EST 1808

CITY OF DELAWARE OHIO

Engineering Standards

Infrastructure Design Manual

Current through September 25, 2025







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EST 1808
CITY OF
DELAWARE
OHIO

Infrastructure Design Manual
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Chapter 1: Introduction & Adoption

Since the early 1990's, the City of Delaware has experienced significant growth in residential, commercial and industrial development activities, at levels never before experienced in the community. In order to properly manage the growth, and more specifically, the design and construction of miles of new roadway, water lines, and sanitary sewer and storm lines, it became necessary to increase the number of city staff dedicated to reviewing and overseeing such development activity, and to adopt more comprehensive design and construction regulations. The combination of improved staffing levels and better regulations has provided the necessary basis by which the city can ensure the adequacy and acceptability of the substantial expansion in public infrastructure being constructed.

More recently, an effort has been undertaken to publish the multiple engineering design and plan development policies, regulations, standards, and specifications implemented during the high growth period within a single document that is readily accessible to developers, contractors, and consultants. In doing so, the process of planning and designing the infrastructure for future development projects will be more efficient as the most current regulations governing such activities will be readily available and accessible to the development team through the Infrastructure Design Manual. The effort to include all design regulations in a single volume necessitated a thorough review of existing city code as well as the many practices and policies of other city departments in order to update and organize the information into a practical design manual. This Design Manual incorporates not only city policy, but also the most applicable regulations of other agencies, such as the Ohio Environmental Protection Agency (OEPA), Ohio Department of Transportation (ODOT), and Federal Aviation Authority (FAA) as it applies to development activity within the City of Delaware. Understanding that many regulations are subject to modification throughout a given period, updates to the Infrastructure Design Manual will be prepared and made available as required. In its entirety, the Engineering Design Standards consist of 3 parts, all utilized concurrently; Part 1-The Land Development Infrastructure Design Manual, Part 2- Plan Notes, and Part 3- Standard Drawings.

This Design Manual is not intended to be a design textbook. It assumes that the user has an understanding of the engineering concepts utilized here in. This manual provides a uniform design procedure for summarizing and submitting plans in an acceptable and understandable manner. It does not provide uniform solution to all engineering problems. The manual provides sufficient information to develop engineering systems in accordance with City of Delaware policy if paired with sound engineering judgment from a registered Professional Engineer licensed in the State of Ohio and in responsible charge of the design.

Section 903.01 of the City of Delaware Codified Ordinances states:

"The City Manager shall have the authority to adopt and periodically update standard construction specifications and regulations for all public improvements and connections thereto, and all developments in the City or under City jurisdiction. Such standards and any order of the City Manager issued in connection therewith shall have the same force and effect as duly enacted legislation".

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Chapter 2: Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADF	Average Daily Flow
ADT	Average Daily Traffic
ANSI	American National Standards Institute
API	Acceptance of Public Improvements
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWWA	American Water Works Association
BMP	Best Management Practice
CAD	Computer Aided Drafting
CBR	California Bearing Ratio
CGB	Compacted Granular Backfill
CGP	Construction General Permit
CLOMR	Conditional Letter of Map Revision
CMS	Construction Material Specifications
COC	City of Columbus
COD	City of Delaware
CWA	Clean Water Act
DelCo	DelCo Water Company, Inc.
DES	Department of Engineering Services
DIP	Ductile Iron Pipe
DXF	Drawing Interchange Format or Drawing Exchange Format
EDU	Equivalent Dwelling Unit
EGL	Energy Grade Line
EOR	Engineer of Record
EOS	End of Service
ESAL	Equivalent Single Axle Loads
FAA	Federal Aviation Administration
FBFM	Flood Boundary Floodway Map
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Association
FIS	Flood Insurance Study
GIS	Graphical Information System
HCS	Highway Capacity Software
HDPE	High Density Polyethylene
HGL	Hydraulic Grade Line
HSG	Hydrologic Soils Group
IES	Illuminative Electrical Society
ITE	Institute of Traffic Engineers
LED	Light Emitting Diode
LEO	Law Enforcement Officer
LOMR	Letter of Map Revision
LOS	Level of Service
MDF	Maximum Daily Flow
MORPC	Mid-Ohio Regional Planning Commission
MOT	Maintenance of Traffic
MOU	Memorandum of Understanding

MS4	Municipal Separate Storm Sewer System
MUTCD	Manual of Uniform Traffic Control Devices
NAD 83	North American Datum of 1983
NAVD 29	North American Vertical Datum of 1929
NAVD 88	North American Vertical Datum of 1988
NEMA	National Electrical Manufacturers Association
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OMUTCD	Ohio Manual of Uniform Traffic Control Devices
ORC	Ohio Revised Code
OUPS	Ohio Utilities Protection Service
PDF	Portable Document Format
PFR	Project Finance Report
PO	Purchas Order
PSWMR	Preliminary Stormwater Management Report
PTI	Permit to Install
PTOE	Professional Traffic Operations Engineer
PVC	Polyvinyl chloride
RCC	Roller Compacted Concrete
RCN	Runoff Curve Number
RCP	Reinforced Concrete Pipe
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Qualifications
ROW	Right of Way (R/W)
RPR	Resident Project Representatives
SAS	Sanitary Sewer
SDR	Standard Dimension Ratio (a pressure rating for pvc pipe)
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Area
SOQ	Statement of Qualifications
SSV	Soil Support Value
SWP3	Storm Water Pollution Prevention Plan
TEM	Traffic Engineering Manual (ODOT)
TRB	Transportation Research Board
TIFF	Tagged Image File Format
TIS	Traffic Impact Study
WSDS	Water Supply Data Sheet

Chapter 3: Engineering Plan Review Process

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1. General

A. All proposed developments in the City of Delaware are subject to review by the Public Works Department to verify conformance to current City design and construction standards, specifications, and regulations. The information contained herein is updated per the revision date on the cover, and should be considered to supersede all previous communications, documents, etc. This document should, however, be construed as supplemental to the Codified Ordinances of the City of Delaware.

B. All information is to be submitted to the City of Delaware, Public Works Department, Attention: Engineering. In some cases, a particular set of engineering plans may be reviewed by an engineering consultant review agency. In this event, an additional set of construction drawings, as outlined in the Submission Requirements section, is to be submitted.

C. It is the City's goal to review and comment on complete sets of construction documents in accordance with the Table below from date of submittal. If the documents are deemed incomplete, the applicant shall be notified in writing and shall have an opportunity to correct the deficiencies and resubmit the required plans for review. The city will not review partial plan submissions. All plans, calculations, and reports are to be signed and sealed by an engineer licensed in the State of Ohio. Each submittal shall be signed and sealed. Un-signed and un-sealed plans or documents will be deemed incomplete and may be returned to the design engineer without being reviewed. Plans are reviewed in the order received and pending workload, in general accordance with the following table:

Table 3-1: Review Times

Document	Submission	Review Time
Preliminary Technical Review	First Submission	2 weeks
Engineering Plans	First Submission	4 weeks
Engineering Plans	Subsequent Submissions	2 weeks
Stormwater Management Plans	Each Submission	2 weeks
Traffic Impact Study	Each Submission	4 weeks
Water Model	Each Submission	2 weeks
SWP3	Each Submission	2 weeks
Plan Revisions	Each Submission	1 week

D. If a Traffic Impact Study or Preliminary Stormwater Management Plan is required for the project, they shall be approved before the acceptance of final engineering plans will be accepted for review. After review of the submission by the Public Works Department or consultant review agency, the plan submitter will receive a set of written review comments specifying required plan changes, modifications, or additional information. A subsequent submission is required to confirm that required changes have been made. Each subsequent submission must be accompanied by a written item by item response to all comments. Comments that are ignored or "explained away" will cause the submission to be deemed incomplete and be returned to the design engineer. Questions regarding review comments are to be directed to the Project Engineer and will be addressed in a timely manner consistent with department workload. Once an

engineering plan is approved, a mylar copy of the title sheet must be submitted for appropriate city official signatures sized accordingly, ANSI D (22" x 34"). The signature routing process takes approximately two (2) weeks from receipt of the mylar.

2. Public Works Department Address

City of Delaware, Public Works Department
440 East William Street
Delaware, Ohio 43015
Phone: 740-203-1800 - Fax: 740-203-1749 - www.delawareohio.net

3. Plan Review and Construction Inspection Fees

City of Delaware Code establishes that the Public Works Department shall collect plan review and construction inspection fees for the cost associated in providing these services. Fees are calculated per the current code, and the current version of the Plan Review and Construction Inspections Fees Form (See Appendix), due at the time an engineering plan is submitted for review and approval by the City, and are non-refundable.

An itemized engineer's cost estimate is required to be submitted for all development projects. This includes, but is not limited to, roadway components, storm sewers, sanitary sewers, water lines, street lights, traffic signals, pavement markings, grading, sidewalks, bike paths, bridges, culverts, erosion and sediment control measures both temporary and permanent, etc., and delineated as either public or private infrastructure.

4. Limitations on Plan Approval

Significant construction of improvements must commence within three (3) years of final engineering plan approval. Engineering Plan approval shall expire if the improvements have not commenced in this time frame and the plans must be resubmitted for approval with all relevant fees. Furthermore, the resubmitted plans shall be updated to the most current City of Delaware design standards. Simply resubmitting previously approved plans will not suffice.

5. Submission Requirements

A. Initial Submission

The initial submission of an engineering plan for review must contain the items denoted below. Incomplete submittals will not be reviewed until all required materials have been received by the Public Works Department.

1. One (1) hard copy and a digital (pdf format) copy of the signed and sealed traffic impact analysis. The City can issue a Letter of Waiver if it is determined that a traffic impact study is not warranted due to site-specific conditions. This waiver must be requested in writing by the design engineer.
2. One (1) hard copy and a digital (pdf format) copy of the signed and sealed Storm Water Management Plan (including all calculations) based on the requirements set forth in this manual.
3. One (1) hard copy and a digital (pdf format) copy of signed and sealed domestic water supply hydraulic calculations (water model) demonstrating conformance to City's fire prevention regulations.

4. Three (3) hard copy sets and a digital (pdf format) copy of signed and sealed plans as further detailed below, submitted on ANSI D bond paper, is required. Subsequent submissions shall include 2 sets of signed sealed plans, as detailed here within, and a digital (PDF format) copy.
5. One (1) hard copy and a digital (pdf format) copy of signed and sealed storm sewer calculations including a tributary drainage map identifying all on and off-site areas tributary to each of the proposed storm sewer inlets. The tributary map shall be submitted on ANSI D bond paper.
6. One (1) hard copy set and a digital (pdf format) copy of signed and sealed sanitary sewer calculations. The sanitary tributary map is to be delineated on the title sheet of the plan set.
7. All plan review fees must be paid before the City will commence the review process.

B. Final Approval

The following items must be submitted before the project is approved and released for construction activities to begin. This list included herein is not intended to be all-inclusive. It is the responsibility of the designer to submit any additional agency approvals prior to the pre-construction meeting (ODOT, FAA, etc.)

1. One (1) hard copy and digital (pdf format) copy of Notice of Intent to Discharge Stormwater (NOI) application and OEPA response letter containing the OEPA tracking number for all developments greater than one (1) acre.
2. One (1) hard copy and digital (pdf format) copy of Permission to Install (PTI) public utilities application for projects extending all sanitary sewer utilities.
3. One (1) hard copy and digital (pdf format) copy of Water Supply Data Sheets (WSDS) and the OEPA Project Summary Sheets for projects extending all water supply utilities.
4. One (1) hard copy and digital (pdf format) copy of the Storm Water Pollution Prevention Plan (SWP3) plan including narrative, plan sheets, and erosion control details.
5. One (1) hard copy and a digital (pdf format) copy of the signed and sealed Storm Water Management Plan (including all calculations) based on the requirements set forth in this manual.
6. Four (4) hard copy sets and a digital (pdf format) copy of the design engineer signed and sealed plans, with a fully executed signature block, submitted on ANSI D bond paper, is required.

C. Construction Shop Drawing Submittals

Prior to commencement of construction activities, Shop Drawings shall be provided by the Developer or their contractor(s), or representative(s) to the City of the Delaware for review and approval per the City of Columbus CMS.
All shop drawing submittal packages should have clearly identified on a cover sheet the name and contact information of the submitting contractor, name of project, date of submission, number of pages included in package.

Shop Drawings required to be submitted include, but are not limited to, the following:

1. Sanitary:
    a. Structures
    b. Pipe
    c. Fittings
    d. Manhole encapsulation system (Wrapidseal)
    e. Frames/Grates/Covers

2. Storm:
    a. Structures
    b. Pipe
    c. Frames/Grates/Covers
3. Water:
    a. Pipe
    b. Tracer wire
    c. Connections
    d. Valves
    e. Valve boxes
    f. Meter box covers
    g. Curb stops, corporation stops
    h. Hydrants
    i. Fittings
    j. Accessories (glands, gaskets, bolts, and nuts)
    k. Couplings, clamps, and restraints
    l. Service saddles
    m. Service boxes

4. Lighting:
    a. Pull boxes
    b. Disconnects
    c. Controller
    d. Main Power Service
    e. Circuit Cable
    f. Cable in Pole
    g. Conduit

Additional shop drawings shall be provided as requested by the City of Delaware.

6. Design Exception Request

During the design and plan review process a Design Exception Request form shall be required for any significant design element that does not meet the requirements of the design guide or standard drawings. This form may be required at the discretion of the City

of Delaware, Public Works Department administrative and land development staff and is included in the Appendix of this document.

7. Procedures for Plan Revisions

A. The City of Delaware reserves the right to require any plan submitted for revision to be updated to the most current City of Delaware design standards. The City of Delaware reserves the right to perform a complete review of any plan submitted for revisions. Any errors or omissions not previously noted may be required to be corrected as a part of the revision process.

B. The following procedure is to be adhered to for all changes to the engineering plan set after the plans are approved. The purpose of the revision process is to account for unexpected field conditions and not for value engineering after the plan approval process. Value engineering is crucial, but it must be performed prior to final plan approval.

C. The engineer of record is to submit a draft of the requested changes with an accompanying written explanation to the Project Engineer. The proposed changes shall be clearly indicated in red. Changes should be numbered both in the revision block on the title sheet, the sheet title block where the revision occurs, and on the plan sheet itself, in close proximity to where the revision is being shown. The change number shall be inscribed in a triangle to help distinguish it from surrounding figures.

D. A review fee, as specified in the fees section of this document shall be submitted before the Public Works Department will review any proposed plan revisions.

E. Upon approval of the plan revision, the mylar title sheet shall be marked with the change and submitted to the Project Engineer for their approval.

The final step in the revision process is the submittal of four (4) complete, full size hard copies of the revised plan sheets, to the Public Works Department. If the revision entails changes to more than 25% of the plan sheets, four (4) complete hard copy sets shall be submitted. A digital copy (PDF format) shall also be submitted.

Chapter 4: Engineering Plan Format & Content

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22. Landscaping Plan 9
23. Lighting & Fiber Optic Line Plan 9

Engineering and construction plans shall be prepared and organized include the following information:

1. General Sheet Information

A. All plan sheets must be ANSI D (22" x 34") bond paper. Oversized plan sheets will not be accepted.
B. The minimum font size shall be 0.08.
C. All drawings shall have the orientation of north, and lettering towards the top or to the right of the sheet.
D. All plan sheets shall be titled and numbered with the Title Sheet being sheet No. 1.
E. All sheets shall contain a horizontal and vertical graphical scale. Only engineering scales are permitted. Plans utilizing architectural scales will not be accepted and will be returned without being reviewed
F. Plan sheets shall be drawn and plotted using computer aided drafting (CAD)
G. North arrow
H. Phasing lines with description
I. Work limits shall be delineated
J. Distinct separation between proposed and existing elements of the plan

2. Title Sheet

This sheet identifies the project and provides information for the project location. The title sheet shall have the following information:

A. Project Name
B. Location map (scale 1-in = 1000-ft), locating the project in the City's vicinity
C. Site Index map (scale either 1-in = 100-ft or a maximum 1-in = 200-ft) showing:
D. General site layout
E. Centerlines and edges of pavement of all abutting streets
F. Street names
G. Municipal corporate boundaries
H. Site boundaries with bearings and distances
I. Identification of adjacent parcels, parcel number, property lines, and property owners
J. Proposed and existing rights-of-way, property lines
K. Project address
L. Standard drawing list indicating applicable municipality or state agency
M. Index of sheets
N. OUPS contact information
O. Benchmark list, referenced to NAVD 88
P. Signature, seal, date of signature, and registration number of the engineer of record.
Q. Plan release date
R. City of Delaware Signature Block, reference Standard Drawings
S. City of Delaware standard revision block, reference Standard Drawings
T. City of Delaware standard infrastructure ownership chart, reference Standard Drawings
U. Developer/Owner and design firm names, addresses, and telephone numbers
V. Current utilities ownership and contact information list

3. General Notes Sheet

The most current edition of City of Delaware standard notes for subdivision or commercial developments and special notes as required. These notes shall contain the Date of Issuance. No deletions or exceptions to the general notes shall be made. See the Engineering Standards, Part 3-Plan Notes.

4. Estimate of Quantities

Estimate of Quantities are to be presented in tabular form using the City of Columbus Item Number or specifying otherwise. All phases must be clearly broken out in the quantity table and on all plan sheets. This table could be included on the General Note Sheet or a separate sheet along with other details. Placing this table on the title sheet is strongly discouraged. These quantities must contain, at a minimum:

A. Lengths and sizes of all proposed utilities and their services
B. Type and Class of all utility conduits
C. Sidewalk and bike path within public right-of-way
D. All public and private roadway items.

5. Details Sheet

The following details need to be provided on this sheet if they deviate from the COD standard detail. This sheet may also be used for any additional pertinent detail drawings needed to adequately describe the construction process.

A. Entrance/approach details
B. Typical pavement sections
C. Show proposed curb
D. Sidewalk

6. Site Demolition Plan

This sheet shall be provided on an as-necessary basis to provide clarity for projects that will be removing existing buildings and structures. It may be combined with the Site Survey Plan at the discretion of the design engineer and with approval the Project Engineer.

7. Site Survey Plan

This sheet shall be provided for all easements and boundary information as well as existing structures. It shall be provided on an as-necessary basis at the discretion of the City.

8. Site Dimension Plan

The site dimension plans shall contain all information necessary for the establishment of the horizontal dimensions of the site including, but not limited to, the proposed building pad(s) location, pavement, setback, rights-of-way, property lines, easements, curb radii, sidewalks, and bike paths. Detailed site improvements such as on-site lighting, utility features, proposed landscaping, signs, grade spots and topographic contours must not be shown on the site dimension plan. This plan shall contain the following information with all appropriate elements clearly dimensioned and labeled:

A. Site layout, to scale, showing existing/proposed buildings, structures, roads

B. Driveway and parking areas
C. Proposed and Existing Storm Water and Sanitary lines and structures
D. Barricade locations
E. Sidewalks
F. Light and power poles
G. Waterways
H. Detention/retention basins
I. Tree/vegetation limits
J. Clearing limits, property lines, utility easements,
K. All property lines, labeled with metes and bounds of the property
L. Identify all contiguous property owners
M. Label property size, subdivision name, and lot number (as applicable)
N. Label current zoning of the property and intended use of all proposed buildings
O. Show and label any FEMA designated floodway, 100-year floodplain ,or OEPA required setback (as applicable)
P. Note any required vehicular access restrictions to public streets
Q. Show and dimension any required emergency vehicle access
R. Show the intersection visibility triangle at all adjacent street intersections (refer to ODOT standards)
S. Show and label all existing and proposed rights-of-way, easements (including type), and no-build zones
T. Show and label centerline, edge of pavement and/or back of curb, and right-of-way of all adjacent public or private streets. Dimension the total width of the street (note EP – EP or BC – BC) and right-of-way (proposed and existing)
U. Dimension all pavement and parking lot areas and note where the dimensions are taken from (e.g. edge of pavement, face of curb, or back of curb). This should include the pavement width, radius returns of curbs, parking spaces, and aisle width
V. Label size, location, and type of all proposed sidewalks or bike paths including all ramps to be built on site or within the public right of way
W. Label location and proposed size of all dumpster enclosures and pads
X. Show and label all required front, side, and rear yard setbacks, including all building and pavement setbacks
Y. Show and label all proposed and/or existing ingress/egress, access, or cross access easement aisles, drives, or driveways

9. Composite Utility Plan

These sheets shall contain all information of the underground and above-ground utilities, easements, rights-of-way, and pipe alignments, including, but not limited to, storm sewer, sanitary sewer, waterline, field tiles, roof drains, gas lines, electric lines, fiber optic lines, cable lines, and associated services. This plan shall contain the following minimum information.

A. All existing (dashed) and proposed (solid) utilities including all field tiles and drainage ditches.
B. Size and type (water, sanitary, etc.) of proposed and existing utility services, mains, and tees.

C. Invert at proposed building and end of service elevations of sanitary services in tabular form
D. Proposed pad and finished floor elevations
E. Location of all fire hydrants, meters, valves, and related service taps
F. Gas lines, Utility Poles (including pole ownership)
G. Property Lines, Easements, and Right-of-ways
H. Bearing and Distance of storm and/or sanitary main lines, measured from center of structure to center of structure, in tabular form as appropriate to plan set
I. Provide a Chart with State Plane Coordinates that includes blank columns for as-built information for storm structure, water structures (valves and Fire Hydrants only), and sanitary manholes.

10. Storm Sewer Profiles

The following information is required on all storm sewer profile sheets:

A. The storm profiles shall state the size, slope, pipe material and class of proposed pipe
B. Existing and proposed grade above the storm sewer
C. All proposed utility crossings
D. The 5-year hydraulic grade line shall be shown on the profiles.
E. The permanent pool and 5-yr ponding elevations must be shown at all end of run locations where the storm system empties into a retention basin.
F. Storm sewer top of casting and invert elevations
G. Structure and Headwall type labeled
H. All backfill types and limits, denoted with hatching. Influence lines and CGB limits are to be shown and stationed
I. Profiles are required for all public and private storm lines
J. Bedrock and groundwater table elevation (if known) shall be shown in all profiles.

11. Grading Plan

These sheets shall contain all information necessary for establishing grades and elevations on the site. Pipe alignments and critical elevations necessary for layout shall be displayed. The proposed grades shall be blended with adjacent property grading. This plan shall contain the following minimum information:

A. Existing contours. (1-ft intervals) Contours shall be extended 50-ft (minimum) beyond the project work limits to show adequate tie-in.
B. Proposed elevation including spot grades and/or contours
C. All existing (dashed) and proposed (solid) storm sewer and other utilities
D. Proposed pad and finished floor elevations of all proposed structures
E. Sanitary and storm sewer top of casting elevations
F. Grading limits
G. Roadway slopes and grades
H. Top of curb and back of walk grades at all lot-lines and grade breaks
I. Proposed landscape mounding contours
J. Major flood routing arrows
K. Major flood routing cross sections with 100-yr flow elevation

L. Rear yard ponding limits and elevation for the major storm
M. Street ponding limits and elevation for the 5-year design storm
N. Ditch centerline including direction of flow and slope
O. Cross-sections of ditches in right-of-way (at 50-foot intervals)
P. Driveway slope(s) from building lines to right-of-way lines
Q. A pre-grade (interim) plan may be required in subdivisions because the final grading of the individual lots will not be done with the initial infrastructure improvements. The development must be well drained when the Developer requests the API; therefore, it must be clearly shown how the area will drain in the interim conditions.
R. Open channels - typical cross sections shall be shown for all proposed open channel systems including, but not limited to, flood routing swales, roadside ditches, and minor storm conveyance channels. Typical cross sections shall show the appropriate dimensions and side slope values for each channel.

12. Basin Details Sheet

Dimensioned cross sections and plan views for each water quality BMP selected shall be shown. A table showing the required WQv and drawdown time as well as the designed storage and designed drawdown time of the basin shall be shown.

A. Ponding tabulations:
    1. Storage needed and provided for the 1- through 100-year return frequency events that were calculated in the stormwater management report.
    2. Elevation of water surface at each of the calculated storm events.
B. Orifice plate location and details
C. Spillway area details - emphasize critical spillway elevations such as top of bank, 100-yr ponding elevation, etc.
D. Outlet design details
E. Culverts: A profile for each roadway culvert shall be provided showing invert, roadway edge of pavement and/or top of curb, roadway centerline, and design storm and 100 year headwater and tail-water surface elevations. A table with each profile shall also be provided showing the Design and 100-year storm discharge values, head and tail water elevations and outlet velocities. Appropriate erosion control (i.e. rock channel protection type and size) must be shown.
F. Provide cut section through the pond. Cross sections of detention basins, wet or dry, shall be provided and dimensioned. Side slopes, basin bottom slope, the elevation of each inlet and outlet structure, and maximum water surface elevations for WQv storage, the critical storm, and the 100-year storm shall be annotated. An elevation view and plan view of each outlet riser structure shall be provided and annotated. Cross sections showing side slope, side slope information, bottom width dimensions, overflow weir elevations, bottom lining etc. shall also be shown.
G. For all basins provide the following information:
    1. 100-year Flood Pool Elevation
    2. Flood Limits
    3. Show pond contours - Max Side Slope 3:1 (4:1 Preferred)
    4. Emergency overflow location
H. Wet Basin, provide the following information:
    1. Normal Pool Elevation
    2. 8-feet wide safety shelf elevation 2-feet below normal pool

3. Pipe into pond may retain water to invert of first structure, however all submerged pipe must have watertight joints.
4. Depth to bottom of basin from normal pool is 8-feet minimum
5. 1-foot minimum freeboard from 100-year flood elevation to top of bank

13. Erosion & Sediment Control Plan

These sheets are to be submitted as part of the plan set as well as the SWP3. The site grading shall serve as the base information for the erosion and sediment control plan. Erosion and sedimentation controls shall meet the minimum requirements of the OEPA and the City of Delaware. The erosion control plan may be combined with the grading plan. The erosion and sediment control plan shall contain the following minimum information:

A. Inlet protection locations
B. Silt fence locations
C. Check dam locations
D. Construction entrance location
E. Staging area location
F. Fuel storage location
G. Concrete washout location
H. Material and debris storage location
I. Stream crossing locations
J. Location and prevention measures take for any other construction activities that may impact stormwater runoff
K. Temporary sediment settling basin locations

14. Erosion & Sediment Control Details Sheet

These sheets shall contain the following minimum information:

A. To be submitted as part of both the plan set and the SWP3
B. Standard erosion control notes including a sequence of construction
C. Erosion control standard details
D. Stream crossing details
E. Sediment basin and temporary outlet structure details

15. Sanitary Sewer Plan

This plan shall contain all information of the proposed sanitary sewer, services, and easements. The sanitary plan may be submitted as a separate submission, however, it must contain all elements of a plan set, including but not limited to, a title sheet, a complete set of general notes, quantities, detail drawings, etc. This plan shall contain the following minimum information:

A. All existing (dashed) and proposed (solid) sanitary sewer and other utilities showing size, length, and type
B. Sanitary sewer services, including station, size, riser height, extension length, slope, and elevation at end of service in tabular form
C. All easements, ROW, edge or pavement, and building lines
D. Proposed pad and finished floor elevations of all proposed structures
E. Property lines, rights-of-way, and easements

F. A tributary map shall be included either as a separate sheet or on the title sheet as part of the index map (title sheet) depending on the size of the project.
G. Provide a Chart with State Plane Coordinates that includes blank columns for as-built information for all sanitary manholes.
H. Provide stationing, bearings, and distances (center of structure to center of structure) for all sanitary main lines.

16. Sanitary Sewer Profiles

These sheets shall contain the following minimum information:

A. All tie-in point elevations shall be field verified
B. Sanitary sewer profile indicating size, slope, and type of proposed sanitary sewer
C. Existing and proposed grade above the sanitary sewer
D. All proposed utility crossings
E. Sanitary sewer top of casting and invert elevations
F. Locations of clay trench dams
G. All backfill and lines of influence shall be shown and labeled with type and station. Areas backfilled with CGB shall be hatched or shaded.
H. Bedrock and groundwater table elevation (if known) shall be shown in all profiles.

17. Roadway Improvement Plan and Profile Sheets (Including Waterline Details)

This plan shall include all information necessary for the construction of the proposed roadway improvements within existing or proposed right-of-way or easements. This plan shall contain the following minimum information:

A. Typical sections for all roadways that deviate from COD standard drawings
B. The design speed and the posted speed for all roadways, public and private.
C. Existing topographic features within development area
D. Right-of-way and property lines information and neighboring property ownership
E. Existing utility location of all known utilities, public and private
F. Centerline stationing of proposed road
G. Centerline bearing
H. Horizontal curve data for proposed road
I. Profile showing profile grade elevation and existing ground
J. Vertical curve information
K. All utility crossings
L. Location, size, and type of any storm structure located in the ROW
M. The public water main shall be shown on the street plan and profile sheet
N. Locate all service taps, fire hydrants, and valves on both the plan and profile
O. All backfill and lines of influence shall be shown and labeled with type and station. Areas backfilled with CGB shall be hatched or shaded
P. Superelevation tables

18. Intersection Detail Sheets

These sheets shall contain the following minimum information:

A. Intersection details that include curb return radii, intersection grading, curve data n

B. Centerline bearing
C. Centerline and gutter line (edge of pavement) slopes
D. Angle between intersecting centerlines
E. Proposed locations, spot elevations and slopes for all handicap ramps. The ramps shall comply with all ADA standards.

19. Roadway Cross-Sections

Roadway cross-sections are required at 50-ft intervals (minimum) when a ditch section is used or a ditch exists beyond the back of curb.
This plan shall contain the following minimum information:

A. Roadway cross-sections, showing existing and proposed utilities and right-of-way limits.
B. Right-of-Way lines and easements
C. Roadway center line and elevation
D. Existing and proposed cut and fill sections
E. Ditch side slopes
F. Grade tie-in points
G. Longitudinal ditch slope

20. Maintenance of Traffic Plan

This plan shall contain the following minimum information:

A. Traffic control and maintenance information during construction including all temporary signage, signals, pavement markings, barrel and barricade locations, etc.
B. MOT phasing
C. MOT Details and references to ODOT standard drawings
D. Cut-sections showing lane widths

21. Signage and Striping Plan

This plan shall contain the following minimum information:

A. General street layout showing all existing and proposed signage and striping
B. Street centerline and stationing
C. Signage and striping station and offset
D. Signage and Striping details and notes

22. Landscaping Plan

This plan shall contain the following minimum information:

A. Mounding
B. Tree planting location and type
C. Planting Notes
D. Retail sign locations (monument signs only not building signs)

23. Lighting & Fiber Optic Line Plan

The following lighting related items, including but not limited to the isolux diagram, all light fixtures, pole heights, on building fixtures and lighting timing, shall be submitted to

the Planning Department for review and approval. The signed and approved isolux diagram and lighting submission shall be included in the final engineering set.

This plan shall contain the following minimum information:

A. Show isolux diagram
B. General site layout
C. Light pole locations (station and offset)
D. Lighting Notes
E. Street lighting control circuit diagram
F. Lighting distribution diagram
G. Lighting details
H. Fiber optic line and pull box location per project design requirements

Chapter 5: Record Plans & Digital Submission

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1. General information on Record Drawings

Within ninety business days after the Engineer's final inspection, the Developer shall submit for record an updated "as-built" plan to the City of Delaware. The original construction drawings for the improvements shall be revised to reflect the actual construction. Prior to preparing record drawings, it shall be the responsibility of the consulting engineering firm to obtain a copy of the City's redline construction drawing plan set. All changes from the approved plans to utility lines, structures or appurtenance locations, roadway, driveway or parking areas, or any other item must be noted on the plans accordingly. In addition to the requirements of these Standards, the information and data obtained for and presented on the "as-built" plan should conform to the "as-built" survey specifications currently accepted by the surveying profession. The "as-built" drawings shall become the "Record Drawings" for the project and must be clearly noted as such. All Record Drawings shall become the property of the Municipality and shall be on file in the Public Works Department.

Record drawings are required to be submitted in electronic format as well as mylar form. All electronic record drawing information shall be contained on a technology approved by the City Engineer. The computer aided design (CAD) drawings shall have a drawing (.DXF) file type. A separate CAD drawing with all utilities shall be drafted in State Plane Coordinates. Sanitary and storm flow calculations should be included on the electronic format. They shall be made accessible through Microsoft Word and Excel. Consult with the City Engineer's office as to which release of the software is acceptable for storage.

Record Drawing sets must contain the same address as the approved development plan set including title sheet, general notes, details, utilities, site grading, etc. All files must be saved and submitted on a CD-ROM in a jewel case without using any file compression. The CD label shall include the following:

A. Engineering Company Name
B. Project Name
C. Date the data is burnt to CD
D. Designate CD is Record Drawing or Construction Plan.
E. File names should make sense to viewer who may not be familiar with the consulting firms naming conventions and be indicative of the contents of the file.
F. Name of file must be 8 characters and include the phase number (where exists) And no spaces included. An underscore may be used to attach letters where applicable.
    1. Ex: Kroger Phase 1 would be Kroger1.dxf Ex 2: Krgr_ph1.dxf
    2. If multiple sections of a project are being submitted, files shall be placed in separate directories on the CD.
G. Coordinate System
    1. Projection shall be referenced to NAD 83 (86 Revision) Ohio State Plane Coordinate System Ohio North
    2. Elevations should be in the NAVD 88 Vertical Datum using U.S. Survey –Feet, Zone 4976.
    3. The coordinate location of the items listed below shall be obtained by a field survey and with vertical data that meets survey grade accuracy.
H. Complete Record Drawing Submittal:
    1. A TIFF file shall be submitted of all Record Drawings.
    2. A DXF File shall be submitted of the Final Engineering Plans (plan view)

3. One (1) full sized (ANSI D) mylar set
4. One (1) electronic copy on disk or CD (a DXF file containing the base drawing and TIFF files of each of the plan sheets).

2. DXF (Digital Exchange Format) Files

The City of Delaware is responsible for maintaining a comprehensive Geographic Information System. The GIS is used primarily to make the process of data management and data sharing a smoother and faster transition. The Cities database is comprised of several layers such as: Schools, Townships, Major Hydrology, Commercial Building Footprints, 1991 and 1997 GPS points, Zoning, Land Use, Right-of-Way, Parcels, Road Center Line Data, Subdivisions, Flood Plains, Water Lines, Sewer Lines, Spot Elevation, and Topography.

One of the basic tasks involved in cadastral map maintenance is performing updates to property information. With the use of CAD and GIS software, a digital submittal drawing can be directly inserted into the GIS base map. In concept, the engineering CAD drawing should be easily placed in the map to afford these benefits. However, the migration of spatial data from CAD to GIS has its problems and is not a seamless procedure. It has to be planned and implemented so that the issues pertaining to the conversion can be addressed thereby having the maximum benefit.

The process includes setting standards for the submittal of digital plat and subdivision drawings and the technique of converting AutoCAD drawings to a format that is congruent with the ArcGIS database design managed by the City of Delaware's GIS office. In order to comply with our Digital Standards, a DXF (Digital Exchange Format) file shall be submitted to the Public Works Department or the Department of Planning and Economic Development, as appropriate, at the conveyance stage (final plats and needed as-builts).

A Digital Submission Drawing should be created from the base drawing files for the project using the City of Delaware template in DXF format. Each DXF file should be for one section of development. Multiple sections will not be accepted in one file and care must be taken to clearly mark existing infrastructure facilities. Files must be in DXF format (generated in AutoCAD version 2000 or higher.) All pertinent drawing elements will reside in the primary drawing file. There should be no cells, nodes, blocks, or reference files (x-refs) attached to the drawing. This file will include features classified in the standard layers defined in Appendix N. If the drawing contains layers that are not included in Appendix H, then a list of these layers shall also be submitted as an ASCII text file labeled: 'subdivisionname_phasesXX_xlyrspec.txt'.

The completed DXF drawing file shall contain text in standard fonts that can be read without third-party software. All data shall be cleaned at a tolerance of .002 map units. No loop back, turn backs, undershoots or overshoots. No annotation shall be included in any feature layer and no feature shall be included in any annotation layer. Annotation for each layer shall be placed in annotation layers as specified in Appendix N. All City of Delaware required layers shall be made visible prior to submission - all other layers can be removed (preferred) or turned off.

Closure is critical in converting CAD elements to GIS features. All polygonal features shall be closed polylines (i.e. parcel boundaries, subdivision boundary, buildings).

The DXF file shall contain the following infrastructure items:

A. Storm Conduit, Storm Water Manholes, Inlets, Catch Basins, Head Walls, End Walls, Junction Boxes, Etc.
B. Detention, Retention Basins
C. Flood Routing Swales
D. Sanitary Sewer Conduits, Manholes, Lift Stations, Force Mains, Junctions, Laterals, Etc.
E. Water Main Lines, Laterals, Junction box, Valves, Hydrants, Etc.
F. Street Lights, pull boxes, disconnects, underground conduits, circuit cable, controller, power service, etc.
G. Power poles and Lines
H. Traffic Signal Poles and associated items (i.e., underground conduit, wiring, pull boxes, etc.)
I. Underground utilities including fiber optic cables, gas lines, electric lines
J. Underground Utilities Appurtenances (pedestals, junction boxes, etc.)
K. Street center lines, curbs, and edge of pavement
L. Sidewalks and/or bike paths
M. Driveways
N. Parking lots
O. Buildings, if applicable (commercial and industrial)
P. Structures will be points (nodes) and have an appropriate Structure ID on the adjoining text layer.
Q. Storm and Sanitary sewer lines must be lines with a beginning and ending at a structure insertion point. Pipes are to be line segments connecting no more than two (2) structures. Pipes are to be drawn from upstream to downstream
R. All infrastructure pipes will have a length, pipe size (in inches) and material listed on a separate layer and
S. A comma-delimited ASCII text file (or)
T. An Excel file
U. Must have graphical representation of all off-site platted easements, right-of-ways, lot-lines, etc. encompassing infrastructure improvements as closed polylines.
V. Impervious Surface boundary lines must be shown for all buildings, parking lots, driveways, sidewalks, gravel areas, etc as closed polylines.
W. Comma-delimited Text Files for as-built information
    1. All elevation points shall be delivered in a single comma-delimited ASCII text file or an Excel file with the following columns. Each line of the file shall contain values in Ohio State Plane Coordinates for a single point as follows:

        (Easting, Northing, Elevation)
    2. All storm water and sanitary structures will have top of castings and invert elevations listed in a comma-delimited ASCII text file or Excel file as follows:

        (Structure Number, Easting, Northing, Invert in, Invert out, Top of casting)
    3. All infrastructure pipes will have as-built information for the pipe length, pipe size (in inches) and pipe material listed a comma-delimited ASCII text file or Excel file as follows:

        (Name, Length, Size, Material)

3. Record Drawings

Record drawings, also known as "as builts". The City of Delaware requires that record drawing engineering plans be submitted to the City Engineering Department at the completion of each development project.

Record drawings are to be submitted in PDF/A format, and/or in other digital form(s) as deemed acceptable by the City of Delaware and be reproducible to scale. Reproducible mylar format may also be required. Verify with Public Works Department the appropriate format(s) of record drawings to be submitted.

Plans are to include the following:

A. Record Drawings must be clearly noted as such.
B. Record Drawing sets must contain the same address as the approved development plan set including title sheet, general notes, details, utilities, site grading, etc.
C. Prior to preparing record drawings, it is the responsibility of the Engineer of Record to obtain a copy of the City's redline construction drawing set. The information contained in this redline must be incorporated into the record drawings.
D. All changes from the approved plans to utility line, structures or appurtenance locations, roadway, driveway or parking areas, or any other item must be noted on the plans accordingly.
E. All sanitary and storm sewer structures located on the site, whether new or existing, must have top of casting and flowline elevations verified and recorded on the plans.
F. State Plane Coordinates for all newly constructed public utility structures, including fire hydrants and main line water valves.
G. Retention/Detention Basin Volume Calculations based on an as-built survey of the basin must be provided to verify that detention/retention facility was constructed per Stormwater Management Plans. The as-built survey sheets (11 x 17) must be included in the submittal.
H. All flood routing swales must be field verified prior acceptance of the Record Drawings
I. Record Drawings of the the lighting plan must show the location of all streetlights, disconnects, pull-boxes, routing circuit cable, controller cabinet, meter, photo sensor, etc., and 20 foot wide minimum easements for all electrical source feeds between the light poles and power source.
J. Record Drawings of fiber optic conduit and cable instalaltion must show the location of all conduits, cable, pull boxes, etc.

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Chapter 6: Surveying Standards

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1. Purpose

These Standards are intended to define the minimum requirements for the practice of surveying within The City of Delaware. All surveys conducted for the purpose of designing or preparing plans and maps for improvements requiring approval by the City of Delaware shall be performed by or under the direction and close supervision of a Professional Surveyor.

2. Definitions

A. **As-built Surveys:** these are surveys to determine positions of structures as actually constructed. "As-built" surveys are required to check the contractor's work, assure that the structures will function according to design, and provide a record of locations of structures for maintenance and other subsequent design purposes. In addition to the requirements of these Standards, the information and data obtained for and presented on the "as-built" plan should conform to the as-built survey specifications currently accepted by the surveying profession.

B. **Benchmarks:**

1. **Master benchmark:** a vertical control monument which is durable, easily identifiable and permanently located within the development area in a position which affords the highest possible protection from disturbance. At least one "master benchmark" shall be established for each development area.
2. **Master Benchmark Standards**: the elevation of each "master benchmark" shall be determined and established by measurements designed and executed with control over uncertainty, through use of well-designed specifications.
3. **Source benchmark:** an existing, permanently established, and undisturbed monument with a known elevation which is related to the "National Geodetic Vertical Datum" with a high level of certainty.
4. **Temporary benchmark:** a benchmark of a lesser nature and with elevations derived from the "master benchmark" which may be used for control within the development area.

C. **Development Area:** the area of land included within each individual subdivision (or phase of subdivision) as submitted for review and approval.

D. **Photogrammetry:** the science of making measurements on photographs.

1. **Terrestrial photogrammetry** applies to the measurement of photographs that are taken from a ground station, the position of which usually is known or can be readily determined.
2. **Aerial photogrammetry** applies to the measurement of photographs taken from the air and includes all operations, processes and products involving the use of aerial photographs. Among these are included the measurement of horizontal distances, the determination of elevations, the compilation of planimetric and topographic maps, the preparation of mosaics and orthophotos, and the interpretation and analysis of aerial photographs.

E. **Plat, Subdivision:** a map of a subdivision of land prepared in accordance with State Plat statutes and the City of Delaware Subdivision Regulations, located in section 1111 of the city code.

F. **Plat, Survey:** a graphical description drawn to scale showing all essential data pertaining to the boundaries and subdivisions of a tract of land.

G. **Professional Surveyor:** a registered surveyor authorized to practice professional surveying by the Ohio State Board of Registration, as specified under Section 4733 (Adm. Code) ORC

H. **Property Surveying:** the branch of surveying that involves "the art and science of: (1) reestablishing cadastral surveys and land boundaries based on documents of record and historical evidence; (2) planning, designing and establishing property boundaries; and (3) certifying surveys as required by statute or local ordinance such as subdivision plats, registered land surveys, judicial surveys and space delineation" (knowledge of both the weight-of-authority and statute law relative to the establishment of boundaries by both written and unwritten methods is imperative).

I. **Subdivision:** (1) The division of any parcel of land shown as a unit or as contiguous units on the last preceding tax roll into two or more parcels, sites, or lots, any one of which is less than five acres for the purpose, whether immediate or future, of transfer of ownership provided, however, that the division or partition of land into parcels of more than five acres not involving any new streets or easements of access, and the sale or exchange of parcels between adjoining lot owners where such sale or exchange does not create additional building sites shall be exempted; or (2) The improvement of one or more parcels of land for residential, commercial or industrial structures or groups of structures involving the division or allocation of land for the opening, widening or extension of any street or streets, except private streets serving industrial structures; the division or allocation of land as open spaces for common use by owners, occupants or lease holders or as easements for the extension and maintenance of public sewer, water, storm drainage or other public facilities. (Section 711.001, ORC)

J. **Surveying Practice:** includes any professional service which requires the application of special knowledge of the principles of mathematics, the related physical and applied sciences, and the relevant requirements of law for the adequate performance of the art of surveying (included are all major categories of surveying practice, e.g., property, topographic, hydrographic, engineering, geologic, photogrammetric, environmental [remote sensing], and soil surveying, etc.).

3. Engineering Plan and Topographic Surveying

A. The following shall be on all final engineering plans:
   1. The location, description and elevation of the "master benchmark(s)" within the subject development area and the "source benchmark(s)", and
   2. The total expected error and its certainty (90% or greater) in vertical measurements between each "master benchmark" and its respective "source benchmark(s)" based on actual design or sound judgment.

B. Topographic Standards shall be as follows:
   1. The elevation of ninety percent (90%) of all identifiable points shall be in error not more than one-half contour interval.
   2. No point shall be in error more than a full contour interval.

4. Surveys and Monuments

A. General

Survey and monument activities shall meet "Minimum Standards for Boundary Surveys in the State of Ohio" set forth in Ohio Administrative Code Section 4733-37. Permanent monuments shall be tied to and referenced in the Ohio Plane Coordinate System.

B. Lot Monuments (pins)

A minimum of four permanent monuments are required. Iron pins must be set on the property corners at the street ROW line on each lot corner after construction of the house and final lot grading Lot pins shall be one-inch diameter iron pins thirty inches long, buried one foot below finish grade and bearing the identification mark of the surveyor or surveying company that set the marker.

C. Boundary Monuments (pins)

Subdivision boundary pins shall be composed of durable material, have a minimum length of thirty inches and a minimum cross-section area of 0.2 square inches. Every boundary monument shall be identified with a durable marker bearing the surveyor's Ohio registration number and/or name or company name. One such monument shall be placed at each corner and at each change of direction of the boundary. When it is impossible or impractical to set a boundary monument on a corner, the surveyor shall set a reference monument along one of the property lines which intersect at that corner. The datum shall be stated.

D. Roadway Monuments

Roadway monuments shall be placed at the intersection of all newly constructed roadways in accordance with the Standard Details. Additionally center punched railroad spikes shall be placed in the centerlines of all new roads at the limits of the subdivision, at points of curve and at points of tangency. The datum shall be stated. A letter of Certification must be submitted for each monument. The letter shall identify the coordinates and elevations of the monument.

E. Certification

Before release of the surety, the subdivider's surveyor shall certify by letter to the City Engineer that all monuments are in place and those disturbed during construction have been replaced.

5. As-Built Plan Requirements

All final copies of plans and maps that are submitted for record shall conform to Section 5, Record Drawings and Digital Submission standards in this document.

Chapter 7: Roadway Design

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For the purpose of design, right of way and pavement width design values are specified for various capacities for each functional classification type of roadway. The basic design elements for arterial, collector and local streets are shown respectively. Wherever possible, the recommended pavement and right of way widths should be adhered to. However, it is understood that the right of way in already established City areas may continue to be less due to constraints such as existing structures or other geographical and or physical limitations. Minimum pavement widths can be utilized under special or restrictive conditions. It should be noted that local and collector roadways without curb and sidewalk are permitted in industrial areas only and require approval by the City.

The information contained in this section is intended to be utilized as guideline to acceptable roadway design within the City of Delaware and should not be construed as a substitute for other governing design standards and regulations such as the Ohio Department of Transportation Location & Design Manuals and the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). For the purpose of roadway design within the City of Delaware, the designer shall follow ODOT CMS most current edition for all highway material item specifications with the exception of Items 604, 608, 609 and 901 where the City of Columbus Construction Materials Specifications (COC CMS) and/or the City of Delaware (COD) specifications are to be followed.

1. Arterial Street Design Requirements

The following table identifies the design parameter for Arterial Streets.

Table 7-1:
Design Parameters for Arterial Streets

	Minor Arterial		Major Arterial	
ADT	3,500 – 10,000		> 10,000	
Number of Lanes	2-Lane	3-Lane	4-Lane	5-Lane
Street Width (Back/Curb to Back/Curb) (FT)	40	40	52	64
Pavement Width (FT)	36	36	48	60
Lane Width (FT)	14	12	12	12
Right of Way Width (FT)	100	100	100	120
Parking Requirements	Parking is typically prohibited for new arterial construction			
Note: The design of arterial streets shall be in conformance with the current edition of the Ohio Department of Transportation's Location & Design Manual Vol. 1.				

2. Collector and Local Street Design Requirements

A. The length of a block for Local Street shall not exceed 1200ft.
B. A minimum 100-ft tangent section of pavement is required between reverse curves.
C. Public streets shall have a normal crown cross-section with 24-inch combination curb and gutter. Straight, 18-inch curb may be substituted on private streets. Approval for substitution shall be made on a case-by-case basis.
D. Sidewalks are required on both sides of public streets unless exempted by the City.
E. Sidewalks are to be 5ft wide and constructed of concrete. A combination bike/pedestrian path shall be 8ft in width and constructed with an asphalt surface.
F. Bike paths and sidewalks wider than 5ft generally require the establishment of an access easement adjacent to the proposed right of way.

G. Tree lawns shall be sloped at ¼-in per foot towards the street.
H. A temporary "Tee" turn-a-round constructed per City Standard Drawing is required at the end of any stub street that services 2 or more lots.
I. Reference City of Delaware Standards for Typical Street Sections and Curb Details.
J. Collector street design parameters are identified in the following table:

Table 7-2:
Design Parameters for Collector Streets

ADT	1,500 – 3,500
Street Width (Back/Curb to Back/Curb) (FT)	40
Pavement Width (FT)	36
Right of Way Width (FT)	70
Design Speed (MPH)	30 - 40
Minimum CL Radius (FT)	350
Minimum Turning Radius (FT)	5
Min/Max Street Grade (%)	0.5/4.0
Minimum "K" Crest Curve	44
Minimum "K" Sag Curve	64
Tree lawn Width (FT)	10
Parking Requirements	Parking is permitted where collector streets serve a primarily residential area however may be restricted where dedicated turn lanes are required near intersections

K. Local street design parameters are identified in the following table:

Table 7-3:
Design Parameters for Local Streets

	Primary	**Secondary**	**Cul de Sac**	**Alley**
ADT	500 – 1,500	0-500	0-250	N/A
Street Width (Back/Curb to Back/Curb)(FT)	36	32	32	16
Pavement Width (FT)	32	28	R=54.5	16
Right of Way Width (FT)	62	58	R=67.5	32
Design Speed (MPH)	30	30	30	15
Minimum CL Radius (FT)	275	225	125	125
Minimum Turning Radius (FT)	20	20	20	20
Min/Max Street Grade (%)	0.5/4.0	0.5/6.0	0.5/6.0	0.5/6.0
Minimum "K" Crest Curve	19	19	19	
Minimum "K" Sag Curve	37	37	37	
Tree Lawn Width (FT)	8	8	8	N/A
Parking Requirements	Permitted	Permitted, one side only	Permitted	Not Permitted

3. Cul-de-sac Design Requirements

A. Maximum length (L) is 700ft measured from the center of bulb to the centerline of the intersecting street.
B. Paved radius is 40ft measured to the back of curb. (54.5ft for L > 250ft)
C. ROW radius is 53ft allowing for an 8-ft tree lawn and 5ft sidewalk. (67.5ft for L > 250ft)
D. Interior islands on larger cul-de-sacs require prior approval of the City Fire Chief
E. Interior Island radius is 25.5ft measured to back of curb.
F. Slope for inside of island is 2% minimum to 8% maximum to curb.
G. Islands shall be constructed with 24" mountable curb.
H. Parking is prohibited against the center island.
I. Island landscaping and maintenance shall be the responsibility of the HOA.
J. Island shall be landscaped with grass and trees as required by City.

4. Alley Design Requirements

A. All alleys are to be constructed in public right of way or a public access easement.
B. Alleys less than 16ft wide must be posted as "One Way."
C. Minimum distance from edge of alley pavement to any structure is 8 ft.
D. Curbs are not required on alleys except at the ends of alley where the intersecting street radius return ends.
E. Inverted crown pavement section in alleys is acceptable and requires continuous centerline underdrain and storm sewer collection.

5. Curb Ramps & Crosswalks Design Requirements

A. Curb ramps are required in all directions at intersecting street corners.
B. Curb ramps are to be designed utilizing the most current ADAAG requirements, in addition to City of Delaware standards.
C. The width of a curb ramp shall be as wide as the width of adjacent sidewalk, but never less than five feet.
D. Mid-block pedestrian crossings are only permitted as approved by the City and must be appropriately signed and striped per City of Delaware Crosswalk Installation and Enhancement Design Guide.

6. Industrial Roadway Design Requirements

Roadways in designated industrial areas shall be designated by the City as "Industrial Pavement" and designed to the following criteria:

A. The minimum pavement width is 28ft with two 12-ft lanes and 2ft paved shoulders.
B. Ditch drainage sections are permitted but not required.
C. No parking permitted on either side of the roadway
D. 50ft turning radii are required at all intersections.
E. Heavy pavement section is required as per the required pavement composition.

7. Private Streets, Parking Lots & Driveways Design Requirements

A. Private streets shall be constructed to the public street standards except as permitted under this section.
B. The minimum pavement width for two-way traffic shall be 20ft; 28ft if parking is permitted on only one side of the street, opposite the water main/hydrants.

C. The minimum pavement width for an uncurbed private alley or one-way street is 12ft edge to edge of pavement.
D. In parking entrances and areas, curbing is required along all driveway entrances, travel lanes, parking lot pavement edges, and around all free-standing traffic or landscape islands. Curbing is not required around small landscape islands abutting a building.
E. Curbing maybe partially eliminated with City approval, as necessary to provide sheet flow storm drainage to meet an approved storm water management plan
F. Parking areas abutting a sidewalk shall be separated by a combination curb/sidewalk, or by a curb and tree lawn configuration. The tree lawn shall be a minimum of 3ft wide. If no tree lawn is present, then the walk must be at least 6ft wide to account for vehicle overhang. Parking blocks shall be installed in all uncurbed parking stalls.
G. The finished grade behind curb shall match the top of curb elevation.
H. Curbing in public right-of-way is to be combination curb/gutter or 18-in straight curb. Extruded concrete curbing is permitted along the perimeter of private parking lots, parking islands and at the end of parking stalls provided the curb is continuously backed by grade to the top of the curb. The curb shall be 7.5-in in height and shall be Class C, 4000 psi mix with fiber reinforcement or continuous rebar reinforcement. The top course of asphalt shall be placed after the curb is installed to aid in anchoring the curb leaving a 6-inch reveal.
I. Inverted crown pavement sections in alleys are acceptable and shall be designed per the City Standard Drawings with 3/16-inch per foot minimum cross-slope. Perforated drain tile shall be installed along the centerline of the pavement and shall outlet directly to a storm sewer collection system.
J. The maximum algebraic difference in the slopes of pavement on either side of a sump or catch basin shall be less than 2.5%.
K. Private streets and alleys shall be constructed to the public street pavement composition standard.
L. Commercial parking lots should be paved with a minimum of 4.0-inch of asphalt over 6-inches of compacted granular base. Areas subject to heavy vehicles loads shall be constructed with 6-inches of asphalt over 6-inches of stone base.
M. All trench backfill and cover requirements for public streets shall apply to private streets and/or parking lots when utilities are located within paved areas.
N. Individual commercial and business driveway approaches shall be constructed of concrete per the City Standard Drawings. At the direction of the City, private streets or high volume commercial or business driveways serving multiple tenants shall tie to the existing public street intersection with a flexible pavement section equivalent to the intersecting public street pavement section.
O. The location of dumpster pads is subject to the access requirements of the City and approval by the Public Works Director. Dumpster pads must be constructed to City Standard Drawings if City refuse service is desired.
P. See the Stormwater Management Section for limitations on ponding in paved areas
Q. Parking lot drive aisles must be a minimum of 24-ft wide.
R. Parking stalls must be a minimum of 9-ft by 19-ft.
S. All parking stalls, painted islands, and internal pavement markings must be striped in white paint unless otherwise required by ADAAG or Ohio Manual of Uniform Traffic Control Devices requirements.
T. Commercial properties and/or multi-family residences utilizing City of Delaware Refuse Services shall design for and provide dumpster pads per City standards.
U. All driveways shall not exceed 8% slope.

8. Intersection Design Requirements

A. Left Turn Lanes

Left turn lanes and all components associated with left turn lanes shall be designed per the most current edition of the Ohio Department of Transportation Location & Design Manual (ODOT L&D), Volume 1-Roadway Design, Section 400. This includes but is not limited to the design of: the approach, departure, or diverging tapers, turn lane length, and storage length.

B. Islands

An island is an area between traffic lanes used to direct and control vehicular movements, divide opposing or same direction of traffic streams, or provide pedestrian refuge. Islands shall be designed per the most current edition of the Ohio Department of Transportation Location & Design Manual (ODOT L&D), Volume 1-RoadwayDesign, Section 400.

Curbed islands are required in the City of Delaware. A 100 sq. ft. is preferred, however no less than a 75 sq. ft curbed islands will be typically permitted. All curbed islands shall have a mountable curb and concrete surface.

C. Intersection Angles

Intersection angles are typically designed to intersect at 90 degrees, which may require minor realignment of existing streets. In no case should the angle of intersection be less than 70 degrees. The crossroad alignment should be as close to perpendicular as practicable.

D. Intersection Alignment

Combinations of pavement cross slopes and profile grades may produce unacceptable grade breaks on through intersections. This is especially true where a new roadway intersects an existing divided roadway. A centerline profile of a proposed new cross street centerline should be developed in order to analyze the bifurcation through the intersection. The profile through the intersection should be designed to meet the design speed of the crossroad. Since the grade break across a normal crowned pavement is 1.9% or greater, it should be noted that the crown of the through street must be flattened. This will allow the vehicles on the cross street to pass through the intersection without significantly adjusting their speed.

The maximum allowable grade break through an intersection without constructing a vertical curve and/or flattening the crown of the through road is speed dependent, reference the most current edition of the Ohio Department of Transportation Location & Design Manual (ODOT L&D), Volume 1-Roadway Design, Section 200, for the maximum change in vertical alignment (break in grade) permitted without using a vertical curve.

9. Pavement Section Composition

Pavement section composition shall be as shown on the City of Delaware Standard Details for Pavement Sections, both for flexible and composite pavement (refer to the RDWD series of standard drawings).

A. Asphalt binder grade PG 76-22M may be specified by the City for use in roadways subject to significantly high truck loadings.

10. Alternate Pavement Designs

For the design of new arterial and industrial highway pavement sections, alternative pavement design criteria may be used in determining minimum pavement composition and thickness. Such criteria and methodologies shall be submitted in advance to the City for approval. All pavement materials and construction shall conform to the ODOT CMS (latest edition), unless the City determines that additional requirements are needed for a particular project.

11. Pavement Markings & Signage

All pavement markings for public and private sites are to comply with Ohio Manual of Uniform Traffic Control Devices requirements, or as further specified by this manual. All pavement markings within commercial or industrial development parking areas shall be completed in white paint unless otherwise required by ADAAG or Ohio Manual of Uniform Traffic Control Devices requirements.

If "No Parking" zones are required, they should be specified on the same side of the street as the fire hydrants. Approaches to intersections or major entry ways may require "No Parking" zones on both sides of the street. No Parking signs adjacent to an intersection must include the text "From Here to Corner", and must have one arrow pointing towards the intersection. All pavement markings on public roadways are to conform to Item 644 Thermoplastic pavement markings. Temporary painted marking are permitted in cold weather, but they must be replaced with permanent thermoplastic markings before the roadway will be accepted.

12. Maintenance of Traffic (MOT)

A detailed Maintenance of Traffic Plan (MOT) is required for all construction activities within the public right-of-ways. The MOT plan is required as part of the plan set for major road improvements and widening projects but can be submitted separately by a contractor in advance of construction activities or in conjunction with the required Public Way permit.

Construction plans shall include the note "*The Maintenance of Traffic plan is the responsibility of the contractor. A Maintenance of Traffic Plan must be submitted at the time of the Pre-Construction Meeting and be approved by the City in advance of any construction activities within the public right of way.*" MOT plans should be prepared in compliance with OMUTCD, , current edition. Additional MOT plans and permitting may be required for projects within Delaware County, Townships, or ODOT jurisdictions.

13. Emergency Vehicle Access

In accordance with City of Delaware Codified Ordinances, Part 15, all streets (including but not limited to arterial, collector, local, private, alleys, and emergency access drives) shall:

A. be designed and constructed with a sufficient width to provide adequate access for emergency vehicles
B. have a minimum clearance of fourteen feet for all overhead obstructions.

Please reference the Infrastructure Design Guide, Appendix E: Ladder Truck Turning Performance Analysis for the specifications and apparatus turning radius requirements.

14. Roundabouts

Roundabouts shall be designed per the most current edition of the Ohio Department of Transportation Location & Design Manual (ODOT L&D), Volume 1-Roadway Design, Section 400, the OMUTCD for signage and pavement markings, and City of Delaware Standard Details.

Roundabouts in the City of Delaware shall be designed using the RODEL Software System or other pre-approved software. The decision to install a roundabout must be approved by the Public Works Department at the planning stage of the project.

For additional information, see the most current edition of Federal Highway Administration's Roundabouts: An Informational Guide (NCHRP Report 672).

15. Traffic Calming Features

Traffic calming features, including but not limited to median islands, intersection or mid-block bump outs, curb extensions, etc., shall be provided and installed by a project on any public street as determined by the Public Works Department/City Engineer. All traffic calming features shall be in conformance with the City of Delaware Traffic Calming Manual and designed on the engineering plan set.

Chapter 8: Traffic Impact Study (TIS) Standards

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1. Purpose of a Traffic Impact Study (TIS)

The primary objectives of a TIS are as follows:

A. Provide a basis for assessing the transportation impacts of a new development or expansion of an existing development and the need for any improvements to the adjacent road system to provide satisfactory levels of service and address safety issues.
B. Address relevant transportation issues associated with development proposals that may be of concern to neighboring residents, businesses, and property owners.
C. Determine the appropriate location, spacing, and design of the access system for the proposed development, in compliance with City standards and sound engineering judgment.
D. Evaluate the internal circulation and connectivity of the proposed development to provide safe and efficient internal traffic flow and access(es) to and from the adjacent and nearby roadway system.
E. Ensure compliance with the current edition of the City of Delaware Transportation Plan.
F. Provide a basis for improvement and funding discussions in conjunction with zoning, special permit, and subdivision plat approvals.

2. TIS Warrants

A TIS shall be submitted when a new development or expansion of an existing development generates greater than 100 trip ends during the peak hour of the land use or the peak hour of the roadway. These trip ends are to be calculated using the latest Institute of Traffic Engineers (ITE) trip generation methodology and definitions. If the proposed development is to be implemented in phases, each major phase along with the total development trips shall be calculated for warrant purposes. The table below serves as a guideline to determine the minimum size of typical developments which would require a TIS.

Table 8-1:
Guidelines for the Minimum Size of Typical Land Uses Requiring a Traffic Impact Study*

ITE Land Use Code	Land Use	Size
210	Single Family Homes	100 DU
220	Apartments	150 DU
230	Residential Condominiums/Townhomes	200 DU
710	General Office	50,000 sf gfa
820	Shopping Center	all
832	High Turnover, Sit Down Restaurant	all
834	Fast Food Restaurant with Drive-Thru Window	all
845	Service Station with Convenience Market	all
850	Supermarket	all

* Actual requirement is based on trip ends greater than 100 during the peak hour of the land use or the roadway.

A TIS may also be required for the following situations unless in the opinion of a qualified traffic engineer, the development will generate less than 100 trips in the peak hour of the land use or the peak hour of the roadway:

A. All developments which are not addressed in the latest ITE Trip Generation Report
B. Mixed use developments

C. Proposed development and redevelopment at locations where the existing roadway network already functions at an unacceptable level of service.

The City of Delaware retains the right to request a TIS or other traffic study for a non-major development (less than 100 trip ends during the peak hour of the land use or roadway). Such a request shall be made within 30 days of the receipt by the City of the developer's application for rezoning, zoning variance, special permit, or preliminary subdivision plat.

The City shall be consulted to determine if a revised or new TIS is required where development plans change significantly between the time that one rezoning, zoning variance, special permit, or preliminary subdivision plat approval is granted and another is sought.

3. TIS Preparer Qualifications

Engineers with specific training in traffic and transportation engineering shall prepare a TIS under the supervision of a professional engineer registered in the State of Ohio. The registered professional engineer shall have experience in traffic engineering and shall sign and seal the report.

4. Methodology Meeting

Prior to commencing the TIS, the preparer shall schedule a meeting with appropriate city staff. Other participants in this pre-meeting may be Delaware County or ODOT staff, where deemed appropriate by COD personnel. The participants at the pre-meeting shall identify and agree upon the following issues and needs prior to the preparation of the TIS:

A. Study Area
B. Opening and Design Year
C. Field data collection requirements
D. Acceptable volume, accident, signal and other traffic data
E. Development phasing, if applicable
F. Peak traffic hours (analysis hours)
G. Trip generation, trip distribution and assignment methods
H. Applicable planning documents
I. Other traffic impact studies prepared for developments in the study area
J. Utilization of MORPC Regional Transportation Model
K. Background traffic and growth factors
L. Acceptable Level-of-Service (LOS)
M. Analyses – i.e., capacity, signal warrant
N. Safety issues – i.e., sight distance and accident data
O. Existing geometrical issues
P. Committed and planned roadway improvements and schedule
Q. Existing Environmental issues that could affect roadway alignment
R. TIS submittal date

The preparer shall submit a Memorandum of Understanding (MOU) which details the assumptions and methodologies agreed upon in the pre-meeting and request City staff concurrence with its contents. The MOU shall be submitted to the City within one week after the meeting and shall be approved within one additional week.

5. Requirements

A. Study Area

The minimum geographical area to be analyzed in the TIS shall be defined as an area which includes all site access drives and the major roadway intersections nearest to the subject development site. The City of Delaware retains the right to modify the minimum study area based on local or site-specific issues or development size. Any changes shall be clearly defined at the pre-meeting and in the MOU.

B. Access Management

Unless otherwise justified, the recommendations made in the TIS shall comply with the standards and specifications contained in the:

1. ODOT State Highway Access Manual for State Highways
2. Access Management Standards set forth by the City of Delaware
3. The City of Delaware South East Area Transportation Improvement Plan
4. The City of Delaware South West Access Management Plan (Industrial Park)
5. The Delaware County Thoroughfare Plan
6. The ODOT District 6 Delaware US 23 Access Management Plan
7. And any related, applicable transportation plans

C. Design Year

The table below shall be used to determine the design year to be implemented.

Table 8-2:
Vehicle Trips vs. TIS Design Year

Vehicle Trip Ends in the Peak Hour of the Proposed Development	TIS Design Year
100 but less than 400	10 years from the planned build-out of the development
400 or greater	20 years from the planned build-out of the development

Note: The planned build-out date is to be used as the default condition.
Opening day may be used at the discretion of the City on a case-by-case basis.

D. Existing Conditions

The TIS shall examine existing conditions using Synchro® software and level-of-service (LOS) using traffic count data less than one year old unless otherwise agreed upon during the pre-meeting.

E. No Build/Build

The TIS shall examine "before and after", or No Build and Build, conditions in order to evaluate traffic impacts associated with the proposed development. No Build and Build conditions shall be calculated for the opening year and for the design year using the current edition of Synchro® Software from Trafficware® Ltd., based on the procedures of the current edition of the *Highway Capacity Manual, TRB Special Report #209*. If the proposed development is to be implemented in phases, each major phase shall be analyzed and the conditions noted in the MOU.

F. Analysis Time Period

All analyses shall examine the weekday peak traffic hours of the adjacent roadway. However, land use classifications which experience their highest trip generation levels during periods other than weekday street peak hours shall require analyses of off peak conditions to determine proper site access and turn lane storage requirements. Examples of such land uses include but are not limited to shopping centers, discount stores, recreational uses, and special events. The peak traffic hours to be analyzed shall be decided at the pre-meeting and be clearly stated in the MOU.

G. Site Traffic

Trips generated by the proposed site development shall be calculated using the current edition of the Institute of Transportation Engineers (ITE) *Trip Generation* manual and the methodologies contained therein including those relating to pass-by, internal and diverted trips. The engineer is cautioned not to automatically assume the least value assigned to any specific trip generation category.

Distribution and assignment of the site traffic shall be based on the method agreed upon at the pre-meeting and on engineering judgment and take into account the following:

1. Type of proposed development and the area from which it will attract traffic
2. Size of the proposed development
3. Surrounding land uses, employment centers, residential centers and population during both opening and design years
4. Conditions on the surrounding street system
5. Logical routings
6. Projected roadway capacities
7. Travel times

H. Non-site Traffic

All significant developments within the study area that have approved or TIS studies should be identified and incorporated into the study. The land use type and magnitude of probable future developments should be identified during the pre-meeting and enumerated in the MOU. The method of projecting non-site traffic shall depend upon the area of study. Use of the traffic volumes from the transportation model, historic growth rates, or the buildup method shall be agreed upon during the pre-meeting and documented in the MOU.

I. Level-of-Service (LOS) Criteria

It is the goal of the City of Delaware to maintain a LOS D or better during peak traffic hours for the operation of all roadways. In any area where the current level of service D or worse during peak traffic hours, this baseline level of service must be maintained or improved after development.

All approaches shall be required to be a LOS D or better. All individual movements on public roadways shall be required to be LOS E or better.

J. Mitigation

Recommendations shall be made in the TIS for site access points, external roadway improvements such as additional through lanes and turn lanes, and traffic control devices necessitated as a result of the proposed development. The developer will be

required to mitigate the impacts of traffic generated by the project. The time period for the recommended improvements shall be identified, particularly if improvements are associated with various phases of the development. Identified improvements to the roadway system, unrelated to the proposed development, shall also be reported.

K. Traffic Signal Warrant

Traffic signal warrant analyses shall be conducted at un-signalized intersections in the study area for Opening Day and the Design Year and at all multi-movement access points to the proposed development. A full signal warrant analysis and an estimation of the year the warrant is met shall be done if the main site access appears to meet Traffic Signal Warrant 1 (Eight-Hour Vehicular Volume) or Warrant 2 (Four-Hour Vehicular Volume) based on the current edition of the Ohio Manual of Traffic Control Devices (OMUTCD). Any proposed access or intersection which meets signal warrant thresholds but does not otherwise meet the spacing requirements and standards noted in the ODOT *State Highway Access Management Manual* for the access category assigned by the City of Delaware Transportation Plan may be required to be redesigned, reconstructed, and/or relocated.

Any other signal warrant may be required to be analyzed on a case-by-case basis at the discretion of the City. If a signal is warranted it may not be permitted if it conflicts with the City of Delaware Transportation Plan.

The City reserves the right to require access limitations to offset the warrant if adequate signal spacing cannot be accomplished. Conversely, the City may approve a signal where it is technically not warranted if it is in the public's best interest, is needed from a practical standpoint, and is justified by sound engineering judgment.

L. Turn Lane Criteria

1. Left Turn Lane

   A left turn lane at driveways or unsignalized movements at intersections should be provided under the following conditions:

   a. In accordance with the current edition of the ODOT *Location and Design Manual*, Volume 1, Section 400.
   b. On major and minor arterial roadways with posted speed limits greater than 40 mph.
   c. On major collector roadways with posted speed limits greater than 40 mph and more than 10 left turning vehicles during the peak hour for full build out of the development.

   The size of left turn lanes shall be the minimum per this Manual or be based upon the criteria contained in the current edition of the *ODOT Location and Design Manual*, Volume I, Section 400.

2. Right Turn Lane

   Right turn lanes should be provided in accordance with the current edition of the ODOT *Location and Design Manual,* Volume 1, Section 400, with the following exceptions:

   a. Right turn lanes are not required for right turn volumes less than 10 vehicles during the peak hour for full build out of the development.
   b. Right turn lanes are not required for less than 200 vehicles in the peak hour in the approach lane or curb lane for roadways with greater than 1 approach lane for full build out of the development.

Left or right turn lanes shall also be required when deemed necessary for safety as determined by the City of Delaware.

6. Report Contents

Each TIS shall have, along with the body of the report, the following unless a letter report is agreed upon at the pre-meeting:

A. Cover – Noting the name and location of the development, the applicant's name, preparer's name, and report date.
B. Title Page – Containing all information on the cover in addition to the applicant's street and email address, telephone and fax numbers; the preparer's street and email address, telephone and fax numbers and the preparer's signature and seal.
C. Table of Contents
D. List of Exhibits and Tables
E. Executive Summary
F. Summary of Revisions (for revised reports)
G. Body of Report
   1. Proposed Site Development
   2. Area Conditions
   3. Existing Traffic
   4. Trip Generation and Distribution
   5. Site Traffic
   6. Total Traffic – Opening Year and Design Year
   7. Traffic Analyses
      a. Capacity Analyses
      b. Signal Warrant Analyses
      c. Turn Lane Warrant Analyses
      d. Sight Distance
      e. Accident Analyses
   8. Conclusions
   9. Recommendations – including the identification of responsibility for all recommended improvements
   10. Appendix

The following items shall also be included in the body of the report:

1. Location Map
2. Site Layout Map

3. *Site Trip Generation Factors and Volumes Table* – including the specific excepts from the current edition of the Institute of Transportation Engineers (ITE) *Trip Generation* manual
4. Site Traffic Distribution by Percent Map
5. Existing Traffic Volumes Map
6. *Opening Year Traffic Volumes Map* – use A + B + C + D = Total diagram where A is opening year background traffic, B is other site traffic (if applicable), C is site pass by traffic, D is site traffic
7. *Design Year Traffic Volumes Map* – use A + B + C + D = Total diagram where A is design year background traffic, B is other site traffic (if applicable), C is site pass by traffic, D is site traffic
8. Internal Trip Capture Table (if applicable) – As approved in the MOU Existing and Projected LOS Table
9. *Preliminary Site Plan Map* - showing recommended improvements, both sides of streets and extending 1000 feet beyond the site.

Digital copy of the Synchro® files and SimTraffic® files (or other pre-agreed upon format(s) as specified by the City) shall also be provided.

7. Submittal

Two copies of the TIS shall be submitted to the City of Delaware Public Works Department at the time of filing an application for zoning or rezoning. If zoning is already in place, the TIS shall be submitted to the Public Works Department at the time of application for Preliminary Plat approval or at the time of application for a Preliminary Development Plan, whichever occurs first.

It is the City of Delaware's goal to review and respond within 6 – 8 weeks of the submittal date of a TIS that is formatted in an acceptable manner to the Department.

- Upon review, if the document is deemed inadequate, the applicant shall be notified in writing and shall have an opportunity to correct the deficiencies and resubmit the report.
- Upon approval, two paper copies and one digital copy (including all Synchro® and SimTraffic® files or other pre-agreed upon format(s) as specified by the City) of the final TIS shall be provided.

Chapter 9: Access Management Guidelines

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1. Purpose

The primary objective of establishing access management guidelines is to expedite the movement of traffic. This is achieved by clearly identifying access points, providing connections between adjacent properties to reduce trips on the through streets, reducing delay by minimizing the number of conflict points between opposing traffic flows, and separating turning movements from through movements wherever necessary and practicable. Successful application of access management techniques create a corridor with a uniform driving environment which improves traffic safety by providing sufficient sight distance and time to react to potential hazards. It also provides property owners and developers access to their site that is as quick, convenient, and reasonable as possible for the property owner's approved use.

Emphasis is on prevention, although correction of some existing conditions can be remedied as the use of a property changes. Such changes happen slowly but can be an essential part of a long-term plan for any community. If access points are allowed to occur at random along a roadway with little or no thought given to proper design or long term effects, it will be very costly, perhaps impossible to correct the situation once development along the corridor is complete. Sometimes, existing conditions can be corrected if a proposal to modify or otherwise redevelop a property is submitted to the City for consideration and approval. The City will consider each case individually and work closely with the property owners to improve access control while maintaining a viable development site for the owner. It should be noted that access management guidelines are not a solution to all traffic problems and do not negate the need for road widening or other geometric improvements.

2. Access Management Categories

There are five access management categories based on the functional classifications of roadways. Each classification defines the degree of mobility for motor vehicle traffic versus recommended access limitations to adjacent properties. The difference in the classifications demonstrates the relationship between the need to control property access and the management of adequate traffic flow. Access management guidelines should be applied to all roadways within the City as reasonably and practically as feasible. If it becomes apparent due to existing or future conditions that a particular roadway, or section of roadway, will be unable to attain the specifications for its assigned access management category, the City may assign a more applicable access management category or provide a site specific access plan.

There remains some difficulty in applying the access management guidelines to the central business district in downtown Delaware. Although the existing access conditions may be deficient according to current guidelines, the "Main Street" facilities in the fully developed urban areas should not have their access category changed. Such routes should have their access treatment accepted of "grandfathered" because upgrading would be disruptive to the local economy, downtown culture, and too costly to justify.

Access Category Description and General Guidelines			
Category		**Characteristics**	**Guidelines**
I	Major Arterial	• High speed (>50 MPH) and volume • arterial freeways primarily utilized by interregional and interstate traffic	Multi-lane facilities, some with medians; controlled access at interchanges; no direct property access permitted.
II	Major Arterial	• High speed (45-50MPH) and volume • Major arterials that primarily carry intercity, interregional and interstate traffic through the city while providing access to properties.	Access points limited to connecting streets at interchanges or public street intersections; Signals at public intersections to be coordinated to minimize through traffic delay; no direct private access permitted unless there are no reasonable alternative means to access property and then access may be restricted to Right in Right Out (RiRo) only.
III	• Major Arterial • Minor Arterial • Collector	• Moderate to high speed (35-45MPH) and volume • Major and minor arterials, and collectors that primarily provide access to business and commercial properties and/or while carrying through traffic for moderate to longer distances through the city.	General provision is to provide one private access point for each parcel unless it can be shown that additional access points are necessary and would not be detrimental to the safety and operation of the roadway. Access may be restricted to right-in/right-out (Ri-Ro) where traffic conditions on abutting street pose substantial risk, congestion or delay in permitting a conflicting traffic movements or turns. Consideration to be given to provide access off side street connections and controlled intersection points. Full access may require provision of left turn lanes to minimize delay and improve safety on through street.
IV	Collector	• Low to moderate speed (25-35MPH) and volume • Collector streets providing access to primarily residential areas with a mix of business uses, and carrying through traffic for short to moderate distances.	General provision is to provide one private access point for each parcel unless it can be shown that additional access points are necessary and would not be detrimental to the safety and operation of the roadway. Access points/driveways may be restricted away from intersecting higher classification streets and should be at least 150ft from street intersections to accommodate minimum vehicle reaction and stopping distances.
V	Local	• Low speed (25 MPH) and volume • minor collector and local streets serving primarily residential areas, where speed limits are 25 MPH with little benefit to providing higher speed of travel.	Provide reasonable and safe direct access to all properties. Driveways should avoid alignment with utility structures, be spaced away from adjacent driveways and at least 100ft from street intersections to accommodate minimum vehicle reaction and stopping distances.

3. Number of Access Points

Each existing tract of land is entitled to one direct or indirect access point to the public roadway network provided the location and design meet the sight distance and design requirements of the City standards. Properties should not be denied all access to the public street system without appropriate compensation for loss in property value. Additional access points are approved on an individual case basis and only when it can be demonstrated that the access point will not adversely affect the capacity or safety of the roadway. In some cases, access points to a property may be restricted to right-in/right-out, left-in only, no left out etc. based on the condition of traffic volumes, speeds, pavement width, and available turn lanes to accommodate traffic ingress and egress movements.

4. Consolidation and Modification of Existing Access Points

Whenever the use of a parcel of land changes, is modified or otherwise upgraded, or where two or more parcels of land are assembled under one purpose, plan, entity, or usage, the existing driveway access becomes subject to review and approval against the current access category guidelines. Access to the modified or improved site should be based upon the developer/owner's plans to use one or more of the existing access points, and/or to close and relocate driveway access. Access points may have to be relocated or restricted based upon changes in traffic conditions of the adjacent street network that may not have posed the same concerns when the original development was initially constructed. In all cases, redeveloped properties shall start with the requirement of permitting a single access point for the property, with additional access points allowable if they can be shown that they are necessary and would not be detrimental to the safety and operation of the roadway.

5. Coordination of Access Points

Access points on opposite sides of category II, III or IV roadways shall be aligned with each other. Access points on opposing sides of a street that do not align may have turning movement restrictions imposed upon them as determined necessary, to maintain the safety and efficient operation of the street network. Access points and driveways shall be designed, located, and constructed in a manner to provide for the coordination of access between adjacent properties for current and future development. In some cases, shared or common access drives may be required to minimize impact to the roadway. Access connections between adjacent properties in the form of parking lot connectors, frontage or service roads shall also be considered to improve internal access with minimal disruption to through traffic flows along the adjacent public street network.

6. Temporary Access Points

In some circumstances, due to phased development or future roadway improvement plans, it is possible to permit an access point with a design or location which will ultimately interfere with the operation of traffic on the through street or is otherwise not in compliance with the access management guidelines, but for now remains the best practical alternative. Such access points must be designated as "Temporary" on all approved plans and documents relating to the development. Plans must also be submitted and approved by the City that address the timing, means, and responsibility associated with the eventual abandonment of the temporary access point and construction of the permanent access point, before the temporary access point is approved.

7. Minimum Driveway and Unsignalized Intersection Spacing

To minimize the potential for accidents and delay to through traffic, access points to businesses, and low volume unsignalized intersections on category II and III roadways should be separated by the minimum distance measured from the nearest edge of adjacent driveways as shown, and in accordance with the posted speed limit. Spacing of driveways between intersections should be as uniform as possible.

Minimum Driveway and Intersection Spacing for Access Management Category II & III	
Posted Speed Limit (MPH)	**Minimum Driveway Spacing (FT)**
25	150
30	200
35	250
40	325
45	495
50	550
55	605

8. Minimum Signalized Intersection Spacing

Preserving the quality of traffic flow and safety requires the spacing of signals that assures the continuous, progressive movement of traffic. Uniform, or near uniform spacing is required for the most efficient flow of traffic. The optimal spacing of signals depends on the cycle length and posted speeds. Long cycle lengths combined with high speeds require long distances between signals, while shorter cycle lengths and lower speeds require closer signal spacing. The need for a signal shall be determined by a warrant analysis using the OMUTCD and conducted by a qualified traffic engineer.

Minimum Signalized Intersection Spacing for Access Management Category I, II, III			
	I	**II**	**III & IV**
Preferred Spacing	At grade intersections not permitted	1 mile	1 mile
Acceptable Spacing		½ mile	½ mile
Minimum Spacing		½ mile	¼ mile

9. Street Listing by Access Management Category*

Street Name	Access Management Category
US 23 (Cottswold Dr to Pennsylvania Av)	I - Major Arterial
US 42 (London Rd to US 23)	I - Major Arterial
US 42 (West of London Rd)	I - Major Arterial
SR 37 (West of Lexington Bl)	II- Major Arterial
SR 521 (AKA Kilbourne Rd)	II- Major Arterial
US 23 (not included in Catergory I)	II- Major Arterial
US 36 (East of "the Point")	II- Major Arterial
US 36 (West of Applegate Ln)	II- Major Arterial
Glenn Parkway	II- Major Arterial
Sawmill Parkway	II- Major Arterial
Sunbury Rd (AKA US 36/SR 37) (E_o "the Point")	II- Major Arterial
Central Av (AKA SR 37) (Lexington Bl to "the Point")	III - Major Arterial
Sandusky St	III - Major Arterial
William St (AKA US 36) (Applegate Ln to "the Point")	III - Major Arterial
Lake St (US 42)	III - Major Arterial
Belle Av	III - Minor Arterial
Cheshire Rd	III - Minor Arterial
Hills Miller Rd	III - Minor Arterial
Houk Rd	III - Minor Arterial
Liberty Rd	III - Minor Arterial
London Rd	III - Minor Arterial
Pennsylvania Av	III - Minor Arterial
Pittsburgh Dr	III - Minor Arterial
Stratford Rd	III - Minor Arterial
Troy Rd	III - Minor Arterial
Armstrong Rd	III - Collector
Berlin Station Road	III - Collector
Bowtown Rd	III - Collector
Braumiller Rd	III - Collector
Curtis St	III - Collector
Curve Rd	III - Collector
Glenn Rd	III - Collector
Henry St	III - Collector
Meeker Way	III - Collector
Merrick Bl	III - Collector
Mill Run Crossing	III - Collector
Nutter Farms Ln	III - Collector
Ohio Health Bl	III - Collector
Olentangy Av	III - Collector
Peachblow Rd	III - Collector
Slack Rd	III - Collector
Warrensburg Rd	III - Collector
Boulder Dr	IV - Collector
Buehler Dr	IV - Collector
Carson Farms Bl	IV - Collector
Cheshire St	IV - Collector
Cobblestone Dr	IV - Collector
Eagle Walk Rd	IV - Collector

Street Name	Access Management Category
Elizabeth St	IV - Collector
Euclid Av	IV - Collector
Executive Bl	IV - Collector
Ferguson Av	IV - Collector
Firestone Dr	IV - Collector
Fountain Ave	IV - Collector
Franklin St	IV - Collector
Grand Circuit Bl	IV - Collector
Hawthorn Bl	IV - Collector
Hayes St	IV - Collector
Heffner St	IV - Collector
Hull Dr	IV - Collector
Lantern Chase Dr	IV - Collector
Lexington Bl	IV - Collector
LincoLn Ave	IV - Collector
Locust Curve Dr	IV - Collector
New Market Dr	IV - Collector
North St	IV - Collector
Park Av	IV - Collector
Pollock Rd	IV - Collector
Rock Creek Dr	IV - Collector
Union St	IV - Collector
Washington St	IV - Collector
Winter St	IV - Collector
Winterbourne Dr	IV - Collector

*This street listing is current as of 12/31/18. Typically other streets not listed are Category V-local streets, however it shall be the developers responsibility to verify the access management category of any street, listed or not listed.

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Chapter 10: Bike and Pedestrian Paths

The City of Delaware requires the inclusion of new bicycle and pedestrian facilities with all new development activities in accordance with our Bicycle & Pedestrian Master Plan. Not every development will include the construction of a new pedestrian facility; however, the Central Ohio Greenways, Design Guidelines, attached herein and referenced as Exhibit 10-1 (13 pages total), shall be the basis of design in the City of Delaware.



DESIGNGUIDELINES

DESIGN GUIDELINES

These guidelines are intended to assist communities in the early stages of shared-use path development. They are simply meant to highlight some of the basic design requirements so that potential path alignments can be screened for possible physical or geometric restrictions so that they may be excluded early to help minimize preliminary engineering expenditures. They in no way cover all of the technical details that a professional engineer or landscape architect would provide to ensure the path satisfies the American Association of State Highway & Transportation Officials (AASHTO) "Guide for the Development of Bicycle Facilities" and Americans with Disabilities Act (ADA) design standards. They are also not meant to conflict with any formally adopted designed standards by local City Engineer / Public Service offices, Parks & Recreation Departments, or other trail organizations.

Definitions:

The following list of terms and definitions is meant to clarify the terminology common when discussing trails. With so many terms and different types of pedestrian and bicycle amenities, it is important that communities speak the same language---that there is a fundamental understanding and agreement---which allows interagency collaboration. As such, a common vernacular is used throughout this manual in describing the trail, its components, and amenities associated with the Louisville Loop. To ensure a shared understanding of the standards and their implications, a list of terms and their usage have been developed. This list of terms and their definitions are intended to reduce confusion and create uniformity throughout the system.

American Association of State Highway and Transportation Officials (AASHTO): A standards setting body which publishes specifications, test protocols and guidelines which are used in highway design and construction throughout the United States. Despite its name, the association represents not only highways but air, rail, water, recreation trails and public transportation as well.

Americans with Disabilities Act of 1990 (ADA): A federal law prohibiting discrimination against people with disabilities. Requires public entities and public accommodations to provide accessible accommodations for people with disabilities.

Americans with Disabilities Act Accessibility Guidelines (ADAAG): Design guidelines for providing access to a range of indoor and outdoor settings by people with disabilities.

Bicycle Boulevard: A local/neighborhood street is modified, by way of traffic calming, to function as a through street for bicycles while maintaining local access for automobiles. Bicycle boulevards are intended to provide an advantage for bicycles over motor vehicles, introducing low speed traffic conditions, and significantly improve bicycle and pedestrian environment.

Bicycle Lane: A portion of the roadway that has been designated by stripping, signing and pavement marking (bicycle stencil and directional arrow) for the preferential or exclusive use of bicyclists. This facility is typically used by experienced bicyclists.

Bicycle Path: A pathway designated for bicycle use, often a multi-use trail separated from other sidewalks and streets.

Bicycle Route: A designated location, either on or off-street, that is identified and designated as a route for bicycle traffic.

Clear Height (Vertical Clearance): The vertical dimension, which must be cleared of all tree branches and other obstructions that would otherwise obstruct movement along the trail.

Clear Zone: The area over and beside a trail that is cleared of trees, limbs, and other obstructions.

Crossing, Grade-Separated: Overpasses or tunnels that allow trail users to cross a railroad right-of-way or street at a different level than trains or traffic.

Crosswalk (Crossing): Any portion of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.

Curb Cut: A cut in the curb where a trail crosses a street. The curb cut should be the same width as the trail.

Greenway: A linear open space established along a natural corridor, such as a river, stream, ridgeline, rail-trail, canal, or other route for conservation, recreation, or alternative transportation purposes. Greenways can connect parks, nature preserves, cultural facilities, and historic sites with business and residential areas.

Definitions Continued:

Multi-use / Mixed-Use Path: These terms have been used in the past for separated paths used by pedestrians and bicycles, but are no longer recommended.

Pavement, Porous/Pervious: A special type of pavement that allows rain and snowmelt to pass through it, thereby reducing the runoff from a site and surrounding areas. There are both special asphalt and concrete porous mixtures that satisfy this criteria.

Pavement, Impervious: Hard surfaces that do not allow absorption of water into the soil and that increase runoff. Examples are standard asphalt and concrete mixtures.

Pedestrian: Any person on foot or in a wheelchair.

Rail-Trail (Rail-to-Trail): A multi-purpose, public path or trail (paved or natural) created along an inactive railroad corridor.

Rail-with-Trail: Any shared-use path that is located on or directly adjacent to an active railroad or fixed route transit corridor.

Right-of-Way: A linear corridor of land held in fee simple title, or as an easement over another's land, for use as a public utility (highway, road, railroad, trail, utilities, etc.) for a public purpose.

Railing: A 47.5-inch high railing for guarding against danger at the edge of a deck, bridge, or boardwalk to prevent people from falling. Also a barrier (posts and steel cables or bars) placed along the edge of a highway at dangerous points.

Shared-use Path: Shared-use paths encompass facilities physically separated from motorized vehicular traffic by an open space or barrier and may be used by pedestrians, bicyclists and other non-motorized users. "Shared-use path" is the official term adopted by the American Association of State Highway and Transportation Officials (AASHTO) and the Ohio Department of Transportation (ODOT) for such facilities.

Sidepath: An inferior option to a shared-use path, but superior to a sidewalk. It is usually wider than a typical sidewalk but not as wide as a shared-use path. The separation is usually less than a shared-use path but equal to that of a sidewalk. Sidepaths are often an interim, less preferred solution.

Sidewalk: A paved strip (typically four to five feet wide of concrete construction) which runs parallel to vehicular traffic and is separated from the road surface by a curb and gutter or grass strip that typically provides for above ground drainage of stormwater. Sidewalks are common in urban areas and in some suburban residential areas.

Sight Line (Sight Distance): The visible and unobstructed forward and rear view seen by a trail user from a given point along the trail.

Definitions Continued:

Signage: A board, post, or placard that displays written, symbolic, tactile, or pictorial information about the trail or surrounding area. Signage provides important safety, wayfinding, or educational information to trail users. **The different categories of signage are:**

Regulatory:

- Tells the "rules of the trail" by prohibiting certain uses or controlling direction of travel.

Cautionary:

- Warns of upcoming roadway crossings, steep grades, blind curves, and other potential trail hazards.

Wayfinding:

- Gives street names, trail names, direction arrows, mileage to points of interest, and other navigational information.

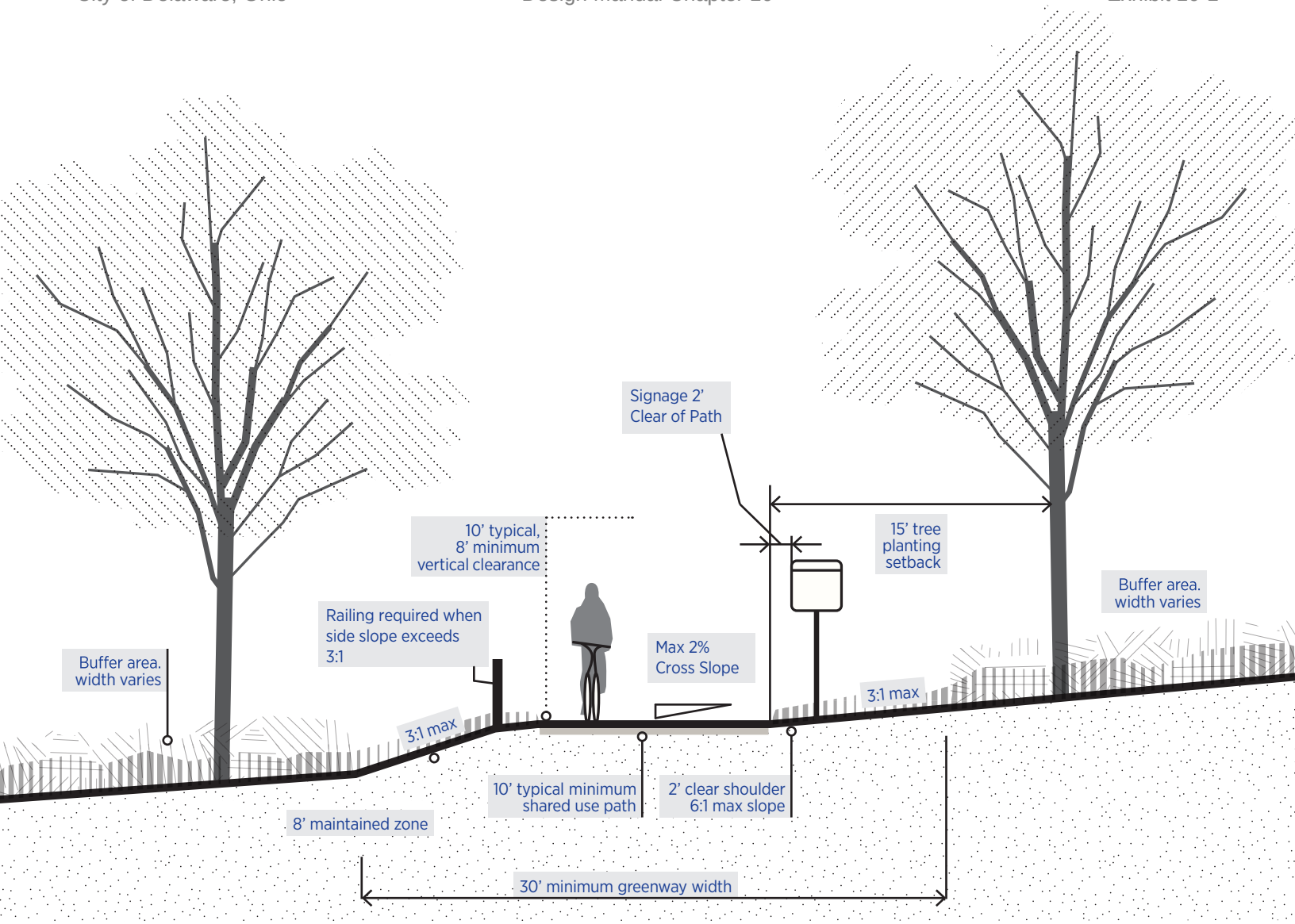
Interpretive:

- Offers educational information that describes and explains a natural or cultural point of interest on or along the trail.

Signed Bicycle Route: A shared lane, without any pavement markings, that is signed for use by bicyclists as a preferred route.

Trail: A trail is a designated route that is physically separated from motorized vehicular traffic by an open space or barrier and may be used by pedestrians, bicyclists and other non-motorized users. "Trail" is the term adopted and regularly used by Central Ohio Greenways (COG) when referring to such facilities.

Trailhead: A physical facility that marks a major access point to a bicycle and pedestrian facility. The shape, size and form of trail head will vary and may include amenities such as parking, transit station, signage, drinking fountain, and art.



TRAIL TYPICAL SECTION

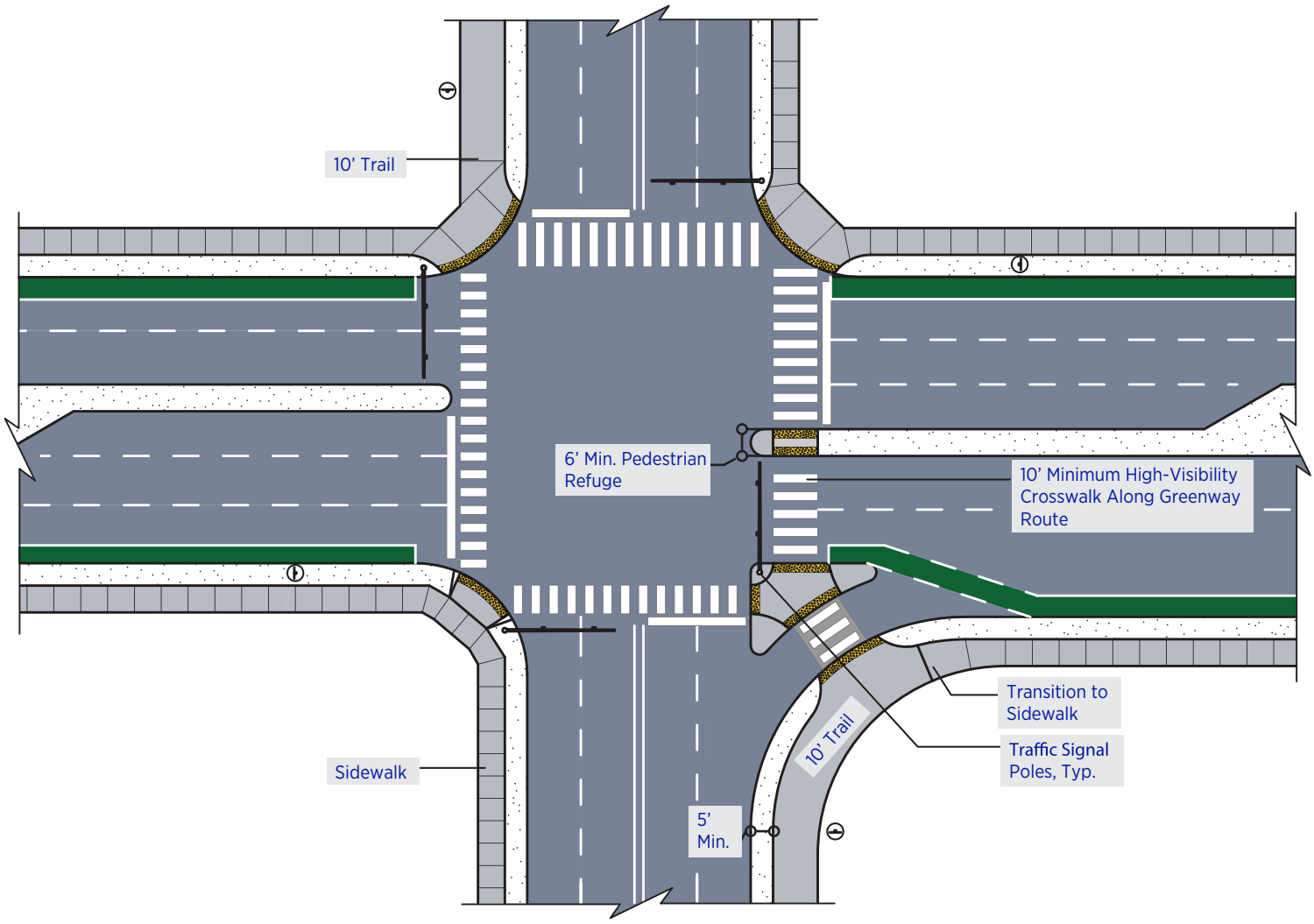
Width: Trail width should typically be 10-foot minimum. In cases of limited right-of-way, an 8 foot wide trail may be used. A wider trail may be necessary in areas that are expected to have a high number of users and/or a greater mix of user types (cyclists, walkers, in-line skaters, etc.) that require more horizontal space for passing.

Paths should have a maximum of a 2 percent cross slope. The maximum horizontal grade should be 5 percent (grades steeper than 5 percent are permitted, but should be limited to distances indicated in the AASHTO guidelines).

Clear Zone: A clear zone should occur on both sides of the shared-use path at a minimum of 2-feet wide. Area should be graded at a maximum slope of 6:1. Additionally, a minimum 1-foot buffer zone between the edge of the graded clear zone and any fixed objects such as signs, mile markers, lighting, or plantings should occur. On bridges this guideline does not apply. The clear zone should include shoulder height obstructions such as pathway signage or fences.

Vertical Clearance: Clear height zone should be a minimum of 8 feet, with 10 feet being typical.

Drainage: Path drainage should be addressed to ensure safe passage for users during moderate rain events.



4-WAY INTERSECTION W/ INTERSECTING PATH

All crossings shall comply with AASHTO and ADA guidelines

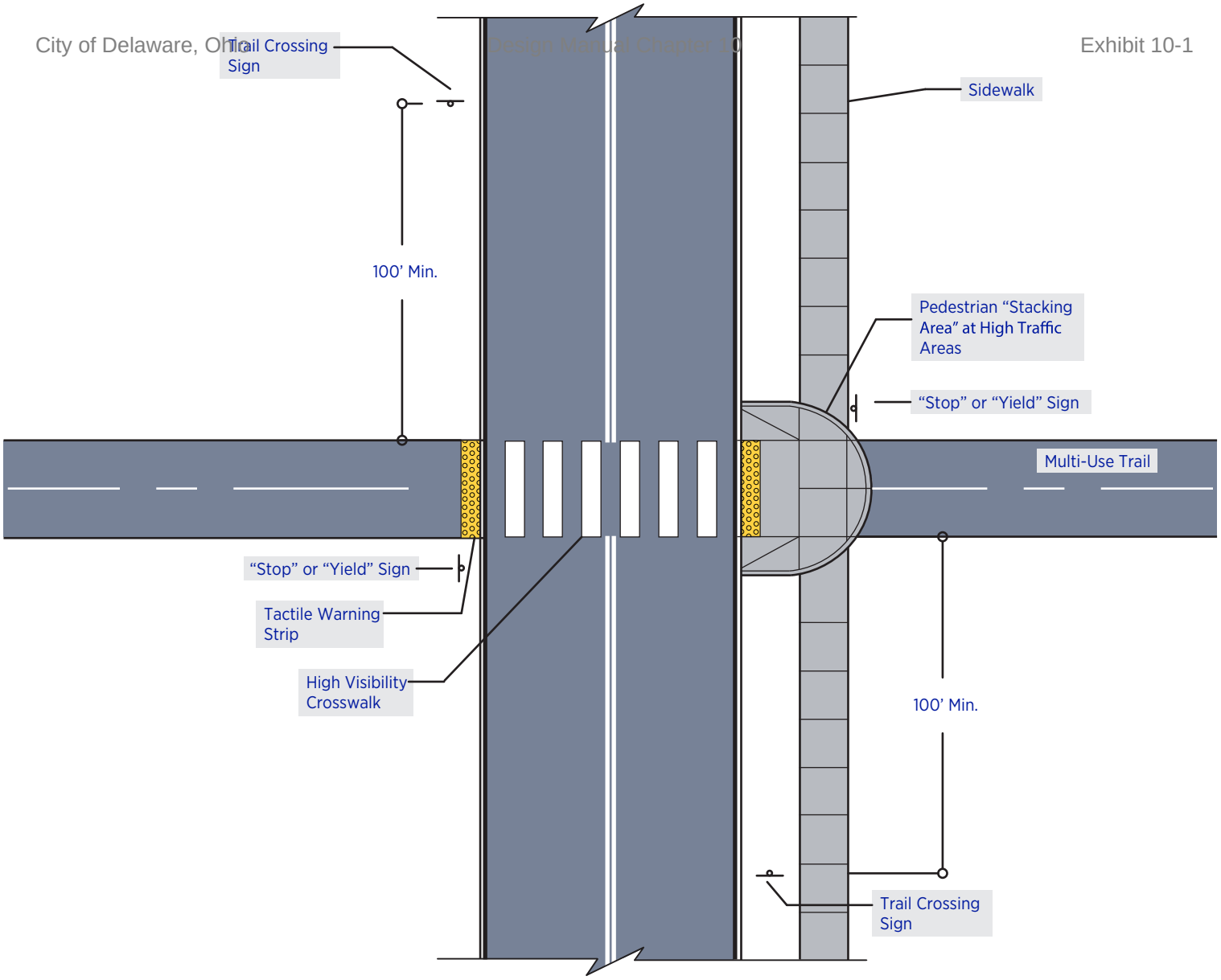
In instances where trails cross through signalized intersections, crossings must be carefully designed and constructed to ensure safety of pedestrians, trail users, and vehicles. For trail users, it is also important that there is a visible, obvious route for the trail or greenway through the intersection. This is especially important at intersections where the trail crosses two streets. This standard illustrates how greenway routes should be incorporated into the design of signalized intersections.

DESIGN:

- At major roadway crossings such as this, the overall design shall be dictated by the Engineering / Public Service Department responsible for the roadway.
- Greenways should be constructed to merge into the existing pedestrian walks at the intersections.
- Sufficient space should be provided to accommodate bicycles and other users from the trail.

MARKINGS:

- Vehicular-scaled signage should be incorporated into the intersection to alert motorists that the greenway route is passing through the intersection.
- If the greenway follows the street well before or beyond the intersection, an additional identification sign should be placed between the trail and street in advance of the intersection to alert motorists that the greenway is sharing the street corridor.
- Crossings should be designed to provide high visibility. High visibility lane markings and signage should be used to call attention to the crossing. All signage shall conform to MUTCD standards.
- For the trail route, the crossing markings shall be the same width as the trail route, or 10' minimum width.
- Pedestrian-activated signals are desired. Signals with "countdown" display preferred.



MID-BLOCK CROSSING: ARTERIAL/COLLECTOR STREETS

All crossings shall comply with AASHTO and ADA guidelines.

Mid-block crossings may be used with special design consideration that include pedestrian crossing signals, pavement markings and signs on the roadway. For vehicles, it is critical that they are alerted and aware of the crossing well in advance. This standard illustrates how mid-block crossings should be used on arterial & collector streets.

TRAILS:

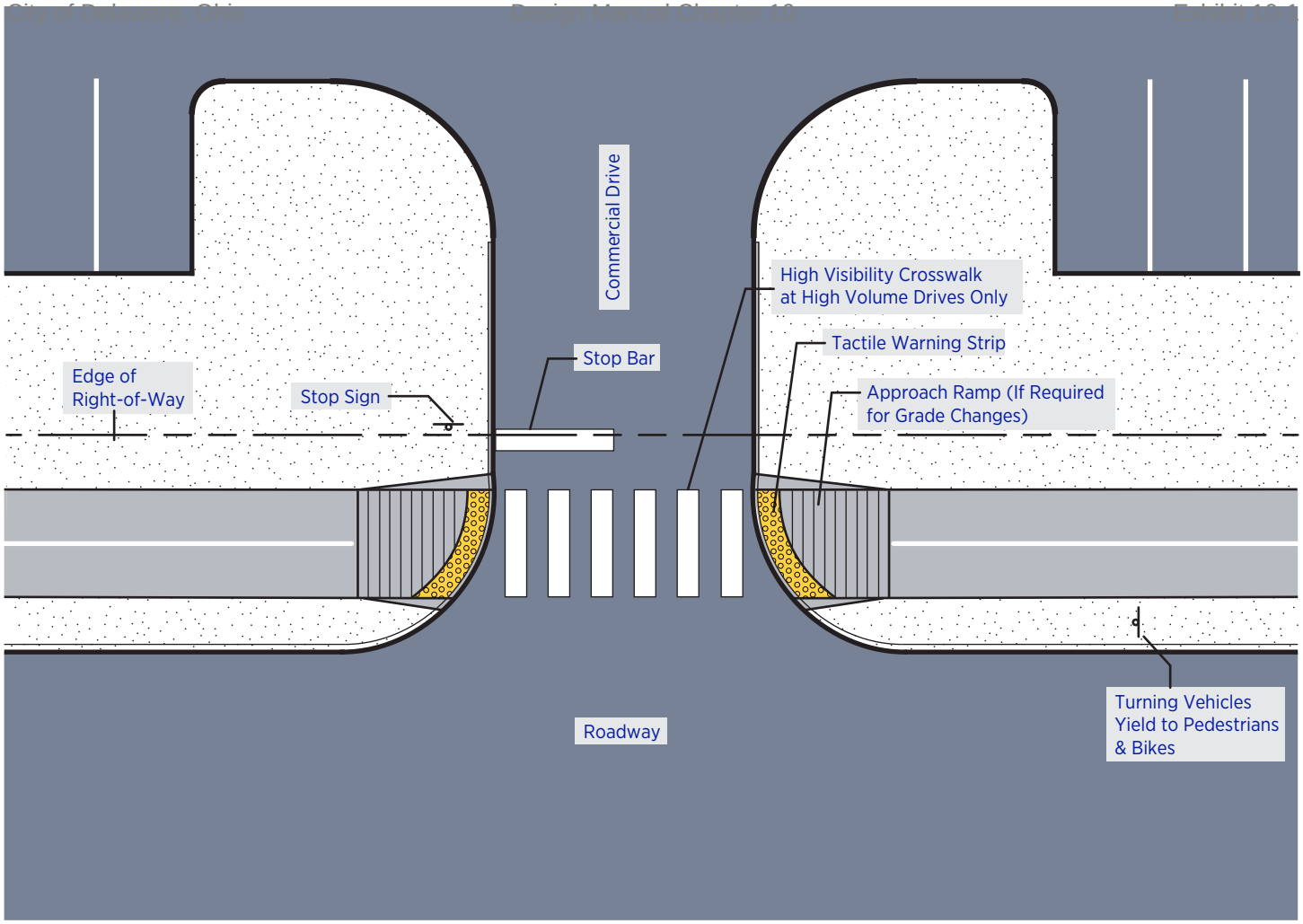
- The trails should cross streets at **90-degree** angles.
- Where trails approach a crossing at a skew, the trail should ideally be routed so that the physical crossing is at 90 degrees to the street; or as close to 90 degrees as practicable.
- When determined to be necessary, pedestrian stacking areas shall be provided at each edge of the crossing and shall be shall be sized to accommodate users waiting to cross the street.

MARKINGS:

- High visibility pavement markings and signage should be used to call attention to the crossing.
- All regulatory signs and markings, for the both streets and trails, should comply with MUTCD's Traffic Controls for Bicycle Facilities.
- Crossing markings shall be the same width as the trail.

TREATMENTS:

- Treatments to increase visibility of the crossing or to increase motorist yielding to trail users, such as overhead signs or pedestrian-activated RRFBs, may be used at mid-block crossings.
- Such treatments should be evaluated on a case-by-case basis depending on the volume/speed of vehicular traffic and volume of trail user crossings during peak vehicle periods.



COMMERCIAL DRIVE CROSSING

All crossings shall comply with AASHTO and ADA guidelines.

In some areas where a greenway follows a street corridor, crossings of commercial drives will be required. Because of the volume and frequency of vehicular traffic at these drives, special design considerations are required to promote awareness of the greenway and ensure the safest condition for both trail users and vehicles. This standard illustrates a typical standard for commercial drive crossings.

TRAILS:

- The trails should cross streets at **90-degree** angles.
- Where trails approach a crossing at a skew, the trail should ideally be routed so that the physical crossing is at 90 degrees to the street; or as close to 90 degrees as practicable.

MARKINGS:

- High visibility pavement markings and signage should be used to call attention to the crossing at high volumes drives.
- All regulatory signs and markings, for the both streets and trails, should comply with MUTCD's Traffic Controls for Bicycle Facilities.
- Crossing markings shall be the same width as the trail.

STOPPING:

- For commerical drive crossings, vehicles exiting a commercial use and entering the street should be required to stop prior to proceeding through the crossing.
- Signage and pavement markings should comply with MUTCD's Traffic Controls for Bicycle Facilities.
- Warning signs should be used along the street for vehicles turning into the commercial drive.
- These drivers should be required to yield to trail users.
- Trail users shall not be required to stop, although measures should be taken to make them aware of the potential interaction with vehicles.
- Warning signs should be used to alert trail users of the approaching traffic.

RESIDENTIAL DRIVE CROSSING

In some areas where a trail follows a street corridor, crossings of residential drives will be required. Since traffic volumes and frequency are low at these crossings, these crossings should be treated differently than commercial drives and minimal design treatments are required. This standard illustrates a typical standard for residential drive crossings.

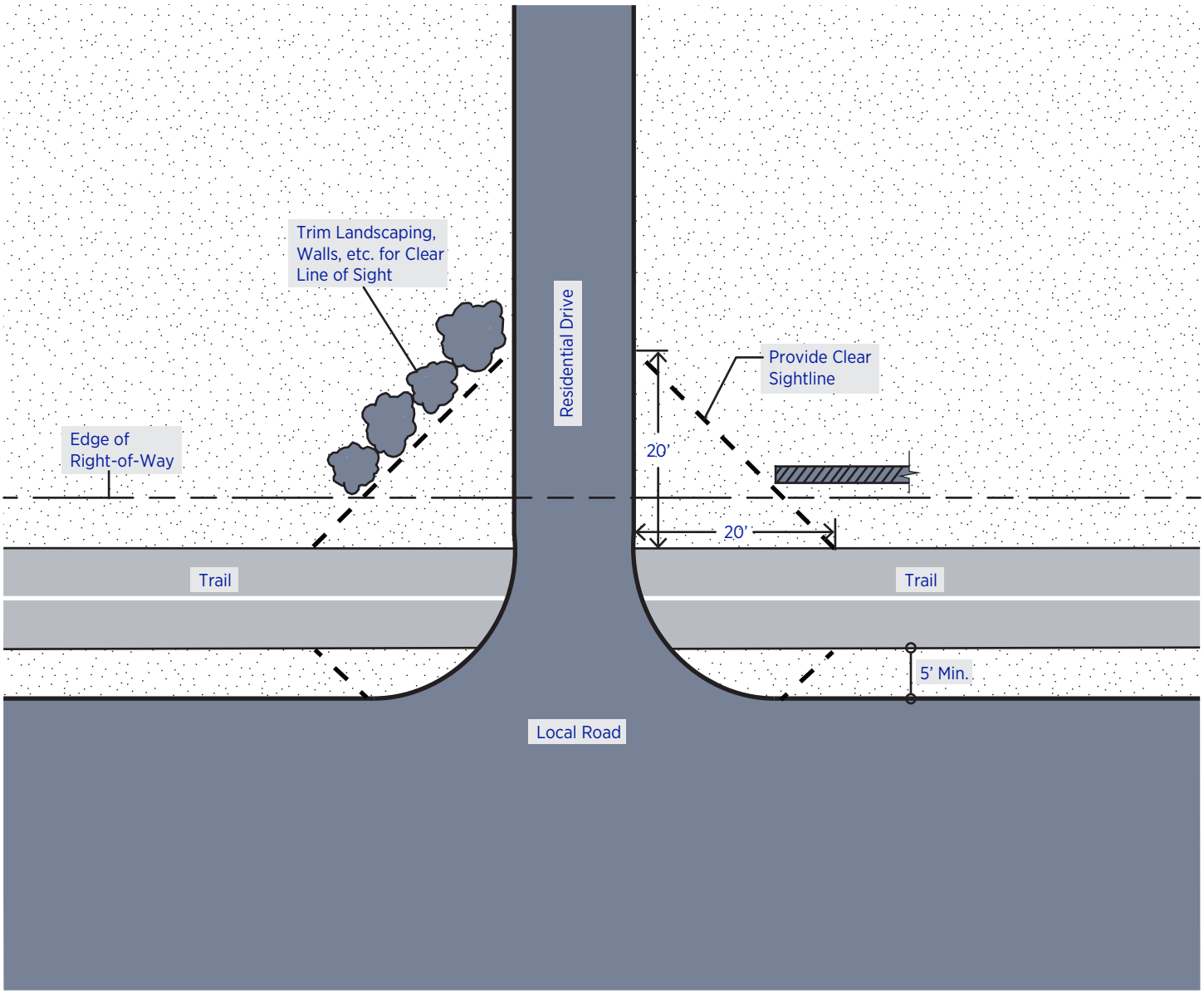
TRAILS:

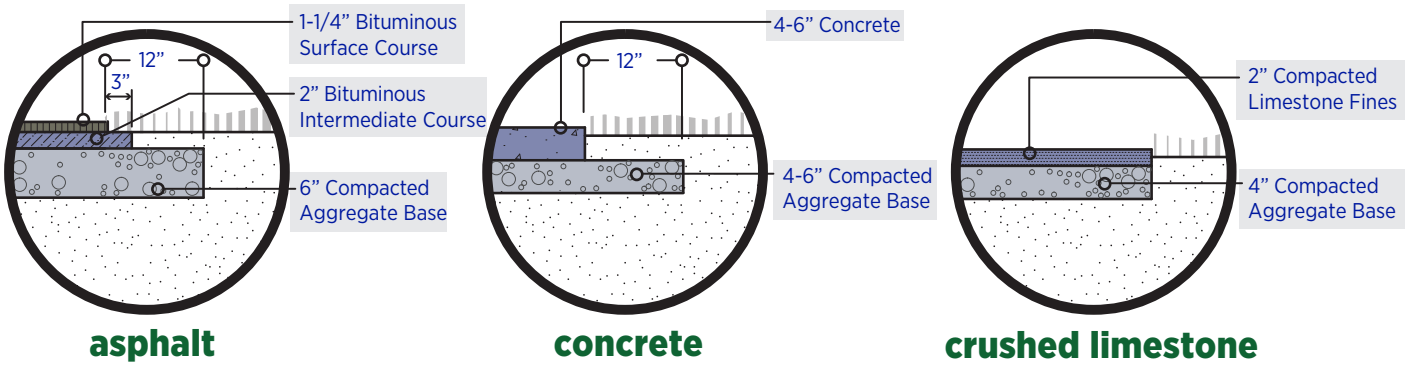
- For residential drive crossings, ensure that clear sightlines are maintained within 20' of the drive.
- Do not include enhancements or any other potential visual obstructions within 20‘ of the drive.

MARKINGS:

- Warning signs and pavement markings should not be used unless there are extenuating circumstances where their use is mandated.

All crossings shall comply with AASHTO and ADA guidelines.





TRAIL CONSTRUCTION: PAVEMENTS

Trail materials and designs should comply with local agency design standards. This page shows minimum recommendations.

Asphalt Paving:

- Asphalt cross section shall meet the minimum depths, thicknesses, and base materials as illustrated above.
- Design width and other spatial standards should be consistent with the design standards illustrated in the geometric standards noted elsewhere.
- Pervious asphalt designs are encouraged.

Concrete Paving:

- Concrete pavement may be used in certain circumstances such as areas with annual flooding, urban areas, or other areas where substantial benefit or durability can be gained through the use of concrete.
- These areas should be dictated by site specific evaluation.

Crushed Limestone Paving:

- Crushed limestone paving cross section shall meet the minimum depths, thicknesses, and base materials as illustrated above.
- The use of crushed limestone is not the most preferred method of construction, but is an option open to agencies.

All pavements and bases shall be designed to accommodate the weight of service, security, and emergency vehicles and meet ADA accessibility requirements.

RAILINGS

Height:

47.5” Min, up to 54” where conditions warrant extra protection.

Railing should not encroach into required 2’-0” clear zones adjacent to greenways.

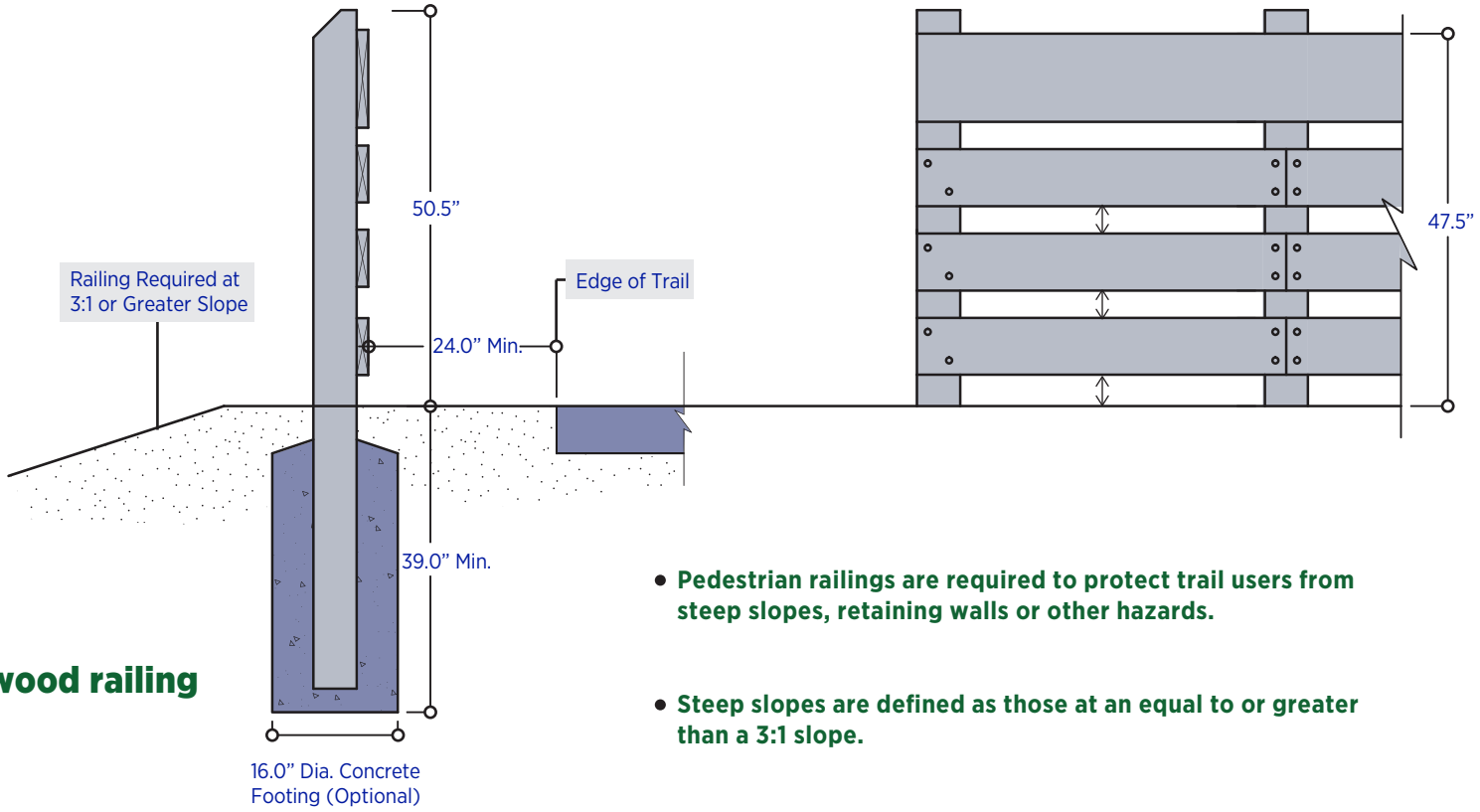
Utilize cable railing in areas where wood railings would interrupt desirable views such as along stream corridors.

Lumber:

Pressure-treated and/or decay-resistant lumber, stainless steel cable systems and other weather-resistance materials should be considered for railing construction.

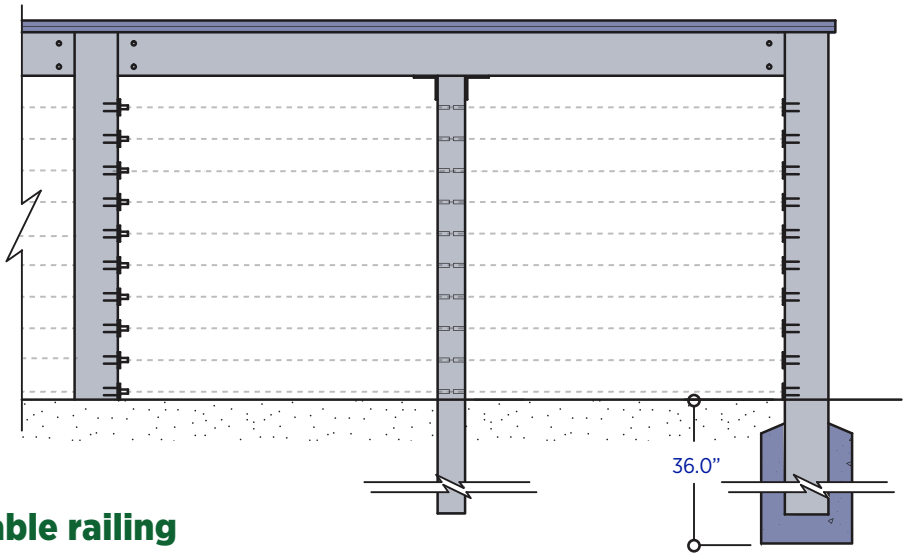
Pedestrian railings:

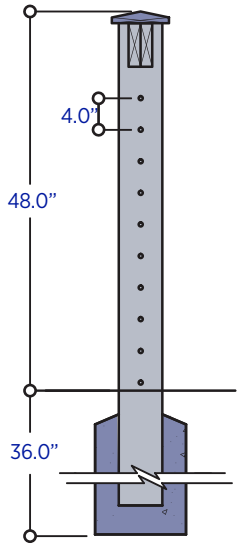
Railings shall be designed to meet both recreational and transportation standards including AASHTO and ADA.



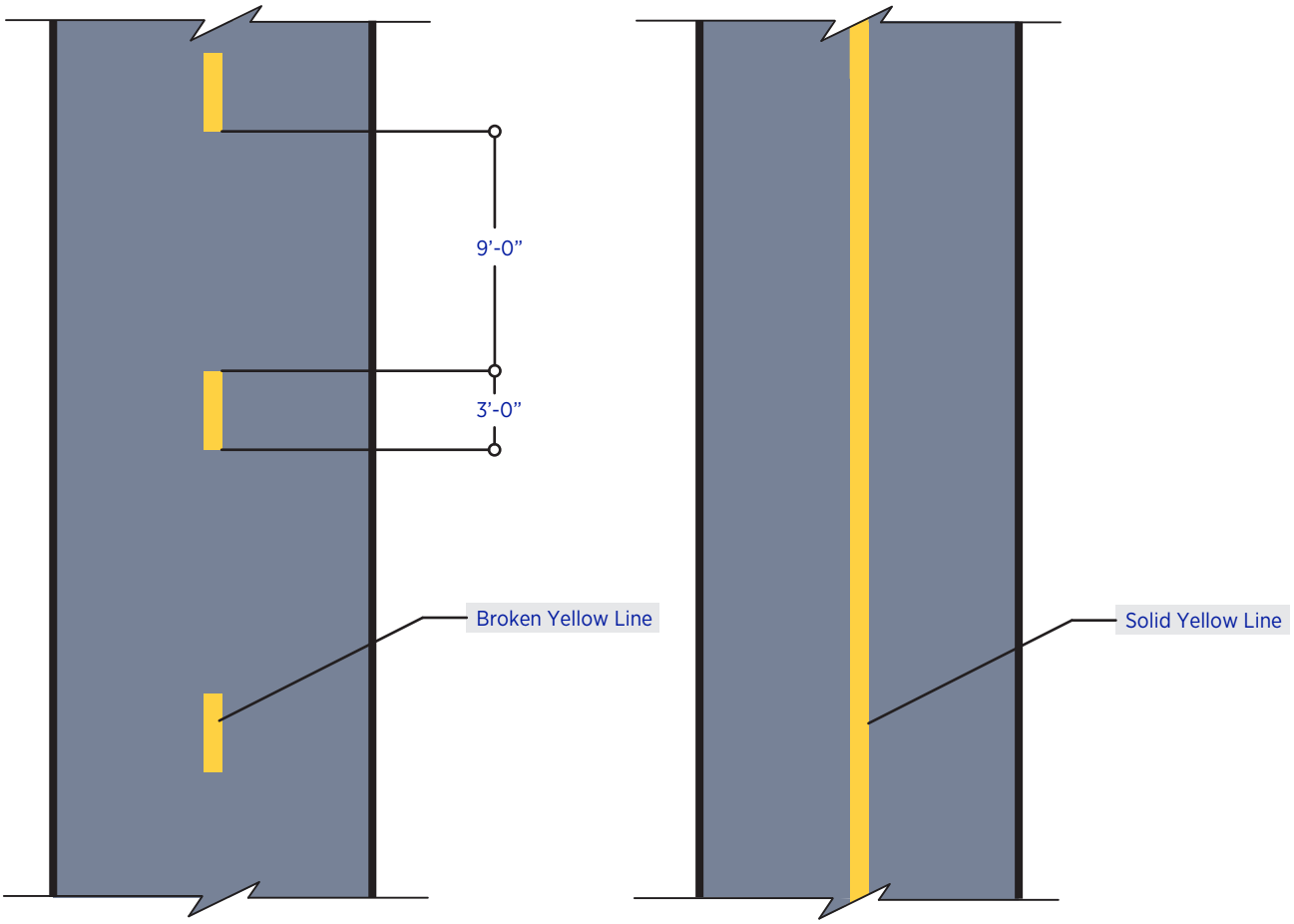
wood railing

- **Pedestrian railings are required to protect trail users from steep slopes, retaining walls or other hazards.**
- **Steep slopes are defined as those at an equal to or greater than a 3:1 slope.**





cable railing



passing permitted **passing not permitted**

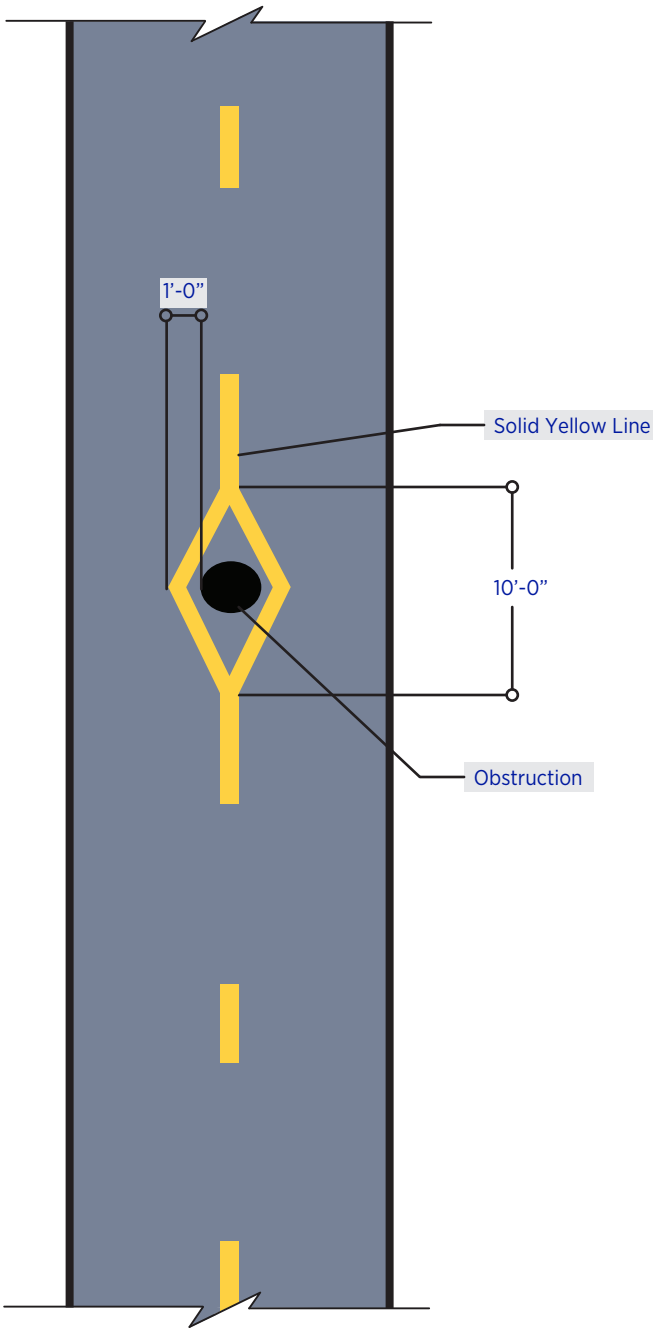
PAVEMENT MARKINGS

DESIGN:

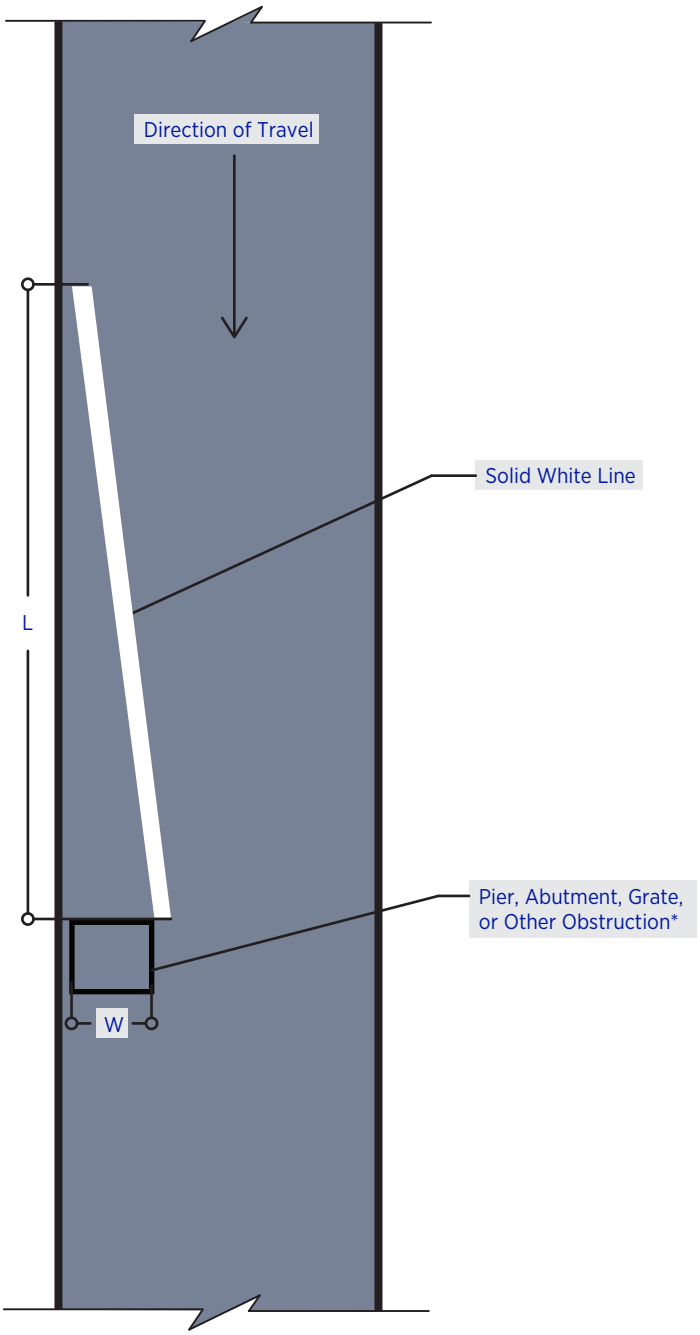
- Typically use pavement markings on high-volume trails only.

MARKINGS:

- Avoid the use of "thermoplastic" marking on trails.



obstruction within path



obstruction at edge of path

OBSTRUCTION PAVEMENT MARKINGS

DESIGN:

- **L = WS**, where W is the offset in feet and **S** is bicycle approach speed in mph
  - * Provide an additional foot of offset for a raised obstruction and use the formula **L = (W+1)S** for the taper length

MARKINGS:

- Avoid the use of "thermoplastic" marking on trails.

Chapter 11: Traffic Signals

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3. Traffic Signal General Notes 10

Traffic signals shall be designed in accordance with the most current edition of the Ohio Manual of Uniform Traffic Control Devices (OMUTCD), Part 4, ODOT specifications, applicable ODOT standard drawings, the ODOT Office of Traffic Operations (OTO) Signal Design Reference Packet, and the following COD requirements.

1. Design Criteria

The following concepts are to be considered in making engineering decisions in design and operation of traffic signal installations. Most of them are in addition to those of the OMUTCD. In any case, the intersection's condition must be taken into account as part of the decision-making process.

A. Vehicular Signal Heads

1. Size: Twelve (12) inch polycarbonate heads with backplates shall be used.

2. Signalization of Protected Only Turn Movements
   Use a three (3) section head with red arrow, yellow arrow and green arrow indication. Two three (3) sections heads are to be used if two turn lanes exist.

3. Location
   Signal heads shall be placed per ODOT specifications and the most current edition of the ODOT Office of Traffic Operations (OTO) Signal Design Reference Packet.

   Signs to be placed in conjunction with the signal head shall be installed as follows:
   a. For a single left-turn-only lane, the sign should be placed 1.5 feet to the right of the center of the lane.
   b. For a single right-turn-only lane, the sign should be placed 1.5 feet to the left of the center of the lane.
   c. For two left-turn-only lanes, the sign should be placed on the lane line between the two turn lanes.
   d. For two right-turn-only lanes, the sign should be placed on the lane line between the two turn lanes.

4. Mounting Height
   The mounting height for all signal heads shall be placed per ODOT specifications and the most current edition of the ODOT Office of Traffic Operations (OTO) Signal Design Reference Packet.

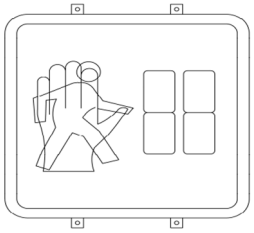
5. Horizontal Signal Faces
   The horizontal location of signal faces must be per Figure 4D-2 of the OMUTCD.

B. Pedestrian Signal Heads

1. Pedestrian signal heads shall be as specified in the most current edition of the OMUTCD.
2. Installation of pedestrian signal heads and push buttons shall be as specified on ODOT Standard Drawing TC-85.10.
3. At all locations where crossing is prohibited the "No Pedestrian Crossing

Symbol" Sign (R9-3) is required.

4. Marked crosswalks shall be installed where pedestrian signal heads are installed.
    a. Other locations of marked crosswalks are at the discretion of the COD.
    b. The type of crosswalk shall be determined per the *Crosswalk Installation & Enhancement Design Guide.*
    c. All pedestrian signal heads shall be LED, Type D2 with countdown timer, as illustrated below:



    d. Pedestrian Interval Timing shall be as specified in the most current edition of the OMUTCD.

C. **Pedestrian Clearance Intervals**

Pedestrian clearance intervals at any signalized intersection, with or without pedestrian signal heads, shall be as specified in the most current edition of the OMUTCD.

D. **Maintenance of Traffic (MOT) for Signals**

1. Temporary detection must be provided if existing detection will be disturbed during construction. The type of temporary detection must be specified on the approved plans.
2. ODOT Maintaining Traffic Standard Construction Drawing MT-120.00 shall be followed upon the installation of a new signal.
3. A Signal Operation Changed Sign shall be used when an existing signal has been modified (i.e. timing change, phasing change, etc.).

E. **Traffic Control Signs at Signalized Intersections**

Signs shall be placed on the span wire/mast arm adjacent to the appropriate signal head, preferably to the right of the right-most head and to the left of the left-most head (whichever is applicable).

1. "Left on Green Arrow Only" sign (R10-5) shall be used when signalizing for protected left turn movement
2. "Left Turn Yield on Green" sign (R10-12) shall be used when signalizing for a permissive left turn movement
3. Appropriate signage shall be used when signalizing for protected right turn movement; signage shall be R10-10R, R10-11B, R10-11C, or R10-11D, depending upon the configuration.
4. "No Turn on Red" sign (R10-11) shall be evaluated and used when an engineering study finds conditions specified in the most current edition of the OMUTCD, Part 2 are met.

F. **Detector Design**

Intersections where a new signal is be installed or an existing signal is to be modified shall have detection for all approaches of all lanes. Type of detection (video or radar) shall be determined by the COD.

1. Left turn detection
    a. For presence operation (non-lock operation using 5-section head) of a left turn phase:
        i) on a main street second car detection should be utilized in most instances (front of zone should be 26-FT from center of stop line)
        ii) On a side street first and second car detection should be utilized
    b. If left turn lanes are offset such as on a divided highway, then only first car detection should be used, this is applicable on both a main street and a side street.
    c. If the left turn phase is a protected only phase, presence operation should be used to avoid false calls during light traffic conditions, this is applicable for both a main street and a side street. Non-locking versus locking operation shall be determined by COD on a case-by-case basis.

G. **Pullboxes**

Size and location of all pullboxes must be specified on the plans. Those that are utilized are:

1. Loop Lead-ins – 18" pullboxes (if applicable)
2. Multiple conduits joining – 24" pullboxes (at the discretion of the Engineer)
3. Fiber (reference the Fiber Optic Conduit Chapter of this Design Guide for details)

H. **Conduit**

1. Specify the size of all conduit on the plans and verify the capacity of each conduit with respect the conductor(s) proposed to be within, per ODOT specifications and the most current edition of the ODOT Office of Traffic Operations (OTO) Signal Design Reference Packet.
2. All ODOT OTO Signal Calculations-Conduit Sizing documents shall be provided to the COD.
3. An additional empty 3" conduit with tracer wire shall be provided under all disturbed approaches, i.e., drives, streets, bike paths, etc., in addition to other required signal conduits.

I. **Interconnect**

Interconnect communication shall be included with all new traffic signal installations and existing signal upgrades utilizing either fiber or radio as directed by the COD. Reference the Traffic General Notes for details.

J. **Preemption**

Preemption shall be required with all signal upgrades, modifications, or new signal installations utilizing Opticom Radio/GPS Model as manufactured by Global Traffic technologies. Preemption at signals in close proximity to active railway lines may be required on a case by case bases depending on the distance from the railway and and/or

based on the Fire Departments requirements. Reference the Traffic General Notes for details.

2. Signal Plan Format

These traffic signal plan sheets shall contain all Traffic Signal General Notes, as well as the following information with all appropriate elements clearly dimensioned and labeled:

A. Mast Arm and Signal Pole Color

All traffic signals in the City of Delaware shall be rigid mounted on a mast arm. In special circumstances or in a phased project, a strain pole with span wire configuration may be considered; appropriate design including tethering will be required. The design engineer must submit the request for the exemption in writing and the variance must be approved by the City Engineer.

1. Arm Types: The Arm types should be either an arched arm type (in the Downtown District, or in other locations as specified by the City of Delaware) or a straight arm type (typical) as shown below.



Figure 11-1*: Arched Arm Type (Downtown District)

*Backplates and rigid mounting are required, not shown in these figures.

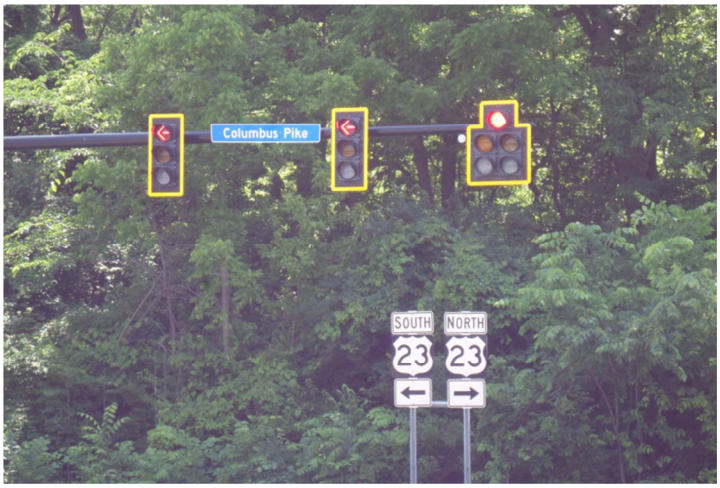


Figure 11-2: Straight Arm Type (Typical Installation)

2. Luminaire Type: The Luminaire should be either a conventional box luminaire, cobra head luminaire, or a decorative luminaire (in the Downtown District or in other locations as specified by the City of Delaware), as shown below. All shall be LED and approved by the City of Delaware.

   All street lights must be mounted at a height of 37-FT or less in order to maintained by the City of Delaware. Any exceptions to this must be submitted and approved by the City of Delaware.



Figure11-3: Conventional Box Luminaire



Figure 11-4: Cobra Head Luminaire



Figure 11-5: Decorative Luminaire (Downtown District)

3. Pole Color: The standard color of the poles and arm shall be powder coated black or as directed by the City, See Chapter 12 Street Lighting Standards. Reference table below for additional details.

Table 11-1:
Mast Arm and Luminaire Details

District	Arm Type	Luminaire Type
Downtown District	Arched	MainStreet
US 23 Corridor	Straight	Cobra
US 42 Corridor west of US 23	Straight	Cobra
US 36 west of Downtown	Straight	Cobra/Conventional
US 36/SR 37 east of Railroad	Straight	Cobra
US 36 east of Downtown to Railroad	Arched	MainStreet
SR 37 east of Downtown to Railroad	Arched	MainStreet
SR 37 West of Downtown	Straight	Cobra/Conventional

B. **Quantities**

All items associated with the installation and operation of the traffic signal shall be quantified in tabular form on the plan sheets. An extra support shall be provided per installation. The size of this extra support will be chosen by the Public Works Director.

C. **Signal Plan Required Items**

The following items shall be included in the signal plan, per the current edition of the ODOT Office of Traffic Operations (OTO) Signal Design Reference Packet:

1. All Tables and Diagrams
2. All items in the plan view
    a. All items shall be located in relation to the station and offset distance of the street centerline.
    b. Details shall also be provided for the Generator Power Panel Enclosure, reference the City of Delaware Traffic Signal General Notes Plan Insert Sheet.
3. Signal Head and Cabinet Field Wiring Hookup Chart
4. Phasing and Wiring Diagram
5. Signal Timing Chart
6. Detector Assignments Chart with Loop Description
7. Signal Coordination.

a. On request, the City will provide the existing timing plans of any existing traffic signal under the direct jurisdiction of the City.

D. **Color Chart**

All wiring for the signal controller and signal heads must be per NEMA Standards, and per the wiring color chart below.

COLOR CHART

PED UNIT FIELD WIRIING HOOKUP

PED UNIT LOCATION	*CROSSWALK DISPLAY*	*WIRE COLOR*
South Crosswalk	*Walk*	*Black*
	Don't Walk	*Orange*
West Crosswalk	*Walk*	*Green*
	Don't Walk	*Red*
North Crosswalk	*Walk*	*Blue*
	Don't Walk	*White w/Black Tracer*
East Crosswalk	*Walk*	*Green w/Black Tracer*
	Don't Walk	*Red w/Black Tracer*

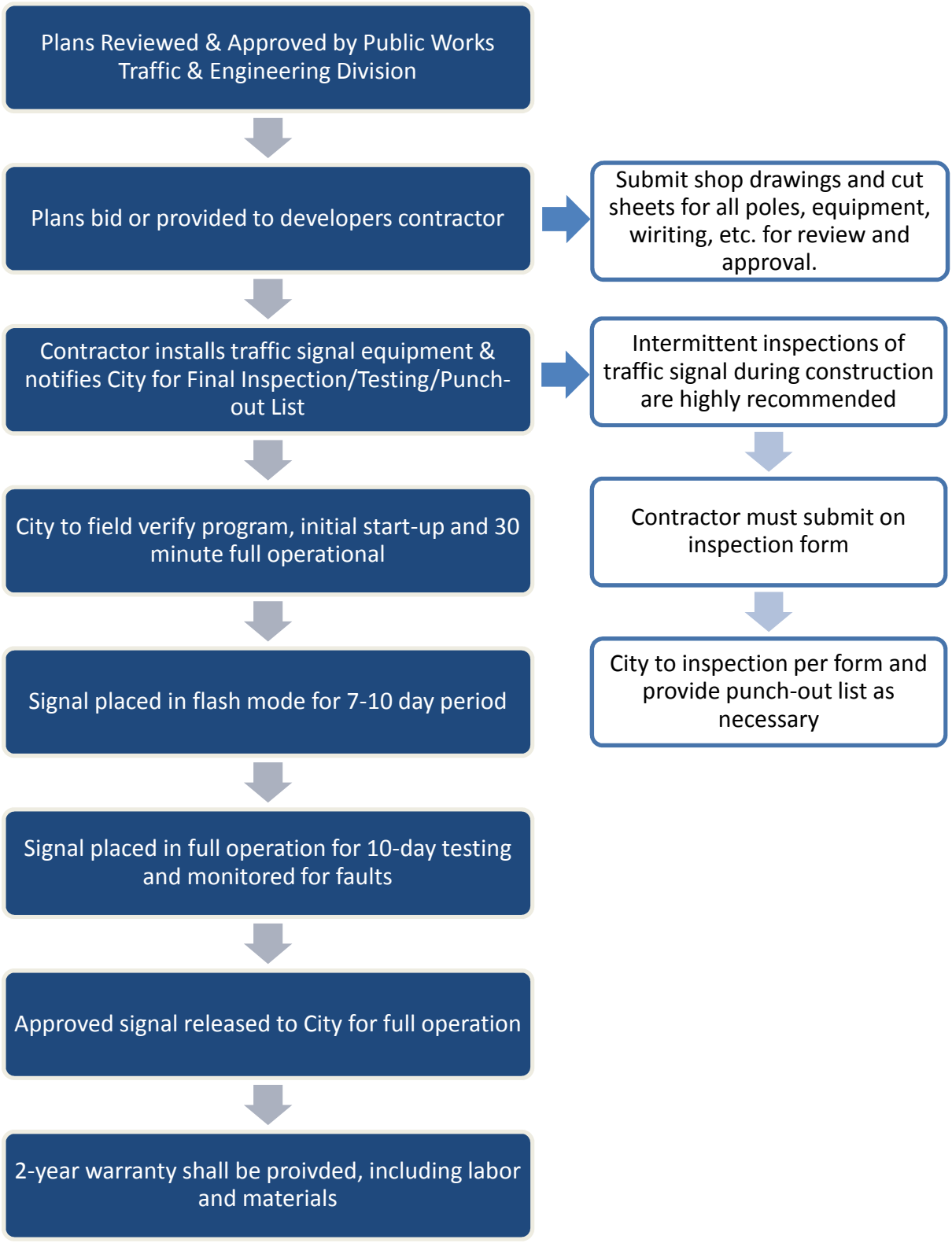
SIGNAL HEAD & CABINET FIELD WIRING HOOKUP

SIGNAL DISLPAY	*WIRE COLOR PER APPROACH*
THRU R	*RED*
THRU Y	*ORANGE*
THRY G	*GREEN*
L/T R	*BLACK (FUTURE USE ONLY)*
L/T ~~Y~~	*WHITE W/BLACK TRACER*
L/T ~~G~~	*BLUE*
R/T R	*NOT USED BY CITY*
R/T ~~Y~~	*RED W/BLACK TRACER*
R/T ~~G~~	*GREEN W/BLACK TRACER*

E. **New Traffic Signal Installation**

When installing a new traffic signal the following process must be followed:

City or Developer Installation of New Traffic Signals



F. **Inspection Form**

The inspection form is attached herein at the end of the chapter and referenced as Exhibit 11-1 (12 Pages total).

3. Traffic Signal General Notes

The Traffic Signal General Notes shall be included in any plan set in which a new or existing traffic signal shall be installed or improved, or as directed by the City of Delaware. The Traffic Signal General Notes can be found under separate cover, titled "Plan Notes".

ODOT TRAFFIC SIGNAL INSPECTION CHECKLIST

Project Number _____ Date _____

Project Engineer / Supervisor _____

Signal Contractor _____

Final Inspector _____

Intersection _____

Note: Checklist based on 2016 Construction Material Specifications.

OSIS No: _____

Controller/Make/Model No: _____ S/N: _____

MMU: _____ S/N: _____

Cabinet Type: _____ S/N: _____

Meets	Deficient	N/A	WARRANTY INFORMATION:
☐	☐	☐	1. Ensure that each unit has a permanent label or stamp indicating the date of shipment. Controller, Monitor, BIU, 2070 CPU board, field I/O module, Front Panel (CMS 733.02B)
☐	☐	☐	2. CMS 733.02B Furnish 60-month warranties or the manufacturers' standard warranty, whichever is greater for the following equipment: **1. NEMA Controller Equipment** a. TS-2 Controller Units b. Bus Interface Units c. Malfunction Management Units d. TS-1 Conflict Monitors **2. CalTrans Controller Equipment** a. Model 2010 Conflict Monitor Units b. 2070L and 2070E Controller Units including the following subassembly units: (1) 2070-1C, 2070-1E, 2070-1B CPU Board (2) 2070-2A Field I/O Module (3) 2070-3B Front Panel. (4) 2070-6A,B. Ensure that the warranty period begins on the date of shipment to the project. **Ensure that each unit has a permanent label or stamp indicating the date of shipment.**

Comments:

Meets	Deficient	N/A	CONTROLLER & CABINET:
☐	☐	☐	1. Is the cabinet sealed to the concrete base (and/or riser) with waterproof material? (TC-83.20 & CMS633.08 & 633.09)
☐	☐	☐	2. Are all tags or labels properly installed and legible including the service wire, phase numbers and directions? (CMS 632.05)
☐	☐	☐	3. Are the connectors soldered on the loop lead in wires? (CMS 632.23)
☐	☐	☐	4. Is all field wiring neatly arranged and routed to prevent being pinched when the cabinet door is closed and free of debris? (CMS 633.08)
☐	☐	☐	5. Is the work pad in place? (CMS 633.11)
☐	☐	☐	6. Was the work pad poured separate from the foundation pour? (CMS 633.11)
☐	☐	☐	7. Is all wiring (except power) fitted with spade terminals? (CMS 633.08)
☐	☐	☐	8. Is all power wiring fitted into spade, screw, or spring terminals? (CMS 633.08)
☐	☐	☐	9. Is there LED lighting in the cabinet? (CMS 733)
☐	☐	☐	10. Is the controller properly grounded (max 10 ohms)? (CMS 625.16) Ground Rod Readings=
☐	☐	☐	11. When shorted, does the conflict monitor cause the intersection to go to flash? (CMS 733.03)
☐	☐	☐	12. Is the control equipment, terminal blocks, or shelves no closer than 6" to the top of the foundation? (CMS 633.08)
☐	☐	☐	13. Is there ½" preformed joint filler between foundation and adjacent paved areas (this includes work pad)? (TC-83.20)
☐	☐	☐	14. Does the enclosure include a vent, fan and thermostat? (CMS 733.03)
☐	☐	☐	15. Is the conduit sealed with a removable sealing compound? *No foam sealer!* (CMS 633.08)
☐	☐	☐	16. Are the proper diodes cut on the permissive card (2070)? Additional diodes shall not be allowed to be removed.
☐	☐	☐	17. Are there two (2) sets of equipment lists, operation and maintenance manuals, and board-level schematic and wiring diagrams of the UPS, and the battery data sheets? (CMS 633.05 and UPS Note)
☐	☐	☐	18. Data key present?
☐	☐	☐	19. Does the cabinet have the proper finish inside and out as per plan (CMS 733.03)
☐	☐	☐	20. Is all the equipment as per plan or ODOT approved? (CMS 733.03)
☐	☐	☐	21. Is the pole-mounted cabinet at the proper height? Less than 36” high cabinet equal 30” +/- 3”. Over 36” high cabinet equals 23” +/- 3”. (TC-83.10)
☐	☐	☐	22. Are all wire terminals tight? (CMS 632.28)
☐	☐	☐	23. Is the cabinet air filter in place and clean? Front and/or Back (CMS 733.03)
☐	☐	☐	24. Are all unused conductors grounded in the controller cabinet?
☐	☐	☐	25. In a TS-1 cabinet, are the neutral (AC-) and grounding bars in the controller cabinet NOT connected together? (CMS 733.03.A.2.g) In a TS-2 cabinet, are the neutral (AC-) and grounding bars in the controller cabinet connected together? (CMS 733.03.B.1.b)

Comments:

Meets	Deficient	N/A	CABINET:
☐	☐	☐	1. Do all empty conduits have a #10 AWG pull wire installed and then have all the ends sealed? (CMS 625.12)

Comments:

Meets	Deficient	N/A	OPERATIONAL CHECKS:
☐	☐	☐	1. Upload timings from controller. Are they per plan?
☐	☐	☐	2. Do the detectors work for the assigned detector in the proper phase?
☐	☐	☐	3. Do the detectors place a call to the controller on the proper phase?
☐	☐	☐	4. Does the controller call in the proper direction and movement?
☐	☐	☐	5. Do all movements come in when a call is placed on a detector for that movement?
☐	☐	☐	6. Do ped push buttons put a call into the controller through the DC isolator?
☐	☐	☐	7. Does the controller receive the pedestrian call and call in the proper movement?
☐	☐	☐	8. Hook up generator and make sure generator panel works correctly.
☐	☐	☐	9. Do the left turn phases not conflict with WALK indication on intersecting street and/or driveway?
☐	☐	☐	10. Is the controller programmed properly for the UPS alarms? (ON Battery, Battery 2 Hour Timer, Low Battery)
☐	☐	☐	11. Flash All Red (or Y/R) as per plan?
☐	☐	☐	12. Countdown peds go to zero on yellow?

Comments:

Meets	Deficient	N/A	RADAR DETECTION:
☐	☐	☐	1. Are the radar sensors aimed/aligned properly?
☐	☐	☐	2. Are the detection zones at the proper location? Confirm in software.
☐	☐	☐	3. Are the controller detector channels assigned to the proper detection zone?

☐	☐	☐	4. Are the sensors grounded?
☐	☐	☐	5. Was dielectric grease used on the sensor's electrical connections? (inside the military connector)
☐	☐	☐	6. Are all conduit entrances, ends of bracket arms, etc. sealed? Grommets in place, if necessary?
☐	☐	☐	7. Is the cabinet interface panel properly installed?
☐	☐	☐	8. Are the cables tagged?
☐	☐	☐	9. Is the Ethernet module in place?
☐	☐	☐	10. Is all mounting hardware tight and none missing?
☐	☐	☐	11. Has strain relief been provided for the pigtail between the splice box and the sensor?
☐	☐	☐	12. Was the existing Loop Lead-In Cable removed per the plan note?

Comments:

Meets	Deficient	N/A	**UPS:**
☐	☐	☐	1. Does the UPS have lightning surge protection? (CMS 733.09)
☐	☐	☐	2. Does the UPS include a backlit LCD display that includes an event counter, hour meter, line and battery voltages/percentages and fault status? (CMS 733.09)
☐	☐	☐	3. Are the UPS alarms wired to the controller backpanel? (ON Battery, Battery 2 Hour Timer, Low Battery)

Comments:

Meets	Deficient	N/A	**UPS OPERATIONAL CHECKS:**
☐	☐	☐	1. Does UPS take over when disconnect is opened?
☐	☐	☐	2. Does Manual Bypass switch remove power from the UPS input on the terminal block?
☐	☐	☐	3. Check line voltage of cabinet with AC power and after UPS is tripped.
☐	☐	☐	4. Confirmation light installed and functioning?

Comments:

Meets	Deficient	N/A	LOOP DETECTORS:
☐	☐	☐	1. Were the corners, cracks, and/or joints drilled with a minimum diameter 1-1/4" drill bit? (TC-82.10)
☐	☐	☐	2. Is the lead-in conduit installed a minimum of 2 feet from edge of pavement (not shoulder, normally the white line) or edge of full depth shoulder? Conduit shall not go through curb and/or gutter (TC-82.10)
☐	☐	☐	3. Is the Lead-in-Cable twisted 3 to 5 turns per foot from the loop to the splice? (CMS 632.23)
☐	☐	☐	4. Is cured loop sealant flush with or higher than the pavement surface? (CMS 632.11)
☐	☐	☐	5. Are all adjacent loop slots a minimum of 1'-0" apart? (TC-82.10)
☐	☐	☐	6. If loop crosses joint in concrete pavement, was a 3"x3" square of material removed and filled with elastic join material or asphalt across joint? (TC-82.10)
☐	☐	☐	7. Are the detector loops installed at the proper location as per plan?

Comments:

Meets	Deficient	N/A	TRENCHING:
☐	☐	☐	1. Is the trench at final grade and restored? (CMS 107.10) a. If noted in the plans, is the area seeded?
☐	☐	☐	2. Is the trench in paved areas restored? (CMS 625.13)
☐	☐	☐	3. Is the trench 24 inches deep and less than 12 inches wide? CMS 625.13
☐	☐	☐	4. Have the conduit threads been protected with zinc paint? (CMS 625.12)

Comments:

Meets	Deficient	N/A	BATTERIES:
☐	☐	☐	1. Are batteries deep cycle, sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Mat / Valve Regulated Lead Acid)? (CMS 733.09)
☐	☐	☐	2. Are batteries rated for 105 Ahrs? (CMS 733.09)
☐	☐	☐	3. Are batteries labeled to operate over a temperature range of -13 °F to +165 °F (– 25 °C to +74 °C)? (CMS 733.09)

☐	☐	☐	4. Are batteries **placed on** battery heater mats in the enclosure? (CMS 733.09)
☐	☐	☐	5. Disconnect and load test each battery

Comments:

Meets	Deficient	N/A	**POLES:**
☐	☐	☐	1. Is all the hardware on the poles: caps, covers, etc. (TC-81.10 & TC-81.21)
☐	☐	☐	2. Is pole essentially vertical or slightly raked away from intersection? (CMS 632.16)
☐	☐	☐	3. Is the pole properly grounded (max 25 ohms)? Table below. (CMS 625.16)
☐	☐	☐	4. Are all scratches coated with zinc coating? *Do not use galvanizing spray* (CMS 711.02)
☐	☐	☐	5. Are all required washers and nuts in place? (CMS 630.06) *Leveling nut underneath. Plain structural washer & anchor nut on top.*
☐	☐	☐	6. Does it appear that anaerobic adhesive (lock-tite) was used on anchor bolt? (CMS 630.06)
☐	☐	☐	7. Are all conduits 2" minimum above foundation but less than the height of the anchor bolts? (TC-21.20)
☐	☐	☐	8. Are all conduits into the pole sealed? (CMS 625.12)
☐	☐	☐	9. Are the anchor bolts the proper height above the foundation? (TC-81.10 & TC-81.21) *The top of the bolt should be one full bolt thread above the nut so that water does not sit in there.*
☐	☐	☐	10. Is there at least one conduit ell in addition to the grounding PVC, even if not used (minimum 2" conduit) (TC-21.20)
☐	☐	☐	11. (*Only if there is a plan note requiring it*) Do all the poles contain permanent legible markings indicating month/date of fabrication, pole gauge, bottom diameter, pole height, bolt circle, anchor bolt diameter, flange bolt diameter, quadrant and intersection? Do all the arms contain permanent legible markings indicating month/date of fabrication, arm gauge, arm diameter, arm length, connecting flange bolt diameter, quadrant and intersection?
☐	☐	☐	12. Are the cable support assembles in place and the correct size? (CMS 732.17). Cable and wire inside of poles shall include cable support assemblies. (CMS 632.21 and TC-84.20)
☐	☐	☐	13. Does the strain pole have at least one 2-inch cable entrance with a weather head and a welded blind half-coupling? (CMS 732.12)
☐	☐	☐	14. Is the pole properly grounded, cad welded with 2 coats of varnish applied over the welds and exposed cable? (CMS 625.09)
☐	☐	☐	15. Are all unused holes plugged? (CMS 732.11, TC-81.20)
☐	☐	☐	16. Are the pole identification tags present? (TC-81.10, TC-81.21)

Pole Ground Readings							
NW		NE		SW		SE	

Comments:

Meets	Deficient	N/A	PEDESTRIAN SIGNALS:
☐	☐	☐	1. Is the bottom of the pedestrian signal head 8' to 9' above the walk? (TC-85.10)
☐	☐	☐	2. Is the front of the signal head visor (or sun shade) more than 2' from the face of the curb? (TC-85.10)
☐	☐	☐	3. Is the signal head properly oriented to its crosswalk? (CMS 632.08)
☐	☐	☐	4. There should be no visible wiring on the pedestrian push button? (CMS 632.09)
☐	☐	☐	5. Are the signs installed and oriented correctly? (CMS 632.09)
☐	☐	☐	6. Is the bottom of the pedestrian push button 3'-6" to 4'-0" above the walk? (TC-85.10)
☐	☐	☐	7. On steel poles the push button and pedestrian heads must have a ¾" diameter rubber grommet installed where the signal cable passes through the pole. (TC-85.10)
☐	☐	☐	8. The cover assembly shall be attached to the housing by stainless machine screws resulting in a weatherproof and shock proof assembly. (CMS 732.06)
☐	☐	☐	9. Any unused conduit attachment holes shall be plugged. (CMS 632.08 and CMS 632.09)
☐	☐	☐	10. Are the Pedestrian Push Button Signs in place on all corner and as per plan? (CMS 632.09)
☐	☐	☐	11. Are all signal heads visors and lenses of the proper material and color as per plan? (CMS 732.05)
☐	☐	☐	12. Are the pedestrian push buttons operational?
☐	☐	☐	13. Do the pedestrian push buttons call the proper phase?
☐	☐	☐	14. Do countdown peds go to zero on yellow?

Comments:

Meets	Deficient	N/A	SERVICE:
☐	☐	☐	1. Can the service be padlocked in the ON or OFF position? (CMS 732.21)
☐	☐	☐	2. Is conduit of the size and type shown on the plans? (CMS 625.12)
☐	☐	☐	3. Were all conduit nipples coated with zinc paint? (CMS 625.12)
☐	☐	☐	4. All service hardware shall have connections sealed as to have no water leaks? (TC-83.10)
☐	☐	☐	5. Is disconnect furnished with a padlocked keyed to the maintaining agency? (CMS 631.06)
☐	☐	☐	6. Is power feed run through a disconnect before it is run inside the signal pole? (TC-83.10)
☐	☐	☐	7. Is the ground rod and cable connected by an exothermic weld over the weld and exposed cable? (CMS 625.16)

☐	☐	☐	8. Are the cable tags attached to all services wires except bare ground bonding cables? (CMS 625.17)
☐	☐	☐	9. Conduit risers mounted on painted poles shall be painted to match the poles. (CMS 632.24)
☐	☐	☐	10. All conduit fittings in steel poles for the service disconnect switch shall be a welded blind half coupling. (TC-83.10)
☐	☐	☐	11. Is the lock in place on the "Service Disconnect" switch? (CMS 631.06)
☐	☐	☐	12. Is the disconnect switch the proper height? (TC-83.10)
☐	☐	☐	13. Is the neutral bar in the "Service Disconnect Switch connected directly to the pole grounding lug? (CMS 725.19.F)
☐	☐	☐	14. Is the ground wire connected from the ground rod directly to the disconnect switch neutral (AC-) then to the pole? (G&B Note and TC-83.10)

Comments: Meter #

Meets	Deficient	N/A	**SPAN WIRE AND SIGNAL CABLES:**
☐	☐	☐	1. Are bull rings located as per plan? (CMS 632.22)
☐	☐	☐	2. Is the wire chafing against any span hanger or other type of mounting brackets? (TC-85.20)
☐	☐	☐	3. Is the messenger wire sag between 3% and 5%? Check using a tension force gauge. (CMS 632.22)
☐	☐	☐	4. Are the drip loops greater than 6"? TC-84.20
☐	☐	☐	5. Were 3 bolt clamps used to attach the span wire to the shackle? (TC-84.20)
☐	☐	☐	6. Is the lashing rod the proper size for the conductors being wrapped? (CMS 632.22, 732.18)
☐	☐	☐	7. Are there no splices in the wire, except between: A) Detector wire and lead-in-cable (CMS 632.23) B) Power cable and power supply source or service cable (CMS 632.23) C) Long lengths of interconnect or service cable (CMS 632.23)
☐	☐	☐	8. Tag end of span wire shall be Min. of 12 inches long and Max. of 24 inches long and be served or clamped. (TC-84.20)
☐	☐	☐	9. Have the Cable Support Assemblies (Grips) been properly installed? (CMS 632.21) Max 4 cables per grip.

Comments:

Meets	Deficient	N/A	SIGNAL HEADS:
☐	☐	☐	1. Is the signal head height between 16 and 18 feet? (TC-81.21) *Non-ODOT maintained signals are allowed to be between 15 and 19 feet if the maintaining agency agrees.*
☐	☐	☐	2. Are the signal heads hanging plumb? (CMS 632.06 & TC-85.20)
☐	☐	☐	3. Are all LEDs oriented correctly installed in the UP position?
☐	☐	☐	4. Are signal heads more than 8 feet apart? (OMUTCD 4D-15-(F))
☐	☐	☐	5. Is each signal face oriented to its traffic approach? (CMS 632.06)
☐	☐	☐	6. Are spade terminals used, not wires wrapped around the screw? (CMS 632.05)
☐	☐	☐	7. Are all wire entrances facing the direction of the controller housing? (Our preference)
☐	☐	☐	8. Are signal heads sealed with silicone against water leakage? (CMS 732.01, 732.02, 732.03, 732.05)
☐	☐	☐	9. Is all hardware used to join optical sections together (tri-stud) stainless steel? (CMS 732.01) *Not zinc plated. Zinc plated is shiny like it is chromed. Stainless steel is barely magnetic. Test with a magnet*
☐	☐	☐	10. Do all signal heads have at least 6-inch drip loops? (TC-85.20)
☐	☐	☐	11. Are all set screws and locking nuts tight?
☐	☐	☐	12. Are all unused openings plugged?
☐	☐	☐	13. Are balance adjusters required by the Plans? (CMS 632.06)
☐	☐	☐	14. Are all signal heads visors and lenses of the proper material and color as per plan? (CMS 732.01)
☐	☐	☐	15. Are the “optically programmed” heads masked properly or according to the plan? (CMS 732.02, 732.03)
☐	☐	☐	16. Do the OPTICOM receiver heads have a weep hole drilled in the bottom?
☐	☐	☐	17. Are all signal heads placed as per plan?
☐	☐	☐	18. Are the signals installed using an extender hanger at the top of the signal? Bottom tether anchor extenders shall only be used if there is interference between the backplate and tether wire.
☐	☐	☐	19. Are supplemental, pole mounted signals installed 11’ to 12’ above the pavement?

Comments:

Meets	Deficient	N/A	PULL BOXES:
☐	☐	☐	1. Are pull boxes installed to grade? (CMS 625.11)
☐	☐	☐	2. Is the pull box installed on a 6" gravel base? (CMS 625.11)

☐	☐	☐	3. Are all tags/labels in place and legible? (CMS 632.05)
☐	☐	☐	4. Is there duct seal in all the conduits entering the base of a signal pole, sign support, light pole, light tower or pad mounted equipment? (CMS 625.12)
☐	☐	☐	5. Is the proper ID “TRAFFIC” or “ELECTRIC” on the pull box lid? (CMS 725.08)
☐	☐	☐	6. Are there bolts in the pull box lid? *Shall be countersunk hex head or socket head cap screws* (HL-30.11)
☐	☐	☐	7. Splice kits are completely filled with sealant and air voids are less than 1/4"? (TC-82.10)
☐	☐	☐	8. Are all the openings, around conduits or knockouts, sealed? (HL-30.11)
☐	☐	☐	9. If necessary, are drains installed to under drains or side slopes? (HL-30.11)
☐	☐	☐	10. Are all ends of rigid metal conduits capped with proper bushings? (CMS 625.12)
☐	☐	☐	11. Are bolt holes in metal diagonal pieces not in the concrete pull box itself? (HL-30.11)
☐	☐	☐	12. Is the equipment grounding conductor attached to the frame diagonal? (CMS 625.11)
☐	☐	☐	13. Is there a durable label reminding of the need to lubricate the threads of the cover hold down screws with grease or anti-seize compound on the inside of the frame or upper wall? (HL-30.11)
☐	☐	☐	14. Are all metallic items enclosing electrical conductors bonded together and to a good earth ground? (CMS 625.12)
☐	☐	☐	15. Are the Splice Kits ODOT approved? (CMS 632.23)
☐	☐	☐	16. Is “cement grout” in place around the conduits that enter the pull box? (HL-30.11)
☐	☐	☐	17. Are the pull boxes the correct size and type according to the plan? (HL-30.11)
☐	☐	☐	18. Is the final grade and seeding complete around the pull boxes? (CMS 625.01,625.11,632.01,HL-30.22, and HL-30.11)
☐	☐	☐	19. Do all empty conduits have a #10 AWG pull wire installed and then have all the ends sealed? (CMS 625.12)

Comments:

Meets	Deficient	N/A	**TETHER & BACKPLATES:**
☐	☐	☐	1. Is S-hook and turnbuckle at least at one end of simple span or at all ends of complex span?
☐	☐	☐	2. Is S-hook closed at pole end?
☐	☐	☐	3. Is 1/8” stainless steel wire wound around turnbuckle to prevent turning of turnbuckle?
☐	☐	☐	4. Is tether installed horizontally?
☐	☐	☐	5. Is S-hook properly sized? 3 / 8” for Pole Design No 1-4 1 / 2” for Pole Design No. 5-14
☐	☐	☐	6. Is safety tie installed at each turnbuckle?
☐	☐	☐	7. Is safety tie 1x19, 1 / 8” stainless steel wire?

☐	☐	☐	8. Is safety tie slack but not so slack that it touches pole?
☐	☐	☐	9. Does the safety tie have three clips per end at 3-1/4” spacing?
☐	☐	☐	10. Is safety tie thimble clamp less than 6” from messenger wire clamp?
☐	☐	☐	11. Does tether wire have a vertical clearance of 17 feet to 19 feet over the roadway?
☐	☐	☐	12. Is tether wire 1 / 4” ASTM A475 Utilities Grade wire?
☐	☐	☐	13. If heads have backplates, is the tether wire below the backplate? (TC-85.20)
☐	☐	☐	14. Is tether wire in the bottom of the breakaway clamp?
☐	☐	☐	15. Do backplates have 2” wide continuous fluorescent yellow reflective border? (TC-85.20)
☐	☐	☐	16. Are backplates aluminum? (CMS 732.22)
☐	☐	☐	17. Does backplate extend 5” beyond the outside of the signal assembly on all sides? (CMS 732.22)
☐	☐	☐	18. Are there no gaps between the backplate and the signal head or between signal sections? (CMS 732.22)
☐	☐	☐	19. Is all assembly and mounting hardware stainless steel? (CMS 732.22)
☐	☐	☐	20. If used, are machine nuts thread-deforming or nylon locknuts? (CMS 732.22)
☐	☐	☐	21. Rivets shall not be used for mounting the backplate. (CMS 732.22)
☐	☐	☐	22. Were a minimum of four mounting points used on each signal section for attaching the backplate? (CMS 732.22)
☐	☐	☐	23. Is the tether wire tension adjusted to minimize movement of signal heads in high winds? Typical tension is 600-800 lbs (check with tension gauge).

Comments:

ODOT DISTRICT 6
TRAFFIC SIGNAL INSPECTION
CONTRACTOR CERTIFICATION

Project Number _____ Date _____

Project Engineer / Supervisor _____

Signal Contractor _____

Intersection _____

I _____ request a final inspection of the work completed at the signal
Print Name (Contractor Representative)
noted above. I have verified by checking all applicable boxes above that all work has been completed as per the contract requirements.

_____
Contractor Representative Signature

Chapter 12: Street Lighting Standards

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1. General

Public street lighting for Local, Collector, and Arterial streets shall also be provided in accordance with the City of Delaware Street Lighting Standard Details (refer to the RDWD series of standard drawings) and this chapter:

A. Light Fixtures

All light fixtures shall be as identified on the City of Delaware Street Lighting Standard Details (refer to the RDWD series of standard drawings). The City of Delaware shall determine which fixture design will be required during the initial plan review.

B. Electrical Installation Requirements

Fixtures must be wired and installed per the current edition of the Nation Electrical Code (N.E.C.-NFPA 70), manufacturer's specifications, and all requirements identified in the City of Delaware Street Lighting Standard Details (refer to the RDWD series of standard drawings).

C. General Lighting Plan Requirements

1. Public street lighting shall be required on all new public streets at locations indicated in this chapter and shall be included with the engineering plans as part of a development plan submittal for each new section under design. The city shall determine which light pole and fixture design shall be used during initial plan review.
2. The lighting plan submission shall include an isolux diagram with point-by-point foot-candle coverage. A minimum of 0.5 foot-candle average shall be designed for all locations where lighting is required, with a Luminance Uniformity "L" average to "L" minimum of 6 to 1 per American National Standard Practice for Roadway Lighting prepared by IES (Illuminating Engineering Society).
3. The lighting plan must show the location of proposed public infrastructure including streetlights, disconnects, pullboxes, circuit cable, controller cabinet, meter, photo sensor, etc. Where located outside the public right of way, a 20-foot wide easement shall be provided and centered on the lighting conduit between the right of way and power source.
4. The height of all luminaires above finished grade shall be in accordance with the foundation, pole and fixture dimensions specified.
5. All street lighting poles shall be installed 2'-6" to the center of the foundation from the back of curb and placed where noted on the approved lighting plan. In general the fixture shall not be installed above sanitary sewers, storm sewers, water mains or other utilities.
6. Street trees shall not be permitted within 50-FT feet of streetlights, so the light fixture is not impacted by the tree canopy.
7. The following lighting related items, including but not limited to the isolux diagram, all light fixtures, pole heights, building fixtures, and lighting timing shall be submitted on the lighting plan submission to the Public Works Department for review and approval. The signed and approved isolux diagram and lighting submission shall be included in the final engineering plan set.
8. Voltage drop calculations demonstrating no more than 5% drop shall be provided to the City.

9. Controller:
    a. On the development plat, the controller location(s) shall be shown; this is required to determine an address as required for the meter/service location.
    b. Controller cabinet shall be located in the rear yard or reserve space, away from the roadway no closer than the established building setback.
    c. Each controller shall be labeled as follows:

STREET LIGHTING
XXX Volt
Address

    d. A 5-FT minimum boundary surrounding the concrete controller pad shall be clear of any landscaping, ornamental grass, etc.; clear and unobstructed access shall be provided on the door side of the controller cabinet. Any landscaping shall be included on the landscaping plan and included with the engineering plan set.
    e. The maximum quantity of lights per controller is to be determined by the design engineer, not to exceed controller capacity. Multiple sections of a development are permitted to be on the same the controller, provided adequate capacity is available. The City of Delaware shall make the final determination of the maximum quantity of lights per controller during the plan review process.
    f. It is the developer's responsibility to arrange for the extension of electric service to the controller in order to energize the lighting circuits.

D. Replacement Stock

Replacement stock, both light fixtures and poles, shall be provided to the City of Delaware, Public Works Department, for maintenance purposes for all infrastructure added by development, including local, collector, and arterial roadways. The table below shall be used to determine the required quantities. These quantities are to be accounted for on the plan estimate of quantities.

Table 12-1:

Required Light Fixture Replacement Stock*

Quantity of Lights Proposed Per Phase/Section	Replacement Stock Required
1-15	1 luminaire and pole; or 2 luminaires**
16-30	2 luminaires and poles, each; or, 3 luminaires**
31-45	3 luminaires and poles, each; or, 4 luminaires**
46-60	4 luminaires and poles, each; or, 5 luminaires**
61+	Contact Public Works Department

*A minimum of three days' notice to the Public Works Department is required for the delivery of all replacement stock, at a facility designated by the City of Delaware. A transmittal shall be provided with the owner stock specifying all items delivered, where it was delivered, and the date it was provided. The delivery of replacement stock is to

be observed by Public Works Department; the transmittal is to be provided at the time of delivery for verification.

**Quantities of luminaires and poles or just luminaires is to be determined by the Public Works Department.

2. Residential Street Lighting (25 mph streets)

On all public streets with a posted speed of 25 mph, a minimum of two public streetlights shall be installed at all roadway intersections, mid-block crossings, and at other locations as required by the City Engineer. Where single-family residential lots abut these streets, residential post lamps shall be provided on each lot per the requirements given below.

A. Design

Lighting with an average illuminance and uniformity ratio per the General Lighting Plan Requirements shall be provided within the entire intersection or mid-block crossing as measured to 10' beyond the crosswalks.

B. Light Fixtures

Light fixtures shall be provided as specified in the standard drawings.

C. Light Poles

1. Residential street lighting poles shall be Hapco 12-FT Decorative Pole, aluminum tube, 4-IN fluted with cast aluminum base, as shown in **Figure 12-1.** Pole shall match Holophane fixture color.
2. Where a 25-mph street is expected to be a classified as a collector street, the City reserves the ability to require collector light poles.
3. The following light pole requirements shall also apply:
    a. The interior side of the hand hole access door shall have a permanent label marker noting the voltage.
    b. The pole shall have an approved cable grip on the top interior of the pole to support the weight of the wiring cables.
    c. All set screws shall be lubricated with a compound to prevent seizing.

D. Pole Foundation

The pole foundation shall in accordance with the Light Pole Foundation for Residential Street Lighting standard drawings.

E. Residential Post Lamps

A residential post lamp meeting the following requirements shall be provided on each parcel.

1. Developer shall select a standard residential exterior post lamp of uniform style and color, to be placed at each residence on public streets, and included with the development plan submittal. The post lamp shall be uniform throughout the entire residential development.
2. Post lamps shall be placed a uniform distance from the back of sidewalk and cannot be contained within any existing easement.
3. The height of the lamppost shall be 5-ft to 6-ft above ground measured to the light source
4. Lamp shall be LED, with a color range of 3000k.
5. Lamp shall be properly shielded from light being cast vertically upward.

6. Lamp lighting shall be automatically lit from down to dusk.
7. Post lamps shall be installed with the residential building construction.
8. Post lamps shall be owned and maintained by the property owner.

F. Controller

In addition to the general controller requirements given in paragraph 1.C.7, the following requirement shall apply:

1. One controller shall be placed per intersection, mid-block crossing, or other streetlight location. Where lighting locations are withing 500-ft of each other, one controller may be used for both locations.

3. Collector and Arterial Street Lighting (Over 25 mph streets)

On all public streets with a posted speed greater than 25 mph, public streetlights shall be provided along the full length of the roadway.

A. Design

Lighting with an average illuminance and uniformity ratio per the General Lighting Plan Requirements shall be provided for the full length of the roadway. Calculations zones shall be provided on the photometric for all sidewalks.

B. Light Poles

Collector and Arterial street light poles shall be either single luminaire or double luminaire as follows:

1. Type A – Single Luminaire

   The light pole shall be manufactured by "Main Street" Lighting Company, model as specified below. The pole shall be painted as specified in the Figures (unless otherwise specified by the City) and match the Holophane fixture. The total height of the light pole shall be 15-ft, not including the luminaire.

   a. Model AATF-1515-FPB (no banner arm), reference Figure 12-2.
   b. Model AATF-1515-FPB-BA10 (with banner arm), reference Figure 12-3.

2. Type B – Double Luminaire

   The light pole shall be manufactured by "Main Street" Lighting Company, model as specified below. The pole shall be painted as specified in the Figures (unless specified another color by the City) and match the Holophane fixture. The total height of the light pole shall be 13.5-ft, not including the luminaire.

   a. Model AATF-1513.5-FPB-PB72 (no banner arm), reference Figure 12-4.
   b. Model AATF-1513.5-FPB-PB72INV (with banner arms), reference Figure 12-5.

3. The following light pole requirements shall also apply:

   a. The interior side of the hand hole access door shall have a permanent label marker noting the voltage.
   b. Flag holders and banners arms shall only be provided when specified by the City. When specified, the cast brass flag bracket (installed perpendicular to the curb and positioned street side) shall be permanently installed 10-IN from the top of pole.
   c. The pole shall have an approved cable grip on the top interior of the pole to support the weight of the wiring cables.
   d. All set screws shall be lubricated with a compound to prevent seizing.

C. Pole Foundation

The pole foundation shall be in accordance with the Light Pole Foundation for Collector Street Lighting standard drawing.

D. Alternate Arterial Street Lighting

Arterial streets may be required to have lighting in accordance with this section or an alternative design. For example, an alternative design may be required on state highways in accordance with Ohio Department of Transportation highway lighting requirements.

4. Private Development Site Lighting

Design Engineer/Developer is to submit private site lighting (including photometrics, details on light fixtures, pole height, building fixtures and timing) directly to the Chief Building Official, for review in conformance of code for private development site lighting and subsequent approved. Once approved the signed lighting plan is to be included in the engineering site improvement plans reviewed and approved by the Public Works Department.

Figure 12-1: Residential Light Pole

Hapco Dwg. No. B74514

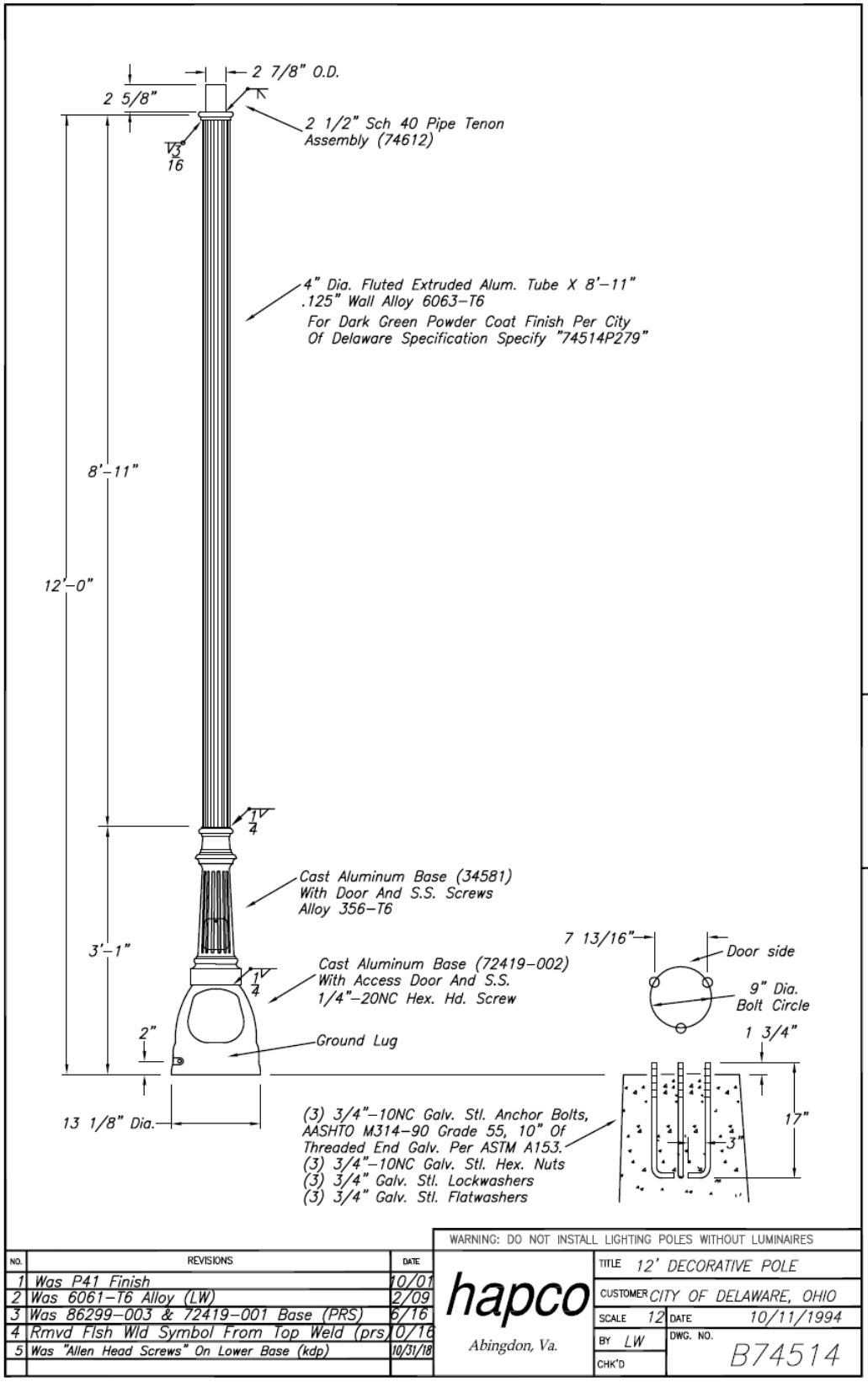


Figure 12-2: Collector Light Pole, Single Luminaire – No Banner Arm

Main Street Lighting Model No. AATF-1515-FPB

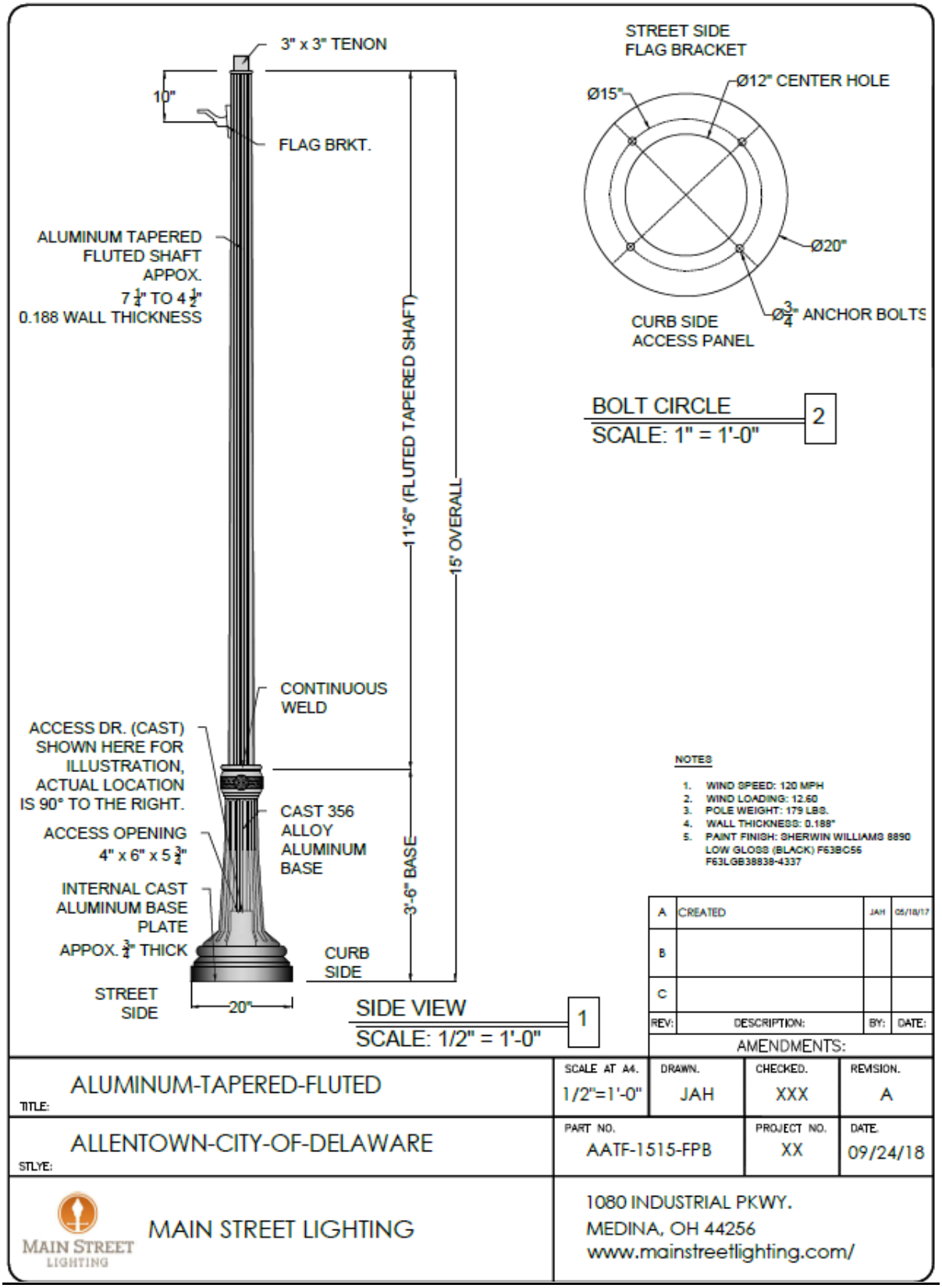


Figure 12-3: Collector Light Pole, Single Luminaire – With Banner Arms

Main Street Lighting Model No. AATF-1515-FPB-BA10

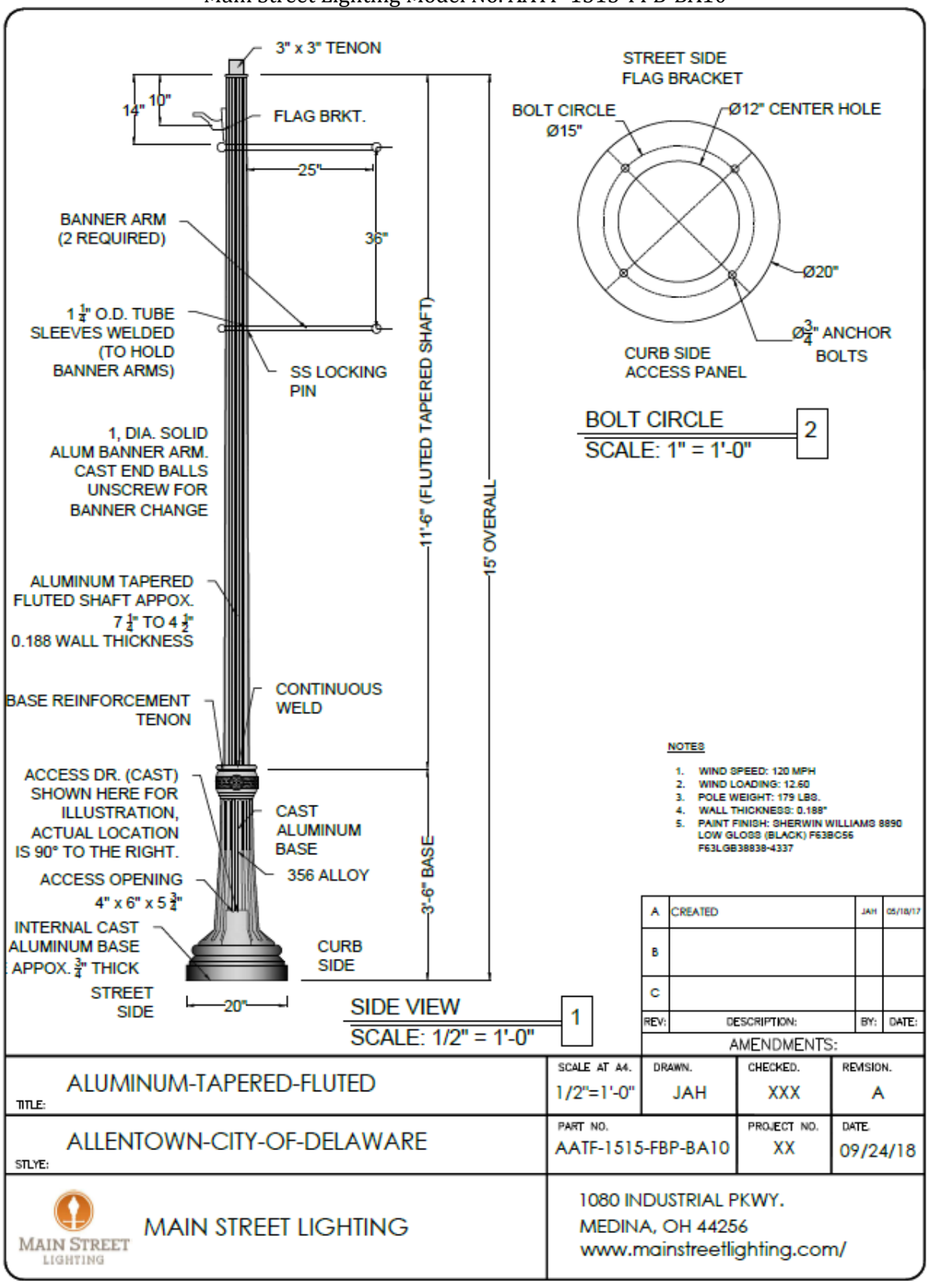


Figure 12-4: Collector Light Pole, Double Luminaire – No Banner Arm

Main Street Lighting Model No. AATF-1513.5-FPB-PB72

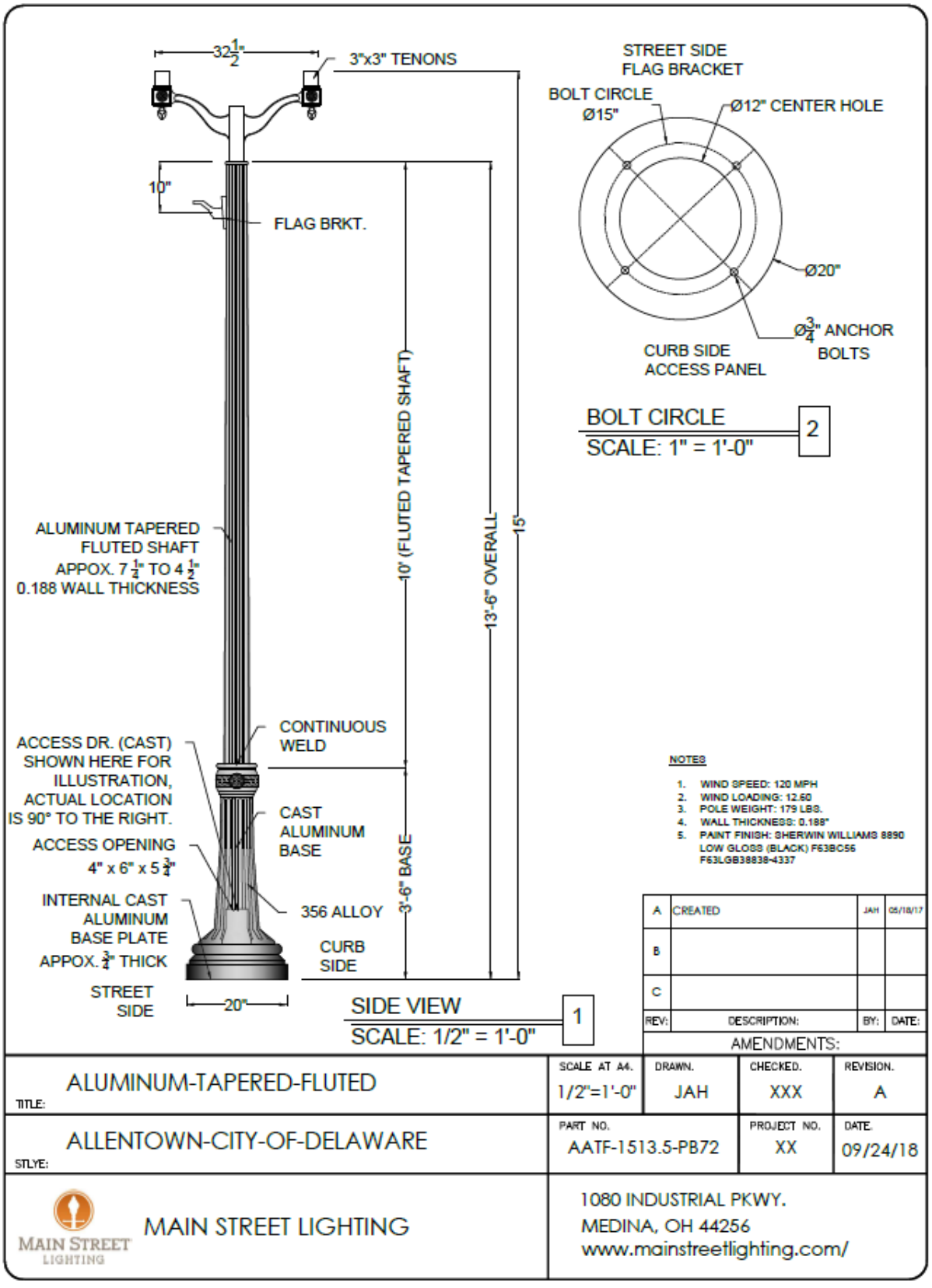
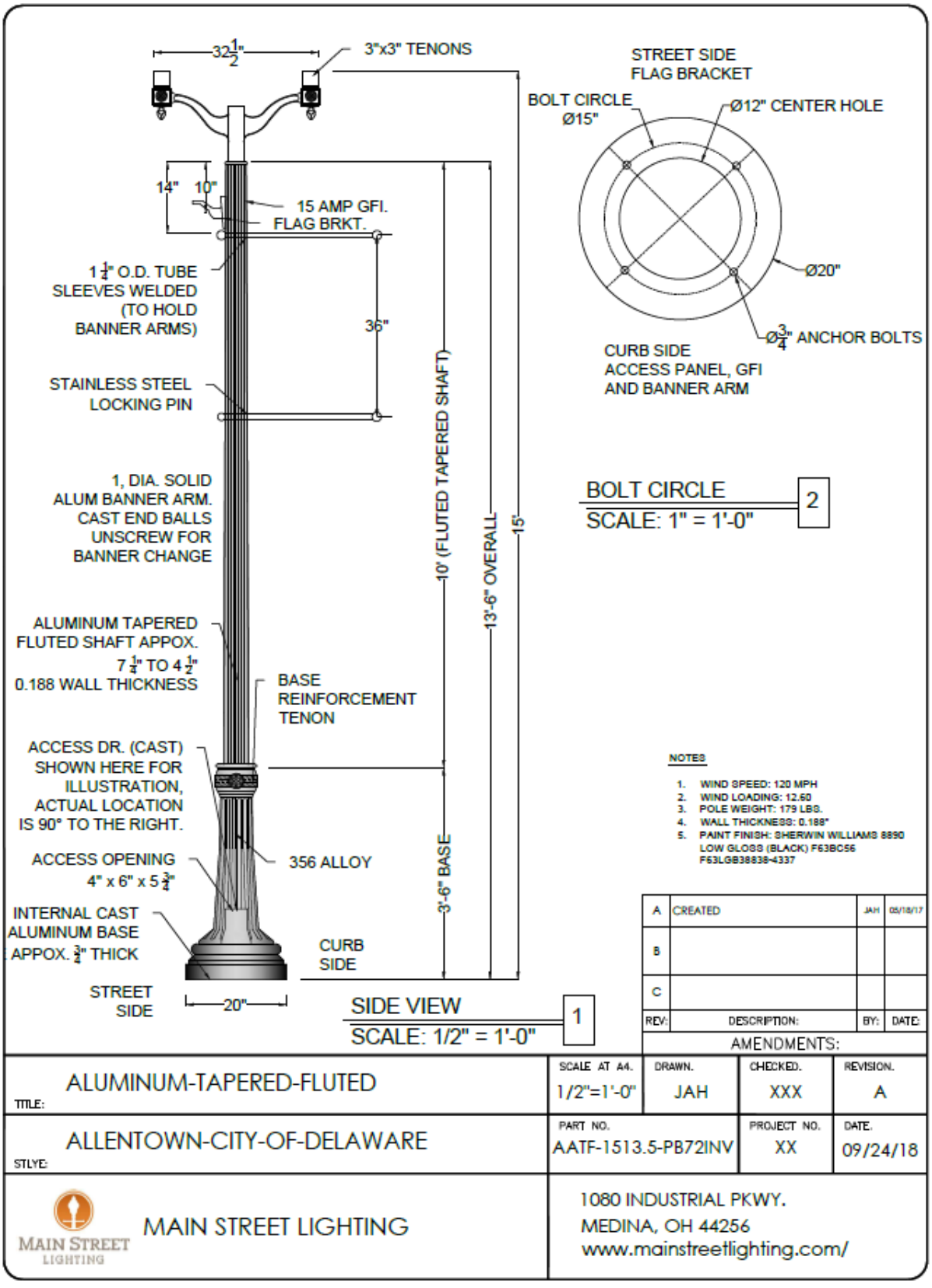


Figure 12-5: Collector Light Pole, Double Luminaire – With Banner Arms

Main Street Lighting Model No. AATF-1513.5-FPB-PB72INV



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Chapter 13: Fiber Optic Conduit & Cable Installation

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1. General

A. Fiber optic cables shall be installed in accordance with *NECA 301-2004, Installing and Testing Fiber Optic Cables,* and the following City of Delaware standards.

1. NECA 301-2004, Standard for Installing and Testing Fiber Optic Cables (ANSI) - This standard describes practices for installing and testing fiber optic networks used for high-speed data connections. It is developed jointly with the Fiber Optic Association (FOA), the leading certifier of fiber optic installers. It is an update to standard NEIS 301-1997.
2. National Electrical Installation Standards (NEIS) are the standards for electrical construction. NEIS are published by the National Electrical Contractors Association (NECA), developed in cooperation with other industry expert groups, and approved by the American National Standards Institute (ANSI).

B. Drawings

1. The contractor shall provide record drawings in the format specified by the City of Delaware upon completion and acceptance of the project.

2. Fiber Specifications

A. A minimum of 144 strand fiber optic cables are to be installed.
B. All splicing must be color coded between different cables where possible. i.e. red tube fibers must be spliced into red tube fibers, etc.
C. All contractors that are to install fiber lines must be approved prior to the start of construction by the City.

3. Aerial Installation

A. For an aerial installation, a slack loop is required every seven spans and at logical locations where a splice off the main fiber line is anticipated. The splice location will be determined by the Public Works Department and the Department of Information Technologies.
B. The contractor shall install riser "U-Guards" at all locations were the conduit is ascending or descending from any aerial construction.

4. Subsurface Installation

A. For subsurface installation, three 1 ¼ inch (minimum) SDR 11 HDPE conduits shall be installed for each run of fiber line.

- 1st conduit for primary backbone
- 2nd for distribution fiber
- 3rd to be used as a maintenance conduit (fiber upgrade/cut over replacement).

1. When constrained, with the COD approval, two 4"conduits may be used in lieu of three 1 ¼ inch.
2. Sweep of the conduits under the bottom edge of the pull-boxes should be done by a 22.5 or 30 degree sweep that is slightly higher than the substrate base in the bottom of the pull-box. The majority of the space in the box needs to be free for fiber cable slack and splice case.

B. The conduits are to be blue, orange, and green, unless otherwise specified.

C. The minimum vertical and horizontal separation shall be 1.5 feet between the fiber conduits and public water and private utility lines; and 1.5 feet vertical and 5 feet horizontal between all sanitary and storm sewers.
D. The bury depth is to be 36-inches below finish grade
E. For new construction, all conduit crossing under roadways shall be concrete encased to the top of subgrade and extend from right-of-way line to right-of-way line, unless bored.
F. When crossing existing roadways, the fiber conduit may be directional bored under the roadway with an appropriately sized steel casing pipe extending from right-of-way line to right-of-way line.
G. If trenching, plastic caution tape is to be placed over the conduit at a depth of 18-inches. Newly installed pull-boxes must be marked with 4" x 4" x full depth (bottom of box) wye poles painted orange at the top. The wye poles shall remain in place until fiber is installed with tracer wire.

5. Pull Boxes

A. All pull boxes must meet or exceed all test provisions of ANSI/SCTE 77 2013.
B. All pull boxes shall be polymer concrete and rated for 20K lbs. minimum load, bolt down covers with stainless steel penta-head hardware and stamped with a label designating "FIBER OPTICS". Quazite PG style or equivalent.
C. Distribution and branch line pull-boxes shall be 30" x 48" x 36"D or larger as required to meet the minimum bend radius of the fiber optic cable. Quazite # PG3048BA36, 2 piece bolt down cover with stainless steel penta-head hardware and labeled FIBER OPTICS, Quazite # PG3048HS0021P or equivalent.
D. Pull-boxes shall have a spacing of no more than 1000-feet between boxes. An additional pull-box shall be placed at logical locations where a splice off the main fiber line is anticipated.
E. Boxes are to be located so water drains away from the box.
F. Select projects may utilize 30" x 48" x 24"D pull boxes if no future splicing is anticipated, as approved by the City.
G. Shop drawings of the pull-box and lid that differ from the ones specified above are to be approved by the City prior to installation.

6. Tracer Wire

A. Tracer wire or a trace fiber shall be used throughout the system and is to be placed inside the solid orange conduit.
B. Underground locating test stations shall be installed no more than every 2000 feet.
C. Rhino TriView test stations shall be installed adjacent to pull-boxes and connected via 1.25" HDPE duct through the bottom opening of the pull-box; the connected tracer wire shall pass through the duct into the test station. Specifications for the Rhino TriView test Station is available at http://rhinomarkers.com/DP_Doco/SPEC/ISOLEVER_SPEC.pdf
D. Test station tracer wire bonded to the main tracer wire system shall be grounded in the pull-box.

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Chapter 14: Street Tree Planting Standards

The City of Delaware requires all new residential development to include the installation of street trees to be planted within the tree lawn area of the public right of way. The species to be planted will be selected by the City Shade Tree Commission in advance of project approval.

1. Notification

   The City shall be notified five (5) days in advance as to location, time, and number of trees to be planted. The City reserves the right to inspect planting procedures for adherence to requirements regarding spacing, clearance, and obstructions as specified in Chapter 907.03 of the City code. It shall be the responsibility of the developer or his designee to contact OUPS to avoid underground utilities. The City of Delaware will spot tree planting locations by placing a white dot on the curb. Trees planted without prior City approval risk of having to be removed, relocated or replaced.

2. Site Preparation

   The planting hole shall be excavated to a depth so that the root flare and first order of lateral roots will be 2-inches above grade. The planting hole shall be a minimum of one foot wider than the diameter of the root ball, and prepared with sloped sides.

3. Planting

   Prepare the tree for planting by removing the top 1/3 of the wire basket, all plastic shipping collars and ropes. Remove burlap from top of root ball and tuck in hole. Treated or plastic burlap is not permitted. Care shall be taken to not damage the root ball when handling or back filling. Place the tree within the hole and adjust its position so that it is plum in the hole. Tree shall be planted so that the root flare is one to two inches above finished grade. Never plant trees deeper than existing grade. Backfill around the root ball with existing un-amended soil and thoroughly water. Tamp soil to remove air pockets. Apply two to three inches of hardwood mulch leaving a 2-inch open space around the trunk. When finished, the top of the mulch shall be not more than 5-inches above existing grade. Excess soil must be removed from the site and not piled on top of the root ball.

4. Maintenance

   It is the responsibility of the developer to maintain the trees in a healthy condition until final inspection and acceptance by city officials.

5. Warranty and Final Inspection

   The developer shall guarantee that all trees will be healthy and vigorously growing two-years after planting. The city will inspect all newly planted trees twice a year and report all unacceptable trees to the developer. A tree will be considered unacceptable if it is dead, has more than 33% dieback of lateral branches, or has more than 20% dieback of the terminal branch. Trees not 1.75-inches in caliper, wrong species, or that show poor quality or lack tags will be unacceptable. It will be the responsibility of the developer to remove all unacceptable trees within 30 days of notification. Replacement trees will carry the same two year warranty and the warranty will start when the tree is planted and inspected by the city. Nursery inspection certificates and documentation of plant origin will be provided prior to trees being planted. Only trees grown in zones 4 and 5 are deemed acceptable unless prior approval has been granted. Trees grown in zones 7 or greater will never be accepted by the City of Delaware.

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Chapter 15: Storm Water Management

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PART 1 – GENERAL REQUIREMENTS

This chapter of the Infrastructure Design Manual is not a text of hydrology or hydraulic design. It assumes that the user has an understanding of hydrology and hydraulic engineering. This manual provides a uniform design procedure for summarizing and submitting plans in an acceptable and understandable manner. It does not provide uniform solution to all drainage problems. This section of the design manual provides sufficient information to develop drainage systems in accordance with city policy.

1. Summary of Stormwater Requirements

A. Submittal and General Planning Requirements

Requirements for submittal and approval of stormwater management plans can be found in Part 1 of this chapter.

B. Hydrology

Acceptable hydrologic methodologies and requirements can be found in Part 2 of this chapter.

C. Water Quantity

Requirements for water quantity control, also known as peak runoff control, can be found in Part 3 of this chapter. The City uses the Critical Storm method for determining allowable discharge rates and detention or retention volumes.

D. Water Quality

Requirements for water quality treatment are found in Chapter 16 of this manual. The City follows the Ohio Environmental Protection Agency (OEPA) construction stormwater permit requirements for post-construction water quality treatment. City-specific requirements that differ from the OEPA construction stormwater permit are also found in Chapter 16.

E. Sediment and Erosion Control During Construction

Requirements for sediment and erosion control during construction can be found in Chapter 16 and Chapter 17 of this manual. The City follows the Ohio Environmental Protection Agency (OEPA) construction stormwater permit requirements for erosion and sediment control during construction.

F. Design of Minor Stormwater Conveyances

Hydraulic design requirements for minor stormwater conveyances, such as storm sewers, culverts, open water courses, and flood routing can be found in Part 4 of this chapter.

2. Preliminary Stormwater Management Plans

A. General

The City of Delaware requires a preliminary stormwater management plan to be submitted for review showing basic hydrology prior to submittal of the final Stormwater Plan. This requirement may be waived at the discretion of the City upon written request by the design engineer for commercial outlots that are a part of a larger development and incorporated in an existing approved Stormwater Management Plan.

All Runoff Curve Numbers are to be per appropriate tables contained within this manual and using best engineering judgment and are subject to review by the Public Works Department.

It is highly recommended that the design engineer contact the Public Works Department as early in the design process as practicable. The purpose of this meeting is to come to an agreement on methodology, Runoff Curve Numbers, site specific constraints and other pertinent details before the Design Engineer invests a significant amount of time and resources in a design that will ultimately be un-approvable.

Centralized storm water detention is recommended and strongly encouraged for all developments over one (1) acre in size. This may include but is not limited to retention and detention basins, parking lot detention, bio-swales, underground detention, etc. All storm water best management practices (BMPs), layout, and location(s) shall also be considered with the preliminary stormwater management plan, in order to meet necessary requirements, specifically for basins.

B. Preliminary Stormwater Plan Content

The City of Delaware requires that a preliminary storm water management plan for a proposed development site be submitted to the Public Works Department for review and approval prior to proceeding with a full storm water management plan design. The preliminary review material must include:

1. Project Name & Location
2. Development Owner/Address/Telephone/email
3. Engineer/Address/Telephone/email
4. Topographic tributary area(s) map for both the entire site and offsite areas tributary to the property
5. Conceptual development site layout
6. Existing County and local field tile systems and drainage ditches as identified on current Delaware Water and Soil Conservation District office records.
7. Total property acreage & proposed pre-developed runoff coefficients
8. Proposed post development runoff coefficients
9. Identify proposed major flood routing, storm sewer outfall points, and off-site improvements
10. Identify downstream capacity concerns or limitations to the existing system
11. Critical storm calculation, pre-developed 1-year and 100-year flows
12. Required detention volumes for 1-year, critical, and 100-year events
13. Design methodology being implemented
14. Proposed detention and/or retention basin locations
15. Identify all EPA and Army Corp of Engineers permits applicable to the project.

3. Final Storm Water Management Plan

Final Stormwater Management Plans shall have the following content:

A. Existing Conditions Tributary Map

1. ANSI D bond paper
2. Existing contours
3. Delineated Existing Tributary Area
4. On site acreages for each tributary area
5. Offsite acreages for each tributary area
6. Flow line with sheet, shallow concentrated and channel flow areas labeled along with the slope of each section of the flow line and Time of Concentration for each tributary area
7. Label existing outfalls for each area

8. Existing storm structures and other infrastructure such as roads, buildings, sidewalks, parking lots, etc. that will impact the stormwater runoff.
9. RCN or C values for each area
10. The one year flow generated by each tributary area
11. Existing Field Tiles per SCS, ODNR, County Records

B. Proposed Conditions Tributary Map

1. ANSI D bond paper
2. Proposed and existing contours as appropriate
3. Delineated Proposed Tributary Area and offsite areas that are passing through the site
4. On site acreages for each tributary area
5. Offsite acreages for each tributary area
6. Flow line with sheet, shallow concentrated, pipe flow and channel flow sections labeled along with the slope of the flow line and time of concentration for each tributary area.
7. RCN or C values for each area
8. Detention/Retention Basin locations
9. Label proposed outfalls for each area
10. Existing and proposed storm structures as well as other infrastructure; such as roads, buildings, sidewalks, parking lots, etc.
11. Existing Field Tiles per SCS, ODNR, and/or County Records and details of the tie in points to new structures

C. Soils Map

1. ANSI D bond paper
2. Soil boundary line, soil type, and hydrological group
3. Site boundaries

D. Proposed Storm Structure Tributary Map

1. ANSI D bond paper
2. Proposed storm structures as well as other infrastructure such as roads, buildings, sidewalks, parking lots, etc.
3. Delineated tributary area to each structure
4. Structure tributary acreages
5. Structure number
6. Composite C values or C values from chart for each tributary area
7. Tc for each area
8. Use 10 minutes to inlet for paved areas and 15 minutes to inlet for grassy areas for Tc to structures taking in onsite flow.
9. Structures taking in offsite flow will use the Tc generated during the existing tributary analysis
10. Existing storm structures

E. Report Body

The design engineer should provide a written general summary of the stormwater management plan. The body of the report should have a minimum of seven (7) sections. More may be needed on a case by case basis.

1. Site Description
2. Hydrologic Methodologies used to determine the runoff
3. Existing Hydrologic conditions
4. Developed Hydrologic conditions
5. Storm water management plan – how the runoff is being moved through the site
6. Applicable permits
7. Calculation sheets and hydrograph printouts

F. Report Body Tables

1. The design engineer should provide a summary table for all onsite and offsite tributary areas for the pre-developed conditions in the Existing Conditions Section of the report. Use the following format:

Tributary Area Name	Area	CN	Tc	Q1	Q2	Q5	Q10	Q25	Q50	Q100

The design engineer should provide a summary table for all onsite and offsite tributary areas for the post-developed conditions in Developed Conditions Section of the report. Use the following format:

Tributary Area Name	Area	CN	Tc	Q1	QCrit	Q50	Q100

2. The design engineer should provide a summary table for all allowable release rates for each area. Use the following format:

Tributary Area Name	Q1-allowable	Q2-allowable	Q5-allowable	Q10-allowable	Q25-allowable	Q50-allowable	Q100-allowable

3. The design engineer should provide a table for each basin showing the required detention volumes and peak Water Surface Elevation for each named storm event in Developed Conditions Section of the report. Use the following format:

Storm Event	Water Surface Area (acre **or** sq ft)	Peak Water Surface Elevation (feet)	Detention Storage Volume (ac-ft **or** cubic feet)
1-Yr			
2-Yr			
5-Yr			
10-Yr			
25-Yr			
50-Yr			
100-Yr			

G. Calculations and Exhibits

The calculations and exhibits need to be arranged so an accurate comparison of the pre-developed and post-developed conditions can be accomplished. A partial list of calculations that may be required follows. All of these calculations may not apply to every project. Appropriate calculations to document and justify the engineering design of the project shall be submitted for review. The calculations shall be signed and sealed by the Design Engineer.

1. Composite C and/or RCN numbers - Documenting existing and design C and RCN values
2. MORPC Critical Storm Calculations
3. Time of Concentration Calculations- Documenting Existing and Design time of concentration
4. Storage Calculations indicating the amount of storage required and amount provided
5. Water Quality Volume Calculations per OEPA NPDES permits.
6. Downstream Capacity Calculations identifying any downstream "choke points" and verifying capacity of downstream systems as determined at the pre-design meeting for the Preliminary Stormwater Management Plan.
7. Storm Sewer Design Calculations indicating drainage to, and capacity of, any proposed storm sewers
8. Overland Flow and Flood-routing Calculations. The maximum elevation for the 100-yr flow shall be 1-ft below the Finished Floor elevation.
9. Culvert Design Data Sheet Calculations indicating:
10. Drainage area to the culvert
11. Inlet or outlet control
12. Headwater or tail-water (if applicable)
13. Capacity of the proposed culverts
14. Channel Calculations indicating drainage area, shape, slope, and capacity of all channels
15. Weir Calculations indicating sizing for all weirs including the emergency spillway
16. Orifice Calculations Orifice Calculations showing the size and number of orifices for the basin outlet structure
17. Spread Calculations-Indicating the gutter capacity of streets and amount of pavement flooded for the 5-yr design storm
18. Grate Calculations-Indicating the capacity of inlet grates to handle 5-yr design storm
19. Pump curves for stormwater lift stations (assumes pre-approval of a stormwater lift station by the City)
20. Construction Sedimentation Basin calculation
21. Temporary outlet structure calculations per OEPA NPDES & ODNR

4. General Design Considerations:

The City of Delaware has implemented MS4 community requirements in regards to considering Phase II storm water quality and design. All development activity within the City is subject to the regulations of OEPA's General Permit OHCO00002.

A. Discharge Point

Onsite stormwater systems must discharge to one of the following offsite stormwater systems:

1. A USGS "Blue Line" stream,
2. An open channel system (including roadside ditches)
3. A storm sewer system adequately sized for the intended flows

If none of the options above is feasible, then the Applicant must demonstrate that only sheet flow is being discharged with adequate quantity and quality controls in place, since concentrated flow may cause offsite erosion.

The Applicant shall use an accepted hydrologic method to demonstrate that the existing offsite stormwater system can convey existing offsite flows and projected onsite flows in a manner that does not increase downstream peak water surface elevations during the 1-year through the 100-year design storms and satisfies the various design criteria in this design manual.

B. Stormwater Diversions

The diversion of stormwater runoff from one watershed or receiving stormwater system to another is generally prohibited because such diversions have the potential to cause or exacerbate flooding, erosion, or water quality problems in receiving watercourses. For the purposes of this manual, stormwater diversions are defined as the relocation of stormwater discharges from original receiving streams or stormwater systems to other systems that did not receive such discharges prior to construction. While it is recognized that stormwater runoff from small, onsite, tributary areas must be conveyed between catch basin sub-catchments, the City of Delaware will not allow the diversion of stormwater runoff from one major storm sewer system or open watercourse to another without proper documentation that includes proof of benefit. Stormwater system diversions may be considered on a case-by-case basis under circumstances where it can be shown that flooding and erosion will not increase and benefits to each watercourse can be achieved as a result of diverted flows. The diversion of any stormwater runoff from one stormwater system or watercourse to another shall be at the sole discretion of the City Engineer or their designee.

C. Field Tiles

Agricultural field tiles are for agricultural drainage purposes only and may not be used as an outlet of any development or stormwater facility. Field tiles that are discovered or intercepted during construction and do not exhibit evidence of conveying septic effluent shall be reconnected or connected into the proposed stormwater system. Field tiles that exhibit evidence of conveying septic effluent shall not be used for stormwater conveyance and shall be reported to the Delaware County Health Department for resolution upon discovery.

Designers preparing plans for development on existing agricultural lands shall, at a minimum, contact the Delaware County Engineer's office and the Delaware Soil and Water Conservation District to confirm the existence and location of existing tile systems. All visible field tile outlets and locations shall be field located and shown on the stormwater management plans. Any plan information for field tile systems received from county agencies shall also be shown.

All field tiles discovered either through preliminary investigation or during construction shall be shown on as-built drawings.

PART 2 – HYDROLOGY

1. Methodologies for Determining Runoff Volume and Peak Flows

A. Rational Method

This method should only be used for drainage areas of 1 acres or less. This method is not acceptable for runoff attenuation. (Retention/Detention Basin Design) The most outstanding limitation of the Rational Method is that the only product of the method is peak discharge. The method provides only an estimate of a single point on the runoff hydrograph and, therefore, does not permit estimation of runoff volume - a computation that is mandatory for the design of stormwater storage facilities. As such, the rational method is more appropriately used in the sizing to stormwater conveyance systems.

Rational Method: Q = CiA

Where:

Q = the maximum rate of rainfall runoff in cubic feet per second (cfs)

C = the runoff coefficient which is the ratio between the maximum rate of runoff from the area and the average rate of rainfall on the area during the time of concentration.

i = the average rainfall intensity, in inches per hour, for a duration equal to the time required for the runoff to flow from the most remote part of the drainage area to the point under design.

A = the drainage area in acres tributary to the point under design.

Under the Rational Method, it is assumed that the rate of runoff to each point under design consideration is a function of the average rainfall rate during the time required for water to flow from the most distant part in the tributary area to the point. This time of flow is called the "time of concentration". The rational method assumes that the peak rate of rainfall occurs within the time of concentration.

The runoff coefficients as shown in the table below shall be used to determine the values for use with the rational method.

Table 1: Runoff Coefficients for the Rational Formula

Cover type and hydrologic condition	Coefficients for hydrologic soil group:		
C Values for Urban Areas	**B**	**C**	**D**
Fully developed urban areas (vegetation established)			
Open space (lawns, parks, golf courses, cemeteries, etc.)			
Poor condition (grass cover < 50%)	0.45	0.61	0.69
Fair condition (grass cover 50% to 75%)	0.28	0.45	0.50
Good condition (grass cover > 75%)	0.16	0.36	0.47
Impervious areas:			
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.96	0.96	0.96
Retention Basins, Ponds, River and Streams	0.96	0.96	0.96
Streets and roads:			
Paved; curbs and storm sewers (excluding right-of-way)	0.96	0.96	0.96
Paved; open ditches (including right-of-way)	0.69	0.77	0.80
Gravel (including right-of-way)	0.59	0.69	0.74
Dirt (including right-of-way)	0.52	0.64	0.69
Urban districts:			
Commercial and business (85% Impervious)	0.77	0.83	0.86
Industrial (72% Impervious)	0.66	0.74	0.80
Residential districts by average lot size:			
1/8 acre or less (town houses) (65% Impervious)	0.59	0.72	0.77
1/4 acre (38% Impervious)	0.37	0.54	0.64
1/3 acre (30% Impervious)	0.32	0.50	0.61
1/2 acre (25% Impervious)	0.29	0.47	0.59
1 acre (20% Impervious)	0.26	0.45	0.96
2 acres (12% Impervious)	0.21	0.41	0.52
C Values for Developing Urban Areas	**B**	**C**	**D**
Newly graded areas (pervious areas only, no vegetation)	0.61	0.74	0.83
C Values for Undeveloped or Agricultural Areas	**B**	**C**	**D**
Cultivated Land:			
With conservation treatment	0.37	0.47	0.59
Without conservation treatment	0.30	0.43	0.50
Pasture, grassland, or range - continuous forage for grazing			
Poor hydraulic condition (<50% ground cover)	0.39	0.52	0.61
Fair hydraulic condition (50 to 75% ground cover)	0.28	0.45	0.50
Good hydraulic condition (> 75% ground cover)	0.16	0.36	0.47
Meadow - continuous grass, protected from grazing, and mowed for hay	0.13	0.30	0.43
Brush - brush, weed, and grasses with brush the major element			
Poor hydraulic condition (<50% ground cover)	0.24	0.41	0.54
Fair hydraulic condition (50 to 75% ground cover)	0.11	0.29	0.41
Good hydraulic condition (> 75% ground cover)	0.05	0.39	0.34
Woods, Poor: forest litter, small trees & brush w/ regular grazing & burning	0.23	0.41	0.54
Fair: Woods are grazed but not burned, some forest litter covers the soil	0.15	0.34	0.45
Good: Woods are protected from grazing, litter & brush cover soil	0.10	0.29	0.41
Farmsteads - buildings, lawns, and driveways	0.36	0.52	0.61

B. NRCS (SCS) Methods

For drainage areas over 1 acre, the methods explained in "Urban Hydrology for Small Watersheds", Technical Release No. 55, latest edition, and/or Technical Release No. 20, latest edition shall be used to calculate runoff volumes and peak rates of flow. Technical Releases No. 55 & No. 20 can be obtained from the United States Department of Agriculture, Natural Resources Conservation Service.

C. USGS Regression Equations

The regression equations presented in USGS Report 93-135 is an accepted method for estimating design peak-discharge values for streams with drainage areas between 17 and 2,600 acres. **The application of this method is limited to the estimation of peak discharges for City funded culvert installation and replacement projects. The following equations shall be used for the various design storms:

$$Q_2 = 155\ (A)^{0.68}\ (P - 30)^{0.50}\ (13 - BDF)^{-0.5}$$

$$Q_5 = 200\ (A)^{0.71}\ (P - 30)^{0.63}\ (13 - BDF)^{-0.44}$$

$$Q_{10} = 228\ (A)^{0.74}\ (P - 30)^{0.68}\ (13 - BDF)^{-0.41}$$

$$Q_{25} = 265\ (A)^{0.76}\ (P - 30)^{0.72}\ (13 - BDF)^{-0.37}$$

$$Q_{50} = 293\ (A)^{0.78}\ (P - 30)^{0.74}\ (13 - BDF)^{-0.35}$$

$$Q_{100} = 321\ (A)^{0.79}\ (P - 30)^{0.76}\ (13 - BDF)^{-0.33}$$

Where:
Q_N = peak discharge rate in cfs,
A = the drainage area in square miles,
P = average annual precipitation in inches = 36.6* inches for Delaware, Ohio
BDF = the basin development factor.

* Data derived from The National Climatic Data Center (NCDC) Cooperative Stations. 58 complete years between 1931 and 1995.
** See USGS Report 93-135 pg. 22 for the statistical limitations for this method

The basin development factor (BDF) is determined by subdividing the drainage basin into thirds (lower, middle, and upper) with two lines drawn across the basin that are perpendicular to the main channel and principal tributaries. Four aspects of the drainage system are then evaluated within each third of the basin and assigned a value of 1 or 0:

1. Channel improvements include any straightening, enlarging, deepening, and clearing made in the main drainage channel and principal tributaries. If at least 50 percent of the upstream channels in the basin are improved, then a value of 1 is assigned.
2. Channel linings include any length of the main drainage channels and principal tributaries that have been lined with an impervious material such as concrete. A value of 1 is assigned if at least 50 percent of the upstream channels have been lined.

3. Storm drains or storm sewers are defined as enclosed drainage structures (usually pipes) frequently used on secondary tributaries where drainage is received directly from streets or parking lots. A value of 1 is then assigned when more than 50 percent of the upstream secondary tributaries consist of storm drains.
4. Curb and gutter streets frequently empty into storm drains. If more than 50 percent of the upstream basin is developed with streets and highways constructed with curbs and gutters, then a value of 1 will be assigned.

The following table provides an example for calculating the overall BDF for the entire basin that has channel improvements throughout, no channel linings, and storm drains with curb and gutter streets in the lower two-thirds (2/3) of the basin:

Table 2: Example Determination of the Basin Development Factor

Portion of Basin	Channel Improvements	Channel Linings	Storm Drains	Curb & Gutter Streets	Basin Development Factor
Lower 1/3	1	0	1	1	3
Middle 1/3	1	0	1	1	3
Upper 1/3	1	0	0	0	1
				Total:	7

D. Software

List any software used in the methodology section of the Stormwater Management Report. Common software programs that are acceptable to the Public Works Department are:

1. ODOT's CDSS, used primarily for culvert design, inlet spacing, and ditch design
2. Hydra-Flow, Computer program by "intelSOLVE", Program is based on the Rational Method and used primarily for storm sewer design
3. Haestad Methods POND 2 Software, which includes the U.S. SCS TR-55
4. Win-TR-55 - Hydrology design
5. HydroCAD Software Solutions LLC – Hydrology design
6. TR-20 - Hydrology design
7. HEC-RAS – The US Army Corps of Engineers river analysis program
8. Other software may be approved after review by the Public Works Department

2. Drainage Area Determination

A. The drainage area shall be determined from one or more of the following sources:
   1. USGS maps
   2. Photogrammetrics
   3. Field investigations & Surveys
   4. Soil Survey of Delaware County
   5. Delaware County topographical maps and/or GIS contours.

B. Offsite Tributary Area

Stormwater runoff from offsite upstream tributary areas that discharge to or across a development site shall be accommodated within the stormwater facilities planned for the development site. No stormwater management plans will be approved until it is demonstrated that offsite runoff will be adequately conveyed through the development site in a manner that will not cause or contribute to hazardous or detrimental upstream and downstream flooding and erosion. The estimation of the offsite flows must be done separately from the estimation of onsite flows (i.e., separate hydrographs for offsite areas must be determined). Detention / Retention is not required for the offsite flows unless downstream condition warrant it. Offsite flows must be treated for water quality per Ohio EPA requirements.

The allowable release rate from a site that is "passing through" offsite runoff shall be the allowable release rate for the site plus the pre developed offsite flow for the design storm.

3. Time of Concentration (T_c)

Time of concentration (T_c) for a drainage area is defined as the time a drop of water takes to drain from the hydraulically most remote point in the watershed to the point of interest. T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge rate. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading. In general, higher and faster peak discharge is associated with smaller T_c. The time of concentration determines the average rainfall rate on the rainfall intensity-duration-frequency curve.

Different methods are available for computing T_c for a drainage area. Acceptable methods in the City of Delaware are the TR-55 tabular method and SCS Lag method

A. Factors affecting Time of Concentration (T_c) and Travel Time (T_t)
    1. Surface roughness

       One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development. The flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

    2. Channel shape and flow patterns

       In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

    3. Slope

       Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when

channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

B. SCS Lag Method for Computing T_c

This method was proposed by the Soil Conservation Services (SCS) and evaluates the drainage basin based on the average land slope, curve number (CN) and the hydraulic length.

From the known CN, the available storage (S) is computed using:

$$S = \frac{1000}{CN} - 10$$

The basin lag is then estimated using:

$$Lag = \frac{L^{0.8} \times (S+1)^{0.7}}{1900 \times (s \times 100)^{0.5}} hours$$

Where:
Lag = basin lag in hours
L = hydraulic length in feet
S = available storage
s = average slope of the drainage area in ft/ft (It is not the slope of a specific flow path, but rather the average slope of the watershed area.)

The time of concentration (Tc) for the drainage basin is then computed using:

T_c = 1.67 x Lag (hours)
T_c = 1.67 x Lag x 60 (minutes)

C. Velocity Method for Computing T_c

The velocity method of computing T_c assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path. Travel time for each segment are computed and summed to arrive at the time of concentration. The segments used in the velocity method are of three types: (1) sheet flow, (2) shallow concentrated flow, and (3) open channel flow. Water moves through a watershed in combinations of these segments in the order given. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Time of concentration (T_c) is the sum of time of travel values for the various consecutive flow segments:

$$T_c = t_{sheet} + t_{shallow} + t_{channel} + t_{conduit}$$

1. Sheet flow

Sheet flow is flow over plane surfaces and usually occurs at the upstream boundary of a watershed. Generally the depth of sheet flow is less than 0.1 feet and is a steady, uniform flow. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, rocks, erosion and transportation of sediment. The table below gives Manning's n values for

sheet flow for various surface conditions. Typically sheet flow length is less than 100-feet for paved areas with a maximum of 300-feet in length for unpaved areas, and is less than 20 minutes in duration. In general, sheet flow will not exceed 1-inch in depth.

For Sheet flow of less than 300 feet, use Manning's Kinematic Solution (Overton and Meadows 1976) to compute T_{sheet}

$$t_{sheet} = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}}$$

where:
t_{sheet} = travel time (hr),
n = Manning's roughness coefficient (table 3)
L = flow length (ft)
P2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following assumptions:

a. Shallow steady uniform flow,
b. Constant intensity of rainfall excess (that part of a rain available for runoff),
c. Rainfall duration of 24 hours, and
d. Minor effect of infiltration on travel time.

Rainfall depth can be obtained from the rainfall runoff equations.

Table 3: Roughness coefficients (Manning's n) for Sheet Flow

Surface Description	n [1]
Smooth Surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short Grass Prairie	0.15
Dense Grasses [2]	0.24
Bermuda Grass	0.41
Range (natural)	0.13
Woods [3]	
Light Underbrush	0.40
Dense Underbrush	0.80
[1] The n values are a composite of information compiled by Engman (1986)	
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures	
[3] When selecting n, consider cover to a height of about 0.1 feet. This is the only part of the plant cover that will obstruct sheet flow.	

2. Shallow Concentrated Flow

   Sheet flow is assumed to occur for no more than 300 feet after which water tends to concentrate in rills and then gullies of increasing proportion. This type of flow is classified as shallow concentrated flow. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. To estimate shallow concentrated flow travel time, a velocity is determined based on the slope and surface type. For the purposes of this manual, only paved and unpaved surfaces will be considered. The following equations will provide the estimated velocity based on slope for paved and unpaved surfaces:
   $V = 16.1345\ s^{0.5}$ (Unpaved)
   $V = 20.3282\ s^{0.5}$ (Paved)

   Where:
   V = average velocity (ft/s), and
   s = slope of hydraulic grade line (watercourse slope, ft/ft)

   These two equations are based on a solution of the Manning equation with different assumptions for n (Manning roughness coefficient) and r (hydraulic radius, ft). For unpaved areas, n is 0.05 and r is 0.4; for paved areas, n is 0.025 and r is 0.2.

   After determining average velocity, use the $t_{shallow}$ equation to estimate travel time for the shallow concentrated flow segment. The travel time for shallow concentrated flow is calculated as follows:

$$t_{shallow} = \frac{L}{3600 \cdot V}$$

where:
$t_{shallow}$ = Travel time for shallow concentrated flow in hours
L = Flow length in feet
V = Velocity in fps

3. Open Channel Flow

Open channel flow occurs beyond shallow concentrated flow when the flow depth exceed 0.5 feet in depth and enters into pipe systems, drainage ditches, or natural channels. The velocity of flow in an open channel or pipe can be estimated using the Manning's equation. Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. However, field observations should be made to determine the presence of defined channels or swales where depth of flow would exceed the 0.5 foot limitation of shallow concentrated flow. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for the bankfull condition.

Manning's equation is:

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

where:
V = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/ p_w
a = cross sectional flow area (ft^2)
p_w = wetted perimeter (ft)
s = slope of the hydraulic grade line (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow. (See tables below)

After average velocity is computed using the above equation, $t_{channel}$ (for both channel and conduit flow) can be determined using the following equation:

$$t_{channel} = \frac{L}{3600 \cdot V}$$

where:
$t_{channel}$ = Travel time for shallow concentrated flow in hours
L = Flow length in feet
V = Velocity in fps

Given varying cross-sections of flow paths, and varying peak rates of flow and resulting varying depths of flow for different return periods, it is expected that

each return period would result in a different t_c. In order to help simplify the modeling process the City will accept an average cross-section of the open channel in segments of 250-ft in length, with a depth of flow determined by the 2-year return period event. This simplification is for determining the t_c only, and is not to be used for the design of new open channels. New channels are to be designed using the design storm specified in the section on Open Watercourses.

Table 4: Manning's n Values for Excavated Channels

Roughness Coefficient for Excavated Open Channels			Manning's n Range		
Type	**Characteristics**		**Minimum n**	**Normal n**	**Maximum n**
Earth, straight and uniform	clean, recently completed		0.016	0.018	0.020
	clean, after weathering		0.018	0.022	0.025
	gravel, uniform section		0.022	0.025	0.030
	clean with short grass, few weeds		0.022	0.027	0.033
Earth, winding and sluggish	no vegetation		0.023	0.025	0.030
	grass, some weeds		0.025	0.030	0.033
	dense weeds or aquatic plants in deep channels		0.030	0.035	0.040
	earth bottom and ruble sides		0.028	0.030	0.035
	stony bottom and weed banks		0.025	0.035	0.040
	cobble bottom and clean sides		0.030	0.040	0.050
Dragline-excavated or dredged	no vegetation		0.025	0.028	0.033
	light brush on banks		0.035	0.050	0.060
Rock cuts	based on design section		0.035	0.045	0.050
	based on actual mean section	smooth and uniform	0.025	0.035	0.040
		jagged and irregular	0.035	0.040	0.050
Channels not maintained, weed and brush uncut	dense weed high as flow depth		0.050	0.080	0.120
	clean bottom, brush on sides		0.040	0.050	0.080
	clean bottom, brush on sides, highest stage of flow		0.045	0.070	0.110
	dense brush, high stage		0.080	0.100	0.140

Table 5: Manning's n Values for Roadside Ditches

Roadside channels and swales with maintained vegetation (Values shown are for velocities of 2 and 6 ft/sec)			Manning's n Range		
			Minimum n	Normal n	Maximum n
Depth of flow up to 0.7 ft	Bermuda grass, Kentucky bluegrass, buffalo grass	Mowed to 2 in	0.045	0.058	0.070
		Mowed to 6 in	0.050	0.070	0.090
	Good stand, any grass	Length about 12 inches	0.090	0.135	0.180
		Length about 24 inches	0.150	0.225	0.300
	Fair stand, any grass	Length about 12 inches	0.080	0.110	0.140
		Length about 24 inches	0.130	0.190	0.250
Depth of flow 0.7 - 1.5 ft	Bermuda grass, Kentucky bluegrass, buffalo grass	Mowed to 2 in	0.038	0.044	0.050
		Mowed to 6 in	0.040	0.050	0.060
	Good stand, any grass	Length about 12 inches	0.070	0.095	0.120
		Length about 24 inches	0.100	0.150	0.200
	Fair stand, any grass	Length about 12 inches	0.060	0.080	0.100
		Length about 24 inches	0.090	0.130	0.170

Table 6: Manning's n Values for Lined Channels

Roughness Coefficient for Lined Open Channels		Manning's n Range		
Type	**Characteristics**	**Minimum n**	**Normal n**	**Maximum n**
Cement	neat surface	0.010	0.011	0.013
	mortar	0.011	0.013	0.015
Concrete	trowel finish	0.011	0.013	0.015
	float finish	0.013	0.015	0.016
	finished, with gravel on bottom	0.015	0.017	0.020
	unfinished	0.014	0.017	0.020
	gunite, good section	0.016	0.019	0.023
	gunite, wavy section	0.018	0.022	0.025
	on good excavated rock	0.017	0.019	0.020
	on irregular excavated rock	0.022	0.025	0.027
Concrete bottom float finished with sides of :	dressed stone in mortar	0.015	0.017	0.020
	random stone in mortar	0.017	0.020	0.024
	cement rubble masonry, plastered	0.016	0.020	0.024
	cement rubble masonry	0.020	0.025	0.030
	dry rubble or riprap	0.020	0.030	0.035
Gravel bottom with sides of:	formed concrete	0.017	0.020	0.025
	random stone in mortar	0.020	0.023	0.026
	dry rubble or riprap	0.023	0.033	0.036
Brick	glazed	0.011	0.013	0.015
	in cement mortar	0.012	0.015	0.018
Masonry	cemented rubble	0.017	0.025	0.030
	dry rubble	0.023	0.032	0.035
Dressed ashlar	--	0.013	0.015	0.017
Asphalt	smooth	0.013	0.013	0.013
Vegetal lining	--	0.030	0.040	0.500

Table 7: Manning's n Values for Natural Channels

Natural Stream Channels			Manning's n Range		
Type	**Characteristics**		**Minimum n**	**Normal n**	**Maximum n**
Minor Streams (surface width at flood stage is less than 100 feet)	Fairly regular section	Some grass and weeds, little or no brush	0.030	0.033	0.035
		Dense growth of weed, depth of flow materially greater than weed height	0.035	0.043	0.050
		Some weeds, light brush on banks	0.040	0.045	0.050
		Some weeds, heavy brush on banks	0.050	0.060	0.070
		Some weed, dense willows on banks	0.060	0.070	0.080
	For trees within the channel, with branches submerged at high stage, increase all above values by:		0.010	0.015	0.020
	For irregular section, with pools, slight meander, increase value for fairly regular sections by about:		0.010	0.015	0.020
	Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage	Bottom of gravel, cobbles and few boulders	0.040	0.045	0.050
		Bottom of cobbles, with large boulders	0.050	0.060	0.070

4. Reservoirs or lakes

   Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed as zero.

5. Limitations
   a. Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Typically sheet flow length is less than 100-feet for paved areas with a maximum of 300-feet in length for unpaved areas. It takes approximately 20 minutes of rainfall at the 2 year intensity for measurable runoff to occur. In general, sheet flow will not exceed 1-inch in depth.
   b. Manning's Kinematic Equation was developed for use with the four standard SCS rainfall intensity-duration relationships.
   c. In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate Tc. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or non-pressure flow.
   d. The minimum T_c used in TR-55 is 0.1 hour.

e. A culvert or bridge can act as a reservoir outlet if there is significant storage behind it. The procedures in TR-55 can be used to determine the peak flow upstream of the culvert. Detailed storage routing procedures should be used to determine the outflow through the culvert.

4. SCS Runoff Curve Numbers (CN)

The major factors that determine CN are the hydrologic soil group, cover type, treatment, hydrologic condition, and antecedent runoff condition. Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected).

Table 9: Runoff Curve Numbers (CN) for Typical Land Uses in the City of Delaware is provided to aid in selecting the appropriate figure or table for determining curve numbers for the City of Delaware. The CN values in table 9 represent average the runoff condition for urban, developing urban, and pre-developed agricultural land uses typical to area in and around the City of Delaware. The values in table 9 are to be used in all projects in the city and may be vary slightly from those found in other publications. In all cases the values found in table 9 supersede those found in other publications. Table 9 assumes impervious areas are directly connected to a suitable outlet.

5. Hydrologic Soil Groups (HSG)

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. The vast majority of the soils in Delaware County fall into the C or D group. The soils in the area of interest may be identified from the Delaware County Soil Survey, which can be obtained from the Delaware Soil and Water Conservation office.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. In areas where soil has been previously disturbed by construction activities in the urban environment an HSG of D shall be used.

6. Ground Cover

Table 9 addresses most cover types typically found in the City of Delaware, such as common native and cultivated vegetation, bare soil, water surfaces and impervious surfaces. There are a number of methods for determining existing cover type for the proposed development. The most common are field reconnaissance, aerial photographs, and land use maps. Ponds are considered impervious and must be included at a CN of 98 or a C of 0.96.

7. SCS Type II Storm

Different rainfall distributions can be developed to emphasize the critical rainfall duration for the peak discharges. To avoid the use of a different set of rainfall intensities for each drainage area size, a set of synthetic rainfall distributions having “nested” rainfall intensities was developed. The set “maximizes” the rainfall intensities by incorporating

selected short duration intensities within those needed for longer durations at the same probability level.

For the size of the drainage areas for which NRCS usually provides assistance, a storm period of 24 hours was chosen the synthetic rainfall distributions. The 24-hour storm, while longer than that needed to determine peaks for these drainage areas, is appropriate for determining runoff volumes. Therefore, a single storm duration and associated synthetic rainfall distribution can be used to represent not only the peak discharges but also the runoff volumes for a range of drainage area sizes. For the City of Delaware, the synthetic storm to be used in modeling rainfall events is the NRCS (SCS) Type II Storm.

Table 8: Runoff Curve Numbers (CN) for Typical Land Uses in the City of Delaware

Cover type and hydrologic condition	Curve numbers for hydrologic soil group		
Runoff Curve Numbers for Urban Areas	**B**	**C**	**D**
Fully developed urban areas (vegetation established)			
Open space (lawns, parks, golf courses, cemeteries, etc.)			
Poor condition (grass cover < 50%)	79	86	89
Fair condition (grass cover 50% to 75%)	69	79	84
Good condition (grass cover > 75%)	61	74	80
Impervious areas:			
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98
Retention Basins, Ponds, River and Streams	98	98	98
Streets and roads:			
Paved; curbs and storm sewers (excluding right-of-way)	98	98	98
Paved; open ditches (including right-of-way)	89	92	93
Gravel (including right-of-way)	85	89	91
Dirt (including right-of-way)	82	87	89
Urban districts:			
Commercial and business (85% Impervious)	92	94	95
Industrial (72% Impervious)	88	91	93
Residential districts by average lot size:			
1/8 acre or less (town houses) (65% Impervious)	85	90	92
1/4 acre (38% Impervious)	75	83	87
1/3 acre (30% Impervious)	72	81	86
1/2 acre (25% Impervious)	70	80	85
1 acre (20% Impervious)	68	79	84
2 acres (12% Impervious)	65	77	82
Runoff Curve Numbers for Developing Urban Areas	B	C	D
Newly graded areas (pervious areas only, no vegetation)	86	91	94
Runoff Curve Numbers for Undeveloped or Agricultural Areas	B	C	D
Cultivated Land:			
Without conservation treatment	75	80	85

With conservation treatment	71	78	81
Pasture, grassland, or range - continuous forage for grazing			
Poor hydraulic condition (<50% ground cover)	76	82	86
Fair hydraulic condition (50 to 75% ground cover)	69	79	84
Good hydraulic condition (> 75% ground cover)	61	74	80
Meadow - continuous grass, protected from grazing, and mowed for hay	58	71	78
Brush - brush, weed, and grasses with brush the major element			
Poor hydraulic condition (<50% ground cover)	67	77	83
Fair hydraulic condition (50 to 75% ground cover)	56	70	77
Good hydraulic condition (> 75% ground cover)	48	76	73
Woods , Poor: forest litter, small trees & brush w/ regular grazing & burning	66	77	83
Fair: Woods are grazed but not burned, some forest litter covers the soil	60	73	79
Good: Woods are protected from grazing, litter & brush cover soil	55	70	77
Farmsteads - buildings, lawns, and driveways	74	82	86

8. Rainfall Data

Acceptable rainfall data for use in culvert, storm system, and Hydrological design are those provided in the "Rainfall Frequency Atlas of the Midwest" by Floyd A. Huff and James R. Angel (Bulletin 71).

Total rainfall amounts for Delaware are presented in table 9 (below) for selected rainfall durations and recurrence intervals. The 24-hour rainfall amounts are to be used with the NRCS TR-55 methods.

Table 9: Bulletin 71 Sectional Mean Frequency Distributions for the City of Delaware

Duration	Rainfall (inches) for Given Recurrence Interval														
	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	18-hr	24-hr	48-hr	72-hr	5-day	10-day
2-month	0.14	0.25	0.32	0.44	0.56	0.69	0.76	0.90	1.04	1.12	1.19	1.27	1.36	1.49	1.81
3-month	0.17	0.29	0.38	0.51	0.65	0.81	0.89	1.04	1.21	1.31	1.39	1.48	1.59	1.78	2.18
4-month	0.18	0.32	0.41	0.56	0.71	0.88	0.97	1.14	1.32	1.43	1.52	1.65	1.80	2.01	2.51
6-month	0.21	0.37	0.48	0.65	0.83	1.02	1.13	1.32	1.53	1.65	1.76	1.91	2.09	2.34	2.95
9-month	0.24	0.42	0.54	0.74	0.94	1.16	1.28	1.50	1.74	1.88	2.00	2.20	2.40	2.69	3.39
1-year	0.26	0.46	0.59	0.80	1.02	1.26	1.39	1.63	1.89	2.04	2.17	2.39	2.61	2.92	3.69
2-year	0.32	0.57	0.73	1.00	1.27	1.57	1.73	2.03	2.35	2.54	2.70	2.97	3.23	3.67	4.69
5-year	0.40	0.70	0.90	1.24	1.57	1.94	2.14	2.51	2.91	3.15	3.35	3.67	3.99	4.65	5.93
10-year	0.46	0.81	1.04	1.43	1.81	2.24	2.47	2.89	3.36	3.63	3.86	4.21	4.54	5.39	6.78
25-year	0.56	0.97	1.25	1.72	2.18	2.69	2.97	3.48	4.04	4.36	4.64	5.02	5.36	6.37	7.82
50-year	0.64	1.12	1.44	1.97	2.51	3.09	3.41	4.00	4.64	5.01	5.33	5.72	6.09	7.11	8.56
100-year	0.73	1.27	1.64	2.24	2.85	3.51	3.88	4.55	5.27	5.70	6.06	6.50	6.92	7.89	9.27

Source of data: Bulletin 71, Part 2, Table 8 for Climatic Section 5

A tabulation of rainfall intensities for the 1-, 2-, 5-, 10-, 25-, 50-. and 100-year recurrence intervals, and for duration ranging from 10 through 200 minutes, has been developed for Delaware and is shown in table 11. This data supersedes the rainfall data from Technical Paper No. 40. Intensities for durations not shown shall be calculated by the rainfall intensity equations provided.

A. Rainfall Intensity Equations incorporating Bulletin 71 Data

Federal Highway Administration Hydraulic Engineering Circular No. 12 Appendix A offers a methodology for converting I-D-F data points to an equation of the general form. The Intensity can be found using the following equation:

$$i = \frac{\mathrm{x}}{(\mathrm{y} + \mathrm{t})^{z}}$$

Where:
i = Rainfall Intensity in inches per hour
t = time of concentration (minutes)
Constants x, y, and z given for each of the design year storms given in the table below:

Table 10 - Constants for I-D-F Curves

Frequency (Years)	Constant "x"	Constant "y"	Constant "z"
2	90.36	18.49	0.98
5	61.39	12.49	0.86
10	68.67	12.08	0.85
25	101.85	14.86	0.89
50	96.25	12.89	0.85
100	334.68	23.51	1.08

Table 11: Bulletin 71 – Selected Design Rainfall Intensities

Duration (min)	Rainfall Intensity (in/hr) for Recurrence Interval of: 2 years	5 years	10 years	25 years	50 years	100 years
10	3.42	4.27	4.95	5.82	6.72	7.62
10.5	3.36	4.20	4.85	5.72	6.60	7.50
11	3.31	4.12	4.77	5.62	6.48	7.38
11.5	3.25	4.05	4.68	5.52	6.37	7.27
12	3.20	3.97	4.60	5.43	6.26	7.16
12.5	3.15	3.91	4.52	5.34	6.15	7.05
13	3.10	3.84	4.44	5.26	6.05	6.95
13.5	3.05	3.78	4.37	5.18	5.95	6.85
14	3.01	3.72	4.30	5.10	5.86	6.75
14.5	2.96	3.66	4.23	5.02	5.77	6.65
15	2.92	3.60	4.16	4.94	5.68	6.56
15.5	2.88	3.54	4.10	4.87	5.60	6.47
16	2.84	3.49	4.03	4.80	5.51	6.38
16.5	2.80	3.44	3.97	4.73	5.43	6.30
17	2.76	3.39	3.92	4.67	5.36	6.21
17.5	2.72	3.34	3.86	4.60	5.28	6.13
18	2.69	3.29	3.80	4.54	5.21	6.05
18.5	2.65	3.25	3.75	4.48	5.14	5.97
19	2.62	3.20	3.70	4.42	5.07	5.90
19.5	2.58	3.16	3.65	4.36	5.00	5.82
20	2.55	3.12	3.60	4.31	4.94	5.75
21	2.49	3.04	3.51	4.20	4.81	5.61
22	2.43	2.96	3.42	4.10	4.70	5.48
23	2.37	2.89	3.34	4.00	4.58	5.35
24	2.31	2.83	3.26	3.91	4.48	5.23
25	2.26	2.76	3.18	3.82	4.38	5.12
26	2.21	2.70	3.11	3.74	4.28	5.00
27	2.16	2.64	3.05	3.66	4.19	4.90
28	2.12	2.58	2.98	3.58	4.10	4.80
29	2.08	2.53	2.92	3.51	4.02	4.70
30	2.03	2.48	2.86	3.44	3.94	4.60
32	1.95	2.38	2.75	3.31	3.79	4.42
34	1.88	2.30	2.65	3.19	3.65	4.26
36	1.81	2.21	2.55	3.08	3.52	4.11
38	1.75	2.14	2.47	2.97	3.41	3.96
40	1.69	2.07	2.39	2.88	3.30	3.83
42	1.64	2.00	2.31	2.79	3.19	3.70
44	1.59	1.94	2.24	2.70	3.10	3.58
46	1.54	1.89	2.17	2.62	3.01	3.47
48	1.49	1.83	2.11	2.55	2.92	3.37
50	1.45	1.78	2.06	2.48	2.85	3.27
52	1.41	1.74	2.00	2.41	2.77	3.18
54	1.37	1.69	1.95	2.35	2.70	3.09
56	1.34	1.65	1.90	2.29	2.63	3.00
58	1.30	1.61	1.85	2.23	2.57	2.93
60	1.27	1.57	1.81	2.18	2.51	2.85

PART 3 – STORMWATER CONTROLS

1. Peak Runoff Control (Critical Storm Method)

Stormwater runoff controls shall be designed in order to control the peak rate of runoff from small, moderate, and large storm events before it is discharged offsite. Peak runoff shall be controlled in accordance with the Critical Storm Method as presented in this chapter for all land development and redevelopment projects. The requirement for peak runoff control on developments and redevelopments less than one acre in size may be modified or waived on a case-by-case basis if approved by the Public Works Department after submission of a Design Exception Form. The project size shall be based on area of disturbance associated with the development or redevelopment

The peak rate of runoff from an area after development shall not exceed the peak rate of runoff from the same area before development for all storms up to a 100-year frequency, 24-hour storm. In addition, if it is found a proposed development will increase the volume of runoff from an area, the peak rate of runoff from certain more frequent storms must be controlled further in accordance with the Critical Storm Method as described below

There are two reasons why increases in volume of runoff require a control standard more restrictive than controlling to the predevelopment condition. First, increases in volume mean runoff will be flowing for a longer period of time. When routed through a watershed, these longer flows may join at some point or points downstream thereby creating new peak flows and the problems associated with peak flow (flooding). This is known as the "Routing Problem." Second, longer flow periods of large runoff quantities place a highly erosive stress on natural channels. Reducing the rate of discharge can minimize this stress. The permissible peak rate shall be determined as follows:

Determine the total volume of runoff from a 1-year frequency 24-hour storm, occurring over the area before and after development. The following are the equations used in the TR-55 method for determining runoff volume. Alternative methods can be used if they (a) give a runoff volume, and (b) are pre-approved by the Public Works Department. The Rational Method does not produce a runoff volume and cannot be used to determine either the critical storm or detention/retention requirements.

$$q = \frac{[I - (0.2 \times S)]^2}{I + (0.8 \times S)}$$

Where,

q = Direct surface runoff in inches

I = Storm rainfall in inches

S = Maximum potential difference between rainfall and runoff in inches

$$S = \frac{1000}{RCN} - 10$$

$$Q = \frac{q}{12} \times A$$

Where,

Q = volume of flow in acre-feet
A = area in acres

Determine the percent of increase in volume due to development

$$Increase = \left(\frac{Q_{post}}{Q_{ex}} - 1 \right) \times 100\%$$

Using this percentage, pick the critical storm from the following table:

Table 12: Critical Storm

If the percentage of increase in the volume of runoff is:				The Critical Storm for discharge limitation will be:
Equal to or greater than		and less than		
0%	~	10%		1 year critical storm
10%	~	20%		2 year critical storm
20%	~	50%		5 year critical storm
50%	~	100%		10 year critical storm
100%	~	250%		25 year critical storm
250%	~	500%		50 year critical storm
500%	~	-		100 year critical storm

The peak rate of runoff from the critical storm occurring over the development shall not exceed the peak rate of runoff from a 1-year frequency storm occurring over the same area under predevelopment conditions. Storms of less frequent occurrence (longer return period) than the critical storm shall have peak rate of runoff not greater than for the same storm under predevelopment conditions. As an example, if the total volume is shown to be increased by 35%, the critical storm is a 5-year storm. The peak rate of runoff for all storms up to this intensity shall be controlled so as not to exceed the peak rate of runoff from a 1-year frequency storm under predevelopment conditions for the area. The runoff from a more intense storm need only be controlled so as not to exceed the predevelopment peak rate from the same frequency of storm. The critical storm shall be computed for each sub-catchment of a parcel. The allowable release rates are to be based on the individual sub-catchment. If the development has multiple outlets it may have differing critical storms for each outlet.

Storage volume does not have to be provided for off-site upstream flows. Flow from such areas will be routed through the drainage system in the development under consideration at a rate determined in the same manner as the on-site system. Off-site land uses prevailing at the time of development shall be considered as the predevelopment condition for the purpose of calculating changes in runoff.

2. Retention/Detention Basins

This section provides design criteria for facilities that control stormwater discharges to control peak rates of runoff, prevent flooding, stream bank erosion, and water quality

impairment downstream of development / redevelopment projects. Separate design criteria are provided for stormwater quantity and quality control facilities; however, in many cases quantity and quality controls are integrated into a single facility. This section provides criteria in three major sections: (A) General Criteria, (B) Stormwater Quantity Controls, and (C) Post Construction Stormwater Quality Controls.

A. General Criteria

1. Centralized storm water detention is recommended for all developments wherever possible.
2. Rear yard or enlarged drainage swale detention basins are not recommended unless no other option is available to the property.
3. Stormwater control facilities shall not be located within the Stream Corridor Protection Zone defined using OEPA Criteria
4. Stormwater control facilities shall not be located within designated Federal Emergency Management Agency (FEMA) floodplain boundaries.
5. Discharges from stormwater control facilities shall be directed into an approved discharge point as previously defined in this design guide.
6. Stormwater runoff shall not be diverted from an existing naturally occurring wetland that is not approved for filling and/or removing (as necessary) via an approved Section 404 permit issued by the U.S. Army Corps of Engineers. Wetland hydrology shall be sustained to the extent possible. The quantity and quality of this runoff shall be controlled prior to its release to the wetland system.

B. Stormwater Quantity Controls

Detention structures can be categorized as dry basins, permanent (wet) basins (A.K.A. ponds), underground storage chambers, stormwater wetlands, vegetated swales, bioretention facilities, multi-use storage areas such as rooftops, parking lots, and other shallow holding areas. The objective of control structures is to reduce the peak rate of discharge by storage and controlled release.

1. General Design Criteria for Retention/Detention Basins

   All proposed dry and wet detention basins shall be designed according to the general criteria in this section, as well as the specific criteria for stormwater quantity basins stormwater quality basins or both.

   NOTE: There are special considerations for basins in the vicinity of Delaware Airport; therefore the developer, owner, and/or design engineer shall contact the Public Works Department to discuss these considerations and requirements should the development be within 5000-feet of the Delaware Airport. See Appendices for additional information.

2. Layout and Geometry Requirements

   Modern day water quality requirements have created a proliferation of stormwater basins commonly constructed near roadways. There is a growing concern in the City over proximity of ponds to roadways as more incidents of vehicles entering ponds are reported. The Engineer is required to implement a pond buffer of some type between roadways and retention ponds – whether it be a large physical separation, mounding, rail, or combination thereof. The

purpose of this section is to provide guidance to the Engineer in order to design a buffer that is approvable by the City.

Proposed stormwater retention basins shall be located as far as practicable from existing and proposed roadways. Most developments cannot accommodate large enough separations that would eliminate the concern of vehicles entering the pond, therefore, the following guidance is provided so the Engineer can determine an appropriate and approvable buffer to propose for approval by the City.

The Clear Zone, per the OMUTCD, shall be clear and unobstructed by a stormwater basin; otherwise the stormwater basin shall be considered an obstruction of the clear zone as a non-traversable hazard and the designer shall provide the appropriate corrective treatment per the OMUTCD. Again, the preference is for the pond to be as far as practicable from the roadway.

If a stormwater basin has to be located near a roadway, the following design parameters are to be met, in order of preference as listed:

a. The stormwater basin shall be designed as a dry detention basin. Under most circumstances, a buffer will not be required for safety purposes around dry detention basins if the side slopes do not exceed 3:1.
b. Landscaped mounding shall be constructed six (6) feet in height not to exceed 3:1 side slopes between the roadway and the basin in combination with the largest practicable separation between the roadway and the pond.
c. If the proposed roadside grading is such that the ground slopes continuously down from the edge of pavement to the pond, then guardrail shall be required adjacent to the roadway – regardless of the separation distance between the roadway and the pond. The Engineer shall attempt to avoid this condition whenever possible.
d. If mounding is not practicable, the pond is out of the clear zone, and the grading is relatively flat between the road and the basin, the Engineer shall incorporate a wood rail barrier - located near the top of slope down to the normal water surface. Reference the RDWD series of the standard drawings for an example of an acceptable single wood rail barrier.

The Engineer must incorporate a more robust stormwater basin buffer when any of the following conditions are present:

- High ADT (i.e. collector or arterial roadway)
- Speeds greater than or equal to 35 mph
- Curved roadway alignment
- Pond located across from T-intersection
- Parking stalls fronting a pond

Even if mounding or rail is not needed because the physical separation between the roadway and retention basin is so large, the wet retention pond must be delineated somehow (ex. Plantings, fencing, etc.) so the pond is clearly delineated and identifiable when frozen and/or covered with snow.

Guardrail may be wood timber guardrail, reference USDOT FHWA Federal Lands Highway Standard Drawings Section 617-Guardrail.

Additionally, the following criteria shall be used to define the layout and geometry of all stormwater basins in the City:

a. Detention basins shall not be located on un-compacted fill, on slopes greater than 3:1, or where infiltrating groundwater could adversely impact slope stability.
b. Where berms constructed of fill which will be over 6 feet high are proposed, calculations supporting the stability of the fill berms are to be submitted by a Geotechnical Engineer.
c. Detention basins shall be designed such that they readily accommodate flow from a site's major flood routing path(s) Overland flow from a site shall be directed to a site's detention basin(s), to ensure that all site runoff is controlled.
d. The basin shall be designed with an emergency spillway for storms that exceed the 100-year, 24-hour storm event. The emergency spillway shall be designed to direct the flow to a suitable downstream flood routing path without erosion, scouring, or soil undermining, and to meet other pertinent Ohio Dam Safety requirements. A cut section detailing the emergency spillway showing elevations and cross sections is required as a part of the plan set.
e. The basin shall be designed so that the peak water surface elevation in the basin does not overtop the basin embankment or flood structures around the basin. One foot (1-ft) of freeboard is required on all earthen basins, measured from the peak 100-yr 24-hour storm event to the top of embankment.
f. Side slopes within and adjacent to the basin must not exceed 3:1, with a 4:1 slope or flatter preferred at all locations to prevent bank erosion and minimize safety risks when the basin is full.
g. All basins shall have a 10-foot wide vehicle access way or berm adjacent to the entire perimeter of the basin to provide access for maintenance vehicles. The maximum cross slope for the vehicle access way shall be 10:1.
h. Basins shall be designed to limit the migration of groundwater from the basin towards sanitary sewers and building basements. No sanitary lines may pass under the basin or within the 100-year ponding limits of the basin.
i. All inflow pipes to the detention basin shall be designed with full height headwalls.
j. Rock channel protection shall be used to minimize erosion around the headwall, as well as along the side slopes of the basin under each inflow pipe or open channel.
k. Woody vegetation may not be planted or allowed to grow on the embankment, within 15 feet of the toe of the embankment, and within 25 feet from the principal spillway structure. The establishment of woody vegetation in other areas around the basin is encouraged to provide shade and moderate surface water temperatures.

l. Permanent stormwater quantity control basins, as defined herein, may be used as temporary sedimentation basins designed to control sedimentation during construction as long as collected sediments are removed, the design grade of the facility is restored, permanent vegetation is established, the temporary outlet is removed, and permanent outlet structure is constructed as designed.

3. Debris Control Requirements

   Debris control structures (trash racks) for both wet and dry basins may be required at the basin outlet if the potential exists for large debris to enter the detention basin through an open watercourse or large diameter inlet pipe. Debris control structures shall be designed using Hydraulic Engineering Circular No. 9, available from the U.S. Department of Transportation, Federal Highway Administration.

4. Outlet Control Structure and Outfall Protection Requirements
   a. The basin shall be designed with an outlet control structure sized to meet the stormwater quantity and quality control requirements
   b. The outlet structure shall be designed to minimize the transport of floating debris, oil, and grease through the detention facility. The design of the facility shall also include adequate provisions to minimize erosion in the vicinity of the inlet and outlet, and on the side slopes of surface facilities. Open channels receiving discharges from the facility shall be protected with rock channel protection.
   c. Seepage along any conduit that extends through the basin embankment to the downstream slope shall be controlled using an approved, engineered anti-seep collar or clay dam.
   d. The minimum orifice size is 4 inches in diameter. Required orifice openings of less than 4-inches in diameter must conform to current control structure specifications per ODOT STD DWG WQ-1.1 & W-Q1.2. Alternative outlet designs (e.g., V-notch weir, perforated riser pipes, etc.) may be permitted upon the approval of the Public Works Department and if acceptable design practice is proven for site conditions.

5. Useful Equations for Basin Routing
   a. Weir Equation ~ Broad-crested Weirs and Spillways

      Typically a basin emergency spillway is a broad-crested weir or an ogee spillway. A weir is considered broad-crested if the weir thickness is greater than half of the head (H). An ogee spillway is one that is designed with an ogee shaped bottom to minimize cavitation of the overflow. The flow through both of these weirs can be approximated by the following equation:

      $$Q = \frac{2}{3} \cdot C_s \cdot b \cdot \sqrt{2 \cdot g} \cdot H^{3/2}$$

      Where,
      C_s = 0.50 to 0.57 (broad-crested)
      C_s = 0.60 to 0.75 (ogee spillway)

b = bottom width
H = head
g = 32.2 ft/sec^2

b. Orifice Equation

$$Q = C_d \cdot A \cdot \sqrt{2 \cdot g \cdot h}$$

Where,
C_d = discharge coefficient
A = cross-sectional area of the orifice
h = elevation of the water surface above the center of the orifice
g = gravitational constant (32.2 ft/sec^2)

6. Additional Layout Requirements for Dry Detention Basins

The following additional requirements shall apply to the design of dry detention basins for stormwater quantity control:

a. Dry detention basins shall be designed to drain toward the outlet or micro-pool in order to minimize standing water and saturated soil conditions that impede maintenance and mowing of the facility.
b. The detention basin bottom shall be sloped to drain, and such slopes shall be sufficient to militate against "flat spots" developing due to construction errors and soil conditions. The minimum transverse slope for the bottoms of such facilities shall be 2%. Basins with less fall across the bottom shall include a paved low flow channel from each inlet pipe or open channel to the basin's outfall.
c. Low flow channels shall be designed per the following requirements:
    i) Bottom width – minimum width shall be 4 feet
    ii) Side slopes – shall not be steeper than 4:1,
    iii) Channel slope – minimum slope toward the basin outlet shall be 0.5 percent for channels with paved bottoms,
    iv) Channel depth – minimum depth of channel shall be 0.5 feet
    v) The bottom and side slopes of the paved channel shall be Class C concrete reinforced with steel mesh a minimum of 6 inches thick,
    vi) Weep holes shall be designed in the concrete side walls.
d. The minimum bottom width for dry detention basins, other than the low flow channel, shall be 12 feet.
e. Dry detention basins shall be provided with topsoil, and shall be seeded and mulched to prevent erosion. Grasses seeded within the basin should be able to survive 48 hours under water. Jute and Excelsior matting shall be used as required to stabilize slopes and prevent erosion.

7. Additional Layout Requirements for Wet Detention Basins

The following additional requirements shall apply to the design of wet basins for stormwater quantity control:

a. The permanent pool must have adequate depth to during the dry season. The minimum depth of from the normal pool elevation to the bottom of the basin shall be 8-feet. The depth of wet detention basins shall be no

more than 12 feet below the basin's normal water elevation. The minimum bottom width of wet basins shall be 12 feet.

b. The perimeter of all permanent pool areas deeper than 4 feet shall be surrounded by an aquatic bench that extends at least 8 feet and no more than 15 feet outward from the normal water edge. The aquatic bench shall have an average depth of 24 inches below the permanent pool to promote the growth of aquatic vegetation. The maximum slope of the aquatic bench shall be 10:1
c. The City prohibits the construction of wet detention basins and stormwater wetlands 5,000-ft from the municipal airport, as recommended by the Federal Aviation Administration (FAA), Advisory Circular Number 150/5200-33. As an alternative stormwater best management practice that does not maintain a permanent pool of water and is not as likely to attract large numbers of waterfowl is required in the vicinity of the airport. An access easement that extends 12 feet from the top of bank outward for any BMP in this zone shall be dedicated to the City of Delaware to ensure that proper maintenance is performed. See standard details for additional specifications and details.
d. Submerged Outlets
    i) Submerged outlets may be permitted provided a structure is constructed between the outlet at the retention basin and the main storm system. The pipe can be submerged to this first structure only. This structure must also be after the last pavement crossing. The structure shall have a grated cover
    ii) The pipe from the pond outlet to the first manhole shall have watertight joints.
    iii) The invert elevation of the pipe entering into this first structure will be at least 0.5-feet above the normal pool elevation.
    iv) The slope of the basin at the outlet shall be no flatter than 2:1 to avoid siltation at the outlet.

8. Parking Lot Storage

   Parking lot storage is a stormwater quantity control method allowing shallow ponding within paved portions of the parking lot during the design storm event. Parking lot storage is a convenient multi-use structural control method where impervious parking lots are planned. The following criteria shall apply to parking lot storage facilities:

   a. Ponding in parking or traffic areas shall be designed for a maximum ponding depth of twelve (12) inches for all storms up to and including the 100-year event. Flood routing or overflow to a designed conveyance system must occur after the maximum depth is reached.
   b. Runoff from specific graded areas within a parking lot shall be controlled by orifices. The release rate of the flow from a parking lot storage facility shall meet the allowable post-development runoff criteria. The minimum size outlet device shall be a 4-inch single orifice for water quantity control. Alternative outlet designs of smaller diameter may be permitted with Public Works Department approval.
   c. A site with a parking lot storage facility shall employ a separate water quality treatment This BMP may be located either downstream of the

parking lot or integrated into the medians, landscaping, or other pervious areas of the parking lot.

d. Ponding areas must also be designed so that a minimum of 8 feet of traveled way is provided during a critical-year storm if a storm structure is located in a drive aisle or along an inverted crown.

9. Underground Storage Units

Underground storage is a stormwater quantity control method that employs a series of underground pipes or chambers and has a designed release feature to control stormwater discharge. This method is most applicable where land is valuable or the site is constrained, such as in industrial, commercial, and redevelopment areas. Construction costs and operation costs, which may include pumps, make this method relatively expensive.

a. If underground storage is to be used for a site, a plan for long term maintenance of the facility shall be provided to the Public Works Department, including a health and safety plan for confined space entry.
b. The release rate of the flow from an underground storage facility shall meet the calculated allowable post-development runoff rate.
c. A site with an underground storage facility shall employ a separate water quality BMP that meets all of the water quality treatment criteria.

C. Stormwater Quality Controls

Post Construction Storm Water Best Management Practices (BMPs) are provided for perpetual management of runoff quality and quantity so that a receiving stream's physical, chemical and biological characteristics are protected and stream functions are maintained.

For stormwater quality requirements, Chapter 16 should be referenced. This section only provides design requirements for specific BMPs that provide stormwater quality treatment. In addition to this section, requirements of the current edition of the Ohio Rainwater and Land Development Manual shall be followed in the design of stormwater BMPs.

For all projects with one or more acre of development or projects that are a part of a larger common plan of development which will have one or more acre of development, BMPs shall be incorporated into the permanent drainage system for the site.

1. Stormwater Wetlands

Stormwater wetlands are similar in design to wet basins. Constructed wetlands treat stormwater by providing an extended detention zone above shallow permanent pools that are sized to capture and release the calculated WQv over a minimum time of 24 hours. Stormwater wetlands are heavily planted, depressed areas that are designed to maintain flow during dry periods in order to support aquatic vegetation. The amount of surface area required for a stormwater wetland is typically larger than that of a wet basin due to the limited allowable depths required for wetland design. The following criteria shall apply to the design of stormwater wetlands.

a. Owners of wetland systems must agree to provide a mosquito monitoring and control plan within the maintenance plan.
b. The recommended minimum drainage area of 20 acres is proposed to avoid wetlands where the permanent pool completely evaporates during dry weather conditions.
c. The permanent pool of any proposed stormwater wetland shall be at least two times the volume of evapotranspiration during a thirty day drought at summer evaporation rates or 0.75 WQv, whichever is greater.
d. An extended detention volume equal to the WQv shall be provided above the permanent pool of the stormwater wetland. The outlet structure of the stormwater wetland shall be designed with a WQv draw-down time of not less than 24 hours.
e. The minimum length-to-width ratio for a constructed wetland shall be 2:1. Where site conditions allow, basins should be wedge-shaped, narrowest at the inlet and widest at the outlet, to achieve the required length-to-width ratio. Where site conditions do not allow this configuration, the length-to-width ratio shall be increased by relocating the basin inlet or outlet where possible, or by installing berms or baffles within the basin to the full depth of the WQv to avoid short-circuiting and to increase travel time to the outlet.
f. Approximately 50 percent of the permanent pool volume, plus a sediment storage volume equal to at least 20 percent of the WQv, shall be placed in deep water zones (areas with depths between 4- and 12-feet) to sustain fish communities and provide wave action to control mosquito populations. At a minimum, deep water zones shall be placed (1) within the forebay and (2) around the primary outlet.
g. The remainder of the facility shall consist of shallow water zones. Dry weather depths in shallow water zones (i.e., areas less than 18 inches deep) should vary depending on the vegetation selected. Permanent pool depths shall be 6 inches or less within at least 35 percent of the shallow water zone.
h. The bottom of the permanent pool between the deep and shallow water zones shall be sloped no steeper than 3:1.
i. The maximum depth of the extended detention zone above the permanent pool shall not exceed 2 feet to reduce stress on herbaceous wetland plants.
j. Permanent pool areas of wetlands that are deeper than 4 feet shall be provided with an aquatic safety bench. Wetland plants shall be placed along the aquatic bench and other shallow pool areas (less than 4 feet).

Due to the sensitivity of wetland vegetation to sedimentation, a forebay, or other pretreatment feature, shall be provided at the inlets of all stormwater wetlands. Wetland forebays shall be three feet to six feet in depth and shall meet the following minimum requirements:

a. Wetland forebays shall be sized to provide at least 10 percent of the WQv. The storage volume provided within the forebay will count toward the total WQv requirement.
b. The forebay shall consist of a separate cell, formed by an acceptable barrier such as a rock weir.

c. Direct maintenance access shall be provided to the forebay at a slope no steeper than 10:1.
d. Forebay side-slopes shall not exceed 3:1.
e. A fixed vertical sediment depth marker shall be installed in the forebay to measure sediment deposition over time. The maintenance schedule must address the dredging of accumulated sediment from the forebay.
f. A landscaping plan shall be provided that indicates the methods used to establish and maintain wetland coverage. Minimum elements of a plan include: delineation of landscaping zones, selection of appropriate plant species, planting plan, sequence for preparing the wetland bed (including soil amendments, if needed), and sources of plant material. The width of the vegetation zones and amount of emergent vegetation shall be limited to no more than 50 percent of the wetland area in order to control mosquitoes. If a minimum vegetative coverage of 50 percent is not achieved in the planted wetland zones after the second growing season, a reinforcement planting will be required. All landscaping and reinforcement plans shall be signed by a landscape architect, with direction provided by an experienced wetland scientist.

2. Vegetated Swales

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade.

Vegetated swales are designed to treat the entire WQv from the tributary area. Since treatment occurs as stormwater "flows through" the swale, it is necessary to develop a design peak flow for the WQv representative of flow conditions that maximize treatment and retard flow. The following procedure shall be used to develop the design peak flow:

a. Determine the time of concentration for the area draining into the swale.
b. Define the peak intensity of the design storm producing the WQv using the intensity-duration-frequency curve
c. Use the rational method to determine the peak flow through the swale.

The topography of the site shall be used or re-graded as needed to design a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls.

Swales are generally recommended for drainage areas less than 5 acres, with a total drainage area of 1 to 2 acres preferred.

Trapezoidal channels are normally recommended, but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.

If the design peak for the WQv is larger than 1 cfs, then more than one swale shall be provided in order to maintain sheet flow and shallow flow depths

within the swale. Flow shall be distributed among the swales to keep peak flows during the WQv design event less than 1 cfs in each.

Use Manning's Equation to design the swale under peak WQv design storm conditions, using criteria within this section to establish design limits for the swale.

The swale shall be designed so that the water level does not exceed 3 inches at the design peak flow for the WQv.

It is recommended that longitudinal slopes along the swale shall not exceed 2.5 percent, and shall be milder if necessary to keep the peak velocity within the swale less than 0.9 feet/second. However, longitudinal slopes may range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.
The width of the swale should be determined using Manning's Equation, at the peak flow during the water quality design storm, using a Manning's "n" of 0.25. The maximum bottom width shall not exceed 10 feet unless a dividing berm is provided.

The swale shall have a length that provides a minimum hydraulic residence time, or the time it takes for the water to pass through the swale, of at least ten minutes. Regardless of the hydraulic residence time, the length of the swale shall not be less than 100 feet.

Swales may be designed to safely convey storms generating more than the WQv. The peak velocity of the 10-year design storm through the swale shall be non-erosive for the soil and vegetative cover provided Three inches of freeboard should be provided. The side slopes of the swale shall be no steeper than 3:1.

Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

The surface shall be graded flat prior to placement of vegetation. Initial establishment of vegetation shall receive attentive care, including appropriate watering, fertilization, and prevention of excessive flow, until vegetation completely covers the area and is well established.

Runoff shall enter swales as sheet flow. Use of a level spreading device (vegetated berm, sawtooth concrete border, rock trench, etc.) to facilitate overland sheet flow may be allowed, but is not normally recommended because of maintenance considerations and the potential for standing water.

3. Bioretention Facilities

A bioretention system consists of a soil bed planted with native vegetation located above an underdrained gravel layer. Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the soil bed before being conveyed downstream through the underdrain system, slowing the runoff velocity and treating stormwater runoff by absorption, decomposition, and filtration. Bioretention facilities are often sited adjacent to and used to treat runoff from paved surfaces such as parking lots. Sites utilizing bioretention facilities for water quality control must also meet the stormwater quantity control requirements. Stormwater quantity controls may either be integrated into the bioretention system or provided in a separate downstream facility.

Bioretention facilities shall be designed to capture and store the WQv prior to filtration and shall provide a filtration time of no less than 24 hours (when the filter media is new) and no more than 40 hours (when the filter media is clogged and requires maintenance). A drawdown time of 40 hours shall be used for facility design. The following criteria shall apply to the design of bioretention facilities.

The recommended maximum total drainage area of a bioretention facility is 5 acres, with drainage areas of one acre or less preferred in order to maximize sheet flow into the facility and to minimize ponding depth.

Bioretention systems may be constructed on-line or off-line. On-line systems receive runoff from all storms, providing treatment of the WQv, with runoff from larger storms conveyed and/or stored within the bioretention system and discharged through an overflow. In off-line bioretention systems, most of the runoff from storms larger than the
WQv bypasses the system through an upstream diversion and is directed toward a stormwater quantity control device.

Bioretention facilities shall not be allowed in areas where the water table or bedrock is above the invert of the underdrain system.

In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosion as sheet flow is conveyed to the treatment area.

Runoff from the tributary area of the bioretention facility shall be directed into a swale or other storage area sized to contain the entire WQv. This swale shall partially or completely overlay the bioretention facility, as long as the maximum depth of water over the filtering media is no more than 12 inches. Water shall not cover the media longer than 72 hours after a precipitation event.

The surface area of the bioretention soil bed shall be determined based on the following equation:

$$A = \frac{WQv \cdot d}{\left[3600 \cdot K \cdot T \cdot (h + d)\right]}$$

where:
A = surface area of the bioretention planting soil bed (acre)
WQv = water quality volume (acre-ft)
d = depth of the planting soil bed (ft)
T = drawdown time (hours) = 40 hours
K = permeability of the planting soil within the soil bed (feet/sec) = 1.2×10^{-5} feet/sec (minimum), which is equivalent to 0.5 inches/hr
h = average depth of water above filter bed (ft) = half the maximum depth of water (maximum depth = 12 inches)

The minimum dimensions of the bioretention facility shall be 15 feet wide by 40 feet long, with facility widths of 25 feet preferred. These width criteria are established to allow enough space for a dense, randomly-distributed area of trees and shrubs to become established, enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations.

The side slopes for bioretention facilities shall not exceed 3:1.

The function of a bioretention facility is largely dependent on the characteristics of the planting soil (filter media) through which the runoff passes. The following criteria shall be used:

a. The planting soil for bioretention facilities shall consist of a mixture of sand, topsoil, and compost with a pH range of 5.5 and 6.5, a range where pollutants such as organic nitrogen and phosphorus can be absorbed by the soil and microbial activity can flourish. In addition, the soil shall have infiltration rates no less than 0.5 inches per hour, achieved through the following standards:
b. 4 parts sand
c. 2 parts topsoil, and
d. 2 parts compost.
e. Additional recommendations for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.
f. If the existing soil does not meet the above characteristics, then it shall either be adjusted to meet the criteria or removed and replaced with an acceptable planting soil. Soil tests shall be performed for every 500 cubic yards of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area.
g. To prevent root intrusion into the underdrain system, the depth of the planting soil shall be no shallower than the root zone of the vegetation planted in the bioretention cell. The minimum depth shall be 2.5 feet. In addition, the depth shall be at least 4 inches below the largest root ball.
h. Planting soil depths of greater than 4 feet may require additional construction practices such as shoring measures. Planting soil shall be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached.
i. An 8-inch thick sand layer shall be placed along the sides of the trench, starting 12 inches below the final grade level and extending to the gravel

layer in the bottom of the trench. The sand shall comply with CMS 703.06, and shall be surrounded with a filter fabric.

Bioretention facilities shall be planted with a mixture of grass and other hardy, vegetation that can withstand prolonged periods in a wet environment, and be tolerant to road salts if receiving runoff from areas to be treated with deicing materials. Vegetation may include a mix of grasses and woody species, or may include woody species only with bare ground covered with mulch. Approximately one tree or shrub per 50-ft2 (or 1000 per acre) of bioretention area should be included. It is recommended that three species each of both trees and shrubs are planted. Trees with high branching or open habits of growth are recommended to avoid shading and loss of grass cover. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. The shrub-to-tree ratio shall be 2:1 to 3:1.

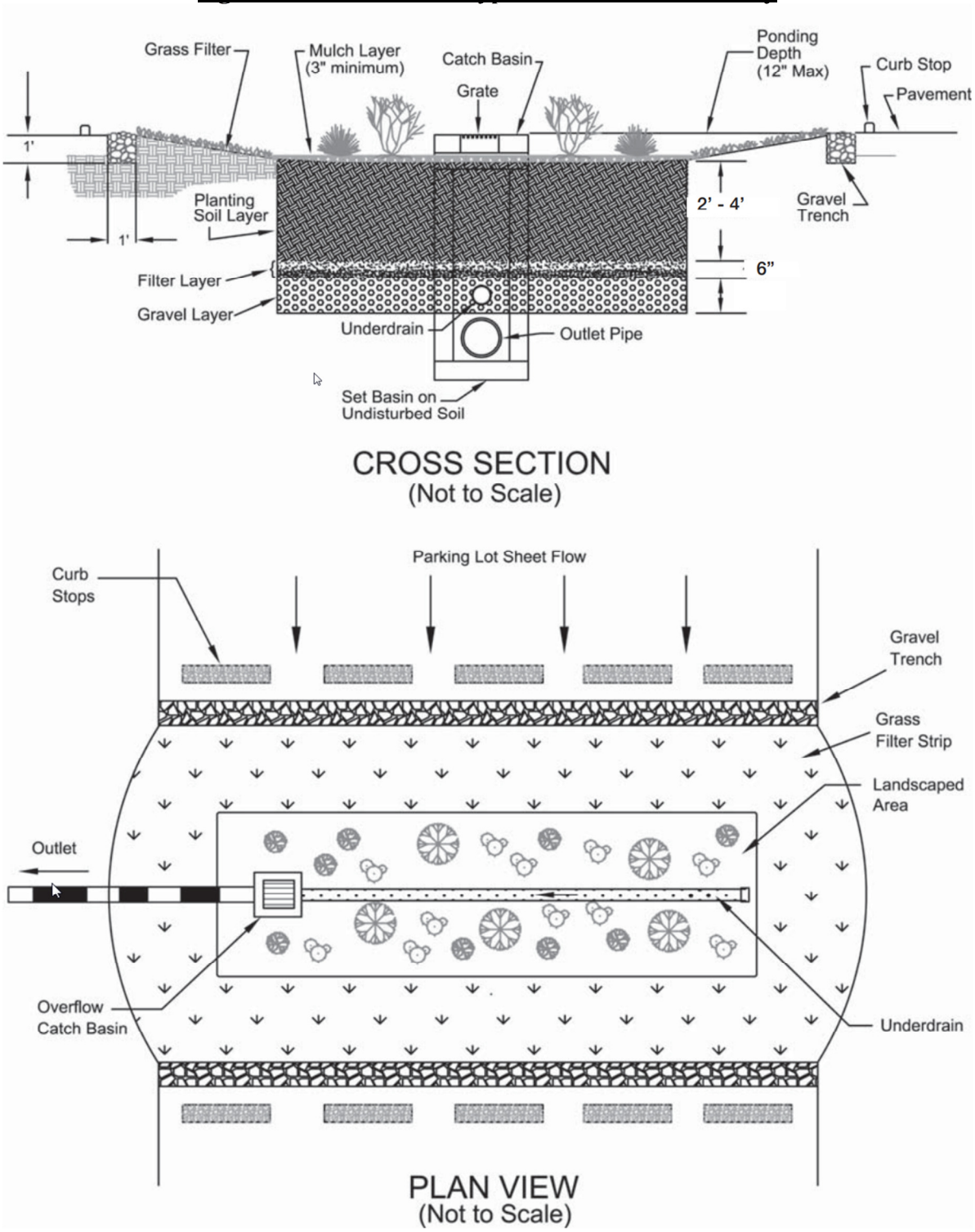
A mulching layer 2 to 3 inches thick shall be provided above the planting soil when grass is not used, and shall be composed of shredded hardwood material to avoid floating. Mulch plays an important role in the bioretention facility. It helps maintain soil moisture, prevents erosion and helps to trap finer sediments.

A perforated pipe underdrain shall be provided beneath the planting soil. The underdrain shall have a minimum grade of 0.5 percent. The perforated pipe shall have a diameter of 4 or 6 inches. A granular backfill of durable No. 57 aggregate shall be provided up to a minimum of 4 inches above the outside diameter of the pipe.

An overflow designed to convey all storms up to and including the 100-year event shall be provided. Use of a vertical stand pipe or catch basin is recommended. For on-line facilities, this overflow may be designed to achieve the water quantity control criteria.

Flow entering the bioretention facility shall be limited to sheet flow to prevent eroding the side slopes of the facility. If flow has been concentrated prior to entering the bioretention facility, it shall be converted to sheet flow using a level spreader. In addition, the frequency of maintenance for bioretention facilities may be reduced by providing vegetated swales or filter strips around the facility. The purpose of the filter strip is to trap course sediments before they reach filter media, thereby reducing maintenance and increasing media longevity. Vegetated swales and filter strips can also be used as holding areas for the WQv prior to filtration.

Figure 1: Schematic of a Typical Bioretention Facility



PART 4 – DESIGN OF MINOR STORMWATER CONVEYANCES

1. Methodology

The design of minor stormwater conveyances shall be performed utilizing the Rational Method (Q = CiA).

2. Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the most remote part of the drainage area under consideration to the design point. For urban storm sewers, the time of concentration consists of an inlet time, or time required for runoff to flow over the surface to the nearest inlet, and time of flow in the sewer to the point under consideration. Inlet time will vary with surface slope, depression storage, surface cover, antecedent rainfall and infiltration capacity of soil, as well as distance of surface flow. Pipe flow time can be calculated by Manning's Formula.

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Where,
V = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/pw
A = cross sectional flow area (ft2)
pw = wetted perimeter (ft)
s = slope of the hydraulic grade line (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow.

$$Q = V \times A$$

Where,
Q = flow in cfs (ft3/sec)
V = velocity (ft/sec)
A = Cross sectional flow area (ft2)

3. General Requirements

A. All drainage calculations, drainage area outlines, and contributing areas used in drainage design shall be furnished.
B. All stormwater calculations to be signed, stamped and dated
C. Easements are required for all drainage ways that pass from one parcel to another or which contain public storm systems, either surface or subsurface, on private property. Where an open watercourse is used, an easement shall be provided at least equal to the area required for the 100-year rainfall. The easement shall be shown on the final plat as a "Drainage and Utility Easement." Restrictions as to the use of this easement shall be shown on the final plat. If a plat is not recorded, a recorded easement is necessary.

4. Flood Routing Path

A. The routing path for the major drainage system is that part of the storm drainage system which carries the runoff which exceeds the capacity of the designed drainage facilities. The major drainage system shall have the capacity to carry runoff from a storm with a return period of not less than 100 years without causing significant threat to property or public safety. The peak water surface elevation of the flow shall be at least one-foot below the first floor elevation of the structures within and adjacent to the development. The major storm routing path shall begin along swales located between structures that drain individual properties, be directed to either roads, other public rights-of-way , or constructed open watercourses through the development, to the stormwater detention facility serving the development. This detention facility shall be designed to control the 100-year event without overtopping its embankment.

B. Generally, it is not economically feasible to size a storm sewer system to collect and convey more than the frequent storm runoff. Essentially, the complete drainage system of an urban area contains two separate drainage elements. While the storm sewers belong to the initial system, surface drainageways must be provided for the major flow from more intense storms. The intent of planning for the major drainage element is to ensure stormwater runoff which exceeds the capacity of the initial drainage system has a route to follow which will not cause a major loss of property or any loss of life. It should be remembered that the major drainage system exists even when it is not planned and whether or not development exists with respect to it. To get in the way of the major storm is careless and costly.

C. A hydraulic analysis shall be required to verify that the peak water surface elevation during the 100- year design storm meets the design criteria cited in this section. For preliminary design purposes, the flow in the major drainage system during the 100-year design storm event shall equal the design capacity of the major system.

D. The use of normal flow depths derived using the Manning's Equation will suffice for estimating inundation limits along streets. At culverts, the major storm shall be designed to flow across streets at low areas or in sags of vertical curves. Street elevations shall be set to permit the major storm to flow across the street and to prevent damage to any existing or proposed building structure. Backwater calculations shall be performed along USGS Blue Line streams where a roadway crossing over these streams is proposed as part of the development. The backwater analysis shall proceed upstream from the roadway crossing to the boundary of the development site.

E. Where a major drainage way is located outside of a street right-of-way, easements shall be provided. The 100-year flood routing path shall be shown on the master drainage plan that is to be submitted with the Stormwater Management Report. Routing path illustrations shall include elevations along the routing path and other elevations necessary to show that the major storm is contained within the planned area and dedicated easements.

F. Street rights-of-way are a common choice for conveying major drainage flows. Again, such use must be anticipated when the street layout is established. Side and rear lot lines offer one alternative to the street. The problem with this alternative is the possibility that individual property owners may encroach on the major drainage easement. Rarely is the

problem recognized until the infrequent rainstorm occurs and the major system fails to operate properly. Where the street is designated as the major drainage way, the depth of flow shall not exceed 12 inches at the gutter line for local and collector streets and shall not exceed 6 inches of depth at the crown for arterial streets. The same maximum depth criteria will apply where a major drainageway crosses the street. Where a major drainageway is located outside of a street right-of-way, easements should be provided and a grading plan should be submitted with detailed engineering plan submission. The grading plan will include elevations along the routing path and other elevations necessary to show the major storm is contained within the planned area.

G. In order to protect the integrity of non-street drainage rights-of-way, it is effective to design routing paths for multi-purpose functions. Pedestrian, bicycle paths, and utility easements lend themselves naturally to this application. Linear parks aligned along the major drainage corridor are also very effective, but usually require greater width than would normally be necessary for drainage purposes.

H. The major storm runoff is routed through the drainage system to determine if the combined capacity of the routing path and storm sewer system is sufficient. The capacity of the conduit at any given point is assumed to be the same for the major storm as for the initial storm. (the flood route capacity shall equal the 100-yr flow minus the 2-year flow) Routing of the major storm at culvert locations shall be at low areas or sags of vertical curves of streets. Elevations for the design of the street shall be such to permit the major storm to flow across the street and to prevent damage to any existing or proposed building structure.

I. Certain limited areas of the City lie within the floodplain of the Olentangy River or its tributaries. The City shall maintain on file for public examination current maps delineating the boundaries within the City of all lands designated "100-year Floodplain" by the Federal Emergency Management Agency (FEMA). All improvements in a floodplain shall be in compliance with the City of Delaware regulations pertaining to floodway districts.

5. Culvert Design

A. General

A culvert is a relatively short segment of conduit that is typically used to transport water underneath a roadway or other type of earthen embankment. Two types of flow may occur in culverts: flows with inlet control and flow with outlet control. The design engineer shall determine the appropriate flow conditions for each culvert in the project. Culvert Design should be according to the principles outlined in the Ohio Department of Transportation, Location and Design Manual, Volume 2, Drainage Design, current edition. The publication, Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5, Federal Highway Administration 1985 by J. M. Normann, R. J. Houghtalen, and W. J. Johnston, also outline an acceptable design procedure.

B. Design Procedure

1. The design must account for the ability of the downstream channel to handle the flow satisfactorily. Additionally, in order to minimize property damage, the 100-year frequency head water shall not exceed any existing or proposed building first floor elevation.

2. Culverts are to be designed to transport the flows from the design year storm listed in the following table.

Table 13: Design Year Flows

Roadway Type	Design Storm Event
Interstate Highways, Other Freeways and Expressways	50-Year
Major Arterials (ADT>10,000)	25-Year
Minor Arterial and Collectors (ADT 3,501 – 10,000)	25-Year
Local Streets and Roads (ADT ≤ 3,500) and Parking Lots	10-Year

3. In addition to conveying the design year flows, the design of the culvert must take into account the maximum allowable headwater for the 100-year event. The maximum headwater on all public streets and bike paths is 1-foot below the near, low edge of pavement or 18-inches below the top of curb elevation. The maximum allowable headwater is at or below the near edge of pavement for driveway culverts conveying runoff along roadside ditches.

4. The maximum allowable outlet velocity for culverts is as follows:
    a. Bare Earth Channel 6 fps
    b. Engineered Rock Protection 18 fps
    c. Stilling Basin Over 18 fps

5. Culverts shall have full height headwall with flared wings at upstream and downstream ends. Other special type headwalls must be approved before use.

6. The structural design criteria for culverts will be as required by the City of Delaware together with the City of Columbus, Ohio, Construction and Material Specifications, including all specifications thereto.

6. Storm Sewer System Design Requirements

A. Methodology

The method outlined herein will provide a general guide as to the criteria and procedures to be used for storm sewer design.

1. Storm sewer pipe sizes are to be determined by using Manning's Formula with a minimum coefficient of roughness n = 0.013 for all pipe laid to proper line and grade.
2. The Rational Method shall be used for all storm sewer design (closed system.)
3. The following rainfall frequency curves shall be used for design:
    a. Storm Sewer Capacity - 2-year rainfall
    b. Strom Sewer Hydraulic Grade Line – 5-year event below the top of casting
4. The minimum post-development time of concentration for storm inlets is 15 minutes in grassy areas and 10 minutes in paved areas.
    a. All future and offsite flows must be accounted for.
    b. Match crowns where possible for all storm systems. If matching crowns is not feasible due to site constraints match 0.80 diameters.

B. General Requirements

1. A chart with State Plane Coordinates Including blank columns for as-builts must be provided for all public and private storm structures.
2. Minimum cover for storm sewer pipe shall be 30-inches from the top of pavement to the outside top of the pipe except as approved by the Public Works Department. If minimum cover is not met under any private or public street the conduit shall be concrete encased from structure to structure per City of Delaware standards. Under no circumstances will less than 9-inches of cover to the bottom of the aggregate base be permitted.
3. A minimum of 1.5-feet of cover from the finished ground surface to the outside top of the pipe for any storm sewer system located beyond the limits of street right-of-way must be maintained.
4. There must be 1.5-ft vertical and 10-ft horizontal separation (outside wall to outside wall) from all sanitary and water lines
5. Standard full height headwalls are to be constructed at the inlet and outfall of all daylighted storm sewers, and shall be shown on the plan and profile. Half height headwall may be permitted for large (36-inch and greater) pipes that are submerged outlets to a retention basin.
6. Erosion control shall be provided at the outfall of all storm sewers, and shown on the plan and profile. In addition, measures approved by the City shall be taken to control erosion during construction in accordance with the current Water Pollution and Sediment Runoff Control Regulations.
7. The invert of the first downstream storm sewer outlet shall be above the computed floodplain elevation.
8. Pipe for all storm sewers (public and private) shall not be less than 12-inches in diameter unless solely serving as roof drain collector.
9. All structures are to be; City of Delaware, ODOT, or City of Columbus standard structures with the exception of combined curb and gutter inlets, which must be City of Delaware standard structures only. The inverts of all curb inlets, manholes, yard inlets, and other appurtenances shall be formed to reduce turbulence to a minimum.
10. Blind taps are not permitted.
11. The maximum distance for overland flow shall be 300 feet before entering a surface yard inlet or 425 feet before entering a curb inlet. Except that the maximum overland drainage area tributary to any yard inlet or curb inlet shall not exceed 1 acre. At the discretion of the City and on a case by case basis, an exception may be made where there is phased construction or for structures that are receiving large amounts of offsite flow.
12. The maximum spacing of storm access structures is 300-feet for pipes 12-inches to 60-inches in diameter and 500-feet for pipes greater than 60-inches in diameter.
13. Rear yard swales must be designed at a a minimum 1.5% slope and have storm structures constructed on every other property line. The preferred slope on rear yard swales is 2.0%. All rear yard swales with a slope less than 2% shall have an underdrain for the full length of the swale that outlets to a catch basin.
14. The minimum allowable velocity shall be 3 feet per second (fps) in all storm pipes in the just full condition and the minimum Manning's "n" value shall be 0.013. (See table below) The maximum allowable velocity shall be 15 fps.

Table 14: Minimum Slope for all Storm Conduits

Pipe Size (inches)	Pipe Size (feet)	Minimum Slope for a Velocity of 3 FPS	Capacity of Pipe At Minimum Slope (cfs)	Elliptical Equivalent (inches)
4	0.34	1.89%	0.26	---
6	0.50	1.10%	0.59	---
8	0.67	0.75%	1.05	---
10	0.83	0.56%	1.64	---
12	1.00	0.44%	2.36	---
15	1.25	0.32%	3.68	---
18	1.50	0.25%	5.30	14 x 23
21	1.75	0.21%	7.22	---
24	2.00	0.17%	9.42	19 x 30
27	2.25	0.15%	11.93	23 x 34
30	2.50	0.13%	14.73	24 x 38
36	3.00	0.10%	21.21	29 x 45
42	3.50	0.08%	28.86	34 x 53
48	4.00	0.07%	37.70	38 x 60
54	4.50	0.06%	47.71	43 x 68
60	5.00	0.05%	58.90	48 x 76
66	5.50	0.05%	71.27	53 x 83
72	6.00	0.04%	84.82	58 x 91
78	6.50	0.04%	99.55	63 x 98

B. Profiles

1. Profiles are required for all Public and Private storm sewers
2. The storm conduit material and class is to be listed on both in the quantities and on the profiles.
3. The 5-year hydraulic grade line shall be shown on the profile sheet. The hydraulic grade line shall be calculated based on an observed or calculated tailwater depth in the receiving channel or basin determined through downstream analysis or the following equation, whichever is greater:

   $T_w = (d_c + D)/2$

   where:
   Tw = Tailwater depth (feet)
   d_c = Critical depth in the pipe (feet)
   D = Inside pipe diameter (feet)

C. Backfill Requirements

1. Compacted granular backfill, COC Item 912, is required beneath all paved areas, including public and private roadways and parking lots.

2. COC Item 911 is required outside of the pavement influence, but inside the Right-of-Way. A minimum of 95% compaction for all fill material is to be maintained.
   Storm Sewers between homes shall be reinforced concrete pipe (RCP) with watertight rubber gasket joints (ASTM C-443) and have no granular bedding or backfill.

D. Curb and Gutter Inlets

The satisfactory removal of surface water from curbed pavement is as important as any other phase of stormwater control. Gutter flow in streets serves to transport runoff from surface areas to storm inlets or to open drainage channels. The primary function of the street inlet is to provide stormwater runoff flow from the gutter into the storm sewer. Spread of water on the pavement for the design storm is considered as the best control for pavement drainage. Standard City of Delaware curb and gutter structures and frames are to be used for all land development projects.

1. Maximum spread of flow: Spread calculations are required for all public curb and gutter inlets. The design storm is the 5-yr event for local and collector roads and the 10-yr event for Arterials.
   a. Local streets with a width of 28-foot from back of curb to back of curb or less, the flow may spread to a width of 8 feet from face of curb.
   b. Local streets with a width greater than 28-foot and up to 38-foot back of curb to back of curb, the flow may spread to a width of 9 feet from face of curb.
   c. Collector streets, a minimum of one lane in each direction, to remain passable to traffic.
   d. Arterials are per current edition of ODOT's Location and Design Manual, Volume II.

2. Design Criteria for Curb and Gutter inlets: The maximum spacing for curb inlets shall not exceed 400 feet unless approved by the City.

3. Sag or Sump at Adverse Slopes: Curb and gutter inlets are required at all sag locations. On combined runs of over 300 feet contributing to a sag curve, an additional inlet may be required near the low point, 0.2 + or - feet above the inlet at the sag.

4. Continuous Grade: Curb inlets shall be located at all points where the maximum pavement encroachment is reached and at the low points of street intersections. No cross street flow is permitted. The City may require additional inlets at intermediary points if the flow in the gutter at design conditions might create a hazard to vehicular traffic, public safety, or property flooding. The rational method and a minimum time of concentration of 10 minutes shall be used to determine the amount of runoff that will be collected by the proposed inlet structures. Hydraulic analyses used to size and space inlets and catch basins shall be based on the methods presented in (FHWA) Hydraulic Engineering Circular No. 12: "Drainage of Highway Pavements" and Hydraulic Engineering Circular No. 22: "Urban Drainage Design Manual." The following table

summarizes the dimensions of the inlets and catch basins that are provided in the City of Delaware's standard drawings. These dimensions may be used with the design aids (i.e., charts, graphs, nomographs, etc.) provided in the references cited above to assist in determining the capacity and spacing of the inlets and catch basins under different pavement and flow conditions.

Table 15: Selected COD & COC Basin Grate & Curb Inlet Dimensions

Standard Drawing	Description	Clear Opening Area, A (ft^2)	Grate Length, L (ft)	Grate Width, W (ft)	Inlet Length (ft)	Inlet Height (ft)**
SEWD 09*	Combination Curb & Gutter Inlet*	3.27	2.95	1.48	-	-
SEWD 11	Square Catch Basin	2.5	1.9	1.9	-	-
AA-S115	Round Catch Basin	2.9	3	3	-	-
AA-S116	Round Catch Basin	2.7	3	3	-	-
AA-S123	42 inch Curb Inlet	-	-	-	3.5	>4
AA-S123	60-inch Curb Inlet	-	-	-	5	>4
AA-S126	Standard Curb Inlet	-	-	-	2.33	6.25
AA-S133	Square Catch Basin	2.5	3.9	2.1	-	-
AA-S138	Round Catch Basin	0.9	1.9	1.9	-	-
AA-S139	Square Catch Basin	1.9	13.6	2	-	-
AA-S140	Rectangular Catch Basin	1.1	1.8	1.2	-	-
AA-S141	Square Catch Basin	1.9	1.9	2	-	-

* The capacity of combination curb & gutters shall be calculated as a grate inlet. The additional capacity for the curb inlet is to serve as overflow when the grate becomes blocked with debris.

** Depth of inlet opening can vary depending on the height of curb and capacity needs. A depression should be provided to achieve an inlet height of at least 4-inches.

5. The projected gutter flow approaching each basin/inlet, the flow projected to enter each basin/inlet, and the flow projected to bypass each basin/inlet shall be provided in the Stormwater Management Report.

7. Open Watercourses

The requirements in this section are applicable to newly constructed open watercourses. A constructed channel shall be shaped or graded to the required dimensions and established with a suitable lining as necessary to convey stormwater runoff without allowing channel erosion.

A. All open watercourses having less than 3% longitudinal (running) slope shall have a 4-inch (minimum) diameter perforated underdrain. Underdrains are to be outleted to storm structure if practicable, or if this is unfeasible the underdrain is to be daylighted before the termination of the channel. The crown of the underdrain shall be 12-inches below the bottom of the watercourse. The underdrain ditch shall be a minimum of 16-inches by 16-inches, backfilled with #57 stone, and lined with filter-fabric. Watercourses that are engineered to be used as bio-swales to help treat water quality should follow the design criteria outlined in the **Vegetated Swales** section of this manual

B. Constructed open watercourses shall be designed to convey the 10-year design storm without causing erosion, sedimentation, or overbank flooding within and along the channel. Criteria outlined in the Flood Routing Section shall be used if the channel will also serve as a flood routing channel for the 100-year design storm. Open watercourses may also be designed for stormwater quality control.

C. A ditch computation sheet shall be used to present open channel calculations.

D. Parabolic and trapezoidal channel shapes shall be used for open watercourses within development projects. Side slopes shall be 3:1 or milder, with a minimum 2-foot bottom width for trapezoidal channels, unless alternative dimensions are approved by the City due to specific project conditions. Channel cross sections shall be designed such that erosion and sediment deposition is minimized.

E. An open channel is categorized by its lining. There are three main types of channel linings:

    1. Vegetated - A vegetative lining, such as grass with mulch and sod and lapped sod, is required where site constraints and flow velocity conditions allow.
    2. Flexible - Flexible linings include rock channel protection and cellular soil retaining mats and are typically less expensive than a rigid lining. The use of flexible linings, however, may require the installation of a filter fabric or other means to protect the underlying soil, prevent washout, and prevent soil piping through the rock when using channel protection.
    3. Rigid - Rigid linings include concrete and rigid block and are usually used where high velocities are unavoidable.

F. Final design of constructed open channels should be consistent with velocity limitations for the selected channel lining. Maximum velocity values for selected vegetated and non-vegetated lining categories are presented in the table below. The Manning's Equation shall be used to design an open channel that satisfies the maximum velocity criteria in the previous sections:

G. Open Watercourse Profile

All open watercourses that are to be constructed or modified with the project shall be profiled. The profile shall include:

1. Profile of the top of bank on both sides where difference in elevation exists
2. Profile of flow line (invert) of streambed.
3. Profile of the computed water elevation.
4. Where land included is subject to flood, cross-sections, topography, and spot elevations are required.

Table 16: Maximum Velocities for Channel Lining Materials

Channel Lining Material	Maximum Allowable Velocity (ft/s)
Vegetated Channels	
Seed mixtures for urban areas	2.5
Other seed mixtures	2.5
Crown vetch	2.5
Established Seed or Sodded Channels	6.0
Flexible Linings	
Slope Erosion Protection	Follow manufacturer's criteria
Erosion Control Matting	
Rock Channel Protection	Use shear stress analysis
Rigid linings	
Concrete	18
Concrete block mat	18

H. Open channels shall be designed to flow under subcritical flow conditions at all times. A subcritical flow regime is characterized by a Froude Number less than 1:

$$F = \frac{V}{(g \cdot D)^{0.5}} < 1$$

Where,
F = Froude Number
D = hydraulic depth (ft) = A / T
A = cross-sectional area of flow (ft^2)
T = top width of water surface (ft)
V = flow velocity (ft/sec)
g = acceleration due to gravity = 32.2 $feet/sec^2$

The Stormwater Management Report shall demonstrate that the calculated Froude Number is less than 1 over the anticipated range of flow conditions within the channel.

I. Rock Channel Protection Shear Stress Analysis

1. Type B, C or D rock channel protection shall be provided in accordance with CMS Section 601.08. Type B, C or D rock channel protection shall only be placed outside of guardrails, barriers or other unobstructed areas provided outside of the traveled way for vehicles to stop safely or regain control. The actual shear stress (r_{ac}) must be less than or equal to the allowable sheer stress (r_a) listed in the following table for the rock channel protection type used. The actual shear stress shall be determined for the channel slope and the depth of flow during a 10-year design storm. The following equation is valid for discharges less than 50 cfs and with slopes less than 10%:

$$\tau_{ac} = 62.4 \cdot D \cdot S$$

Where,
D = depth of flow (feet)
S = channel slope (feet/feet)
r_{ac} = actual shear stress (lbs/feet^2)

Table 17: Allowable Shear Stress for Rock Channel Protection

Type of Rock Channel Protection	r_a (lbs/feet^2)
B	6
C	4
D	2

2. In extreme site conditions, Type B or C rock channel protection shall be utilized for lining channels with steep grades (slopes 10%-25%) that carry flow from the end of a cut section down to the lowest elevation on the bottom of the channel. Federal Highway Administration's HEC-15 procedures for steep gradient channels shall be used with a safety factor of 1.5. The Public Works Department shall be consulted if rock channel protection is proposed in instances where the peak flow during the 10-year design storm is greater than or equal to 50 cfs.
3. All constructed open watercourses shall have a structurally sound and stable outlet with adequate capacity to prevent ponding or flooding damage.

8. Rock Channel Protection

A. Description: A rock or riprap apron is typically needed at the outlet of storm drains, culverts, or open channels. Rock Outlet Protection provides an erosion resistant transition area where concentrated or high velocity flows enters less modified channels or natural streams.

B. Conditions Where Practice Applies: This practice applies where discharge velocities from channels, storm drains or culverts are high enough to erode receiving streams or areas. Suggested areas of application are:

1. Outfalls of stormwater detention facilities or sediment traps or basins.
2. Constructed channel outlets
3. Culvert outlets

This practice is not intended for use on slopes greater than 10%, or at the top of cut or fill slopes. Caution should be used when design flows exceed 100 cubic feet per second (cfs) from a 10-yr.-frequency storm.

C. Planning Considerations: Rock Outlet Protection may be used in conjunction with other practices, such as level spreaders. Rock Outlet Protection and Level Spreaders can both be used at the end of pipe outlets. This practice should be used alone where flow will continue as concentrated flow. Level Spreaders can be used with Rock Outlet Protection only when flow can be converted to and continue as sheet flow.

D. Permits: The U.S. Army Corps of Engineers and the Ohio Environmental Protection Agency, through Sections 404 and 401, respectively, of the Clean Water Act, may require a permit for an outlet protection that is located adjacent to a stream.

E. Water Quality: Rock outlet protection may also provide water quality benefits by providing for channel stability, prevention of excessive erosion, and limiting subsequent downstream sedimentation.

F. Design Criteria

1. Runoff: Runoff computation will be based upon the most severe soil and cover conditions that will exist in the area draining into the channel during the planned life of the structure. NRCS Technical Release 55 (TR 55) or other approved method shall be used to determine peak rate of runoff.

2. Velocity: Outlet protection shall be designed to be stable for discharge velocity expected from a 10-year frequency storm. Where high-hazard conditions exist, higher frequency storms should be chosen to provide protection compatible with conditions. Outlet protection shall meet the following criteria:

3. Design Velocity: Outlet protection shall be designed to be stable for the velocity of flow expected from a 10-year frequency storm. Outlet protection shall be designed to meet the criteria below or by other accepted engineering methods.

4. Width: The width of the outlet protection shall be the greater of either the width of the headwall or 4 feet wider than the pipe diameter (2 feet on each side of the edge of pipe).

5. Bottom Grade: The outlet protection should be constructed with no slope along its length. The elevation on the downstream end of the outlet protection shall be equal to the elevation of the receiving stream or channel.

6. Length of Rock Outlet Protection and Rock Size: Use the velocity calculated at the pipe outlet, the pipe diameter, and Figure 4. Outlet Protection Length, to find the length of outlet protection needed and rock size to use.

G. Rock Lining: The outlet protection shall consist of the rock riprap layer and an underlying filter or bedding. Minimum thickness of the rock riprap layer shall be the maximum stone size. Stone used for riprap shall be dense and hard enough to withstand exposure to air, water, freezing and thawing. Rock riprap must have a well-graded distribution and be placed to obtain a solid, compact layer of riprap. This may require some hand placing and tamping with construction equipment. Spreading gravel over top of the placed riprap surface will fill the voids by interlocking the riprap together.

Table 18: Rock Riprap Size

Type of Rock or Riprap (ODOT)	"n" Value	Size of Rock	
		50% by weight	95% by weight
Type D	.036	> 6 inches	3 – 12 inches
Type C	.040	> 12 inches	6 – 18 inches
Type B	.043	> 18 inches	12 – 24 inches
Type A	.045	> 24 inches	18 – 30 inches

1. Filter or Granular Bedding: Filter or granular bedding must be placed beneath all riprap to prevent the underlying soil from eroding and undermining the riprap, and to collect seepage and base flow. Minimum bedding thickness shall be 4 inches. Use of large size riprap may necessitate the use of a thicker bedding layer or 2 differently sized bedding layers. Care should be taken to select granular bedding that that is suitable with the subgrade material.

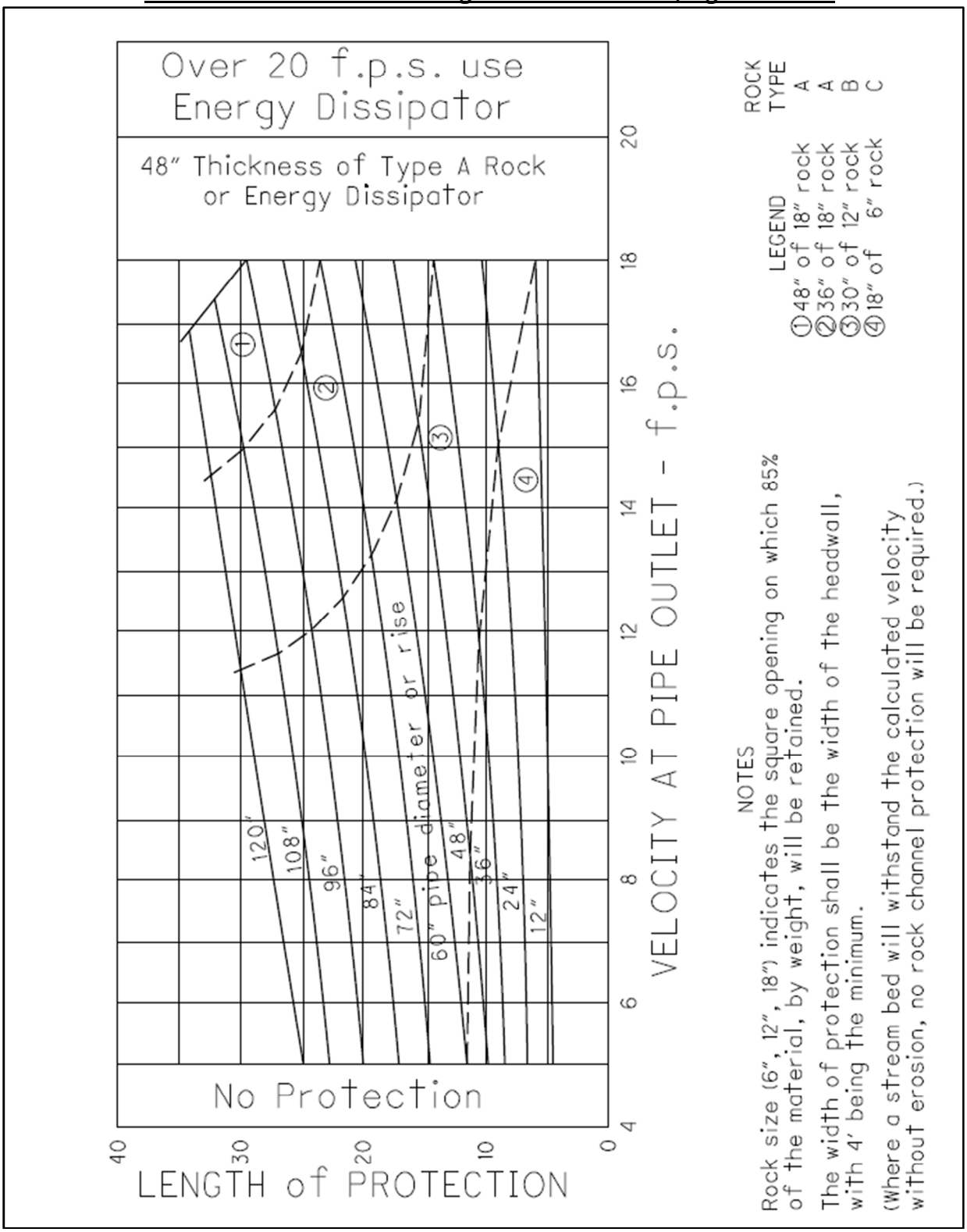
2. Geotextile: Geotextile may be used as a filter to be placed beneath the riprap to prevent piping of the soil where wetness, seepage, or prolonged base flow is the reason for lining the channel with riprap. If design of the outlet protection results in high velocities and steep grades, granular bedding should be used instead of geotextile. Care should be taken to properly anchor the geotextile to prevent unraveling under flowing water. Geotextile shall be woven or nonwoven monofilament yarn and shall meet Class I criteria in the attached table "Requirements for Geotextile".

Table 19: Requirements for Geotextiles

Property	Test Method	Woven – Class 1	Nonwoven – Class 1
Tensile strength (pounds) 1/	ASTM D 4632 grab test	200 minimum in any direction	180 minimum
Elongation at failure (percent) 1/	ASTM D 4632 grab test	< 50	≥ 50
Puncture (pounds) 1/	ASTM D 4833	90 minimum	80 minimum
Ultraviolet light (% residual tensile strength)	ASTM D 4355 150-hr exposure	70 minimum	70 minimum
Apparent opening size (ADS)	ASTM D 4751	As specified, but no smaller than 0.212 mm (#70) 2/	As specified max. #40 2/
Percent open area (percent)	CWO-02215-86	4.0 minimum	---
Permittivity sec-1	ASTM D 4491	0.10 minimum	0.70 minimum
1/ Minimum average roll value (weakest principle direction)			
2/ U.S. standard sieve size			
Note: CWO is a USACE reference			

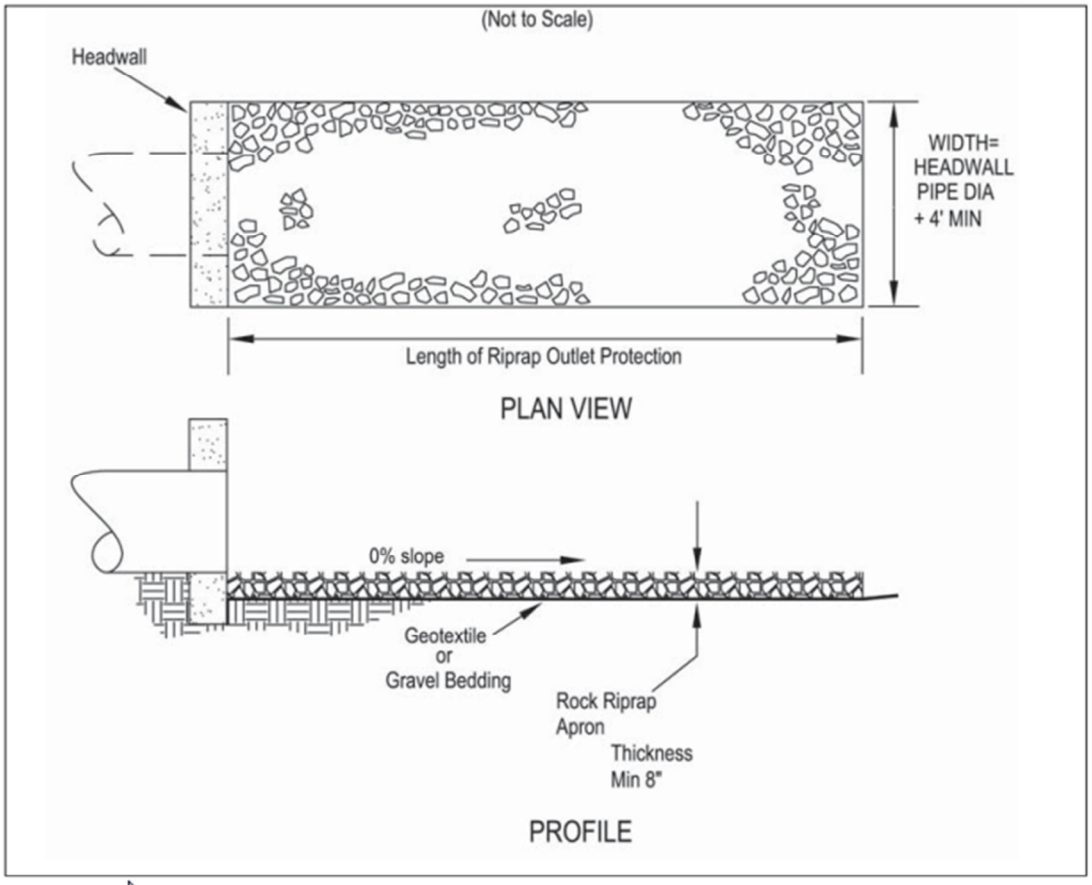
H. Maintenance: A maintenance program shall be established to maintain riprap, vegetative cover above the riprap, and associated structural components such as pipe outlets, and tile lines. Items to consider in the maintenance program include:
   1. Determine responsible party to inspect and maintain the outlet protection after construction
   2. Missing riprap should be replaced as soon as possible.
   3. Protect the outlet protection from damage by equipment and traffic
   4. Fertilize the vegetated area annually to and maintain a vigorous stand of grass
   5. Mow the vegetated area to maintain a healthy and vigorous stand of grass.
   6. Seed and mulch any bare areas that develop.
   7. Remove sediment and debris that have accumulated.
   8. Easements, or other means, should be obtained to ensure the channel is maintained as constructed

Figure 2: Rock Channel Protection
Source: ODOT Location & Design Manual Volume II, Figure 1107-2



I. Specifications for Rock Outlet Protection: The figure below provides the specifications required.

Figure 3: Plan and Profile for Typical Rock Outlet Protection



1. Subgrade for the filter or bedding and riprap shall be prepared to the required lines and grades as shown on the plan. The subgrade shall be cleared of all trees, stumps, roots, sod, loose rock, or other material.
2. Riprap shall conform to the grading limits as shown on the plan.
3. Geotextile shall be securely anchored according to manufacturers' recommendations.
4. Geotextile shall be laid with the long dimension parallel to the direction of flow and shall be laid loosely but without wrinkles and creases. Where joints are necessary, strips shall be placed to provide a 12-in. minimum overlap, with the upstream strip overlapping the downstream strip.
5. Gravel bedding shall be ODOT No. 67's or 57's unless shown differently on the drawings.
6. Riprap may be placed by equipment but shall be placed in a manner to prevent slippage or damage to the geotextile.
7. Riprap shall be placed by a method that does not cause segregation of sizes. Extensive pushing with a dozer causes segregation and shall be avoided by delivering riprap near its final location within the channel.
8. Construction shall be sequenced so that outlet protection is placed and functional when the storm drain, culvert, or open channel above it becomes operational.
9. All disturbed areas will be vegetated as soon as practical.

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Chapter 16: Stormwater Quality Regulations

The City of Delaware (City) is committed to the protection of the natural waterways that exist throughout the community, as well as improving the quality of these waterways through responsible and practical development practices and the establishment of protective easements and covenants as required. Strict enforcement of these regulations is made possible through the combined efforts of the City Engineering Division, Planning and Community Development Department, and Public Utilities Department, each of which employs full time staff dedicated to the enforcement of current zoning and construction regulations.

Recognizing the potential impact of uncontrolled silt laden storm water runoff to the local perennial, intermittent, and ephemeral streams in the immediate proximity of construction sites, and the longer term impacts to the Olentangy River from unregulated and prolonged community wide runoff, the City has adopted the Ohio Environmental Protection Agencies "General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under The National Pollutant Discharge Elimination System. (OHCO00006)", as revised herein and approved by the OEPA, as the City's storm water quality regulations. The permit as revised, in combination with the City's codified ordinances, shall be considered the applicable and enforceable storm water quality standards and regulations for the City of Delaware.



Olentangy River, just downstream of the City of Delaware

The information contained within this chapter is a duplication of Ohio EPA permit OHCO0006 with modifications for additional City requirements shown in red and is to be considered the governing regulations for construction site storm water management within the City. The City's Construction/Post-Construction Program is deemed to be acceptable by OEPA. The City will review and approve all NPDES regulated construction activity documents including SWP3's and enforce the regulations contained within. All NOI applications, related documents, and SWP3 plans remain subject to final approval by the Ohio EPA as indicated within these regulations.

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Issuance Date: **April 23, 2023**
Effective Date: **June 1, 2023**
Expiration Date: **April 22, 2028**

OHIO ENVIRONMENTAL PROTECTION AGENCY

GENERAL PERMIT AUTHORIZATION FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et. seq. hereafter referred to as "the Act") and the Ohio Water Pollution Control Act [Ohio Revised Code (“ORC”) Chapter 6111], dischargers of stormwater from sites where construction activity is being conducted, as defined in Part I.B of this permit, are authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the outfalls at the sites and to the receiving surface waters of the state identified in their Notice of Intent (“NOI”) application form on file with Ohio EPA in accordance with the conditions specified in Parts I through VII of this permit.

It has been determined that a lowering of water quality of various waters of the state associated with granting coverage under this permit is necessary to accommodate important social and economic development in the state of Ohio. In accordance with OAC 3745-1-05, this decision was reached only after examining a series of technical alternatives, reviewing social and economic issues related to the degradation, and considering all public and intergovernmental comments received concerning the proposal.

This permit is conditioned upon payment of applicable fees, submittal of a complete NOI application form, development (and submittal, if applicable) of a complete Stormwater Pollution Prevention Plan (SWP3) and written approval of coverage from the director of Ohio EPA in accordance with Ohio Administrative Code (“OAC”) Rule 3745-38-02.

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Anne M. Vogel
Director

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PART I. COVERAGE UNDER THIS PERMIT

A. Permit Area.

This permit covers the entire State of Ohio. Appendices A and B of this permit contain additional watershed specific requirements for construction activities located partially or fully within the Big Darby Creek Watershed and portions of the Olentangy River Watershed.

These regulations are applicable to all areas within the corporation limits of the City of Delaware (City), land owned by the City outside the corporation limits, and all land proposed to be annexed into the City as part of a proposed development to be reviewed and approved by the City. Where the term "permit" is used herein, it shall be understood to refer to the OEPA permit OHC000006 and/or City regulations. For portions of the City located outside of the portions of the Olentangy River Watershed (as defined above), these regulations shall apply with the exception of Appendix B Part B.3 "Riparian Setback Requirements" and Appendix B Part B.4 "Riparian Setback Mitigation".

B. Eligibility.

1. Construction activities covered. Except for stormwater discharges identified under Part I.B.2, this permit may cover all new and existing discharges composed entirely of stormwater discharges associated with construction activity that enter surface waters of the state or a storm drain leading to surface waters of the state.

   For the purposes of this permit, construction activities include any clearing, grading, excavating, grubbing and/or filling activities that disturb one or more acres. Discharges from trench dewatering are also covered by this permit as long as the dewatering activity is carried out in accordance with the practices outlined in Part III.G.2.g.iv of this permit.

   Construction activities disturbing one or more acres of total land or will disturb less than one acre of land but are part of a larger common plan of development or sale that will ultimately disturb one or more acres of land are eligible for coverage under this permit. The threshold acreage includes the entire area disturbed in the larger common plan of development or sale. Additionally, for redevelopment sites with less than one acre of disturbance, the requirements for water quality treatment found in Part III.G.2.e shall apply.

   This permit also authorizes stormwater discharges from support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided:

   a. The support activity is directly related to a construction site that is required to have NPDES permit coverage for discharges of stormwater associated with construction activity;

   b. The support activity is not a commercial operation serving multiple unrelated construction projects and does not operate beyond the completion of the construction activity at the site it supports;

c. Appropriate controls and measures are identified in a stormwater pollution prevention plan (SWP3) covering the discharges from the support activity; and

d. The support activity is on or contiguous with the property defined in the NOI (offsite borrow pits and soil disposal areas, which serve only one project, do not have to be contiguous with the construction site).

2. Limitations on coverage. The following stormwater discharges associated with construction activity are not covered by this permit:

a. Stormwater discharges that originate from the site after construction activities have ceased, including any temporary support activity, and the site has achieved final stabilization. Industrial post-construction stormwater discharges may need to be covered by an NPDES permit;

b. Stormwater discharges associated with construction activity that the director has shown to be or may reasonably expect to be contributing to a violation of a water quality standard and such discharge would be a violation of this permit; and

c. Stormwater discharges authorized by an individual NPDES permit or another NPDES general permit.

3. Waivers. After March 10, 2003, sites whose larger common plan of development or sale have at least one, but less than five acres of land disturbance, which would otherwise require permit coverage for stormwater discharges associated with construction activities, may request that the director waive their permit requirement. Entities wishing to request such a waiver must certify in writing that the construction activity meets one of the two waiver conditions:

a. Rainfall Erosivity Waiver. For a construction site to qualify for the rainfall erosivity waiver, the cumulative rainfall erosivity over the project duration must be five or less and the site must be stabilized with a least a 70 percent vegetative cover or other permanent, non-erosive cover. The rainfall erosivity must be calculated according to the method in U.S. EPA Fact Sheet 3.1 Construction Rainfall Erosivity Waiver dated January 2001 and be found at: **https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/stormwater-program**. If it is determined that a construction activity will take place during a time period where the rainfall erosivity factor is less than five, a written waiver certification must be submitted to Ohio EPA at least 21 days before construction activity is scheduled to begin. If the construction activity will extend beyond the dates specified in the waiver certification, the operator must either: (a) recalculate the waiver using the original start date with the new ending date (if the R factor is still less than five, a new waiver certification must be submitted) or (b) submit an NOI application form and fee for coverage under this general permit at least seven days prior to the end of the waiver period; or

b. TMDL (Total Maximum Daily Load) Waiver. Stormwater controls are not needed based on a TMDL approved or established by U.S. EPA that addresses the pollutant(s) of concern or, for non-impaired waters that do not require TMDLs, and equivalent analysis that determines allocations for small construction sites for the pollutant(s) of concern or that determines that such allocations are not needed to

protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. The pollutant(s) of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. The operator must certify to the director of Ohio EPA that the construction activity will take place, and stormwater discharges will occur, within the drainage area addressed by the TMDL or equivalent analysis. A written waiver certification must be submitted to Ohio EPA at least 21 days before the construction activity is scheduled to begin.

4. Prohibition on non-stormwater discharges. All discharges covered by this permit must be composed entirely of stormwater with the exception of the following: discharges from firefighting activities; fire hydrant flushings; potable water sources including waterline flushings; irrigation drainage; lawn watering; routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated groundwater from trench or well point dewatering and foundation or footing drains where flows are not contaminated with process materials such as solvents. Dewatering activities must be done in compliance with Part II.C and Part III.G.2.g.iv of this permit. Discharges of material other than stormwater or the authorized non-stormwater discharges listed above must comply with an individual NPDES permit or an alternative NPDES general permit issued for the discharge.

   Except for flows from firefighting activities, sources of non-stormwater listed above that are combined with stormwater discharges associated with construction activity must be identified in the SWP3. The SWP3 must identify and ensure the implementation of appropriate pollution prevention measures for the non-stormwater component(s) of the discharge.

5. Spills and unintended releases (Releases in excess of Reportable Quantities). This permit does not relieve the permittee of the reporting requirements of Title 40 of the Code of Federal Regulations ("CFR") Part 117 and 40 CFR Part 302. In the event of a spill or other unintended release, the discharge of hazardous substances in the storm water discharge(s) from a construction site must be minimized in accordance with the applicable stormwater pollution prevention plan for the construction activity and in no case, during any 24-hour period, may the discharge(s) contain a hazardous substance equal to or in excess of reportable quantities.

   40 CFR Part 117 sets forth a determination of the reportable quantity for each substance designated as hazardous in 40 CFR Part 116. The regulation applies to quantities of designated substances equal to or greater than the reportable quantities, when discharged to surface waters of the state. 40 CFR Part 302 designates under section 102(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, those substances in the statutes referred to in section 101(14), identifies reportable quantities for these substances and sets forth the notification requirements for releases of these substances. This regulation also sets forth reportable quantities for hazardous substances designated under section 311(b)(2)(A) of the Clean Water Act (CWA).

C. Requiring an individual NPDES permit or an alternative NPDES general permit.

1. The director may require an alternative permit. The director may require any operator eligible for this permit to apply for and obtain either an individual NPDES permit or coverage under an alternative NPDES general permit in accordance with OAC Rule 3745-38-02. Any interested person may petition the director to take action under this paragraph.

   The director will send written notification that an alternative NPDES permit is required. This notice shall include a brief statement of the reasons for this decision, an application form and a statement setting a deadline for the operator to file the application. If an operator fails to submit an application in a timely manner as required by the director under this paragraph, then coverage, if in effect, under this permit is automatically terminated at the end of the day specified for application submittal.

2. Operators may request an individual NPDES permit. Any owner or operator eligible for this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner or operator shall submit an individual application with reasons supporting the request to the director in accordance with the requirements of 40 CFR 122.26. If the reasons adequately support the request, the director shall grant it by issuing an individual NPDES permit.

3. When an individual NPDES permit is issued to an owner or operator otherwise subject to this permit or the owner or operator is approved for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of approval for coverage under the alternative general permit, whichever the case may be.

D. Permit requirements when portions of a site are sold

If an operator obtains a permit for a development, and then the operator (permittee) sells off lots or parcels within that development, permit coverage must be continued on those lots until a Notice of Termination (NOT) in accordance with Part IV.B is submitted. For developments which require the use of centralized sediment and erosion controls (i.e., controls that address stormwater runoff from one or more lots) for which the current permittee intends to terminate responsibilities under this permit for a lot after sale of the lot to a new owner and such termination will either prevent or impair the implementation of the controls and therefore jeopardize compliance with the terms and conditions of this permit, the permittee will be required to maintain responsibility for the implementation of those controls. For developments where this is not the case, it is the permittee's responsibility to temporarily stabilize all lots sold to individual lot owners unless an exception is approved in accordance with Part III.G.4. In cases where permit responsibilities for individual lot(s) will be terminated after sale of the lot, the permittee shall inform the individual lot owner of the obligations under this permit and ensure that the Individual Lot NOI application is submitted to Ohio EPA.

E. Authorization

1. Obtaining authorization to discharge. Operators that discharge stormwater associated with construction activity must submit an NOI application form and Stormwater Pollution

Prevention Plan (SWP3) if located within the Big Darby Creek watershed or portions of the Olentangy watershed in accordance with the requirements of Part I.F of this permit to obtain authorization to discharge under this general permit. As required under OAC Rule 3745-38-02(E), the director, in response to the NOI submission, will notify the applicant in writing that he/she has or has not been granted general permit coverage to discharge stormwater associated with construction activity under the terms and conditions of this permit or that the applicant must apply for an individual NPDES permit or coverage under an alternate general NPDES permit as described in Part I.C.1.

2. No release from other requirements. No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations. Other permit requirements commonly associated with construction activities include, but are not limited to, section 401 water quality certifications, isolated wetland permits, permits to install sanitary sewers or other devices that discharge or convey polluted water, permits to install drinking water lines, single lot sanitary system permits and disturbance of land which was used to operate a solid or hazardous waste facility (i.e., coverage under this NPDES general permit does not satisfy the requirements of OAC Rule 3745-27-13 or ORC Section 3734.02(H)). The issuance of this permit is subject to resolution of an antidegradation review. This permit does not relieve the permittee of other responsibilities associated with construction activities such as contacting the Ohio Department of Natural Resources, Division of Water, to ensure proper well installation and abandonment of wells.

F. Notice of Intent Requirements

1. Deadlines for notification.

   a. Initial coverage: Operators who intend to obtain initial coverage for a stormwater discharge associated with construction activity under this general permit must submit a complete and accurate NOI application form to the OEPA, a completed Stormwater Pollution Prevention Plan (SWP3) for projects within the Big Darby Creek and portions of the Olentangy river watersheds and appropriate fee at least 21 days (or 45 days in the Big Darby Creek watershed and portions of the Olentangy watershed) prior to the commencement of construction activity. Said NOI application form and SWP3 shall also be submitted to the City in accordance with Part III.B. The City reserves the right to require modifications to an NOI or SWP3 after OEPA approval of the NOI provided the operator updates the NOI or SWP3 in accordance with the requirements of this permit. If more than one operator, as defined in Part VII of this general permit, will be engaged at a site, each operator shall seek coverage under this general permit prior to engaging in construction activities. Coverage under this permit is not effective until an approval letter granting coverage from the director of Ohio EPA is received by the applicant. Where one operator has already submitted an NOI prior to other operator(s) being identified, the additional operator shall request modification of coverage to become a co-permittee. In such instances, the co-permittees shall be covered under the same facility permit number. No additional permit fee is required.

   b. Individual lot transfer of coverage: Operators must each submit an individual lot notice of intent (Individual Lot NOI) application form (no fee required) to Ohio EPA at least seven days prior to the date that they intend to accept responsibility for permit

requirements for their portion of the original permitted development from the previous permittee. Transfer of permit coverage is not granted until an approval letter from the director of Ohio EPA is received by the applicant.

2. Failure to notify. Operators who fail to notify the director of their intent to be covered and who discharge pollutants to surface waters of the state without an NPDES permit are in violation of ORC Chapter 6111. In such instances, Ohio EPA may bring an enforcement action for any discharges of stormwater associated with construction activity.

3. How to submit an NOI. Operators seeking coverage under this permit must submit a complete and accurate Notice of Intent (NOI) application using Ohio EPA's electronic application form which is available through the Ohio EPA eBusiness Center at: **https://ebiz.epa.ohio.gov/**. Submission through the Ohio EPA eBusiness Center will require establishing an Ohio EPA eBusiness Center account and obtaining a unique Personal Identification Number (PIN) for final submission of the NOI. Existing eBusiness Center account holders can access the NOI form through their existing account and submit using their existing PIN. Please see the following link for guidance: **https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/electronic-business-services-sub/streams**. Alternatively, if you are unable to access the NOI form through the agency eBusiness Center due to a demonstrated hardship, the NOI may be submitted on a paper NOI form provided by Ohio EPA. NOI information shall be typed on the form. Please contact Ohio EPA, Division of Surface Water at (614) 644-2001 if you wish to receive a paper NOI form.

4. Additional notification. NOIs and SWP3s are considered public documents and shall be made available to the public in accordance with Part III.C.2. The permittee shall make NOIs and SWP3s available upon request of the director of Ohio EPA, local agencies approving sediment and erosion control plans, grading plans or stormwater management plans, local governmental officials, or operators of municipal separate storm sewer systems (MS4s) receiving drainage from the permitted site. Each operator that discharges to an NPDES permitted MS4 shall provide a copy of its Ohio EPA NOI submission to the MS4 in accordance with the MS4's requirements, if applicable.

5. Re-notification. Existing permittees having coverage under the previous generation of this general permit shall have continuing coverage under OHC000006 with the submittal of a timely renewal application. Within 180 days from the effective date of this permit, existing permittees shall submit the completed renewal application expressing their intent for continued coverage. In accordance with Ohio Administrative Code (OAC) 3745-38-02(E)(2)(a)(ii), a renewal application fee will not apply to existing permittees having general permit coverage issued on or after April 22, 2022. Permit coverage will be terminated if Ohio EPA does not receive the renewal application within this 180-day period.

Part II. NON-NUMERIC EFFLUENT LIMITATIONS

You shall comply with the following non-numeric effluent limitations for discharges from your site and/or from construction support activities. Part III of this permit contains the specific design criteria to meet the objectives of the following non-numeric effluent limitations. You shall develop and implement the SWP3 in accordance with Part III of this permit to satisfy these non-numeric effluent limitations.

A. Erosion and Sediment Controls. You shall design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants. At a minimum, such controls shall be designed, installed and maintained to:

1. Control stormwater volume and velocity within the site to minimize soil and stream erosion;

2. Control stormwater discharges, including both peak flowrates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and streambank erosion;

3. Minimize the amount of soil exposed during construction activity;

4. Minimize the disturbance of steep slopes;
5. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls shall address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site;

6. If feasible, provide and maintain a 50-foot undisturbed natural buffer around surface waters of the state, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration. If it is infeasible to provide and maintain an undisturbed 50-foot natural buffer, you shall comply with the stabilization requirements found in Part II.B for areas within 50 feet of a surface water; and

7. Minimize soil compaction and, unless infeasible, preserve topsoil.

B. Soil Stabilization. Stabilization of disturbed areas shall, at a minimum, be initiated in accordance with the time frames specified in the following tables.

Table 1: Permanent Stabilization

Area requiring permanent stabilization	Time frame to apply erosion controls
Any areas that will lie dormant for one year or more	Within seven days of the most recent disturbance
Any areas within 50 feet of a surface water of the state and at final grade	Within two days of reaching final grade
Other areas at final grade	Within seven days of reaching final grade within that area

Table 2: Temporary Stabilization

Area requiring temporary stabilization	Time frame to apply erosion controls
Any disturbed areas within 50 feet of a surface water of the state and not at final grade	Within two days of the most recent disturbance if the area will remain idle for more than 14 days
Any disturbed areas that will be dormant for more than 14 days but less than one year, and not within 50 feet of a surface water of the state	Within seven days of the most recent disturbance within the area For residential subdivisions, disturbed areas must be stabilized at least seven days prior to transfer of permit coverage for the individual lot(s).
Disturbed areas that will be idle over winter	Prior to the onset of winter weather

Where vegetative stabilization techniques may cause structural instability or are otherwise unobtainable, alternative stabilization techniques must be employed. Permanent and temporary stabilization are defined in Part VII.

C. Dewatering. Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, are prohibited unless managed by appropriate controls.

D. Pollution Prevention Measures. Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants. At a minimum, such measures must be designed, installed, implemented and maintained to:

1. Minimize the discharge of pollutants from equipment and vehicle washing, wheel washwater, and other washwaters. Washwaters shall be treated in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge;

2. Minimize the exposure of construction materials, products, and wastes; landscape materials, fertilizers, pesticides, and herbicides; detergents, sanitary waste and other materials present on the site to precipitation and to stormwater; and

3. Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures.

E. Prohibited Discharges. The following discharges are prohibited:

1. Wastewater from washout of concrete, unless managed by an appropriate control;

2. Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;

3. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance; and

4. Soaps or solvents used in vehicle and equipment washing or all other waste water streams which could be subject to an individual NPDES permit (Part III.G.2.g).

F. **Surface Outlets**. When discharging from sediment basins utilize outlet structures that withdraw water from the surface, unless infeasible. (Note: Ohio EPA believes that the circumstances in which it is infeasible to design outlet structures in this manner are rare. Exceptions may include time periods with extended cold weather during winter months. If you have determined that it is infeasible to meet this requirement, you shall provide documentation in your SWP3 to support your determination.)

G. **Post-Construction Stormwater Management Controls.** So that receiving stream's physical, chemical and biological characteristics are protected, and stream functions are maintained, post-construction stormwater practices shall provide long-term management of runoff quality and quantity.

PART III. STORMWATER POLLUTION PREVENTION PLAN (SWP3)

A. Stormwater Pollution Prevention Plans.

A SWP3 shall be developed for each site covered by this permit. For a multi-phase construction project, a separate NOI shall be submitted when a separate SWP3 will be prepared for subsequent phases. SWP3s shall be prepared in accordance with sound engineering and/or conservation practices by a professional experienced in the design and implementation of standard erosion and sediment controls and stormwater management practices addressing all phases of construction. The SWP3 shall clearly identify all activities which are required to be authorized under Section 401 and subject to an antidegradation review. The SWP3 shall identify potential sources of pollution which may reasonably be expected to affect the quality of stormwater discharges associated with construction activities. The SWP3 shall be a comprehensive, stand-alone document, which is not complete unless it contains the information required by Part III.G of this permit. In addition, the SWP3 shall describe and ensure the implementation of best management practices (BMPs) that reduce the pollutants and impact of stormwater discharges during construction and pollutants associated with the post-construction land use to ensure compliance with ORC Section 6111.04, OAC Chapter 3745-1 and the terms and conditions of this permit.

B. Timing.

An acceptable SWP3 shall be completed and submitted to the City ~~applicable regulated MS4 entity (for projects constructed entirely within a regulated MS4 area)~~ prior to the timely submittal of an NOI. Projects within the Big Darby Creek and portions of the Olentangy watersheds must submit a SWP3 with the NOI. The SWP3 shall be updated in accordance with Part III.D. Submission of a SWP3 does not constitute review and approval on the part of Ohio EPA. Upon request and good cause shown, the director may waive the requirement to have a SWP3 completed at the time of NOI submission. If a waiver has been granted, the SWP3 must be completed prior to the initiation of construction activities. The SWP3 must be implemented upon initiation of construction activities.

In order to continue coverage from the previous generations of this permit, the permittee shall review and update the SWP3 to ensure that this permit's requirements are addressed within 180 days after the effective date of this permit. If it is infeasible for you to comply with a specific requirement in this permit because (1) the provision was not part of the permit you were previously covered under, and (2) because you are prevented from compliance due to the nature or location of earth disturbances that commenced prior to the effective date of this

permit, you shall include documentation within your SWP3 of the reasons why it is infeasible for you to meet the specific requirement.

Examples of OHC000006 permit conditions that would be infeasible for permittees renewing coverage to comply with include:

- OHC000006 post-construction requirements, for projects that obtained NPDES construction stormwater coverage and started construction activities prior to the effective date of this permit;

- OHC000006 post-construction requirements, for multi-phase development projects with an existing regional post-construction BMP issued under previous NPDES post-construction requirements. This only applies to construction sites authorized under Ohio EPA's Construction Stormwater Permits issued after April 20, 2003; or

- Case-by-case situations approved by the Director.

C. SWP3 Signature and Review.

1. Plan Signature and Retention On-Site. The SWP3 shall include the certification in Part V.H, be signed in accordance with Part V.G., and be retained on site during working hours.
2. Plan Availability

    a. On-site: The plan shall be made available immediately upon request of the director or his authorized representative and MS4 operators or their authorized representative during working hours. A copy of the NOI and letter granting permit coverage under this general permit also shall be made available at the site. The NOI and letter granting permit coverage may be maintained electronically under the condition that they can be immediately produced on-site upon request. The SWP3 may be prepared, signed, and kept electronically, rather than in paper form, if the records are: (a) in a format that can be read in a similar manner as a paper record; (b) legally dependable with no less evidentiary value than their paper equivalent; and (c) immediately accessible to the inspector during an inspection to the same extent as a paper copy stored at the site would be, if the records were stored in paper form. For additional guidance on the proper practices to follow for the electronic retention of inspection report records, refer to this general permit's Fact Sheet at https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/storm-water-discharges-from-small-and-large-construction-activities--general-permit

    b. By written request: The permittee must provide the most recent copy of the SWP3 within 7 days upon written request by any of the following:

        i. The director or the director's authorized representative;

        ii. A local agency approving sediment and erosion plans, grading plans or stormwater management plans; or

iii. In the case of a stormwater discharge associated with construction activity which discharges through a municipal separate storm sewer system with an NPDES permit, to the operator of the system.

c. To the public: All NOIs, general permit approval for coverage letters, and SWP3s are considered reports that shall be available to the public in accordance with the Ohio Public Records law. The permittee shall make documents available to the public upon request or provide a copy at public expense, at cost, in a timely manner. However, the permittee may claim to Ohio EPA any portion of an SWP3 as confidential in accordance with Ohio law.

3. Plan Revision. The director or authorized representative may notify the permittee at any time that the SWP3 does not meet one or more of the minimum requirements of this part. Within 10 days after such notification from the director or authorized representative and/or City authorized representative (or as otherwise provided in the notification), the permittee shall make the required changes to the SWP3 and shall submit to Ohio EPA the revised SWP3 or a written certification that the requested changes have been made. Failure to comply with these requirements may result in penalties to the permittee as established in City Codified Ordinances.

D. Amendments.

The permittee shall amend the SWP3 whenever there is a change in design, construction, operation or maintenance, which has a significant effect on the potential for the discharge of pollutants to surface waters of the state or if the SWP3 proves to be ineffective in achieving the general objectives of controlling pollutants in stormwater discharges associated with construction activity. Amendments to the SWP3 may be reviewed by the City or Ohio EPA in the same manner as Part III.C.

E. Duty to inform contractors and subcontractors.

The permittee shall inform all contractors and subcontractors not otherwise defined as "operators" in Part VII of this general permit who will be involved in the implementation of the SWP3 of the terms and conditions of this general permit. The permittee shall maintain a written document containing the signatures of all contractors and subcontractors involved in the implementation of the SWP3 as proof acknowledging that they reviewed and understand the conditions and responsibilities of the SWP3. For contactors and subcontractors which do not meet the definition of an operator, the written document shall be created and signatures shall be obtained prior to commencement of each contractors/subcontractors work.

F. Total Maximum Daily Load (TMDL) allocations.

If a TMDL is approved for any waterbody into which the permittee's site discharges and requires specific BMPs for construction sites, the director may require the permittee to revise his/her SWP3. Specific conditions have been provided in Appendix A (for the Big Darby Creek Watershed) and Appendix B (for portions of the Olentangy river watershed).

G. SWP3 Requirements.

Operations that discharge stormwater from construction activities are subject to the following requirements and the SWP3 shall include the following items:

1. Site description. Each SWP3 shall provide:

    a. A description of the nature and type of the construction activity (e.g., low density residential, shopping mall, highway, etc.);

    b. Total area of the site and the area of the site that is expected to be disturbed (i.e., grubbing, clearing, excavation, filling or grading, including off-site borrow areas);

    c. A measure of the impervious area and percent imperviousness created by the construction activity (existing, new and total impervious area after construction);

    d. Stormwater calculations, including the volumetric runoff coefficients for both the pre-construction and post- construction site conditions, and resulting water quality volume; design details for post-construction stormwater facilities and pretreatment practices such as contributing drainage areas, capacities, elevations, outlet details and drain times shall be included in the SWP3; and if applicable, explanation of the use of existing post-construction facilities. Ohio EPA recommends the use of data sheets (see Ohio's Rainwater and Land Development manual and Ohio EPA resources for examples);

    e. Existing data describing the soil and, if available, the quality of any discharge from the site;

    f. A description of prior land uses at the site;

    g. A description of the condition of any on-site streams (e.g. prior channelization, bed instability or headcuts, channels on public maintenance, or natural channels);

    h. A BMP implementation schedule which describes the sequence of major construction operations (i.e., designation of vegetative preservation areas, grubbing, excavating, grading, utilities, infrastructure installation and others) and the implementation of erosion, sediment and stormwater management practices or facilities to be employed during each operation of the sequence;

    i. The name and/or location of the immediate receiving stream or surface water(s) and the first subsequent named receiving water(s) and the areal extent and description of wetlands or other special aquatic sites at or near the site which will be disturbed, or which will receive discharges from disturbed areas of the project. For discharges to an MS4, the point of discharge to the MS4 and the location where the MS4 ultimately discharges to a stream or surface water of the state shall be indicated;

j. For subdivided developments, a detail drawing of individual parcels with their erosion, sediment or stormwater control practices and/or a typical individual lot showing standard individual lot erosion and sediment control practices.

   A typical individual lot drawing does not remove the responsibility to designate specific erosion and sediment control practices in the SWP3 for critical areas such as steep slopes, stream banks, drainage ways and riparian zones;

k. Location and description of any stormwater discharges associated with dedicated asphalt and dedicated concrete plants covered by this permit and the best management practices to address pollutants in these stormwater discharges;

l. A cover page or title identifying the name and location of the site, the name and contact information of all construction site operators, the name and contact information for the person responsible for authorizing and amending the SWP3, preparation date, and the estimated dates that construction will start and be complete;

m. A log documenting grading and stabilization activities as well as amendments to the SWP3, which occur after construction activities commence; and

n. Site map showing:

   i. Limits of earth-disturbing activity of the site including associated off-site borrow or spoil areas that are not addressed by a separate NOI and associated SWP3;

   ii. Soils types for all areas of the site, including locations of unstable or highly erodible and/or known contaminated soils;

   iii. Existing and proposed contours. A delineation of drainage watersheds expected during and after major grading activities as well as the size of each drainage watershed, in acres;

   iv. The location of any delineated boundary for required riparian setbacks;

   v. Conservation easements or areas designated as open space, preserved vegetation or otherwise protected from earth disturbing activities. A description of any associated temporary or permanent fencing or signage;

   vi. Surface water locations including springs, wetlands, streams, lakes, water wells, etc., on or within 200 feet of the site, including the boundaries of wetlands or stream channels and first subsequent named receiving water(s) the permittee intends to fill or relocate for which the permittee is seeking approval from the Army Corps of Engineers and/or Ohio EPA;

   vii. Existing and planned locations of buildings, roads, parking facilities and utilities;

viii. The location of all erosion and sediment control practices, including the location of areas likely to require temporary stabilization during site development;

ix. Sediment traps and basins noting their sediment storage and dewatering (detention) volume and contributing drainage area. Ohio EPA recommends the use of data sheets (see Ohio EPA's Rainwater and Land Development manual and website for examples) to provide data for all sediment traps and basins noting important inputs to design and resulting parameters such as their contributing drainage area, disturbed area, detention volume, sediment storage volume, practice surface area, dewatering time, outlet type and dimensions;

x. The location of permanent stormwater management practices (new and existing) including pretreatment practices to be used to control pollutants in stormwater after construction operations have been completed along with the location of existing and planned drainage features including catch basins, culverts, ditches, swales, surface inlets and outlet structures;

xi. Areas designated for the storage or disposal of solid, sanitary and toxic wastes, including dumpster areas, areas designated for cement truck washout, and vehicle fueling;

xii. The location of designated construction entrances where the vehicles will access the construction site; and

xiii. The location of any areas of proposed floodplain fill, floodplain excavation, stream restoration or known temporary or permanent stream crossings.

2. Controls. In accordance with Part II.A, the SWP3 shall contain a description of the controls appropriate for each construction operation covered by this permit and the operator(s) shall implement such controls. The SWP3 shall clearly describe for each major construction activity identified in Part III.G.1.h: (a) appropriate control measures and the general timing (or sequence) during the construction process that the measures will be implemented; and (b) which contractor is responsible for implementation (e.g., contractor A will clear land and install perimeter controls and contractor B will maintain perimeter controls until final stabilization). The SWP3 shall identify the subcontractors engaged in activities that could impact stormwater runoff. The SWP3 shall contain signatures from all of the identified subcontractors indicating that they have been informed and understand their roles and responsibilities in complying with the SWP3. Ohio EPA recommends, and the City requires, that the primary site operator review the SWP3 with the primary contractor prior to commencement of construction activities and keep a SWP3 training log to demonstrate that this review has occurred.

Ohio EPA recommends that the erosion, sediment, and stormwater management practices used to satisfy the conditions of this permit should meet the standards and specifications in the most current edition of Ohio's Rainwater and Land Development (see definitions) manual or other standards acceptable to Ohio EPA. The controls shall include the following minimum components:

a. Preservation Methods. The SWP3 shall make use of practices which preserve the existing natural condition as much as feasible. Such practices may include: preserving existing vegetation, vegetative buffer strips, and existing soil profile and topsoil; phasing of construction operations to minimize the amount of disturbed land at any one time; and designation of tree preservation areas or other protective clearing or grubbing practices. For all construction activities immediately adjacent to surface waters of the state, the permittee shall comply with the buffer non-numeric effluent limitation in Part II.A.6, as measured from the ordinary high water mark of the surface water. Ohio EPA strongly recommends that 50-foot buffers be maintained around surface waters, including wetlands.

b. Erosion Control Practices. The SWP3 shall make use of erosion controls that provide cover over disturbed soils unless an exception is approved in accordance with Part III.G.4. A description of control practices designed to re-establish vegetation or suitable cover on disturbed areas after grading shall be included in the SWP3. The SWP3 shall provide specifications for stabilization of all disturbed areas of the site and provide guidance as to which method of stabilization will be employed for any time of the year. Such practices may include: temporary seeding, permanent seeding, mulching, matting, sod stabilization, vegetative buffer strips, phasing of construction operations, use of construction entrances and the use of alternative ground cover.

   i. **Stabilization.** Disturbed areas shall be stabilized in accordance with Table 1 (Permanent Stabilization) and Table 2 (Temporary Stabilization) in Part II.B of this permit.

   ii. **Permanent stabilization of conveyance channels**. Operators shall undertake special measures to stabilize channels and outfalls and prevent erosive flows. Measures may include seeding, dormant seeding (as defined in the most current edition of the Rainwater and Land Development manual), mulching, erosion control matting, sodding, riprap, natural channel design with bioengineering techniques or rock check dams.

c. Runoff Control Practices. The SWP3 shall incorporate measures which control the flow of runoff from disturbed areas so as to prevent erosion from occurring. Such practices may include rock check dams, pipe slope drains, diversions to direct flow away from exposed soils and protective grading practices. These practices shall divert runoff away from disturbed areas and steep slopes where practicable. Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected.

d. Sediment Control Practices. The plan shall include a description of structural practices that shall store runoff allowing sediments to settle and/or divert flows away from exposed soils or otherwise limit runoff from exposed areas. Structural practices shall be used to control erosion and trap sediment from a site remaining disturbed for more than 14 days. Such practices may include, among

others: sediment settling ponds, sediment barriers, earth diversion dikes or channels which direct runoff to a sediment settling pond and storm drain inlet protection. All sediment control practices must be capable of ponding runoff in order to be considered functional. Earth diversion dikes or channels alone are not considered a sediment control practice unless those are used in conjunction with a sediment settling pond.

The SWP3 shall contain detail drawings for all structural practices.

i. **Timing.** Sediment control structures shall be functional throughout the course of earth disturbing activity. Sediment basins and perimeter sediment barriers shall be implemented prior to grading and within seven days from the start of grubbing. They shall continue to function until the upslope development area is stabilized with permanent cover. As construction progresses and the topography is altered, appropriate controls shall be constructed, or existing controls altered to address the changing drainage patterns.

ii. **Sediment settling ponds.** A sediment settling pond is required for any one of the following conditions:

- Concentrated or collected stormwater runoff (e.g., storm sewer or ditch);
- Runoff from drainage areas, which exceed the design capacity of silt fence or other sediment barriers; or
- Runoff from drainage areas that exceed the design capacity of inlet protection.

The permittee may request approval from the City and Ohio EPA to use alternative controls if the permittee can demonstrate the alternative controls are equivalent in effectiveness to a sediment settling pond. In accordance with Part II.F, if feasible, sediment settling ponds shall be dewatered at the pond surface using a skimmer or equivalent device. The sediment settling pond volume consists of both a dewatering zone and a sediment storage zone. The volume of the dewatering zone shall be a minimum of 1800 cubic feet (ft^3) per acre of drainage (67 yd^3/acre) with a minimum 48-hour drain time. The volume of the sediment storage zone shall be calculated by one of the following methods:

Method 1: The volume of the sediment storage zone shall be 1000 ft^3 per disturbed acre within the watershed of the basin. OR

Method 2: The volume of the sediment storage zone shall be the volume necessary to store the sediment as calculated with RUSLE or a similar generally accepted erosion prediction model.

Accumulated sediment shall be removed from the sediment storage zone once it exceeds 50 percent of the minimum required sediment storage design capacity and prior to the conversion to the post-construction practice unless suitable storage is demonstrated based upon over-design. When determining the total contributing drainage area, off-site areas and

areas which remain undisturbed by construction activity shall be included unless runoff from these areas is diverted away from the sediment settling pond and is not co-mingled with sediment-laden runoff. The depth of the dewatering zone shall be less than or equal to five feet. The configuration between inlets and the outlet of the basin shall provide at least two units of length for each one unit of width (≥ 2:1 length:width ratio); however, a length to width ratio of 4:1 is recommended. When designing sediment settling ponds, the permittee shall consider public safety, especially as it relates to children, as a design factor for the sediment basin and alternative sediment controls shall be used where site limitations would preclude a safe design. Combining multiple sediment and erosion control measures in order to maximize pollutant removal is encouraged.

iii. **Sediment Barriers and Diversions.** Sheet flow runoff from denuded areas shall be intercepted by sediment barriers or diverted to a sediment pond to protect adjacent properties and water resources from sediment transported via sheet flow. Where intended to provide sediment control, sediment barriers shall be placed on a level contour downslope of the disturbed area. For most applications, standard silt fence or a 12-inch diameter tubular filter may be used as a sediment barrier. The relationship between the maximum drainage area to sediment barrier for a particular slope range is shown in the following table:

Table 3 Sediment Barrier Maximum Drainage Area Based on Slope

Maximum drainage area (in acres) to 100 linear feet of sediment barrier	Range of slope for a particular drainage area (in percent)
0.5	< 2%
0.25	≥ 2% but < 20%
0.125	≥ 20% but < 50%

Placing sediment barriers in a parallel series does not extend the size of the drainage area. Stormwater diversion practices shall be used to keep runoff away from disturbed areas and steep slopes where practicable. Diversion practices, which include swales, dikes or berms, may receive stormwater runoff from areas up to 10 acres.

iv. **Inlet Protection.** Other erosion and sediment control practices shall minimize sediment laden water entering active storm drain systems. All inlets receiving runoff from drainage areas of one or more acres will require a sediment settling pond.

v. **Surface Waters of the State Protection.** If construction activities disturb areas adjacent to surface waters of the state, structural practices shall be designed and implemented on site to protect all adjacent surface waters of the state from the impacts of sediment runoff. No structural sediment controls (e.g., the installation of silt fence or a sediment settling pond) shall be used in a surface water of the state. For all construction activities immediately adjacent to surface waters of the state, the permittee shall comply with the buffer non-numeric effluent limitation in Part II.A.6, as measured from the ordinary high water mark of the surface water. Where

impacts within this buffer area are unavoidable, due to the nature of the construction (e.g., stream crossings for roads or utilities), the project shall be designed such that the number of stream crossings and the width of the disturbance within the buffer area are minimized.

vi. **Modifying Controls**. If periodic inspections or other information indicates a control has been used inappropriately or incorrectly, the permittee shall replace or modify the control for site conditions.

e. Post-Construction Stormwater Management Requirements. So that receiving stream's physical, chemical and biological characteristics are protected, and stream functions are maintained, post-construction stormwater practices shall provide long-term management of runoff quality and quantity. To meet the post-construction requirements of this permit, the SWP3 shall contain a description of the post-construction BMPs that will be installed during construction for the site and the rationale for their selection. The rationale shall address the anticipated impacts on the channel and floodplain morphology, hydrology, and water quality. Post-construction BMPs cannot be installed within a surface water of the state (e.g., wetland or stream) unless it is authorized by a CWA 401 water quality certification, CWA 404 permit, or Ohio EPA non-jurisdictional wetland/stream program approval. Note: local jurisdictions may have more stringent post-construction requirements.

i. Operation and Maintenance Plans. Detail drawings and maintenance plans shall be provided for all post-construction BMPs in the SWP3. Maintenance plans shall be provided by the permittee to the post-construction operator of the site (including homeowner associations) upon completion of construction activities (prior to termination of permit coverage). Maintenance plans shall ensure that pollutants collected within structural post-construction practices are disposed of in accordance with local, state, and federal regulations. To ensure that stormwater management systems function as designed and constructed, the post-construction operation and maintenance plan shall be a stand-alone document which contains:

1) a designated entity for stormwater inspection and maintenance responsibilities;
2) the routine and non-routine maintenance tasks to be undertaken;
3) a schedule for inspection and maintenance;
4) any necessary legally binding maintenance easements and agreements;
5) construction drawings or excerpts showing the plan view, profile and details of the outlet(s);
6) a map showing all access and maintenance easements; and
7) for table 4a/4b practices, provide relevant elevations and associated volumes that dictate when removal of accumulated sediments must occur.

Permittees are responsible for assuring all post-construction practices meet plan specifications and intended post-construction conditions have been met (e.g., sediment removed from, and sediment storage restored

to, permanent pools, sediment control outlets removed and replaced with permanent post-construction discharge structures, and all slopes and drainageways permanently stabilized), but are not responsible under this permit for operation and maintenance of post-construction practices once coverage under this permit is terminated.

ii. Point Source Dischargers. Post-construction stormwater BMPs that discharge pollutants from point sources once construction is completed may in themselves need authorization under a separate NPDES permit (one example is stormwater discharges from regulated industrial sites).

iii. No Impervious Surface. Construction activities that do not include the installation of any impervious surface (e.g., park lands), abandoned mine land reclamation activities regulated by the Ohio Department of Natural Resources, stream and wetland restoration activities, and wetland mitigation activities are not required to comply with the conditions of Part III.G.2.e of this permit. Linear construction projects (e.g., pipeline or utility line installation) which do not result in the installation of additional impervious surface are not required to comply with the conditions of Part III.G.2.e of this permit. However, linear construction projects shall be designed to minimize the number of stream crossings and the width of disturbance, and to achieve final stabilization of the disturbed area as defined in Part VII.M.1.

iv. Post-Construction BMPs. For all construction activities that will disturb two or more acres of land or will disturb less than two acres that are part of a larger common plan of development or sale which will disturb two or more acres of land, the post construction BMP(s) chosen shall be able to manage stormwater runoff for protection of stream channels, stream stability, and water quality. The BMP(s) chosen must be compatible with site and soil conditions. Structural post-construction stormwater treatment practices shall be incorporated into the permanent drainage system for the site. The BMP(s) chosen must be sized to treat the water quality volume (WQ_v) and ensure compliance with Ohio's Water Quality Standards in OAC Chapter 3745-1. The WQ_v shall be equivalent to the volume of runoff from a 0.90-inch rainfall and shall be determined using the following equations:

$$WQ_v = Rv * P * A / 12 \qquad \text{(Equation 1)}$$

where:
WQ_v = water quality volume in acre-feet
Rv = the volumetric runoff coefficient calculated using equation 2
P = 0.90 inch precipitation depth
A = area draining into the BMP in acres

$$Rv = 0.05 + 0.9i \qquad \text{(Equation 2)}$$

where i = fraction of post-construction impervious surface

Ohio EPA recommends BMPs be designed according to the methodology described in the most current edition of the Rainwater and Land Development manual or in another design manual acceptable for use by Ohio EPA and in accordance with ORC Chapter 4733.

The BMPs listed in Tables 4a and 4b below are considered standard BMPs approved for general use. However, communities with a regulated MS4 may limit the use of some of these BMPs. BMPs shall be designed such that the drain time is long enough to provide treatment but short enough to provide storage for successive rainfall events and avoid the creation of nuisance conditions. The outlet structure for the post-construction BMP shall not discharge more than the first half of the WQv in less than one-third of the minimum drain time listed in Table 4a. The WQv is the volume of stormwater runoff that must be detained by a post-construction practice as specified by the most recent edition of the Rainwater and Land Development manual.

Post-construction practices shall be sized to treat 100% of the WQv associated with their contributing drainage area. If there is an existing post-construction BMP that treats runoff from the disturbed area and the BMP meets the post-construction requirements of this permit, no additional post-construction BMP will be required. A regional stormwater BMP may be used to meet the post-construction requirement if: (1) the BMP meets the design requirements for treating the WQv; and (2) a legal agreement is established through which the regional BMP owner or operator agrees to provide this service in the long term. Design information for such facilities such as contributing drainage areas, capacities, elevations, outlet details and drain times shall be included in the SWP3.

Table 4a Extended Detention Post-Construction Practices with Minimum Drain Times

Extended Detention Practices	Minimum Drain Time of WQv
Wet Extended Detention Basin[1,2,3]	24 hours
Extended Detention Constructed Wetland[1, 3]	24 hours
Dry Extended Detention Basin with Forebay and Micropool[1,3,4]	48 hours
Permeable Pavement – Extended Detention[1]	24 hours
Underground Storage Facility– Extended Detention[1,5]	24 hours
Sand Filter - Extended Detention[1, 6]	24 hours

Notes:
1. The outlet structure shall not discharge more than the first half of the WQv in less than one-third of the minimum drain time.
2. Provide a permanent pool with a minimum volume equal to the WQv and an extended detention volume above the permanent pool equal to the WQv.
3. An additional volume equal to 20 percent of the WQ_v shall be incorporated into the BMP for sediment storage.
4. Dry extended detention basins must include a forebay and a micropool each sized at a minimum of 0.1 x WQv and a protected outlet, or include acceptable pretreatment and a protected outlet.
5. Underground storage must have pretreatment for removal of suspended sediments included in the design and documented in the SWP3. This pretreatment shall concentrate sediment in a location where it can be readily removed. For non-infiltrating, underground extended detention systems, pretreatment shall be at least 50% effective at capturing total suspended solids according to the testing protocol established in the Alternative Post-Construction BMP Testing Protocol.
6. The WQv ponding area shall completely empty between 24 and 72 hours.

Table 4b Infiltration Post-Construction Practices with Maximum Drain Times

Infiltration Practices	Maximum Drain Time of WQv
Bioretention [1,2,3]	24 hours
Infiltration Basin[2,3]	24 hours
Infiltration Trench[3,4]	48 hours
Permeable Pavement – Infiltration[3]	48 hours
Underground Storage Facility – Infiltration[3,4,5]	48 hours

Notes:

1. Bioretention soil media shall have a permeability of approximately 1 – 5 in/hr. Meeting the soil media specifications in the Rainwater and Land Development manual is considered compliant with this requirement. Bioretention cells must have underdrains unless in-situ conditions allow for the WQv (surface ponding) plus the bioretention soil (to a depth of 24 inches) to drain completely within 48 hours.
2. Infiltrating practices with the WQv stored aboveground (bioretention, infiltration basin) shall fully drain the WQv within 24 hours to minimize nuisance effects of standing water and to promote vigorous communities of appropriate vegetation.
3. The SWP3 shall demonstrate the design infiltration rate values are derived from site-specific measurements obtained through field tests of the in-situ soil for practices designed to infiltrate the WQv.
4. Subsurface practices designed to fully infiltrate the WQv (infiltration trench, permeable pavement with infiltration, underground storage with infiltration) shall empty within 48 hours to recover storage for subsequent storm events.
5. Underground storage systems with infiltration must have adequate pretreatment of suspended sediments included in the design and documented in the SWP3 in order to minimize clogging of the infiltrating surface. Pretreatment shall concentrate sediment in a location where it can be readily removed. Examples include media filters situated upstream of the storage or other suitable alternative approved by Ohio EPA. For infiltrating underground systems, pretreatment shall be at least 80% effective at capturing total suspended solids according to the testing protocol established in the Alternative Post-Construction BMP Testing Protocol.

v. Small Construction Activities. For all construction activities authorized under this permit which result in a disturbance less than 2 acres, a post-construction practice shall be used to treat stormwater runoff for pollutants and to reduce adverse impacts on receiving waters. The applicant must provide a justification in the SWP3 why the use of table 4a and 4b practices or runoff reduction practice are not feasible. The justification must address limiting factors which would prohibit the project going forward should table 4a and 4b practices be required. Please note that practices selected will require approval from the regulated MS4.

vi. Transportation Projects. The construction of new roads and roadway improvement projects by public entities (i.e., the state, counties, townships, cities, or villages) and the construction of publicly accessible, non-vehicular (i.e., pedestrian or shared-use) paths by public entities or non-governmental, non-profit organizations may implement post-construction BMPs in compliance with the current version (as of the effective date of this permit) of the Ohio Department of Transportation's "Location and Design Manual, Volume Two Drainage Design" that has been accepted by Ohio EPA as an alternative to the conditions of this permit.

vii. Offsite Mitigation of Post-Construction. The City and Ohio EPA may authorize the offsite mitigation of the post-construction requirements of Part III.G.2.e of this permit on a case by case basis provided the permittee clearly demonstrates the BMPs listed in Tables 4a and 4b are not feasible and the following criteria are met: (1) a maintenance agreement or policy is established to ensure operations and treatment long-term; (2) the offsite location discharges to the same HUC-12 watershed unit; and (3) the mitigation ratio of the WQv is 1.5 to 1 or the WQv at the point of retrofit, whichever is greater. Requests for offsite mitigation must be received prior to receipt of the NOI application.

viii. Previously Developed Areas. Ohio EPA encourages the redevelopment of untreated impervious areas through a reduction of the WQv treatment requirement. For an untreated previously developed area, where the area of disturbance is one (1) acre or greater, one or a combination of the following two conditions shall be met:

- A 20 percent net reduction of the site's volumetric runoff coefficient through impervious area reduction with soil restoration or replacing impervious roof area with green roof area (for these purposes green roofs shall be considered pervious surface) or
- Treatment of a portion of the site using a practice meeting Table 4a/4b criteria for which the WQv (see Equation 1) equals or exceeds the WQv_R determined with the following equation:

$$WQv_R = P * A * [(Rv_1*0.2) + (Rv_2 - Rv_1)] / 12 \qquad \text{(Equation 3)}$$

where

WQv_R = Redevelopment Water Quality Volume in acre-feet
P = 0.90 inches
A = disturbed area in acres
Rv_1 = volumetric runoff coefficient for existing (current site) conditions within the disturbed area
Rv_2 = volumetric runoff coefficient for proposed (post-construction site) conditions within the disturbed area

and is located to treat impervious areas most likely to generate the highest pollutant load, such as parking lots or roadways.

For previously developed areas with an area of disturbance less than one (1) acre, the City requires one, or a combination, of the following to be approved on a case-by-case basis:

- Catch basin modification or replacement to add hoods and traps for debris and oil control;
- A 20% reduction in the impervious area compared to the existing condition before redevelopment; or
- 20% water quality treatment in accordance with Equation 3b or 20% of the water quality flow rate determined by Equation 4.

$$WQv = P * A * (Rv_2 * 0.2) / 12 \qquad \text{(Equation 3b)}$$

where
P = 0.90 inches
A = area draining into the BMP in acres
Rv_1 = volumetric runoff coefficient for existing conditions (based upon current site impervious area)
Rv_2 = volumetric runoff coefficient for proposed conditions (based upon post-construction site impervious area)

This section does not apply to previous development that was obligated to obtain CGP coverage and provide management of the WQv under previous generations of this general permit (i.e., after April 21, 2003).

ix. Runoff Reduction Practices. The size of structural post-construction practices used to capture and treat the WQv can be reduced by incorporating runoff reducing practices into the design of the site's drainage system. The approach to calculate and document runoff reduction is detailed in the Rainwater and Land Development Manual. BMP-specific runoff reduction volumes are set by specifications in the Rainwater and Land Development Manual for the following practices:

- Impervious surface disconnection
- Rainwater harvesting
- Bioretention
- Infiltration basin
- Infiltration trench
- Permeable pavement with infiltration
- Underground storage with infiltration
- Grass swale
- Sheet flow to filter strip
- Sheet flow to conservation area

A runoff reduction approach may be used to meet the groundwater recharge requirements in the Big Darby Creek Watershed. The runoff reduction practices used for groundwater recharge may be used to reduce the WQv requirement, see appendix A for details on groundwater recharge requirements.

In order to promote the implementation of green infrastructure, the Director may consider the use of runoff reducing practices to demonstrate compliance with Part III.G.2.e of this permit for areas of the site not draining into a common drainage system of the site, e.g., sheet flow from perimeter areas such as the rear yards of residential lots, low density development scenarios, or where the permittee can demonstrate that the intent of pollutant removal and stream protection, as required in Part III.G.2.e of this permit is being addressed through non-structural post-construction BMPs based upon review and approval by the City and Ohio EPA.

x. Use of Alternative Post-Construction BMPs. This permit does not preclude the use of innovative or experimental post-construction stormwater management technologies. Permittees shall request approval from the City and Ohio EPA to use alternative post-construction BMPs on a case-by-case basis. The permittee shall submit an application (form maintained on the Ohio EPA Website) to Ohio EPA for any proposed alternative post-construction BMP and secure any approval from Ohio EPA before permittees submit an NOI for permit coverage. Where the development project is located within a regulated municipal separate storm sewer system (MS4) community, the use of an alternative practice requires pre-approval by the MS4 before submittal of the application to Ohio EPA. Ohio EPA requires that approvals for alternative post-construction BMPs are finalized.

To use an alternative post-construction BMP, the permittee must demonstrate that use of a BMP listed in Tables 4a and 4b is not feasible and the proposed alternative post-construction BMP meets the following three criteria:

a. Alternative post-construction BMPs must be capable of providing sustained, long-term treatment of stormwater. It must be durable and maintainable in accordance with industry standards.

b. Alternative post-construction BMPs shall previously have been tested to confirm stormwater treatment efficacy equivalent to those BMPs listed in Tables 4a and 4b using the protocol described in this permit. BMP testing may include laboratory testing, field testing, or both. For an alternative BMP to be acceptable, the test results must demonstrate that the minimum treatment rate is 80% TSS removal at the design flow rate for laboratory tested BMP. Field test results must demonstrate the minimum treatment rate is 80% TSS removal for influent concentrations equal to or greater than 100 mg/L TSS. If the influent concentration to the proposed alternative BMP is less than 100 mg/L TSS in the field, then the BMP must achieve an average effluent concentration less than or equal to 20 mg/L TSS.

c. The discharge rate from the proposed alternative practice shall be reduced to prevent stream bed erosion and protect the physical and biological stream integrity unless there will be negligible hydrological

impact to the receiving surface water of the state. Discharge rate is considered to have a negligible impact if the permittee can demonstrate that the entire WQv is recharged to groundwater, the larger common plan of development or sale will create less than one acre of impervious surface or the stormwater drainage system of the development discharges directly into a large river with drainage area equal to 100 square miles or larger upstream of the development site or to a lake where the development area is less than 5 percent of the watershed area, unless a TMDL has identified water quality problems into the receiving surface waters of the state. If the conditions above that minimize the potential for hydrological impact to the receiving surface water of the state do not exist, then the alternative post-construction BMP must prevent stream erosion by reducing the flow rate from the WQV. In such cases, discharge of the WQV must be controlled. A second stormwater BMP that provides extended detention of the WQv may be needed to meet the post-construction criteria.

Alternative BMPs that utilize treatment processes such as filtering or centrifugal separation, rather than a detention and settling volume, must be designed to ensure treatment of 90 percent of the average annual runoff volume. For the design of these BMPs, the water quality flow rate (WQF) shall be determined utilizing the Rational Method (Equation 4) with an intensity (i) appropriate for the water quality precipitation event. This intensity shall be calculated using the table given in Appendix C.

$$WQF = C * i * A \qquad \text{(Equation 4)}$$

Where

WQF = water quality flow rate in cubic feet per second (cfs)
C = rational method runoff coefficient
i = intensity (in/hr)
A = area draining to the BMP (acres)

xi. Alternative Post-Construction BMP Testing Protocol. For laboratory testing, the alternative BMP shall be tested using sediment with a specific gravity of 2.65, a particle size distribution closely matching the distribution shown in Table 5, and total suspended sediment (TSS) concentrations within 10% of 200 mg/L (180 mg/L – 220 mg/L TSS).

Table 5 Particle Size Distribution for Testing Alternative Post-Construction BMPs

Particle Size (microns)	Percent Finer (%)
1,000	100
500	95
250	90
150	75
100	60
75	50
50	45
20	35
8	20
5	10
2	5

- For field testing, the alternative BMP shall be tested using stormwater runoff from the field, not altered by adding aggregate or subjecting to unusually high sediment loads such as those from unstabilized construction disturbance. The stormwater runoff used for field testing shall be representative of runoff from the proposed installation site for the alternative BMP after all construction activities have ceased and the ground has been stabilized. The influent and effluent TSS concentrations of stormwater runoff must be collected in the field.

- Testing of alternative post-construction BMPs shall be performed or overseen by a qualified independent, third-party testing organization;

- Testing shall demonstrate the maximum flow rate at which the alternative post-construction BMP can achieve the necessary treatment efficacy, including consideration for the potential of sediment resuspension;

- Testing shall demonstrate the maximum volume of sediment and floatables that can be collected in the alternative post-construction BMP before pollutants must be removed to maintain 80% treatment efficacy;

- Testing shall indicate the recommended maintenance frequency and maintenance protocol to ensure ongoing performance of the alternative post-construction BMP.

The alternative post-construction BMP testing protocol described in this section is similar to testing requirements specified by the New Jersey Department of Environmental Protection (NJDEP) for stormwater Manufactured Treatment Devices (MTD) and therefore testing results certified by NJDEP shall be accepted by Ohio EPA. For a list of BMPs that have been certified by NJDEP, see the website: **www.njstormwater.org**.

Another nationally recognized stormwater product testing procedure is

the Technology Assessment Protocol – Ecology (TAPE) administered by the State of Washington, Department of Ecology. Testing results for a proposed alternative post-construction BMPcertified by TAPE under their general use designation and basic treatment category shall be accepted by Ohio EPA. The State of Washington, Department of Ecology website is **https://ecology.wa.gov/**.

Alternative post-construction BMPs may include, but are not limited to: vegetated swales, vegetated filter strips, hydrodynamic separators, high-flow media filters, cartridge filters, membrane filters, subsurface flow wetlands, multi-chamber treatment trains, road shoulder media filter drains, wetland channels, rain barrels, green roofs, and rain gardens. The City and the Director may also consider non-structural post-construction approaches.

f. Surface Water Protection. If the project site contains any streams, rivers, lakes, wetlands or other surface waters, certain construction activities at the site may be regulated under the CWA and/or state isolated wetland permit requirements. Sections 404 and 401 of the Act regulate the discharge of dredged or fill material into surface waters and the impacts of such activities on water quality, respectively. Construction activities in surface waters which may be subject to CWA regulation and/or state isolated wetland permit requirements include, but are not limited to: sewer line crossings, grading, backfilling or culverting streams, filling wetlands, road and utility line construction, bridge installation and installation of flow control structures. If the project contains streams, rivers, lakes or wetlands or possible wetlands, the permittee shall contact the appropriate U.S. Army Corps of Engineers District Office. (CAUTION: Any area of seasonally wet hydric soil is a potential wetland - please consult the Soil Survey and list of hydric soils for your County, available at your county's Soil and Water Conservation District. If you have any questions about Section 401 water quality certification, please contact the Ohio Environmental Protection Agency, Section 401 Coordinator.)

U.S. Army Corps of Engineers (Section 404 regulation):

- Huntington, WV District (304) 399-5210 (Muskingum River, Hocking River, Scioto River, Little Miami River, and Great Miami River Basins)
- Buffalo, NY District (716) 879-4330 (Lake Erie Basin)
- Pittsburgh, PA District (412) 395-7155 (Mahoning River Basin)
- Louisville, KY District (502) 315-6686 (Ohio River)

Ohio EPA 401/404 and non-jurisdictional stream/wetland coordinator can be contacted at (614) 644-2001 (all of Ohio)

Concentrated stormwater runoff from BMPs to natural wetlands shall be converted to diffuse flow before the runoff enters the wetlands. The flow should be released such that no erosion occurs downslope. Level spreaders may need to be placed in series, particularly on steep sloped sites, to ensure non-erosive velocities. Other structural BMPs may be used between stormwater features and natural wetlands, in order to protect the natural hydrology, hydroperiod, and wetland flora. If the applicant proposes to discharge to natural wetlands, a

hydrologic analysis shall be performed. The applicant shall attempt to match the pre-development hydroperiods and hydrodynamics that support the wetland. The applicant shall assess whether their construction activity will adversely impact the hydrologic flora and fauna of the wetland. Practices such as vegetative buffers, infiltration basins, conservation of forest cover, and the preservation of intermittent streams, depressions, and drainage corridors may be used to maintain wetland hydrology.

g. Other controls.

i. **Non-Sediment Pollutant Controls.** In accordance with Part II.E, no solid (other than sediment) or liquid waste, including building materials, shall be discharged in stormwater runoff. The permittee must implement all necessary BMPs to prevent the discharge of non-sediment pollutants to the drainage system of the site or surface waters of the state or an MS4. Under no circumstance shall wastewater from the washout of concrete trucks, stucco, paint, form release oils, curing compounds, and other construction materials be discharged directly into a drainage channel, storm sewer or surface waters of the state. Also, no pollutants from vehicle fuel, oils, or other vehicle fluids can be discharged to surface waters of the state. No exposure of stormwater to waste materials is recommended. The SWP3 must include methods to minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, and sanitary waste to precipitation, stormwater runoff, and snow melt. In accordance with Part II.D.3, the SWP3 shall include measures to prevent and respond to chemical spills and leaks. You may also reference the existence of other plans (i.e., Spill Prevention Control and Countermeasure (SPCC) plans, spill control programs, Safety Response Plans, etc.) provided that such plan addresses conditions of this permit condition and a copy of such plan is maintained on site.

ii. **Off-site traffic.** Off-site vehicle tracking of sediments and dust generation shall be minimized. In accordance with Part II.D.1, the SWP3 shall include methods to minimize the discharge of pollutants from equipment and vehicle washing, wheel washwater, and other washwaters. No detergents may be used to wash vehicles. Washwaters shall be treated in a sediment basin or alternative control that provides equivalent treatment prior to discharge.

iii. **Compliance with other requirements.** The SWP3 shall be consistent with applicable State and/or local waste disposal, sanitary sewer or septic system regulations, including provisions prohibiting waste disposal by open burning and shall provide for the proper disposal of contaminated soils to the extent these are located within the permitted area.

iv. **Trench and ground water control**. In accordance with Part II.C, there shall be no turbid discharges to surface waters of the state resulting from dewatering activities. If trench or ground water contains sediment, it shall pass through a sediment settling pond or other equally effective sediment

control device, prior to being discharged from the construction site. Alternatively, sediment may be removed by settling in place or by dewatering into a sump pit, filter bag or comparable practice. Ground water which does not contain sediment or other pollutants is not required to be treated prior to discharge. However, care must be taken when discharging ground water to ensure that it does not become pollutant-laden by traversing over disturbed soils or other pollutant sources.

v. **Contaminated Sediment.** Where construction activities are to occur on sites with contamination from previous activities, operators shall be aware that concentrations of materials that meet other criteria (is not considered a Hazardous Waste, meeting VAP standards, etc.) may still result in stormwater discharges in excess of Ohio Water Quality Standards. Such discharges are not authorized by this permit. Appropriate BMPs include, but are not limited to:

- The use of berms, trenches, and pits to collect contaminated runoff and prevent discharges;
- Pumping runoff into a sanitary sewer (with prior approval of the sanitary sewer operator) or into a container for transport to an appropriate treatment/disposal facility; and
- Covering areas of contamination with tarps or other methods that prevent stormwater from coming into contact with the material.

Operators should consult with Ohio EPA Division of Surface Water prior to seeking permit coverage.

h. Maintenance. All temporary and permanent control practices shall be maintained and repaired as needed to ensure continued performance of their intended function. All sediment control practices must be maintained in a functional condition until all up-slope areas they control are permanently stabilized. The SWP3 shall be designed to minimize maintenance requirements. The applicant shall provide a description of maintenance procedures needed to ensure the continued performance of control practices.

i. Inspections. The permittee shall assign “qualified inspection personnel” to conduct inspections to ensure that the control practices are functional and to evaluate whether the SWP3 is adequate and properly implemented in accordance with the schedule proposed in Part III.G.1.h of this permit or whether additional control measures are required. At a minimum, procedures in a SWP3 shall provide that all controls on the site are inspected:

- after any storm event greater than one-half inch of rain per 24-hour period by the end of the next calendar day, excluding weekends and holidays unless work is scheduled; and
- once every seven calendar days.

The inspection frequency may be reduced to at least once every month for dormant sites if:

- the entire site is temporarily stabilized or

- runoff is unlikely due to weather conditions for extended periods of time (e.g., site is covered with snow, ice, or the ground is frozen).

The beginning and ending dates of any reduced inspection frequency shall be documented in the SWP3. Once a definable area has achieved final stabilization, the area may be marked on the SWP3 and no further inspection requirements shall apply to that portion of the site.

Following each inspection, a checklist must be completed and signed by the qualified inspection personnel representative. Inspection reports may be prepared, signed, and kept electronically, rather than in paper form, if the records are: (a) in a format that can be read in a similar manner as a paper record; (b) legally dependable with no less evidentiary value than their paper equivalent; and (c) immediately accessible to the inspector during an inspection to the same extent as a paper copy stored at the site would be, if the records were stored in paper form. For additional guidance on the proper practices to follow for the electronic retention of inspection report records, refer to this general permit's Fact Sheet at **https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/storm-water-discharges-from-small-and-large-construction-activities--general-permit**. At a minimum, the inspection report shall include:

i. the inspection date;
ii. names, titles, and qualifications of personnel making the inspection;
iii. weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred;
iv. weather information and a description of any discharges occurring at the time of the inspection;
v. location(s) of discharges of sediment or other pollutants from the site;
vi. location(s) of BMPs that need to be maintained;
vii. location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location;
viii. location(s) where additional BMPs are needed that did not exist at the time of inspection; and
ix. corrective action required including any changes to the SWP3 necessary and implementation dates.

Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of or the potential for pollutants entering the drainage system. Erosion and sediment control measures identified in the SWP3 shall be observed to ensure that those are operating correctly. Discharge locations shall be inspected to ascertain whether erosion and sediment control measures are effective in preventing significant impacts to the receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site vehicle tracking.

The permittee shall maintain for three years following the submittal of a notice of termination form, a record summarizing the results of the inspection, names(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWP3 and a certification as to whether the facility is in compliance with the SWP3 and the permit and identify any incidents of non-compliance. The record and certification shall be signed in accordance with Part V.G. of this permit.

i. **When practices require repair or maintenance.** If the inspection reveals that a control practice is in need of repair or maintenance, with the exception of a sediment settling pond, it shall be repaired or maintained within 3 days of the inspection. Sediment settling ponds shall be repaired or maintained within 10 days of the inspection.

ii. **When practices fail to provide their intended function.** If the inspection reveals that a control practice fails to perform its intended function and that another, more appropriate control practice is required, the SWP3 shall be amended and the new control practice shall be installed within 10 days of the inspection.

iii. **When practices depicted on the SWP3 are not installed.** If the inspection reveals that a control practice has not been implemented in accordance with the schedule contained in Part III.G.1.h of this permit, the control practice shall be implemented within 10 days from the date of the inspection. If the inspection reveals that the planned control practice is not needed, the record shall contain a statement of explanation as to why the control practice is not needed.

3. Approved State or local plans. All dischargers regulated under this general permit must comply, except those exempted under state law, with the lawful requirements of municipalities, counties and other local agencies regarding discharges of stormwater from construction activities. All erosion and sediment control plans and stormwater management plans approved by local officials shall be retained with the SWP3 prepared in accordance with this permit. Applicable requirements for erosion and sediment control and stormwater management approved by local officials are, upon submittal of a NOI form, incorporated by reference and enforceable under this permit even if they are not specifically included in an SWP3 required under this permit. When the project is located within the jurisdiction of a regulated municipal separate storm sewer system (MS4), the permittee shall certify that the SWP3 complies with the requirements of the stormwater management program of the MS4 operator.

4. Exceptions. If specific site conditions prohibit the implementation of any of the erosion and sediment control practices contained in this permit or site-specific conditions are such that implementation of any erosion and sediment control practices contained in this permit will result in no environmental benefit, then the permittee shall provide justification for rejecting each practice based on site conditions. Exceptions from implementing the erosion and sediment control standards contained in this permit will be approved or denied on a case-by-case basis.

The permittee may request approval from the City and Ohio EPA to use alternative methods to satisfy conditions in this permit if the permittee can demonstrate that the alternative methods are sufficient to protect the overall integrity of receiving streams and the watershed. Alternative methods will be approved or denied on a case-by-case basis.

PART IV. NOTICE OF TERMINATION REQUIREMENTS

A. Failure to notify.

The terms and conditions of this permit shall remain in effect until a signed Notice of Termination (NOT) form is submitted and permit coverage is terminated by Ohio EPA. Failure to submit an NOT constitutes a violation of this permit and may affect the ability of the permittee to obtain general permit coverage in the future.

B. When to submit an NOT.

1. Permittees wishing to terminate coverage under this permit shall submit an NOT form in accordance with Part V.G. of this permit. Compliance with this permit is required until an NOT form is submitted and permit coverage is terminated by Ohio EPA. Prior to submitting the NOT form, the permittee shall conduct a site inspection in accordance with Part III.G.2.i of this permit and have a maintenance plan in place to ensure all post-construction BMPs will be maintained in perpetuity.

2. All permittees shall submit an NOT form within 45 days of completing all permit requirements. Enforcement actions may be taken if a permittee submits an NOT form without meeting one or more of the following conditions:

    a. Final stabilization (see definition in Part VII) has been achieved on all portions of the site for which the permittee is responsible (including, if applicable, returning agricultural land to its pre-construction agricultural use);

    b. Another operator(s) has assumed control over all areas of the site that have not been finally stabilized;

    c. A maintenance plan is in place to ensure all post construction BMPs are adequately maintained in the long-term;

    d. For non-residential developments, all elements of the stormwater pollution prevention plan have been completed, the disturbed soil at the identified facility have been stabilized and temporary erosion and sediment control measures have been removed at the appropriate time, or all stormwater discharges associated with construction activity from the identified facility that are authorized by the above referenced NPDES general permit have otherwise been eliminated. (i)For residential developments only, temporary stabilization has been completed and the lot, which includes a home, has been transferred to the homeowner; (ii) final stabilization has been completed and the lot, which does not include a home, has been transferred to the property owner; (iii) no stabilization has been implemented on a lot, which includes a home, and the lot has been transferred to the homeowner; or

e. An exception has been granted under Part III.G.4.

C. How to submit an NOT.

To terminate permit coverage, the permitee shall submit a complete and accurate Notice of Termination (NOT) form using Ohio EPA's electronic application form which is available through the Ohio EPA eBusiness Center at: https://ebiz.epa.ohio.gov/. Submission through the Ohio EPA eBusiness Center will require establishing an Ohio EPA eBusiness Center account and obtaining a unique Personal Identification Number (PIN) for final submission of the NOT. Existing eBusiness Center account holders can access the NOT form through their existing account and submit using their existing PIN. Please see the following link for guidance: **https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/electronic-business-services-sub/streams**. Alternatively, if you are unable to access the NOT form through the agency eBusiness Center due to a demonstrated hardship, the NOT may be submitted on paper NOT forms provided by Ohio EPA. NOT information shall be typed on the form. Please contact Ohio EPA, Division of Surface Water at (614) 644-2001 if you wish to receive a paper NOT form.

PART V. STANDARD PERMIT CONDITIONS.

A. Duty to comply.

The permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of ORC Chapter 6111 and is grounds for enforcement action.

Ohio law imposes penalties and fines for persons who knowingly make false statements or knowingly swear or affirm the truth of a false statement previously made.

B. Continuation of an expired general permit.

An expired general permit continues in force and effect until a new general permit is issued.

C. Need to halt or reduce activity not a defense.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to mitigate.

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Duty to provide information.

The permittee shall furnish to the City or director, within 10 days of written request, any information which the City or director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with

this permit. The permittee shall also furnish to the City or director upon request copies of records required to be kept by this permit.

F. Other information.

When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the NOI, SWP3, NOT or in any other report to the City or director, he or she shall promptly submit such facts or information.

G. Signatory requirements.

All NOIs, NOTs, SWP3s, reports, certifications or information either submitted to the director or that this permit requires to be maintained by the permittee, shall be signed.

1. These items shall be signed as follows:

    a. For a corporation: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

        i. A president, secretary, treasurer or vice-president of the corporation in charge of a principal business function or any other person who performs similar policy or decision-making functions for the corporation; or

        ii. The manager of one or more manufacturing, production or operating facilities, provided, the manager is authorized to make management decisions that govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

    b. For a partnership or sole proprietorship: By a general partner or the proprietor, respectively; or

    c. For a municipality, State, Federal or other public agency: By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA).

2. All reports required by the permits and other information requested by the director shall be signed by a person described in Part V.G.1 of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described in Part V.G.1 of this permit and submitted to the director;

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator of a well or well field, superintendent, position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

c. The written authorization is submitted to the City or director.

3. Changes to authorization. If an authorization under Part V.G.2 of this permit is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part V.G.2 of this permit must be submitted to the director prior to or together with any reports, information or applications to be signed by an authorized representative.

H. Certification.

Any person signing documents under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

I. Oil and hazardous substance liability.

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject under section 311 of the CWA or 40 CFR Part 112. 40 CFR Part 112 establishes procedures, methods and equipment and other requirements for equipment to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable surface waters of the state or adjoining shorelines.

J. Property rights.

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

K. Severability.

The provisions of this permit are severable and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

L. Transfers.

Ohio NPDES general permit coverage is transferable. Ohio EPA must be notified in writing sixty days prior to any proposed transfer of coverage under an Ohio NPDES general permit. The transferee must inform Ohio EPA it will assume the responsibilities of the original permittee transferor.

M. Environmental laws.

No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

N. Proper operation and maintenance.

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of SWP3s. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

O. Inspection and entry.

The permittee shall allow the director or an authorized representative of the City or Ohio EPA, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment); and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

P. Duty to Reapply.

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit.

Q. Permit Actions.

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

R. Bypass.

The provisions of 40 CFR Section 122.41(m), relating to "Bypass," are specifically incorporated herein by reference in their entirety. For definition of "Bypass," see Part VII.C.

S. Upset.

The provisions of 40 CFR Section 122.41(n), relating to "Upset," are specifically incorporated herein by reference in their entirety. For definition of "Upset," see Part VII.GG.

T. Monitoring and Records.

The provisions of 40 CFR Section 122.41(j), relating to "Monitoring and Records," are specifically incorporated herein by reference in their entirety.

U. Reporting Requirements.

The provisions of 40 CFR Section 122.41(l), relating to "Reporting Requirements," are specifically incorporated herein by reference in their entirety.

V. General Effluent Limitation

The effluent shall, at all times, be free of substances:

1. In amounts that will settle to form putrescent, or otherwise objectionable, sludge deposits; or that will adversely affect aquatic life or waterfowl;
2. Of an oily, greasy, or surface-active nature, and of other floating debris, in amounts that will form noticeable accumulations of scum, foam, or sheen;
3. In amounts that will alter the natural color or odor of the receiving water to such degree as to create a nuisance;
4. In amounts that either singly or in combination with other substances are toxic to human, animal, or aquatic life;
5. In amounts that are conducive to the growth of aquatic weeds or algae to the extent that such growth become inimical to more desirable forms of aquatic life, or create conditions that are unsightly, or constitute a nuisance in any other fashion;
6. In amounts that will impair designated instream or downstream water uses.

PART VI. REOPENER CLAUSE

If there is evidence indicating potential or realized impacts on water quality due to any stormwater discharge associated with construction activity covered by this permit, the permittee of such discharge may be required to obtain coverage under an individual permit or an

alternative general permit in accordance with Part I.C of this permit or the permit may be modified to include different limitations and/or requirements.

Permit modification or revocation will be conducted according to ORC Chapter 6111.

PART VII. DEFINITIONS

A. "Act" means Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117 and Pub. L. 100-4, 33 U.S.C. 1251 et. seq.

B. "Bankfull channel" means a channel flowing at channel capacity and conveying the bankfull discharge. Delineated by the highest water level that has been maintained for a sufficient period of time to leave evidence on the landscape, such as the point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial or the point at which the clearly scoured substrate of the stream ends and terrestrial vegetation begins.

C. "Bankfull discharge" means the streamflow that fills the main channel and just begins to spill onto the floodplain; it is the discharge most effective at moving sediment and forming the channel.

D. "Best management practices (BMPs)" means schedules of activities, prohibitions of practices, maintenance procedures and other management practices (both structural and non-structural) to prevent or reduce the pollution of surface waters of the state. BMP's also include treatment requirements, operating procedures and practices to control plant and/or construction site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage.

E. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

F. "Channelized stream" means the definition set forth in Section 6111.01 (M) of the ORC.

G. "Commencement of construction" means the initial disturbance of soils associated with clearing, grubbing, grading, placement of fill, or excavating activities or other construction activities.

H. "Concentrated stormwater runoff" means any stormwater runoff which flows through a drainage pipe, ditch, diversion or other discrete conveyance channel.

I. "Director" means the director of the Ohio Environmental Protection Agency.

J. "Discharge" means the addition of any pollutant to the surface waters of the state from a point source.

K. "Disturbance" means any clearing, grading, excavating, filling, or other alteration of land surface where natural or man-made cover is destroyed in a manner that exposes the underlying soils.

L. "Drainage watershed" means for purposes of this permit the total contributing drainage area to a BMP, i.e., the "watershed" directed to the practice. This would also include any off-site drainage.

M. "Final stabilization" means that either:

1. All soil disturbing activities at the site are complete and a uniform perennial vegetative cover (e.g., evenly distributed, without large bare areas) with a density of at least 70 percent cover for the area has been established on all unpaved areas and areas not covered by permanent structures or equivalent stabilization measures (such as the use of mulches, rip-rap, gabions or geotextiles) have been employed. In addition, all temporary erosion and sediment control practices are removed and disposed of and all trapped sediment is permanently stabilized to prevent further erosion; or

2. For individual lots in residential construction by either:

    a. The homebuilder completing final stabilization as specified above or
    b. The homebuilder establishing temporary stabilization including perimeter controls for an individual lot prior to occupation of the home by the homeowner and informing the homeowner of the need for and benefits of, final stabilization. (Homeowners typically have an incentive to put in the landscaping functionally equivalent to final stabilization as quick as possible to keep mud out of their homes and off sidewalks and driveways.); or

3. For construction projects on land used for agricultural purposes (e.g., pipelines across crop or range land), final stabilization may be accomplished by returning the disturbed land to its pre-construction agricultural use. Areas disturbed that were previously used for agricultural activities, such as buffer strips immediately adjacent to surface waters of the state and which are not being returned to their pre-construction agricultural use, must meet the final stabilization criteria in (1) or (2) above.

N. "General contractor" – for the purposes of this permit, the primary individual or company solely accountable to perform a contract. The general contractor typically supervises activities, coordinates the use of subcontractors, and is authorized to direct workers at a site to carry out activities required by the permit.

O. "Individual lot NOI" means a Notice of Intent for an individual lot to be covered by this permit (see Part I of this permit).

P. "Larger common plan of development or sale"- means a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan.

Q. "MS4" means municipal separate storm sewer system which means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) that are:

1. Owned or operated by the federal government, state, municipality, township, county, district(s) or other public body (created by or pursuant to state or federal law) including special district under state law such as a sewer district, flood control district or drainage districts or similar entity or a designated and approved management agency under section 208 of the act that discharges into surface waters of the state; and
2. Designed or used for collecting or conveying solely stormwater,
3. Which is not a combined sewer and
4. Which is not a part of a publicly owned treatment works.

R. "National Pollutant Discharge Elimination System (NPDES)" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits and enforcing pretreatment requirements, under sections 307, 402, 318 and 405 of the CWA. The term includes an "approved program."

S. "Natural channel design" means an engineering technique that uses knowledge of the natural process of a stream to create a stable stream that will maintain its form and function over time.

T. "NOI" means notice of intent to be covered by this permit.

U. "NOT" means notice of termination.

V. "Operator" means any party associated with a construction project that meets either of the following two criteria:

1. The party has day-to-day operational control of all activities at a project which are necessary to ensure compliance with a SWP3 for the site and all permit conditions including the ability to authorize modifications to the SWP3, construction plans and site specification to ensure compliance with the General Permit, or

2. Property owner meets the definition of operator should the party which has day to day operational control require additional authorization from the owner for modifications to the SWP3, construction plans, and/or site specification to ensure compliance with the permit or refuses to accept all responsibilities as listed above (Part VII.V.1).

Subcontractors generally are not considered operators for the purposes of this permit. As set forth in Part I.F.1, there can be more than one operator at a site and under these circumstances, the operators shall be co-permittees.

W. "Ordinary high water mark" means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

X. "Owner or operator" means the owner or operator of any "facility or activity" subject to regulation under the NPDES program.

Y. "Permanent stabilization" means the establishment of permanent vegetation, decorative landscape mulching, matting, sod, rip rap and landscaping techniques to provide permanent erosion control on areas where construction operations are complete or where no further disturbance is expected for at least one year.

Z. "Percent imperviousness" means the impervious area created divided by the total area of the project site.

AA. "Point source" means any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or the floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

BB. "Qualified inspection personnel" means a person knowledgeable in the principles and practice of erosion and sediment controls, who possesses the skills to assess all conditions at the construction site that could impact stormwater quality and to assess the effectiveness of any sediment and erosion control measures selected to control the quality of stormwater discharges from the construction activity.

CC. "Rainwater and Land Development" is a manual describing construction and post-construction best management practices and associated specifications. A copy of the manual is maintained on the Ohio EPA website.

DD. "Riparian area" means the transition area between flowing water and terrestrial (land) ecosystems composed of trees, shrubs and surrounding vegetation which serve to stabilize erodible soil, improve both surface and ground water quality, increase stream shading and enhance wildlife habitat.

EE. "Runoff coefficient" means the fraction of total rainfall that will appear at the conveyance as runoff.

FF. "Sediment settling pond" means a sediment trap, sediment basin or permanent basin that has been temporarily modified for sediment control, as described in the latest edition of the Rainwater and Land Development manual.

GG. "State isolated wetland permit requirements" means the requirements set forth in Sections 6111.02 through 6111.029 of the ORC.

HH. "Stormwater" means stormwater runoff, snow melt and surface runoff and drainage.

II. "Steep slopes" means slopes that are 15 percent or greater in grade. Where a local government or industry technical manual has defined what is to be considered a "steep slope," this permit's definition automatically adopts that definition.

JJ. "Stream edge" means the ordinary high water mark.

KK. "Subcontractor" – for the purposes of this permit, an individual or company that takes a portion of a contract from the general contractor or from another subcontractor.

LL. "Surface waters of the state" or "water bodies" means all streams, lakes, reservoirs, ponds, marshes, wetlands or other waterways which are situated wholly or partially within the boundaries of the state, except those private waters which do not combine or effect a junction with natural surface or underground waters. Waters defined as sewerage systems, treatment works or disposal systems in Section 6111.01 of the ORC are not included.

MM. "SWP3" means stormwater pollution prevention plan.

NN. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

OO. "Temporary stabilization" means the establishment of temporary vegetation, mulching, geotextiles, sod, preservation of existing vegetation and other techniques capable of quickly establishing cover over disturbed areas to provide erosion control between construction operations.

PP. "Water Quality Volume (WQ_v)" means the volume of stormwater runoff which must be captured and treated prior to discharge from the developed site after construction is complete.

APPENDICES

Appendix A
Big Darby Creek Watershed
Not applicable to the City

CONTENTS OF THIS APPENDIX

A.1 Permit Area
A.2 TMDL Conditions
A.3 Sediment Settling Ponds and Sampling
A.4 Post-Construction Stormwater Management Selection
A.5 Riparian Setback Requirements
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A.7 Groundwater Recharge Requirements
A.8 Groundwater Recharge mitigation
Attachment A-A: Big Darby Creek Watershed Map
Attachment A-B: Stream Assessment and Restoration

A.1 Permit Area.

This appendix to Permit OHC00006 applies to the entire Big Darby Creek Watershed located within the State of Ohio. Please see Attachment A for permit area boundaries.

A.2 TMDL Conditions.

This general permit requires control measures/BMPs for construction sites that reflect recommendations set forth in the U.S. EPA approved Big Darby Creek TMDL.

A.3 Sediment Settling Ponds and Sampling

Sediment settling ponds additional conditions. The sediment settling pond shall be sized to provide a minimum dewatering volume of 134 cubic yards per acre of drainage area and maintain a target discharge performance standard of 45 mg/l Total Suspended Solids (TSS) or 50 Nephelometric Turbidity Units (NTUs) up to a 0.75-inch rainfall event within a 24-hour period. Unless infeasible, sediment settling ponds must be dewatered at the pond surface using a skimmer or equivalent device. The depth of the sediment settling pond must be less than or equal to five feet. Sediment must be removed from the sediment settling pond when the design capacity has been reduced by 40 percent (This is typically reached when sediment occupies one-half of the basin depth).

Silt Fence and Diversions. For sites five or more acres in size, the use of sediment barriers as a primary sediment control is prohibited. Centralized sediment basins shall be used for sites 5 or more acres in size. Diversions shall direct all stormwater runoff from the disturbed areas to the impoundment intended for sediment control. The sediment basins and associated diversions shall be implemented prior to the major earth disturbing activity.

The permittee shall sample in accordance with sampling procedures outlined in 40 CFR 136. Sampling shall occur as follows:

i. Occur at the outfall of each sediment settling pond associated with the site. Each associated outfall shall be identified by a three-digit number (001, 002, etc.);

ii. The applicable rainfall event for sampling to occur shall be a rainfall event of 0.25-inch to a 0.75-inch rainfall event to occur within a 24-hour period. Grab sampling shall be initiated at a site within 14 days, or the first applicable rainfall event thereafter, once upslope disturbance of each sampling location is initiated and shall continue on a quarterly basis. Quarterly periods shall be represented as January - March, April - June, July - September and October - December. Sampling results shall be retained on site and available for inspection.

If any sample is greater than the performance standard of 45 mg/l TSS or 50 NTUs, the permittee shall modify the SWP3 and install/implement new control practice(s) within 10 days to ensure the performance standard is maintained. Within 3 days of improvement(s), or the first applicable rainfall event thereafter, the permittee shall resample to ensure SWP3 modifications maintain the performance standard target.

For each sample taken, the permittee shall record the following information:

- the outfall and date of sampling;
- the person(s) who performed the sampling;
- the date the analyses were performed on those samples;
- the person(s) who performed the analyses;
- the analytical techniques or methods used; and
- the results of all analyses.

Both quarterly and sampling results following a discharge target exceedance shall be retained on site and available for inspection.

A.4 Post-Construction Stormwater Management Selection.

For all construction activities authorized under this permit that fall within the watershed of the Big Darby Creek, a Table 4b practice shall be used to treat stormwater runoff for pollutants, to reduce adverse impacts on receiving waters, and to further support groundwater recharge if feasible. The applicant must provide a justification in the SWP3 why the use of table 4b practices are not feasible. The justification must address limiting factors which would prohibit the project going forward should Table 4b practices be required. Please note that practices selected will require approval from the regulated MS4.

A.5 Riparian Setback Requirements.

The SWP3 shall clearly delineate the boundary of required stream setback distances. No construction activity shall occur, without appropriate mitigation, within the delineated setback boundary except activities associated with restoration or recovery of natural floodplain and channel form characteristics as described in Attachment B, stormwater conveyances from permanent treatment practices and approvable utility crossings. Such conveyances must be designed to minimize the width of disturbance. If intrusion within the delineated setback boundary is necessary to accomplish the purposes of a project, then mitigation shall be required in accordance with Appendix A.6 of this permit. Streams requiring protection under this section are defined as perennial, intermittent or jurisdictional ephemeral streams with a defined bed, bank or channel. National

Resources Conservation Service (NRCS) soil survey maps should be used as one reference and the presence of a stream requiring protection should also be confirmed in the field. Any required setback distances shall be clearly displayed in the field prior to any construction related activity.

Riparian setbacks distance shall be delineated based upon one of the following two methods:

i. The setback distance shall be sized as the greater of the following:

1. The regulatory 100-year floodplain based on FEMA mapping;

2. A minimum of 100 feet from the top of the streambank on each side; or

3. A distance calculated using the following equation:

$$W = 133DA^{0.43}$$ (Equation 1, Appendix A)

where:
DA = drainage area (mi^2)
W = total width of riparian setback (ft)

W shall be centered over the meander pattern of the stream such that a line representing the setback width would evenly intersect equal elevation lines on either side of the stream.

If the DA remains relatively constant throughout the stretch of interest, then the DA of the downstream edge of the stretch should be used. Where there is a significant increase in the DA from the upstream edge to The downstream edge of the area of interest, the setback width shall increase accordingly.

ii. **Stream Restoration with 100 feet (each side) Riparian Setback**. Each stream segment within the proposed site boundaries can be assessed in accordance with Attachment B, Part 1. In the event the stream segment is classified as a "Previously Modified Low Gradient Headwater Stream", the permittee has the option to restore the stream segment in accordance with Attachment B and include a 100-foot water quality setback distance from the top of the streambank on each side. In the event the stream segment exceeds the minimum criteria in Attachment B to be classified as a "Previously Modified Low Gradient Headwater Stream," this Appendix A, Attachment B may be considered on a case-by-case basis.

No structural sediment controls (e.g., the installation of sediment barriers or a sediment settling pond) or structural post-construction controls shall be used in a surface water of the State or the delineated setback corridor.

Previously developed projects (as defined in Part III.G.2.e.) located within the delineated setback boundary are exempt from Riparian Setback Mitigation (A.6) provided the proposed project does not further intrude into the delineated setback boundary.

Linear transportation projects which are caused solely by correcting safety related issues, mandates of modern design requirements and/or resulting from other mitigation activities are exempt from Riparian Setback Mitigation (Appendix A, A.6) if less than one acre of total new right-of-way is associated with the project.**A.6 Riparian Setback Mitigation.**

The mitigation required for intrusion into the riparian setback shall be determined by the horizontal distance the intrusion is from the stream. Up to three zones will be used in determining the required mitigation. Zone 1 extends from 0 to 25 feet from the stream edge. Zone 2 extends from 25 to 100 feet from the stream edge, and Zone 3 extends from 100 feet to the outer edge of the setback corridor. Intrusion into these zones will require the following mitigation within the same Watershed Assessment Unit (12-digit HUC scale):

i. Four times the total area disturbed in the stream and within Zone 1 of the site being developed shall be mitigated within Zone 1 of the mitigation location.

ii. Three times the area disturbed within Zone 2 of the site being developed shall be mitigated within Zones 1 and/or 2 of the mitigation location.

iii. Two times the area disturbed within Zone 3 of the site being developed shall be mitigated within any zone of the mitigation location.

In lieu of mitigation ratios found within in this section, linear transportation projects which result in total new right-of-way greater than one acre and less than two acres, which are caused solely by correcting safety related issues, mandates of modern design requirements and/or resulting from other mitigation activities, shall provide Riparian Setback Mitigation at a ratio of 1.5 to 1.

All mitigation shall, at a minimum, include conserved or restored setback zone and should be designed to maximize the ecological function of the mitigation. Including mitigation at the stream edge along with associated setback areas is one way to maximize ecological function. Mitigation shall be protected in perpetuity by binding conservation easements or environmental covenants which must be recorded within 6 months of receiving permit authorization. Granting of binding conservation easements or environmental covenants protected in perpetuity for land outside of disturbed area but within a required riparian setback counts towards required mitigation.

Mitigation may also be satisfied by approved pooled mitigation areas and in-lieu fee sponsored mitigation areas. Mitigation resulting from State or Federal environmental regulations may be adjusted in recognition of these requirements.

A.7 Groundwater Recharge Requirements.

The SWP3 shall ensure that the overall site post-development groundwater recharge equals or exceeds the pre-development groundwater recharge. The SWP3 shall describe the conservation development strategies, BMPs and other practices deemed necessary by the permittee to maintain or improve pre-development rates of groundwater recharge. Pre-development and post-development groundwater recharge shall be calculated using the following equation:

i. $Vre_x = A_x * Dre_x / 12$ (Equation 2, Appendix A)

where:
X = represents a land use and hydrologic soil group pair
Vre_x = volume of total annual recharge from land use-soil group X (in acre-ft)
Dre_x = depth of total annual recharge associated with land use-soil group X from Tables 1 or 2 (in inches)
A_x = area of land use-soil group X (in acres)

Table A-1 values should be used for land where the underlying geology indicates a potential for downward migration of groundwater. Table A-1 values represent the combined total groundwater recharge potential including groundwater contribution to stream baseflow and to the underlying bedrock aquifer. The potential for downward migration can be determined from a comparison of the potentiometric maps for the glacial and bedrock aquifers. Use Table A-2 when this potential is unlikely to exist. See attachment B for a map of Table A-1 and A-2 areas. Detailed potentiometric maps for the Franklin county portion of the Darby watershed, and coarse potentiometric maps for the Darby watershed outside of Franklin County and hydrologic soil group data are available at:
https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/stormwater-program.

Table A-1 (Appendix A) Annual Average Expected Total Groundwater Recharge[3]

	Density (DU[1]/acre)	% Impervious	Recharge (inches) by Hydrologic Soil Group2			
			A	B	C	D
Apply the following land covers when calculating an area-weighted average value for the site.[4]						
Woods / Forest	-	-	17.0	16.6	15.6	14.6
Brush	-	-	17.0	16.6	15.6	14.6
Meadow	-	-	17.0	16.5	15.4	14.4
Managed Wood	-	-	16.9	16.0	14.7	13.4
Pasture	-	-	16.5	15.9	14.4	13.0
Row Crop	-	-	15.8	14.2	11.9	8.1
Urban Grasses	-	-	15.7	15.7	14.2	12.7
Impervious	-	-	0.0	0.0	0.0	0.0
Alternatively, the following land use average values may be applied to the site as a whole.[5]						
Low Density Residential	0.5	12%	15.7	15.7	14.2	12.7
Low Density Residential	1	20%	14.8	14.8	13.7	12.2
Medium Density Residential	2	25%	11.5	11.5	11.5	11.5
Medium Density Residential	3	30%	11.2	11.2	11.2	11.2
Medium Density Residential	4	38%	9.6	9.6	9.6	9.6
High Density Residential	≥5	65%	7.3	7.3	7.3	7.3
Commercial & Road Right-of-Way[4]	-	90%	4.3	4.3	4.3	4.3

[1] DU = Dwelling Units

[2] Hydrologic soil group designations of A/D, B/D, and C/D should be considered as D soils for this application.
[3] These values apply when recharge of the aquifer is expected; recharge to the bedrock aquifer can be expected when the potentiometric head of the glacial aquifer is greater than the bedrock aquifer.
[4]). These values may be used where total pervious and impervious areas within the development are tabulated separately..
[5] These values may only be used for an area as a whole (includes impervious and pervious areas).

Table A-2 (Appendix A) Annual Average Expected Baseflow Recharge[3]

	Density (DU[1]/acre)	% Impervious	Recharge (inches) by Hydrologic Soil Group2			
			A	B	C	D
Apply the following land covers when calculating an area-weighted average value for the site.[4]						
Woods / Forest	-	-	11.8	11.4	10.7	9.9
Brush	-	-	11.7	11.4	10.7	9.9
Meadow	-	-	11.8	11.3	10.6	9.8
Managed Wood	-	-	11.7	11.0	10.0	9.1
Pasture	-	-	11.3	11.0	9.9	8.9
Row Crop	-	-	11.1	10.1	9.0	6.2
Urban Grasses	-	-	11.2	11.2	10.3	9.3
Impervious	-	-	0.0	0.0	0.0	0.0
Alternatively, the following land use average values may be applied to the site as a whole.[5]						
Low Density Residential	0.5	12%	11.2	11.2	10.3	9.3
Low Density Residential	1	20%	9.5	9.5	9.0	8.6
Medium Density Residential	2	25%	7.8	7.8	7.8	7.8
Medium Density Residential	3	30%	7.6	7.6	7.6	7.6
Medium Density Residential	4	38%	6.5	6.5	6.5	6.5
High Density Residential	≥5	65%	5.0	5.0	5.0	5.0
Commercial & Road Right-of-Way[4]	-	90%	2.9	2.9	2.9	2.9

[1] DU = Dwelling Units
[2] Hydrologic soil group designations of A/D, B/D, and C/D should be considered as D soils for this application.
[3] These values apply when no recharge of the aquifer is expected.
[4] These values may be used where total impervious and pervious areas are tabulated separately.
[5] These values may only be used for an area as a whole (includes impervious and pervious areas).

Table A-3 (Appendix A) Land Use Definitions

Land Use	Definition
Woods / Forest	Areas dominated by trees. Woods are protected from grazing and litter and brush adequately cover the soil.
Brush	Brush, weeds, grass mixture where brush is the major element and more than 75% of the ground is covered.
Meadow	Continuous grass, protected from grazing, generally mowed for hay.
Managed Wood	Orchards, tree farms, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.
Pasture	Pasture, grassland, or range where at least 50% of the ground is covered and the area is not heavily grazed.
Row Crop	Areas used to produce crops, such as corn, soybeans, vegetables, tobacco, and cotton.
Urban Grasses	Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

Residential	Areas with a mixture of constructed materials and vegetation; the average % imperviousness and number of dwelling units per acre to determine the appropriate density is specified.
Commercial	Includes infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential.

ii. The pre-development ground water recharge volume shall be calculated by determining the area of each land use-soil type pairing on the site of interest. The recharge associated with each such pairing multiplied by the area will give the pre-development volume of total groundwater recharge. The same shall be done for the post-development land use-soil type pairings.

Any activity that is expected to produce stormwater runoff with elevated concentrations of carcinogens, hydrocarbons, metals, or toxics is prohibited from infiltrating untreated stormwater from the area affected by the activity. The groundwater recharge mitigation requirement for areas affected by such activities must be met by methods which do not present a risk of groundwater contamination. The following land uses and activities are typically deemed stormwater hotspots:

Vehicle salvage yards and recycling facilities

- vehicle service and maintenance facilities (i.e. truck stops, gas stations)
- fleet storage areas (i.e. bus, truck)
- industrial sites subject to industrial stormwater permitting requirements
- bulk terminals
- marinas
- facilities that generate or store hazardous materials
- other land uses and activities as designated by individual review

The following land uses and activities are not normally considered hotspots:

- residential streets and rural highways
- residential development
- institutional development
- commercial and office developments
- non-industrial rooftops
- pervious areas, except golf courses and nurseries

The applicant may use structural BMPs within drinking water source protection areas for community public water systems only to the extent that the structural BMP(s) does not cause contaminants in the recharge waters to impact the ground water quality at levels that would cause an exceedance of the drinking water Maximum Contaminant Levels (OAC Section 3745-81 and 3745-82). To obtain a map of drinking water source protection areas for community public water systems contact Ohio EPA's Division of Drinking and Ground Waters at (614) 644-2752.

Linear transportation projects which are caused solely by correcting safety related issues, mandates of modern design requirements and/or resulting from other

mitigation activities are exempt from Groundwater Recharge Mitigation (Appendix B, A.8) if less than one acre of total new right-of-way is associated with the project.

Protection of open space (infiltration areas) shall be by binding conservation easements that identify a third-party management agency, such as a homeowners' association/condominium association, political jurisdiction or third-party land trust.

A.8 Groundwater Recharge Mitigation.

If the post-development recharge volume is less than the pre-development recharge volume, then mitigation will be required. Two options are available for most applications:

i. The preferred method is to convert additional land to land use with higher recharge potential. The difference in groundwater recharge between the existing and converted land use recharge is the amount which can be used as recharge credit. Off-site Groundwater Recharge Mitigation shall occur within the same Watershed Assessment Unit (12-digit HUC scale) as the permitted site and preferably up-gradient and within a 2-mile radius.

   Mitigation shall be protected in perpetuity by binding conservation easements or environmental covenants which must be recorded within 6 months of receiving permit authorization. Granting of binding conservation easements or environmental covenants protected in perpetuity for land outside of the disturbed area, but within a required riparian setback counts towards required mitigation. Mitigation may also be satisfied by approved pooled mitigation areas and in-lieu fee sponsored mitigation areas.

ii. On-site structural and non-structural practices may also be used to achieve groundwater mitigation requirements by retaining and infiltrating on-site a minimum volume of stormwater runoff based on the area and hydrologic soil groups of disturbed soils. If these infiltrating practices are incorporated upstream of the water quality volume treatment practice, the volume of groundwater being infiltrated may be subtracted from the water quality volume for the purpose of meeting post-construction requirements. The on-site retention requirement is determined by the following formula:

$$V_{retention} = A_{HSG\text{-}A}*0.90 \text{ in} + A_{HSG\text{-}B}*0.75 \text{ in} + A_{HSG\text{-}C}*0.50 \text{ in} + A_{HSG\text{-}D}*0.25 \text{ in}$$

(Equation 3, Appendix A)

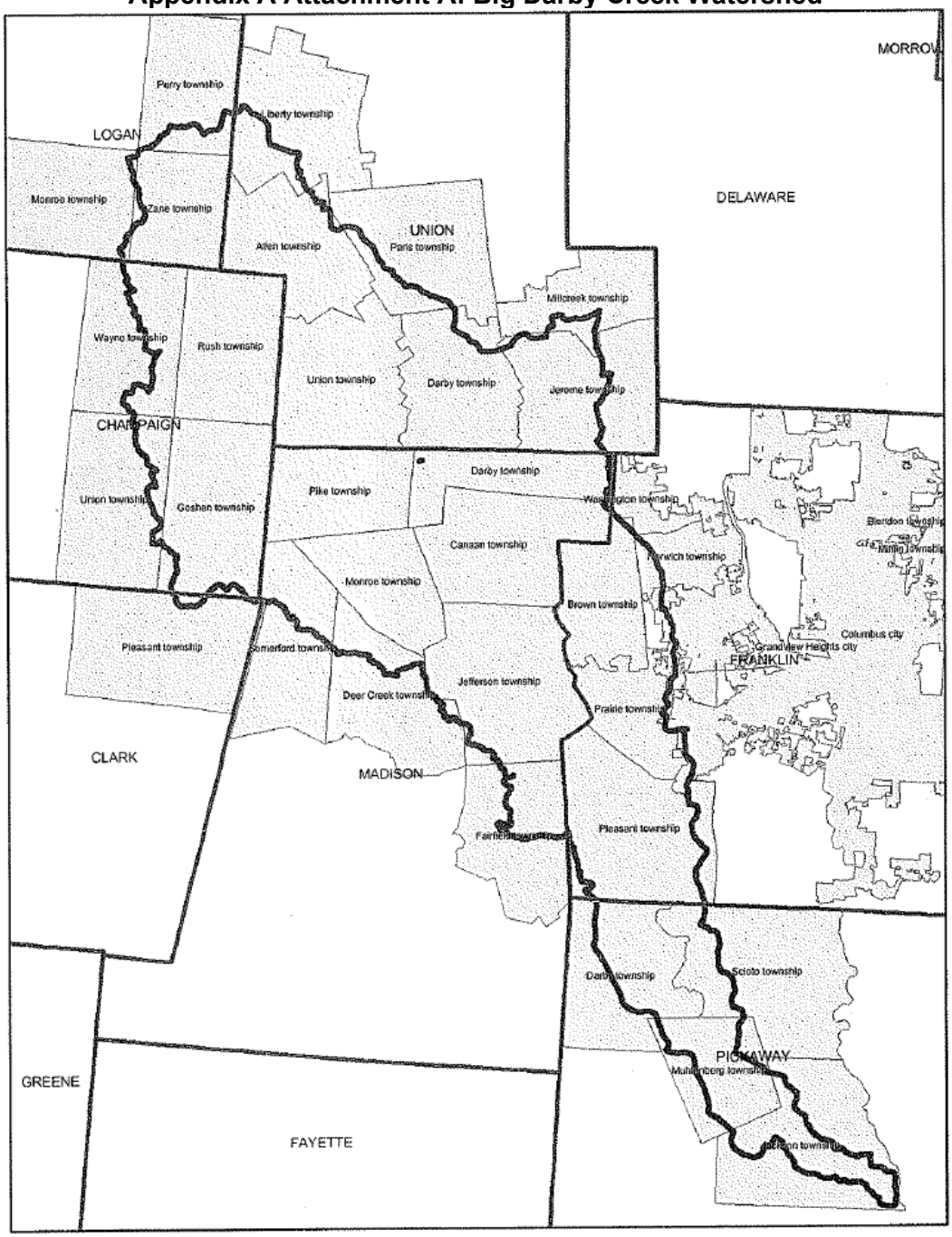
Where,
$V_{retention}$ = volume of runoff retained onsite using an approved infiltration practice
$A_{HSG\text{-}x}$ = area of each hydrologic soil group within the disturbed area

Table A-4: Hydrologic Soil Groups and On-site Retention Depth per Acre

Hydrologic Soil Group	HSG A	HSG B	HSG C	HSG D
Retention Depth (inches)	0.90	0.75	0.50	0.25

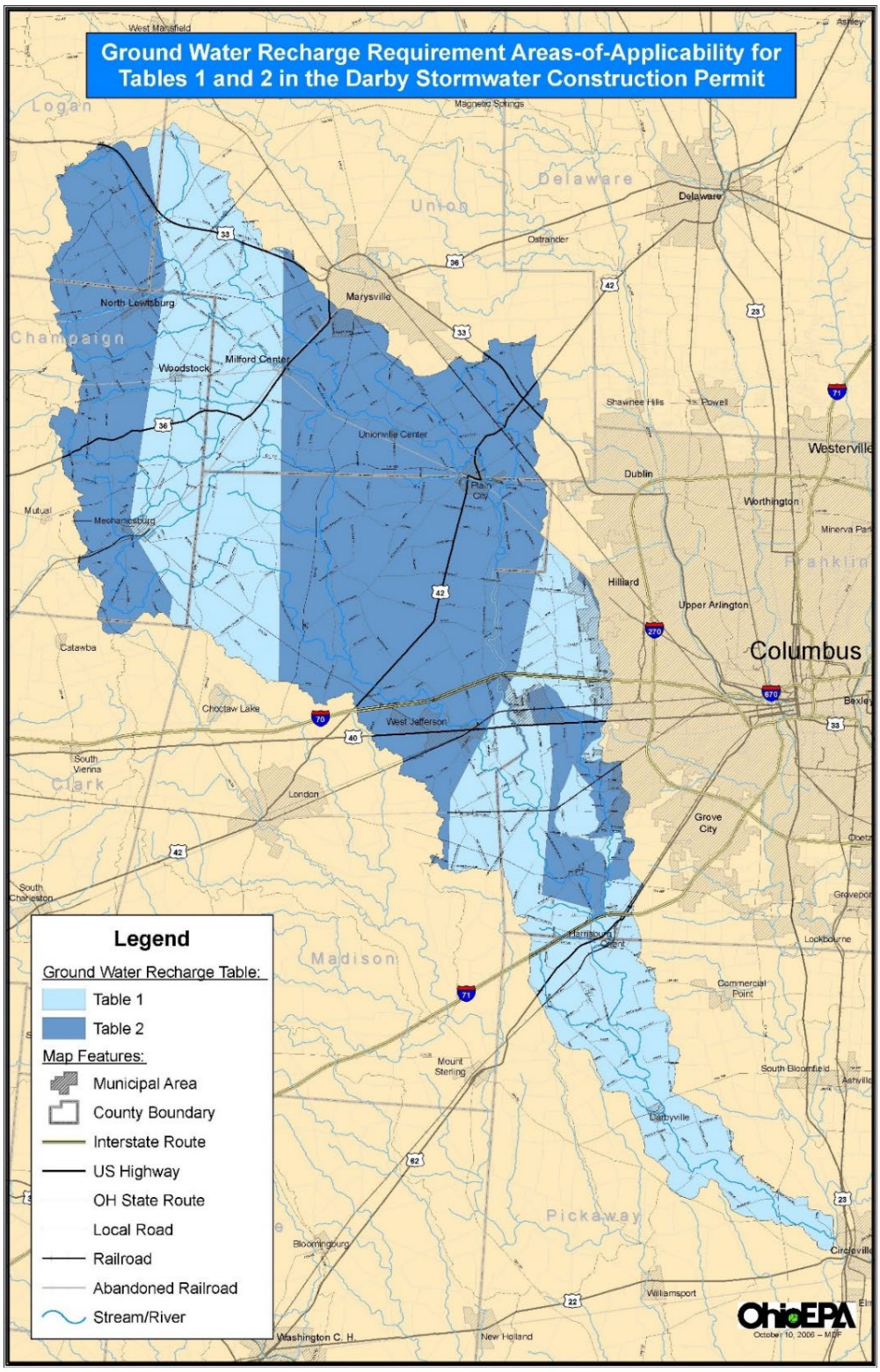
Retention volume ($V_{retention}$) provided by selected practices shall be determined using the runoff reduction method criteria as outlined in Part III.G.2.e, Ohio EPA's Runoff Reduction spreadsheet and supporting documentation in the Rainwater and Land Development manual. Hydrologic soil group (HSG) areas are to be determined by using the current version of SURRGO or Web Soil Survey soils information.

Appendix A Attachment A: Big Darby Creek Watershed



A more detailed map can be viewed at:
https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/stormwater-program

Appendix A Attachment B: Groundwater Recharge Areas



A more detailed map can be viewed at:
https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/stormwater-program

Appendix A Attachment B

Part 1 Stream Assessment

This assessment will determine if a stream is considered a previously channelized, low-gradient headwater stream (a drainage ditch may be a natural stream that has been channelized and can be restored) which would be applicable for stream restoration in lieu of protecting a setback as per Appendix A. A.5.i and ii.

In the event the assessment of the stream, meets all the criteria listed below, restoration (provided 401/404 permits are authorized) as depicted in Part 2 of this attachment, may be a means of reducing the setback distance required by A.5.i. (Appendix A).

Previously Channelized Low-Gradient Headwater Streams, shall for the purposes of this permit, be defined as having all of the following characteristics:

- Less than 10 square miles of drainage area
- Low gradient and low stream power such that despite their straightened and entrenched condition incision (down-cutting) is not evident
- Entrenched, entrenchment ratio < 2.2
- Straight, sinuosity of the bankfull channel < 1.02

Part 2 Restoration

Restoration shall be accomplished by any natural channel design approach that will lead to a self-maintaining reach able to provide both local habitat and watershed services (e.g. self-purification and valley floodwater storage).

a. Construction of a floodplain, channel and habitat via natural channel design;
b. Floodplain excavation necessary to promote interaction between stream and floodplain;
c. Include a water quality setback of 100 feet from top of the streambank on each side.

The primary target regardless of design approach shall be the frequently flooded width, which shall be maximized, at 10 times the channel's self-forming width. Five times the self-forming channel width may still be acceptable particularly on portions of the site if greater widths are achieved elsewhere.

Appendix B
Olentangy River Watershed

CONTENTS OF THIS APPENDIX

B.1 Permit Area
B.2 TMDL Conditions
B.3 Riparian Setback Requirements
B.4 Riparian Setback Mitigation
Attachment B-A: Area of Applicability for the Olentangy Watershed (Map)
Attachment B-B: Stream Assessment and Restoration

B.1 Permit Area.

This appendix to Permit OHC00006 applies to specific portions of the Olentangy River Watershed located within the State of Ohio. The permit area includes the following 12-digit Hydrologic Unit Codes (HUC-12) within the Olentangy River Watershed:

12-Digit Hydrologic Unit Codes

12-Digit Hydrologic Unit Codes (HUC)	Narrative Description of Sub-Watershed
05060001 09 01	Shaw Creek
05060001 09 02	Headwaters Whetstone Creek
05060001 09 03	Claypool Run-Whetstone Creek
05060001 10 07	Delaware Run-Olentangy River
05060001 11 01	Deep Run-Olentangy River
05060001 11 02 (Only portion as depicted in Attachment A)	Rush Run-Olentangy River

Please see Attachment A (Appendix B) for permit area boundaries. An electronic version of Attachment A can be viewed at ***https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/stormwater-program.***

B.2 TMDL Conditions.

This general permit requires control measures/BMPs for construction sites that reflect recommendations set forth in the U.S. EPA approved Olentangy TMDL.

B.3 Riparian Setback Requirements.

The permittee shall comply with the riparian setback requirements of this permit or alternative riparian setback requirements established by a regulated MS4 and approved by Ohio EPA. The SWP3 shall clearly delineate the boundary of required stream setback distances. The stream setback shall consist of a streamside buffer and an outer buffer. No construction activity shall occur, without appropriate mitigation, within the streamside buffer except activities associated with stormwater conveyances from permanent treatment practices, approvable utility crossings and restoration or recovery of floodplain and channel form characteristics as described in Attachment B. Stormwater conveyances must be designed to minimize the width of disturbance. Construction activities requiring mitigation for intrusions within the outer buffer for the Olentangy River mainstem and perennial streams are described in Appendix B.4.

If intrusion within the delineated setback boundary is necessary to accomplish the purposes of a project, then mitigation shall be required in accordance with Appendix B.3. of this permit. Streams requiring protection under this section have a defined bed and bank or channel and are defined as follows:

- The Olentangy River mainstem;
- Perennial streams have continuous flow on either the surface of the stream bed or under the surface of the stream bed;
- Intermittent streams flow for extended periods of time seasonally of a typical climate year; and
- Jurisdictional Ephemeral streams are normally dry and only flow during and after precipitation runoff (episodic flow).

National Resources Conservation Service (NRCS) soil survey maps should be used as one reference and the presence of a stream requiring protection should also be confirmed in the field. Any required setback distances shall be clearly displayed in the field prior to any construction related activity.

Riparian setbacks shall be delineated based upon one of the following two methods:

i. The required setback distances shall vary with stream type as follows:

a. The setback distances associated with the mainstem of the Olentangy River (see Figure 1) shall consist of:

(1) A streamside buffer width of 100 feet as measured horizontally from the ordinary high water mark per side; and

(2) An outer buffer width sized to the regulatory 100-year floodplain based on FEMA mapping. No impervious surfaces shall be constructed without appropriate mitigation and moderate to substantial fill activities with no impervious surface may require appropriate mitigation pending an individual approval by Ohio EPA.

b. The setback distances associated with Delaware Run (see Figure 2) from its confluence with the Olentangy River upstream to King Avenue shall consist of:

(1) A streamside buffer width of 15 feet as measured horizontally from the ordinary high water mark per side; and

(2) There shall be no additional outer buffer beyond the streamside buffer.

c. The setback distance associated with perennial streams, other than the Olentangy mainstem (see Figure 2), shall consist of:

(1) A streamside buffer width of 80 feet per side measured horizontally from the ordinary high water mark; and

(2) An outer buffer width of 80 feet per side measured horizontally from the streamside buffer. ~~sized to the regulatory 100-year floodplain based on FEMA mapping. In the event the regulatory 100-year floodplain is not established, the outer buffer width shall be calculated using the following equation and measured horizontally from the ordinary high water mark.~~ No impervious surfaces, structure, fill, or activity that would impair the floodplain or stream stabilizing ability of the outer buffer shall occur without appropriate mitigation:

In lieu of the 80 feet per side outer buffer, a total riparian setback can be determined based upon the following equation:

$W = 143DA^{0.41}$ (Equation 1 Appendix B)

where:
DA = drainage area (mi^2)
W = total width of riparian setback (ft)

The edges of the total riparian setback (whether the 80 feet per side outer buffer or W is used) ~~W~~ should ~~shall~~ be centered over the meander pattern of the stream such that a line representing the setback width would evenly intersect equal elevation lines on either side of the stream.

If the DA remains relatively constant throughout the stretch of interest, then the DA of the downstream edge of the stretch should be used. Where there is a significant increase in the DA from the upstream edge to the downstream edge of the area of interest, the setback width shall increase accordingly.

d. The setback distance associated with intermittent streams and jurisdictional ephemeral streams shall be a streamside buffer width of 30 feet per side measured horizontally from the centerline of the stream (see Figures 3 and 4, respectively). No outer buffer is required for intermittent and ephemeral streams.

e. The attached Figure 5 is a map of the City and surrounding areas with a background of USGS topographic mapping. This exhibit delineates the limits and names of known perennial streams in and around the City (Delaware Run, Horseshoe Run, Mill Run, Sugar Run, Clear Run, Weiser Run, and Norris Run). All other USGS blue-line streams shown on the exhibit can be considered to be intermittent streams for the purposes of this permit.

ii. Stream Restoration with 100 feet (each side) Riparian Setback. Each stream segment within the proposed site boundaries can be assessed in accordance with Attachment B. In the event the stream segment is classified as a "Previously Modified Low Gradient Headwater Stream", the permittee has the option to restore the stream segment in accordance with Attachment B and include a 100 feet water quality setback distance from the top of the streambank on each side. In the event the stream segment exceeds the minimum criteria in Attachment B to be classified as a "Previously Modified Low Gradient Headwater Stream", this may be considered on a case-by-case basis.

No structural sediment controls (e.g., the installation of sediment barriers or a sediment settling pond) or structural post-construction controls shall be used in a stream or the

streamside buffer. Activities and controls that would not impair the floodplain or stream stabilizing ability of the outer buffer can be considered.

For all streams, the riparian setback (including both streamside buffer and outer buffer) shall not extend past the right-of-way or roadway easement of any roadways that exist at the time these regulations are adopted.

Temporary disturbances to repair existing infrastructure shall be exempt from the riparian setback requirements.

Redevelopment projects (i.e., developments on previously developed property) located within the delineated setback boundary is exempt from Riparian Setback Mitigation (B.3 and B.4) provided the proposed project does not further intrude the delineated setback boundary. In other words, the riparian setback shall be reduced to not extent beyond existing developed impervious surfaces.

B.4 Riparian Setback Mitigation.

The mitigation required for intrusion into the riparian setback of the **Olentangy River mainstem or perennial streams** shall be determined by the horizontal distance the intrusion is from the stream. Up to three zones will be used in determining the required mitigation. Zone 1 extends from 0 to 30 feet from the stream edge. Zone 2 extends from 30 feet to the outer edge of the streamside buffer. Zone 3 extends from the outer edge of the streamside buffer to the outer edge of the outer buffer. Intrusion into these zones will require the following mitigation within the immediate receiving stream ~~the same Watershed Assessment Unit (12-digit HUC scale).~~ Alternative mitigation, within the permit area, may be considered on a case-by-case basis:

1. ~~Four (4)~~ Two (2) times the total area disturbed in the stream within Zone 1 of the site being developed shall be mitigated within Zone 1 of the mitigation location; ~~or, two (2) times the total area disturbed in the stream within Zone 1 shall be mitigated within the watershed of the immediate receiving stream, and the entire required setback of the site shall be protected by binding conservation easements or environmental covenants.~~

2. ~~Three (3)~~ One and one-half (1.5) times the area disturbed within Zone 2 of the site being developed shall be mitigated within Zones 1 and/or 2 of the mitigation location; ~~or, one and one-half (1.5) times the total area disturbed within Zone 2 shall be mitigated within the watershed of the immediate receiving stream, and the entire required setback of the site shall be protected in perpetuity by binding conservation easements or environmental covenants.~~

3. ~~Two (2)~~ One (1) times the area to be mitigated within Zone 3 of the site being developed shall be mitigated within any Zone of the mitigation location; ~~or, one (1) times the total area to be mitigated within any zone shall be mitigated within the watershed of the immediate receiving stream, and the entire required setback of the site shall be protected in perpetuity by binding conservation easements or environmental covenants.~~

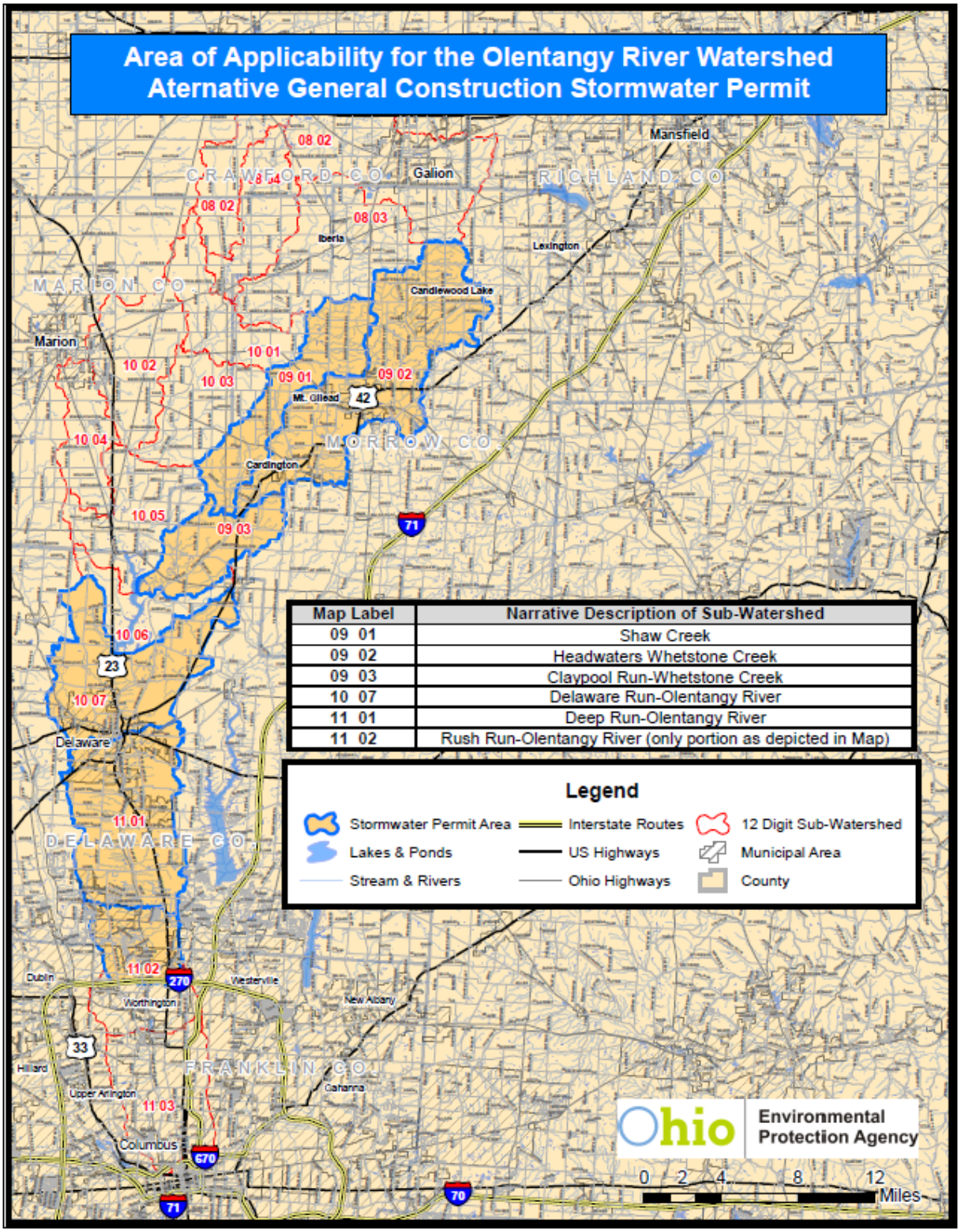
The mitigation required for intrusion into the riparian setback of an **intermittent stream** shall be ~~four (4)~~ two (2) times the total area disturbed within the riparian setback of the site being developed shall be mitigated within any zone of the watershed of the immediate receiving stream~~; or two (2) times the total area disturbed within the riparian setback shall be mitigated within the watershed of the immediate receiving stream, and the entire required setback of the site shall be protected in perpetuity by binding conservation easements or environmental covenants.~~

The mitigation required for intrusion into the streamside buffer of a **jurisdictional ephemeral stream** shall be ~~two (2)~~ one (1) times the total area disturbed within the riparian setback of the site being developed shall be mitigated~~; or one (1) times the total area disturbed within the riparian setback shall be mitigated within the watershed of the immediate receiving stream, and the entire required setback of the site shall be protected in perpetuity by binding conservation easements or environmental covenants.~~

All mitigation shall, at a minimum, include conserved or restored setback zone, and should be designed to maximize the ecological function of the mitigation. Including mitigation at the stream edge along with associated setback areas is one way to maximize ecological function. Mitigation shall be protected in perpetuity by binding conservation easements or environmental covenants which must be recorded within 6 months of permit authorization for the Olentangy mainstem, perennials, and intermittent streams. The City and OEPA will consider drainage easements as mitigation for ephemeral streams if the language is approvable by both entities and the drainage easement meets the intent of protecting the water quality of the stream perpetually. Granting of binding conservation easements or environmental covenants protected for land outside of disturbed area, but within a required riparian setback counts towards required mitigation. Likewise, granting of easements or covenants over land outside of riparian setbacks, in itself, counts towards required mitigation as long as the land provides ecological or water quality benefit to be evaluated on a case-by-case basis by the City and Ohio EPA.

Mitigation may also be satisfied by approved pooled mitigation areas and in-lieu fee sponsored mitigation areas. Mitigation resulting from State or Federal environmental regulations may be adjusted in recognition of these requirements.

Appendix B Attachment A Applicable Portions of the Olentangy Watershed



A more detailed map can be viewed at:
https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/stormwater-program

Appendix B Attachment B

Part 1 Stream Assessment

This assessment will determine if a stream is considered a previously channelized, low-gradient headwater stream (a drainage ditch may be a natural stream that has been channelized and can be restored) which would be applicable for stream restoration in lieu of protecting an outer 'no build' setback as per Appendix B B.2i. and ii.

In the event the assessment of the stream meets all the criteria listed below, restoration as depicted in Part 2 of this attachment or natural channel design could be performed, provided 401/404 permits are authorized, and may be a means of reducing the setback distance required by B.2.i. (Appendix B).

Previously Modified, Low-Gradient Headwater Streams shall, for the purposes of this permit, be defined as having all of the following characteristics:

- Less than 10 square miles of drainage area;
- Low gradient and low stream power such that incision (down-cutting) is not evident;
- Entrenched such that the ratio of the frequently flooded width to the bankfull width is less than 2.2; and
- Straight with little or no sinuosity present such that the ratio of the bankfull channel length to the straight-line distance between two points is less than 1.02.

Part 2 Restoration

Restoration shall be accomplished by any natural channel design approach that will lead to a self-maintaining reach able to provide both local habitat and watershed services (e.g. self-purification and valley floodwater storage).

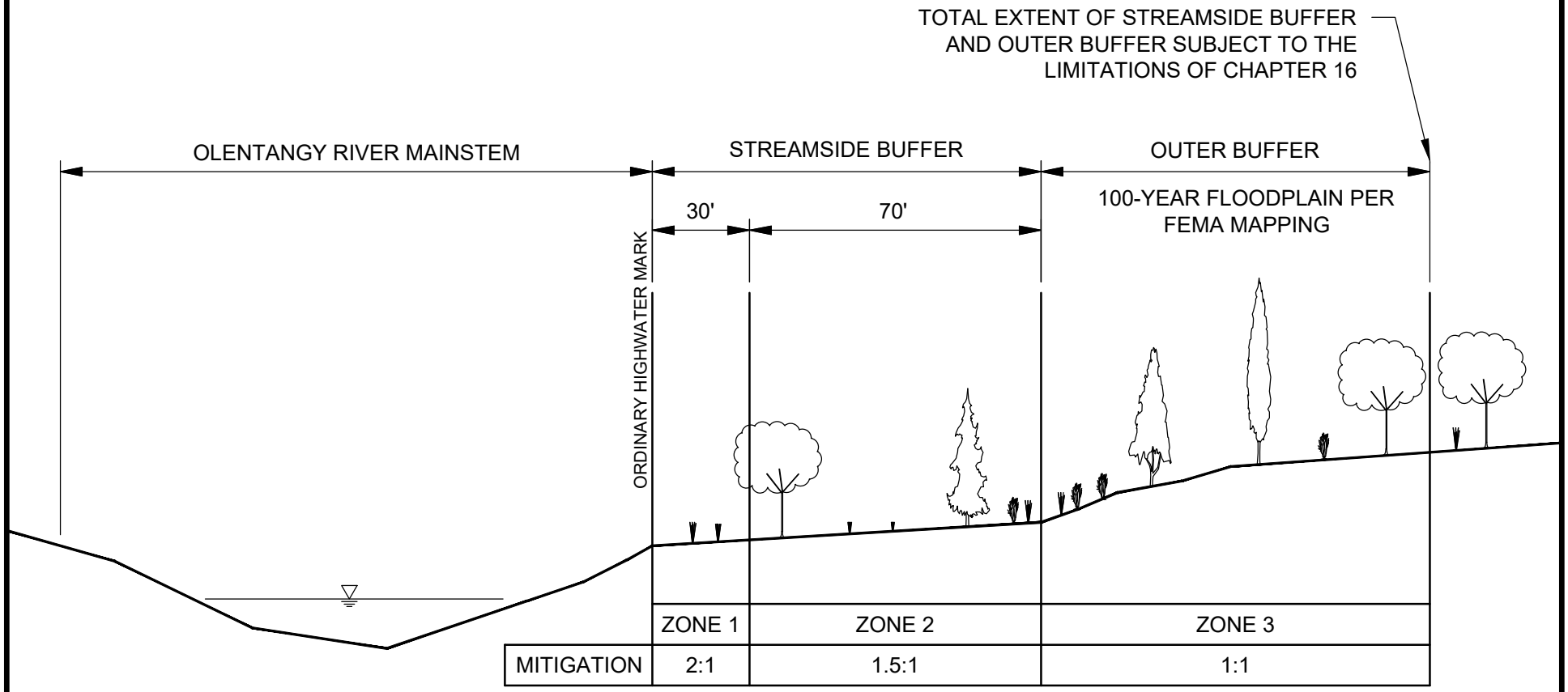
a. Construction of a floodplain, channel and habitat via natural channel design;
b. Floodplain excavation necessary to promote interaction between stream and floodplain;
c. Include a water quality setback of 100 feet from top of the streambank on each side.

The primary target shall be a frequently flooded width of 10 times the channel's self-forming width. Five times the self-forming channel width may be acceptable if sufficient elements of natural channel design are included in the restoration project.

Appendix C. Rainfall Intensity for Calculation of Water Quality Flow (WQF)

DURATION t_c (minutes)	WATER QUALITY INTENSITY [i_{wq}] (inches/hour)	DURATION t_c (minutes)	WATER QUALITY INTENSITY [i_{wq}] (inches/hour)
5	2.37	33	0.95
6	2.26	34	0.93
7	2.15	35	0.92
8	2.04	36	0.90
9	1.94	37	0.88
10	1.85	38	0.86
11	1.76	39	0.85
12	1.68	40	0.83
13	1.62	41	0.82
14	1.56	42	0.80
15	1.51	43	0.78
16	1.46	44	0.77
17	1.41	45	0.76
18	1.37	46	0.75
19	1.33	47	0.74
20	1.29	48	0.73
21	1.26	49	0.72
22	1.22	50	0.71
23	1.19	51	0.69
24	1.16	52	0.68
25	1.13	53	0.67
26	1.10	54	0.66
27	1.07	55	0.66
28	1.05	56	0.65
29	1.03	57	0.64
30	1.01	58	0.64
31	0.99	59	0.63
32	0.97	60	0.62

Note: For t_c < 5 minutes, use i = 2.37 in/hr; for t_c > 60 minutes, use i = 0.62 in/hr. For all other t_c, use the appropriate value from this table.



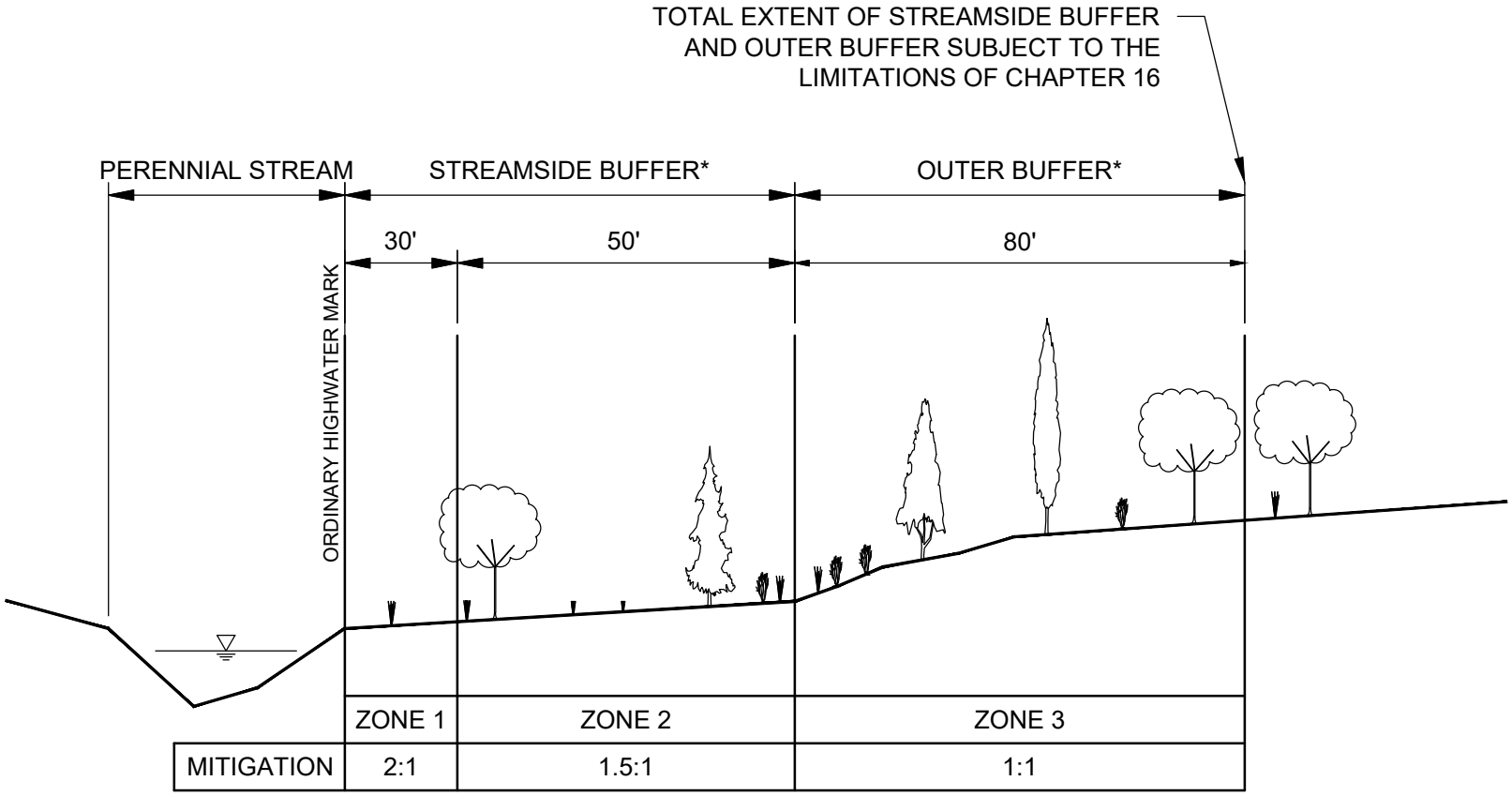
EST 1808
CITY OF
DELAWARE
OHIO

CONSTRUCTION STORMWATER PERMIT

OLENTANGY RIVER MAINSTEM RIPARIAN SETBACK

FIGURE 1

REV. 6/1/2023



*OR PER TOTAL RIPARIAN SETBACK
PER CHAPTER 16 (EQUATION 1
APPENDIX B ON PAGE 58 OF 63)

PERENNIAL STREAMS FLOW AT LEAST 9 MONTHS OF THE TYPICAL CLIMATE YEAR

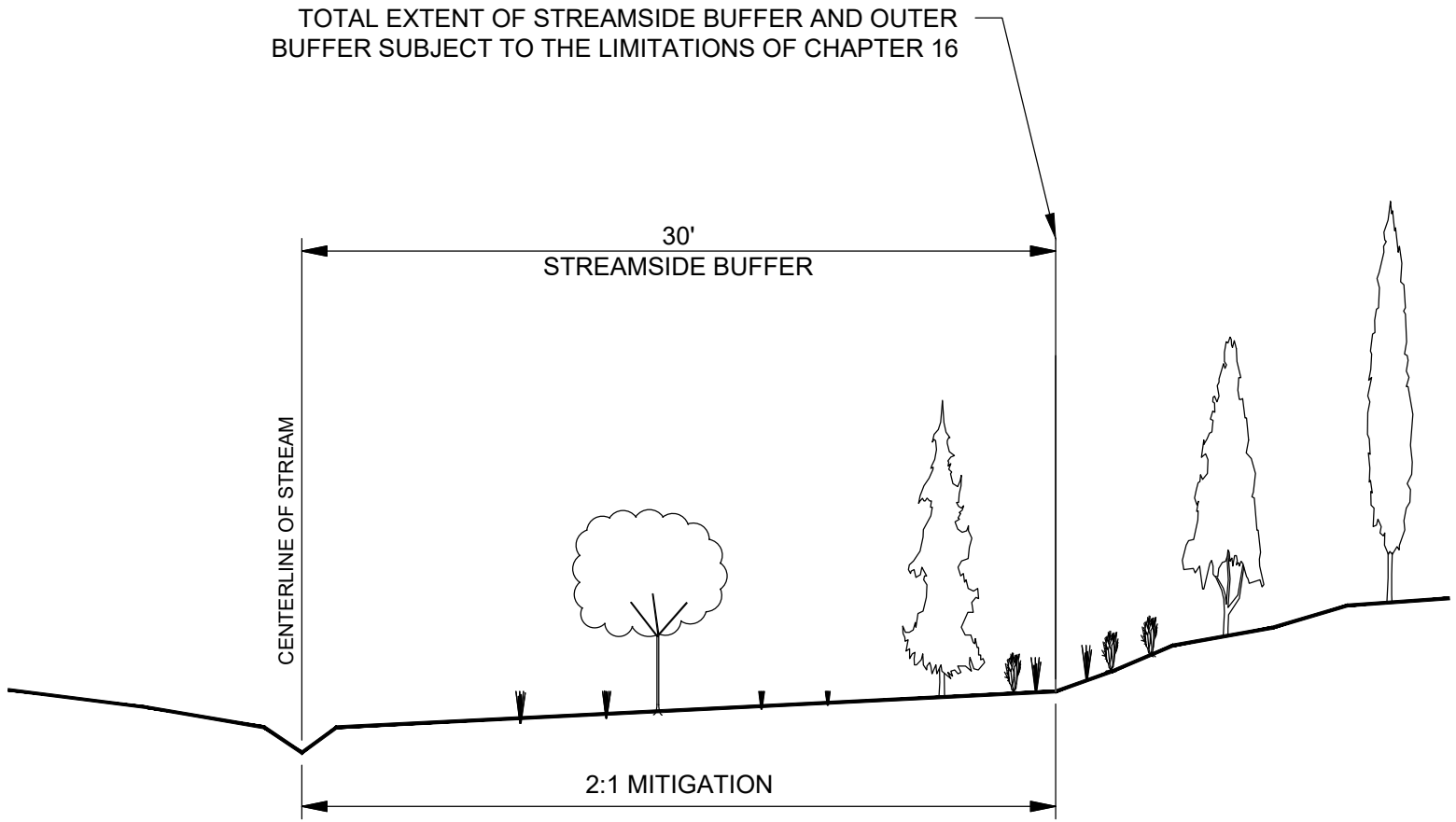
EST 1808
CITY OF
DELAWARE
OHIO

CONSTRUCTION STORMWATER PERMIT

PERENNIAL STREAMS
RIPARIAN SETBACK

FIGURE 2

Rev. 6/1/2023



INTERMITTENT STREAMS FLOW FOR LESS THAN 9 MONTHS OF THE TYPICAL CLIMATE YEAR

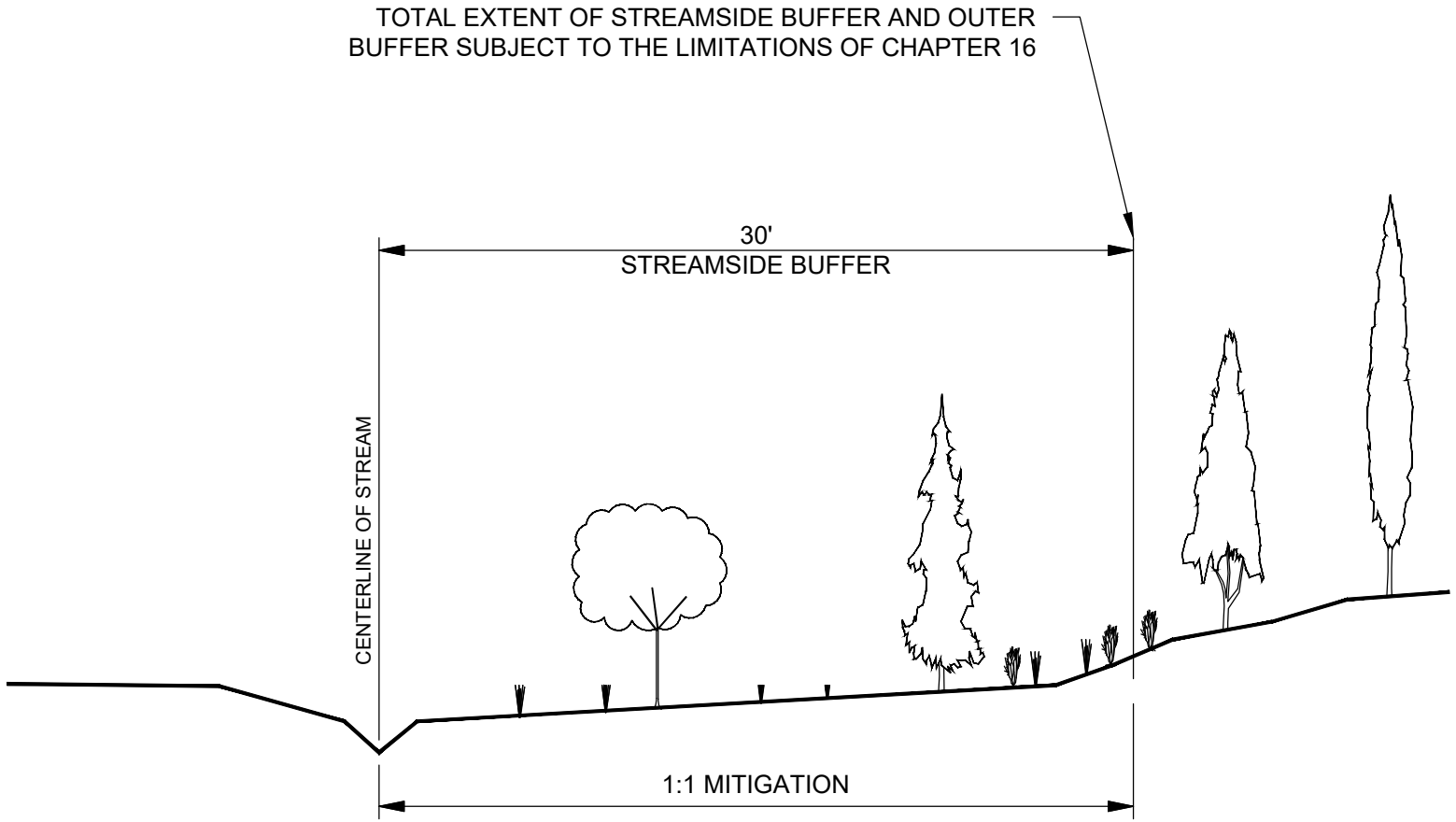
EST 1808 CITY OF DELAWARE OHIO

CONSTRUCTION STORMWATER PERMIT

INTERMITTENT STREAMS RIPARIAN SETBACK

FIGURE 3

Rev. 6/1/2019



EPHEMERAL STREAMS FLOW ONLY IN RESPONSE TO STORM EVENTS

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DELAWARE
OHIO

CONSTRUCTION STORMWATER PERMIT

JURISDICTIONAL EPHEMERAL STREAMS RIPARIAN SETBACK

FIGURE 4

Rev. 6/1/2023

N

0 2000 4000

SCALE: 1" = 2,000'

DELAWARE LAKE

NORRIS RUN

HORSESHOE RUN

CLEAR RUN

SUGAR RUN

SUGAR RUN

DELAWARE RUN

MILL RUN

WEISER RUN

U.S. 23

OLENTANGY RIVER

U.S. 36/SR 37/SUNBURY RD

U.S. 42

PERENNIAL STREAM

SOURCE OF BACKGROUND MAP
USGS The National Map: Nataional Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrogrpahy Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitrarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed October 2018.

EST 1808 CITY OF DELAWARE OHIO

CONSTRUCTION STORMWATER PERMIT
CITY OF DELAWARE, OHIO & SURROUNDING AREAS
PERENNIAL STREAMS

FIGURE 5

REV. 6/1/2019

S:\ENGINEERING\ENGINEERING DEPARTMENT\STANDARDS AND SPECIFICATIONS\2023-06-01 CH16 UPDATE\CADD EXHIBITS\STREAMS EXHIBIT.DWG - 5/31/2023 4:06:40 PM

Chapter 17: Erosion Control/Water Quality

(NPDES Phase II Requirements)

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1. NPDES Construction Storm Water General Permit (CGP) Requirements 2
2. Minimum Standards 2
3. Storm Water Pollution Prevention Plan 3
4. Sublots 4
5. Final Stabilization 4

1. NPDES Construction Storm Water General Permit (CGP) Requirements

The CGP requires an SWP3 to be completed prior to the submittal of a Notice of Intent (NOI) application to obtain coverage under the CGP. The SWP3 contents are described in Part III of the CGP. The City of Delaware requires that the SWP3 and a sediment and erosion control plan be approved by the City prior to initiation of construction activities. The SWP3 does not need to be submitted to Ohio EPA to obtain coverage under the CGP. However, it must be retained at the construction site at all times during the construction activity.

2. Minimum Standards

The City of Delaware, Ohio has developed a Storm Water Management Plan that identifies Best Management Practices (BMPs) which satisfy the Phase II of the National Pollutant Discharge Elimination System (NPDES) Construction Storm Water General Permit which is overseen by the Ohio Environmental Protection Agency (OEPA).

The Public Works Department staff is responsible for administration of the Phase II NPDES Storm Water Program as related to Commercial and Residential Land Development as well as Capital Improvement Projects. The staff inspects the drainage and erosion control on construction projects throughout the City of Delaware to ensure that surface waters are not contaminated by sediment and runoff from construction sites. The department coordinates waterway and stormwater permits for the construction activity done by other city departments.

A Storm Water Pollution Prevention Plan (SWP3) must be submitted to the Public Works Department for all construction projects in the City of Delaware as a part of the plan approval process. A SWP3 must address all minimum components of the NPDES Construction Storm Water General Permit and conform to the specifications of the latest edition of the Rainwater and Land Development Manual. This manual describes Ohio's standards for storm water management, land development, and urban stream protection. To obtain a copy of this manual, contact the Ohio Department of Natural Resources (ODNR), Division of Soil and Water Conservation at (614) 265-6610.

The OEPA checklist is another resource to help ensure that the SWP3 is complete can be found at the OEPA, Division of Surface Water, Storm Water's website:
http://www.epa.state.oh.us/dsw/storm/swp3_cgp_checklist2.pdf

3. Storm Water Pollution Prevention Plan

The SWP3 shall contain the following items:

- A Plan Narrative (the instruction boxes as well as any non-applicable sections should be deleted from the template)
- Calculations for sediment settling ponds (Sediment settling ponds are required for all land disturbances of 10 acres or greater or where the design capacity of silt fence or inlet protection has been exceeded.)
- Settlement pond outlet structures and details.
- General Location Map
- Site Maps / Erosion Control Plan and Detail Sheets showing location and design of BMPs
- A Copy of the State of Ohio Construction General Permit (downloadable from the OEPA website)
- Signed Notice of Intent (NOI) and Acknowledgement Letter from OEPA
- Blank Notice of Termination form (NOT)
- Inspection Reports issued by the City of Delaware and OEPA
- Corrective Action Log
- SWP3 Amendment Log or Modification Report
- Designation of Signatory Authorization
- Delegation of Authority Form
- General Contractor Certification
- Subcontractor Certifications/Agreements
- BMP Implementation Schedule
- Project Stabilization Schedule
- Grading and Stabilization Activities Log
- Training Log
- Project Rainfall Logs
- Construction Site Notice
- Reportable Quantity Release Form
- Any additional pertinent information (i.e., Endangered Species and Historic Preservation Documentation)
- Final Stabilization / Termination Checklist

4. Sublots

For residential or commercial developments with sublots, NPDES permit coverage must be continued on every lot until the lot achieves final stabilization as defined in Part VII of the CGP. For developments with a centralized control (i.e., sediment settling ponds or inlet protection), which receives drainage from multiple lots, the developer may be required to maintain the centralized control until all of the homes are built with the land temporarily stabilized.

- If a developer either decides or is required to maintain permit responsibility on lots where structures are being built, the developer's SWP3 must include a detailed drawing of a typical sublot showing standard best management practices (BMPs) with notes specifying measures for critical areas that must be included in the SWP3.
- If a developer opts to transfer permit responsibility to the new lot owner or operator building the structure (homebuilder) once the lot is sold, the new lot owner must submit an Individual Lot Notice of Intent (Individual Lot NOI) application at least 7 days prior to initiating construction activities. The developer must allow the new lot owner access to the developer's SWP3. The new owner must then maintain and/or install any lot specific sediment controls and develop a site map indicating the location of the BMPs. Once the Individual Lot NOI is processed, the new lot owner is responsible for complying with the CGP on his or her lot.

5. Final Stabilization

Once a construction site reaches final stabilization, a permittee must submit a Notice of Termination (NOT) form to Ohio EPA within 45 days of completion of all permitted land disturbance activities. A NOT form can only be submitted when one or more of the following conditions are met:

- Final stabilization (as defined in Part VII of the CGP) has been achieved on all portions of the site for which the permittee is responsible (including, if applicable, returning agricultural land to its pre-construction agricultural use);
- Another operator(s) has assumed control over all areas of the site that have not been finally stabilized;
- For residential construction only, temporary stabilization has been completed and the lot, which includes a home, has been transferred to the homeowner. (Note: individual lots without housing which are sold by the developer must undergo final stabilization prior to termination of permit coverage.); or
- An exception has been granted under Part III.G.4 of the CGP.

Chapter 18: Water and Sewer Service Policy

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It is the mission of the City of Delaware to provide potable water and sanitary sewer service within its service area.

1. **Annexation Agreement**

   Agreement to annex into the City of Delaware is required to receive water or sewer service, unless a separate agreement is in place.

2. **Service and Fees**

   To receive sewer or water service, an application for connection must be submitted to the Planning and Community Development Department. Upon approval, a capacity fee (including any additional applicable fees) must be paid. Sewer and water line extensions from existing City lines to the building are the customer's responsibility.

3. **Rates**

   Sewer and water rates are paid on a monthly basis and adjusted annually. Current rates and application instructions are provided on the City's website at www.delawareohio.net.

4. **Non-Resident Customers**

   Customers whose property is not currently within the corporate boundaries of the City are required to pay a 50% surcharge on monthly rates until the property is annexed.

5. **Establishing Connection**

   To connect to City sewer, a connection to City water must be established as the City bases sewer billing on water meter readings. For customers who are currently connected to DelCo Water and wish to connect to City sewer, an arrangement must be made for the City to collect water meter readings from DelCo for sewer billing purposes – At such time that City water is available, connection must be made to City water, subject to DelCo approval. City water customers are required to connect to City sewer when such service is available and within 500 feet of the property, per Codified Ordinance 917.08-b. Should a more current ordinance be established that will be the required basis of design and practice.

6. **Oversizing**

   Line sizes may need to be larger than the minimums required by the water model to be in conformance with the City's proposed master water distribution plan sizes. Waterlines extended through the site that are oversized to accommodate future service areas may qualify for a cost contribution from the City at the discretion of the City Manager. The rate of contribution is 1.25 times the difference in material costs only.

7. **Capacity Fees**

   The Chief Building Officer is to collect water and sanitary sewer capacity fees at the time of issuance of a building permit. The Utility Fees Calculation Worksheet was developed to facilitate the calculation of these fees and is to be submitted to the Department of Public Utilities for approval prior to the issuance of a building permit by the Chief Building Official.

   A. Collection of Water Capacity Fees

      City Codified Ordinance 913.20 provides for the collection of Water Capacity Fees. The water capacity fee is five thousand six hundred fifty dollars ($5,650) per EDU effective

from and after January 1, 2007. Should a more current ordinance be established that will be the required basis of design and practice.

1. No person shall make a service connection to the City's water system or any part thereof, unless a permit to do so has been issued by the City.
2. All properties connecting to the City of Delaware water system shall be assigned an Equivalent Dwelling Unit (EDU), or multiple thereof, with one (1) EDU being equal to average daily water consumption of 400 gallons.
    a. All single-family residential properties connecting to the water system are assigned one (1) EDU.
    b. All master metered multi-family residential properties connecting to the water system shall be assigned, by the Public Utility Director (Director), an EDU multiple calculated by multiplying the number of multi-family residential units by the Single Family Equivalent value that follows:

Single-Family Equivalent Values	
1 bedroom	0.63
2 bedrooms	0.75
3 bedrooms	0.88
4 + bedrooms	1.0

    c. All properties connecting to the water system which are not residential properties are to be assigned by the Director, an EDU multiple based upon the properties' estimated daily water consumption (in gallons) divided by 400 gallons (one EDU). This division will be calculated to the second decimal place and rounded according to mathematical convention. In no event shall a non- residential property be assigned an EDU of less than one (1).
3. The EDU multiple established for non-residential properties based on estimated water consumption shall be reviewed twelve (12) months after occupancy is obtained to determine if the estimated daily water consumption is accurate. The Director may extend this 12-month time period if accurate consumption data is not available. Any increase or decrease in the EDU multiple based on actual water consumption which results in a capacity fee charge adjustment of more than one thousand dollars ($1,000) shall be communicated to the property owner in writing. Any additional capacity fee charge or any refund of a previously paid capacity fee charge shall be made within forty-five (45) days of the date of the amended EDU determination letter. An owner may contest the amended EDU assigned to the property by filing an appeal with the Director within forty-five (45) days of the date of the amended EDU determination letter. The appeal shall be in writing and shall state the grounds for the appeal. The Director shall cause an appropriate investigation to be made to determine whether an adjustment of the EDU multiple for the property is warranted. The appellant shall be notified in writing of the Director's determination with respect to the appeal and any resulting adjustment in the amount of the capacity fee charge. Any additional capacity fee charge or any refund of a previously paid capacity fee charge shall be made within forty-five (45) days or the date of the Director's written response to the appellant.

4. The water utility system capacity fee charge for all properties connecting to the water system which are not residential properties and whose estimated daily water consumption is greater than 50,000 gallons per day shall be determined based on an evaluation made of the specific impact on the water utility system for said connection.
5. Existing customers or new water connection permits issued for properties located outside of the City limits will be charged the above mentioned fee on condition that the owner of the property to be served shall, within sixty days of the time said property becomes contiguous to the City of Delaware, prepare and file or join in the preparation and filing of an annexation petition pursuant to Ohio Revised Code 709.02 for such property to be annexed to the City of Delaware. The failure of any such non-resident water customer to comply with this condition shall be grounds for immediate termination of water service to the property. This provision may be waived by the City Manager, with the concurrence of City Council, upon a finding of the existence of a specific necessity.
6. In the event a meter is enlarged, the difference between the charges for the two meter sizes shall be paid.

B. Collection of Sanitary Sewer Capacity Fees

City Codified Ordinance 917.21 provides for the collection of Sanitary Sewer Capacity Fees. The sanitary sewer capacity fee is five thousand three hundred eighty-five dollars ($5,385) per EDU which shall be effective from and after June 1, 2006. Should a more current ordinance be established that will be the required basis of design and practice.

1. No person shall make a service connection to the City's sanitary sewer system or any part thereof, unless a permit to do so has been issued by the City.
2. All properties connecting to the City of Delaware sanitary sewer system shall be assigned an Equivalent Dwelling Unit (EDU), or multiple thereof, with one (1) EDU being equal to average daily water consumption of 400 gallons.
    a. All single-family residential properties connecting to the sanitary sewer system are assigned one (1) EDU.
    b. All master metered multi-family residential properties connecting to the sanitary sewer system shall be assigned, by the Public Utility Director (Director), an EDU multiple calculated by multiplying the number of multi-family residential units by the Single Family Equivalent value that follows:

Single-Family Equivalent Values	
1 bedroom	0.63
2 bedrooms	0.75
3 bedrooms	0.88
4 + bedrooms	1.0

    c. All properties connecting to the sanitary sewer system which are not residential properties are to be assigned by the Director, an EDU multiple based upon the properties' estimated daily water consumption (in gallons) divided by 400 gallons (one EDU). This division will be

calculated to the second decimal place and rounded according to mathematical convention. In no event shall a non- residential property be assigned an EDU of less than one (1).

3. The EDU multiple established for non-residential properties based on estimated water consumption shall be reviewed twelve (12) months after occupancy is obtained to determine if the estimated daily water consumption is accurate. The Director may extend this 12-month period if accurate consumption data is not available. Any increase or decrease in the EDU multiple based on actual water consumption which results in a capacity fee charge adjustment of more than one thousand dollars ($1,000) shall be communicated to the property owner in writing. Any additional capacity fee charge or any refund of a previously paid capacity fee charge shall be made within forty-five (45) days of the date of the amended EDU determination letter. An owner may contest the amended EDU assigned to the property by filing an appeal with the Director within forty-five (45) days of the date of the amended EDU determination letter. The appeal shall be in writing and shall state the grounds for the appeal. The Director shall cause an appropriate investigation to be made to determine whether an adjustment of the EDU multiple for the property is warranted. The appellant shall be notified in writing of the Director's determination with respect to the appeal and any resulting adjustment in the amount of the capacity fee charge. Any additional capacity fee charge or any refund of a previously paid capacity fee charge shall be made within forty-five (45) days or the date of the Director's written response to the appellant.
4. Existing customers or new sanitary sewer connection permits issued for properties located outside of the City limits will be charged the above mentioned fee on condition that the owner of the property to be served shall, within sixty days of the time said property becomes contiguous to the City of Delaware, prepare and file or join in the preparation and filing of an annexation petition pursuant to Ohio Revised Code 709.02 for such property to be annexed to the City of Delaware. The failure of any such nonresident wastewater customer to comply with this condition shall be grounds for immediate termination of sanitary sewer service to the property.
5. In the event a meter is enlarged, the difference between the charges for the two meter sizes shall be paid.
6. Special Sanitary Sewer Fee Districts: The City of Delaware has two special sanitary fee districts. The districts are known as the Southeast Highland Sewer Project and The South Central Delaware Sewer Project. The special sanitary fees are in addition to normal capacity fees. Nothing in either agreement shall waive or mitigate the normal tap fee charges or other City associated sewer fees as to each structure, building, parcel, or lot in the specified tributary areas.
    a. The South East Highland Sewer Project: The City and Developers of subdivisions within the City have pursuant to various agreements established Sanitary Sewer Equivalent Residential Unit (ERU) fees to help offset the construction of the Southeast Highland Sewer Project. Pursuant to City of Delaware Resolution No. 05-75, the Equivalent Residential Unit (ERU) Fee for all units served by the Southeast Highland Sewer is $3200.00. The Chief Building Officer is to collect payment of

the ERU fees as directed by the City Manager at the time of issuance of a building permit for each lot affected by said agreements.

b. The South Central Delaware Sewer Project: Upon being notified by an owner of a subject premises in the sewer tributary area, the City or the City Building and Inspection Department will notify the Delaware County Bank and Trust Company of the name and address of the owner. The Delaware County Bank and Trust Company will contact the potential sewer user and notify them of the deed requirements, execute a Sewer Extension and Cost Reimbursement Agreement and collect the reimbursement fee based on the formula outlined in the South Central Delaware Phase V Sanitary Trunk Sewer Agreement. Preparation of all deed and agreements shall be at the expense of the potential sewer user.

Chapter 19: Water Distribution

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1. Administrative Policy

A. Waterlines shall be designed and operated in accordance with all applicable Local, State and Federal codes, rules and regulations.

B. All water line in the City of Delaware are to be public and centered within a 15-ft wide (minimum) easement outside of the public right of way. Waterlines should be a minimum of 20 feet from the closest part of any structure.

C. All public waterlines require an OEPA PTI prior to construction. The PTI application can be filled out by the Consultant, however, the City must be listed as the Owner (and Applicant) of the water main, and the Utility Director must review and sign the application prior to submission to the OEPA. The City does not participate in the concurrent review process with the OEPA for PTIs. The OEPA water supply number for the City of Delaware is 2100311.

D. Private waterlines are permitted only as approved by the City and are to be constructed to the same public standards.

E. Developers are required to extend waterlines to adjacent property lines, at their own expense, in order to provide for future service area.

F. The City of Delaware requires the use of Ductile Iron Pipe (DIP), for all public water mains. Ten (10) inch in diameter waterline is not permitted. For water mains 12" in diameter and smaller, AWWA C909 polyvinyl chloride (PVC) pipe with cast iron pipe dimensions (CIOD) and Pressure Class 235 may be used as an alternative to DIP.

G. The decision of using a master meter shall be determined by the Public Works Department with agreement from the Department of Public Utilities.

H. All commercial, industrial and institutional water services must incorporate an ASSE 1013 RPP device in a hot box (regardless of access or distance from the road) Grading and installation details are required on all meter pits for services greater than 2-inches.

I. Meter pits, where approved, shall be within 100-ft of the right-of-way.

J. A minimum six-inch meter is required if fire hydrants are being served through the meter.

K. A Chart with State Plane Coordinates including blank columns for as-built information (coordinates) for all main line valves and fire hydrants must be provided in the plan set.

2. Backflow Prevention Policy

A. All new commercial/industrial/institutional sites shall incorporate an ASSE #1013 Reduced Pressure Principle Backflow Preventer after the meter as a containment backflow device on the domestic water service. This is required, regardless of degree of hazard associated with current use, with no exceptions. All ASSE #1013 containment devices must be installed downstream of the meter in a location approved by the Public Utilities Department. Additional backflow isolation devices may still be required depending on what processes are taking place in the facilities for the protection of those within the building, but the distribution system will remain protected regardless.

B. Any renovation of an existing commercial, industrial, or institutional facility shall include the installation of an ASSE #1013 device on the domestic water line after the meter as part of the renovation process, regardless of degree of hazard associated with current use. The Planning Department should notify the Public Utilities Department of

all renovations as they are occurring so that the Backflow installations can be included into the backflow database.

C. No meters shall be placed inside the buildings on new construction. All meters shall be in pits or vaults outside. The water lines will be public to the curb valve or 60' from the water main and copper is required to the meter with one meter and one backflow device per building.

D. All outside hose bibs must have a hose connection vacuum breaker installed.

E. All backflow containment devices must be approved by the Public Utilities Department as to type and location of installation and installed in a horizontal position between 12" to 48" off the floor with test cocks readily accessible for testing purposes. An ASSE 1013 or 1047 device shall not be installed in a pit. All ASSE 1020 or 1021 devices used for irrigation shall not have a shut off valve after the device. If any chemicals are used in the irrigation system (i.e. antifreeze) an ASSE 1013 device is required.

F. Existing homes wanting to use well or cisterns for outside watering shall install backflow prevention devices to prevent contamination of the public main by well or cistern water.

3. General Water Line Requirements

All water lines shall be installed in accordance with the standards outline in the Great Lakes - Upper Mississippi River Board (GLUMRB) of State and Provincial Public Health and Environmental Managers, Recommended Standards for Water Works, Current Edition.

A. Air Relief Valves: At high points in water mains 12-inch diameter and larger where air can accumulate, provisions shall be made to remove the air by means of hydrants or manual air relief valves.

B. Blocking: All tees, bends, plugs, and hydrants shall be provided with reaction blocking and tie rods, or joints designed to prevent movement. Tie rods shall be coated with two coats of bitumastic material equal to Inertol No. 49 thickness.

C. Cover: The minimum cover shall be 48 inches. Excessive bury depth is to be avoided.

D. Separation of Water Mains and Sewers: Water mains shall be laid at least 10-feet horizontally from any existing or proposed sanitary sewer, force main, or storm sewer. The distance shall be measured edge to edge.

E. Crossings: Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18-inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe should be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

F. Pipes: All public water mains greater than 2-inches in diameter shall be ductile iron pipe or polyvinyl chloride pipe as specified herein. K-copper may be used for lines 2-inches in diameter or less. The minimum pipe size for new water mains shall be 6-inches.

G. Stream Crossings

1. Above-water crossings: The pipe shall be adequately supported and anchored, protected from vandalism, damage, and freezing, and accessible for repair or replacement.

2. Underwater crossings: A minimum cover of five feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided; The pipe shall be of special construction, having flexible, restrained or welded watertight joints; Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding; Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

4. Hydrant Testing Requirements

When it is necessary to test flow an existing hydrant for the purposes of determining the capacity of the water distribution system as specific locations, the following minimum data shall be collected and provide the City when submitting such analysis.

A. Effective Point (location of hydrant GPS coordinates)

B. Test point (hydrant) elevation

C. Date of test

D. Who performed the test

E. Static Pressure, psi

F. Residual Pressure, psi

G. Flow (pitot) pressure, psi

H. Hydrant Flow, gpm

I. Fire flow corrected to a 20 psi residual pressure

J. Residual pressure corrected to a 2250 gpm flow

K. Elevation of the water storage tank at time of test

5. Modeling Process

A. A water distribution model is required for all developments served by new mainline extensions. If the development is on an existing main, at a minimum, fire service calculations are required to verify the adequacy of the existing line proposed to be tapped.

B. The water model must be signed and sealed by the Ohio Registered Professional Engineer of record.

C. Multiple analyses should be performed using the Maximum Daily Flow (MDF) without fire flows as well as the Peak Hour Flow without fire flows in order to determine pressures and flows at nodes throughout the system. Once the area of lowest pressure is identified, the fire flow should be added at multiple areas to determine the worst case scenarios under those conditions. The analysis should include pressures and demand flows throughout the system. This process shall be documented in the report summery.

D. Check that the correct elevation used for water in the tank and that the model calibrated from the flow metering point (hydrant) back to the tie-in point. Evaluate the critical point(s) of the model. This point(s) should be described and defended in the report summary and is most likely a dead end or the point furthest from the tie-in.

E. It is City of Delaware policy to promote looping and redundant sources of water in the event of a major failure in one main line.

F. Hazen-Williams coefficient should be between 120-140 (130 is typical for ductile iron). A lower coefficient must be used if minor losses are not accounted for in the model. As the system ages, the Hazen-Williams coefficient should be reduced to account for deterioration in the hydraulic capacity of the pipe.

G. Pressures and Flow Requirements

1. Minimum residual pressure: 20 psi
2. Minimum Static Pressure: 35 psi
3. Average Daily Flow (ADF)
4. Single Family 400 gpd
5. Multi-Family 300 gpd
6. Retail 0.2 gpd per 1.0 sq ft of floor space
7. Demand can be calculated flows based on AWWA design standards or historical data for commercial and industrial users. Additionally, the values in Table 12 for estimating the demand of various facilities in the water model.
8. Maximum Daily Flow (MDF) is 2.0 times the Average Daily Flow (ADF)
9. Peak Hour Demand Factor is 3.0.
10. Meet Fire Flows Requirements in this guide and the current edition of the Ohio Fire Code whichever is greater.

H. Water Tap Sizing: It is the responsibility of the engineer to determine the appropriate service tap size and metering arrangement to meet both the domestic and fire suppression needs of each development. Table 19-1 lists typical sizes for various developments.

Table 19-1: Tap Sizes for Building Type

Residential Building Service Tap Size

Number of Units	Minimum Service Size
Single Family	3/4-Inch
Two (2) Family Units	1-Inch
Three (3) through Six (6) Family Units	1 1/2-Inch
Seven (7) through Twelve (12) Family Units	2-Inch

* This chart is based on the City of Columbus Water Service Manual. (2004 ed.)

Table 19-2: Water Usage for Planning

WATER USAGE SUGGESTED GUIDE *		
PLACE	Gallons/Day	**OCCUPANCY**
Apartments / Condominiums	300	per unit
Assembly Halls	2	per seat
Bowling Alleys (no food service)	75	per lane
Churches (small)	3 - 5	per sanctuary seat
Churches (large with kitchen)	5 – 7	per sanctuary seat
Country Clubs	50	per member
Dance Halls	2	per person
Drive-in Theaters	5	per car space
Factories (no showers)	25	per employee
Factories (with showers)	35	per employee
Food Service Operations		
Ordinary Restaurant (no 24 hour)	35	per seat
24 – Hour Restaurant	50	per seat
Banquet Rooms	5	per seat
Restaurant along Freeway	100	per seat
Tavern (very little food service)	35	per seat
Curb service (drive-in)	50	per car space
Vending Machine Restaurants	100	per seat
Homes in Subdivisions	400	dwelling
Hospitals (no resident personnel)	300	per bed
Institutions (residents)	100	per person
Laundries (coin operated)	400	per standard size machine
Mobile Home Parks	300	per mobile home space
Motels	100	per unit
Nursing and Rest Homes	150	per patient
Nursing and Rest Homes	100	per resident employee
Nursing and Rest Homes	50	per non-resident employee
Office Buildings	20	per employee
Recreational Vehicle Parks and Camps	125	per trailer or tent space
Retail Store	20	per employee
Schools		
Elementary	15	per pupil
High School and Junior High	20	per pupil
Service Stations	1000	first bay or pump island
	500	additional bay or pump island
Shopping Centers (no food service or laundries)	0.2	per 1-sq. ft. of floor space
Swimming Pools (average)	3 – 5	per swimmer
With Hot Water Showers	5 – 7	per swimmer
Travel Trailer Parks and Camps	125	per trailer or tent space
Vacation Cottages	50	per person
Youth and Recreation Camps	50	per person

*From the Ohio EPA publication Guidelines for Design of Small Public Water Systems, 1991.

6. City of Delaware Elevated Water Storage Tanks Data

A. Cheshire Road (Southeast Highlands) Elevated Water Tank (Fluted)

1. Storage available: 2 MG
2. Overflow Elevation: 1100.0-ft
3. Minimum Water Elevation (bottom of the bowl): 1060.0-ft
4. Typical Operating Elevation: 1090.0-1094.0-ft
5. Diameter of Bowl: 100.0-ft
6. Existing Ground Elevation: 941.0-ft
7. Outlet Pipe (Ductile Iron): 16.0-in

B. Sunbury Road (East Side) Elevated Water Tank (Fluted)

1. Storage available: 1 MG
2. Overflow Elevation: 1100.0-ft
3. Minimum Water Elevation (bottom of the Bowl): 1060.0-ft
4. Typical Operating Elevation: 1085.0 – 1100.0-ft
5. Diameter of Bowl: 100.0-ft
6. Existing Ground Elevation: 933.0-ft
7. Outlet Pipe (Ductile Iron): 16.0-in

C. London Road (West Side) Elevated Water Tank (Fluted)

1. Storage available: 1 MG
2. Overflow Elevation: 1100.0-ft
3. Minimum Water Elevation (bottom of the Bowl): 1160.0-ft
4. Typical Operating Elevation: 1085.0 – 1100.0-ft
5. Diameter of Bowl: 100-ft
6. Existing Ground Elevation: 940.0-ft
7. Outlet Pipe (Ductile Iron): 16-in

Note: All elevations are based on NAVD 88

7. Fire Suppression

A. All plans shall be reviewed by the Fire Chief or his representative for the purpose of insuring compliance with applicable Local, State and federal Fire Codes, Rules and Regulations for hydrant spacing, area fire flows, and fire vehicle access. Plans will be drafted with sufficient detail to allow the reviewer to determine code compliance. Approved plans shall be on file prior to the start of construction. Plans that are altered or revised after initial approval shall be resubmitted for review and approval.

B. On commercial buildings if a post indicating valve is installed it must be monitored by the Fire Alarm Control Panel. NFPA 13 requires that on each source of water supply a post indicating valve be installed. The key is the valve must be listed and it must be a listed indicting valve. The sprinkler supply and hydrant water pass through a meter pit with a backflow preventer with two Outside Screw and Yoke Valves. If these two valves

are indicating valves then the code is satisfied. These two valves will have to be monitored by the Fire Alarm Control Panel.

8. Fire Hydrants - General Requirements

A. All fire hydrants are to be installed a minimum of 40-ft away from any building and outside the "collapse zone" whichever is greater.

B. Fire hydrants shall be located in the center of the frontage of any proposed lot.

C. A fire hydrant is required within 50-feet of any roadway intersection.

D. Fire Hydrants adjacent to roadways are to be located 2-ft off the back of curb or 8-ft off edge of pavement for uncurbed roads. Hydrants should not be located in the flowline of any drainage ditch.

E. All fire hydrants shall be first line hydrants and shall conform to the requirements of the latest City specifications adopted by the American Water Works Association. The hydrants shall be manufactured by the Mueller Company (Safety Flange Model) or the M & H Valve and Fittings Company (Traffic Model). Hydrants shall have a main valve opening at least five inches in diameter; two, two and one-half (2-1/2) inch hose nozzles and a four and one-half inch pumper nozzle with bronze National Standard male threads. Public fire hydrants are to be painted with 2 coats of Federal Safety yellow, Sherwin Williams B54Y37 per COD 1507.08(A)(1). Private fire hydrants are to be painted Federal Safety Red and White caps and bonnets per COD 1507.14(B) (4). Hydrants that are part of an industrial looped system (served by a pumping station) shall be painted all Federal Safety Red. All hydrants are to be fitted with a 5-inch Stortz fitting with a quick connect coupling. All hydrants shall be installed with watch valves mechanically connected directly to the hydrant and adjusted to finished grade

F. The location of fire hydrants on both public and private property shall be approved by the Fire Chief before a building permit is issued. Any deviation from the approved location of any new fire hydrant shall be approved by the Fire Chief or his authorized representative.

G. The minimum size water line to serve a hydrant shall be six (6) inches. An eight (8) inch water main is required if the line is dead-ended and exceeds 600 feet in length, the line serves more than two hydrants, or serves one hydrant and a standpipe system.

H. The finished grade for fire hydrants shall not be less than eighteen inches from the center of the four and one-half outlet. The Hydrant Flange elevation is to be 2-inches above finished grade

I. The direction the outlets face shall be approved by the Fire Chief or his authorized representative. In General the largest outlet shall face the adjacent street or driveway.

J. Upon completion of new water main and fire hydrant installations, the Fire Department shall be notified and the contractor will demonstrate to the Fire Chief, or his authorized representative, that all main valves and fire hydrant valves are open. If it becomes necessary for the contractor to close any main or hydrant valves after he has demonstrated to the Fire Chief, or his authorized representative, that they are open, he shall notify the Fire Department so that the above procedure may be repeated, insuring that all fire hydrants and mains are placed back in service.

9. Fire Hydrant Spacing

A. Where a condition exists in a development area with more than one Ohio Building Code Use Group, the greater requirements shall apply.

B. The maximum hydrant spacing shall be 300 feet, with one hydrant provided within 150 feet from the terminus of any dead end street for Industrial Development-Use Groups F and H; Commercial Development-Use Groups R-1, A, B, E, I, M, and S; Multi-family Development-Use Groups R-2, R-3, and Multi-single Family:

C. The maximum distance between adjacent fire hydrants is 400 feet, with one fire hydrant provided within 200 feet of the terminus of dead-end streets for Single-Family Development use Group R-4.

D. The distance from fire hydrants to buildings, or parts thereof, shall be the unobstructed distance as measured by hose laid from fire apparatus within a paved surface.

E. A minimum of two public fire hydrants must be within 500 feet of every building or part thereof. If the spacing requirements cannot be accomplished, on-site fire hydrants shall be provided and the following spacing requirements shall prevail: A minimum of one fire hydrant shall be within 300 feet of every building or part thereof, with a minimum of one additional hydrant within 500 feet of every building or part thereof.

F. Fire hydrants shall be located and/or protected from possible mechanical damage. The means of protection shall be arranged in such a manner which will not interfere with the connection to, operation of, and the maintenance of hydrants. Bollards used to protect hydrants shall be at least three feet from the hydrant on all sides. Fire hydrants shall be located so as not to be obstructed by parking spaces, dumpsters, signs, mailboxes, utility poles, bushes, and any other structures and materials.

G. Fire hydrants shall be located on all public streets and required fire apparatus access roads.

H. Existing fire hydrants on public streets are allowed to be considered as available for new development. Existing hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extended between the properties and easements are established to prevent obstructions of such roads.

I. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000-feet. A hydrant shall be provided within 50-feet of all street intersections, public and private.

10. Fire-Flow Requirements

A. Per City of Delaware Ordinance 07-85, the procedure for determining fire-flow requirements for commercial and residential buildings shall be in compliance with the most current addition of the State of Ohio Fire Code. Should a more current ordinance be established that will be the required basis of design and practice.

B. The minimum acceptable residual pressure available for firefighting is 20 psi.

C. One- and Two-Family Dwellings: The minimum fire-flow for one- and two-family dwellings having an area less than 3,600 square feet is 1,000 gpm. The fire-flow and duration for dwellings with an area greater than 3,600 square feet is specified in the Fire Flow Table. A reduction of 50% is allowed when the dwelling is equipped with an approved automatic sprinkler system, as approved by the Fire Chief.

D. Buildings other than one- and two-family dwellings: For buildings other than one- and two-family dwellings the fire-flow and duration time is specified in the Fire Flow Table. A reduction of 75% is allowed when the dwelling is equipped with an approved automatic sprinkler system, as approved by the fire chief. The resulting fire-flow shall not be less than 1,500 gpm for the duration specified in the Fire Flow Table.

E. The floor area, measured in square footage, is to be used to determine the required fire flow. The calculation area shall be the total floor area of all floor levels within the exterior walls and horizontal projection of the roof of a building. Area separated by firewalls without openings and constructer per the International Building Code, are allowed to be considered as separate fire-flow calculation areas. For Type I-A and Type I-B construction, the area for the three largest successive floors shall be used for the area calculation. Exception; For open parking garages the area of the largest floor shall be used.

F. Construction Types: All buildings are classified according to their construction type. Type I is least combustible and Type V is most combustible. The more combustible a building is and the more hazardous the use is, the more the maximum allowable area is limited. All construction types and use groups are allowed to have increased areas by using sprinklers. Below is a brief summary of Construction Types. For a complete and more detailed description please consult the International Building Code.

    1. Type I (I-A or I-B): Typically these are concrete frame buildings made of noncombustible materials. All of the building elements (structural frame, bearing walls, floors and roofs) are fire resistance rated.

    2. Type II (II-A or II-B): These buildings are constructed of noncombustible materials. Typically these are masonry bearing wall structures with steel studs for walls and steel bar joists for floor and roof structures. II-A has fire rated building elements (structural frame, bearing walls, floors, and roofs). II-B is the most common construction type for commercial buildings because the building elements are not required to be fire resistance rated but still must be non-combustible.

    3. Type III (III-A or III-B): Type III construction permits the exterior walls to be of noncombustible materials and the interior building elements of any material permitted by the code (combustible or non-combustible). This is typical of buildings with masonry bearing walls and wood roofs or floors. Fire-retardant-treated wood framing shall be permitted within exterior wall assemblies of a 2-hour rating or less.

    4. Type IV (IV-A or IV-B): Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. Fire-retardant-treated wood framing shall be permitted within exterior wall assemblies with a 2-hour rating or less. This construction is not common in Ohio except perhaps in some worship facilities.

    5. Type V (V-A or V-B): Type V construction is typically wood frame construction. V-A requires fire rated assemblies for all building elements (structural frame, bearing walls, floors, and roofs); this is often seen in older construction that predates sprinklers but still not commonly used. V-B is very common because it does not require any fire rating.

Table 19-3: FIRE-FLOW CALCULATION AREA (square feet)

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
TYPE IA & IB	TYPE II-A & II-B	TYPE IV & V-A	TYPE II-B & III-B	TYPE V-B		
0 - 22,700	0 – 12,700	0 – 8,200	0 – 5,900	0 – 3,600	1,500	2
22,701 - 30,200	12,701 – 17,000	8,201 – 10,900	5,901 -7,900	3,601 -4,800	1,750	
30,201 – 38,700	17,001 – 21,800	10,901 – 12,900	7,901 – 9,800	4,801 – 6,200	2,000	
38,701 – 48,300	21,801 – 24,200	12,901 – 17,400	9,801 – 12,600	6,201 – 7,700	2,250	
48,301 – 59,000	24,201 – 33,200	17,401 – 21,300	12,601 – 15,400	7,701 – 9,400	2,500	
59,001 – 70,900	33,201 – 39,700	21,301 – 25,500	15,401 - 18,400	9,401 – 11,300	2,750	
70,901 – 83,700	39,701 – 47,100	25,501 – 30,300	18,401 – 21,800	11,301 – 13,400	3,000	3
83,700 – 97,700	47,100 – 54,900	30,301 – 35,200	21,801 – 25,900	13,401 – 15,600	3,250	
97,701 – 112,700	54,901 – 63,400	35,201 – 40,600	25,901 – 29,300	15,601 – 18,000	3,500	
112,701 – 128,700	63,401 -72,400	40,601 – 46,400	29,300 – 33,500	18,001 – 20,600	3,750	
128,701 – 145,900	72,401 – 82,100	46,401 – 52,500	33,501 -37,900	20,601 – 23,300	4,000	4
145,901 – 164,200	82,101 - 92,400	52,501 – 59,100	37,901 – 42,700	23,301 – 26,300	4,250	
164,201 – 183,400	92,401 -103,100	59,101 – 66,000	42,701 – 47,700	26,301 – 29,300	4,500	
183,401 – 203,700	103,101 – 114,600	66,001 – 73,300	47,701 -53,000	29,301 – 32,600	4,750	
203,701 – 225,200	114,601 – 126,700	73,301 – 81,100	53,301 – 58,600	32,601 – 36,600	5,000	
225,201 – 247,700	126,701 – 139,400	81,101 – 89,200	58,601 – 65,400	36,601 – 39,600	5,250	
247,701 – 271,200	139,401 – 152,600	89,201 – 97,700	65,401 -70,600	39,601 – 43,400	5,500	
271,201 – 295,900	152,601 – 166,500	97,701 – 106,500	70,601 – 77,000	43,401 – 47,400	5,750	
295,901 - Greater	166,501 - Greater	106,501 – 115,800	77,001 – 83,700	47,401 – 51,500	6,000	
--	--	115,801 – 125,500	83,701 – 90,600	51,501 – 55,700	6,250	
--	--	125,501 – 135,500	90,601 – 97,900	55,701 – 60,200	6,500	
--	--	135,501 – 145,800	97,901 – 106,800	60,201 – 64,800	6,750	
--	--	145,801 – 156,700	106,801 – 113,200	64,801 – 69,600	7,000	
--	--	156,701 – 167,900	113,201 – 121,300	69,601 – 74,600	7,250	
--	--	167,901 – 179,400	121,301 – 129,600	74,601 -79,800	7,500	
--	--	179,401 – 191,400	129,601 -138,300	79,801 -85,100	7,750	
--	--	191,401 – Greater	138,301 - Greater	85,101 – Greater	8,000	

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Chapter 20: Sanitary Sewer (SAS) Design

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The following design parameters are derived mainly from the Great Lakes and Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers: (GLUMRB) Recommended Standards for Wastewater Facilities, a reference manual widely known as "Ten State Standards." In addition, requirements of the City of Columbus Sanitary Sewer Design Manual and current City of Delaware policy are included in this section.

1. Administrative Policy

A. All sanitary sewers serving more than one building are to be public.

B. All public SAS require an OEPA PTI prior to construction. The PTI application can be filled out by the Consultant, however, the COD must be listed as the Owner (and Applicant) of the sewer, and the Utility Director must review and sign the application prior to submission to the OEPA. The COD does not participate in the concurrent review process with the OEPA for PTIs.

C. Whenever possible, all SAS should be located outside of right of way centered within Utility Easements granted to the City. Minimum easement width for SAS is 20 feet for standard installations. Deeper and/or larger sewers may require wider easements.

D. Developers are required to extend SAS through their site, at their own expense, in order to provide for future upstream tributary area service connections.

E. SAS lift stations will not be permitted without written permission from the City. In the event a lift station is permitted, and the station will serve a single-entity ownership development, the lift station shall be considered privately owned and maintained. However, the lift station still must be built to public standards. If the lift station serves multiple ownership developments, the lift station shall be considered public, and will be maintained the City. The public designation does not preclude the City from assessing a monthly maintenance fee to such organizations as homeowner's associations. Lift stations are not common enough in the City to publish standards and specifications for their design. Requirements for lift stations will be developed by the Public Works Department and approved by the Department of Public Utilities on a case-by-case basis.

F. Temporary holding tanks will not be permitted in areas capable of being served by City sanitary sewer system. In the event a temporary holding tank is necessary to serve a property while a SAS is being built, the Owner must first obtain permission from the Utility Director, OEPA, and the Delaware County General Health District.

G. Aerial sewers and inverted siphons (if deemed appropriate by the Director of Public Utilities) shall be designed per OEPA and Ten State Standards.

H. When SAS are proposed in the vicinity of any water supply facilities, requirements of the GLUMRB Recommended Standards for Water Works must be used to confirm acceptable isolation distances in addition to the following requirements.

I. The sub-divider shall provide the City with all required OEPA submittals and pay all OEPA review fees.

2. Technical Requirements

A. SAS must maintain a minimum separation of 20 feet from any part of any building or structure. More foundation separation may be required for deeper SAS.

B. SAS shall be constructed on the opposite side of the street from water lines in new subdivisions.

C. SAS may be built under proposed residential subdivision streets if the Developer can absorb the cost of compacted granular backfill (COC Item 912 – no exceptions) for the entire trench depth, and only by City approval on a case-by-case basis.

D. SAS must maintain a minimum separation of 10 feet from all water lines and stormwater management systems (i.e., sewers, channels, etc.) SAS should not be aligned under any part of a detention/retention facility. If no other feasible alternative exists, then SAS near these facilities and the water pipe and/or storm pipe must be specified as slip-on or mechanical joint pipe complying with potable water supply requirements and be pressure tested to 150 psi to assure water tightness prior to backfilling.

E. All water supply structures (public and private) within 200 feet of a proposed sewer must be highlighted and shown on the plans

F. All SAS mains must be kept at an elevation to provide basement gravity service to the entire tributary area, regardless of the proposed development plan (generally, 10-foot minimum depth). A critical horizontal/vertical alignment to the end of the tributary boundary may be required as part of any development, in order to determine the appropriate depth of the SAS through a proposed development.

G. State Plane Coordinates must be provided for all manholes in a tabular format. Provide blank columns for coordinates to be entered as part of the conversion to Record Drawings.

H. Buoyancy of sewers shall be considered and the flotation of the pipe shall be prevented with appropriate design considerations wherever high groundwater conditions are anticipated.

3. Manholes

Manholes are required at the following locations:

A. Change in pipe slope, size, or alignment

B. Change in pipe material

C. At intermediate intervals not exceeding 400 feet

D. Upstream of all service connections (i.e. no stubs with service connections)

E. At the end of a sewer stub greater than 50 feet in length (even if no services are proposed into the stub)

F. Manholes for proposed sewers are to be pre-cast and the appropriate size per the City of Delaware Standard Drawings.

G. Manholes over existing flexible SAS 8 to 12 inches in diameter shall be Type C with flexible connections. Otherwise, manholes over existing SAS shall be Type E manholes (cast-in-place base) unless otherwise approved by the City.

H. Manhole bases shall provide a minimum of 0.1 foot drop between the inlet and outlet pipes.

I. Sewers entering proposed manholes 2-feet or more above the invert of the manhole must be designed with an outside drop per Standard Drawings.

J. Proposed sewers entering existing manholes 2-feet or more above the invert of the manhole shall be designed with an inside drop per the Standard Drawings. Only one inside drop is allowed per manhole for accessibility reasons.

K. Drops within the 0.5 to 2.0 feet range should be avoided in the design as they are undesirable from a maintenance standpoint. Avoid such drops by adjusting the grade of the run of sewer to enter the manhole, or design the drop to be greater than 2.0 feet and specify an outside drop. It is understood that 0.5 to 2.0 foot drops cannot always be avoided when attempting to match pipe crowns. Under these circumstances, the invert shall be filleted to prevent solids deposition. A note should appear on the plans to this effect.

L. Cleanouts are not permitted on SAS mains.

M. Manhole castings must be 1 foot above the 100-year floodplain elevation.

4. Materials/Bedding/Backfill

A. SAS pipe materials shall be per COC CMS Section 900.

B. Flexible sewers are subject to deflection testing requirements per COC CMS Section 900. Rigid pipe should be considered when the SAS must be put into use soon after installation.

C. When flexible SAS is deeper than 20 feet, PVC SDR 26 must be specified for pipe and fittings.

D. Bedding per COC Standard Drawings. Type of bedding must be specified in the quantities table.

E. COC Item 912 (compacted granular material) is required full depth of the trench under pavement and up to the pavement influence line (when not directly underneath pavement). See RDWD Standard Drawings for definition of pavement influence line. Vertical limits of the Item 912 must be shown in profile view.

F. Large aggregate backfill material (No. 4 stone) is not an acceptable alternative to Item 912.

G. Outside of the pavement influence, but within ROW or easements, COC Item 911 is the backfill requirement.

H. If neither Item 911 nor 912 requirements apply, then backfill must be compacted to 95% (Standard Proctor) within +/- 2% of optimum moisture content.

I. If a flexible sewer is required to be encased in concrete, it must be encased from structure to structure.

J. The decision to jack-n-bore versus open cut a roadway for sewer installation will be made by the City Engineer on a case-by-case basis. Criteria that affect the decision are ADT, roadway width, number of lanes, pavement condition, etc. Reference the Standard Drawings for a jack-n-bore casing detail.

K. Trench dams shall be installed between each pair of manholes utilizing native compacted clay soil or Benonite Clay material. No granular bedding is permitted at the locations of trench dams.

5. Capacity

A. The minimum diameter for any SAS main is 8-inch; The minimum diameter for any SAS lateral is 6-inch.

B. If velocities exceed 15 feet/second, special provisions shall be made to protect against displacement by erosion and impact.

C. SAS on 20% slopes or greater shall be anchored per Ten States Standards

D. When smaller sewers outlet into larger sewers, attempt to match 0.8 D

E. Reduction in pipe size in the downstream direction will not be permitted regardless of the slope of the downstream pipe.

F. SAS should not be oversized in order to accommodate flatter design slopes.

G. SAS design shall utilize the following hydraulic design criteria:

Table 20-1:

Sanitary Sewer Hydraulic Design Criteria

Pipe Diameter (Inches)	**Minimum Grade (%)**
8	0.4
10	0.28
12	0.22
14	0.17
16	0.14
18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
36	0.046
Population Density	12 capita/acre*
Average Sanitary Flow	120 gpd/capita OR 600 gpd/acre for select areas
Greenspace Factor	10%
Peaking Factor (P = population in thousands)	$\frac{18+\sqrt{P}}{4+\sqrt{P}}$
I/I Allowance	969.5 gpd/acre
Minimum Velocity	2.0 feet/second
Manning's "n" value	0.013 (all materials)
Peak Flow	(Peaking factor) x (Avg. Flow)
Design Flow	Peak flow + I/I Allowance
Design Capacity	**Flowing Full %**
8"-15"	50
18"-27"	75
30" and up	92

** For areas of greater population density of 12 persons per acre, the design flow shall be determined on a basis of population instead of area.*

6. Services

A. No services into manholes, or within 8 feet of a manhole.

B. Service schedule must be provided on the plans showing: stationing, riser height, length, and end of service elevation.

C. All wyes must have a minimum 2-foot riser or extension to reduce the risk of future damage to the SAS main.

D. The length of riser called out in the plan view/service schedule shall be the distance from the pipe invert to a point +/- 9 feet below the existing or proposed ground surface, whichever is higher. This means the Quantities table does not have to match the sum of the riser heights in the plan view/service schedule.

E. Services under new subdivision streets shall be paired per the Standard Drawings.

F. Cleanouts should be specified every 100 feet on a service.

G. Services must extend at least 2 feet beyond other buried utilities.

7. Stream and Utility Crossings

A. SAS crossing open channels must be designed to cross as nearly perpendicular to the channel as possible. Also, stream crossings are to be kept to an absolute minimum within a development.

B. The depth from the channel bed to the crown of the pipe shall be a minimum of 4 feet. Trench backfill shall be in accordance with COC Item 911, with the exception of the upper portion of the trench which must be per COC Item 919 (Watercourse Erosion Protection).

C. If the above requirement cannot be met, 6-inch concrete encasement on all sides of the pipe will be required for all pipe materials. A special detail of the encasement must be included in the plans.

D. All additional requirements as set forth by the OEPA for the stream crossing must be strictly adhered to.

E. Where the SAS crosses under a proposed storm sewer or water line (and minimum clearance is maintained), specify COC Item 912 backfill to the bottom of the storm sewer or water line.

F. Sewers crossing other buried utilities shall be designed and laid to provide a minimum vertical distance of 18 inches (measured from outside of pipe to outside of pipe). The crossing shall be arranged such that the sewer joints are equidistant and as far away as possible from the other utility (especially for crossings of water mains and storm sewers). If it is impossible to meet the 18-inch clearance requirement, then the SAS shall be designed and constructed equal to water main pipe and shall be pressure tested at 150 psi to assure water tightness prior to backfilling.

G. In the rare case where a SAS crosses over a water main, adequate structural support must be provided for the sewer to maintain line and grade. A special detail must be included in the plans. Either the water main or the SAS may be enclosed in a casing pipe which extends 10 feet on both sides of the crossing (measuring perpendicular to the water main). The carrier pipe shall be ductile iron.

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INFRASTRUCTURE DESIGN MANUAL

APPENDICES

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INFRASTRUCTURE DESIGN MANUAL

APPENDIX A
PLAN REVIEW FEES FORM

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EST 1808 CITY OF DELAWARE OHIO

Public Works Department
PLAN REVIEW FEES FORM

DATE:

440 E. William St.

Issued to the Finance Department for Invoice

PROJECT: **PROJECT NO:**

PLAN REVIEW FEES

Traffic Study:				NON-COMPLEX	$	1,500.00	☐
				COMPLEX	$	3,500.00	☐
Storm Water Management Plan:				LEVEL - I	$	700.00	☐
				LEVEL - II	$	3,500.00	☐
				LEVEL - III	$	7,500.00	☐
				SUB-TOTAL:	$		-
Residential Developments:	$350/Sheet	**X**	_____	Sheets (Sanitary)	=	$	-
Residential Developments:	$350/Sheet	**X**	_____	Sheets	=	$	-
Commercial Developments:							
0 to 5 acres	$350/Sheet	**X**	_____	Sheets	=	$	-
>5 to 15 acres	$400/Sheet	**X**	_____	Sheets	=	$	-
>15 to 75 acres	$450/Sheet	**X**	_____	Sheets	=	$	-
>75 acres	$550/Sheet	**X**	_____	Sheets	=	$	-
Off-Site Infrastructure:	$350/Sheet	**X**	_____	Sheets (Sanitary)	=	$	-
Off-Site Infrastructure:	$350/Sheet	**X**	_____	Sheets (Watermain)	=	$	-
Off-Site Infrastructure:	$350/Sheet	**X**	_____	Sheets (Storm)	=	$	-
				INITIAL REVIEW FEE:	$		-

Additional Reviews: (>3 submissions) 10% x initial cost each

0.10 **X** _____ (submissions) **X** $ - (initial cost) = $ -

Plan Changes: (After Approval) $250/each

$250 **X** _____ = $ -

SUB-TOTAL:	$		-
TOTAL PLAN REVIEW FEES:	**$**		**-**

Listing of Plan Changes (Revisions)

Rev. No.	Description

NOTE:

1. The City of Delaware shall determine the level of complexity for both the Stormwater Management Plan and the Traffic Impact Study

2. Sheet crunching is prohibited.

3. Fees are not waived for cover sheets, note sheets, etc.

***Form is in accordance with the Fee Schedule establish by City Code and Codified Ordinance 18-114*

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INFRASTRUCTURE DESIGN MANUAL

APPENDIX B
DESIGN EXCEPTION REQUEST FORM

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Public Works Department
DESIGN EXCEPTION REQUEST

Project: _____ **Date Submitted:** _____

A. Design Stage

☐ Conceptual Plan ☐ Preliminary Plan ☐ Final (Construction Drawings)

B. Describe in detail the exception being requested with references to the current design guide/code. If requesting more than one exception, please number each exception.

C. Provide justification for each exception requested above.

By sealing below, I acknowledge that I have provided justification above for each exception requested:

Submitted By:

_____
Design Engineer (please type or print)

_____ _____
Signature Date

Engineer Seal:

Approval Conditions:

Approval By:

Reviewing Engineer	Date
Deputy City Engineer	Date
Approving Director	Date

Notice: This design exemption request is valid for 24 months from the date of the Approving Director signature. Final engineering plan approval and signed mylar shall be completed within this timeframe

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APPENDIX C
STORM SEWER UTILITY RATE CALCULATION SHEET

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EST 1808 CITY OF DELAWARE OHIO

440 E. William St.

Public Works Department
STORM SEWER UTILITY RATE
CALCULATION SHEET

Date:

This form is to be completed by the applicatant and resubmitted to Public Works Department in .xls format

Project Name: _____

Address: _____

Parcel Number (s): _____

Sumbitted by: _____ **of** _____

IMPERVIOUS AREA CALCULATION

A) Total Roof Area: _____ SF

B) Total Sidewalk Area: _____ SF

C) Total Parking Area: _____ SF

D) Total Driveway Area: _____ SF

E) Total Impervious Area (A+B+C+D): _____ SF

EQUIVALENT RESIDENTIAL UNIT (ERU)

Total Area(E) ÷ 2,773 SF = ERUs

_____ / 2773 SF = _____ ERUs

NOTE: An 11 x 17 scaled site drawing(s) must be provided with impervious areas delineated by rooftop, sidewalk, parking, driveway, and gravel areas.

FOR OFFICE USE ONLY:

☐ No Credits Applicable: Base Rate per Month = $2.50

☐ 25% Detention/Retention Credit: Base Rate per Month = $1.88

☐ 50% Direction Discharge Credit: Base Rate per Month = $1.25

ANNUAL UTILITY FEE CALCUATION

FEE = BASE RATE per MONTH x 12 MONTHS x TOTAL ERUs

FEE = _____ x 12 x _____

FEE = _____ **PER YEAR** which will be _____ **PER MONTH**

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INFRASTRUCTURE DESIGN MANUAL

APPENDIX D
STANDARD LAYERS FOR DXF FILES

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Appendix D: Standard Layers for DXF files

GIS Template Standard Layers				
Layer #	**Layer Name**	**Line Type**	**Color**	**Layer Description**
0	0		white	
1	BRIDGES-MAJOR	Line Segment	yellow	Bridges with spans over 25-ft
2	BRIDGES-MINOR	Line Segment	yellow	Bridges with spans under 25-ft
3				
4	ESMT-TEXT	Text	cyan	Type of Easement (Utility, Transportation, Drainage, Etc.)
5	ESMT-UTIL	Closed Polyline	cyan	Easement for Utilities, Wildlife, Transportation, Drainage, Etc
6				
7	HYDRO-DITCH-CL	Polyline	151-Blue	Ditch or Swale Centerline
8	HYDRO-FLOODPLAIN	Closed Polyline	151-Blue	Flood Plane Boundary
9	HYDRO-FLOODWAY	Polyline	151-Blue	Flood Way
10	HYDRO-LIN1	Polyline	151-Blue	Linear Hydrogaphy, Creeks/Streams
11	HYDRO-NAM1	Text	151-Blue	Hydrographic Feature Name
12	HYDRO-POL1	Closed Polyline	151-Blue	Polygonal Hydrogaphy, Lakes/Ponds Water Surface
13	HYDRO-WETLAND	Closed Polyline	151-Blue	Wetlands
14				
15				
16	PAR-BLDG1	Closed Polyline	cyan	Building / Structure Outline or Footprint
17	PAR-COMAREA1	Closed Polyline	cyan	Public areas such as street islands/community entrances
18	PAR-LOT-DIM	Text	cyan	Bearings, Distances, Acreage, and x/y of POB
19	PAR-LOT-NUM1	Text	cyan	Proposed Lot Number
20	PAR-PARCEL1	Closed Polyline	cyan	Parcel / Lot Boundaries
21	PAR-PARKINGLOT	Closed Polyline	yellow	Parking Lots
22	PAR-SETBK-BLD	Polyline	cyan	Building Setback Line
23	PAR-SETBK-BUFF	Closed Polyline	cyan	Buffers (riparian setback, vegetation buffers, etc)
24	PAR-SETBK-PRK		cyan	Parking Setback Line
25	PAR-SUBD-BDY	Text	cyan	Subdivision Boundary
26	PAR-SUBDIV1	Closed Polyline	cyan	Subdivision Boundaries
27	PAR-SUB-NAM1	Text	cyan	Subdivision Name
28	PAR-TREES	Point	cyan	Existing or Added Trees

Layer #	Layer Name	Line Type	Color	Layer Description
29				
30	RAIL	Polyline	cyan	Railroads
31	RAIL-NAM1	Text	cyan	Railroad name
32				
33				
34	RDWY-BIKEPATH	Polyline	yellow	Multipurpose Recreational Trails
35	RDWY-CL1	Polyline	yellow	Street/Road centerlines (paved and unpaved)
36	RDWY-CURB	Polyline	yellow	Curb and gutter
37	RDWY-EDGEPAV1	Closed Polyline	yellow	Edge of Pavement
38	RDWY-NAME1	Text	yellow	Street Name
39	RDWY-NAME2	Text	yellow	Road Number (Federal, State, County highways, Etc.)
40	RDWY-PAVTYP1	Text	yellow	Annotation describing pavement type (Concrete, Asphalt, Gavel, etc.)
41	RDWY-SIDEWLK1	Line Segment	yellow	Sidewalks (including ramps, if any)
42				
43				
44	ROW1	Closed Polyline	cyan	Rights of way delineating private/public land boundary
45				
46	SAS-LFST	Point	green	Sanitary Sewer Lift Stations
47	SAS-LINE	Line Segment	green	Sanitary Sewer Lines
48	SAS-STRUCTURE	Point	green	Sanitary Sewer Manholes and Cleanouts
49	SAS-TEXT	Text	green	Annotation describing Sanitary Network
50				
51	STM-LINE	Line Segment	13	Storm Sewer Line, Culverts, Etc
52	STM-STRUCTURE	Point	13	Storm Sewer Structure (Manhole, Curb Inlet, Catch Basin, Etc.)
53	STM-TEXT	Text	13	Annotation describing storm drainage network
54				
55	SURVEY-GCP1	Point	magenta	Ground control points (existing, surveyed, or GPS'd)
56				
57	TOPO-CTOUR1	Polyline	white	Un-broken Contour Lines(*design/as-built)
58	TOPO-CTOUR2	Polyline	white	Index Contour Lines (every 5-ft)
59	TOPO-TEXT	Text	white	Contour Elevation Label
60				
61	TRAFFIC-BOX	Point	magenta	Traffic Signal Boxes / Ped Heads
62	TRAFFIC-COND	Polyline	magenta	Traffic Signal Conduits for control boxes, cameras, etc

Layer #	Layer Name	Line Type	Color	Layer Description
63	TRAFFIC-LOOP	Closed Polyline	magenta	Loop Detectors
64	TRAFFIC-POLE	Point	magenta	Traffic Signal Poles
65				
66				
67	UTLY-CTV	Line Segment	30-Orange	Cable TV
68	UTLY-ELECTR	Line Segment	red	Electrical Lines
69	UTLY-FIBER1	Line Segment	30-Orange	Fiber Optic Datacom Conduits and Lines
70	UTLY-FIBER-STR	Line Segment	30-Orange	Fiber Optic Datacom Pull Boxes
71	UTLY-GAS	Line Segment	yellow	Natural Gas Line
72	UTLY-POLE1	Point	cyan	Lamp poles, Power Poles, Etc
73	UTLY-TELCO	Line Segment	30-Orange	Phone Lines
74				
75				
76	WTR-FH	Point	blue	Fire Hydrants
77	WTR-LINE	Line Segment	blue	Water Lines
78	WTR-NODE	Point	blue	Valves and Junction Boxes
79	WTR-TEXT	Text	blue	Annotation describing Water Distribution Network
80				

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EST 1808
CITY OF
DELAWARE
OHIO

INFRASTRUCTURE DESIGN MANUAL

APPENDIX E
LADDER TRUCK TURNING PERFORMANCE ANALYSIS

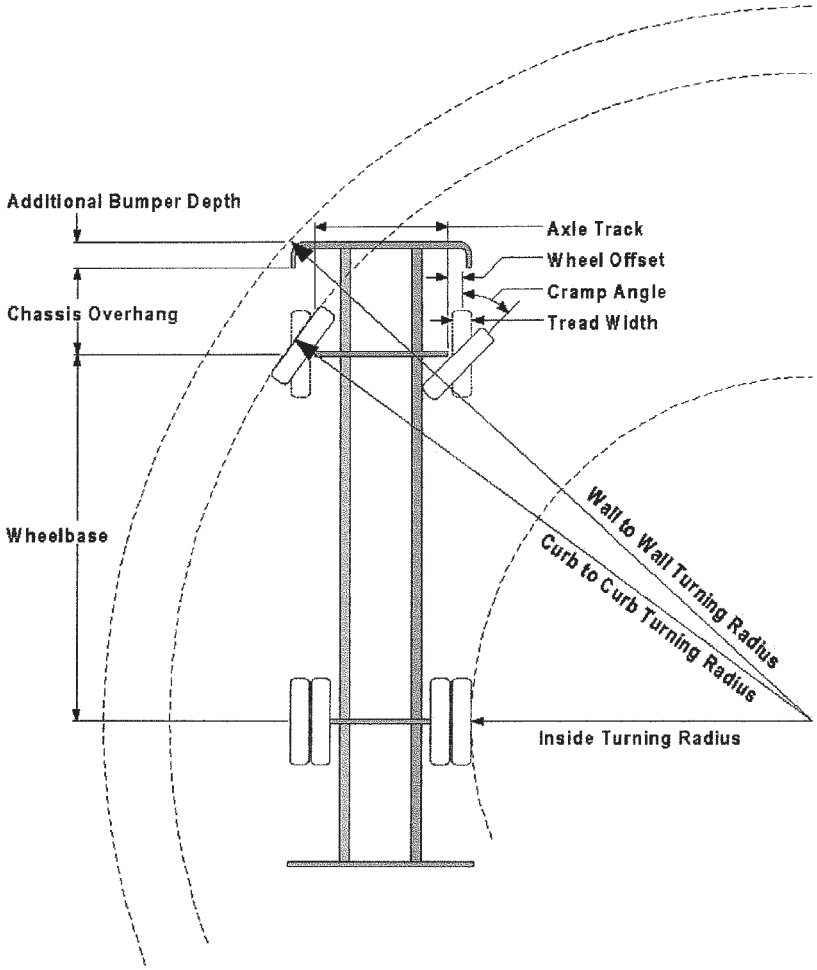
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Turning Performance Analysis

6/24/2009

Bid Number: Delaware, Ohio FD
Department: 1364

Chassis: Velocity Chassis, PAP/SkyArm/Midmount (Big
Body: Aerial, Platform 100', Alum Body



Parameters:

Inside Cramp Angle:	40°
Axle Track:	82.92 in.
Wheel Offset:	5.25 in.
Tread Width:	13.50 in.
Chassis Overhang:	78.00 in.
Additional Bumper Depth:	19.00 in.
Front Overhang:	153.60 in.
Wheelbase:	257.00 in.

Calculated Turning Radii:

Inside Turn:	24 ft. 6 in.
Curb to Curb:	39 ft. 10 in.
Wall to Wall:	47 ft. 10 in.

Comments:

The front overhang dimension given above is the total dimension past the front axle and includes the aerial platform which is 7' off the ground. The aerial platform shall be considered for required clear zone in turns.

Components	PRIDE #	Description
Aerial Devices	0022160	Aerial, 100' Pierce Platform
Wheels, Front	0091794	Wheels, Frt, Steel 22.50" x 13.00", 24K IFS (445)
Tires, Front	0038270	Tires, Goodyear, 445/65R22.50 20 ply G286 SS (24K "IS")
Axle, Front, Custom	0508846	Axle, Front, Oshkosh TAK-4, Non Drive, 24,000 lb, Velocity
Bumpers	0199678	Bumper, 19" Extd-Painted/Reinforced, Imp/Vel, w/Notch for Siren

Notes:

Actual Inside Cramp Angle may be less due to highly specialized options.

Curb to Curb turning radius calculated for a 9.00 inch curb.

Turning Performance Analysis

6/24/2009

Bid Number: Delaware, Ohio FD
Department: 1364

Chassis: Velocity Chassis, PAP/SkyArm/Midmount (Big
Body: Aerial, Platform 100', Alum Body

Definitions:

Inside Cramp Angle	Maximum turning angle of the front inside tire.
Axle Track	King-pin to king-pin distance of the front axle.
Wheel Offset	Offset from the center-line of the wheel to the king-pin.
Tread Width	Width of the tire tread.
Chassis Overhang	Distance from the center-line of the front axle to the front edge of the cab. This does not include the bumper depth.
Additional Bumper Depth	Depth that the bumper assembly adds to the front overhang.
Wheelbase	Distance between the center lines of the vehicle's front and rear axles.
Inside Turning Radius	Radius of the smallest circle around which the vehicle can turn.
Curb to Curb Turning Radius	Radius of the smallest circle inside of which the vehicle's tires can turn. This measurement assumes a curb height of 9 inches.
Wall to Wall Turning Radius	Radius of the smallest circle inside of which the entire vehicle can turn. This measurement takes into account any front overhang due to the chassis, bumper extensions and/or aerial devices.

EST 1808
CITY OF
DELAWARE
OHIO

INFRASTRUCTURE DESIGN MANUAL

APPENDIX F
AIRPORT REQUIREMENTS

Introduction

The City of Delaware (City) owns and operates Delaware Municipal Airport – Jim Moore Field. For land development activities, the Public Works Department Traffic & Engineering Services Division monitors the following in the vicinity of the airport: (1) the height of temporary and permanent objects; and (2) design of stormwater facilities to discourage nuisance waterfowl. These two subjects are described below.

This information is provided by the City as a summary of requirements that are impactful to new development and to redevelopment in the vicinity of the airport. This information and the requirements described below are not intended to take the place of other pertinent regulations by the City or any other jurisdiction including the Federal Aviation Administration (FAA).

Airport Data

Runway Dimensions:	5,800 ft. x 100 ft.
Established Airport Elevation:	945.00
Runway 10 Approach Elevation:	944.21
Runway 28 Approach Elevation:	944.67
Runway High Point:	945.08

Height of Temporary and Permanent Objects

FAA requirements pertaining to the height of temporary or permanent objects in the vicinity of the airport are published in Title 14 Code of Federal Regulations (CFR) Part 77, otherwise known as FAR Part 77. Information about two main FAA criteria related to the height of objects is presented here: (1) Obstruction Limitations; and (2) Notification Threshold Elevations.

Obstruction Limitations

FAA Part 77 includes obstruction standards that define elevations (called imaginary surfaces) above which objects would be classified as "obstructions to air navigation". An object deemed to be an obstruction to air navigation does not automatically disqualify construction of the object. Rather, the obstruction would need evaluated and approved by the FAA and ODOT.

The attached FAA Part 77 Exhibits, Sheet 1 of 2 provides elevations of the imaginary surfaces as defined by FAA Part 77, section 19. This exhibit includes an aerial image background for assistance in determining the imaginary surface elevation at a site.

Notification Threshold Elevations

The notification surface is comprised of elevations below the imaginary surface for obstructions. Temporary or permanent objects proposed with a height that exceeds the notification surface must be reviewed by the FAA and ODOT. This review is initiated by completing and submitting Form 7460-1 to the FAA well as permitting required by ODOT . This form is available at FAA regional offices and on the internet.

Notification and Permitting

Where required to notify the FAA, submit Form 7460-1 to the FAA in accordance with the instructions on the form.

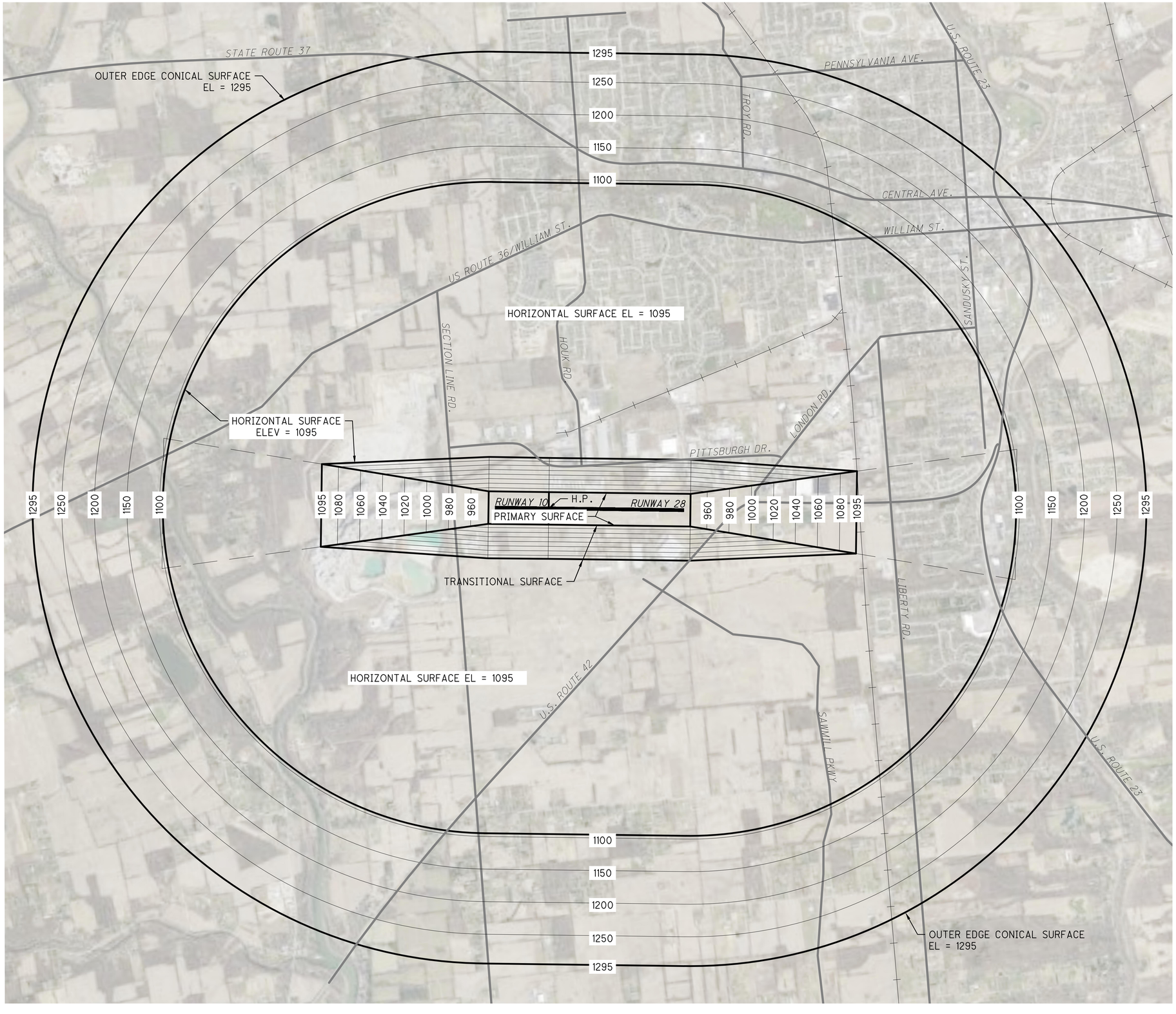
In addition to notifying the FAA, a permit is required to be issued by the Ohio Department of Transportation, Office of Aviation. The filing and permitting requirements are found in the Ohio Administrative Code Section 5501:1. For additional information, see the attached "Airspace Protection" document provided by ODOT.

Design of Stormwater Facilities to Discourage Nuisance Waterfowl

The presence of waterfowl at or near the airport runway are considered a nuisance that can be dangerous to aviation. This concern must be balanced with the need for stormwater management systems necessary for the control of release rates and to meet stormwater quality requirements. Therefore, the City has developed criteria for stormwater management systems located within 5,000 feet of the runway. See the attached exhibits "Airport Vicinity Criteria" for these criteria.

In the first zone, within 2,500 feet of the runway, retention basins (wet basins) are not permitted. The most common alternative to a retention basin is a detention basin (dry basin). The attached exhibits include requirements for detention basins in this zone. It should be noted that these detention basin criteria do not include a sediment forebay or micropool as would normally be required by the Ohio Environmental Protection Agency (OEPA). Therefore, alternate methods of providing water quality treatment should be utilized and approved by the City and OEPA. The detention basin requirement does not prohibit the use of other stormwater management systems, such as below-grade detention.

In the second zone, from 2,500 feet to 5,000 feet from the runway, either detention basins or retention basins with certain design criteria may be used. Specifically, the design of a retention basin in this zone is required to include a minimum of 10 feet wide crushed aggregate slope protection around the entire perimeter of the basin to discourage nuisance waterfowl.



N

0 1500 3000 4500

AIRPORT DATA:

ESTABLISHED AIRPORT ELEVATION = 945.00

RUNWAY 10 APPROACH ELEVATION = 944.21 AT WESTERN MOST EDGE OF PAVEMENT (ROUNDED TO 944.00 FOR PURPOSES OF THIS EXHIBIT)

RUNWAY 28 APPROACH ELEVATION 944.67 AT EASTERN EDGE OF PAVEMENT (ROUNDED TO 945.00 FOR PURPOSES OF THIS EXHIBIT)

A RUNWAY HIGH POINT OF 945.08 EXISTS WHERE INDICATED BY "H.P." (ROUNDED TO 945.00 FOR PURPOSES OF THIS EXHIBIT)

NOTES:

THE PRIMARY SURFACE IS CENTERED ON THE RUNWAY CENTERLINE, EXTENDS PAST BOTH ENDS OF THE RUNWAY FOR 200 FT., HAS A TOTAL WIDTH OF 1,000 FT., AND HAS AN ELEVATION EQUAL TO THE RUNWAY ELEVATION AT A POINT PERPENDICULAR TO THE PRIMARY SURFACE.

THE HORIZONTAL SURFACE IS A HORIZONTAL PLANE AT AN ELEVATION OF 1095 FT. (150 FT. ABOVE THE ESTABLISHED AIRPORT ELEVATION), THE EDGE OF WHICH IS ESTABLISHED BY SWINGING 10,000 FT. RADIUS ARCS FROM THE INTERSECTIONS OF THE EXTENDED RUNWAY CENTERLINE AND PRIMARY SURFACE AND CONNECTING THE ARCS WITH TANGENTIAL LINES.

THE CONICAL SURFACE EXTENDS PAST EDGE OF THE HORIZONTAL SURFACE FOR 4,000 FT. AT A SLOPE OF 20:1

THE TRANSITIONAL SURFACE EXTENDS OUTWARD AND UPWARD FROM THE SIDES OF THE PRIMARY SURFACE AND APPROACH SURFACE AT A SLOPE OF 7:1

REVISIONS

No.	DATE	DESCRIPTION	APPROVED

CITY OF DELAWARE, OHIO
MUNICIPAL AIRPORT
FAA PART 77 EXHIBITS

FAA PART 77
IMAGINARY SURFACES
FOR OBSTRUCTION LIMITATIONS

EST. 1808 CITY OF DELAWARE OHIO

DATE ISSUED:
8/30/2018

SHEET
1 OF 2

S:\ENGINEERING\ENGINEERING DEPARTMENT\STANDARDS AND SPECIFICATIONS\2018 STANDARDS_SPECIFICATIONS_AND TECHNICAL DESIGN MANUAL\FINAL FILES\DESIGN MANUAL\APPENDIX F - AIRPORT RELATED INFORMATION\CADD\HEIGHT RESTRICTION EXHIBIT.DWG - 11/20/2018 6:04:05 PM



1. NOTIFICATION MUST BE SUBMITTED TO THE FEDERAL AVIATION ADMINISTRATION (FAA) ON FORM 7460-1 IN ACCORDANCE WITH THE REQUIREMENTS OF FAR PART 77, SECTION 9 FOR (A) ANY CONSTRUCTION OR ALTERATION THAT EXCEEDS 200 FT. ABOVE GROUND LEVEL (AGL); OR (B) ANY CONSTRUCTION OR ALTERATION THAT EXCEEDS AN IMAGINARY SURFACE EXTENDING OUWARD AND UPWARD FROM THE EDGE OF THE RUNWAY FOR 20,000 FT. AT A H:V SLOPE OF 100:1. NOTIFICATION MUST BE SUPPLIED WHEN ANY OF THE OTHER CRITERIA OF FAR PART 77 IS MET AND WHEN REQUESTED BY THE FAA.

REVISIONS

No.	DATE	DESCRIPTION	APPROVED

CITY OF DELAWARE, OHIO
MUNICIPAL AIRPORT
FAA PART 77 EXHIBITS

FAA PART 77
NOTIFICATION THRESHOLD
ELEVATIONS

EST. 1808 CITY OF DELAWARE OHIO

DATE ISSUED:
8/30/2018

SHEET
2 OF *2*

S:\ENGINEERING\ENGINEERING DEPARTMENT\STANDARDS AND SPECIFICATIONS\2018 STANDARDS_SPECIFICATIONS_AND TECHNICAL DESIGN MANUAL\FINAL FILES\DESIGN MANUAL\APPENDIX F - AIRPORT RELATED INFORMATION\CADD\HEIGHT RESTRICTION EXHIBIT.DWG - 11/20/2018 6:04:14 PM

AIRSPACE PROTECTION







Guidance and considerations for development in the vicinity of Ohio's airports and heliports

UPDATED SPRING 2018

OHIO DEPARTMENT OF TRANSPORTATION

AIRSPACE PROTECTION

When construction is proposed near public use airports and heliports in the State of Ohio, airport authorities, local government officials, zoning and building departments, contractors and everyone else in the planning and construction process should be aware of federal and state notification and permitting requirements.

The criteria for when the Federal Aviation Administration (FAA) requires notification is found in *14 Code of Federal Regulations (CFR) (a.k.a. Federal Aviation Regulations [FAR]) Part 77 - Safe, Efficient Use, and Preservation of the Navigable Airspace)*. In addition to notifying the FAA, a permit is required to be issued by the Ohio Department of Transportation, Office of Aviation. The filing and permitting requirements are found in the *Ohio Administrative Code Section 5501:1*.

IT *MAY* BE A PROBLEM IF:

The proposed construction, alteration or associated construction equipment exceeds (or in the case of trees and other vegetation may eventually exceed) any of the following limits:

- The project is 200 feet or more above ground level at any location within the State of Ohio;

OR

The closer the proposed project is to an airport or heliport, the shorter the structure must be.

- The proposed project is between 0 feet and 200 feet above ground level and;
  - Within 20,000 feet of an Airport with a runway length greater than 3,200 feet; or
  - Within 10,000 feet of an Airport with a runway length less than 3,200 feet; or
  - Within 5,000 feet of a Heliport

…then you need to file a notification and get permission to build, alter or plant.



FILE BEFORE YOU BUILD

WHO: The owner of the land, the development or the project that wants to construct, build or alter any structure or plant anything near an airport or heliport (overpasses, light poles, antenna or cell towers, wind turbines, buildings, billboards, trees…)

WHAT: 1. File FAA Form 7460-1 "Notification of Proposed Construction or Alteration" with the FAA
and
2. Obtain a permit from the Ohio Department of Transportation, Office of Aviation.

WHEN: 90 days prior to the proposed start of construction (45 days for the FAA review and an additional 45 days for ODOT's review)

WHERE: File electronically at http://oeaaa.faa.gov

WHY: To protect the navigable airspace from obstructions, obstacles and hazards.

NOTIFICATION PROCESS

All Four Steps are required even if the FAA issues a Determination of No Hazard

Step 1:

Determine if notification is required based on height of the project and the distance of the project from the runway or helipad.

Step 2:

Submit FAA Form 7460-1 to the FAA.

Step 3:

FAA determines that the project does not adversely affect the surrounding airspace and issues a Determination of No Hazard. Proceed to Step 4 on state level.
OR
Notice of presumed hazard determination is issued.

Step 4:

ODOT conducts an independent aeronautical study and issues a permit
OR
a permit and waiver
OR
ODOT denies the permit.

WHEN IS A PERMIT APPLICATION (FAA FORM 7460-1) REQUIRED?

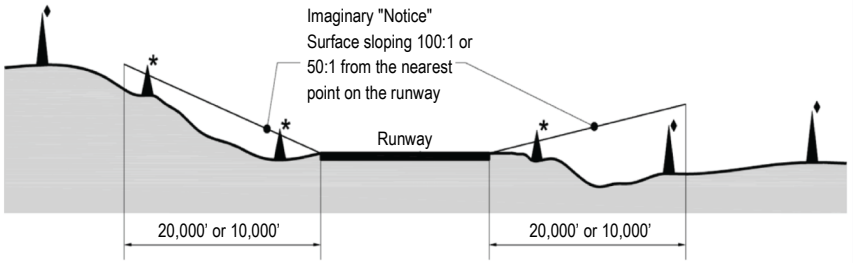
The FAA Form 7460-1 must be filed for any proposed construction, alteration or associated construction equipment of 200 feet or more in height.

Additionally, any construction or alteration that exceeds extending outward and upward in excess of one of the following slopes requires filing:

i) 100 to 1 slope for a horizontal distance of 20,000 feet from the nearest public use runway greater than 3,200 feet in length, excluding heliports.

ii) 50 to 1 slope for a horizontal distance of 10,000 feet from the nearest public use runway less than 3,200 feet in length, excluding heliports.

iii) 25 to 1 slope for a horizontal distance of 5,000 feet from the nearest touchdown and liftoff area of a public use heliport.



♦ §77.13(a)(1) Any proposed construction or alteration 200 feet or more in height above ground level (AGL) at its site requires notice

* §77.13(a)(2) Any proposed construction or alteration penetrating imaginary surfaces in proximity to runways or heliports require notice

Note: Proposed construction or alteration that is lower than 200 feet AGL and is lower than the 100:1 or 50:1 notification surfaces may require notification under other types of notification requirements. Please see §77.13 (a)(3), §77.13(a)(4) and §77.13(a)(5)

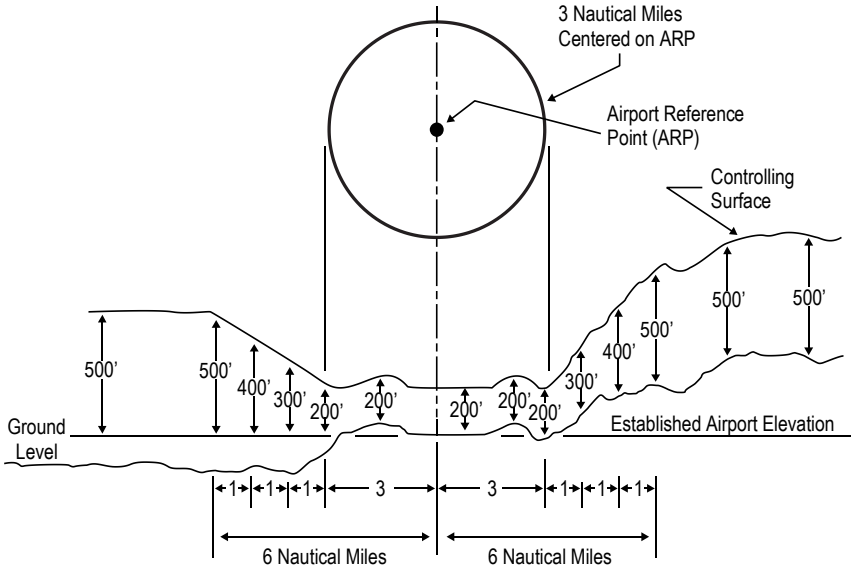
Sources: FAR Part 77. FAA Order 7400.2
Prepared by: Jacobs Consultancy

WHAT AIRSPACE DOES ODOT OFFICE OF AVIATION PROTECT?

ODOT Office of Aviation protects all of 14 CFR Part 77 airspace as a whole for every public use airport and heliport in the State of Ohio. These surfaces are described as:

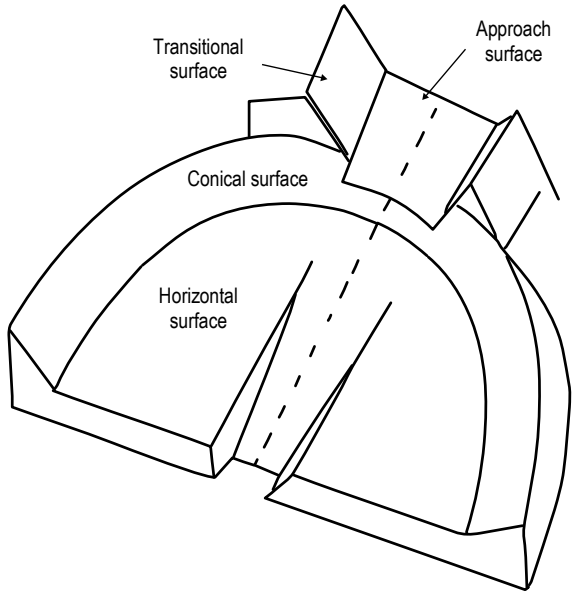
77.17 Obstruction Standards:

- 499 feet AGL anywhere in the State of Ohio
- 200 feet AGL or above airport elevation, whichever is higher, within 3 nautical miles of the established reference point of an airport that has a runway more than 3,200 feet in length. This height increases at a rate of 100 feet per nautical mile up to a maximum of 499 feet.
- Any height within a terminal obstacle clearance area which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area to be less than the required obstacle clearance.



77.19 Civil Airport Imaginary Surfaces:

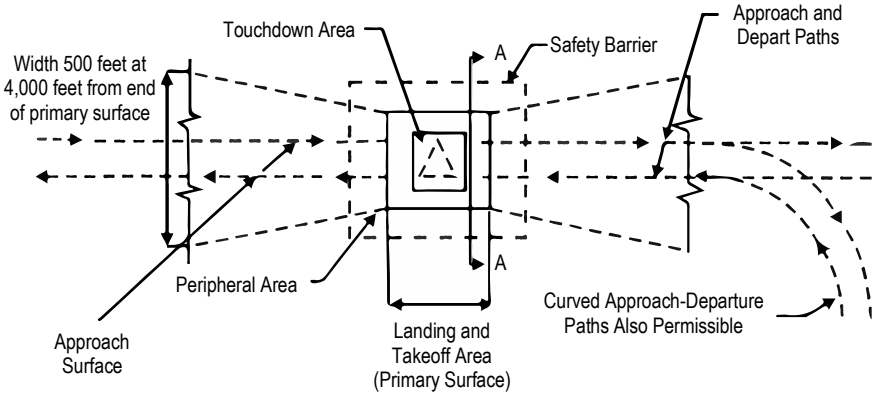
- **Horizontal Surface** – a surface 150 feet above the established airport elevation for a distance of 5,000 feet or 10,000 feet, depending on the classification of the runway
- **Conical Surface** – a surface extending outward and upward from the limit of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.
- **Primary Surface** – a surface centered longitudinally on the runway, the elevation of which is the same as the runway. The width and length are dependent on the classification of the runway.
- **Approach Surface** – a surface longitudinally centered on the extended runway centerline and extending outward and upward from the end of the primary surface. The width and length are dependent on the type of approach available or planned for each end of the runway.
- **Transitional Surface** – surfaces that extend outward and upward at right angles to the runway centerline and extended runway centerline at a slope of 7 to 1 from the sides of the primary surface and approach surface.

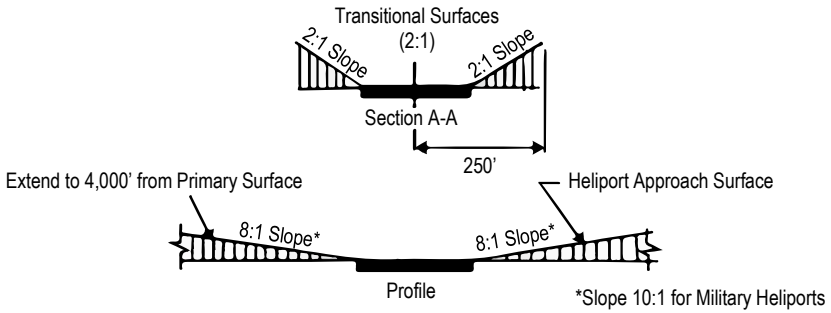


WHAT AIRSPACE DOES ODOT

77.23 Heliport Imaginary Surfaces:

- **Primary Surface** – a surface consisting of a horizontal plane at the elevation of the established heliport elevation that coincides in size and shape with the designated take-off and landing area.
- **Approach Surface** – a surface that begins at each end of the heliport primary surface with the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet to a width of 500 feet. The slope of the approach surface is 8 to 1.
- **Transitional Surface** – surfaces that extend outward and upward from the lateral boundaries of the primary and approach surfaces for a distance of 250 feet measured horizontally from the centerline of the primary and approach surfaces. The slope of the transitional surface is 2 to 1.





OFFICE OF AVIATION PROTECT?

PERMIT APPROVALS

A permit is issued, allowing the proposed construction to move forward.

PERMIT DENIALS

In accordance with the Ohio Administrative Code, anyone denied a permit has the right to request an administrative hearing pursuant to section 119.06 of the Revised Code.

WAIVER REQUESTS

The Department may grant a permit that includes a waiver from compliance with the obstruction standards. Waivers are based on sound aeronautical principles. The consideration of safety shall be paramount to considerations of economic or technical factors. Waivers are considered on a case by case basis.







DEFINITIONS

Airport: Any area of land or water used in maneuvering for landing and taking off of aircraft.

Aeronautical Study: The FAA's or State's review of the effects of proposed construction or alteration of a structure on navigable airspace.

AGL: Height Above Ground Level.

Hazard: An obstruction that is determined to interfere with air navigation.

Heliport: Any area used in maneuvering for landing and taking off of helicopters.

Imaginary Surface: A surface defined in 14 CFR Part 77 and used to identify objects that exceed that surface and may, therefore, affect air navigation. Imaginary surfaces are typically three-dimensional sloping surfaces and are determined based on approach and departure aircraft procedures.

Navigable Airspace: The air and surface space that an aircraft requires to remain clear of obstructions when taking off and landing at an airport or heliport.

Object: Any structure, natural or artificially made, permanent or temporary, existing or future, that lies within the notification criteria area surrounding any public use airport/heliport.

Obstacle: Any object that penetrates clearance requirements within 14 CFR Part 77 protected surfaces.

Obstruction: Any obstacle that impacts navigable airspace.

Runway: The surface of the airport used for landing and taking off of aircraft.

Traverse Way: Any roadway, highway, driveway, railroad, waterway or bikeway that allows mobile objects and vehicles to navigate.

RESOURCES

The Ohio Airport Directory:

All Public Use airports, heliports and seaplane landing areas and their runway lengths are listed in the Ohio Airport Directory.
The Ohio Airport Directory can be found online at:

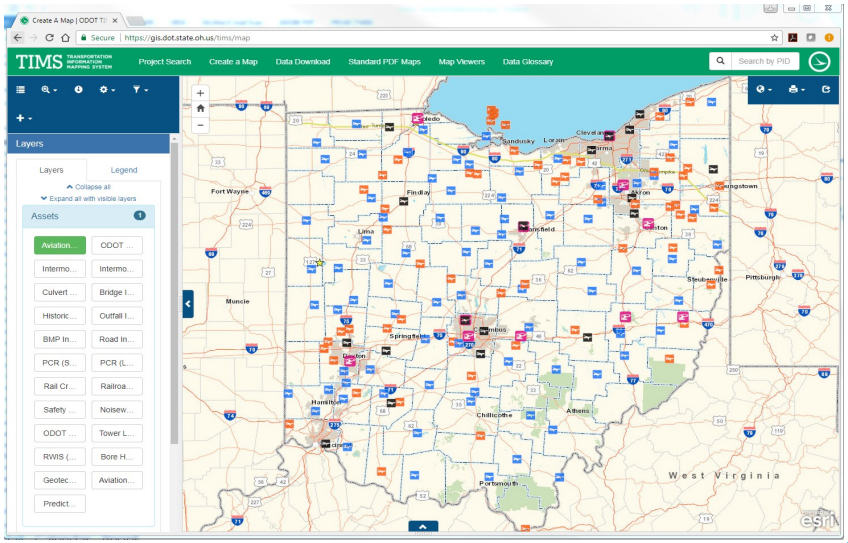
http://transportation.ohio.gov/aviation
& click on "Aeronautical Publications."

This information is available as well in ODOT's Transportation Information Mapping System (TIMS).

Transportation Information Mapping System (TIMS) found at:
http://gis.dot.state.oh.us/tims

Although notification is not required when building around private use airports and heliports, it is strongly encouraged. Coordinate with the private owner of the airport or heliport and ODOT, Office of Aviation. Private use airports, heliports, and seaplane bases can be located in the TIMS system.

Select "Create A Map", under "Assets", select "Aviation Facilities (Private Use)."



WHEN IN DOUBT

File a FAA Form 7460-1 "Notification of Proposed Construction or Alteration" at http://oeaaa.faa.gov

OR

Contact the Ohio Department of Transportation Office of Aviation

Contact Information:

ODOT Office of Aviation

2829 West Dublin-Granville Road

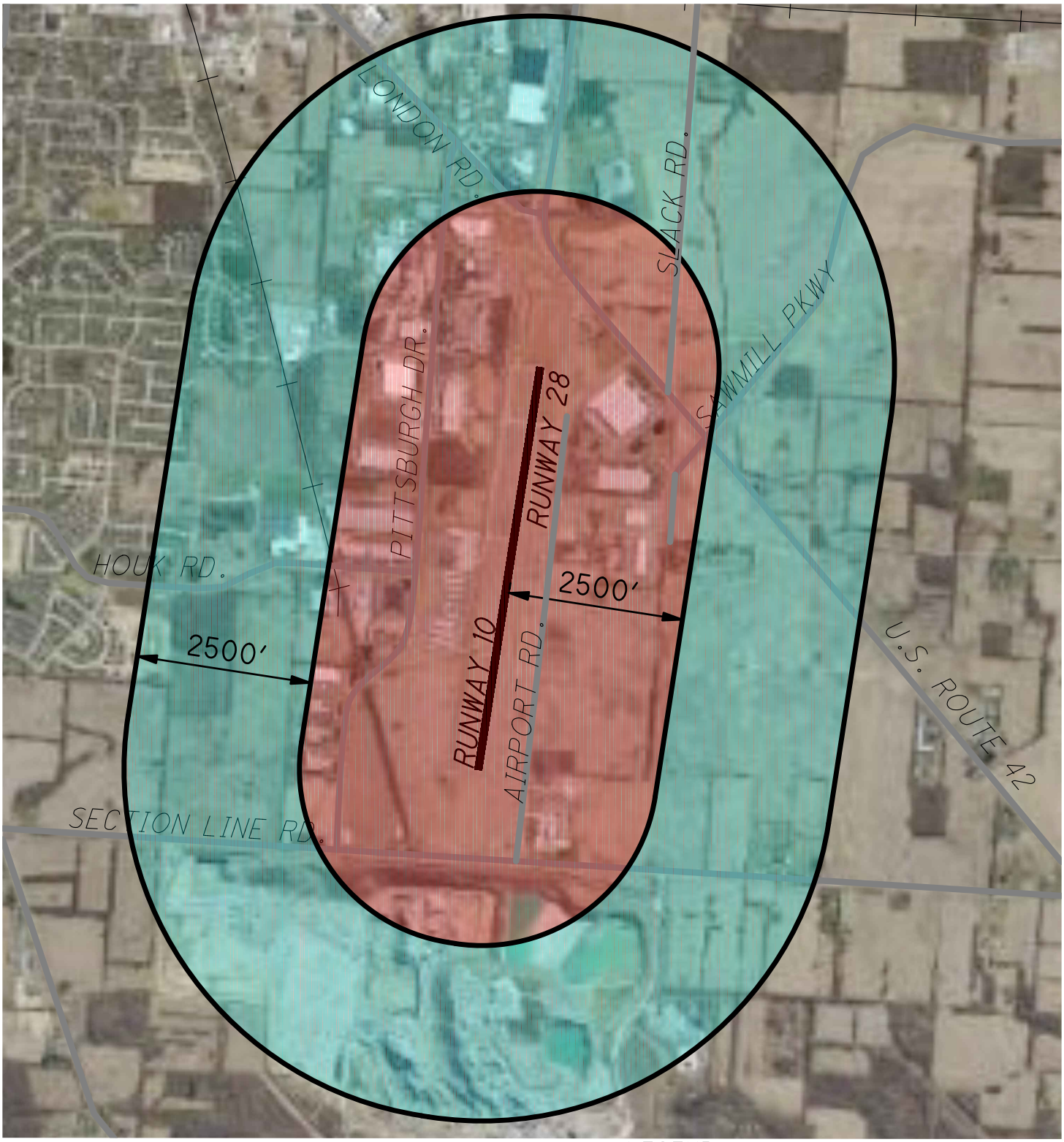
Columbus, Ohio 43235-2786

Ohio Airport Protection Hotline: (614) 466-6804

Ohio Airport Protection Toll Free: (855) 867-1852

Email: Ohio.Airport.Protection@dot.ohio.gov

Web: transportation.ohio.gov/aviation & click on *Ohio Airport Protection Act*



LEGEND

ONLY DETENTION (DRY) BASINS PERMITTED WITHIN 2,500 FT. OF RUNWAY, SEE EXHIBITS 2 AND 3 OF 4

DETENTION (DRY) BASINS OR RETENTION (WET) BASINS FROM 2,500 FT. TO 5,000 FT. FROM RUNWAY, SEE EXHIBITS 2 THROUGH 4 OF 4.

EST 1808
CITY OF
DELAWARE
OHIO

INFRASTRUCTURE DESIGN MANUAL APPENDIX F

AIRPORT VICINITY CRITERIA OVERALL VIEW

APPENDIX F

1 OF 4

Rev.12/31/2018

WATERFOWL EXHIBITS.DWG - 11/20/18

CITY OF DELAWARE OHIO
EST 1808

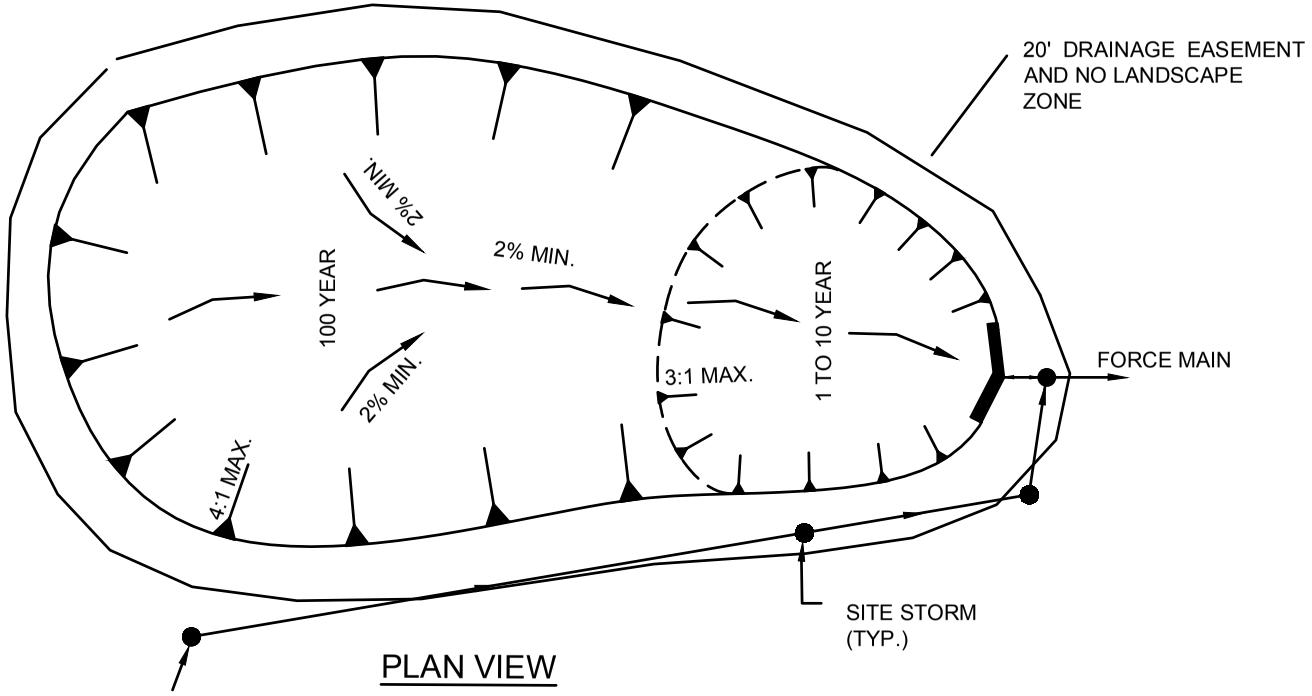
INFRASTRUCTURE DESIGN MANUAL APPENDIX F

AIRPORT VICINITY CRITERIA
DETENTION BASINS

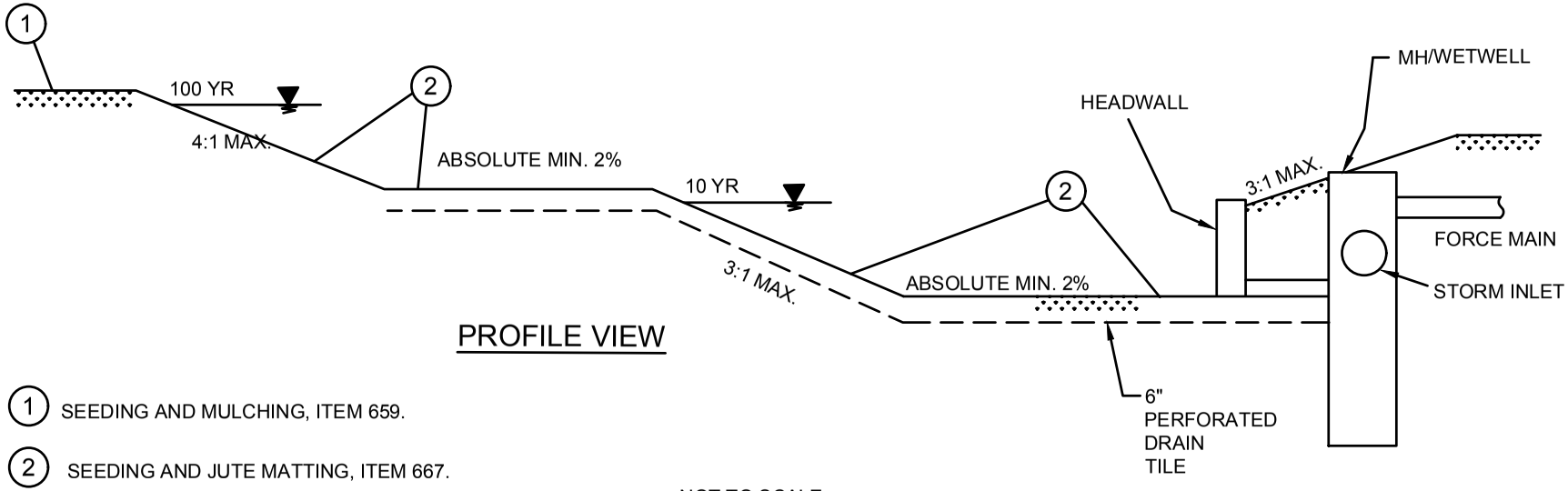
EXHIBIT

2 OF 4

Rev.12/31/2018



PLAN VIEW



PROFILE VIEW

(1) SEEDING AND MULCHING, ITEM 659.

(2) SEEDING AND JUTE MATTING, ITEM 667.

NOT TO SCALE

NOTES:

1. THIS SPECIFICATION IS APPLICABLE TO ALL STORM WATER DETENTION BASINS LOCATED WITHIN 2,500 LF OF THE CITY OF DELAWARE AIRPORT RUNWAY.

2. BASIN IS TO BE MAINTAINED FREE OF ANY VEGETATION OR PLANT MATERIAL BY MEANS OF ROUTINE TRIMMING, CHEMICAL TREATMENT OR OTHER APPROVED METHOD.

3. A 20' MINIMUM NO LANDSCAPE CLEAR ZONE AROUND THE PERIMETER OF THE BASIN SHALL BE FREE OF ANY PLANTINGS, BUSHES, TREES, ETC., WITH THE EXCEPTION OF A WELL MAINTAINED STAND OF GRASS THAT IS MOWED REGULARLY.

4. ADDITIONAL COUNTER MEASURE SHALL BE IMPLEMENTED IN THE BASIN TO DISCOURAGE THE PRESENCE OF WATERFOWL IN ACCORDANCE WITH FAA ADVISORY CIRCULAR NO. 150/5200-33 HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

5. BASINS WITHOUT ADEQUATE GRAVITY OUTFALL WILL REQUIRE A WET WELL/ PUMPING SYSTEM AS INDICATED ON THE DRAWING.

6. THE DRAINAGE EASEMENT SHALL BE GRANTED TO THE CITY FOR MAINTENANCE PER CITY CODE.

7. BASINS ARE TO BE LOCATED AT FURTHEST DISTANCE ON PROPERTY FROM AIRPORT, WHENEVER PRACTICABLE.

8. WHERE THESE DETENTION BASIN REQUIREMENTS VARY FROM THOSE OF THE OHIO EPA CONSTRUCTION STORM WATER PERMIT, OHIO EPA APPROVAL WILL NEED TO BE GRANTED IN COORDINATION WITH THE CITY.

CITY OF DELAWARE OHIO EST 1808

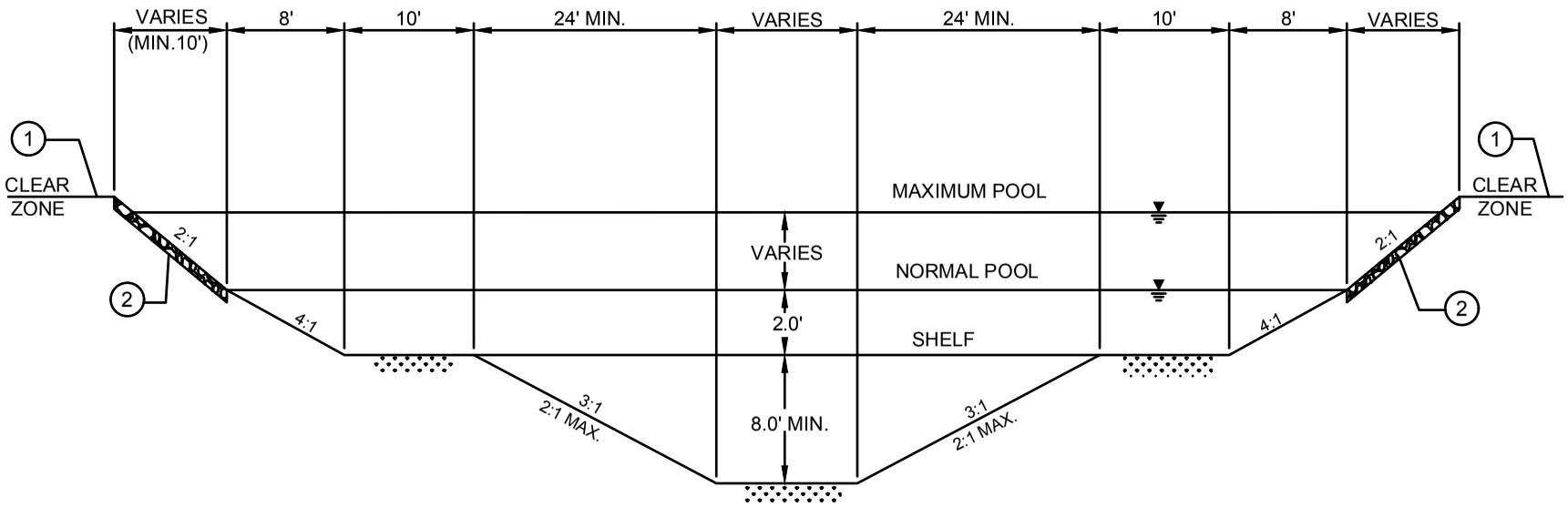
INFRASTRUCTURE DESIGN MANUAL APPENDIX F

AIRPORT VICINITY CRITERIA
RETENTION BASINS

EXHIBIT

4 OF 4

Rev.12/31/2018



WET BASIN TYPICAL SECTION

NOT TO SCALE

NOTES:

1. THIS SPECIFICATION IS APPLICABLE TO ALL STORM WATER RETENTION BASINS LOCATED WITHIN 2,500 LF TO 5,000 LF OF THE CITY OF DELAWARE AIRPORT RUNWAY.
2. BASINS ARE TO BE LOCATED AT FURTHEST DISTANCE ON PROPERTY FROM AIRPORT, WHEREVER PRACTICABLE.
3. BASIN IS TO BE MAINTAINED FREE OF ANY VEGETATION OR PLANT MATERIAL BY MEANS OF ROUTINE TRIMMING, CHEMICAL TREATMENT OR OTHER APPROVED METHOD.
4. A 20' MINIMUM NO LANDSCAPE CLEAR ZONE AROUND THE PERIMETER OF THE BASIN SHALL BE FREE OF ANY PLANTINGS, BUSHES, TREES, ETC., WITH THE EXCEPTION OF A WELL MAINTAINED STAND OF GRASS THAT IS MOWED REGULARLY.
5. ADDITIONAL COUNTER MEASURE SHALL BE IMPLEMENTED IN THE BASIN TO DISCOURAGE THE PRESENCE OF WATERFOWL IN ACCORDANCE WITH FAA ADVISORY CIRCULAR NO. 150/5200-33 HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

(1) SEEDING AND MULCHING, ITEM 659.

(2) 8" CRUSHED AGGREGATE SLOPE PROTECTION, ITEM 601 (TYP. ENTIRE PERIMETER OF BASIN).

EST 1808
CITY OF
DELAWARE
OHIO

INFRASTRUCTURE DESIGN MANUAL

APPENDIX G
STORMWATER BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT

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STORMWATER BEST MANAGEMENT PRACTICES
OPERATIONS AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this_____day of _____,20_____, by and between_____, (hereinafter the "**Landowner**"), and The City of Delaware (hereinafter "**City**");

WITHNESSTH

WHEREAS, the Landowner is proceeding to build and develop the Property; and

WHEREAS, the stormwater management BMP(s) Operations and Maintenance Plan has been approved by the City (hereinafter referred to as the "**Plan**") for the property identified herein, which is attached hereto as Appendix A and made part hereof, as approved by the City, provides for management of stormwater within the confines of the Property through the use of Best Management Practices ("**BMP(s)")**; and

WHEREAS, the City and the Landowner, his successors and assigns, agree that the health, safety and welfare of the residents of the City and the protection and maintenance of water quality require that onsite stormwater Best Management Practices be constructed and maintained by the Property: and

WHEREAS, for the purposes of this agreement, the following definitions shall apply;

BMP – "Best Management Practices", activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, seepage pits, filter strips, bio retention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters and detention basins.

Infiltration Trench – A BMP surface structure designed, constructed, and maintained for providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer.

Seepage Pit – An underground BMP structure designed, constructed and maintained for providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer.

Rain Garden – A BMP overlain with appropriate mulch and suitable vegetation designed, constructed and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer, and

WHEREAS, the City requires, through the implementation of the Plan that stormwater management BMPs as required by said Plan and the Municipal Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowner, his successors and assigns;

NOW, THEREFORE, inconsideration of the foregoing promises, the mutual covenants contained herein and the following terms and conditions, the parties hereto agree as follows:

1. **Construction of BMP Facility by Landowner.** The BMPs shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan.
2. **Duty of Operation & Maintenance of Facility.** The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working acceptable to the City and in accordance with the specific maintenance requirements noted on the Plan.
3. **Right of Entry on Premises.** The Landowner hereby grants permission to the City, its authorized agents and employees, to enter upon the property, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.

4. **Options if Landowner fails to Maintain.** In the event the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the City, the City or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the City to erect any permanent structure on the land of the Landowner. It is expressly understood and agreed that the City is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the City.
5. **Reimbursement by Landowner.** In the event the City, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work or labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the City for all expenses (direct and indirect) incurred within 10 day of receipt of invoice from the City. If Landowner fails to reimburse the City within 10 days, the City may certify the charge to the County Auditor so that the charge will be collected at the next tax collection. The County Auditor will place the charge on the tax duplicate of the county with interest and penalties allowed by law, and it shall be collected as other taxes are collected.
6. **Purpose of Agreement.** The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create of effect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.
7. **Release of City.** The Landowner, its executors, administrators, assigns, and other successors in interests, shall release the City's employees and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or City. In the event that a claim is asserted against the City, its elected officials, City Officers or employees, designated representatives or employees, the City shall promptly notify the Landowner and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the City's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.
8. **Duty to Inspect by City.** The City shall inspect the BMP(s) at a minimum of once every three years to ensure their continued functioning.
9. **Recording of Agreement/Covenant running with the Land.** This Agreement shall be recorded at the Delaware County Recorder's Office, Delaware, Ohio and shall constitute a covenant running with the Property and/or equitable servitude, and shall be binding on the Landowner, his or her heirs, successors and assigns, and any other successors in interests, in perpetuity.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed the day and date first above written.

Witnesses:

_____

_____

Landowner:

_____

_____

City of Delaware

By:_____

Attest:_____