City of Omaha

Post Construction Stormwater Management Planning

Guidance

October 2021

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is to provide guidance on the submittal and development of a Post-Construction Stormwater Management Plan (PCSMP). The City adopted ordinances requiring post construction stormwater management to comply with the requirements in their Municipal Separate Storm Sewer System (MS4) permit to establish such a program (Chapter 32, Article V). In addition to the stormwater ordinance, the City of Omaha has adopted the six Stormwater Management Policies developed with the Papillion Creek Watershed Partnership. These policies are referenced as the Stormwater Element in the City of Omaha's Master Plan. The intent of the program is to mandate the incorporation of stormwater best management practices (BMPs) in new developments and re-developments for water quality control of stormwater runoff.

It is important to note that a PCSMP is only one component of the City's current stormwater management program. In addition to the MS4 permit, the City must also meet the criteria set forth in their Combined Sewer Outfall (CSO) permit. Post construction stormwater management evolved as a program requirement in the MS4, but it applies throughout Omaha's corporate limits plus a 3 mile extra territorial jurisdiction (ETJ), i.e., it applies to areas covered by both the MS4 AND the CSO permit.

While this document focuses on the submittal and development of a PCSMP, it includes a summary of the basic stormwater management criteria that are part of the City's overall stormwater management program. This guide is laid out in two main parts: (1) That delineates steps and materials for submitting a PCSMP, and (2) lays out procedures for implementing the plan and maintaining compliance after construction.

1.2 Applicability

A Post Construction Stormwater Management Plan applies to new land development and significant redevelopment projects with the potential to add pollutants to stormwater or to affect the flow rate and velocity of stormwater runoff after construction is completed. Generally, **all projects that disturb more than 5000 square feet require a PSCMP**. New land development includes areas not previously built to urban uses (including but not limited to farmland, pasture, woodland, and green space). Significant redevelopment includes areas that are currently built to urban and suburban land uses, and are being revitalized with rehabilitation of existing structures, or demolition of existing structures and construction of new ones. It does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility or emergency redevelopment activity required to protect public health and safety.

In addition to applicable post construction stormwater management requirements, **new development or re-development projects discharging into the Municipal Separate Storm Sewer System (MS4 - generally west of 72nd Street) must maintain a "No Adverse Impact" condition**. As an example of no adverse impact, consider a previously undeveloped site. The designer must identify all areas where stormwater flows off the site and determine the 2-, 10-, and 100-yr discharge rate at each location. In many cases, the runoff is in a sheet flow condition. The designer may be able to maintain pre-project runoff rates through the use of a detention system, however, if there is no available storm sewer the outfall of that system becomes a point source discharge. The design engineer must take steps to ensure that no damage

occurs on the receiving property. In cases where runoff is flowing on to private property, the designer must obtain an easement from the adjacent property owner. Similarly, projects discharging to the Combined Sewer system (generally speaking, those east of 72nd Street) must control runoff such that there is no net increase in runoff from pre-development conditions as they existed in October 2002 for 2-, 10-, and 100-year storm events. In addition, the City of Omaha may require stormwater detention in areas where there is not adequate downstream sewer capacity. The applicant should meet with the City of Omaha Public Works Department to verify these requirements for each individual development.

A summary is provided on the following pages for your information: the "Stormwater Management Requirement Summary".

Table 1: Stormwater Management Requirement Summary

Stormwater Management Requirements in CSO Permit area (refer to Figure 1)

For all developments with preliminary plat approved by City Council before July 1, 2008 or significant redevelopment that disturbs 1 acre or more and does not require preliminary platting.

- PCSMP (control first ½" of runoff)
    - Reference: Chapter 32, Article V of the Omaha Municipal Code.
    - The PCSMP requirement exists in the CSO areas because once the sewers are separated; the area will then fall under the MS4 permit.

- Maintain pre-project conditions (as they existed in 2002) for 2-, 10- and 100-yr events.

    - This is a result of the requirement in the CSO Permit. One of the 9 minimum controls is "no increase in the magnitude, duration, or frequency of overflows". By maintaining pre-project runoff conditions, this provides engineers and the City a quantifiable means to ensure this requirement is met.

Stormwater Management Requirements MS4 Permit area (areas outside CSO service area)

For all developments with a preliminary plat, or a replat approved by City Council on or after July 1, 2008.

- **PCSMP (control first ½" of runoff)**

    - The PCSMP program is a result of the requirement in the City's MS4 permit to establish a Post Construction Stormwater Management Program.

    - Reference: Chapter 32, Article V of the Omaha Municipal Code.

- **Maintain pre-project conditions (as they existed in 2002) for 2-, 10- and 100-year events**.

- **Maintain "No Adverse Impact" condition**

    - The No Adverse Impact approach assures that the action of one property owner or a community does not adversely impact the properties and rights of other property owners, as measured by increased flood peaks, flood stage, flood velocity, erosion, sedimentation and costs now and costs in the future.

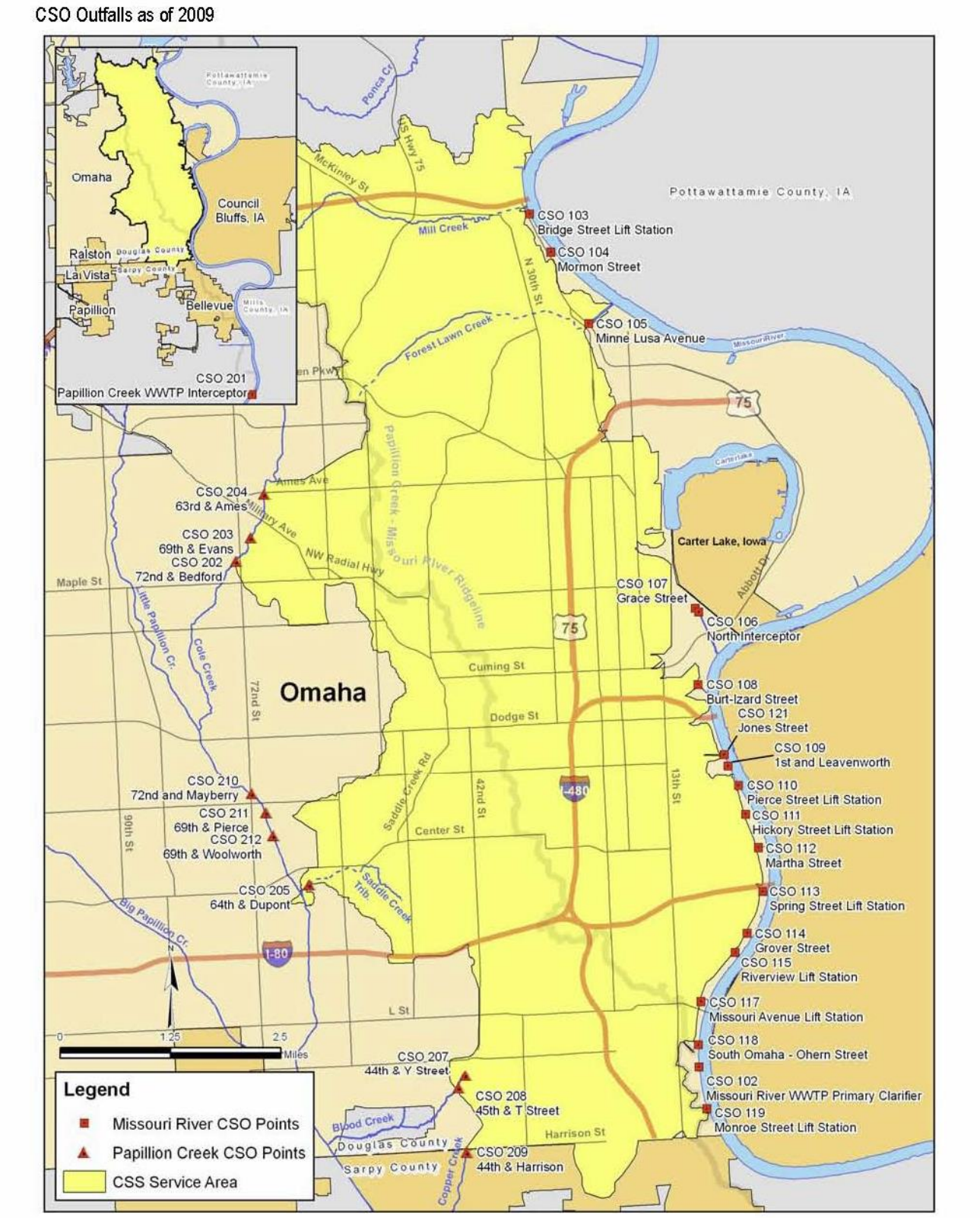


Figure 1: City of Omaha Combined Sewer Overflow Service area map.

2. POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN (PCSMP) SUBMITTAL

Per ORSDM 53-6, the PCSMP must be submitted at the time of the preliminary plat application. ***The PCSMP submittal must be uploaded to the City of Omaha's Permix system for review.*** In order for the preliminary plat application to be forwarded on to City Council, the (preliminary) PCSMP must meet certain minimum criteria, a list of which is included in Appendix E. Approved PCSMP documents will be required with the submittal of (1) storm sewer construction plans for subdivisions that have an approved preliminary plat, (2) a Grading Permit Application for projects that do not require a preliminary plat and disturb 1 acre or more of the site or (3) submittal of a Building Permit Application.

For convenience, communication, document submittal, and review of application material is all completed on the City of Omaha's Permix website. In the Permix system, there are 3 general stages of project review: the application phase, the document phase, and the construction phase. Certain materials and actions are required during each phase. Below is a summary of the elements that shall be submitted during each phase of the review process:

1. Application Phase
    - □ Project Number
    - □ Post-Construction Stormwater Management Plan Application
    - □ Applicant Certification
2. Document Phase
    - □ Drainage Study signed by a professional engineer licensed in Nebraska
    - □ Plan sheets with information pertinent to construction of the proposed BMP's
    - □ BMP calculations
    - □ Maintenance Agreement and Easement (Maintenance Agreement will be required before Final Plat or Certificate of Occupancy is approved)
3. Construction Phase
    - □ BMP Certification
    - □ As Built Drawings

Post-Construction Stormwater Management Plans shall be prepared by or under the supervision of a licensed professional civil engineer registered in the State of Nebraska or other professional approved by the City of Omaha Public Works Department. The responsible professional shall be listed as the "designer" on the Application and will be required to provide a seal on PCSMP sheets and calculations.

2.1 PCSMP Application

2.1.1 Project Numbers

The first step in the application is to obtain a project number for tracking. As of November 16, 2010, project numbers are generated automatically through the Papio Watershed Partnership's Permix website. If logging in for the first time, applicants will first need to set up an account and password.

http://www.omahapermix.com/

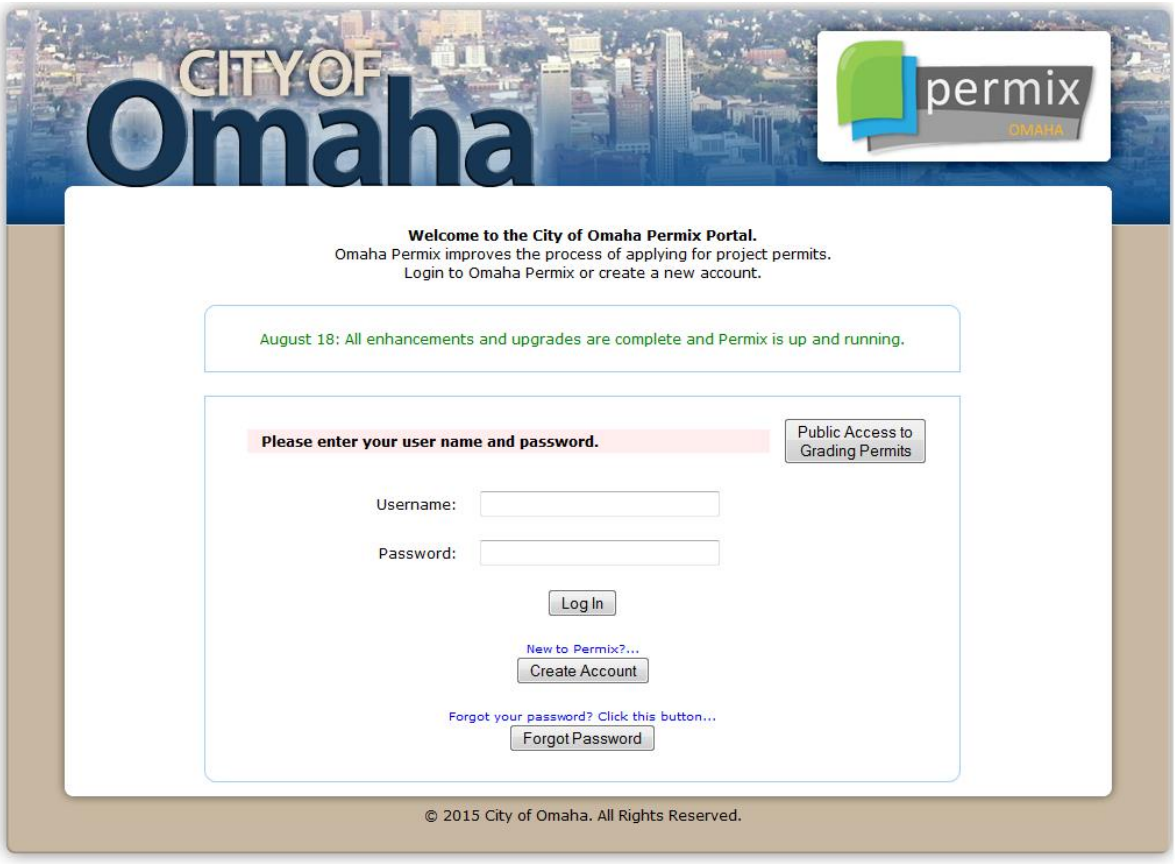


Figure 2: City of Omaha Permix Portal Log-in

The OMA Project Number assigned for the PCSMP submittal is required on the drainage study, plan sheets and all other related documents. If the applicant is preparing a preliminary plat, they must have a completed project application, a PCSMP application, and corresponding OMA number.

2.1.2 Application

The PCSMP application provides the reviewer with critical information about the new development that demonstrates responsibility for the site and an understanding of site conditions that will affect post construction stormwater management. Instructions are provided on the Application. Clear and concise presentation of this information will result in quicker review and fewer questions. It is important to include the following information on the Application:

- ☐ Name & Location

- ☐ Design firm and designer
- ☐ Project Description
- ☐ Existing site conditions
- ☐ Proposed site conditions, including BMP type and storage
- ☐ Applicant Certification Sheet

An application certification sheet can be found in the post-construction section at omahastormwater.org and is required to be signed by the preparer and submitted with the application.

2.2 PCSMP Supporting Documentation

Once the application is approved, the project designer may compile the necessary plans and documentation to submit a PCSMP. At a minimum, submitted PCSMP must include the following documents:

- ☐ Drainage Study
- ☐ Site Resource Plans
- ☐ BMP Plans & Calculations
- ☐ Maintenance Agreement & Easement

2.2.1 Site Resource Plan

- ☐ Existing topography (2' minimum contour interval)
- ☐ Vicinity Map
- ☐ Wetlands
- ☐ Open waterways with 50 acres of drainage or defined bed and bank
- ☐ Ponds or lakes
- ☐ Green space corridors
- ☐ General types of vegetation on site, excluding crops (e.g. tree canopy, turf grass, native grasses or other buffer, wetlands, etc.)
- ☐ Floodplain and floodway
- ☐ Steep slopes (greater than 17%)
- ☐ Utility lines, easements, water supply wells, and sewage treatment systems

2.2.2 Drainage Study

A drainage study including, but not limited to:

- ☐ Site map, include wetlands, open waterways, ponds or lakes and green space corridors
- ☐ Executive summary summarizing pre and post project conditions, hydrologic and hydraulic methodology and assumptions
- ☐ Existing topography (2' minimum contour interval)
- ☐ Proposed land uses/zoning in each drainage basin
- ☐ Drainage area maps and ***impact points*** for existing and proposed conditions. Basins must have unique label, runoff coefficient and drainage area.
- ☐ Sub-basin summary table showing area, land use, curve number, tc and other pertinent information
- ☐ Hydrology calculations, including a summary table of pre- and post-project runoff rates for the 2-, 10- and 100-yr storm ***at each impact point***.
- ☐ Floodplain and Floodway, if applicable

- ☐ Stream setbacks, if applicable
- ☐ Steep slopes (greater than 17%)Utility lines, easements, water supply wells, and sewage treatment systems

An example of good drainage study can be found in Appendix C of this document. Another drainage study checklist is available on the Omaha Stormwater website.

2.2.3 Construction & BMP Plans

Construction Plans:

- ☐ Proposed topography (2' minimum contour intervals)
- ☐ Location of proposed stormwater conveyance systems such as storm sewer, storm drains, grass channels, vegetated swales, and flow paths
- ☐ Proposed areas of fill placement and limits of construction
- ☐ Existing utilities and infrastructure
- ☐ Proposed utility lines, easements, water supply wells, and sewage treatment systems
- ☐ Design water surface elevations
- ☐ Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.
- ☐ Reference to the project geotechnical report (if applicable)
- ☐ Construction notes
- ☐ Other proposed infrastructure as it relates to the construction of the stormwater BMPs

Proposed BMP Plans:

- ☐ Proposed drainage basins labeled with an identifier, runoff coefficient, and drainage basin area (acres)
- ☐ Proposed land uses/zoning in each drainage basin
- ☐ Proposed stormwater BMPs including structural components and identifier that matches their drainage basin.
- ☐ Location of proposed stormwater conveyance systems such as storm sewer, storm drains, grass channels, vegetated swales, and flow paths
- ☐ Proposed areas of fill placement and limits of construction
- ☐ Proposed Storm Sewer Plan and Profile Sheets
- ☐ Other proposed infrastructure as it pertains to stormwater BMPs

Depending on the size and complexity of the project, the designer may elect to combine the components of the plan so long as all elements are represented and clearly identified.

2.2.4 BMP Calculations

This section of the PCSMP provides data and calculations supporting the selection and sizing of stormwater management structures.

1. Final sizing calculations for all stormwater BMPs. Calculating the volume of selected BMPs is simply based on the first one-half inch (0.5") of stormwater runoff. The drainage area to the BMP or series of BMPs is multiplied by 0.5" to determine the volume needed to be treated, referred to as the water quality control volume (WQCV). The following factors can be used to approximate the WQCV.

The first 0.5 inch of runoff will generate

- **1,815** cubic feet of water for 1 acre of area
- **42** cubic feet of water for every 1,000 square feet of area

2. For stormwater BMPs that provide treatment based on a flow rate, the Designer may submit calculations that demonstrate water quality flow rates that are equivalent to treating the first one-half inch (0.5") of stormwater runoff. On sites where the Rational Method is suitable and the time of concentration is 10 minutes or less, designers may use a 1.5 cfs/acre value to size flow based systems (Appendix 8-D, Omaha Regional Stormwater Design Manual). Designers may also use WinTR-55 to estimate flow rate, however, the model must show a correlation to a 0.5" runoff depth in the output report. Proprietary stormwater BMPs shall be pre-approved for use by the City of Omaha Public Works Department.

3. Final sizing calculations for structural stormwater management practices include contributing drainage area, storage or equivalent treatment flow rate, and outlet configurations as applicable. At a minimum, the following information should be provided for each BMP:

BMP Identification Number	**Type**	**Drainage Area (ac)**	**WQCV (cf) or Equivalent Treatment Flow Rate (cfs)**	**Design Volume (cf) or Equivalent Treatment Flow Rate (cfs)**

4. For projects that discharge into a combined sewer, the design must include the water quality volume or equivalent treatment flow rate plus any storage necessary to control runoff such that there is no net increase in peak runoff from pre-development conditions as they existed in October 2002 for the 2-, 10- and 100-year storm events. Documentation to support the final design volume and structural components shall be included in the submittal.

5. For projects that discharge into the municipal separate storm sewer system, designers must verify that the system has appropriate capacity, and follow the "No Adverse Impact" approach. (The no adverse impact approach assures that the action of one property owner or a community does not adversely impact the properties and rights of other property owners, as measured by increased flood peaks, flood stage, flood velocity, erosion, sedimentation and costs now and costs in the future.) Documentation to support the final design volume and structural components shall be included in the submittal.

2.2.5 Maintenance Agreement & Easement

Section 32-124 of the City of Omaha Municipal Code states, "the applicant or owner is required to execute an inspection and maintenance agreement, to be filed on record, binding on all subsequent owners of land served by a private stormwater management facility. Such agreements shall provide for access to the facility, at reasonable times, for inspections by the City or its authorized representative to ensure that the facility is maintained in proper working condition to meet design standards."

To ensure compliance with the municipal code, maintenance agreements for post construction stormwater BMPs must be documented. Such agreements shall document the responsibilities of the owner, the Home Owner's Association or other responsible party (for Sanitary Improvement Districts), and the City of Omaha. The maintenance agreement shall be approved by the Public Works Department as part of the PCSMP and recorded with the Register of Deeds. A sample copy of the Maintenance Agreement can be downloaded at https://omahastormwater.org/wpfd_file/pcsmp-maintenance-agreement/.

Maintenance Agreement exhibits shall include the following:

- Exhibit A – Real Property Depiction – Provide lot certificate or platted subdivision with legal description, or PCSMP plan sheet if that information is contained on the sheet already (11"x17") For above ground BMP's, an easement defined by a legal description must be included. The easement must allow for access on all sides of the selected BMP.
- Exhibit B – BMP Maintenance Requirements including site information, BMP information and a description and schedule of maintenance and repair tasks for each BMP. These requirements guarantee that the system will continue to function properly.

2.3 PCSMP Construction & Certification

At this time, while the rest of the PCSMP is prepared, a building permit may be issued. This is achieved by submitting a letter to the City requesting a Hold on the Certificate of Occupancy (CO) until such time as the PCSMP is approved. An example of a CO Hold letter is provided in Appendix A and the Performance Bond Form can be found in Appendix B.

2.3.1 As-Built Drawings & BMP Certification

Upon construction completion, all stormwater BMPs that are part of the Final Post-Construction Stormwater Management Plan shall be certified by a licensed professional civil engineer registered in the State of Nebraska or other professional approved by the City of Omaha Public Works Department, the Designer.

a. Record Drawings of the Final Post-Construction Stormwater Management Plan Sheets with "As-Built" stamp, date, and name of engineer. **Any change in the function of a BMP, whether volume, capacity, release rate, etc. must be verified and documentation included with the as-builts.**
b. BMP Certification Document

The BMP Certification document can be found at www.omahastormwater.org. This document also provides space for indicating the inspector and inspection report holder as part of the annual monitoring requirements for the BMPs.

2.3.2 Maintenance Inspection Sheets

Section 32-124 of the City of Omaha Municipal Code states, "The owners and occupants of lands on which post-construction BMPs have been installed to meet the requirements of this chapter shall ensure the maintenance of these BMPs and shall themselves maintain those BMPs if other persons or entities who are also obliged to maintained those BMPs (by contract or covenant, or pursuant to this chapter) fail to do so. BMPs shall be inspected or reviewed as appropriate at least annually, and a written record of inspection results and any maintenance work shall be maintained and available for review by the City." Annual review and inspection of BMPs shall be done by a professional qualified in stormwater BMP function and maintenance. Information on the Inspector that will provide annual review and inspection of BMPs and the holder of the annual inspection report shall be provided on the BMP Certification Form.

Prior to annual review and inspection by the city, BMP inspection forms must be completed and sent to Omaha EQC Environmental Inspectors ***upon request***. A cover sheet is required for all post construction sites along with one form corresponding to each type of BMP installed at the site. The following is a list of inspection forms:

- PCWP Annual Inspection Form Cover Sheet
- PCWP Bioretention System Annual Inspection Form
- PCWP Bioswale Annual Inspection Form
- PCWP Hydrodynamic Separator Annual Inspection Form
- PCWP Level Spreader Annual Inspection Form
- PCWP Underground Detention Annual Inspection Form
- PCWP Dry Detention Basin Annual Inspection Form
- PCWP Other BMP Annual Inspection Form

These forms are available online at https://omahastormwater.org/?s=Inspection. If the PCSMP includes a BMP type that does not a have a specific form, the project manager may describe it in the "Other BMP" inspection form.

3. BMP DEVELOPMENT GUIDELINES

3.1 Site Evaluation

In developing a PCSMP it is important to characterize and evaluate the site. Information obtained during the site assessment enables the applicant and their consultant to assess site conditions that will contribute to an effective post construction stormwater management plan. A complete evaluation shall include consideration of limitations and advantages of each individual site. This process will enable the selection, sizing and siting of practices that address the unique circumstances of a site.

The development of the Post Construction Stormwater Management Plan must be initiated in the early stages of site planning and design. However, before a stormwater management plan can be developed, defining site conditions must be completed by conducting a site assessment. The data collected during the site assessment will be used for describing site conditions, including vegetation, soils and drainage patterns. When this information is obtained, appropriate stormwater BMPs can be selected, located, sized, and designed.

The following data should be collected, to the extent practical, during the development of the PCSMP:

Natural Resources: The development site's natural resources, including vegetative communities, soils and geology, and aquatic resources need to be determined to assist in stormwater management plan development and is part of the permit application. Important data includes wetlands, riparian (stream) corridors, native prairie and/or woodland. Natural resources should be assessed by trained professionals.

Site topography: Topography dictates how and where water will drain from a site. On steeper sites, stormwater will runoff more rapidly, with less infiltration and greater volume. Stormwater management requirements are substantially different than for more gently rolling or flat sites.

Soils: Soil information is important for development of the stormwater management plan, and for optimal planning of the new community. Soil depth, texture (sand, silt, and clay content), and structure are important factors that will provide understanding of infiltration capacity (permeability), ability to support vegetation, and erodability. Engineering qualities and limitations of the soil are important for determining where structures can be placed, how stormwater runoff can be managed, and possible limitations for underground utilities. If hydric soils are present, it is important to understand limitations of building in these areas. Much of the information can be obtained from a USDA County Soil Survey, but an on-site soil assessment is recommended.

Aquatic Resources: The identification of streams, ponds, and lakes as receiving waters and as an integral part of the stormwater management plan is critical. Understanding the function of these water bodies, their current condition, and potential impacts from proposed development may influence your choice of stormwater BMPs. The identification of these resources may also be necessary to comply with local, State and Federal regulations.

3.2 BMP Selection

Chapter 8 of the Omaha Regional Stormwater Design Manual provides information about BMPs most often used for control and treatment of stormwater, including minimum control requirements, site design feasibility, conveyances issues, pre-treatment requirements, and other design criteria for stormwater quality. Allowable practices are not limited to what is included in Chapter 8 of the Omaha Regional Stormwater Design Manual and can be selected from other acceptable design manuals.

The stormwater BMPs listed in Chapter 8 emulate natural systems by integrating a variety of dispersed treatments at multiple scales, from backyard rain gardens to district-level bioretention basins (Table 1). They are widely applicable in both urban and rural environments. These treatments can be designed into new developments or retrofit into existing community open spaces, parks, road rights-of-way, side and rear areas of homes and commercial buildings, rooftops of structurally adequate buildings, below parking lots and in many other settings. All aspects of stormwater management can be integrated to contribute to positive community aesthetics and economics.

Stormwater BMPs include a variety of methods that are simple and practical in design, yet provide effective stormwater management as well as aesthetic enhancements for urban, suburban, and rural landscapes. These methods can be cost effective to build while providing long-term sustainability for City infrastructure and conservation of Omaha's water resources.

Typical BMP's and recommended design guidelines are:

- Infiltration (rain gardens, bioretention gardens, swales, green space)
    - Sod on fill not considered infiltration area.
    - If using green space, test the permeability of the soil.
        - Recommended infiltration rate: ~0.5 inches/hour.
- Water Quality Detention (wet and dry detention)
    - 24-40 hour drawdown
    - Forebay recommended
    - Floatable capture recommended if feasible
- Green Roof
- Pervious Pavement or Permeable Pavers
- Hydrodynamic Separators
    - 80% TSS removal efficiency
- Subsurface Storage
    - Analyze as detention basin
- Inlet Filters, Roof Drain Filters
    - 80% TSS removal efficiency
- Conditioned Soil
    - Based on 2" of compost tilled in to the top 6" of in situ material. May claim 10% of volume for storage

Table 2: Suitability of BMP applications at multiple planning and management scales

BMP	Development Density				
	Parcel		Block	Neighborhood	Transportation Corridor
	Residential	Commercial/ Governmental			
Bioretention System		X	X	X	X
Retention Wet Ponds		X	X	X	X
Extended Dry Detention Basin		X	X	X	X
Filter Strip	X	X	X	X	X
Grassed Swale	X	X	X	X	X
Green Roof	X	X			
Infiltration Trench	X	X	X		X
Permeable Pavement	X	X	X	X	X
Rain Garden	X	X	X		
Subsurface Storage		X			X
Vegetated Bioswale	X	X	X	X	X
Hydrodynamic Separators		X			X
Roof Drain Filters[1]		X			
Manufactured System		X	X	X	X
Constructed Wetland		X	X	X	
Sand Filter		X	X	X	X
Permeable Pavers	X	X	X	X	
Level Spreader		X			X
Disconnected Impervious Cover		X			
Other (flow-based)		X			
Other (volume-based)		X			
Rain Barrel/Cistern	X				
Soil Conditioning	X	X	X	X	X

[1]Use of in line roof drain filters must be approved by the Permits and Inspection Department.

3.3 Scheduled Maintenance Plans

According to Omaha Municipal Code, owners are required to take care of stormwater BMP maintenance. Maintenance requirements will change depending on the BMP and over time, however all BMPs will require routine maintenance. One should be prepared to develop a maintenance plan that includes, but is not limited to, the following tasks:

- Removing trash and debris on a monthly basis.
- Regularly inspecting inlets, outlets, and collection systems for proper functioning and promptly repairing or replacing broken/malfunctioning infrastructure.
- Watering vegetation as needed. This will be much more important when they are young and during warmer months. After the first year, this may not have to be done.
- Eliminating weeds and non-native/invasive species when needed. Use of herbicide should be done on a spot basis and in combination with other methods as to prevent.
- Inspecting vegetation for health.
- Mowing turfgrass as needed.
- Ensuring soils are draining properly and replacing poorly draining soils as needed.
- Removing accumulated sediment as needed.

Chapter 8 of the Omaha Regional Stormwater Design Manual includes a lists of scheduled maintenance tasks specific to each BMP type that can help one prepare a maintenance plan.

4. ADDITIONAL RESOURCES

Below are some resources that provide guidance and assistance in implementing stormwater BMPs on new development and redevelopment:

Omaha Regional Stormwater Design Manual. April 2014. Fundamental requirements for stormwater management in the Omaha region are provided in this document. Chapters 2, 6 and 8 are specifically cited as relevant to Post-Construction Stormwater Management. The document can be downloaded at https://omahastormwater.org/orsdm/.

Omaha Municipal Code. *Chapter 32: Stormwater Management Ordinance* discusses post-construction stormwater management requirements pertaining to new construction. https://library.municode.com/ne/omaha/codes/code_of_ordinances?nodeId=PTIIIMUCO_CH32STMAOR

Papillion Creek Watershed Management Plan. This site provides resources that provide additional resources, watershed policy considerations and documents. http://www.papiopartnership.org.

The Stormwater Manager's Resource Center. This site provides a wide variety of resources for stormwater management planning and implementation. http://www.stormwatercenter.net/.

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices. December 2007. EPA 841-F-07-006. United States Environmental Protection Agency, Nonpoint Source Control Branch (4503T), 1200 Pennsylvania Ave., NW, Washington, DC 20460

Low Impact Development Center. This site provides several resources and links to aid in the planning and design of stormwater quality BMPs. http://www.lowimpactdevelopment.org/index.html.

Urban Design Tools - Low Impact Development. This site provides watershed managers with a new set of tools and techniques that can be used to meet regulatory and receiving water protection program goals for urban retrofits, re-development projects, and new development sites. http://www.lid-stormwater.net/.

Stormwater BMPs – Selection, Maintenance, & Monitoring. England, Gordon and Stewart Stein, 2007, Forester Press, Santa Barbara, California. This book describes stormwater pollutants, pollutant removal mechanisms, BMP selection criteria, types of BMPs, maintenance of BMPs and monitoring.

Bioretention Gardens, a Manual for Contractors in the Omaha Region to Design and Install Bioretention Gardens. 2009. Hartsig and Rodie. The City of Omaha produced this manual to provide technical design guidelines for bioretention gardens and is written specifically for the Omaha region. These manuals are available at the Douglas County Extension Office.

American Public Works Association 5600 Stormwater BMP Guidance. This document provides detailed information about stormwater management planning and design, including determining the best approach for attaining stormwater discharge requirements. The document can be downloaded at http://www.marc.org/environment/Water/bmps.htm.

Better Site Design: A Handbook for Changing Development Rules in Your Community. 1998. Center for Watershed Protection

Hydraulic Design of Energy Dissipaters for Culvers and Channels. Kilgore, Roger and Thompson, Phillip, 2006. Hydraulic Engineering Circular Number 14 Ed. 3. Design for riprap aprons and other dissipation structures. https://www.fhwa.dot.gov/engineering/hydraulics/pubs/06086/hec14.pdf

Urban Drainage and Flood Control District Reference Library. A library of useful documents, presentations, and technical papers relating to stormwater and flood management. https://udfcd.org/library

Appendix A

Date:

Selma Kessler
Environmental Quality Control Division
City of Omaha
5600 South 10th Street
Omaha, NE 68107

RE: Project Name:
P & I Number:
Project Address:

Ms Kessler:

I am requesting that the Permit and Inspection Department of the City of Omaha hold all full, partial and/or temporary certificates of occupancies (C.O.'s) for building permit number BLD-_____. The C.O.'s will he held until all required paperwork for Post Construction Stormwater Management Plan number OMA_____-P has been submitted to the satisfaction of the Public Works Department. The information to be filed would include the following:

1. Applicant Certification
2. Drainage Study
3. Plan Sheets pertinent to the selected best management practices (BMPs)
4. Recorded Maintenance agreement/easement
5. BMP Certification Statement signed by a licensed Professional Engineer
6. As Built Drawings (information pertaining to the BMPs only)

The supporting documentation will include all items necessary by the Public Works Department (executed permits and approvals from all impacted governmental agencies; executed easements; inspection reports; etcetera).

All information will be submitted via the City of Omaha's Permix system (omahapermix.com)

Sincerely,

(Project Applicant)

Appendix B

Performance Bond

KNOW ALL MEN BY THESE PRESENTS: That _____

_____

as principal, and _____

_____, as surety, are held and firmly bound unto the City of Omaha, Nebraska, in the penal and full sum of _____ Thousand Dollars ($_____), for the payment of which well and truly to be made we hereby jointly and severally bind ourselves, our heirs, executors, administrators, personal representatives, successors and assigns.

The conditions of the above obligation are such that, whereas the above bounden principal has applied for a Certificate of Occupancy, for the property located at _____ Omaha, Nebraska, prior to the installation of _____

_____

_____

as required by the Ordinances, Rules and Regulations of the City of Omaha, and other laws. That said Certificate must be obtained prior to occupancy of the property.

NOW, THEREFORE, in consideration of a Certificate of Occupancy being issued, said principal shall:

1) Complete the required installation of _____

_____

_____ by the ___ ____ day of _____, 20_____.

2) Indemnify and save harmless the City of Omaha, its officials, employees, and any members of the applicable Department or Board, and their successors, from and on account of any and all judgments, claims, demands, losses, costs, expenses, or liabilities of any kind whatsoever which said City and any or all of the persons above enumerated may sustain or which may be recovered from it or them, from or by reason of the issuance of such Certificate, or by reason of any act, neglect or thing done under or by virtue of the authority given in any such Certificate, or in any way connected with, relating to, or growing out of any work performed by said principal, his or its agents and employees, or any sub-contractor or anyone in any way under his or its supervision and direction.
3) In all respects be bound hereby to any and all applicable requirements and provisions required to be in this bond by existing and hereafter existing Ordinances, Rules and Regulations of the City of Omaha, and other laws, the same as though such requirements and provisions were fully set forth in this bond, and by reference such requirements and provisions are made a part hereof;
4) Comply with and faithfully observe and obey all applicable Rules and Regulations and Ordinances of the City of Omaha now or hereafter existing and all other applicable laws now or hereafter existing affecting or relating to the issuance of the Certificate of Occupancy.
5) Pay all damages or loss that may occur from any act, neglect, or carelessness of said principal, his or its agents or employees, anyone under his or its supervision or direction, or any subcontractor, from such work pertaining to said Certificate of Occupancy, or from poor or defective work or material;
6) Properly perform and execute and fully protect any and all work undertaken by principal or under his or its direction and supervision, or by any agent or employee, or by any subcontractor.

Compliance with all and several of the above enumerated items shall make this bond void. Otherwise, it shall remain in full force and effect within the City of Omaha, Nebraska.

IN WITNESS WHEREOF, we have hereunto set our hands this _____ day of _____, 20_____.

In Presence of

_____

_____

Principal

Address of Witness _____

_____

_____

Street

_____

_____

Surety

_____

City State Zip

_____

Attorney-In-Fact

APPROVED AS TO FORM:

_____

_____

Resident Agent

_____

Assistant City Attorney

Appendix C

DRAINAGE STUDY

November 2017

(Revised 02-20-18)

engineering
& surveying

JCC Omaha
333 South 132nd Street, Omaha, NE

EXECUTIVE SUMMARY

This drainage study was prepared for the proposed construction of an outdoor pool area, and proposed building additions located at 333 South 132nd Street in Omaha, Nebraska. The project is expected to occur in two (2) separate phases. Phase 1 consists of the removal of existing sports courts and replacing them with a new outdoor pool area. The approximate disturbed area for Phase 1 is 2.27 acres, of which 0.23 acres will drain directly to the sanitary sewer (due to pools). Phase 2 will consist of the elimination of the existing pool area along with the additions to the main building and childhood development center that will encompass approximately 32,861 sq. ft. of new impervious area. Storm water run-off from the project site will be collected via grate inlets, storm sewers and swales then directed through one of two hydrodynamic separators before discharging into a proposed detention basin in the southeast corner of the site. The detention basin will discharge into the existing public storm sewer system located in S 129th Street. Since this project will add and/or disturb more than 5,000 square feet it falls under the City of Omaha's definition of "significant re-development", therefore, per the City of Omaha Regional Storm water Design Manual (ORSDM) the first half-inch (or 1.5 cfs per acre) must be treated from all disturbed areas and no net increase in peak run-off is permitted.

Existing Conditions

Although the total property area is approximately 29.1 acres, the project site is predominately located on the eastern portion of the developed part of the property. The project site area (phases 1 & 2) encompasses approximately 2.27 acres that is currently comprised of parking, sports courts, outdoor pools and landscaped areas. Drainage within the project area is primarily from northwest to southeast and is handled via grass swales and private storm sewer. Flows from the site storm sewer and primary (southern) swale are discharged through the existing manhole/grate inlet located near the southeast corner of the property (Impact Point #1). Impact Point #1 (IP#1) is where flows from the JCC property discharge into the City's storm sewer and public Right-of-Way for S 129th Street.

Existing slopes within the project area range from ~<1.00% to ~30.00%, with the steeper slopes occurring around the southeast corner of the site.

There are five (5) primary existing drainage areas. Area E1 is approximately 0.57 acres and drains east into the on-site storm sewer prior to entering the drainage swale on the south edge of the site. Area E2 is approximately 1.10 acres and drains south into the on-site storm sewer prior to entering the drainage swale on the south edge of the site. Area E3 is approximately 0.71 acres and drains southeast into the on-site storm sewer prior to entering the drainage swale on the south edge of the site. Area E4 is approximately 1.45 acres and drains southeast into the on-site storm sewer prior to entering the drainage swale on the south edge of the site. Areas E1, E2 and E3 contain the existing tennis courts and parking areas to be replaced by the proposed outdoor pool and associated parking. Area E4 contains the existing outdoor pool. Area E5 is approximately 13.06 acres and drains south into the existing swale along the south edge of the property. Area E5 is primarily to remain undisturbed other than the grading required for the proposed detention basin and primarily contains pervious areas. The existing site has approximately 36% of impervious coverage (Areas E1:E4 85%, Area E5 22% calculated from Douglas County GIS data). The pervious areas of the site are generally in good condition. **Appendix A** contains a copy of the existing drainage map.

Proposed Conditions

This project involves the construction of an outdoor pool area, with plans for future building additions. The approximate size of the pool area is approximately 0.94 acres, of which 0.23 acres will drain directly to the sanitary sewer (due to pools). The proposed building additions (Phases 1 & 2) will encompass approximately 32,861 sq. ft. The total increase of impervious coverage after construction will be approximately 16,000 sq. ft. (this accounts for elimination of existing outdoor pool). Under proposed conditions there are five (5) drainage areas, A1 through A3, B1 and B2. Area A1 is approximately 1.32 acres and includes mostly parking on the north side of the site. Area A2 is approximately 0.87 acres that includes 0.23 acres of pool area (drains to sanitary sewer), outdoor pool deck and some landscaped areas. Area A3 is approximately 1.63 acres and contains the proposed building additions as indicated on the drainage map. Area B1 is approximately 12.96 acres and contains primarily pervious areas. Area B2 is approximately 0.18 acres and consists of mostly impervious areas that enter the private storm sewer and discharge directly into the public storm sewer system.

The proposed site is calculated to have 37% of impervious coverage (Areas A1:A2 88%, Area A3 79%, Area B1 22% calculated from Douglas County GIS data, Area B2 95%). The developed drainage areas are shown on the Drainage Map (**see Appendix A**).

Per the ORSDM the initial 0.5-inch of run-off from all disturbed areas (or 1.5 cfs per disturbed acre) must be treated as well as maintaining no net increase in peak discharges associated with the re-development. Based on these requirements, the treatment rate for this project (Phases 1 & 2) is 3.41 cfs (2.27 Ac. * 1.5 cfs/Ac). Due to site limitations, hydrodynamic separators (Hydro-International Model FD-4HC) have been specified to meet the City's treatment requirement of 1.5 cfs per disturbed acre. One system will be constructed as part of the Phase 1 pool and parking lot improvements while the second one is anticipated to be installed as part of the Phase 2 main building addition. Building additions shown on the Children's Development Center are not anticipated to be built as part of the main building Phase 2 construction; however, for planning purposes the building areas indicated on the drainage map have been accounted for in both treatment and detention in this PCSMP. The total treatment capacity for the specified hydrodynamic units is 3.76 cfs (1.88 cfs per unit).

To mitigate the impacts of the additional impervious surfacing from the pool and building addition projects, a 8,100 cu. ft. detention basin is proposed at the property's existing outlet location (IP#1). Discharge from the detention basin will be regulated via an orifices (that will be cut into the side of the existing outlet structure) as well as through the existing grate and overflow weir that currently exists. This detention volume was determined based on the analysis of the Phase 1 & 2 disturbed areas only since the overall SCS Curve Number (CN) value for IP#1 does not change based upon the limited amount of impervious coverage being added as compared to the overall size of the drainage area discharging to IP#1 (16.89 ac.).

The proposed detention basin design was performed by evaluating only the 2.27 acres associated with Phases 1 & 2 and analyzing that system as if it were functioning independently. Once the size of the basin was determined in this manner, an analysis was then performed on the basin with all applicable IP#1 flows being routed through it to check how it would function. As Table 1 illustrates the proposed basin is adequate to mitigate the peak flow impacts associated with Phases 1 & 2 for the 2, 10 & 100 year events when looked at independently. However, when all flows to IP#1 are introduced into the proposed basin only the 2 and 10 year events can be regulated to keep discharges at or below existing rates (See Table 2). Therefore, unless the existing 18-inch pipe (and related downstream pipes) is upsized or a substantially larger detention basin, than what is necessary to mitigate the Phase 1 & 2 impacts, is constructed the existing (or proposed) property discharges cannot be regulated to control the 100 year discharges. Based on the information noted above, it is TD2's opinion that under the scope of this project detention is being provided to the "maximum extent practical".

Run-off Summary

Design and analysis of the storm sewer system was based upon requirements outlined in the ORSDM. AutoCAD Civil 3D's Hydraflow Hydrographs Extension (2017) software using SCS Method (Type II) was used to evaluate the detention and discharge requirements for the site. Overland flow, from larger storm events, which cannot be handled by the on-site storm sewer system, will continue to flow along historic routes which is generally to the south and east side of the site where it enters a grass drainage swale that ultimately discharges at the existing area inlet and/or onto the S 129th Street R.O.W. The total calculated peak flow to Impact Point #1 during a 100-year event (using Rational Method) is approximately 80 cfs which is less than the calculated capacity of 90 cfs for the grass swale.

The following **Table 1** summarizes the pre-developed and post-development run-off anticipated from the 2.27 acres of Phase 1 & Phase 2 only. For the purposes of pre-vs-post comparison only, this detention analysis is based on assumption that only the 2.27 acres is regulated through the proposed detention basin:

TABLE 1 – Phase 1 & Phase 2 Only

	SCS METHOD		
	2 Year (cfs)	10 Year (cfs)	100 Year (cfs)
Existing Conditions (Site - E1:E4)	13.38	22.48	34.26
Developed Conditions (Site - A1:A3)	13.27	22.26	33.90
Developed Conditions w/ Detention (Site – B2, Basin Outflow)	12.16	19.89	31.77

Appendix B includes output information from the Hydraflow Hydrographs software.

The following **Table 2** summarizes the pre-developed and post-development run-off anticipated from all areas flowing to Impact Point #1 and accounts for the proposed 8,100 cu. ft. of detention being provided:

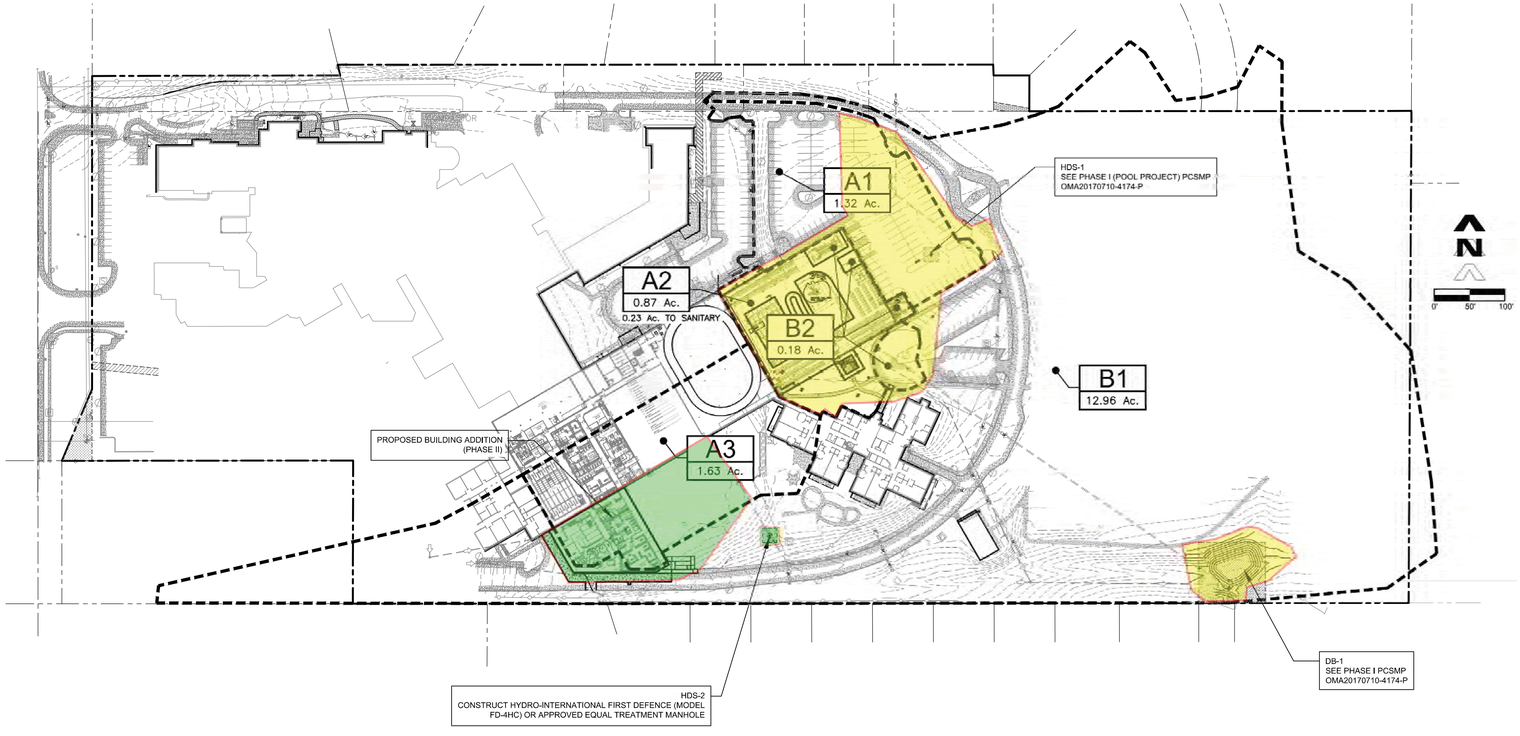
TABLE 2 – Phase 1 & Phase 2 with all other flows to Impact Point #1

	SCS METHOD		
	2 Year (cfs)	10 Year (cfs)	100 Year (cfs)
Existing Conditions	17.77	34.51	N/A
Developed Conditions	18.06	34.86	N/A
Developed Conditions w/ Detention	16.60	33.52	N/A

Note: The discharge rates indicated in Table 2 are based upon a 10-foot Cipoleti overflow weir that is anticipated to be further defined into the existing overflow that currently discharges into the S 129th Street right-of-way at IP#1

Appendix C includes output information from the Hydraflow Hydrographs software.

APPENDIX A
Drainage Maps



APPROXIMATE LIMITS OF PHASE 1

APPROXIMATE LIMITS OF PHASE 2

STRUCTURE TABLE		
STRUCTURE NAME	ELEVATIONS	LOCATION TO CENTER OF STRUCTURE
HDS-2 HYDRO-INTERNATIONAL MODEL FD-4C OR APPROVED EQUAL. CONSTRUCT OVER EXISTING 15" STORM SEWER	RIM: 1182.5 I.E. 15"=1176.2(NW) I.E. 15"=1175.8(SE)	N: 108560.76 E: 113126.09

NOTE: INVERT ELEVATIONS MUST BE FIELD VERIFIED PRIOR TO ORDERING HDS UNIT. VALUES PROVIDED ARE ESTIMATED BASED ARE CALCULATED PIPE SLOPE.

REFER TO OMA20170710-4174-P FOR PHASE I & II PCSMP INFORMATION REGARDING DETENTION, DRAINAGE STUDY ETC.

PCSMP CONSTRUCTION NOTES:

1. CONTRACTOR SHALL SUBMIT DETAILED SHOP DRAWINGS OF PROPOSED VORTEX TREATMENT SYSTEM PRIOR TO STARTING CONSTRUCTION.
2. CONTRACTOR MUST NOTIFY ENGINEER A MINIMUM OF 48 HOURS PRIOR TO STARTING CONSTRUCTION OF PCSMP ELEMENTS IN ORDER TO PROVIDE ENGINEER WITH OPPORTUNITY TO OBSERVE CONSTRUCTION. CONTRACTOR'S FAILURE TO PROVIDE PROPER NOTICE AND COORDINATION WITH ENGINEER MAY RESULT IN DELAYS IN OBTAINING CITY MANDATED PCSMP "CERTIFICATION", WHICH IMPACT CONTRACTOR/OWNER'S ABILITY TO OBTAIN BUILDING CERTIFICATION OF OCCUPANCY.
3. PRIOR TO FINAL APPROVAL OF PCSMP AND OWNER ACCEPTANCE OF PROJECT, THE CONTRACTOR SHALL REMOVE ALL SILT, DEBRIS, AND/OR OTHER MATERIALS FROM ALL ON-SITE STORM SEWER INLETS, PIPE, AND PCSMP ELEMENTS. PHOTOGRAPHIC/VIDEO DOCUMENTATION OF THE CLEANED SYSTEM IS STRONGLY RECOMMENDED.

POST CONSTRUCTION BMP'S

BMP IDENTIFIER	TYPE OF BMP	LONGITUDE / LATITUDE
HDS-2	HYDRODYNAMIC SEPARATOR (FD-4HC)	N41.256175, W96.115875

PERMANENT POST CONSTRUCTION STORMWATER MANAGEMENT EASEMENT NO. _____ OF THE DOUGLAS COUNTY RECORDS.

OMA-20171122-4366-P
SHEET 1 OF 1

Nebraska811 Know what's below. Call before you dig.

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thompson, dreessen & dorner, inc.
10836 Old Mill Rd
Omaha, NE 68154
p.402.330.8860 www.td2co.com

Project Name
JCC OMAHA

JCC OMAHA PHASE II RENOVATIONS

333 S. 1323ND STREET
OMAHA, NE

Client Name
The Staenberg Group/ Farnsworth Group

Professional Seal

Revision Dates

No.	Description	MM-DD-YY
1	CONSTRUCTION SET	02-15-18
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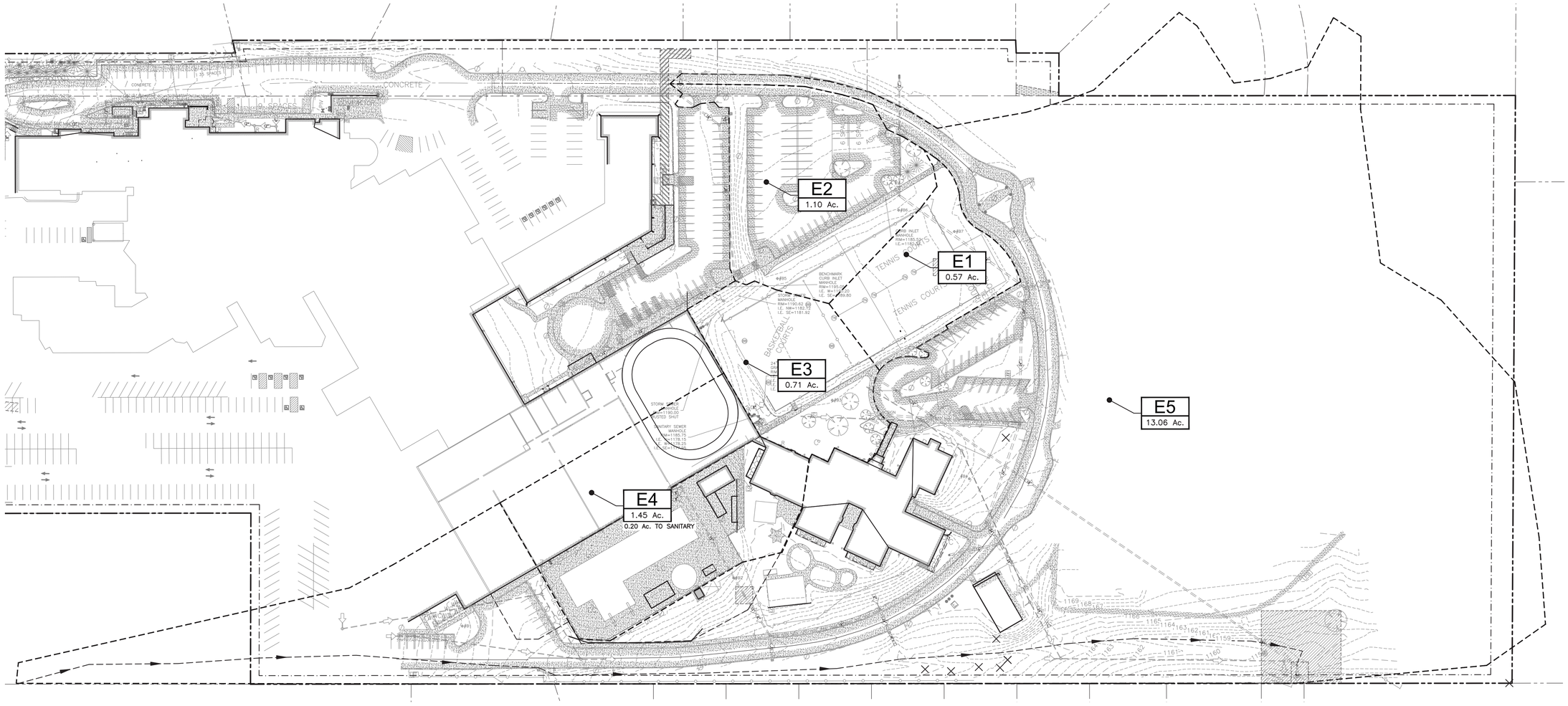
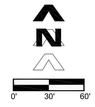
Drawn By: JJP Reviewed By: GAN
Job No.: 2070-101 Date: 01-26-18

Sheet Title
P.C.S.M.P
PHASING EXHIBIT

Sheet Number
EXH-1





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Project Name

JCC Omaha

Client Name

The Staenberg Group/ Farnsworth Group

Professional Seal

Revision Dates

No.	Description	MM-DD-YY
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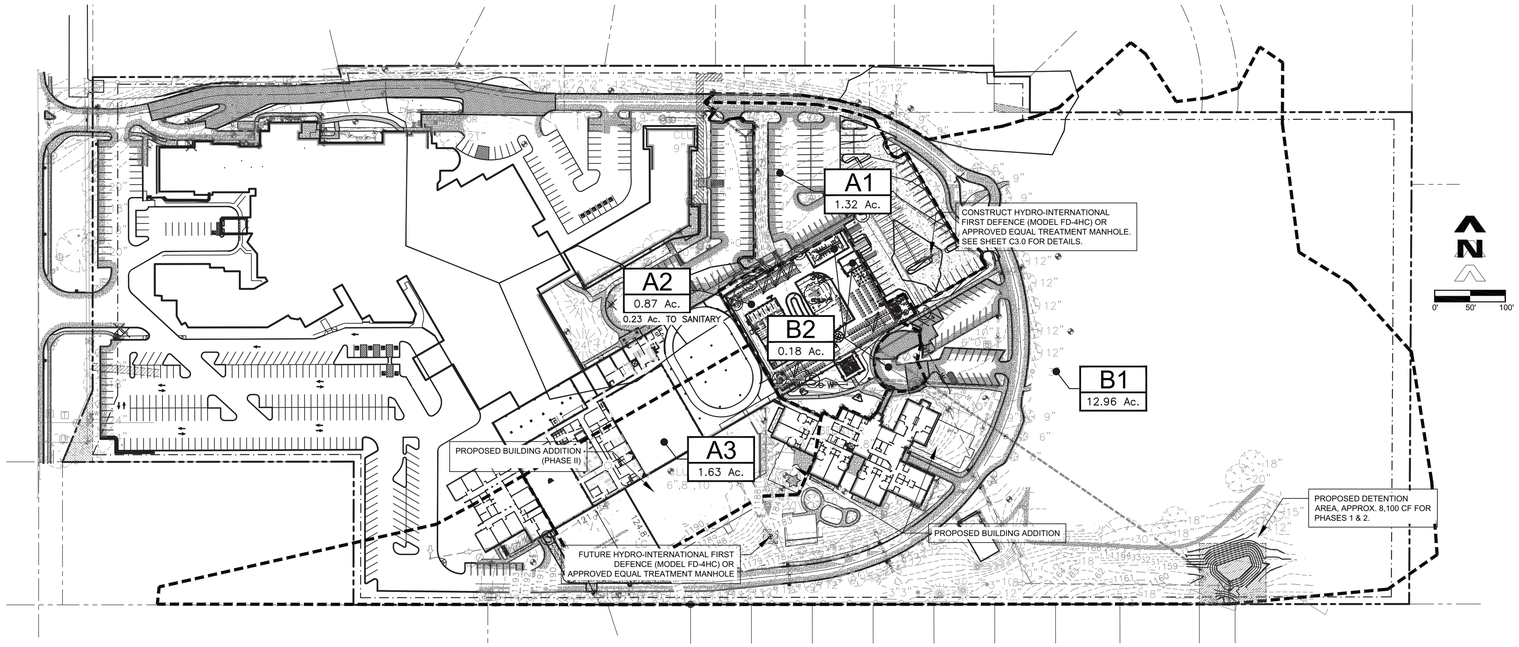
Drawn By: MGG Reviewed By: GAN
Job No.: 2070-101 Date: 11-3-17

Sheet Title

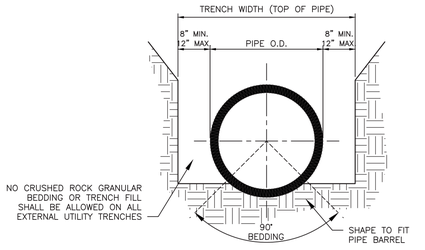
Existing Drainage Map

Sheet Number

DM1

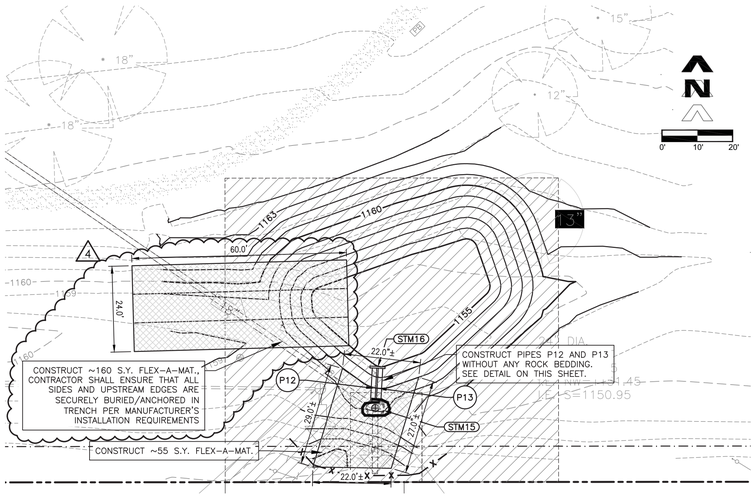


1 THIS ENTIRE SHEET HAS BEEN REVISED AS OF REVISION 1



NOTE: EXCAVATE FOR PIPE BELLS AS REQUIRED

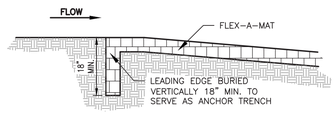
STORM SEWER PIPES (P12 & P13) BEDDING DETAIL
NOT TO SCALE



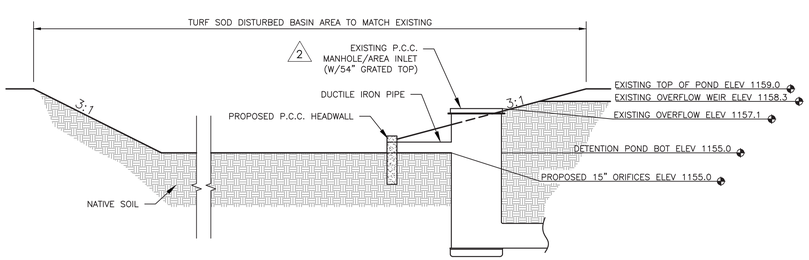
DETENTION BASIN AREA

STRUCTURE TABLE (Storm)		
STRUCTURE NAME	ELEVATIONS	LOCATION TO CENTER OF STRUCTURE
STM15 CORE DRILL 2– 15" D.I.P. INTO EXISTING AREA INLET	I.E. 18": 1151.45 (NW) I.E. 15": 1155.00 (N) I.E. 15": 1155.00 (N) I.E. 18": 1150.95 (S)	N: 108486.29 E: 113767.66
STM16 OUTLET STRUCTURE SEE DETAIL ON SHEET C5.0	I.E. 15": 1155.00 (S) I.E. 15": 1155.00 (S)	N: 108497.69 E: 113768.28

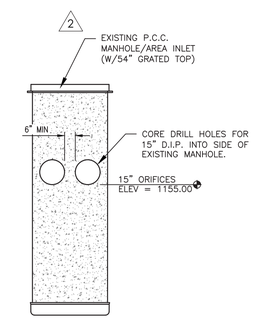
PIPE TABLE (Storm)				
NAME	SIZE	LENGTH	SLOPE	MATERIAL
P12	15"	11.35'	0.00%	D.I.P.
P13	15"	11.28'	0.00%	D.I.P.



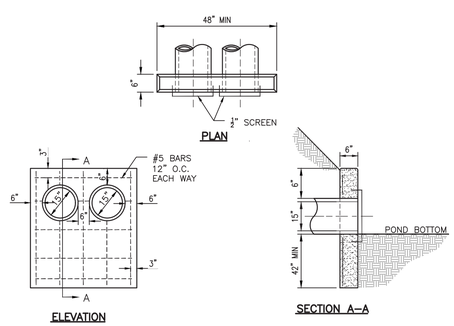
TYPICAL FLEX-A-MAT LEADING EDGE DETAIL
NOT TO SCALE



DETENTION BASIN SECTION
NOT TO SCALE



MANHOLE WALL DETAIL
NOT TO SCALE



OUTLET STRUCTURE DETAIL
NOT TO SCALE

IMPORTANT BASIN NOTES

CONTRACTOR MUST NOTIFY ENGINEER A MINIMUM OF 48 HOURS PRIOR TO INSTALLING BASIN CONSTRUCTION AND/OR HYDRODYNAMIC SEPARATORS TO ALLOW OBSERVATION OF WORK AS PART OF THE CITY REQUIRED "BMP CERTIFICATION" PROCESS. THE CONTRACTORS FAILURE TO PROVIDE THE ENGINEER WITH PROPER NOTICE AND OPPORTUNITY TO OBSERVE THE WORK COULD LEAD TO DELAYS AND/OR THE INABILITY OF THE ENGINEER TO SIGN THE REQUIRED CLOSE OUT FORMS. THE BUILDING'S CERTIFICATE OF OCCUPANCY COULD ALSO BE DELAYED OR WITHHELD AS WELL

POST CONSTRUCTION BMP'S

BMP IDENTIFIER	TYPE OF BMP	LONGITUDE / LATITUDE
DB–1	DETENTION BASIN	N41.255955, W96.113528
HDS–1	HYDRODYNAMIC SEPARATOR (FD–4HC)	N41.257153, W96.114894
HDS–2	HYDRODYNAMIC SEPARATOR (FD–4HC)	N41.256175, W96.115875

PERMANENT POST CONSTRUCTION STORMWATER MANAGEMENT EASEMENT NO. _____ OF THE DOUGLAS COUNTY RECORDS.

OMA-20170710-4174-P
SHEET 1 OF 1

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Project Name
JCC Omaha

Client Name
The Staenberg Group/ Farnsworth Group

Professional Seal

Revision Dates

No.	Description	MM-DD-YY
1	ASI#1	11-10-17
2	REVISIONS FOR CITY COMMENTS	12-15-17
4	ADDITIONAL CITY COMMENTS	02-20-18
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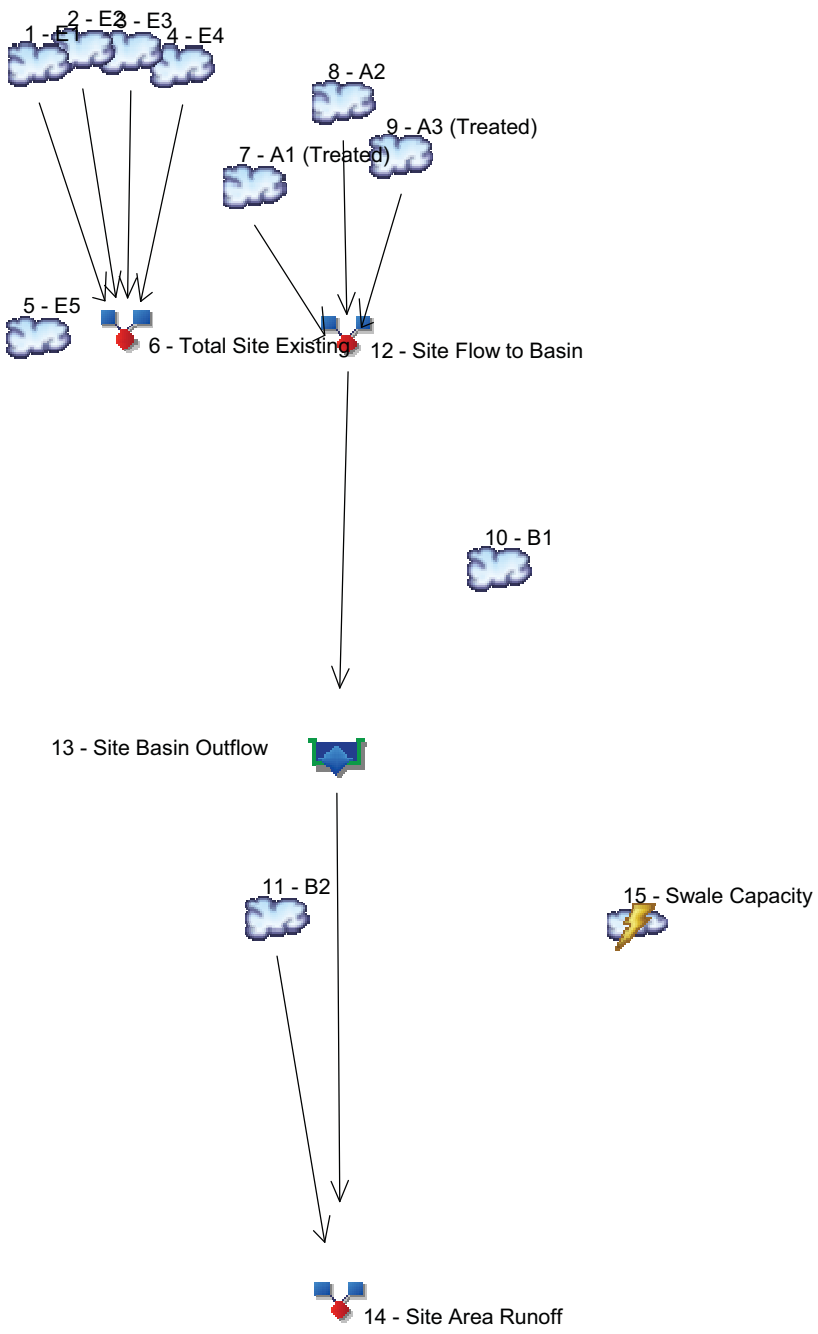
Drawn By: JJP Reviewed By: GAN
Job No.: 2070-101 Date: 12-08-17

Sheet Title
P.C.S.M. PLAN

Sheet Number
C5.0

APPENDIX B
Hydraflow Output for Phases 1 & 2

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	E1
2	SCS Runoff	E2
3	SCS Runoff	E3
4	SCS Runoff	E4
5	SCS Runoff	E5
6	Combine	Total Site Existing
7	SCS Runoff	A1 (Treated)
8	SCS Runoff	A2
9	SCS Runoff	A3 (Treated)
10	SCS Runoff	B1
11	SCS Runoff	B2
12	Combine	Site Flow to Basin
13	Reservoir	Site Basin Outflow
14	Combine	Site Area Runoff
15	Rational	Swale Capacity

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	2.102	-------	-------	3.529	-------	-------	5.379	E1
2	SCS Runoff	------	-------	4.056	-------	-------	6.811	-------	-------	10.38	E2
3	SCS Runoff	------	-------	2.618	-------	-------	4.396	-------	-------	6.700	E3
4	SCS Runoff	------	-------	4.609	-------	-------	7.740	-------	-------	11.80	E4
5	SCS Runoff	------	-------	10.98	-------	-------	25.16	-------	-------	45.87	E5
6	Combine	1, 2, 3, 4,	-------	13.38	-------	-------	22.48	-------	-------	34.26	Total Site Existing
7	SCS Runoff	------	-------	5.030	-------	-------	8.325	-------	-------	12.59	A1 (Treated)
8	SCS Runoff	------	-------	2.439	-------	-------	4.036	-------	-------	6.104	A2
9	SCS Runoff	------	-------	5.804	-------	-------	9.895	-------	-------	15.21	A3 (Treated)
10	SCS Runoff	------	-------	10.90	-------	-------	24.97	-------	-------	45.52	B1
11	SCS Runoff	------	-------	0.728	-------	-------	1.172	-------	-------	1.748	B2
12	Combine	7, 8, 9,	-------	13.27	-------	-------	22.26	-------	-------	33.90	Site Flow to Basin
13	Reservoir	12	-------	11.54	-------	-------	18.87	-------	-------	30.16	Site Basin Outflow
14	Combine	11, 13	-------	12.16	-------	-------	19.89	-------	-------	31.77	Site Area Runoff
15	Rational	------	-------	36.21	-------	-------	54.33	-------	-------	79.59	Swale Capacity

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.102	1	717	4,419	------	------	------	E1
2	SCS Runoff	4.056	1	717	8,529	------	------	------	E2
3	SCS Runoff	2.618	1	717	5,505	------	------	------	E3
4	SCS Runoff	4.609	1	717	9,692	------	------	------	E4
5	SCS Runoff	10.98	1	733	48,437	------	------	------	E5
6	Combine	13.38	1	717	28,145	1, 2, 3, 4,	------	------	Total Site Existing
7	SCS Runoff	5.030	1	717	10,679	------	------	------	A1 (Treated)
8	SCS Runoff	2.439	1	717	5,178	------	------	------	A2
9	SCS Runoff	5.804	1	717	12,107	------	------	------	A3 (Treated)
10	SCS Runoff	10.90	1	733	48,066	------	------	------	B1
11	SCS Runoff	0.728	1	717	1,584	------	------	------	B2
12	Combine	13.27	1	717	27,963	7, 8, 9,	------	------	Site Flow to Basin
13	Reservoir	11.54	1	720	27,961	12	1156.58	2,218	Site Basin Outflow
14	Combine	12.16	1	719	29,545	11, 13	------	------	Site Area Runoff
15	Rational	36.21	1	32	69,532	------	------	------	Swale Capacity

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.529	1	717	7,670	------	------	------	E1
2	SCS Runoff	6.811	1	717	14,802	------	------	------	E2
3	SCS Runoff	4.396	1	717	9,554	------	------	------	E3
4	SCS Runoff	7.740	1	717	16,820	------	------	------	E4
5	SCS Runoff	25.16	1	733	105,455	------	------	------	E5
6	Combine	22.48	1	717	48,846	1, 2, 3, 4,	------	------	Total Site Existing
7	SCS Runoff	8.325	1	717	18,280	------	------	------	A1 (Treated)
8	SCS Runoff	4.036	1	717	8,863	------	------	------	A2
9	SCS Runoff	9.895	1	717	21,305	------	------	------	A3 (Treated)
10	SCS Runoff	24.97	1	733	104,648	------	------	------	B1
11	SCS Runoff	1.172	1	717	2,637	------	------	------	B2
12	Combine	22.26	1	717	48,447	7, 8, 9,	------	------	Site Flow to Basin
13	Reservoir	18.87	1	720	48,445	12	1157.54	4,119	Site Basin Outflow
14	Combine	19.89	1	719	51,082	11, 13	------	------	Site Area Runoff
15	Rational	54.33	1	32	104,305	------	------	------	Swale Capacity

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.379	1	717	12,042	------	------	------	E1
2	SCS Runoff	10.38	1	717	23,240	------	------	------	E2
3	SCS Runoff	6.700	1	717	15,000	------	------	------	E3
4	SCS Runoff	11.80	1	717	26,409	------	------	------	E4
5	SCS Runoff	45.87	1	732	190,467	------	------	------	E5
6	Combine	34.26	1	717	76,691	1, 2, 3, 4,	------	------	Total Site Existing
7	SCS Runoff	12.59	1	717	28,456	------	------	------	A1 (Treated)
8	SCS Runoff	6.104	1	717	13,797	------	------	------	A2
9	SCS Runoff	15.21	1	717	33,739	------	------	------	A3 (Treated)
10	SCS Runoff	45.52	1	732	189,009	------	------	------	B1
11	SCS Runoff	1.748	1	717	4,037	------	------	------	B2
12	Combine	33.90	1	717	75,992	7, 8, 9,	------	------	Site Flow to Basin
13	Reservoir	30.16	1	719	75,990	12	1158.69	7,118	Site Basin Outflow
14	Combine	31.77	1	719	80,026	11, 13	------	------	Site Area Runoff
15	Rational	79.59	1	32	152,805	------	------	------	Swale Capacity

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	110.8217	18.3000	1.0108	--------
2	74.1125	11.8000	0.8974	--------
3	0.0000	0.0000	0.0000	--------
5	82.1212	10.1000	0.8627	--------
10	113.9855	12.1000	0.9024	--------
25	106.6791	11.3000	0.8449	--------
50	119.8696	11.8000	0.8406	--------
100	145.8254	12.7000	0.8636	--------

File name: Omaha.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	4.60	3.78	3.20	2.78	2.46	2.20	1.99	1.82	1.67	1.55	1.44	1.35
2	5.89	4.66	3.87	3.32	2.91	2.60	2.35	2.14	1.97	1.83	1.71	1.60
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	7.90	6.17	5.09	4.35	3.81	3.40	3.07	2.81	2.58	2.40	2.24	2.10
10	8.79	6.98	5.80	4.98	4.37	3.90	3.52	3.22	2.96	2.75	2.56	2.40
25	10.09	8.05	6.74	5.81	5.13	4.60	4.18	3.83	3.54	3.29	3.08	2.90
50	11.19	8.99	7.56	6.54	5.79	5.20	4.73	4.34	4.02	3.74	3.51	3.30
100	12.19	9.84	8.28	7.18	6.35	5.70	5.18	4.75	4.40	4.09	3.83	3.60

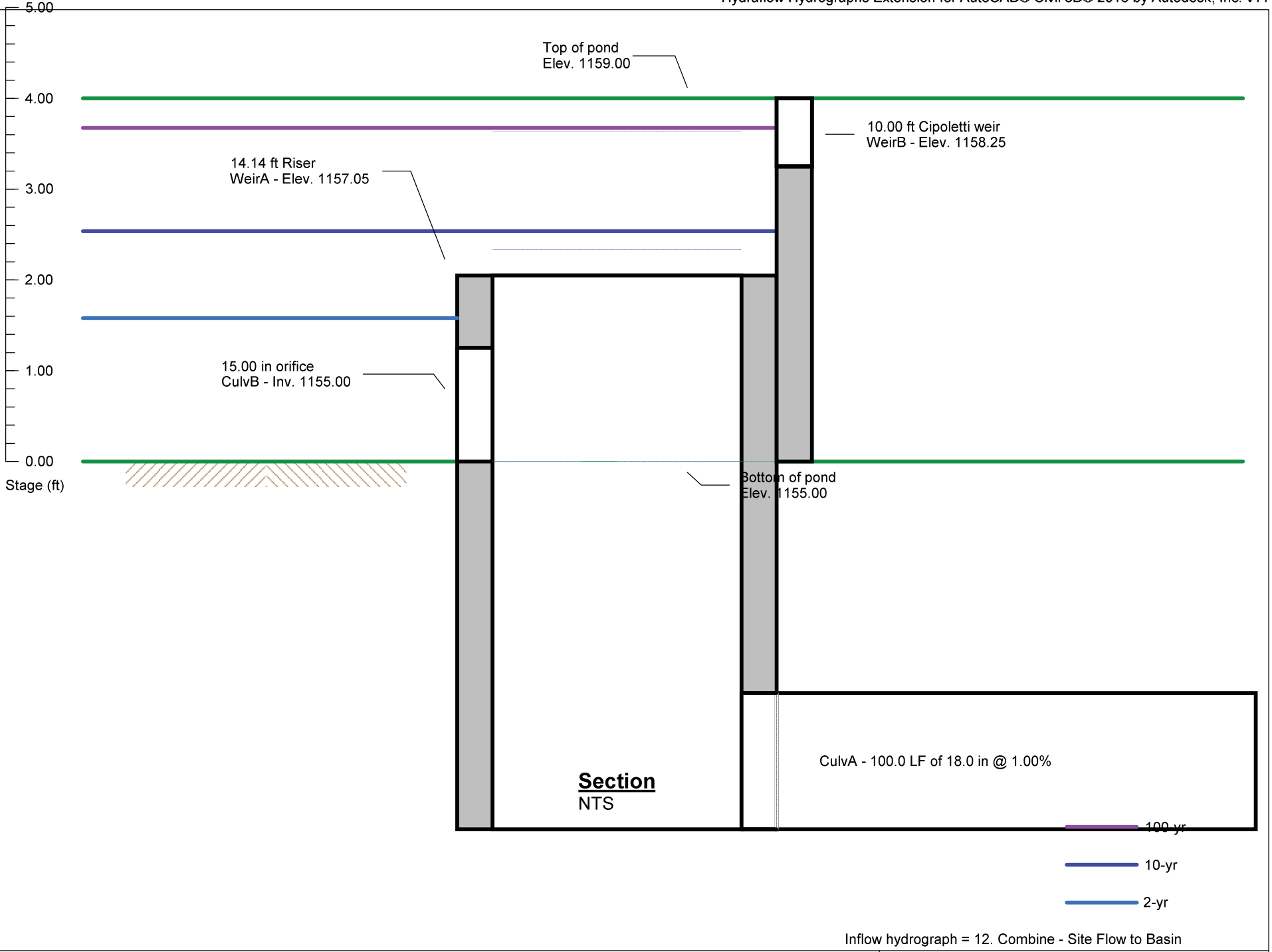
Tc = time in minutes. Values may exceed 60.

Precip. file name: H:\Hydroflow Data\Omaha 24-hr Precip SCS.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.00	0.00	3.90	4.60	5.30	6.00	6.70
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

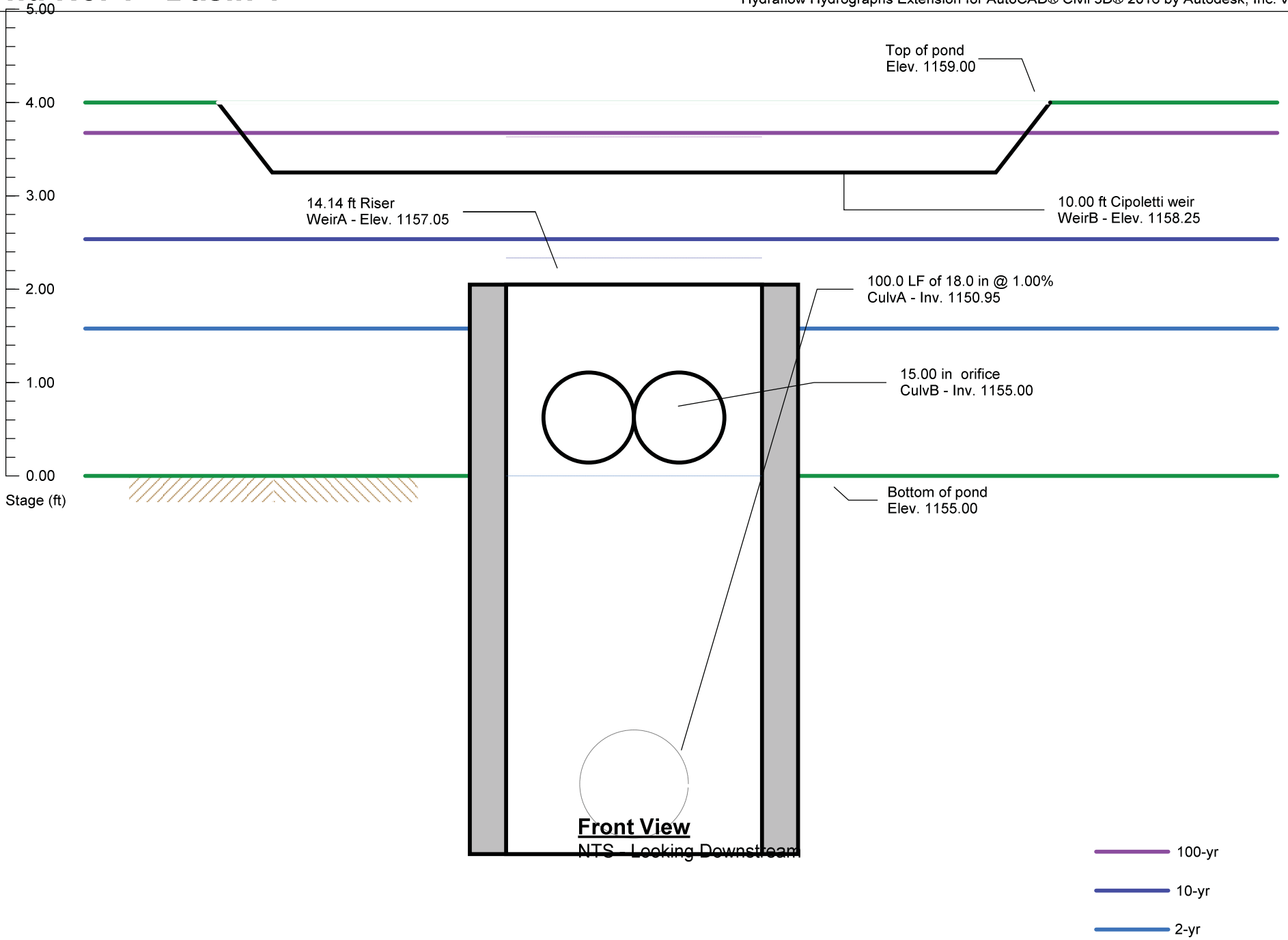
Hydraflow Table of Contents

Pond No. 1 - Basin 1



Inflow hydrograph = 12. Combine - Site Flow to Basin

Pond No. 1 - Basin 1



Inflow hydrograph = 12. Combine - Site Flow to Basin

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Oct 26 2017

South Swale

Trapezoidal

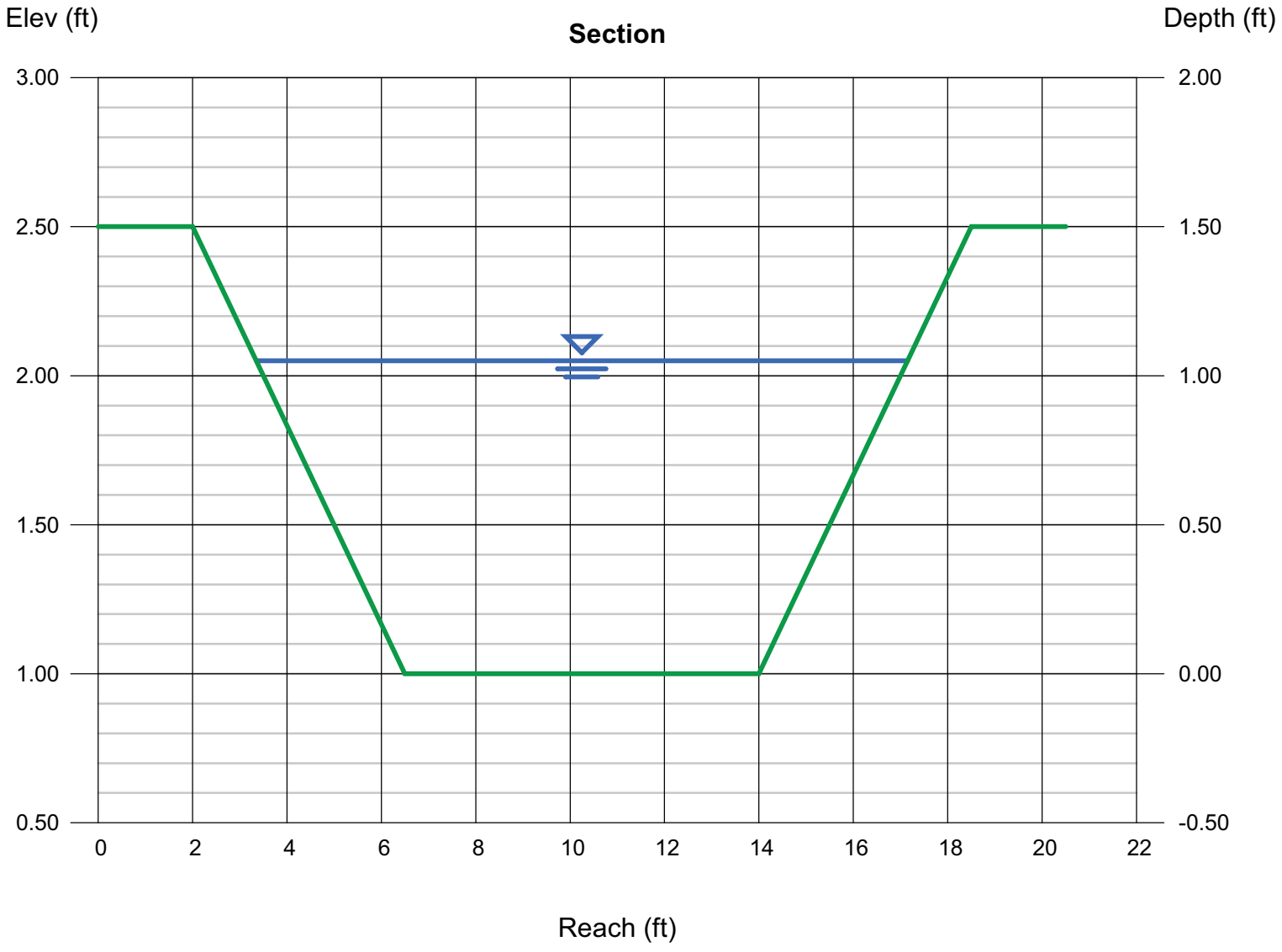
Bottom Width (ft)	= 7.50
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 1.00
Slope (%)	= 2.50
N-Value	= 0.025

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

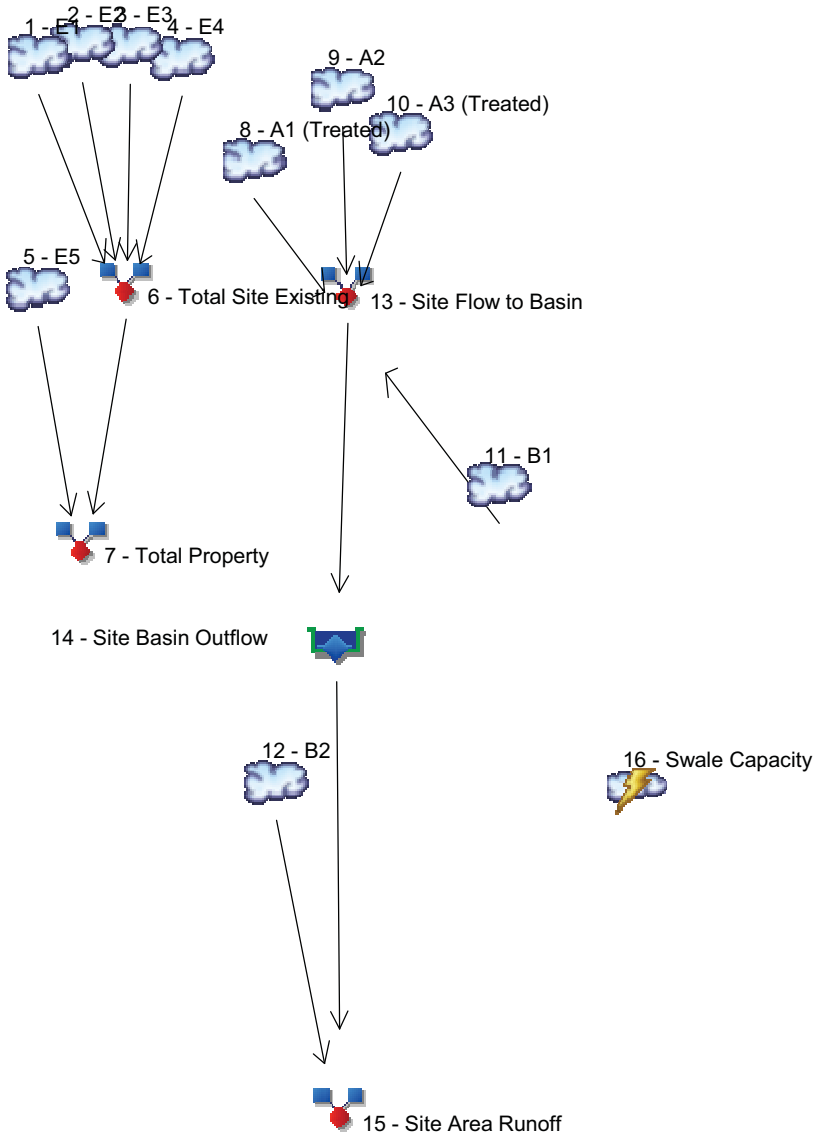
Highlighted

Depth (ft)	= 1.05
Q (cfs)	= 89.87
Area (sqft)	= 11.18
Velocity (ft/s)	= 8.04
Wetted Perim (ft)	= 14.14
Crit Depth, Yc (ft)	= 1.37
Top Width (ft)	= 13.80
EGL (ft)	= 2.05



APPENDIX C
Hydraflow Output for Impact Point #1

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	E1
2	SCS Runoff	E2
3	SCS Runoff	E3
4	SCS Runoff	E4
5	SCS Runoff	E5
6	Combine	Total Site Existing
7	Combine	Total Property
8	SCS Runoff	A1 (Treated)
9	SCS Runoff	A2
10	SCS Runoff	A3 (Treated)
11	SCS Runoff	B1
12	SCS Runoff	B2
13	Combine	Site Flow to Basin
14	Reservoir	Site Basin Outflow
15	Combine	Site Area Runoff
16	Rational	Swale Capacity

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	2.102	-------	-------	3.529	-------	-------	-------	E1
2	SCS Runoff	------	-------	4.056	-------	-------	6.811	-------	-------	-------	E2
3	SCS Runoff	------	-------	2.618	-------	-------	4.396	-------	-------	-------	E3
4	SCS Runoff	------	-------	4.609	-------	-------	7.740	-------	-------	-------	E4
5	SCS Runoff	------	-------	10.27	-------	-------	24.16	-------	-------	-------	E5
6	Combine	1, 2, 3, 4,	-------	13.38	-------	-------	22.48	-------	-------	-------	Total Site Existing
7	Combine	5, 6	-------	17.77	-------	-------	34.51	-------	-------	-------	Total Property
8	SCS Runoff	------	-------	5.030	-------	-------	8.325	-------	-------	-------	A1 (Treated)
9	SCS Runoff	------	-------	2.439	-------	-------	4.036	-------	-------	-------	A2
10	SCS Runoff	------	-------	5.804	-------	-------	9.895	-------	-------	-------	A3 (Treated)
11	SCS Runoff	------	-------	10.90	-------	-------	24.97	-------	-------	-------	B1
12	SCS Runoff	------	-------	0.728	-------	-------	1.172	-------	-------	-------	B2
13	Combine	8, 9, 10, 11,	-------	18.06	-------	-------	34.86	-------	-------	-------	Site Flow to Basin
14	Reservoir	13	-------	16.08	-------	-------	32.69	-------	-------	-------	Site Basin Outflow
15	Combine	12, 14	-------	16.60	-------	-------	33.52	-------	-------	-------	Site Area Runoff
16	Rational	------	-------	36.21	-------	-------	54.33	-------	-------	-------	Swale Capacity

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.102	1	717	4,419	------	------	------	E1
2	SCS Runoff	4.056	1	717	8,529	------	------	------	E2
3	SCS Runoff	2.618	1	717	5,505	------	------	------	E3
4	SCS Runoff	4.609	1	717	9,692	------	------	------	E4
5	SCS Runoff	10.27	1	733	45,848	------	------	------	E5
6	Combine	13.38	1	717	28,145	1, 2, 3, 4,	------	------	Total Site Existing
7	Combine	17.77	1	718	73,993	5, 6	------	------	Total Property
8	SCS Runoff	5.030	1	717	10,679	------	------	------	A1 (Treated)
9	SCS Runoff	2.439	1	717	5,178	------	------	------	A2
10	SCS Runoff	5.804	1	717	12,107	------	------	------	A3 (Treated)
11	SCS Runoff	10.90	1	733	48,066	------	------	------	B1
12	SCS Runoff	0.728	1	717	1,584	------	------	------	B2
13	Combine	18.06	1	718	76,030	8, 9, 10, 11,	------	------	Site Flow to Basin
14	Reservoir	16.08	1	721	76,027	13	1157.16	3,327	Site Basin Outflow
15	Combine	16.60	1	721	77,611	12, 14	------	------	Site Area Runoff
16	Rational	36.21	1	32	69,532	------	------	------	Swale Capacity

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.529	1	717	7,670	------	------	------	E1
2	SCS Runoff	6.811	1	717	14,802	------	------	------	E2
3	SCS Runoff	4.396	1	717	9,554	------	------	------	E3
4	SCS Runoff	7.740	1	717	16,820	------	------	------	E4
5	SCS Runoff	24.16	1	733	101,598	------	------	------	E5
6	Combine	22.48	1	717	48,846	1, 2, 3, 4,	------	------	Total Site Existing
7	Combine	34.51	1	718	150,444	5, 6	------	------	Total Property
8	SCS Runoff	8.325	1	717	18,280	------	------	------	A1 (Treated)
9	SCS Runoff	4.036	1	717	8,863	------	------	------	A2
10	SCS Runoff	9.895	1	717	21,305	------	------	------	A3 (Treated)
11	SCS Runoff	24.97	1	733	104,648	------	------	------	B1
12	SCS Runoff	1.172	1	717	2,637	------	------	------	B2
13	Combine	34.86	1	718	153,095	8, 9, 10, 11,	------	------	Site Flow to Basin
14	Reservoir	32.69	1	721	153,093	13	1158.75	7,335	Site Basin Outflow
15	Combine	33.52	1	721	155,730	12, 14	------	------	Site Area Runoff
16	Rational	54.33	1	32	104,305	------	------	------	Swale Capacity

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	110.8217	18.3000	1.0108	--------
2	74.1125	11.8000	0.8974	--------
3	0.0000	0.0000	0.0000	--------
5	82.1212	10.1000	0.8627	--------
10	113.9855	12.1000	0.9024	--------
25	106.6791	11.3000	0.8449	--------
50	119.8696	11.8000	0.8406	--------
100	145.8254	12.7000	0.8636	--------

File name: Omaha.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	4.60	3.78	3.20	2.78	2.46	2.20	1.99	1.82	1.67	1.55	1.44	1.35
2	5.89	4.66	3.87	3.32	2.91	2.60	2.35	2.14	1.97	1.83	1.71	1.60
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	7.90	6.17	5.09	4.35	3.81	3.40	3.07	2.81	2.58	2.40	2.24	2.10
10	8.79	6.98	5.80	4.98	4.37	3.90	3.52	3.22	2.96	2.75	2.56	2.40
25	10.09	8.05	6.74	5.81	5.13	4.60	4.18	3.83	3.54	3.29	3.08	2.90
50	11.19	8.99	7.56	6.54	5.79	5.20	4.73	4.34	4.02	3.74	3.51	3.30
100	12.19	9.84	8.28	7.18	6.35	5.70	5.18	4.75	4.40	4.09	3.83	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: H:\Hydroflow Data\Omaha 24-hr Precip SCS.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.00	0.00	3.90	4.60	5.30	6.00	6.70
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

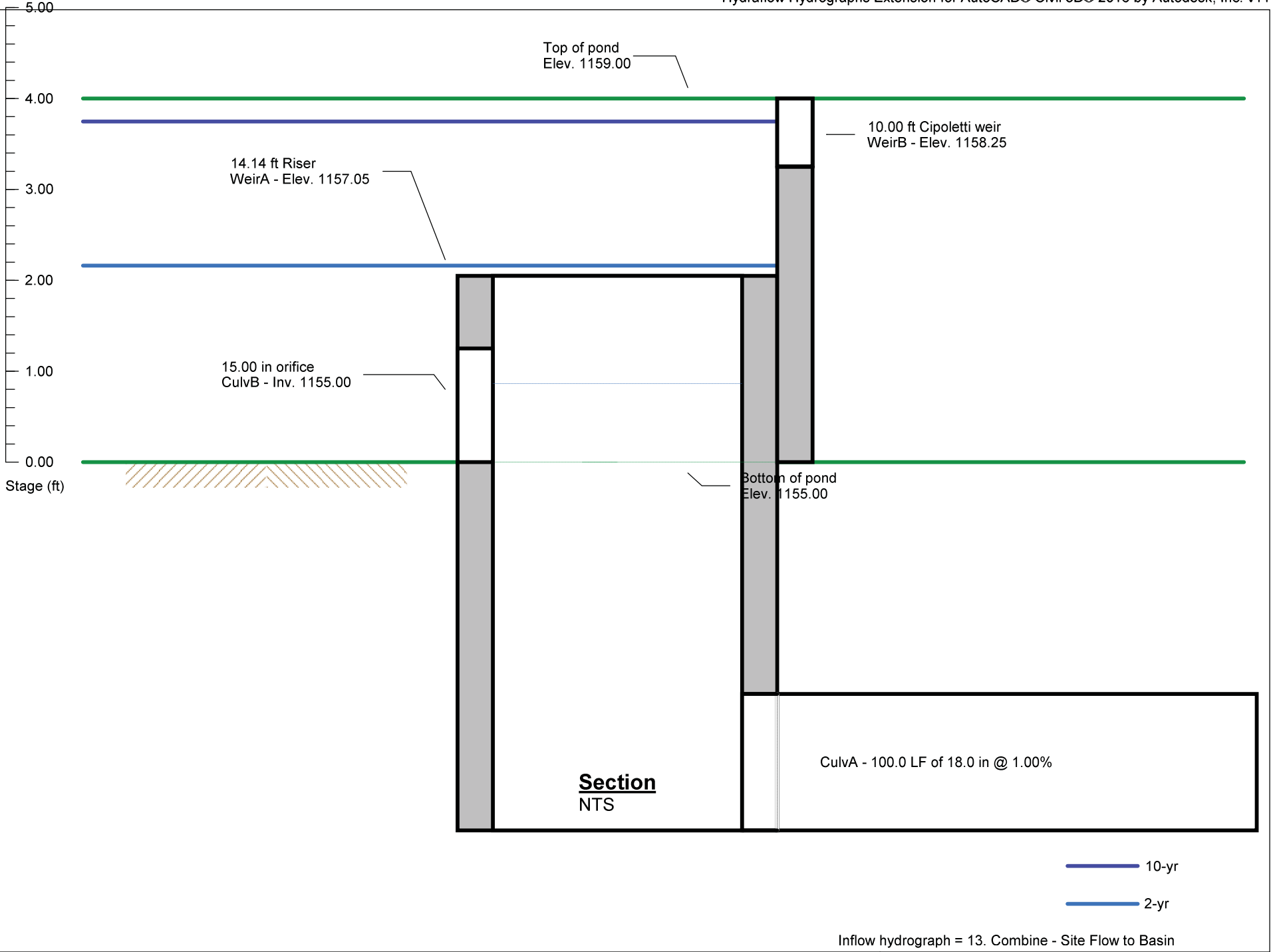
Hydraflow Table of Contents

2070-101 Drainage_2&10.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

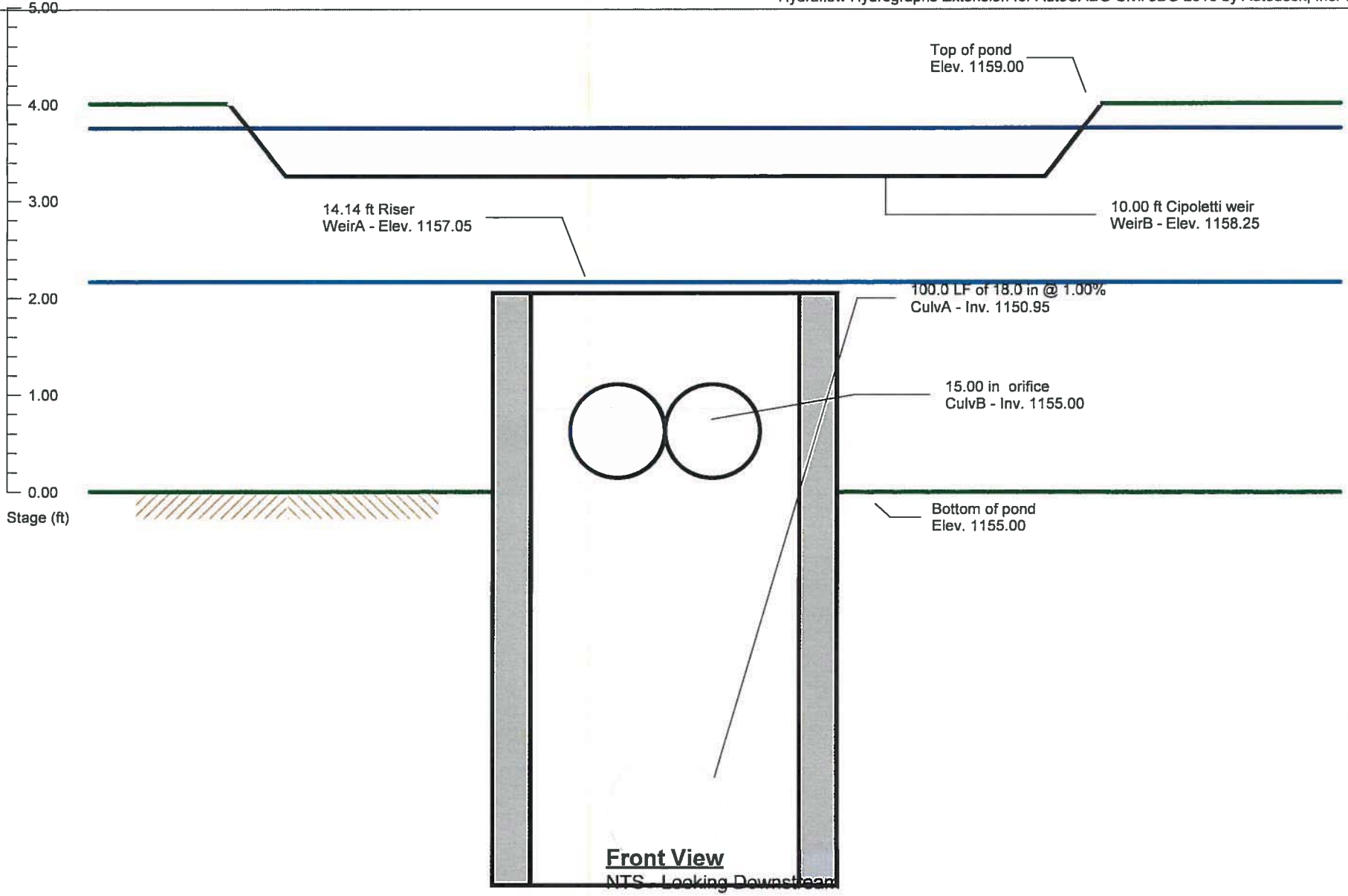
Monday, 11 / 6 / 2017

Pond No. 1 - Basin 1



Inflow hydrograph = 13. Combine - Site Flow to Basin

Pond No. 1 - Basin 1



Inflow hydrograph = 13. Combine - Site Flow to Basin

Appendix D

PAPILLION CREEK WATERSHED PARTNERSHIP

DRAINAGE STUDY CHECKLIST

PROJECT INFORMATION	
PROJECT NAME	
LOCATION	
PROJECT DESCRIPTION	

HYDROLOGIC ANALYSIS	YES	NO
Is there a drainage area map at an appropriate scale?	☐	☐
Is each subbasin area delineated and uniquely labeled in a consistent manner on the Drainage Area Map?	☐	☐
Is a flow diagram included on the Drainage Area Map?	☐	☐
Is a subbasin summary table included showing parameters such as subbasin area, land use, hydrologic soil group, curve number, time of concentration, etc.?	☐	☐
Are the methodologies, including computer models, used for the analysis described?	☐	☐
Are any assumptions made during analysis documented and justified?	☐	☐
Are both existing and proposed conditions analyzed?	☐	☐
Are detailed subbasin calculations for curve numbers and times of concentration included?	☐	☐
Is a summary table of hydrologic analysis results included?	☐	☐

HYDRAULIC ANALYSIS	YES	NO
Are design criteria for conveyance systems described?	☐	☐
Is a channel reach summary table included showing Manning's n numbers, slope, length, etc.?	☐	☐
Are the diameter, length, slope, and construction material of pipe systems specified?	☐	☐
Are detailed plans for outlet structures, including erosion control at each structure, included?	☐	☐
Are the methodologies, including computer models, used for analysis described?	☐	☐
Are conveyance systems clearly marked on a site map?	☐	☐
Are any assumptions made during analysis documented and justified?	☐	☐
Is a summary table of release rates included?	☐	☐

PAPILLION CREEK WATERSHED PARTNERSHIP

ORDINANCE REQUIREMENTS		
	YES	NO
Has the first ½" of stormwater runoff been treated on-site?	☐	☐
If a detention basin is being used for the first ½", is an emergency spillway/overflow identified and adequately protected from erosion?	☐	☐
Is the project located in a CSO area?	☐	☐
If in a CSO area, is a no net increase in stormwater runoff shown?	☐	☐
Has a post construction stormwater management plan been completed?	☐	☐
Has a construction erosion control plan been developed?	☐	☐
Has a Construction Stormwater NOI been filed with NDEQ?	☐	☐
Has a construction SWPPP been prepared?	☐	☐
Are stream setbacks shown on a site map?	☐	☐
Are any areas of the site in a designated floodplain?	☐	☐
If a designated floodplain is present, is this shown on a site map?	☐	☐

Appendix E

Preliminary Platting PCSMP Requirements

The following summary is a list of requirements that the City of Omaha requires for the preliminary PCSMP. This list includes some bullets pertaining to stream setbacks, however, it primarily focuses on detention systems, specifically above ground detention systems, either bioretention systems, dry detention basins or wet detention basins. The intent is to demonstrate that adequate area is set aside for these systems for storage and long term maintenance. This preliminary approval phase will also serve to meet any PCSMP approvals as part of getting an approved grading permit.

If a detention basin or basins are part of the development, they must have adequate volume

- This must be demonstrated with supporting calculations, including the permanent outlet structure sizing and permanent outfall pipe sizing.
    - CN value must be selected based on the type of development
    - Time of concentration must be calculated.
    - Show the travel path of flow for existing conditions.
- Requires design to be far enough along to confirm that post project runoff does not exceed the pre-project runoff rates.
- The grading must show that the 100-yr event can get to the basin.
- Minimum water quality opening 2” (50 mm)
- Include anti-seep collars.

If the basin(s) are also meant to meet the minimum water quality requirement, include the stage vs. time drawdown curve to show a 24 – 40 hour drawdown time.

Basin side slopes, interior or exterior, should be no steeper than 3h:1v; ORSDM calls for minimum 4h:1v slopes.

Maximum allowable depth is 10’

Minimum 8’ wide vehicle access around the entire basin-- *This will more than likely vary depending on the location of the detention system. A large basin with steep slopes immediately adjacent to a homeowners yard will need wider access.*

Basins must have a minimum radius to accommodate maintenance vehicle access.

Easements for maintenance access to the basin must begin at public property and be clearly defined.

Basin must be outside any stream setback

Stream setbacks must be clearly defined.

Basin must not be built over the top of the sanitary sewer.

Basin must not be in any State ROW

Basin should not be in City of Omaha ROW ***(In some cases, it may be possible to allow a portion of the detention basin in City ROW; this must be approved by the City in advance.)***

If a basin has a permanent outfall connecting to an existing storm sewer, the connection must be approved by Brian Lodes.

Any permanent outfalls must be designed in compliance with ORSDM Chap 3, Sec 3.7.1, Pipe Outlets

The physical location of the basin must be approved prior to grading permit package approval if it will be converted from a temporary sediment basin

Any permanent feature of a basin that is used as part of temporary BMP (i.e. riser, barrel, &/or outfall associated with a temporary sediment basin), must be approved prior to grading permit package approval