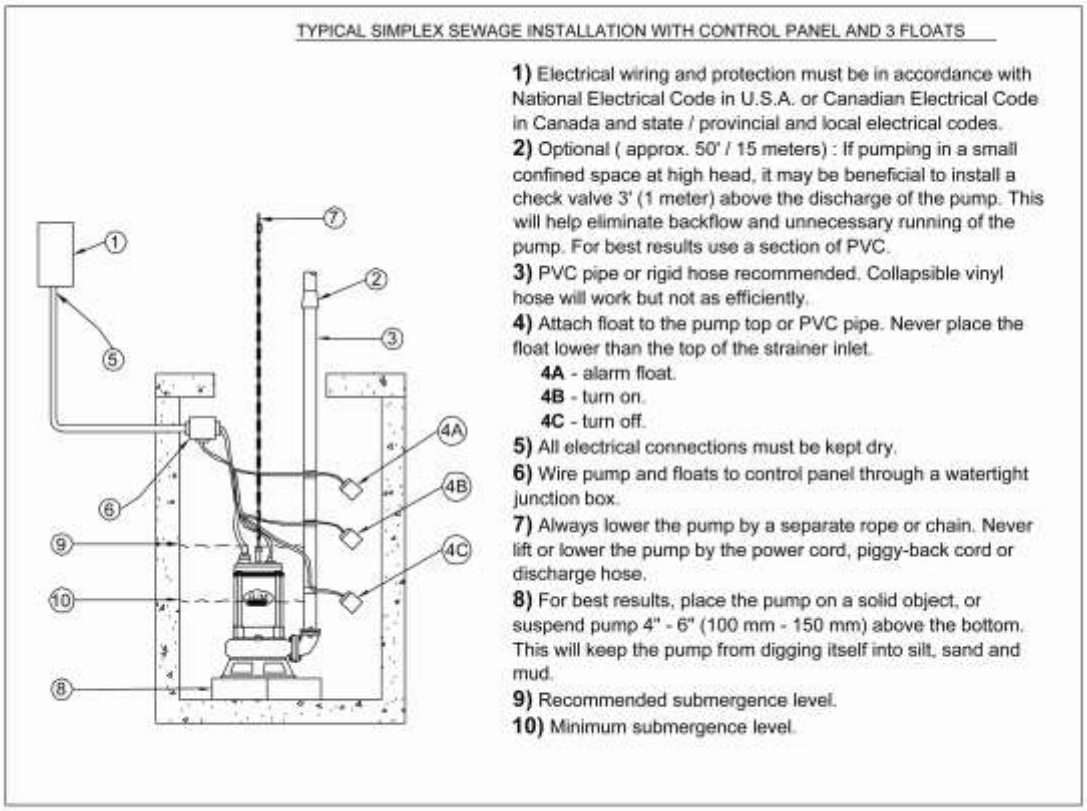
⚠WARNING Do not alter the length or repair any power cable with a splice. The pump motor and cable must be completely waterproof. Damage to the pump or personal injury may result from alterations.

For manual operation: 208, 230, 460 & 575 volt: Attach the proper plug, connect directly to the power source or control box. Check the direction of the rotation. Tilt the pump and start it. It should twist in the opposite direction of the arrow (on pump). It is recommended that a Ground Fault Interrupter (GFI) type receptacle (or equivalent) be used.



STOPPING

To stop the pump (manual and automatic mode), unplug it from the power source, turn off the breaker, or turn the power source off (generator).



Typical 3 phase manual control 1

TYPICAL MUNICIPAL OR INDUSTRIAL WASTEWATER INSTALLATION

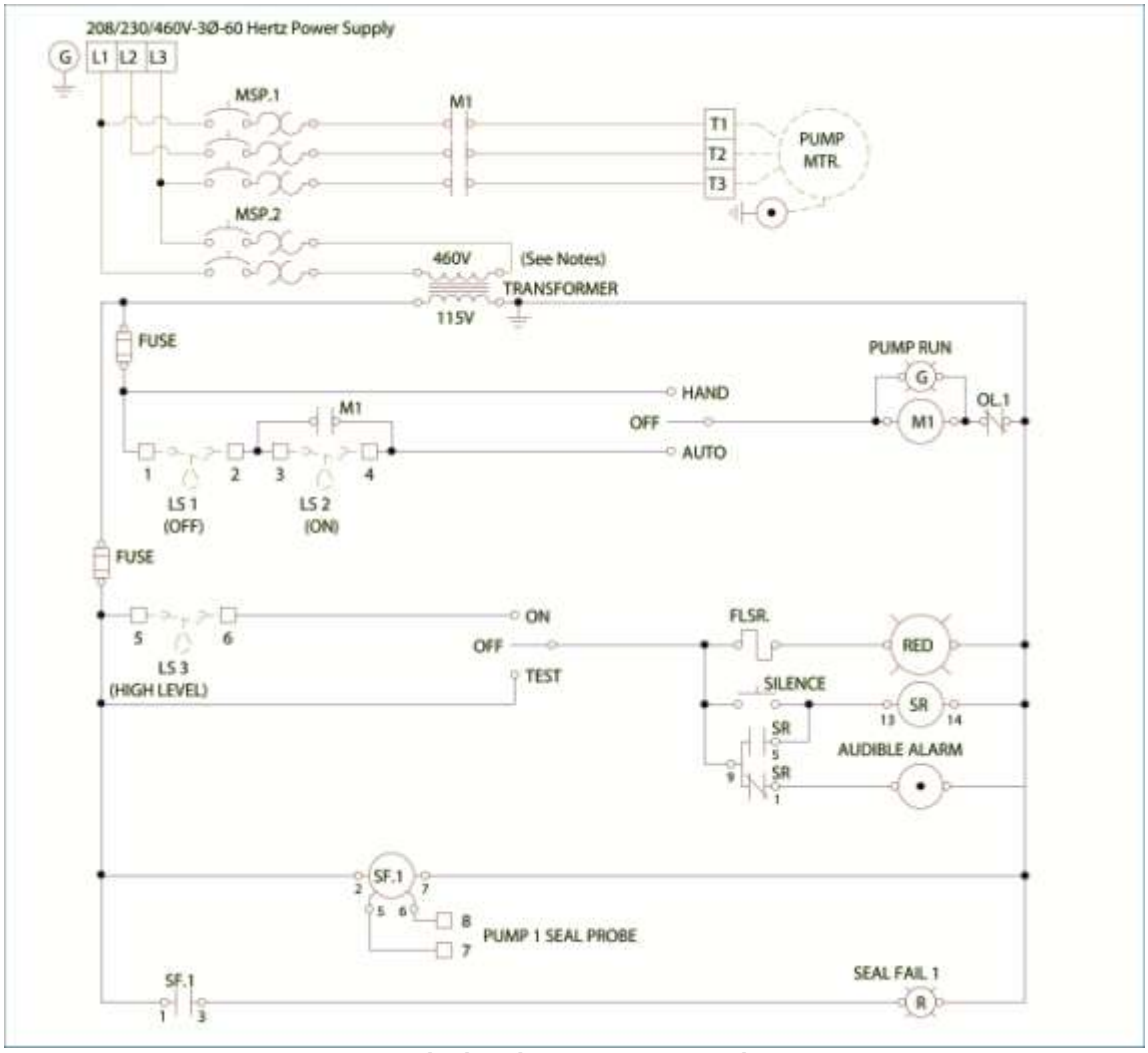
NOTE: Maximum recommended starts should not exceed 10 times per hour.

AUTOMATIC OPERATION

Three phase pumps need a separate control box with float(s) for automatic operation.

STOPPING

To stop the pump (manual and automatic mode), unplug it from the power source, turn off the breaker, or turn the power source off (generator).



Typical 3 phase Auto Control 1

INTENDED METHODS OF CONNECTION

⚠ CAUTION Use with approved motor control that matches motor input in full load amperes. “UTILLISER UN DÉMARREAR APPROUVÉ CONVENANT AU COURANT Á PLEINE CHARGE DU MOTEUR.”

BJM Pumps has been evaluated for use with water or water based solutions. Please contact the manufacturer for additional information.

THREE PHASE WIRING INSTRUCTIONS

⚠ WARNING **FOR YOUR PROTECTION, ALWAYS DISCONNECT PUMP FROM ITS POWER SOURCE BEFORE HANDLING.**

⚠ CAUTION **“Risk of electrical shock”** Do not remove power supply cord and strain relief or connect conduit directly to the pump.

⚠ WARNING Installation and checking of electrical circuits and hardware should be performed by a qualified licensed electrician.

To automatically operate a non-automatic three phase pump, a control panel is required. Follow the instructions provided with the panel to wire the system. For automatic three phase pumps see automatic three phase wiring diagram.

Before installing a pump, check the pump rotation to insure that wiring has been connected properly to power source, and that the green lead of power cord (See wiring diagram), is connected to a valid ground, momentarily energize the pump, observing the directions of kick back due to starting torque. Rotation is correct if kick back is in the opposite direction of rotation arrow on the pump casing. If rotation is not correct, switching of any two power leads other than ground will provide the proper rotation.

⚠ DANGER **DO NOT PLACE HANDS IN PUMP SUCTION WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SERVER PERSONAL INJURY.**

Three phase pumps have integral motor overload protection. It is recommended that all three phase pumps using a motor starting device also incorporate motor overload protection. Pumps **must** be installed in accordance with the National Electrical Code and all applicable local codes and ordinances. Pumps are not to be installed in locations classified as hazardous in accordance with National Electrical Code, ANSI/NFPA 70.

Connect pump to a junction box, outlet box, control box, enclosure with a wiring compartment that meets NEC and local codes. The provision for supply connection shall reduce the risk of water entry during temporary, limited submersion and shall comply with the applicable requirements of the Standard for Enclosures for Electrical

Equipment, UL 50, or the standard for Metallic Outlet Boxes, UL 514A, and the standard for Motor-Operated Water Pumps. UL 778.

TROUBLE SHOOTING

⚠WARNING **Disconnect the power source to the pump BEFORE attempting any type of trouble shooting, service or repair.**

PUMP WILL NOT RUN

1. Check power supply (fuses, breaker). Reset power.
2. Blocked impeller. Check and clean.
3. Defective cable or incorrect wiring.
4. Float switch tangled/obstructed. Clean and free float switch from obstruction.
5. Float switch defective. Replace float switch.
6. Pump overheated or temperature of liquid exceeds pump operating temperature.

Warning: Pump will restart automatically when motor over-heat protection switch cools.

PUMP RUNS BUT DOES NOT DELIVER RATED CAPACITY

1. Discharge line clogged, restricted or hose kinked. Check discharge hose/pipe.
2. Worn impeller and/or suction cover. Inspect and replace as necessary.
3. Pump overloaded due to liquid pumped being too thick.
4. Pumping air. Check liquid level and position of pump.
5. Excessive voltage drops due to long cables.
6. Three phase only; pump running backwards, check rotation.

SERVICING YOUR SUBMERSIBLE PUMP

Pump should be disconnected from the electric power supply before proceeding to do any service or maintenance**.**
To service or repair your pump, please contact your local **BJM Pumps** distributor. Service should only be performed by a qualified electrician.

MAINTAINING YOUR PUMP

- Pump should be disconnected from the electric power supply before proceeding to do any service or maintenance**.**
- Pump should be inspected at regular intervals.

- More frequent inspections are required if the pump is used in a harsh environment.
- Preventative maintenance should be performed to reduce the chance of premature failure.
- Worn impellers and lip seals should be replaced.
- Cut or cracked power cords must be replaced. **(Never operate a pump with a cut, cracked or damaged power cord.)**
- Seal oil should be checked once per year.
- Maintenance should always be done when taking a pump out of service before storage.
- The impeller to suction cover clearance should be adjusted to between 0.01" to 0.02" for optimal pumping performance. Shim kits are available if adjustment is required.

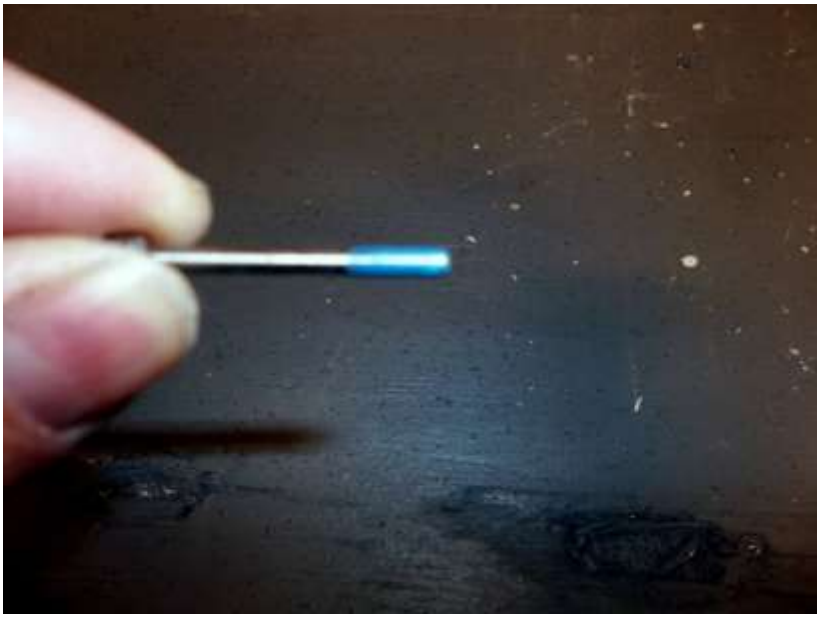
    1) Clean pump of dirt and other build up.
    2) Check condition of oil around the shaft seals.
    3) Check hydraulic parts: check for wear.
    4) Inspect power cable. Make sure that it is free of nicks or cuts.

Shredder Element Assembly and Adjustment

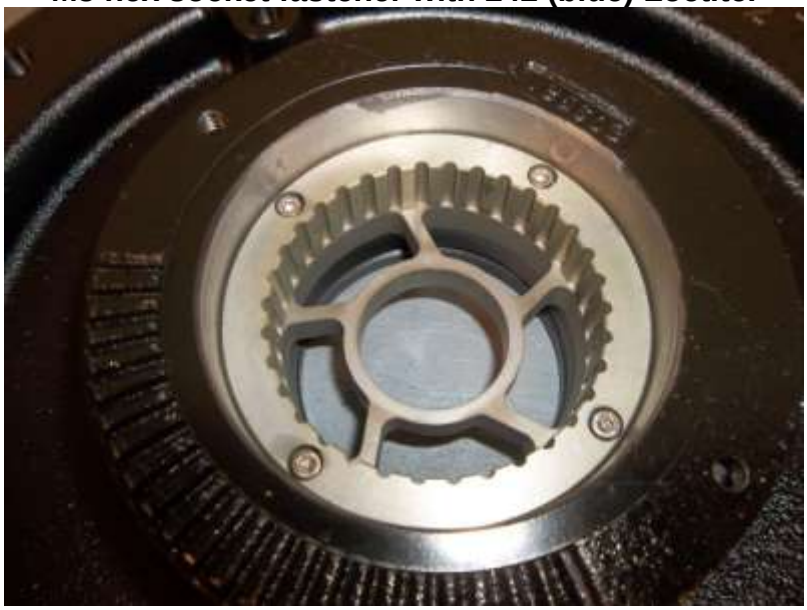
1. **Installing the Stationary Shredding Elements into Shredder Housing –** Place the axial cutter ring into the shredder housing with the angle of the cutter legs slanting counter clockwise as shown in the picture. Note that this is a tight sliding fit, so the parts must be aligned carefully. A plastic mallet can be used to carefully to tap the stationary rings into place. Once the axial shredder ring has been installed, it should be able to be rotated to align the mounting screw holes. The radial cutter ring can be installed in the same manner. Once each ring has been installed, the mounting holes should be aligned with the mounting holes in the shredder housing. With a drop of 242 (blue) Loctite on each of the four M3 retaining screws, these can be added. Tighten carefully these are small screws.

Axial shredding ring with leg slanted counter clockwise.

Radial shredder ring installed.



M3 hex socket fastener with 242 (blue) Loctite.



The shredder rings installed in the housing and retained with the four M3 screws.

2. **Impeller Shimming –** With the volute installed on the motor, the impeller is added to the shaft. The suction cover is then added without the shredder housing in place. An initial reading is taken on the gap between the impeller and the suction cover with the feeler gauges. Shims are added and this step is repeated until the gap is between 0.010” and 0.020”. Once the impeller gap has been set, the suction cover can be mounted to the volute case.

Impeller shown on shaft. Note volute case has not been added to give clearer picture of the impeller on the shaft.

Feeler gauge shown between impeller vane and top of suction cover.

3. **Installing the Shredder Housing –** First apply a light coating of the Jet Lube Marine Grade Anti-Seize to the shredder housing threads. Next thread the housing into the suction cover until the housing has hit the bottom of the threads. Add a light coating of the Jet Lube Marine Grade Anti-Seize to the inside threads on the shredding cutting bar. Thread the bar onto the shaft and tighten with the proper tools.

With the housing threaded completing into the suction cover, the shredder cutter bar can be threaded onto the shaft to retain the impeller.

The shredder cutting bar should be tightened to the proper torque using the special socket tool on an impact driver.

Once the shredder cutting bar has been tightened to the shaft, verify that it can spin freely. The cutter elements are sharp, so care should be taken not to cut fingers.

4. **Shredder Cutting Element Adjustment –** With all of the elements installed, the housing should be rotated counter clockwise until the stationary axial cutting ring is tight against the shredding cutter bar (and the housing will not turn any more). Align the center of one of the stand mounting bosses with one of the 5 degree markers cast into the shredding housing. With a paint pen or a light colored Sharpie marker, mark the proper marker point that is aligned with the boss. Next count 6 degree markers counter clockwise and make a paint mark. Rotate the housing clockwise until the second mark is aligned with the boss. Add the 242 (blue) Loctite to the two M6 set screws and run them down until they hit. Once the lock screws have hit the suction cover housing, tighten ¼ turn. Carefully check to make sure the shredder cutting bar spins freely.

Mark the point where the stationary axial shredding ring interfaces with the shredding cutter bar.

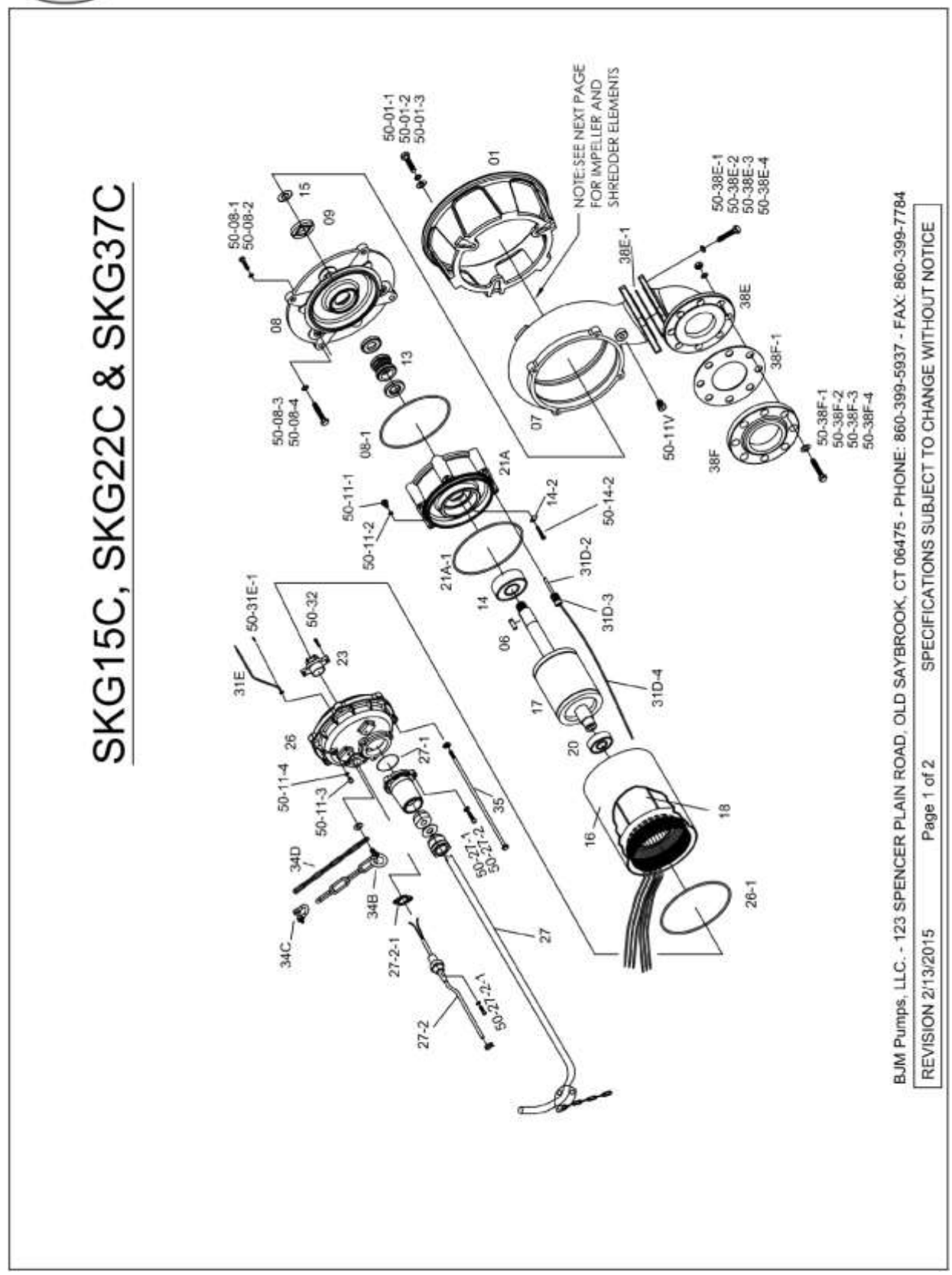
Rotate the shredder housing clockwise 6 markers.

Thread the locking screws down until contact is made with the suction cover. Tighten ¼ turn.

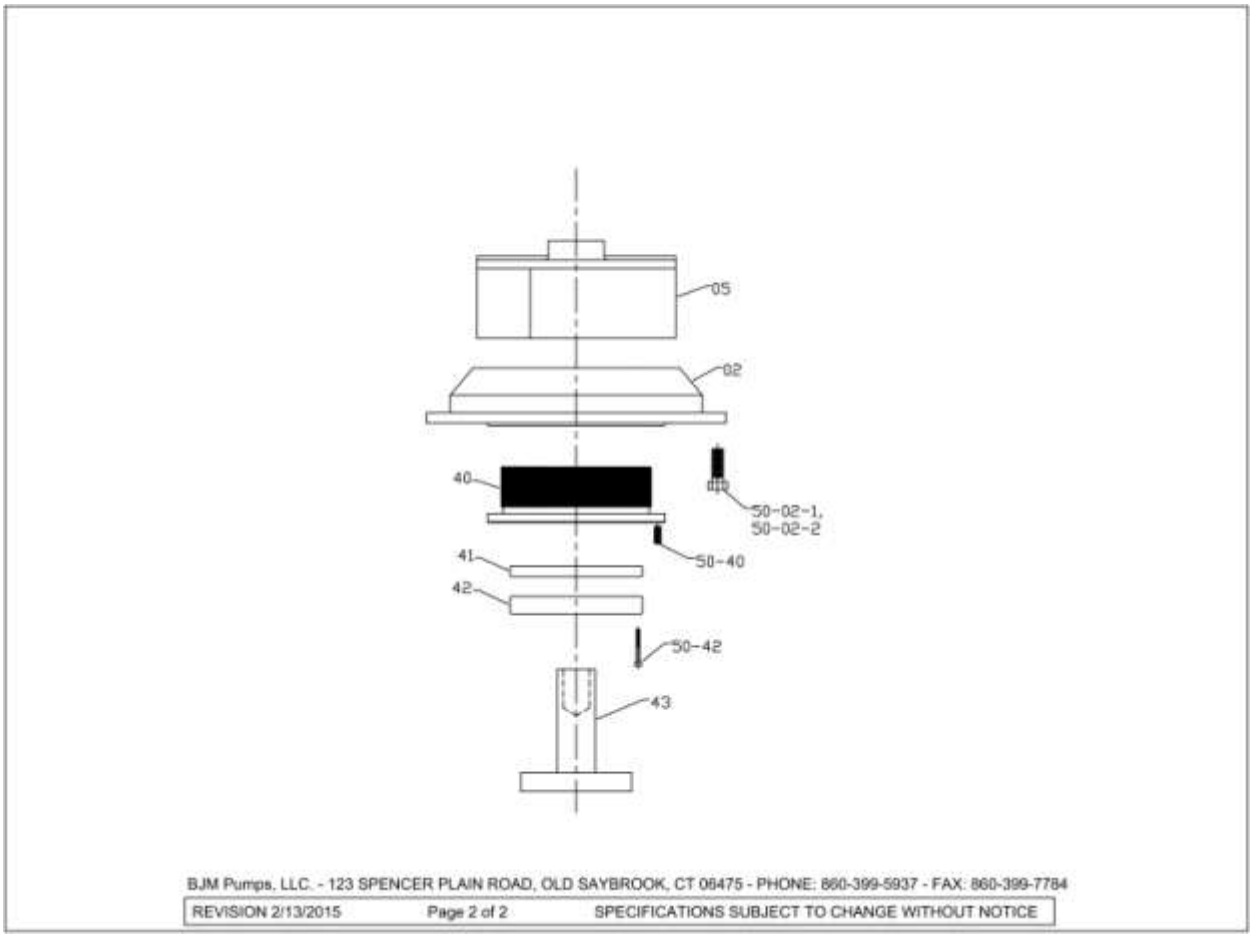
CHANGING SEAL OIL

Changing the seal oil in the SKG series pumps is very easy.

1) Make sure that the pump cable is disconnected from the power source.
2) Lay the pump on its side with the oil inspection bolt facing up.
3) Remove the oil inspection bolt.
4) Pour out or draw out with a syringe, a small sample of oil. If it's milky white, or contains water/contaminants, then the oil should be changed and the mechanical seal should be checked and changed if needed.
5) Replace the oil. See oil fill quantity/type chart for the oil volume and oil type.
6) Replace the oil inspection bolt.



EXPLODED VIEW OF SKG 15C, 22C, 37C



IMPELLER & SHREDDER ELEMENTS OF SKG 15C, 22C, 37C

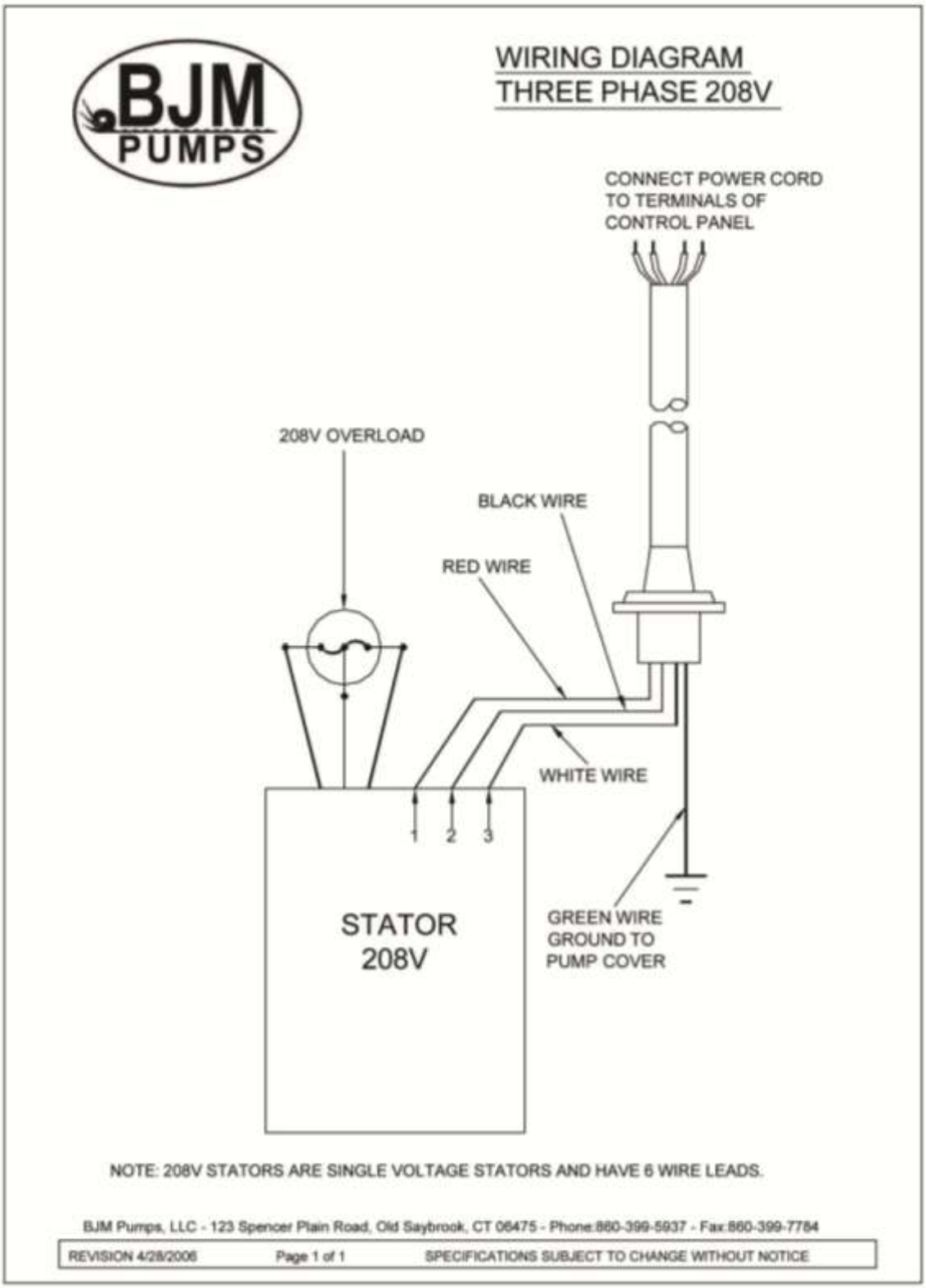
SKG SERIES PARTS LIST

	Pump Model	SKG15	SKG22	SKG37
Item No.	Part Description	Item #	Item #	Item #
01	Stand/Base	204574	204574	204574
02	Suction Cover	203928	203930	203932
05	Impeller	203895	203897	203899
06	Impeller Key	202141	202141	204575
07	Pump Housing	204576	204576	204577
08	Seal Housing Cover	204578	204578	204578
08-1	O-Ring (Kit Only)	-	-	-
09	Lip Seal Buna-N	202248	202248	202251
09	Lip Seal FKM (Optional)	202250	202250	202254
09	Lip Seal EPDM (Optional)	204647	204647	204648
13	Mechanical Seal - FKM	200304	200304	200307
13	Mechanical Seal - Buna-N (Optional)	200305	200305	200308
13	Mechanical Seal - EPDM (Optional)	200306	200306	200309
14	Lower Ball Bearing	200961	200961	200962
14-2	Lower Bearing Retainer	202279	202279	202279
15	Impeller Shim Kit (Required)	200479	200479	204580
17	Rotor w/Shaft	204581	204582	204583
18	Stator w/ Casing 208V	204584	204736	204739
18	Stator w/ Casing 230/460V	204585	204737	204740
18	Stator w/ Casing 575V	204586	204738	204741
20	Upper Ball Bearing	200958	200958	200958
20-2	Spring Washer	203755	203755	203755
21A	Seal Housing	204587	204587	204588
21A-1	O-Ring (Kit Only)	-	-	-
23	Overload Protector 208V, 3PH	202388	202390	202392
23	Overload Protector 230V, 3PH	202388	202390	202392
23	Overload Protector 460V, 3PH	202386	202389	202391
23	Overload Protector 575V, 3PH	202387	202386	202389
26	Top Cover	202445	202445	202445
26-1	O-Ring (Kit Only)	-	-	-
27	Power Cable Assembly - 14/4 SOOW	204347	204347	-
27	Power Cable Assembly - 12/4 SOOW	-	-	204348
27-1	O-Ring (Kit Only)	-	-	-
27-2	Seal Minder Cable - 18/2	201711	201711	201711
31D	Seal Minder Probe	202410	202410	202410
31E	Ground Wire w/Ring Terminal	203145	203145	203145
32	Power Cable Strain Relief	204161	204161	202497
33	Seal Minder Cable Clip	203163	203163	203163

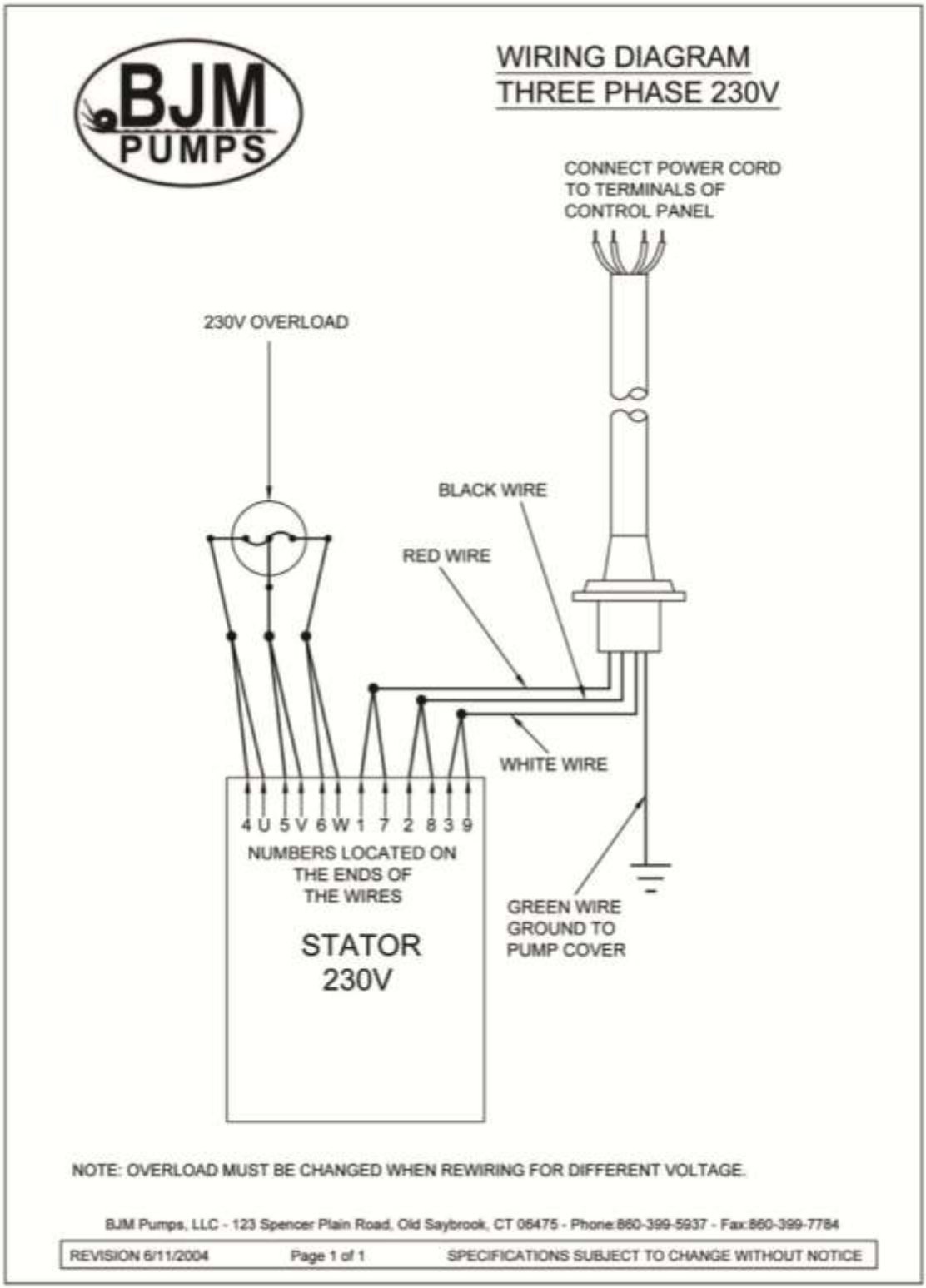
34	Lifting Chain	202509	202509	202509
35	Rod Bolts	202670	202671	202673
38E	Discharge Elbow	202557	202557	202557
38E-1	Gasket, Discharge Elbow	203208	203208	203208
38F	Discharge Flange - 3"	203188	203188	203188
38F	Discharge Flange - 4" (Optional)	202606	202606	202606
38F-1	Discharge Gasket - Buna-N	201564	201564	201564
38F-1	Discharge Gasket - FKM	201565	201565	201565
40	Shredder Housing	203922	203924	203926
41	Axial Shredder Ring	203913	203914	203915
42	Radial Shredder Ring	203916	203917	203918
43	Shredder Bar	203910	203911	203912
50-01-1	Cap Screw, Stand, M10x1.5x30	203262	203262	203262
50-01-2	Split Lock Washer M10	202909	202909	202909
50-01-3	Flat Washer M10	202910	202910	202910
50-02-1	Cap Screw, Suc. Cover, M10x1.5x25	203298	203298	203298
50-02-2	Split Lock Washer M10	202909	202909	202909
50-08-1	Cap Screw, Seal Cover, M10x1.5x30	203262	203262	203262
50-08-2	Flat Washer M10	202910	202910	202910
50-08-3	Cap Screw, Housing, M10x1.5x30	203262	203262	203262
50-08-4	Split Lock Washer M10	202909	202909	202909
50-11-1	Cap Screw, Oil Inspection	203282	203282	203282
50-11-2	O-Ring (Kit Only)	-	-	-
50-11-3	Screw, Inspection	203218	203218	203218
50-11-4	O-Ring (Kit Only)	-	-	-
50-11V	Valve, Air Release	202707	202707	202707
50-14-2	Cap Screw, Lower Bearing Retainer	203219	203219	203219
50-23	Screw, Overload	202700	202700	202700
50-27-1	Screw, Power Cable Housing	203220	203220	203220
50-27-2	Split Lock Washer M6	202900	202900	202900
50-27-2-2	Screw, Seal Minder Cable	203216	203216	203216
50-31E-1	Screw, Ground	202692	202692	202692
50-38E-1	Cap Screw, M12x1.75x55	203255	203255	203255
50-38E-2	Flat Washer M12	202912	202912	202912
50-38E-3	Split Lock Washer M12	202905	202905	202905
50-38E-4	Nut, M12x1.75	202892	202892	202892
50-38F-1	Cap Screw, M16x2x60	203270	203270	203270
50-38F-2	Flat Washer M16	202908	202908	202908
50-38F-3	Split Lock Washer M16	202906	202906	202906
50-38F-4	Nut, M16x2	202893	202893	202893
50-40	Set Screw, M6x1x12MM	204374	204374	204374
50-42	Socket Head Screw, M3x.5x30mm	204375	204375	204375
	O-Ring Kit - Buna	204589	204589	204589
	O-Ring Kit - FKM	204590	204590	204590

THREE PHASE WIRING DIAGRAMS

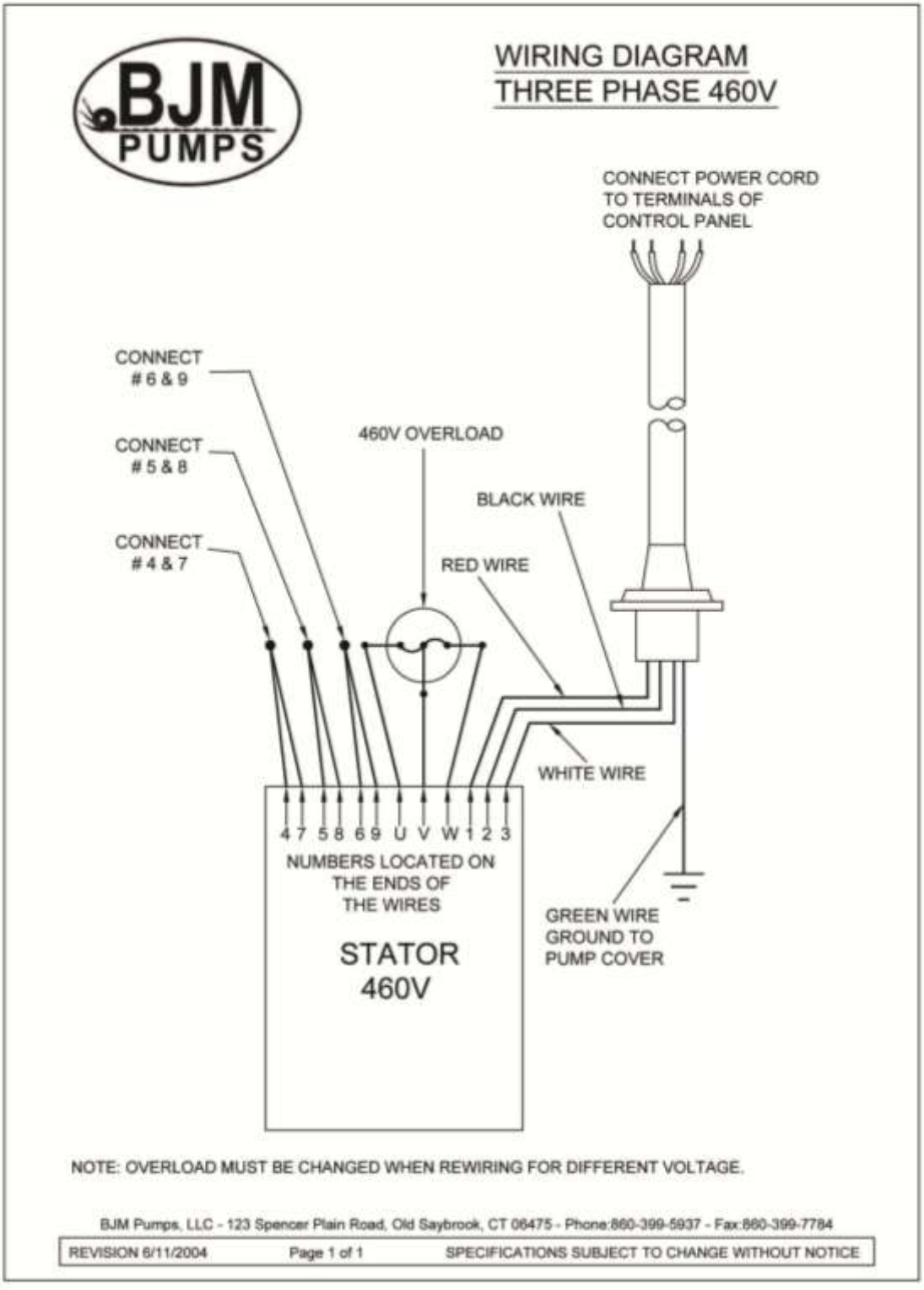
208V



230V


BJM PUMPS
WIRING DIAGRAM
THREE PHASE 230V
CONNECT POWER CORD
TO TERMINALS OF
CONTROL PANEL
230V OVERLOAD
BLACK WIRE
RED WIRE
WHITE WIRE
4 U 5 V 6 W 1 7 2 8 3 9
NUMBERS LOCATED ON
THE ENDS OF
THE WIRES
STATOR
230V
GREEN WIRE
GROUND TO
PUMP COVER
NOTE: OVERLOAD MUST BE CHANGED WHEN REWIRING FOR DIFFERENT VOLTAGE.
BJM Pumps, LLC - 123 Spencer Plain Road, Old Saybrook, CT 06475 - Phone:860-399-5937 - Fax:860-399-7784
REVISION 6/11/2004
Page 1 of 1
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

460V


BJM PUMPS
WIRING DIAGRAM
THREE PHASE 460V
CONNECT POWER CORD TO TERMINALS OF CONTROL PANEL
CONNECT #6 & 9
CONNECT #5 & 8
CONNECT #4 & 7
460V OVERLOAD
BLACK WIRE
RED WIRE
WHITE WIRE
4 7 5 8 6 9 U V W 1 2 3
NUMBERS LOCATED ON THE ENDS OF THE WIRES
STATOR 460V
GREEN WIRE GROUND TO PUMP COVER
NOTE: OVERLOAD MUST BE CHANGED WHEN REWIRING FOR DIFFERENT VOLTAGE.
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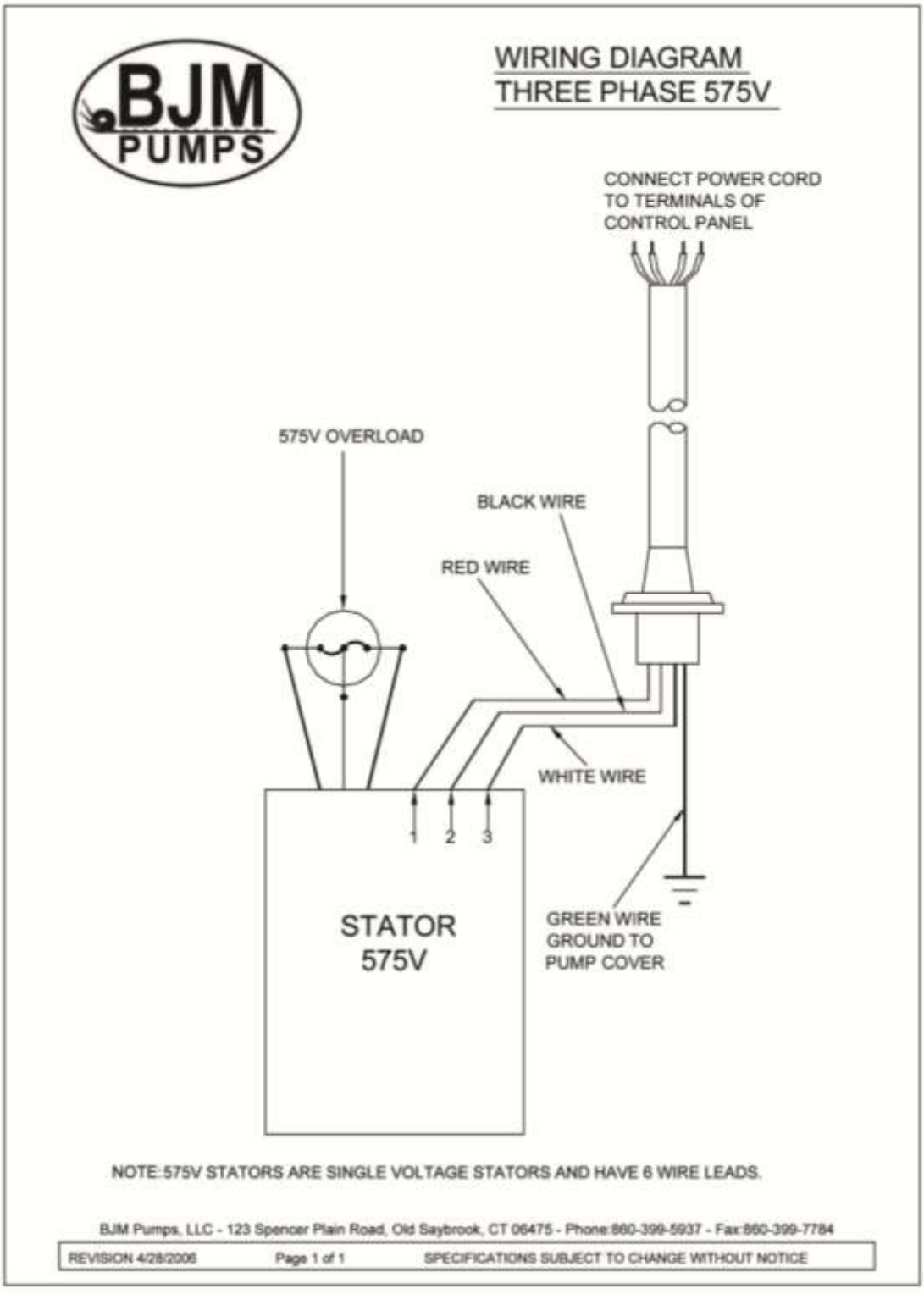
REVISION 6/11/2004
Page 1 of 1
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

575V


BJM PUMPS
WIRING DIAGRAM
THREE PHASE 575V
CONNECT POWER CORD TO TERMINALS OF CONTROL PANEL
575V OVERLOAD
BLACK WIRE
RED WIRE
WHITE WIRE
1
2
3
STATOR 575V
GREEN WIRE GROUND TO PUMP COVER
NOTE:575V STATORS ARE SINGLE VOLTAGE STATORS AND HAVE 6 WIRE LEADS.
BJM Pumps, LLC - 123 Spencer Plain Road, Old Saybrook, CT 06475 - Phone:860-399-5937 - Fax:860-399-7784
REVISION 4/28/2006
Page 1 of 1
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Seal Minder® INFORMATION

Seal Minder:
Also known as a seal failure circuit (or moisture detection circuit) is designed to inform the pump operator that there is moisture within the oil chamber. This early warning can allow the operator to schedule repair & inspection on the pump. The **Seal Minder** is a sensor probe is inside the oil chamber. (The oil chamber houses the mechanical seals that are cooled & lubricated by oil). The **Seal Minder,** when properly connected to a control panel, can help indicate seal failure. The **Seal Minder** cord requires a seal fail circuit in control panel for warning signal.

The open end of the **Seal Minder** circuit cord should be connected to a control panel with an optional seal failure alarm relay circuit or a standalone **Seal Minder** Panel manufacturers can incorporate the **Seal Minder** cord option. BJM Pumps, LLC has a stand alone, **Seal Minder** panel for both simplex (P/N MSP8350A) and duplex (P/N MSP8350B) systems. For more information contact BJM Pumps, LLC or visit us online at www.bjmpumps.com

The **Seal Minder** cord has two leads, black and white. Note that the power cable is much larger and has 3 to five leads, depending on the model. Inside the pump, the black lead is connected to the casing ground, and the white lead is connected to the seal probe that is suspended into the oil chamber fluid. These leads need to be properly connected to the seal failure alarm relay circuit. Most controls that have provided for this option have a connection terminal point that is clearly marked for these connections. Consult the control panel manual for proper connection instructions.

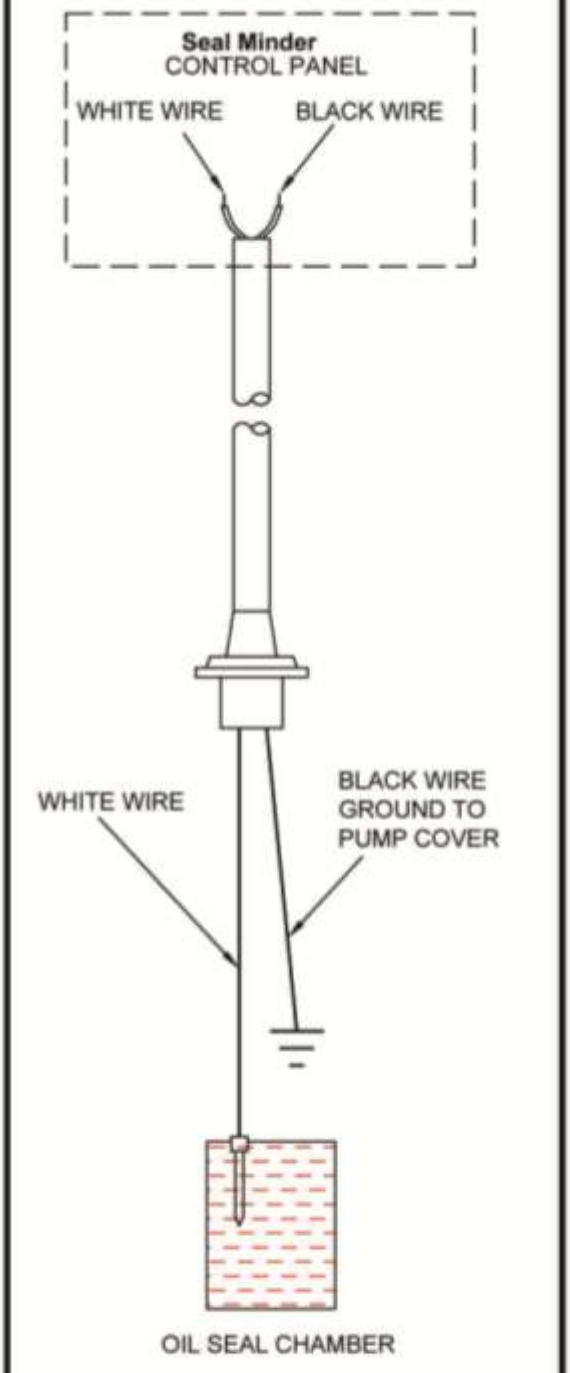
Although highly recommended, the pump does not need a control box with seal fail relay or stand alone seal panel to operate.

If the operator does not use the Seal Minder:

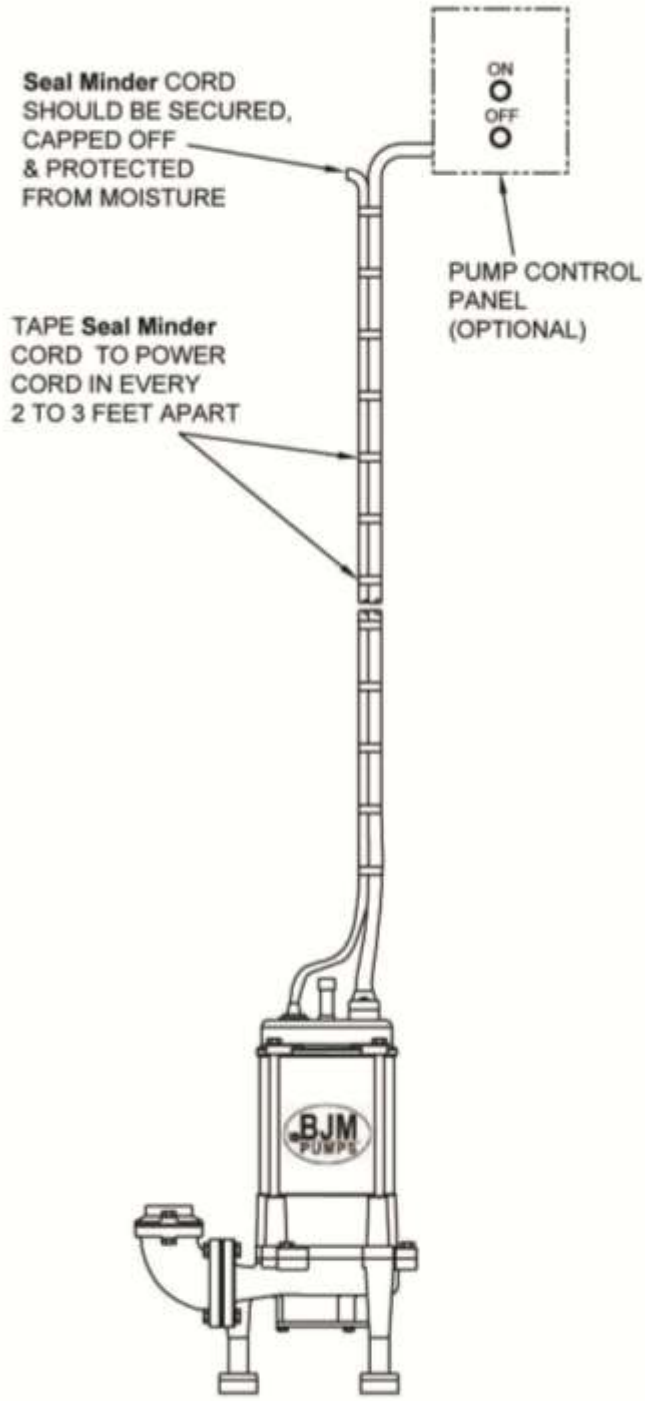
1. The recommended procedure is to take the **Seal Minder** cord off the pump and seal with a **Seal Minder** cap (P/N M02738) and gasket (P/N M05121 for Buna, P/N M05121V for FKM). This should be done by an authorized BJM Pumps service center or distributor as not to void warranty Detailed instruction sheet available for this procedure.
2. Alternate method of securing **Seal Minder** cable if not being used: Tape the **Seal Minder** cord to the power cord. Make sure that the cords are taped together in an even run, at about 2' to 3' apart. Use electrical tape to tape off the end of the **Seal Minder** cable (Do not connect to power source). The taped leads should be kept dry and out of the liquid. (See next page for detailed drawing.

Seal Minder CORD DIAGRAM

(**Seal Minder** CORD REQUIRES A SEAL FAIL CIRCUIT IN CONTROL PANEL FOR WARNING SIGNAL)



ALTERNATE METHOD OF SECURING **Seal Minder** CORD IF NOT USED



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

BJM Pumps, LLC - 123 SPENCER PLAIN ROAD, OLD SAYBROOK, CT 06475 - PHONE: 860-399-5937 - FAX: 860-399-7784

BJM PUMPS, LLC
123 Spencer Plain Road
Old Saybrook, CT 06475, U.S.A.

WARRANTY AND LIMITATION OF LIABILITY

Unless otherwise expressly authorized in writing, specifying a longer or shorter period, BJM Pumps,LLC warrants for a period of eighteen (18) months from the date of shipment from the Point of Shipment, or one (1) year from the date of installation, whichever occurs first, that all products or parts thereof furnished by BJM Pumps,LLC under the brand name **BJM Pumps**, hereinafter referred to as the "Product" are free from defects in materials and workmanship and conform to the applicable specification.

BJM Pumps,LLC's liability for any breach of this warranty shall be limited solely to replacement or repair, at the sole option of BJM Pumps,LLC, of any part or parts of the Product found to be defective during the warranty period, provided the Product is properly installed and is being used as originally intended. Any breach of this warranty must be reported to BJM Pumps,LLC or BJM Pumps,LLC's authorized service representative within the aforementioned warranty period, and defective Product or parts thereof must be shipped to BJM Pumps,LLC or BJM Pumps,LLC's authorized representative, transportation charges prepaid. Any cost associated with removal or installation of a defective Product or part is excluded.

IT IS EXPRESSLY AGREED THAT THIS SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF BJM PUMPS, LLC'S DISTRIBUTORS AND CUSTOMERS. UNDER NO CIRCUMSTANCES SHALL BJM PUMPS, LLC BE LIABLE FOR ANY COSTS, LOSS, EXPENSE, DAMAGES, SPECIAL DAMAGES, INCIDENTAL DAMAGES OR CONSEQUENTIAL DAMAGES ARISING DIRECTLY OR INDIRECTLY FROM THE DESIGN, MANUFACTURE, SALE, USE OR REPAIR OF THE PRODUCT, WHETHER BASED ON WARRANTY, CONTRACT, NEGLIGENCE, OR STRICT LIABILITY. IN NO EVENT WILL LIABILITY EXCEED THE PURCHASE PRICE OF THE PRODUCT.

THE WARRANTY AND LIMITS OF LIABILITY CONTAINED HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, EXPRESSED OR IMPLIED. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY BJM PUMPS, LLC AND EXCLUDED FROM THIS WARRANTY.

BJM Pumps,LLC neither assumes, nor authorizes any person to assume for it, any other warranty obligation in connection with the sale of the Product. This warranty shall not apply to any Product or parts of Product which have (a) been repaired or altered outside of BJM Pumps,LLC's facilities unless such repair was authorized in advance by BJM Pumps,LLC or by its authorized representative; or (b) have been subject to misuse, negligence or accident; or (c) have been used in a manner contrary to BJM Pumps,LLC's instruction.

In any case of products not manufactured and sold under the BJM Pumps,LLC brand name, there is no warranty from BJM Pumps,LLC; however BJM Pumps,LLC will extend any warranty received from BJM Pumps,LLC's supplier of such products.

START-UP REPORT FORM

This form is designed to record the initial installation, and to serve as a guide for troubleshooting at a later date (if needed).

BJM Pumps, LLC
123 Spencer Plain Road
Old Saybrook, CT. 06475

Pump Owner's Name	
Location of Installation	Date of Installation:
Dealer	Dealer Phone ( )
Date of Purchase	
Model	Serial No
Voltage Phase	Hertz HP
Does impeller turn freely by hand?	☐ Yes ☐ No
Condition of Equipment	☐ New ☐ Good ☐ Fair ☐ Poor
Condition of Cable Jacket	☐ New ☐ Good ☐ Fair ☐ Poor
Rotation: Direction of Impeller Rotation (viewed from bottom) (Use C/W for clockwise, CC/W for counterclockwise): _____	
Resistance of cable and Pump Motor (measured at pump control)	
Red-Black_____ohms Red-White_____ohms White-Black____ohms	
Resistance of ground circuit between control panel and outside of pumps _____ Ohms	
MEG OHM CHECK OF INSULATION Red to ground_____ White to ground_____ Black to ground_____	
Condition of location at start-up	☐ Dry ☐ Wet ☐ Muddy
Was equipment stored If YES, length of storage:	☐ Yes ☐ No.
Liquid being pump	
Debris in bottom of station?	☐ Yes ☐ No

START-UP REPORT FORM

Are guide rails vertical?	☐ Yes	☐ No
Is base elbow installed level?	☐ Yes	☐ No
Liquid level controls: Model_____		
Is control installed away from turbulence?	☐ Yes	☐ No

Float Operation Check

Tip lowest float (stop float), all pumps should remain off.
Tip second float (and stop float), one pump comes on.
Tip third float (and stop float), both pumps on (alarm on simplex).
Tip fourth float (and stop float), high level alarm on (omit on simplex).

☐ Check here if using manual on/off only.

Does liquid level ever drop below volute top?	☐ Yes	☐ No
Control Panel MFG & model no.		
Number of pumps operated by control panel		

NOTE: At no time should hole be made in top of control panel, unless proper sealing devices are utilized.

Short Circuit protection:	Type:	
Number and size of short circuit device(s)	Amp rating:	
Overload type:	Size:	Amp rating:
Do protective devices comply with pump motor amp rating?	☐ Yes	☐ No
Are all pump connections tight?	☐ Yes	☐ No
Is the interior of the panel dry?	☐ Yes ☐ No If No, correct moisture problem.	

Electrical readings

SINGLE PHASE

Voltage supply at panel line connection, pump off	L1	L2
Voltage supply at panel line connection, pump on	L1	L2
Amperage load connection, pump on	L1	L2

THREE PHASE

Voltage supply at panel line connection, pump off

L1-L2	L2-L3	L3-L1

Voltage supply at panel line connection, pump on

START-UP REPORT FORM

L1-L2	L2-L3	L3-L1
Amperage load connection, pump on		
L1	L2	L3

FINAL CHECK		
Is pump secured properly?	☐ Yes	☐ No
Was pump checked for leaks?	☐ Yes	☐ No
Do check valves operate properly?	☐ Yes	☐ No
Flow: Do pumps appear to operate at proper rate?	☐ Yes	☐ No
Noise level:	Acceptable ☐	Unacceptable ☐

Comments:

Installed by:

Company:

Person:

Date:

NOTES:

123 Spencer Plain Road • PO Box 1138 • Old Saybrook, CT 06475, USA
• Phone: (860) 399-5937 • Fax: (860) 399-7784
Email: sales@bjmcorp.com • Web Site: www.bjmpumps.com