



DEVELOPMENT AND ENGINEERING STANDARDS

November/2018

DEVELOPMENT AND ENGINEERING STANDARDS

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COUNTY OF BRANT

**DEVELOPMENT AND
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SECTION A

LIST OF CONTACTS

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SECTION B

DEFINITIONS

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LIST OF CONTACTS

SECTION A

County of Brant Contacts:

DEVELOPMENT SERVICES DEPARTMENT: Responsible for processing and making recommendation for approval to Committee and Council of development applications. Responsibilities include preparation and coordination for the signing of development agreements including condominium and subdivision agreements.

Contact: **Mark Pomponi, General Manager of Development Services,
Chief Planning Official
Paris Office, 66 Grand River Street North, Paris, Ontario, N0E 1A0
(519) 442-6324**

PUBLIC WORKS DEPARTMENT: Responsible for the engineering review and approval of development applications with respect to infrastructure. All services responses (roads, sidewalks, water, storm sewer and sanitary sewer) are coordinated through the Public Works Department. Also responsible for administration of development agreements after signing and inspection of all infrastructure during the construction period.

Contact: **Lee Robinson P. Eng., Manager of Infrastructure Services
Alex Davidson P. Eng., Water Division Manager
Mike Tout C.E.T., Roads Operations Manager
Burford Office, 26 Park Avenue, P.O. Box 160, Burford, Ontario, N0E 1A0
(519) 449-2451**

DEFINITIONS

SECTION B

“ACCEPTANCE” as it relates to Municipal Services within a plan of subdivision

“Provisional Acceptance” shall be the terminology used to describe the date when the services are complete and acceptable to the County of Brant, subject to the maintenance requirements of the Development Agreement (generally after the placement of base course asphalt). Building permits will not be issued until the underground services have received Provisional Acceptance and the base course of asphalt has been placed with exception to model homes as may be detailed in the Development Agreement.

“Final Acceptance” shall be the terminology used to describe the date when the Developer's maintenance requirements have been fulfilled and the services are acceptable to the County of Brant. Dates for underground and above ground acceptance may not necessarily coincide.

“CONSULTING ENGINEER” or **“DEVELOPER’S ENGINEER”** means a professional possessing a current certificate of authorization to practice professional engineering as required by the Professional Engineers Act. The consulting firm should also be a member in good standing of the Consulting Engineers of Ontario.

“DRAFT PLAN APPROVAL” means approval of the proposed plan of subdivision by the Council of the County of Brant subject to certain conditions. The conditions of approval are to be fulfilled in part by the Owner entering into a Development Agreement with the County of Brant.

“ASSUMPTION” as it relates to municipal services within a plan of subdivision shall be the date on which the Council of the County of Brant agrees by By-law that **ALL** conditions of the Development Agreement have been fulfilled and all maintenance requirements have been completed.

“MULTIPLE UNIT DEVELOPMENT” refers to development such as townhouses and apartments as opposed to single detached, semi-detached or duplex dwellings.

“DEVELOPMENT AGREEMENT” refers to any agreement related to development which may include but is not limited to the following: Pre-servicing Agreements, Subdivision Agreements, Site Plan Agreements, etc.

“PLANNING APPROVALS”

For a **“Minor Variance”** or **“Consent (Severance)”** means approval by the Committee of Adjustment where the appeal period has expired;

For **“Zoning Amendment”**, **“Official Plan Amendment”**, **“Plan of Subdivision”** or **“Plan of Condominium”** means approval by the Council of the County of Brant where the appeal period has expired. In addition, Official Plan Amendments also require Provincial approval.

“PLANNING STAFF” – since there are different planning staff members that can assist with preparation of agreements, one contact person cannot be provided. Therefore, the Chief Planning Official or another Planner can assist, in consultation with the Public Works Department, with agreement preparation depending upon the type and complexity of the agreement.

“SOILS CONSULTING ENGINEER” - is a geotechnical engineering firm whose services have been engaged by the Developer or the Developer's Engineer, usually to provide predevelopment soils investigations as well as a quality control function through the servicing/construction phase.

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SECTION 1

GENERAL INFORMATION

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1.0 INTRODUCTION

1.01 COUNTY OF BRANT

The County of Brant is a single tier municipality and, as such, is responsible for all roadways, storm sewers, sanitary sewers and watermains that are to be installed within all road allowances and registered easements within The County of Brant except provincial highways. The County is also responsible for all parks and open space on municipally owned lands.

1.02 PURPOSE OF DEVELOPMENT AND ENGINEERING STANDARDS

The purpose of this document is to provide a clear and concise description of the County's Engineering review processes and Engineering design standards. All development-related Engineering design proposals are to be prepared in a manner that conforms to the design criteria contained in this document. This document will be periodically updated to include revisions where required. All submissions will be required to conform to the latest revision.

NOTE: Additional Items may be required to address specifics for any given development. Each property is looked at based on its own merit and may require items over and above the Zoning By-Law requirements depending upon the site and the nature of the development. Special circumstances may require items over and above these design standards. Incomplete submissions will not be reviewed and will be returned to the applicant unprocessed.

**ANY STANDARD WITHIN THESE DEVELOPMENT AND ENGINEERING STANDARDS
MAY BE MODIFIED BY THE CONDITIONS OF A DEVELOPMENT AGREEMENT.**

1.03 SUBMISSIONS

Submission and circulation of Engineering drawings related to Planning Approvals is co-ordinated through the County of Brant's Development Services Department. The developer is required to make the initial contact with the Development Services Department prior to submission of the Engineering drawings.

Acceptance of engineering drawings must be obtained from the County of Brant's Development Services Department and any required permits obtained from all applicable parties (GRCA, The County, MOE, MNR, DFO, etc. prior to commencement of any and all development work.

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SECTION 2

**ENGINEERING REVIEW FOR
PLANNING APPROVALS**

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2.01 TYPE / SCALE OF PLANNING APPROVALS

The County's responsibility includes the review and acceptance of engineering design plans for development proposals, including but not limited to severances, site plans, condominiums and subdivisions. Depending on the type of development application and/or the scale of the project, an increased level of detail may be required to be provided by the Developer's Engineer concerning engineering design.

2.02 FAMILIARIZATION

Prior to commencement of the engineering design for planning approvals, the Developer's Engineer shall obtain copies of the County of Brant's Development and Engineering Standards to become familiar with the requirements for engineering design in the County of Brant. Pre-Consultation meetings should be arranged with Development Services and other appropriate staff to confirm general requirements and site-specific concerns, prior to commencement of the engineering design.

2.03 SCALE OF ENGINEERING DESIGN

There are a number of planning applications that are typically used by the County to review the engineering design of development or redevelopment. Such planning applications range from minor variances (which provide minor relief from regulations in a Zoning By-law) to Plans of Subdivision (which typically deal with the creation of multiple lots, internal roads, etc.).

Varying levels of engineering design review are required in association with such applications, depending on the size and scale of a project. For example, a minor variance to allow an addition to an existing residential building lot typically requires the Developer's Engineer to consider the post-development grade of the property, while a plan of subdivision typically requires the consideration of such things as roadway standards, storm drainage, water and waste water mains and connections, signage, parklands, street lighting, etc.

The following "Table 2-1" is presented as a guide illustrating the typical engineering design information to be provided by a Developer's Engineer to assist the County with its engineering review. The Developer's Engineer is encouraged to contact the County staff at the outset of any development project to confirm if the specific circumstances of the proposal warrant the omission of any engineering design review information.

TABLE 2-1
DESIGN CRITERIA TO BE CONSIDERED FOR PLANNING APPROVALS:

PLANNING APPLICATION		ENGINEERING DESIGN CRITERIA TO BE CONSIDERED (By Section)										
		3	7	8 & 9	10 & 11	12	13	14	15	17	18	20
		Functional Servicing Report	Roadways	Storm Drainage	Lot Grading	Signs	Street Tree Planting	Parklands	Street Lighting	Sanitary Sewers	Watermains	Traffic Impact Study
Minor Variance	Urban			✓	✓	✓						✓
	Rural			✓	✓	✓						✓
Consent (Severance)	Urban	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rural	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Zoning By-law / Official Plan Amendment	Urban	✓	✓	✓		✓			✓			✓
	Rural	✓	✓	✓		✓			✓			✓
Plan of Subdivision and/or Condominium	Urban	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rural	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Site Plan	Urban	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rural	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Note: The above table is intended to serve as a general guide and cannot address every type of development scenario. Therefore consultation with the County's Development Services Department and Public Works Department is required to determine the specific background engineering information required for the proposal.

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SECTION 3

FUNCTIONAL SERVICING REPORT

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3.1 FUNCTIONAL SERVICING REPORT

Generally a functional servicing report (feasibility study) is required in accordance with the Planning Act and the Official Plan as background information for Draft Approval for a Plan of Subdivision. A functional report may also be required, for other mid to large-scale developments potentially having an impact on servicing, grading and drainage, water quality or quantity, and traffic, at the discretion of the County of Brant.

Prior to the commencement of the design and the functional servicing report, the Developer's Engineer shall meet with the County of Brant to discuss the County's requirements. It is suggested that, when possible, this be a joint pre-consultation meeting with all other affected departments and agencies. The functional servicing report shall provide all details, calculations, costs, alternatives and recommendations necessary to facilitate logical and appropriate decision-making.

The report should provide all relevant background information with respect to Site Constraints / Existing Conditions such as:

- topography and drainage
- all pipelines (Trans Canada, Enbridge, Union Gas etc.)
- hydro easements / corridors
- trunk sewers and watermains
- utilities
- environmental features (protected watercourses, terrestrials)

The functional servicing report shall include, but will not necessarily be limited to the following considerations:

- i) Concept Plan
- ii) Contour Plan
- iii) General Plan of Services
- iv) Drainage Plan
- v) Geotechnical Investigation
- vi) Major roadway alignments, cross-sections and intersections;
- vii) Roadway structures;
- viii) Watercourse improvement and channelization;
- ix) Railway crossings;
- x) Parkland development
- xi) Major trunk sewers, storm and sanitary;
- xii) Storm drainage systems, including overland flow routes and outlets;
- xiii) Sanitary drainage systems, including assimilative capacity analysis of the receiving system (if applicable);
- xiv) Water distribution systems, including independent pressure and flow testing of the existing systems and network

- modelling;
- xv) Lot grading design;
- xvi) Pumping station locations;
- xvii) Photometrics
- xviii) Utilities
- xix) Traffic Impact study
- xx) Parking Plan

(a) Concept Plan

The Concept Plan for the development must be in a form acceptable to the County of Brant.

(b) Contour Plan

This plan shall be drawn at a scale acceptable to the County of Brant giving contour lines at 1.0m intervals or less as to permit proper assessment of existing surface drainage patterns. This plan must extend to the limits of any drainage area to be served by proposed sanitary and storm sewer systems, including lands beyond the boundaries of the subdivision or development. All elevations are to refer to UTM 17N NAD 83 Geodetic Datum.

(c) General Plan of Services

This plan will be based on the Concept Plan and shall schematically show the proposed storm sewer systems, including overland flow routes, outlets and ponds, and their connection to a legal and adequate outlet, sanitary sewer and watermain. Direction of flow must be accompanied by preliminary engineering calculations indicating the quantity of storm water flow at the connection to existing systems and/or at proposed outfalls. Consideration must be given to the entire catchment area that will ultimately be developed. Blocks and easements for storm drainage systems shall also be shown.

(d) Utilities

The Developer shall investigate availability of all utilities such as hydro, gas, telephone and cable. Availability and capacity of all utilities must be confirmed by the utility provider.

(e) Drainage Plan

When a natural drainage channel passes through and is affected by the construction of the subdivision, drawings must be submitted to indicate the location and typical cross-sections of the existing

channel and of any proposed changes. In general, creek diversions will not be permitted, unless they make an improvement to the existing watercourse. Approvals must be obtained from the appropriate Conservation Authority, the Department of Oceans and Fisheries and an erosion-sediment control plan will be required. A preliminary storm water management plan will be required.

(f) Geotechnical Investigation

A preliminary geotechnical investigation and report from an independent Soils Consultant is required. The soils report should include sufficient information so as to assess constructability of all municipal systems, founding levels for buildings, engineered fill requirements, water table information and a recommended pavement structure.

(g) Additional Reports

The County of Brant may require a Study and Report which evaluates the geographical and hydro-geological characteristics of a rural area where private services are proposed. This study shall identify the suitability of the development area and its component sub-areas to safely accommodate private water supply and sewage disposal systems. Studies shall demonstrate to the satisfaction of the County, that development is sustainable from a source water and sewage disposal basis.

In cases where the subdivision development under consideration forms part of a larger area set aside for future development, the functional servicing report shall be a requirement in order to confirm that the servicing design will allow for orderly and efficient future development. The functional servicing report shall be signed and sealed by a professional engineer.

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SECTION 4

**ENGINEERING REVIEW FOR DEVELOPMENT
INCLUDING NEW LOT CREATION - POST
PLANNING APPROVAL AND SUPPORTING
INFORMATION**

November/2018

**4.1.01 (A) SUBMISSION OF ENGINEERING DRAWINGS FOR PLANS OF SUBDIVISION
AND/OR CONDOMINIUM**

After approval of a planning application, the initial submission of engineering drawings for review by the County shall contain the following information as may be deemed necessary by the County:

- a) The approved draft plan
- b) The proposed plan for registration showing all lot and block numbering and dimensioning
- c) A declaration from the Developer's Engineer indicating that he/she has been retained to design and supervise the construction of the work in the development according to the terms of the Development Agreement(s)
- d) General Plan of Services
- e) Lot Grading Plan
- f) Area Rough Grading Plan
- g) Siltation Control Plan
- h) Storm Drainage Plan
- i) Storm Sewer Design Sheets
- j) Storm Water Management Report
- k) Sanitary Drainage Plan
- l) Sanitary Sewer Design Sheets
- m) Water Distribution Plan
- n) Plan and Profile Drawings
- o) Park Grading Plan, if necessary
- p) Hydro Distribution System and Street Lighting
- q) Composite Utility Plan, to be submitted prior to installation of utilities
- r) Street Signage and Traffic Control Plan
- s) All detail drawings other than the O.P.S. Detail Drawings
- t) All drawings pertinent to the design
- u) All other calculations necessary to check the design
- v) A copy of a Geotechnical Investigation report prepared by a qualified Soils Consulting Engineer
- w) Sanitary and Storm Sewer Bedding Design Sheets
- x) Traffic Impact Study
- y) Hydrogeological Study
- z) Noise Study
- aa) Parking Plan
- bb) Sign Evaluation Study

Number of copies of plans may vary from time to time dependant upon type of development and changes in processes within the County itself. Development Services staff will confirm the number of information sets required at the time of application.

**4.1.01 (B) SUBMISSION OF ENGINEERING DRAWINGS FOR MULTIPLE LOT
SEVERANCES**

After conditional approval of a planning application but, before draft approval lapses, the initial submission of engineering drawings for review by the County shall be made and contain the following information as may be deemed necessary by the County:

- a) The approved draft plan
- b) The proposed plan for registration showing all lot and block numbering and dimensioning
- c) A declaration from the Developer's Engineer indicating that he/she has been retained to design and supervise the construction of the work in the development according to the terms of the Development Agreement(s)
- d) General Plan of Services
- e) Lot Grading Plan
- f) Area Rough Grading Plan
- g) Storm Drainage Plan
- h) Storm Sewer Design Sheets
- i) Storm Water Management Report
- j) Sanitary Drainage Plan
- k) Sanitary Sewer Design Sheets
- l) Plan and Profile Drawings
- m) Park Grading Plan, if necessary
- n) Hydro Distribution System and Street Lighting
- o) Composite Utility Plan, to be submitted prior to installation of utilities
- p) All detail drawings other than the O.P.S. Detail Drawings
- q) All drawings pertinent to the design
- r) All other calculations necessary to check the design
- s) A copy of a Geotechnical Investigation report prepared by a qualified Soils Consulting Engineer
- t) Traffic Impact Study
- u) Hydrogeological Study
- v) Noise Study
- w) Sign Evaluation Study

Number of copies of plans may vary from time to time dependant upon type of development and changes in processes within the County itself. Development Services staff will confirm the number of information sets required at the time of application.

The above information in 4.1.01 (A) or (B) will be reviewed by the County of Brant and any applicable agencies.

County comments forwarded to the Developer's Engineer, shall be addressed in subsequent submissions.

A qualified Consulting Engineer shall complete the design of the hydro distribution system, and the street lighting. This design shall be submitted to both the appropriate Hydro authority and the County of Brant concurrently.

The street light poles, standards and lamps shall be in accordance with the County of Brant standards. The location of the street light poles and transformers shall be shown on the General Plan of Services.

4.1.02 SUBSEQUENT SUBMISSIONS

Subsequent submissions shall be made until the engineering drawings and design are acceptable to the County of Brant. Responses from all County departments and other agencies will be coordinated through the Development Services Department.

4.1.03 MINISTRY OF THE ENVIRONMENT APPLICATIONS

Once the engineering design and drawings are determined to be acceptable to the County, copies of the Ministry of Environment application forms for the sewer and water systems and one complete set of engineering drawings shall be submitted to the County. This application shall be signed by the County of Brant and shall be returned to the Developer's Engineer. The Developer's Engineer shall then make application to the Ministry of the Environment.

4.1.04 OTHER APPROVALS

The Developer's Engineer shall be required to make all submissions and representations necessary to obtain approval from all other affected authorities (Ministry of Natural Resources, Ministry of Transportation, applicable Conservation Authority, etc.). The County of Brant shall be kept informed of the progress of these submissions by copies of all correspondence. A list of other affected authorities shall be maintained and referred to as the Distribution Schedule.

4.2.00 ORIGINAL DRAWINGS AND ENGINEERING DRAWING REQUIREMENTS

The latest revision of the Ontario Provincial Standard Drawings (OPSD) and Specifications (OPSS) must be used. A list of OPSS and OPSD used is to be included as part of the engineering drawings for the development and must be referred to by number on the affected plan and profile drawings.

The Developer's Engineer shall be responsible to check the suitability of the details provided on these standard drawings for the proposed application. Individual details shall be provided by the Developer's Engineer for all special features not covered by the Ontario Provincial Standards.

These special details shall be drawn on standard sized sheets and shall be included as part of the engineering drawings. The minimum scale to be used for any maintenance hole or sewer detail shall be 1:50.

Upon receipt of all approvals from all affected agencies, the original drawings shall be submitted to the County of Brant. These originals shall be signed and dated by the County indicating the acceptance of the County of Brant, and returned to the Developer's Engineer. No changes or revisions may be made to the drawings after being signed by the County. The County will require three paper copies after the drawings have been signed.

If, after one year from the date of the original approval of the engineering drawings by the County, the Developer fails to enter into a Development Agreement with the County of Brant, or the work has not been initiated, the County reserves the right to revoke all approvals related to the engineering drawings.

4.3.00 DRAWING STANDARDS

4.3.01 GENERAL

All engineering drawings shall be prepared in a neat and legible fashion. The information presented on these drawings shall be completed using a computer aided drafting program (i.e. AutoCAD current within 3 years).

All General Servicing Plans, Plan and Profile Drawings, Grading Plans and Detail Drawings shall be prepared on standard A1 size sheets. (590mm x 841mm).

Each individual drawing must give clear instructions as to the materials, methods and details of construction.

- The lot numbering and block identification in accordance with the Registered Plan shall be shown on all engineering drawings.
- All elevations shown on the engineering drawings are to be related to UTM 17N NAD 83 Geodetic datum.
- All plan and profile drawings are to be prepared so that each roadway can be filed separately. Road names shall be identified on the plan portion of the drawings.
- When the roads are of a length that requires more than one drawing, match lines are to be used with no overlapping of information.
- The reference drawing numbers for all intersecting roads and match lines shall be shown on all plan and profile drawings.
- A title block depicting the date, date of revisions, and scale of the plan in metric units shall be on all drawings.
- A north arrow shall be referenced on all drawings.
- All engineering drawings must be stamped and signed by a professional engineer.

4.3.02 AUTOCAD DRAWING STANDARDS

- The drawing scale for plan and profile drawings shall be in metric, using a scale of 1:500 horizontally and 1:50 vertically. A scale of 1:250 horizontally should be used in congested areas.
- Drawings shall be oriented such that North points up and/or to the right (or left if required).
- Dimensions and elevations shall be provided in metric units.
- Existing conditions should appear faded in comparison to the proposed work, and use a text size of 1.6mm of the final hard copy.
- The various utility lines should be identified and appear slightly darker than existing topography.
- Proposed work should appear heavier than existing conditions, and use a text size of 2.0mm for notes, elevations and dimensions.
- All linework and text should be drawn using a bylayer colour and linetype to facilitate easy modifications.

4.4.00 ENGINEERING DRAWINGS

A complete set of Engineering Drawings, in addition to the requirements in Section 4.3.00 - Drawing Standards, shall be comprised of the following:

4.4.01 COVER SHEET

A cover sheet shall be provided and include the name of the development or project, the owner/developer's name and contact information, Developer's Engineer's name and contact information, drawing index and a key plan showing the site location.

**4.4.02 GENERAL PLAN OF SERVICES
(Max. scale 1:1000)**

The General Plan of Services will indicate the general overall scope of the project and the geographic relationship to surrounding lands.

- A General Plan of Services drawing shall be prepared for all developments at a scale of no greater than 1:1000
- When more than one General Plan of Services drawing is required for any development then the division of drawings shall reflect the limits of the Registered Plans as closely as possible.
- The reference Geodetic Bench Mark and the Site Bench Marks to be used for construction shall be identified on the General Plan of Services. Iron property bars are not acceptable construction benchmarks.
- A Key Plan shall be shown on all General Plan of Services and the area covered by each drawing shall be clearly identified within the Key Plan.
- Road allowances, lots, blocks, easements and reserves are to be shown and are to be identified in the same manner as the Registered Plan.
- Existing services, utilities and abutting properties are to be shown.
- All proposed services to be constructed are to be shown.
- All sewers are to be shown and labelled with length, size, material and flow directions.
- Sewer manholes and catchbasins will be shown and are to be numbered in accordance with the County's numbering system.
- All watermains, valves, hydrants, reducers, tees and blow-offs are to be shown. Watermains are to be identified by size and material.
- All curb and sidewalks to be shown.
- All fencing to be indicated by the height and type of fence.

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- All street light poles and transformers are to be shown.
 - Dimensioning of utilities and roadways is not a requirement on the General Plan of Services.
 - Registered Plan number must be shown on the As-Constructed General Plan of Services.
 - All site information for parks, schools, churches, commercial and industrial development must be shown.
 - If a subdivision encroaches on an existing floodplain, the approved fill lines and restrictions must be shown, as specified by the conservation authority.
 - Mail Box locations must be shown on the As-constructed General Servicing Plan.

**4.4.03 PLAN AND PROFILE DRAWINGS
(Scale 1:500 horizontal, 1:50 vertical)**

Plan and Profile Drawings will provide the detailed information required for construction of roads and municipal services.

- Plan and Profile drawings are required for all roadways, blocks and easements within the development, for all outfalls beyond the development to the permanent outlet, for all boundary roadways abutting the development and for other areas where utilities are being installed below grade.
- All existing or future services, utilities and abutting properties are to be shown.
- All proposed services to be constructed are to be shown.
- The profile portion of the drawing shall be a vertical projection of the plan portion whenever possible.
- All road allowances, lots, blocks, easements and reserves are to be shown and are to be identified in the same manner as the Registered Plan. Lot and block frontages are to be shown.
- All curb and gutter and sidewalks shall be shown and dimensioned on the plan portion of the drawing.
- All storm and sanitary sewers and watermain shall be shown and dimensioned on the plan and shall also be plotted on the profile of the drawings. The sewers shall have a complete description on the plan and profile portion of the drawing including length, grade, material, class of pipe, and bedding requirements. The size of the pipe shall be plotted to full scale on the profile.

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- All sewer manholes shall be shown on the plan and on the profile portions of the drawing. The manholes shall be identified by number on the plan and on the profile portion of the drawing. All invert elevations shall be shown on the profile with each having reference to the north arrow.
 - All catchbasins and catchbasin connections shall be shown. Catchbasins are to be identified by number.
 - All top of grate and invert elevations for catchbasins and manholes are to be shown.
 - All sewer manholes which have safety platforms are to be noted.
 - All drop connections are to be noted and referred to the applicable O.P.S. specification, drawing or detail sheet. All drop connections shall be external wye type.
 - All watermains, hydrants, valves, sample stations, etc. shall be shown, described and dimensioned on the plan portion of the drawing. In addition, the watermain shall be plotted to true scale size on the profile portion of the drawing and labelled with the pipe size, material and depth of cover.
 - The location of all storm, water and sanitary service connections shall be shown on the plan portion of the drawing using different symbols, and line types for each service type. The connections to all blocks in the development shall be fully described and dimensioned (size, length, grade, invert elevations, material, class of pipe, bedding, etc.).
 - Curb stops for all water service connections are to be located in landscaped areas. Locating curb stops in other areas may be considered, but only in areas of reduced frontage i.e. cul-de-sacs.
 - The centreline of construction with 20 metre stations noted by a point or small cross shall be shown on the plan portion of the drawing.
 - The original ground at centreline and the proposed centreline road grade shall be plotted on the profile. The proposed centreline and centreline grades shall be fully labelled including length, grade, P.I. stations and elevations, vertical and horizontal curve data, etc.
 - Details of the gutter grades around all 90 degree bends, crescents and cul-de-sacs shall be provided on the plan portion of the drawing as a separate detail at a scale of 1:100.
 - Special notes necessary to detail construction procedures or requirements are to be shown.
 - Chainages for the centreline of construction are to be shown on the profile portion of the drawing. The P.I., B.H.C., E.H.C., B.V.C., and, E.V.C. chainages shall also be noted.
 - Any test pit or borehole locations and soil profile information shall be shown.
 - The basement elevation of all existing dwellings on the streets where sewers are to be constructed shall be noted.

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- **All** of the proposed services, utilities and features are to be shown on the plan portion of the drawing. Those services and utilities below grade that are critical to the new construction shall also be shown in the profile. Test holes may be required to determine actual elevation of these services and utilities.
 - The curb radii at all intersections shall be shown on the plan portion of the drawing.
 - Profiles of roadways shall be produced sufficiently beyond the limits of the proposed roads, to confirm the feasibility of possible future extensions.
 - The location of all streetlights and transformers shall be clearly shown on the plan portion of the drawings.
 - All Driveway locations are to be shown on the plans.

4.4.04 LOT GRADING PLANS (Max. scale 1:500)

The Lot Grading Plan shall establish the final grade control for all lots and blocks within the development in accordance with the County of Brant's current lot grading criteria given within the Lot Grading Sections 10 and/or 11 of these Development and Engineering Standards.

- The Lot Grading Plan shall be prepared at a scale of 1:500 for single family or semi-detached areas and 1:200 for multi-family areas.
- All lots and blocks within the subdivision are to be shown and are to be identified in the same manner as the Registered Plan.
- Existing contours are to be shown at maximum 0.5 m intervals within the subdivision limits and 30 metres beyond the subdivision limits.
- Proposed centreline road elevations are to be shown at 20 m stations along all roads within and abutting the subdivision. Elevations are to be shown for the 20 m stations in accordance with the chainage on the profile drawings. In addition, centreline road elevations shall be shown opposite all lot corners.
- Proposed elevations are to be shown for all lot corners and intermediate points of grade change. On larger blocks, a proposed elevation is to be shown at 15 m intervals along the frontage of the block and at reasonable intervals along the sides and rear of the block to clearly illustrate the grading of the block in relation to the surrounding lands and house type.
- The specified lot grade shall be shown at a location 6.0 m minimum from the street line. For "split" type drainage patterns, the specified rear house grade shall be shown. The specified minimum basement floor elevation for each lot shall also be shown.

-
- The direction of the surface water runoff from the rear of all the lots shall be indicated by means of an arrow pointing in the direction of the runoff.
 - All swales, other than the normal side yard swales, are to be shown along with the invert elevation of the swale at regular intervals (i.e. centreline of each lot for rear yard swales).
 - All rear yard catchbasins shall be shown along with the rim elevation of the catchbasin grate and the invert elevation of the outlet pipe.
 - All curbs, sidewalks, catchbasins, valves, hydrants, streetlight poles, transformers, Canada Post community mailbox locations and easements shall be shown on the lot grading plans. Driveways must have a minimum 1 m clearance to these utilities.
 - All 3:1 slopes (terracing) required shall be shown with the intermediate grades specified.
 - Existing elevations are to be shown on adjacent lands approximately 30 metres from the subdivision limit to enable assessment of the grading between the subdivision and the adjacent areas. The interval of those elevations shall be dependent upon the degree of development of the adjoining lands with the developed areas requiring the most information.
 - The grading along the limit of the subdivision shall be carefully controlled to avoid disturbance to the adjoining areas. A 0.6 m strip shall be left undisturbed along the boundary of the subdivision next to adjacent properties. Such strip must be indicated on the approved Lot Grading Plan.
 - Temporary silt fencing shall be installed along the inside of the 0.6 metre undisturbed barrier strip and maintained for the duration of the contract until such time as seeding or sodding takes place. This fencing shall be noted on the grading plan.
 - All semi-detached lots shall be indicated with SD on all drawings.
 - The lot grading plans shall show proposed locations for building envelopes, enveloped for private sewage disposal systems and private water supply systems for rural estate developments.
 - All culverts shall be designed and shown on the lot grading plans identifying culvert diameter, gauge, minimum length and type.
 - All typical grading details and specifications shall be shown on the Lot Grading Plan.
 - Masked imaging of the Storm Drainage Areas shall be shown.
 - Engineered fill areas shall be clearly shown on the lot grading plan. All lots within fill areas shall be clearly indicated.
 - Parking areas shall be shown in all areas in which on street parking is to be deemed available.

(Scale to suit)

A Detail Plan will be required when there is not sufficient space on the Plan and Profile Drawings or other drawings to fully describe the necessary works.

- A Typical road cross section shall be shown on the Detail Plan, illustrating R.O.W. dimensions, pavement structure, sewer and watermain locations, curb and sidewalk locations, and proposed utility locations.
- Details of special chambers, such as metering chambers shall be shown.
- Details of special structures, such as storm sewer inlets and outlets or retaining walls shall be shown.
- Details of special drainage features, including stormwater retention /detention ponds shall be shown.
- Pumping station details shall be shown.
- Any other details or notes as required shall be shown.
- Silt fence detail.

**4.4.06 STORM AND SANITARY DRAINAGE PLANS
(Scale to suit)**

A separate drainage area plan for storm and sanitary drainage shall be prepared.

- The street and lot layout of the subdivision, street names and property descriptions shall be shown on the Drainage Plans.
- All existing and proposed sewers, manholes, catchbasins shall be shown and labeled with identifying numbers, sizes, lengths, grades and direction of flow.
- All external areas shall be shown on the Drainage Plans. If the external areas are too large to be accommodated, a separate drawing for the external storm areas shall be included in the set.
- Storm drainage areas shall be delineated on an actual contributing drainage area and manhole to manhole basis.
- Sanitary drainage areas shall be delineated on a lotline by lotline and manhole to manhole basis.
- All drainage areas shall be numbered and shall include area in hectares, run-off coefficients for storm or population densities for sanitary.
- The design sheets shall be included with the submission of the storm and sanitary drainage plans.

**4.4.07 UTILITY PLAN
(Max. scale 1:1000)**

The Developer's Engineer will compile the Utility Plan for utilities other than water and sewer from the requirements of the various public and private utility agencies. The Utility Plan shall also detail the layout for street lighting. The Utility Plan shall be submitted prior to the installation of any utility.

- A legend using standard symbols shall be shown on the Utility Plan.
- The location of all existing and proposed utilities (Hydro, Telephone, Cable TV, Gas, Streetlight), including those in common trenches, shall be shown on the Utility Plan.
- The location of all existing and proposed utility structures and pedestals, including Canada Post community mailboxes shall be shown and labeled.
- Typical utility trench details and duct locations shall be shown.
- Any specific duct and trenches cross section details for road crossing shall be shown.
- Any other utility details or notes shall be shown on the Utility Plan.

4.4.08 LANDSCAPE PLAN

All landscaping plans shall be prepared in accordance with the criteria given within Sections 13 and/or 14 of this Development and Engineering Standards and in accordance with the Ontario Landscape Contractors Standard.

4.5.00 SUPPORTING INFORMATION FOR AGREEMENTS

4.5.01 (A) SUBDIVISIONS AND/OR CONDOMINIUMS – PRIOR TO COMMENCEMENT OF PREPARATION OF THE DEVELOPEMENT AGREEMENT

The general agreement process is set out in Section 6. Please contact the County of Brant, Development Services Department for agreement matters.

When more than one General Plan of Services drawing is required for any development, the division of drawings shall reflect the limits of the Draft Plans as closely as possible to ensure a match between the engineering drawings and the plan to be registered.

NOTE: After acceptance of the items in Section 4.1.01 (A) and prior to the commencement of preparation of the Development Agreement, or construction (which may occur should the developer elect to enter into a pre-servicing agreement,) in addition to the items listed in Section 4.1.01 (A) the Developer's Engineer shall provide the County of Brant with the following:

To the Development Services Department:

- a) The name of the person and/or company and mortgagee where applicable with whom the Development Agreement will be executed
- b) One copy of the legal description of the subdivision based on the Reference Plan and approved by the Land Titles Office
- c) Engineering cost estimates
- d) A summary of the number of units proposed within the subdivision:
 - i.e. - Single detached units
 - Semi detached units
 - Townhouse units
 - Apartment units
 - one bedroom and bachelor
 - two or more bedrooms
- e) Proposed phasing, if applicable
- f) Certificate of Insurance
- g) Evidence of land titles application and status
- h) Ministry of Environment Certificates of Approval for County services to be constructed for the proposed subdivision
- i) One copy of the General Plan of Services
- j) One copy of a detailed cost estimate prepared by a professional engineer for services to be constructed for the subdivision itemized on a per unit basis. The cost estimate shall be signed and sealed by the professional engineer. A draft copy of the Schedule shall be submitted to the County for approval prior to preparation of the above noted copies. This cost estimate will be used as a basis for calculation of the security deposit
- k) Copies of a Schedule identifying lands and easements to be deeded to the County
- l) Proposed phasing, if applicable; and
- m) One copy of the engineers estimate signed and sealed by a P.Eng, one digital copy of the engineers estimate and one copy of the Form of Tender taken from the executed contract documents.

To Hydro Authority: (to be confirmed)

- a) Three (3) complete sets of engineering plans and cost estimates for hydro servicing requirements
- b) One (1) copy of the executed contract documents and two field copies (i.e. Tender Document). The draft copy of the specifications shall be submitted to the hydro authority for approval

4.5.01(B) MULTIPLE LOT SEVERANCES OR DEVELOPMENT ON EXISTING LOTS – PRIOR TO COMMENCEMENT OF PREPARATION OF THE DEVELOPMENT AGREEMENT

In addition to the general agreement process set out in Section 6, the draft of the Agreement, as prepared by the County of Brant, will be completed and forwarded to the Developer for review and signing after internal circulation of the agreement to various County Departments and agencies by the Development Services Department.

If required, engineering cost estimates will need to be submitted by the Developer's Engineer to the Development Services Department who will then circulate the cost estimates. If acceptable, the Development Services Department will include the cost estimates in the applicable Schedules to the Agreement.

The engineering drawings must be accepted by the County prior to the finalization of the Agreement Schedules.

When more than one General Plan of Services drawing is required for any development then the division of drawings shall reflect the limits of the subject lands.

NOTE: After acceptance of the items in Section 4.1.01 (B) and prior to the commencement of preparation of the Agreement, in addition to the items listed in Section 4.1.01 (B) the Developer's Engineer shall provide the County of Brant with the following:

To the Development Services Department:

- a) The name of the person and/or company and mortgagee, where applicable, with whom the Agreement will be executed
- b) One copy of the most current legal description of the subject property. Please provide copy of registered reference plan if

available and evidence that the land titles process has been completed.

- c) Engineering cost estimates if required
- d) For residential development, a summary of the number of units proposed:
 - i.e.
 - Single detached units
 - Semi detached units
 - Townhouse units
 - Apartment units
 - one bedroom and bachelor
 - two or more bedrooms
- e) Proposed phasing, if applicable
- f) Certificate of Insurance
- g) Ministry of Environment Certificates of Approval for County services to be constructed (3 copies submitted to the Public Works Department)
- h) One (1) copy of the General Plan of Services
- i) If required, one (1) copy of a detailed cost estimate prepared by a professional engineer for services to be constructed for the development. If residential development proposed, the cost estimate must be itemized on a per unit basis. The cost estimate shall be signed and sealed by the professional engineer. A draft copy of the Schedule shall be submitted to the County for acceptance prior to preparation of the above noted copies. This cost estimate will be used as a basis for calculation of the security deposit
- j) Where applicable, copies of a Schedule identifying lands and easements to be deeded to the County
- k) Proposed phasing, if applicable; and
- l) One copy of the engineers estimate signed and sealed by a P.Eng, one digital copy of the engineers estimate and one copy of the Form of Tender taken from the executed contract documents.

To Hydro Authority: (To be confirmed)

- a) Three (3) complete sets of engineering plans and cost estimates for Hydro servicing requirements
- b) One (1) copy of the executed contract documents and two field copies (i.e. Tender Document). The draft copy of the specifications shall be submitted to the hydro authority for approval

4.5.02 AFTER APPROVAL OF THE ENGINEERING DRAWINGS

4.5.02 (A) SUBDIVISIONS AND/OR CONDOMINIUMS

After Acceptance of the Engineering Drawings by the County, the Developer's Engineer will provide:

To the Development Services Department:

- a) Five (5) mylars including a signing block for the Director of Development Services of the proposed final plan for registration completed with the street names, lot numbers, surveyor's certificate, owner's certificate and all other pertinent information required by the Registry Office **(Electronic copy where possible Autocad current within 3 years)**
- b) Five (5) white paper prints of the proposed final plan of subdivision
- c) One (1) legal size copy of the proposed final plan for attachment to the agreement
- d) One (1) full size and six (6) legal size copies of the Reference Plans for any easement to be granted by the County
- e) One (1) mylar and Ten (10) white paper copies of the General Plan of Services as accepted by the County and other applicable agencies
- f) One (1) mylar and ten (10) white paper copies of the grading control plan accepted by the County and other applicable agencies (the mylar is provided to the registry office)
- g) Copies of a Schedule identifying lands and easements to be deeded to the County. A draft copy of the Schedule shall be submitted to the County for acceptance prior to preparation of the above noted copies
- h) Evidence of entering into a separate agreement with the appropriate Hydro Authority for design, supply and installation of an underground electrical distribution system using above ground, low profile transformers and junction boxes to service all lots and blocks within the subdivision, according to plans and specifications approved by the Hydro Authority
- i) Consulting Engineer's request for acceptance of services
- j) Letter of Credit for the required financial securities; and
- k) Any other requirements to fulfil the conditions of draft approval
- l) Distribution Schedule listing all other affected authorities

4.5.02 (B) MULTIPLE LOT SEVERANCES OR DEVELOPMENT ON EXISTING LOTS

After Acceptance of the Engineering Drawings by the County, the Developer's Engineer will provide:

To the Development Services Department:

-
- a) Where applicable, three full size copies of the Reference Plans for any easement to be granted by the County
 - b) Ten (10) white paper copies of the General Plan of Services as accepted by the County and other applicable agencies.
 - c) Ten (10) white paper copies of the grading control plan accepted by the County and other applicable agencies.
 - d) If applicable, copies of a Schedule identifying lands and easements to be deeded to the County. A draft copy of the Schedule shall be submitted to the County for acceptance prior to preparation of the above noted copies
 - e) Where applicable, evidence of entering into a separate agreement with the appropriate Hydro Authority for design, supply and installation of an underground electrical distribution system using above ground, low profile transformers and junction boxes to service the development, according to plans and specifications approved by the Hydro Authority
 - f) Where required, Letter of Credit for the required financial securities; and
 - g) Any other requirements to fulfil the conditions of approval or site plan approval where applicable
 - h) Distribution Schedule listing all other affected authorities

4.6.00 REQUIREMENTS PRIOR TO COMMENCING CONSTRUCTION

Prior to commencement of construction, the Developer's Consulting Engineer shall arrange/provide the following to the County.

- a) A pre-construction meeting shall be held at least one week prior to the start of construction with the Manager of Infrastructure Services or designate, Consulting Engineer, and Contractor
- b) One (1) copy of the construction specifications and four sets of all approved engineering drawings, landscaping and electrical drawings
- c) The name of the proposed contractor and contact numbers for key personnel
- d) Proposed schedule of construction
- e) Copy of the signed Contract between Contractor and Owner
- f) All other information specified in the Pre-servicing and Subdivision Agreement as a requirement prior to commencement of construction or other information required by the County (i.e. Securities, certificate of insurance, etc). The Developer's Engineer will provide these items to the Development Services Department.

4.7.00 REQUIREMENTS DURING CONSTRUCTION

- a) Site meetings will be held at least every two weeks with the same parties present
- b) Testing results are to be forwarded to the County of Brant
- c) The work may be stopped at any time if it is not satisfactory to the County
- d) Application of dust suppressant, satisfactory to the County and re-vegetation of all disturbed areas as directed

4.8.00 ACCEPTANCE

Acceptance shall be as per the registered subdivision or development agreement.

The County of Brant General Subdivision Agreement is available on the County website at www.brant.ca. Please note that this is a base document and that conditions may vary from development to development.

4.9.00 AS-CONSTRUCTED DRAWINGS

4.9.01 GENERAL

The As-Constructed drawings constitute the original engineering drawings which have been amended to incorporate the construction changes and variances in order to provide accurate information on the works as installed in the development. The Registered Plan Number must be clearly shown on all As-Constructed General Plan of Services.

4.9.02 AS-CONSTRUCTED FIELD SURVEY

The As-Constructed revision shall be based upon a final survey of all the subdivision services and firm construction records. The final survey of the subdivision services shall include a field check of the following items:

- Location, top of grate and invert elevations of all sewer maintenance holes.

-
- Distances between all sewer maintenance holes.
 - Location, top of grate and invert elevations of all catchbasins.
 - Locations of all sidewalks and curbs.
 - Location and ties to all valve boxes and valve chambers located in sodded areas.
 - Location of all hydrants.
 - Location and ties to all sample stations and other special watermain appurtenances.
 - Road centerline elevations.
 - Site benchmarks.
 - Location of all service connections to all lots and blocks. Services are to be labelled with the centerline distance to the nearest downstream sanitary maintenance hole.
 - Sewer and watermain pipe sizes and material.
 - Location of all fencing constructed as part of the subdivision services.
 - Location of all driveways, tree plantings, streetlight poles and transformers.
 - Lot Servicing Records.

4.9.03 DRAWING REVISIONS

The original plans shall be revised to incorporate all changes and variances found during the field survey and to provide ties and additional information to readily locate all underground services.

One (1) mylar print, two (2) paper copies and a digital copy in an AutoCAD Format acceptable to the County of the as-constructed drawings shall be submitted to the Public Works Department.

The following information shall be verified by the as-constructed field survey and updated on the As-constructed drawings:

- All sewer and road grades are to be recalculated to two (2) decimal places.
- All street line invert elevations for storm and sanitary service connections to each lot or block shall be noted on the drawing.
- All street names, lot numbering and block identification shall be checked against the Registered Plan and corrected if required.
- The Contractor, the date of commencement of construction and the date of completion shall be noted on the General Plan of Services.
- The "As-Constructed" revision note and date shall be placed on all drawings in the revision block.
- All civic address numbers shall be identified.

4.9.04 TOLERANCES

A maximum vertical plotting tolerance of 0.1 metres on the 1:50 vertical profile portion of the drawings and a maximum horizontal plotting tolerance of 1 metres on the 1:500 scale drawing shall be considered acceptable without replotting.

All sewer lengths are to be shown to the nearest 0.1 metres. The information shown on the As-Constructed drawings may be checked by the County of Brant at any time up to two years after final acceptance of the subdivision and if discrepancies are found between the information shown on the drawings and the field conditions, then the drawings will be returned to the Developer's Engineer for rechecking and further revisions.

The Developer's Engineer shall be required to explain; in writing, any major difference between the design and the As-Constructed data and to provide verification that alteration does not adversely affect the design of the subdivision services.

4.9.05 SUBMISSIONS

Upon completion of all construction work and the As-Constructed revisions, the drawings shall be submitted to the County of Brant for their permanent records.

The submission of the As-Constructed drawings to the County of Brant must be completed before Provisional Acceptance of the above ground works will be given (AutoCad current within 3 years).

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 5

**ENGINEERING REVIEW FOR
DEVELOPMENT ON EXISTING LOTS**

November/2018

5.1.01 SUBMISSION OF ENGINEERING DRAWINGS

After approval of a planning application, and/or in cases where development or redevelopment is proposed for a property that is under site plan control in the applicable Zoning By-law the initial submission of engineering drawings for review by the County's Public Works Department, shall contain the following information:

- a) A plan showing the location and extent of the subject lands
- b) A declaration from the Developer's Engineer indicating that he/she has been retained to design and supervise the construction of the work in the development
- c) General Plan of Services
- d) Lot Grading Plan
- e) Area Rough Grading Plan
- f) Storm Sewer Design Sheets
- g) Storm Water Management Plan
- h) Sanitary Sewer Design Sheets
- i) Plan and Profile Drawings
- j) Electrical Distribution System, Street Lighting and photometrics, if necessary
- k) All detail drawings other than the O.P.S. Detail Drawings
- l) All drawings pertinent to the design
- m) Other calculations necessary to check the design including capacity of outlets
- n) Independent water pressure/flow testing and associated analysis, if necessary
- o) Composite utility plan, and
- p) A copy of a soils report prepared by a qualified Soils Consulting Engineer (may not be required on all sites)
- q) Parking Plan
- r) Sign Evaluation Study

The above information will be reviewed by the County of Brant and other agencies where applicable. The County and any other agencies comments forwarded to the Developer's Engineer shall be addressed in subsequent submissions.

A qualified Consulting Engineer shall complete the design of the electrical distribution system, and the street lighting. This design shall be submitted to the appropriate Hydro Authority and the County and shall be accepted prior to the final approval of the other engineering drawings

The street light poles, standards and lamps shall be to the County of Brant standards. The location of the street light poles and transformers

shall be shown on the General Plan of Services.

Note:

Additional information regarding engineering design standards for multiple unit dwellings, commercial, industrial or institutional is included in Section 16.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 6

AGREEMENTS

November 2018

6.0 AGREEMENTS

6.01 DRAINAGE

In cases where the development of a subject property for multi-lot or multi-unit development could potentially impact drainage on neighbouring properties, or require a legal outlet, a drainage agreement may be required if a suitable easement or block of land is not available. A grading plan may be attached to the drainage agreement and registered on title for the property. Arrangements for such an agreement shall be the responsibility of the Developer.

6.02 DEVELOPMENT

Development Agreements are required prior to registration of a plan of subdivision. A pre-servicing agreement is not required in cases where the Developer does not intend to install municipal services prior to registration of the plan of subdivision.

Development Agreements, as prepared by the County of Brant, will be completed and forwarded by Development Services Department staff to the Developer for review and signature, following internal circulation of the agreements to various County Departments and agencies.

Engineering cost estimates shall be submitted by the Developer's Engineer to County for review. If acceptable, Development Services Department staff will include the cost estimates in the applicable Schedules to the Development Agreements

The engineering drawings must be accepted by the County prior to the finalization of the Draft Agreement Schedules.

6.03 SERVICING

In cases where the extension of municipal water, sanitary sewer, and/or roads is required for a development other than a plan of subdivision, a servicing agreement may be required by the County.

6.04 SITE PLAN

In cases where a subject property is affected by site plan control in the applicable zoning by-law, the Developer may be required to enter into a Development Agreement with the County of Brant prior to the

commencement of construction of any building or service on or within the parcel of land.

6.05 GENERAL AGREEMENT PROCESS

When a development application has received the required planning approvals, the following process outlines the major steps in preparing and administering an agreement to permit the development of the lands. This process is coordinated by staff of the Development Services Department.

1. Preliminary Review by the County and determination of supporting information required (list of supporting information included in Section 2.);
2. Submission of required information to the County by the Developer's Engineer ;
3. Assembling information and preparation of the draft agreement by the County;
4. Circulation of the draft agreement to County staff and applicable agencies for comments;
5. Preparation of the final agreement based on comments from various County Departments and applicable agencies;
6. The final agreement is forwarded to the Developer for review and signature;
7. Once the Developer returns the signed copies of the agreement and the M Plan; submits all securities and disbursements for peer review of the engineering drawings; and after acceptance by Council, the agreement is registered on title by the County;
8. Developer meets the requirements of the agreement; and
9. Building Permits are released in accordance with the agreement.

6.06 OTHER AGREEMENT INFORMATION

- There are fees charged for the preparation and administration of every agreement.
- There may be additional payments required such as development charges, payment of cash-in-lieu of parkland, etc.
- Performance securities are required in most instances.
- Confirmation of Commitment Forms indicating all professionals and their responsibilities with respect to the project complete with the professionals signatures/stamps and the proponent's

signatures form an integral part of every agreement.

Approvals from other agencies such as the local Conservation Authority, Ministry of the Environment, etc. may also be required.

Please consult the appropriate department for more details.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 7

ROADWAYS

November/2018

SECTION 7 ROADWAYS

7.1.00 CLASSIFICATIONS

7. 1.01 ROAD/STREET CLASSIFICATION

All roadways shall be classified according to the traffic volume expected and the intended use of the roadway. For predominantly residential areas three classifications shall be noted as follows: Local, Collector or Arterial. For industrial areas the streets shall be classified Local or Collector dependent upon length of street, traffic volume expected and percentage of truck traffic. The proposed classification of all streets in the development shall be confirmed with the County of Brant prior to the commencement of the design. The following table is presented as a guide to the determination of the road/street classification. Additional information of road/street classification can be found in the County of Brant Official Plan or the County of Brant Transportation Master Plan.

Roadway Classification Guidelines

	Arterial Road	Collector Road	Local Road
Traffic Service Function	Traffic Movement Primary	Traffic mobility and land access of equal importance	Priority to land access
Typical Traffic Volumes (ADT)	5,000 to 30,000 vehicles per day	1,000 to 12,000 vehicles per day	Less than 3,000 vehicle per day
Typical Speed Limits	50 to 80 kph	50 to 80 kph	50 to 80 kph
Vehicle types	All types	May restrict heavy trucks in specific cases	Passenger and service vehicles
Connects to	Freeway, highway, arterial, collector, local	Highway, arterial, collector, local	Arterial, collector, local
Typical Right-of-way width	24 to 45 metres	20 to 45 metres	20 to 24 metres

7.1.02 ROADWAY CROSS-SECTIONS:

Type	Uses
Rural Local Road (open ditch)	To be used in Rural Residential Areas only if lot frontages are greater than 30 metres.
Urban Local Road (curb and gutter)	To be used in all Urban, Semi-urban and Hamlet Residential Areas (9.2 metre pavement width minimum)
Rural Collector Road (open ditch)	To be used in Rural Areas with lower anticipated traffic volumes (AADT < 5000)
Urban Collector Road (curb and gutter)	To be used in all Urban Areas (10.0 metre pavement width minimum)
Rural Arterial Road (open ditch)	To be used in Rural Areas with high anticipated traffic volumes (AADT > 5000)
Urban Arterial Road (curb and gutter)	To be used in all Urban Areas (11.0 metre pavement width minimum)

7.2.0 GEOMETRIC DESIGN ELEMENTS

7.2.01 ROAD GEOMETRICS

Geometric Detail	Rural			Urban		
	Local	Collector	Arterial	Local	Collector	Arterial
Minimum ROW (m)	20-24	24-45	24-45	20-22	20-26	24-45
Design Speed (km/hr)	50-80	60-100	80-100	60	60-70	80-90

All other requirements including the following shall be designed in accordance with the latest revision of the Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads Part 1 and Part 2.

- Minimum Stopping Sight Distance
- Minimum Sag Curve K Value
- Minimum Crest Curve K Value
- Minimum Curve Radius
- Minimum Lane Width
- Minimum Width of Pavement
- Pavement Crossfall
- Minimum Grade
- Maximum Grade
- Intersection Angles
- Minimum Tangent Length between Intersections
- Minimum Tangent Length between Reverse Curves
- A minimum centreline radius of 20 metres is required for local urban situations at 90 degree bends.

7. 2.02 ARTERIAL ROADS

Arterial roads, except for those roads under Provincial Jurisdiction, are the responsibility of the County of Brant, and all geometric design elements should correspond to this criteria or the Geometric Design Guide for Canadian Roads, whichever is more conservative.

7. 3.00 DESIGN ELEMENTS

7. 3.01 VERTICAL CURVES

All point of grade changes in excess of **1.5%** shall be designed with vertical curves as outlined in the current Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads Part 1 and Part 2. The minimum visibility curves to be used are outlined in the geometric details for each roadway classification. The minimum tangent length of any road grade shall be 9 metres.

7. 3.02 BACKFALL AT INTERSECTING STREETS

At all street intersections, the crown line of the minor street shall not interrupt the normal crossfall of the major street. A 1 to 2 percent backfall shall be provided on the minor street at all street intersections. This backfall shall continue to the end of the curb return radii to facilitate proper drainage of the intersection.

7. 3.03 CURB RETURN RADII AT INTERSECTIONS

The curb return radii at residential street intersections shall conform to the following minimum dimensions:

Roadway Width Street A	Roadway Width Street B	Curb Return Radii
8.5m	8.5m	8.0m
8.5m	9.2m	10.0m
8.5m	10.0m	10.0m
8.5m	11.0m	10.0m
8.5m	14.0m	12.0m
9.2m	9.2m	12.0m
9.2m	10.0m	12.0m
9.2m	11.0m	12.0m
9.2m	14.0m	15.0m
10.0m	10.0m	12.0m
10.0m	11.0m	12.0m
10.0m	14.0m	15.0m
11.0m	11.0m	12.0m
11.0m	14.0m	15.0m
14.0m	14.0m	15.0m

7. 3.04 CUL-DE-SACS AND BULBS

Subdivision street pattern designs should try to avoid the use of cul-de-sacs. If cul-de-sacs are included the developer shall provide a statement indicating the reasons.

Permanent cul-de-sacs shall be constructed in accordance with the details provided in the standard drawings. Minimum gutter grades of 1% shall be maintained along the flow line of all gutters around the cul-de-sacs, the design road grade on the cul-de-sac and at the beginning of the bulb area where catchbasins are to be located. All cul-de-sacs, bulbs and intersections shall be detailed at a scale larger than the road plan. The details shall show gutter, crown and other grades sufficient to determine that the road will properly drain and shall be used as a basis for layout.

Cul-de-Sac for rural roadside environments shall conform to OPSD-500.01. Urban roadside environments shall conform to OPSD 500.02. **Hammerheads are not permitted.**

NOTE: OPSD 500.02 has been modified for use in County of Brant as follows: For residential roads R=14.6m To Curb R=20.0m To ROW. For industrial roads R=21.5m To Curb R=27m To ROW.

7. 3.05 TEMPORARY TURNING CIRCLES

Temporary turning circles must be constructed whenever a road is to be continued in the future to an approved Plan of Subdivision. Details for the requirements of temporary circles are to be adequately detailed on the engineering drawings and are subject to the acceptance of the County.

7. 3.06 PERMANENT TURNING CIRCLES

Permanent turning circles must be constructed whenever a municipally owned road is terminated, in accordance with OPSD 500.010, 500.020, 500.030. The design or installation of Hammer Heads will not be considered on municipally owned roads.

7. 3.07 LOCATION OF UTILITIES

The location of all utilities within the road allowance shall be as detailed on the typical cross-section drawings found in section 23. Utility drawings shall be submitted to the Manager of Infrastructure Services for approval. All utility wiring is to be constructed underground. Hydro transformers are to be housed in suitable enclosures and mounted on transformer pads installed at the final ground elevation. Bell telephone junction boxes may be mounted at the surface in approved standard enclosures.

7. 4.00 PAVEMENT DESIGN

7. 4.01 The **minimum** pavement design for all **local residential** roads in new subdivisions shall be 40mm of HL3, 50mm of HL4, 150mm of Granular A and 450mm of Granular B. All urban road cross-sections shall have sub-drains located lower than the lowest elevation of granular material in the road base.
- The **minimum** pavement design for **collector roads** shall be 50mm of HL3, 50mm of HL4, 200mm of Granular A and 450mm of Granular B. All urban road cross-sections shall have sub-drains located lower than the lowest elevation of granular material in the road base.

The minimum pavement design for **arterial roads** shall be 50mm of HL3, 100mm of HL4, 200mm of Granular A and 550mm of Granular B. All urban road cross-sections shall have sub-drains located lower than the lowest elevation of granular material in the road base.

The Developer shall engage a qualified Soils Consultant to sample, test and design a suitable pavement structure, should a pavement depth greater than the minimum be required. Soil sampling shall be carried out in the presence of the Soils Consultant at intervals not exceeding 50 metres along the centreline of the subdivision road, to a minimum depth of 1.5 m, if an existing road is to be reconstructed as part of the development, the borehole should extend a minimum of 0.5 m into native subgrade.

The composition and design thickness of the pavement section shall be determined from:

1. Sub-grade soil classification with gradation analyses including hydrometer testing of material with more than 10% passing the 75um sieve.
2. Subgrade soil frost susceptibility
3. Subgrade soil drainage, and
4. Traffic Volumes including the percentage of trucks based on a 20 year life cycle

Pavement structure design shall be undertaken using empirical or mechanistic methodologies.

Copies of all test results and proposed road designs and supporting calculations shall be submitted with the Engineering Drawings. Pavement design not meeting the minimum standards, as indicated above for the particular road classification, will not be acceptable.

7. 4.02 MATERIAL REQUIREMENTS

The source of supply and quality of all materials and supplies is subject to the approval of the County and by the Developer's Engineer. The Consulting Engineer shall perform testing and approval of all granular materials at the designated pits and subsequent in-situ verification tests.

All granular materials shall meet OPS specifications. The Developer's Engineer shall submit physical testing results to the County for acceptance of each source.

Prior to the placement of asphalt pavement, the Developers's Engineer must submit the asphalt pavement mix designs to the County for acceptance. The asphalt mix design shall meet the appropriate OPS specification.

7. 5.00 CONCRETE CURB AND GUTTER

Concrete curb and gutter conforming to O.P.S.D. 600.100 shall be used on all new subdivision roadways. When boulevard slope is greater than 4% in a retrofit, a barrier curb is required conforming to OPSD 600.040. Construction shall conform to OPSS 353.

Adjustment and final setting of catchbasin frames shall be completed by pouring concrete, or using concrete riser units, immediately prior to the placement of the top lift of asphalt. Riser units shall be parged on the outside of the catchbasins only. Catchbasins shall be initially set to base asphalt elevation. Temporary asphalt curb shall be placed at catchbasins between the preliminary acceptance and final acceptance stages of the development.

Driveway depressions, where barrier type curb is used, shall be formed in the curb according to the details and locations as shown on the engineering drawings. Should any driveway depressions be improperly located, then repairs may be made by removing those sections and replacing them with the required curb and gutter section. **The concrete capping of a depressed curb shall not be permitted.**

Sawcutting of curb to create depressed curb will be permitted.

7. 6.00 SIDEWALKS

The location requirements for sidewalks in new subdivisions shall be as per the most current revision of the standard cross-section drawing BCSD 001.01. This shall be confirmed with the County prior to commencing the detailed design. Sidewalks are required on all urban roads as shown in the following table.

Road Classification	One Side	Both Sides
Urban Local Residential	X	
Urban Local Industrial	X	
Urban Collector Residential		X
Urban Collector Industrial	X	
Urban Arterial		X

The need for sidewalk along rural roads will be assessed on a case by case basis. In general, sidewalk along rural roads should be placed only in areas leading to schools, parks, and recreational or shopping centres.

The sidewalk shall conform, in details and dimensions, to the current Ontario Provincial Standards and shall be installed at locations as shown on the typical road cross-sections. The minimum width for all sidewalks shall be 1.5 metres with a maximum crossfall of 4%.

The sidewalks shall be increased in thickness at all driveway locations to a minimum of 175mm. In new subdivisions sidewalks are not to be installed until after driveway location has been established. In cases where the sidewalk has been constructed prior to the establishment of an entrance, the existing sidewalk shall be removed and replaced with a thickened sidewalk section. Sidewalk depth shall be transitioned from a thickened section to a standard section at a slope of 10:1.

At street intersections the curb and the sidewalk shall be depressed to meet the roadway elevations as shown on the Ontario Provincial Standards drawings. Wheelchair ramps in accordance with OPSD to be provided. Tactile walking surface indicators shall be provided at all pedestrian crossings in accordance with Ontario Regulation 413/12 under the Accessibility for Ontarians with Disabilities Act 2005.

Sidewalk construction immediately adjacent to a curb will be generally avoided. If at anytime sidewalk is constructed adjacent to curb a 50mm key shall be provided along the back of the curb.

7. 7.00 DRIVEWAY APPROACHES

All driveway approaches shall be graded, gravelled and paved (or concrete or interlocking stone) from back of the curb to the property line. In areas that sidewalk is installed asphalt will not be required between sidewalk and property line. Rural entrances shall conform to OPSD 301.010 and 301.020. If new construction in an urban area, all driveways are to be paved (or concrete or interlocking stone) from back of curb to the front of the garage.

7. 7.01 MINIMUM DRIVEWAY DESIGN

The minimum consolidated depth requirements for driveways shall be as follows:

- a) **SINGLE FAMILY RESIDENTIAL**
 - HL3 asphalt - 50mm
 - Granular base - 150mm of Granular 'A'
- b) **COMMERCIAL, LIGHT INDUSTRIAL AND APARTMENTS**
 - Asphalt - 40 mm HL3 surface course
 - 50mm HL4 base course
 - Granular base - 150mm of Granular 'A'
 - 450mm of Granular 'B'

c) **HEAVY INDUSTRIAL DRIVEWAYS**

- Asphalt - 50 mm HL3 surface course
- 100mm HL4 base course
- Granular Base - 200mm of Granular 'A'
- 450mm of Granular 'B'

7. 7.02 DRIVEWAY GRADES

The minimum grade for any driveway shall be 2%. The maximum permissible design grade for any driveway shall be **8%**. This maximum grade is not recommended and should be employed only in exceptional cases where physical conditions prohibit the use of lesser grades.

The specified grades for driveways shall be directed away from the houses. **The use of reverse fall driveways will not be permitted.**

For industrial and commercial sites requiring site plan approval, a break in grade for driveways shall occur at the property line.

7. 7.03 DRIVEWAY WIDTHS/CURB DEPRESSIONS

The width and location of the driveway depressions for apartment, commercial and industrial driveways shall be detailed on the engineering drawings. These driveways shall be designed to accommodate the anticipated vehicular traffic without causing undue interference with the traffic flow on the street.

Driveway widths (throats at property line) shall be as follows:

Residential

Rural	3.5m – 8.0m
Urban Single	3.0m to 4.3m
Urban Double	6.0m to 7.3m

Industrial, Commercial and Institutional

Single	4.5m to 9.0m
Double	7.2m to 15.0m

The width of any driveway curb depression for commercial, apartment or industrial driveways shall be width + 2R (Example: 6.7 + 2(4.5) = 15.7 metres). (R=radius)

All apartments, commercial and industrial driveways shall be provided with curb constructed to blend into the roadway curb and gutter.

The minimum width of a driveway curb depression for a single width driveway is 3.5m.

Roadway curb & gutter shall be continuous across the entire width of any entrance.

Minimum entrance radius requirements are stipulated by OPSD and an enlarged radius may be required further to review by other County Department/Agencies.

7. 7.03(1) SHARED AND MUTUAL DRIVEWAYS

Type I and Type II driveways may be allowed in situations in which limitations in sight distance require that two (2) driveways be placed immediately adjacent to each other.

The use of adjacent driveways is not desirable and will only be permitted if sufficient justification for same is provided, to the satisfaction of the County.

Type I

Two driveways adjacent to one another under separate care and control of different properties and of sufficient width that under the provisions of the entrance by-law they are technically considered two separate entrances.

Type II

Two driveways adjacent to one and another under shared care and control with only their combined width being sufficient to be considered an entrance under the provisions of the entrance by-law.

An easement is required to be established describing how the entrance is to function and are the shared responsibility of the property owners to maintain same. These requirements are to be placed on total at the sole expense of the Owner/Applicant.

7. 7.04 DRIVEWAY APPROACHES WITH OPEN DITCHES

The Developer is responsible for the grading, gravelling and paving of all driveways from the edge of the pavement of the roadway to the property line. The minimum consolidated depth requirements for the granular base in driveways shall be 300mm Granular A

The minimum length of each C.S.P. (2.0mm gauge) or HDPE (min. 320 kPa) driveway culvert shall be 9.0 metres (for a single width entrance) and the minimum diameter shall be 450mm. The maintenance and repair of such culverts shall remain the responsibility of the Developer until such time as the County has assumed the works.

The construction of driveway headwalls at each end of the driveway culvert will not be permitted.

7. 8.00 BOULEVARDS

All boulevard areas are to be graded between 2% and 8% to the satisfaction of the County. In order to minimize construction problems for the other utility companies, the grade of the boulevard shall be constant from the back of the curb to the property line. Terracing or embankments within the road allowance on new subdivision streets shall not be permitted.

All debris and construction materials shall be removed from the boulevard area upon completion of the initial stage of road construction and the boulevards shall be maintained in a clean state until the roadway section is completed.

Clean, weed free topsoil shall be placed on all boulevard areas prior to sodding. The minimum depth of topsoil shall be 150mm.

All boulevards shall be sodded to the right-of-way limit.

7. 9.00 STAGING OF CONSTRUCTION

The construction of all roads in new subdivisions shall be staged in order that the completion of the roadway coincides with the completion of the development of the surrounding lands. The initial stage of construction shall provide roadways of adequate quality for building construction, traffic movement and land access. Dust control measures shall be maintained during all phases/stages of construction. All roadway catchbasins shall be protected as to prevent the accumulation of deleterious materials. Roads shall be periodically cleaned and maintained by the developer in such a way that no debris shall accumulate on the road. The second stage of construction shall complete the roadway to the final design cross section.

The second stage of roadway construction shall not commence in any area until all of the following conditions are met:

- (1) A minimum period of two years, from Preliminary Acceptance of the underground works and roadway, including base asphalt, has expired;
- (2) 90% of the dwellings with frontage or flankage on the street are completed to the fine grading and topsoil stage (or three-year period);
- (3) All undeveloped lots are rough graded in accordance with the approved lot grading plan;
- (4) All service connections for multiple family, commercial, institutional or other blocks are installed; and
- (5) The acceptance of the County is obtained in writing.
- (6) All conditions of the subdivision pre-servicing agreement are met for Final Acceptance.

7. 9.01 RURAL LOCAL AND RURAL COLLECTOR ROADWAYS

For rural residential and rural collector roadways, the initial stage of road construction shall consist of the grading (to the full cross sectional width as shown on the Standard Detail Drawings), the complete granular base, the base course of asphalt, topsoiling and sodding/seeding of all boulevards and ditches.

The second stage of road construction shall comprise the surface course of asphalt, final adjustment to grade of all utilities and all other work necessary to complete the roadway to the final design cross section. Roadways with open ditch cross-sections shall be cleaned to design grades and re-seeded.

Roadside ditches shall have a minimum grade of 1%, a minimum depth of 0.30m below top of roadway subgrade and a maximum side slope of 3:1.

7. 9.02 URBAN LOCAL ROADWAYS

For urban local roadways, the initial stage of construction shall consist of the grading to the full cross sectional width as shown on the Standard Detail Drawing, the complete granular base, curb and gutter sidewalk, the grading, topsoiling and seeding/sodding of all boulevards and the base course of asphalt. Maintenance holes, valves, and catchbasins are to be set to base asphalt elevation. Standard Cross sections are shown at the back of this section

The second stage of road construction shall be comprised of the grading, gravelling and paving of all driveway approaches, the completion of the surface courses of asphalt, the final adjustment to grade of all utilities and all other work necessary to complete the roadway to the final design cross section, including tree plantings.

Roadside ditches shall have a minimum grade of 1%, a minimum depth of 0.30m below top of roadway subgrade and a maximum side slope of 3:1.

7. 9.03 URBAN COLLECTOR, AND ARTERIAL ROADWAYS

For these roadways, the initial stage of construction shall be comprised all work necessary to complete the roadway to the final design cross section with the exception of the surface asphalt and the driveway approach paving. The curb and gutter, sidewalk, topsoil and seeding/sodding of boulevards are to be completed as part of the Stage 1 construction for these roadway classifications. Maintenance holes, valves, and catchbasins are to be set to base asphalt elevation.

The second stage of construction shall include the surface asphalt, the driveway approach paving, the final adjustment to grade of all utilities and all other work necessary to complete the roadway to the final design cross section, including tree plantings. Roadways in open ditch cross-sections shall be cleaned to design grades and re-seeded.

Roadside ditches shall have a minimum grade of 1%, a minimum depth of 0.30m below top of roadway subgrade and a maximum side slope of 3:1.

7. 10.00 CONSTRUCTION REQUIREMENTS

7. 10.01 CLEARING AND GRUBBING AND AREA ROUGH GRADING

The road allowance shall be cleared of all trees and shrubs not to be included in final landscaping, and of all other obstructions for such widths as are required for the proper installation of roads, services, and other works.

Rough grading shall be done to bring the travelled portion of the road to the necessary grade, in conformity with the cross-section shown on the drawings. Rough grading of all lots and easements must be performed prior to the placement of granular materials in the roadways.

In all cases, topsoil shall be stripped for the complete width of the road allowance and stockpiled at locations approved by the Developer's Engineer. For any excess fill removed to a disposal site classified as swamp, ravine, floodplain or lake, the Developer must receive prior written permission from the local Conservation Authority.

The sub-grade for all roads shall be properly shaped and compacted to 95% Standard Proctor Maximum Dry Density (SPMDD), **prior to any application of granular base course materials. The finished sub-grade shall be proof rolled in the presence of the geotechnical consultant and certified as being acceptable.**

7. 10.02 ROAD SUB-DRAINS

Sub-drains are required on all urban cross-section roads, and will be installed after subgrade cross-section is established.

7. 10.03 SNOW CLEARING

Snow clearing operations will be carried out in accordance with the conditions of the subdivision agreement.

7. 10.04 OTHER REQUIREMENTS

Whenever it is necessary to cut through an existing County road, the Developer will be responsible for properly restoring the surface pavement to its original conditions immediately upon completion of backfilling operations. All such road cuts shall be backfilled with unshrinkable fill (OPSS 1359), up to the subgrade level, and topped with the appropriate granular and asphalt layers, properly installed and compacted.

At the time that the initial stage of construction is given Provisional Acceptance and the warranty period has commenced, the developer shall place signs at all entry points to the development indicating "Unassumed Road".

Permission is required from the County for **any** proposed detours. Where the proposed route utilizes roads that are not part of the County road system, approval from the appropriate road authority will also be necessary. In all cases the following agencies must be notified, when a detour route is created, a minimum of 48 hours prior: Police, EMS, Fire and the County.

NOTE:

For road closures the following information is to be supplied to Police,

Fire and Ambulance:

- Location of closure
- Civic addresses located on either side of the closure
- period of closure

All work will be done in accordance with ordinances and by-laws of the County of Brant.

All road closures require Council approval.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 8

**STORM WATER MANAGEMENT
AND DRAINAGE**

November/2018

SECTION 8 - STORM DRAINAGE

8 1.00 Storm Drainage Policy

8 1.01 Quantity Control

Flood Management Criteria

All newly developing or redeveloping areas must assess their potential impacts on local and regional flooding (minor and major events), and mitigate accordingly.

Design

In areas where no Watershed or Sub-watershed Planning or Subwatershed Impact Study has been completed, it is required that runoff peak flows are controlled to pre-development levels for the 2 year through 100 year events, unless the proponent can demonstrate through appropriate modeling and analysis that uncontrolled flow will not cause detrimental impacts on flood conditions on downstream properties and watercourse systems. Before the County will accept any increase in runoff rates, it must also receive endorsement from the other agencies having jurisdiction.

Where the Subwatershed Plans or Subwatershed Impact Studies have been completed, the development proponent will be required to comply with the recommendations of the specific plan. Any variations will need to be appropriately supported by detailed analysis and also be approved by any agencies having jurisdiction.

All design submissions shall contain a statement from the designer indicating which Best Management Practices have been reviewed and utilized in the design of the Stormwater management system for the proposed development.

Any design of a flood management system involving the determination of peak flows or runoff volume needs to be supported with acceptable hydrologic calculations using rainfall information from the County. The following criteria would apply

- Only hydrologic models currently approved by MNR will be considered acceptable.
- Consideration will be given to the type of design methodology utilized dependant upon the size and type of the site. Generally, computer models will be preferred.

- All stormwater management design shall be carried out using a Chicago storm of 3 hour duration.
- Storm sewers and open channels can be designed using the Rational Formula; all other flood management components will require a hydrograph technique.

(b) Erosion Control

Criteria

Depending on the downstream water level and the nature of the soil strata affected, stream banks can be subject to increased erosion potential as a result of development. In these cases the proponent(s) will be required to provide appropriate protection in accordance with the Watershed or Sub-watershed Plans or with local drainage studies, as well as policies of governing Conservation Authority.

In areas where no Sub-watershed Plan exists, it shall be the responsibility of the development proponent to provide adequate erosion protection in accordance with Provincial Guidelines, unless it can be demonstrated through appropriate modeling and/or analysis that erosion processes will not be adversely affected by the proposed development.

Design

Erosion Control and management involves:

- Extended Detention storage for the 25mm rainfall event as outlined in the Provincial Guidelines (ref. SWM Planning & Design Manual, MOE, 2003), in the absence of specific direction from a Sub-watershed or Watershed Plan.
- Assessment of downstream erosion susceptibility and critical flow values in conjunction with event modeling.
- Assessment of downstream erosion critical velocity or shear forces in conjunction with continuous simulation techniques (duration analysis)

In areas where the downstream receiving watercourse is determined to be unstable, or where control/over control of flow rates is ineffective or not feasible, design of channel alterations may be considered, subject to design in accordance with natural channel design principles (ref. Ministry of Natural Resources, 2001 or most current).

Storm sewer outfalls in natural channels should be provided with proper protection against erosion which includes appropriate bank scouring protection on either side of the outfall and creek. When storm sewer outfalls outlet to steep and/or deep valleys, drop structures should be designed in such a manner as to provide integral bank stability. Such local erosion protection measures should be designed so as not to interfere with the natural channel forming processes of the receiving watercourse system.

(c) Conveyance System (i) Major System

Criteria

Flows in excess of the minor system capacity (i.e. during periods of surcharging or higher intensity events) are referred to as **major system** flow. The major system inherently comprises the minor system, as well as the overland route followed by runoff not captured by the minor system (i.e. either due to excessive flow or operational failures). Common elements of the major system include natural streams, valleys, swales, ponds, roadways, dedicated blocks and drainage channels.

The level of protection should be established based on the nature of the area drained (i.e. risk to loss of life and property damage).

Design

The County of Brant supports the policies of the local Conservation Authorities, which generally require that no new building be subject to flood damages from the Regulatory flood as per the revised Technical Guidelines for Flood Plain Management in Ontario (February, 1986). The Regulatory flood is the greater of the Hurricane Hazel flood (transposed), modeled 100-year flood, observed flood, or frequency-based 100-year flood.

No development, other than necessary access or services, should intrude upon Hazard Lands without the approval of the local Conservation Authority, and the County of Brant. In conjunction with this objective, the County shall require the Development Proponent to delineate floodplains in a proposed development resulting from the 100-year and Regional Storm for both the pre- and post-development conditions

Major overland flooding should not exceed 150mm depth over the crown during a **100-year** event for any roadway and should remain within the designated right-of-way. Blocks dedicated through easement or ownership to the County will be required to convey overland flow from roadways to open watercourse systems. These

blocks should be designed for stability and safety to the satisfaction of the County of Brant.

Conveyance System (ii) Minor System

Criteria

The **minor system** (commonly referred to as the conveyance system), handles urban drainage from relatively "minor" storms having a frequency (return period) of **5 years**. These works typically consist of drainage pipes, roadway gutters and swales and enclosed conduits. Their purpose is to prevent frequent flooding which may "inconvenience" motorists, home and business owners, and pedestrians.

The County will not allow development to proceed until adequate provision, in the form of storm sewers has been made available. Rural development will also require adequate provision for storm drainage, however it may not require storm sewers.

Design

The minor or convenience system, comprising street gutters, catch basins and storm sewers, shall be designed to a 1 in 5 year unsurcharged standard. In some higher value commercial areas, the criteria may be increased to 1 in 10 year storm event at the direction of the County of Brant.

Direct Connections of foundation drains to the storm sewers are generally not permitted. The County preference is that sump pumps be discharged to a splash pad immediately outside of the foundation wall.

The use of sumac trees is not permitted in Storm Water Management Facilities property.

8.1.02 Quality Management Criteria

Water quality treatment will be required for all new development within the County of Brant. Water quality treatment performance shall conform to Provincial requirements (ref. Storm Water Management Practices -Planning and Design Manual, MOE, 2003, Water Management Policies, Guidelines Provincial Water Quality Objectives (Blue Book), MOEE, 1994).

In areas of existing development where re-development is proposed, provisions for water quality measures will be evaluated on a site-specific

basis, based on the feasibility of implementation. Where on-site measures are considered infeasible, the County of Brant may consider the potential for contributions to off-site improvements (i.e. cash-in-lieu), subject to agency concurrence. A master plan approach to compensation towards off-site works is advocated by the County. At the time of writing, this had not yet been implemented.

In areas where a Sub-watershed Plan has been prepared and approved, the guidelines and criteria cited within the plan shall be adopted by the Development Proponent.

Design

Specific guidelines for SWMP application have been developed by the Province based on the type of fisheries habitat downstream of the proposed development, as:-

Three levels of protection are given, with the goal to maintain or enhance existing aquatic habitat, based on the suspended solids removal performance for the different end-of-pipe storm water management facilities developed in the continuous simulation modeling. These levels of protection are based on a general relationship between the end-of-pipe storm water management facilities long-term suspended solids removal and the lethal and chronic effects of suspended solids on aquatic life. The levels of protection correspond to the following long-term suspended solids removal:

Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term removal of 80% of suspended solids.

Normal protection corresponds to the end-of-pipe storage volumes required for the long-term removal of 70% of suspended solids.

Basic protection corresponds to the end-of-pipe storage volumes required for long-term removal of 60% of suspended solids.

As a general consideration, maintenance of the natural hydrologic cycle including infiltration is encouraged where soil conditions permit. Therefore the use of storm water management practices which enhance or maintain infiltration should be considered for each development. Generally active infiltration measures will be applicable in permeable soils areas only and their use will require supporting soils documentation.

Passive measures such as disconnection of roof leaders have been historically utilized in many areas and should be implemented as a

matter of course in all areas unless specific constraints preclude these measures.

In all cases the potential for groundwater contamination shall be considered, particularly where infiltration of road runoff is contemplated.

In areas where hydrogeologic concerns are identified and/or critical linkages to fisheries habitat are present, additional study and analysis may be required to determine the appropriate level of mitigation.

8.1.03 Stormwater Infrastructure Low Impact Development and Quantity and Quality Control Techniques

8.1.03.1 General

Current storm water management practice advocates the consideration of SWM Practice's on a hierarchical basis, whereby more pro-active techniques are considered first. The SWM Practice's are grouped under the following headings in order of preferred application.

- (i) Lot Level Techniques and Source Controls and Alternative Development Standards
- (ii) Transport or Conveyance Controls
- (iii) End-of-Pipe Management Techniques

The philosophy behind this hierarchy is that storm water management techniques are usually more effective when applied at the source. Table 8.1 constitutes a comprehensive list of currently available techniques associated with each of the foregoing categories. It is recognized that storm water management remains an emerging science, hence this list will change over time. It will be the responsibility of the proponent to demonstrate that any technique, not currently endorsed by the County, will address the intended function within expected maintenance and cost parameters, to the satisfaction of the County of Brant.

The County of Brant currently endorses the Provincial Standards for storm water management systems unless otherwise noted herein.

All stormwater management design models shall include but not be limited to the following: soil conditions, infiltration parameters for the selected method (Horton, Green-Ampt, CN Value), depression storage (mm) for both pervious and impervious areas, and shall contain storm system catchment drawings illustrating pre and post drainage connectivity. All design submissions shall contain a statement from the

designer indicating which Best Management Practices have been reviewed and utilized in the design of the stormwater management system for the proposed development.

All Stormwater Management Facilities, for quantity and/or quality control require an Operation and Maintenance Manual prior to acceptance. Operation and Maintenance Manuals are to be in accordance with the sample Table of Contents as provided at time of submittal.

TABLE 8.1 COMPREHENSIVE LIST OF AVAILABLE SWMP'S AND LOW IMPACT DEVELOPMENT	
Stormwater Management Technique	Brant County Perspective¹
Alternative Development Standards	Not currently endorsed
Source Controls	
• roof leader discharge to surface at front of dwelling	Encouraged
• roof leader and sump pumps discharge to soakaway pits	Discouraged in residential land use due to maintenance and impacts on use of rear yards
• rear yard ponding	Not currently endorsed
• rooftop storage • parking lot storage	Applicable for peak flow control only in industrial/commercial applications.
Conveyance Controls	
• pervious pipe systems • pervious catchbasins	Site specific consideration. Supporting geotechnical investigation to be provided to ensure soil conditions are suitable for infiltration
• grassed swales (semi-urban road sections)	Encouraged where applicable
• oversized pipes (Superpipes)	Appropriate in redevelopment of existing areas only.
End-of-Pipe Facilities²	
• wetlands • wet ponds	Applicable for water quality/quantity treatment
• dry ponds	Applicable for water quantity control only
• infiltration basins	Site Specific Consideration
• infiltration trenches	Site Specific Consideration
• filter strips	Only considered appropriate for low density, small drainage areas
• buffer strips	Only considered appropriate for low density, small drainage areas
• oil/grit separators and equivalent systems	Applicable; most appropriate for Commercial/Industrial land use; require consideration of treatment train philosophy Stormceptor oil/grit separators are the only acceptable separators for use in the County of Brant.

¹ The use of any of the foregoing SWMP's is subject to appropriate soil conditions.

² The County requires appropriate signage for all surface end-of-pipe techniques.

8.1.04 Sediment and Erosion Control During Construction

Criteria

New urban developments generally produce increased sediment loading to the surrounding streams particularly during construction. In order to avoid the inherent detrimental side effects from development (i.e. poor water quality and aesthetics, restricted channel conveyance etc.), it is recommended that sediment control measures be instituted. Some of these measures typically include, sediment traps (temporary or permanent), vegetation screens, catch basin filter bags and phased stripping of developable lands. In all cases, it is recommended that sediment loading be controlled as per guidelines published by the local Conservation Authority and "Ontario Guidelines on Erosion and Sediment Control for Urban Construction Sites" 2006.

Design

As a minimum all Erosion and Sediment Control Plans should incorporate recommendations and protection measures pertaining to:-

- Construction Scheduling
- Minimizing soil exposure and re-establishment of vegetative cover
- On-site sediment and erosion techniques
- Site Supervision
- Monitoring and Maintenance
- Site Restoration
- Special Considerations (i.e. in-stream construction/crossings, fisheries timing constraints)
- The OPSD drawings in section 200 may assist in the erosion and sediment control specifications.

8.2.00 WATERSHED AREA

The watershed area shall be determined from contour plans and site inspection and shall include all areas that naturally drain into the system and any fringe areas not accommodated in adjacent storm drainage systems, as well as other areas which may become tributary by reason of re-grading. The information shall be confirmed with the County prior to the start of the design of the internal servicing of the site.

8.3.00 STORM DRAINAGE PLANS

8.3.01 EXTERNAL AREAS

A plan shall be prepared to a scale of 1:1000 or 1:2000 dependent upon the size of the watershed area, to show the nature of the drainage of the lands surrounding the development site and to show all external drainage areas that are contributory to the drainage system for the development. The external drainage areas shall be divided into smaller tributary areas and the area and the location to which the tributary area is considered in the design shall be clearly shown. The plan shall clearly show all existing contours used to justify the limits of the external drainage area.

In lieu of precise information on development on the whole or any part of a watershed area, the latest zoning by-law and Official Plan issued by the County shall be used for all external areas in the design and to determine the specific areas to which these values apply.

This external drainage area plan shall be prepared and shall be submitted at the functional report stage and prior to the commencement of the detailed storm sewer design.

8.3.02 INTERNAL DRAINAGE PLAN

All internal storm drainage plans shall be prepared to a scale of 1:1000 and shall include all streets, lots, blocks and other lands within the development. The proposed storm sewer system shall be shown on this plan with all manholes numbered consecutively from the outlet.

These manholes shall be the tributary points in the design and the area contributing to each manhole shall be clearly outlined on this plan. The area, in hectares, of each contributing area (to the nearest tenth) and the runoff co-efficient used shall be shown in a circle located within the contributing area. In cases where areas of different runoff co-efficients may be tributary to the same manhole, the areas and the co-efficients shall be separately indicated on the plan.

In determining the tributary area to each manhole, the proposed grading of the lots must be considered to maintain consistency in the design.

In the case of large areas under single ownership of blocks requiring future site plan agreements, the design shall be prepared on the basis of the whole area being contributory to one manhole in the abutting storm sewer unless more than one private storm connection is necessary to serve the property in which case the appropriate area

tributary to each connection shall be clearly shown and taken into account in the storm sewer design.

The length, size and grade of each section of storm sewer shall also be shown on the storm drainage plan.

8.4.00 STORM SEWER DESIGN

8.4.01 DESIGN FLOWS

The design flow, in each manhole length of sewer, shall be computed on design sheets in the format recommended by MOE guidelines (attached at the end of this section), according to the Rational Formula **$Q=0.002778 CIA$** where:

A = contributing drainage area in hectares

I = rainfall intensity mm/hr

C = runoff co-efficient dimensionless

Q = volume of runoff in cubic metres per second

0.002778 is a constant

8.4.02 RAINFALL INTENSITY

The County has prepared local IDF relationships based on local rainfall patterns. The IDF curves (found at the back of this section) and/or the information that they represent is to be utilized for all storm water design.

For normal residential and industrial developments, the rainfall intensity shall be determined from the formula indicated on the IDF Curve chart for the respective storm for the 5 year Storm.

The inlet time is site specific. An estimate of the inlet time may be classified according to the estimated runoff coefficient in the following manner: $T_c = 15\text{min.}$ when $C < 0.5$, $T_c = 10\text{min.}$ when $0.5 \leq C \leq 0.75$ and $T_c = 5\text{ min.}$ when $C > 0.75$

For high value commercial and existing heavily developed urban areas, the rainfall intensity shall be determined from the formula indicated on the IDF Curve chart for the respective storm for the 10 year Storm.

A 5-minute inlet entry time shall be used at the head of the system.

The 25-Year Storm Curve, as contained in the Ministry of Transportation Manuals, shall be used as a minimum for all culvert, watercourse and

major trunk sewer design. Larger storms are used for roads other than local residential, dependant upon their function. **For example, a 50-year storm is typically used for all Arterial and some Collector roads**

8.4.03 MAJOR SYSTEM/OVERLAND FLOW ROUTE

The depths of flooding permitted on streets, while acting as part of the minor drainage system, are generally designed for the **50-year storm**, as follows:

- a) Flooding shall be limited to 100mm above centreline on local roads and/or shall be contained within the roadway
- b) On collector roads, the flow spread must leave one lane free of water
- c) On arterial roads, the flow spread must leave one lane in each direction free of water.

The overland flow for a 100-year event shall be accommodated in road cross-sections and /or in blocks of land dedicated to the municipality. Complete design calculations and plans shall be prepared and submitted for approval.

8.4.04 RUNOFF CO-EFFICIENTS

Minimum Runoff co-efficients to be used in storm sewer design shall be as follows:

- a) Based on the description of Area:

Parks over 4 hectares	0.20
Parks 4 hectares and under	0.25
Single Family Residential	0.45
Single Family Residential (Lot frontage less than 12.2m)	0.60
Semi-detached Residential	0.60
Townhouses, Maisonette, Row Houses, etc.	0.75
Apartments	0.75
Schools and Churches	0.75
Industrial	0.80
Commercial	0.90
Heavily Developed Areas	0.90

- b) Based on character of Surface:

Pavement: - Asphalt and Concrete	0.95
- Stone, brick and precast concrete	

Paving panels:	
with sealed joints	0.85
with open joints	0.65
- Gravel road and shoulder	0.70
Roofs	0.95

RUNOFF COEFFICIENTS FOR RURAL AREAS

Lawns	Sandy Soil	Heavy Clay Soil
Flat 0 – 2%	0.05 to 0.10	0.13 to 0.17
Average – 2% - 7%	0.10 to 0.15	0.18 to 0.22
Steep - > 7%	0.15 to 0.20	0.25 to 0.35

The runoff coefficients (C) listed above are applicable for storm 2, 5 and 10-year frequencies. For less frequent storms Antecedent Precipitation Factor (Ca) should be used and Rational Formula to be modified accordingly to:

$$Q = Ca \times C \times I \times A$$

'Ca' value are listed below:

2 to 10 year storm	- Ca = 1.00
25 year storm	- Ca = 1.10
50 year storm	- Ca = 1.20
100 year storm	- Ca = 1.25

and the product of 'Ca x C' should not exceed 1.00

8.4.05 IMPERVIOUSNESS

Impervious values for overall storm analysis and modelling of new development should reflect maximum impervious coverage through Zoning By – Law regulations.

Usually the increases in imperviousness from a pre to a post development condition are approximately:

- For residential development	- 55%
- for commercial and industrial development	- 85%

Development submissions reflecting an imperviousness increase of less than the values noted above will require clear justification.

8.4.06 TIME OF CONCENTRATION

The preferred method to calculate time of concentration of the overland flow in the pre-development condition, if the runoff

coefficient is less than 0.40, is the Airport Formula.

Airport Formula

$$T_c = 3.26 * (1.1 - C) * L^{0.5} / S_w^{0.33}$$

T_c = Time of Concentration (minutes)

C = Runoff Coefficient (dimensionless)

L = Watershed Length (metres)

S_w = Watershed Slope % (m/m)

8.4.07 PIPE CAPACITIES

Manning's formula shall be used in determining the capacity of all storm sewers. The capacity of the sewer shall be determined on the basis of the pipe flowing full, but the design flows should not exceed 95% of full capacity.

The value of the roughness co-efficient 'n' used in the Manning's formula shall be as follows:

(a) Concrete Pipe all sizes	0.013
(b) Concrete Box Culverts	0.013
(c) Corrugated Metal 13mm corrugations	0.024
(d) Corrugated Metal 25% paved invert	0.021
(e) All smooth walled pipe materials -	0.013

8.4.08 FLOW VELOCITIES

Minimum acceptable velocity = 0.8m/sec
Maximum acceptable velocity = 6.0m/sec

8.4.09 MINIMUM SIZES AND SLOPES

The minimum pipe size for a main line storm sewer is 300mm. For sites requiring outlet controls, orifice plates are to be used. The minimum design grades shall be governed by the minimum velocity requirements. Minimum design grades for pipe storm sewers shall be as follows:

<u>Sewer Size</u>	<u>Minimum Grade</u>
300mm to 375mm	0.35%
450mm to 525mm	0.25%
600mm to 900mm	0.15%
975mm to 1200mm	0.10%
1350mm and over	0.05%

8.4.10 MINIMUM COVER

The depth of the storm sewer shall be sufficient to provide frost protection. The minimum cover to the top outside pipe barrel of a shallow storm sewer system shall in no case be less than 1.2 metres from the centreline of the roadway.

If the proposed system has less than 1.2m cover, then the proper insulation shall be provided in accordance with MOE guidelines. Supporting calculations must be provided.

8.4.11 LOCATION

The storm sewers shall be located as shown on the County of Brant Typical Local Urban Cross Section Drawing 7-101. In the case of crescents, looped and curvilinear streets, this standard location may be varied to the extent that the storm sewer remains on the same side of the centreline of the street (i.e., left or right) to avoid crossing and maintain a constant offset from the sanitary sewer trenches at the changes in direction of the street.

8.4.12 DEEP AND SHALLOW STORM SEWERS IN RURAL SUBDIVISIONS

For Rural Estate Subdivision Road Cross-sections in the rural areas, a shallow storm sewer system will be permitted provided the lot sizes are equal to or in excess of 0.20 hectares (i.e. partial storm systems in roads with ditches).

Catchbasin manholes will be permitted in shallow storm sewer systems.

8.4.13 CURVED SEWERS

Radial pipe shall be allowed for all storm sewers 1000mm in diameter and larger, providing that a manhole is located at the beginning or at the end of the radial section. The Minimum centreline radius allowable shall be 15 x the pipe diameter.

8.4.14 LIMITS

All sewers shall be terminated at the upstream subdivision limit when external drainage areas are considered in the design with suitable provision in the design of the terminal manholes to allow for the future extension of the sewer.

When external areas are not included in the sewer design, the sewer shall extend at least half way across the frontage and/or flankage of any lot or block in the subdivision.

8.4.15 SEWER ALIGNMENT

All storm sewers shall be laid in a straight line between manholes unless radial pipe has been designed. The maximum change in direction of flow in manholes for sewer sizes 1000mm diameter and over shall be 45 degrees.

8.4.16 PIPE CROSSINGS

A minimum clearance of 0.15 metres shall be provided between the outside of all pipe barrels at all points of crossing. In cases where the storm sewer crosses a recent utility trench at an elevation higher than the elevation of the utility, a support system shall be designed to prevent settlements of the storm sewer, or alternatively the original trench will be re-excavated to the top of the utility and shall be backfilled with compacted crushed stone or concrete to adequately support the storm sewer. When the storm sewer passes under an existing utility, adequate support shall be provided for the utility during and after construction to prevent damage to that utility.

8.4.17 CHANGES IN PIPE SIZES

No decrease of pipe size from a larger upstream to a smaller size downstream will be allowed regardless of the increase in grade. (capacity)

8.4.18 HEAD LOSSES

Suitable drops shall be provided across all manholes to compensate for the loss in energy due to the change in flow velocity and for the difference in the depth of flow in the sewers.

Hydraulic calculations shall be submitted for all junction and transition manholes on sewers where the outlet is 1050mm or greater. In addition, hydraulic calculations may be required for manholes where the outlet pipe is less than 1050mm diameter if, in the opinion of the County, there is insufficient invert drop provided across any manhole. Regardless of the invert drop across a manhole as required by

calculations, the obvert of the outlet pipe shall not be higher than the obvert of the inlet pipes at any manhole location.

The minimum drop across maintenance holes shall be as follows:

<u>Change of Direction</u>	<u>Minimum Drop (mm)</u>
0	20
1 degree to 45 degrees	50
46 degrees to 90 degrees	80

8.4.19 ORIFICE CONTROL

Orifice devices are to be permanently fixed in a manner which reduces the possibility of being tampered with. The preference of the County is that flow control be via pipe diameter and not orifice plates. Should orifice plates be used, they shall be welded in. The County will not accept horizontal restrictors, such as catchbasin inserts, as a form of orifice control.

8.5.00 SEWER PIPE

8.5.01 MATERIALS

Storm sewers shall be constructed of concrete, PVC and HDPE pipe meeting OPSS standards. Concrete pipe is preferred for Storm Sewers however PVC and HDPE will be accepted for sizes up to 450mm with a minimum strength of 320kPa. The type and classification of all storm sewer pipe and the sewer bedding type shall be clearly indicated on all profile drawings for each sewer length.

RIBBED PIPE SHALL NOT be permitted for use in the County of Brant storm sewer systems. *Ribbed pipe is acceptable for driveway culvert and cross culverts (see 7.7.04).

All sewers shall as a minimum be designed for a trench condition

Concrete pipe shall conform to the requirements of C.S.A. Specification A257 for the particular classes as shown below:

- a) Class 3 non-reinforced concrete pipe, CSA Standard A257.1
- b) Reinforced concrete pipe, CSA Standard A257.2.

8.5.02 PIPE BEDDING

The class of pipe and the type of bedding shall be selected to suit

loading and proposed construction conditions. Generally, all pipes are to be designed assuming a trench condition. Details of the types of bedding are as illustrated in the Ontario Provincial Standard Drawings. In general, Granular A compacted to 95% Proctor Density to Springline with a minimum 300mm sand cover shall be used for all non-concrete pipes in new developments. Alternative cover material may be used for concrete pipe.

8.6.00 MAINTENANCE HOLES

8.6.01 MAXIMUM SPACING

The maximum spacing between maintenance holes shall be as follows:

<u>Pipe Size</u>	<u>Maximum Maintenance Hole Spacing</u>
300mm to 750mm	100 metres
750mm to 1200mm	150 metres
1200mm and over	as approved by the County

Maintenance holes are required at all mainline pipe junctions, changes in grade or changes in alignment.

8.6.02 MAINTENANCE HOLES TYPES

Maintenance holes may be constructed of precast or poured concrete. O.P.S.D. details shall be used for maintenance hole design where applicable. Although these Standard Drawings provide details for maintenance hole up to certain maximum depths and sizes, the Consulting Engineer shall analyse, individually, each application of the standards related to soil conditions, loading and other pertinent factors to determine structural suitability. In all cases where the Standard Drawings are not applicable, the maintenance hole shall be individually designed and detailed. Working drawings must be provided for poured in place structures.

A reference shall be made on all profile drawings to the type and size of all storm maintenance holes. In the case of the standard 1200mm precast maintenance hole, the size of the maintenance hole may be omitted and reference need only be made to the Standard Drawing number.

Precast maintenance holes shall conform to A.S.T.M. Specification C-478M latest revision.

8.6.03 MAINTENANCE HOLE DESIGN

- (a) All maintenance hole chamber openings shall be located on the side of the manhole parallel to the flow for straight run maintenance holes, or on the upstream side of the manhole at all junctions.
- (b) The direction of flow in any manhole shall not be permitted at acute interior angles.
- (c) Safety grating are required at the mid-point depth of maintenance hole, when the depth is between 5.0 and 10.0m. Additional safety grates are required at third-point depths, when the maintenance hole is equal to or greater than 10.0m to 15.0m deep. All incoming pipes are to be below safety gratings, where possible.
- (d) The obverts on the upstream side of maintenance holes shall not be lower than the obvert of the outlet pipe.
- (e) Where the difference in elevation between the obvert of the inlet and outlet pipes exceed 0.6m, a drop structure shall be placed on the inlet pipe with the invert of the drop pipe located at the spring line of the outlet pipe. Design should be in conformity with OPSD 1003.020.
- (f) All storm sewer maintenance holes shall be benched to the obvert of the outlet pipe on a vertical projection from the spring line of the sewer.
- (g) The minimum width of benching in all maintenance holes shall be 250mm.
- (h) Maintenance holes in boulevards shall be located, wherever possible, a minimum of 1.5m from the face of curb or other service.

8.6.04 GRADES FOR MAINTENANCE HOLE FRAME AND COVERS

All maintenance holes located within the travelled portion of roadway shall have the top of grate elevation set flush with the surface of the base course asphalt. The setting of the frame and cover shall be completed in accordance with the details provided in the Ontario Provincial Standard Drawings. Frames and covers shall be raised to surface course asphalt elevation just prior to paving. Frames and covers shall be as per OPSD 401.010 type B open cover.

8.7.00 CATCHBASINS

8.7.01 LOCATION AND SPACING

Catchbasins shall be selected, located and spaced in accordance with the conditions of design. The design of the catchbasin location

and type shall take into consideration the lot areas, the lot grades, pavement widths, road grades and intersection locations. The recommended maximum catchbasin spacings are as follows:

Pavement Width	Road Grade	Maximum Spacing
8.5m	Up to 4%	90m
8.5m	Over 4%	69m
9.2m	Up to 4%	87m
9.2m	Over 4%	65m
10.0m	Up to 4%	84m
10.0m	Over 4%	61m
11 m	Up to 3.5%	76m
11 m	Over 3.5%	53m
14 m	Up to 3%	61m
14 m	Over 3%	46m

Catchbasins shall be generally located upstream of sidewalk crossings at intersections and upstream of all pedestrian crossings, at the ends of the curb returns. Catchbasins shall not be located in driveway curb depressions.

Double catchbasins shall be normally required when the catchbasin intercepts flow from more than one direction. Single catchbasins may be used in the case where the total length of drainage to the catchbasin, from both directions, is less than 90m.

Rear lot catchbasins and connections shall be located as outlined in the Lot Grading Criteria, **but are to be used only as a last resort.** Preference shall be given to other lot grading patterns.

8.7.02 CATCHBASIN TYPES

All catchbasin structures shall be constructed in accordance with all Ontario Provincial Standard Specifications and Drawings.

Special catchbasins and inlet structures shall be fully designed and detailed by the Consultant.

8.7.03 CATCHBASIN CONNECTIONS

For single catchbasins, the minimum size of connection shall be 250mm and the minimum grade shall be 1.0%.

For double catchbasins, the minimum size of connection shall be 300 mm and the minimum grade shall be 1.0%.

For rear lot catchbasins, the minimum size of the connection shall be 250mm and the minimum grade shall be 1.0%.

In general, catchbasin leads should be connected to tees in the storm sewer main. Long catchbasin connections (in excess of 23m) shall be connected to a maintenance hole or, alternatively, the lead can be connected to the sewer and a 1200mm manhole catchbasin used in lieu of the normal 600mm square catchbasin.

8.7.04 GRATINGS

In general, the bike-proof catchbasin grate (with lugs) shall be required for all catchbasins located in roadway (OPSD 400.110) or walkway areas, and beehive type (OPSD 403.010) used for ditch inlets and rear lot catchbasins.

8.7.05 GRADES FOR CASTINGS AND ADJUSTMENTS

In roadways, the grade for the top of concrete shall be established, as shown on the Standard Drawings. The adjustment to the final elevation shall be made at the time of curb construction.

8.7.06 CATCHBASINS AT INTERSECTIONS

All catchbasins at street intersections shall be located on the tangent section of the curb a minimum of 0.6 metres distant from the beginning or the end of the radial portion of the curb and the grading of the intersection shall provide for drainage to the catchbasins' location.

8.8.00 INLETS, OUTFALLS AND SPECIAL STRUCTURES

8.8.01 GENERAL

Inlet and outlet structures shall be fully designed on the engineering drawings. The details provided shall include the existing topography, proposed grading and the work necessary to protect against erosion.

8.8.02 INLETS

For other than minor swales, where catchbasins with beehive tops are used, inlet structures shall be fully designed. Inlet grates shall generally consist of inclined parallel bars or rods set in a plane at approximately 45 degrees with the top away from the direction of flow. Gabions or rip-rap shall be provided at all inlets to protect against erosion and to channel the flow to the inlet structure.

8.8.03 OUTLETS

The O.P.S.D. Standard Headwall shall be used for all storm sewers up to 1800mm. For sewers over 1800mm in diameter, the headwalls shall be individually designed. All headwalls shall be equipped with a horizontal grating over the outlet end of the pipe and a railing across the top of the headwall for the protection of the public. Alternate outlet designs will be considered on a specific basis.

All outlets shall blend in the direction of flow of the watercourse with the directional change being taken up in the sewer rather than the channel.

Gabions, rip-rap or other erosion protection shall be provided at all outlets to prevent erosion of the watercourse and to the area adjacent to the outlet. The extent of the erosion protection shall be indicated on the engineering drawings and shall be dependent upon the velocity of the flow in the storm sewer outlet, the soil conditions, the flow in the existing watercourse, site conditions and the requirements of the appropriate Conservation Authority, if applicable.

8.8.04 OPEN CHANNELS

The proposed criteria for an open channel design shall be submitted to the County for acceptance, by the Developer's Engineer, prior to the actual design being undertaken. The Developer's Engineer shall also be responsible for obtaining the approval of the design from the Ministry of Natural Resources, the Department of Fisheries and Oceans and the local Conservation Authority. Generally, the stream alignment, and erosion control features, should follow a natural path.

8.9.00 CONSTRUCTION

Construction of all storm sewers and appurtenances shall be in accordance with the OPSS's and OPSD's at the time of acceptance of the design drawings by the County of Brant.

TABLE 1 INTENSITY-DURATION-FREQUENCY VALUES COUNTY OF BRANT						
Duration (min)	Rainfall Intensity (mm/hr)					
	2	5	10	25	50	100
5	109.4	139.3	169.6	191.6	215.8	239.4
10	81.1	109.7	134.2	155.5	176.2	196.5
15	65.3	90.9	111.4	131.1	149.1	166.9
30	42.4	60.9	74.6	89.7	102.5	115.3
60	26.1	37.6	45.7	55.6	63.6	71.7
120	15.6	21.9	26.4	32.1	36.6	41.2
360	6.7	8.8	10.3	12.3	13.9	15.5
720	3.8	4.8	5.6	6.6	7.4	8.2
1440	2.2	2.7	3.0	3.5	3.9	4.2

TABLE 2 IDF PARAMETERS – COUNTY OF BRANT						
Parameter	2	5	10	25	50	100
A	743	1593	2221	3158	3886	4688
B	6.0	11.0	12.0	15.0	16.0	17.0
C	0.7989	0.8789	0.9080	0.9355	0.9495	0.9624

COUNTY OF BRANT

**DEVELOPMENT AND
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SECTION 9

STORM DRAINAGE CONNECTIONS

November/2018

9.1.00 SINGLE FAMILY AND SEMI-DETACHED LOTS

The roof water leaders shall be discharged to splash pads in all Single Family, Semi-detached, Condominiums or Townhouse residential developments.

9.1.01 FOUNDATION DRAINS

Direct gravity connections of foundation drains to the storm sewers may be permitted in special cases. Foundation drains may be discharged to the storm sewer only in accordance with the specifications within this section.

Sump pumps shall be discharged to a splash pad immediately outside of the foundation wall. Connection of sump pumps to storm sewer will not be permitted.

The connection of the storm drain to the storm sewer shall be made by means of a manufactured tee on the storm sewer line (for storm sewer sizes up to and including 900mm) or by means of a saddle (for storm sewer sizes in excess of 900mm). Core and seal type products would also be acceptable.

9.1.02 STORM DRAIN MATERIALS

Storm drain connections shall be constructed of min. **150mm** polyvinyl chloride (SDR 28) pipe. Storm laterals from the Storm water main in the road allowance shall be white in colour.

9.1.03 PRIVATE DRAINS

Private drains/tiles are not permitted to discharge directly to a municipal ditch without approval from the County.

9.2.00 MULTI-FAMILY, HIGH RISE, INDUSTRIAL, INSTITUTIONAL, COMMERCIAL AND OTHER BLOCKS

9.2.01 GENERAL

All blocks of land within the plan of subdivision, intended for use other than for park purposes, **shall have a storm drain installed from the storm sewer to the street limit.**

9.2.02 CONNECTION

The storm drain connection to all multi-family, high rise, and other blocks shall be sized individually according to the intended use of the lands. The minimum size shall be 250mm. All connections shall have an inspection manhole constructed at property line

The design for the sizing of the connection shall be based on a constant 102mm/hr rainfall intensity using the appropriate runoff coefficient and the total block area.

9.2.03 DEPTH OF CONNECTION

The depth of the storm drain connection shall be governed by the grading of lands and the extent of the area to be served. The depth of the connection shall be sufficient to provide for drainage of all lands within the block, but in no case shall the depth to the top of the pipe be less than 1.2 metres.

9.2.04 CONNECTION TO MAIN SEWER

The connection of the storm drain to the storm sewer may be made at an existing manhole or directly to the storm sewer (if the size of the connection is less than half of the size of the storm sewer). If the connection size is equal to or greater than one half the size of the main sewer, the connection must be made to a manhole, existing or new, on the storm sewer. If the connection is made directly to the storm sewer pipe, then a manhole must be installed on the private lands within 1.5m of the street line.

9.2.05 STORM DRAIN MATERIALS

Storm drain connections shall be constructed of polyvinyl chloride (SDR 28) pipe

9.2.06 LOCATION AND TIMING OF CONSTRUCTION

Since the ultimate development of the block may be unknown at the time of the construction of the underground services, it may be desirable to delay the installation of the storm drain connections to the blocks in the plan of subdivision until further information is available.

If the block is developed prior to the placement of the surface course asphalt, then the service connection can be installed to the location required to suit the development. If no development proposals are received for the block at the time of the placement of the surface course asphalt, then the storm drain connections shall be installed to

the location shown on the approved engineering drawings prior to the placing of the surface course asphalt.

In either case, all trenches crossing the travelled portion of the roadway shall be backfilled with unshrinkable fill material.

9.3.00 BEDDING FOR STORM DRAIN CONNECTIONS

All storm drain connections shall be installed using Type B bedding using 150 mm granular A as bedding and 300mm of granular A for cover.

9.4.00 CONSTRUCTION

All storm drain connections shall be constructed in accordance with the O.P.S. standards and specifications current at the time of acceptance of the engineering drawings by the County.

Typical service entry locations can be seen on 17-303.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 10

LOT GRADING

**SEVERANCES, INDIVIDUAL SITE PLANS,
MISCELLANEOUS**

November/2018

10.1.00 GENERAL

The grading of single estate residential lots being developed through severances shall show that the proposed grading will not interfere with, or significantly alter existing drainage patterns and that the proposed house will have positive drainage away from the house while not discharging to adjacent lands.

All lot grading design and lot grading certifications shall only be accepted from qualified consulting engineers.

Ontario Land Surveyors may collect data to prepare the base survey information for the lot grading and certify foundation location and elevations.

10. 2.00 LOT GRADING PLAN

Drawing size is variable dependent upon the size of the lot, but details should be shown at a minimum 1:250 scale. For large (typically rural) lots, details are required for the entire lot. The entire "construction" area, and any areas affected by the construction (drainage, etc.) must be shown. Details of large grassed areas at the rear or sides of the lot are required.

A legal description of the property should be shown on the drawing. A reference to the particular severance should also be shown, along with the civic address and owner's name.

All distances and elevations will be in metric units. Geodetic datum is preferred, but assumed elevations will be accepted in some instances subject to the approval of the County. Plans must be clearly identified as being "proposed" or "final" plans.

Existing contours are to be shown at maximum .5m intervals, on a maximum 15m grid extending a minimum of 15m beyond the limits of the existing plan as to show existing drainage patterns.

Centreline, edge of pavement, shoulder and ditch elevations should be shown at maximum 20m intervals on any roadway adjacent to the lot.

Lot perimeter elevations of any lot to be re-graded shall remain the same with only the internal lot elevations changing. A 0.60m buffer strip shall be left undisturbed around the lot perimeter and shall be indicated on the approved Lot Grading Plan.

Direction of surface runoff will be shown by means of an arrow.

Any swales or ditches to be constructed must be shown.

Any 3:1 slopes must be shown on the drawing.

Rear and Side yard swales shall have a minimum grade of 2.0%. Maximum and minimum depths for all swales shall be 0.5m and 0.15m respectively. Maximum side slope on any swale shall be 3:1.

Grades for rear and side yard swales for infill lots or stormwater quality swales, less than the minimum standard of 2.0%, may be deemed acceptable by the County, in exceptional cases only.

The proposed building, private sewage and private water supply envelopes must be shown on the drawings.

10. 3.00 LOT GRADING DESIGN

All slopes on the property must provide positive drainage away from the building envelope. All proposed elevations (to properly define the grading of the property) are to be shown on the plan.

Slopes shall be between 2% and 10% with grade differences being taken up by 3:1 slopes maximum (4:1 preferred)

The driveway grade shall be between 2% and 5% sloping away from the house.

All retaining wall plans are to be designed, stamped and signed by a qualified structural engineer. Retaining walls shall be designed in accordance with the Ontario Building Code.

10. 4.00 CERTIFICATION

Plans are preferred to be prepared in digital format by a Consulting Engineer. Foundations and final lot grading are to be certified by the design engineer.

All lot grading design and lot grading certifications shall only be accepted from qualified consulting engineers.

Ontario Land Surveyors may collect data to prepare the base survey information for the lot grading and certify foundation location and elevations.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 11

SUBDIVISION LOT GRADING

November/2018

11.1.00 GENERAL

NOTE: Please contact the County for requirements for all Parklands, Walkways, etc.

The grading of all lots and blocks in new developments must be carefully monitored by the Developer's Engineer in order to provide sites that are suitable for the erection of buildings and to ensure satisfactory drainage from all lands within the development. In this regard, the design of the grading for all developments will be of primary concern to the municipality and the following criteria shall be used in the preparation of all lot grading plans. In applying the criteria, the main objective is to ensure that the property owner (i.e. resident) will have maximum use of his/her property while still providing good drainage. Although maximum limits are specified, initial grading design shall avoid maximum grades unless there are no alternatives.

The following grading criteria are applicable to all subdivision lots with less than 25m frontage.

All lot grading design and lot grading certifications shall only be accepted from qualified consulting engineers.

Ontario Land Surveyors may collect data to prepare the base survey information for the lot grading and certify foundation location and elevations.

11.2.00 LOT GRADING PLAN

Drawing size: (594mm x 841mm) A1

Scale: 1:500 for single family or semi-detached areas and 1:200 for multi-family areas.

All lots and blocks within the subdivision are to be shown and are numbered in accordance with the proposed registered plan.

Existing contours are to be shown at maximum 0.5m intervals within the subdivision limits extending approximately 30 metres, to enable assessment of the grading between the subdivision and the adjacent areas. (The interval of those elevations shall be dependent upon the degree of development of the adjoining lands, with developed areas requiring the most information.)

Proposed centreline road elevations are to be shown at 20m stations along all roads within and abutting the subdivision in accordance with the chainage on the profile drawings. In addition, centreline road elevations shall be shown opposite all lot corners.

Proposed elevations are to be shown for all lot corners and intermediate points of grade change. On larger blocks, a proposed elevation is to be shown at 15m intervals along the frontage of the block and at reasonable intervals along the sides and rear of the block to clearly illustrate the grading in relation to the surrounding lands and house type.

The **specified lot grade** (apron elevation) shall be shown at a location 6.0m minimum from the street line. For split type drainage patterns, the specified rear house grade shall also be shown. **The specified minimum basement floor elevation and top of foundation elevation for each lot shall also be shown.**

The specified lot grade (apron elevation) shall be a minimum of 0.3m above the lowest lot corner and in accordance with all other grading specifications in these standards.

Surface water runoff from the rear of all lots shall be indicated by means of an arrow indicating flow direction.

All swales, other than the normal side yard swales, are to be shown along with the invert elevations at regular intervals (i.e. centreline of each lot for rear yard swales).

All rear yard catchbasins shall be shown along with the top of grate elevation and the invert elevation of the outlet pipe.

All above ground infrastructure, (curbs, sidewalks, catchbasins, valves, hydrants, streetlight poles, transformers, supermailbox locations, etc), shall be shown on the lot grading plans. Driveways must have a minimum 1m clearance from these features.

Easements shall be shown on the lot grading plans.

All 3:1 slopes (terracing) required shall be shown with the intermediate grades specified.

The Lot Grading Plan shall make note of the grading styles that are applicable to the grading of the development.

The grading along the subdivision limits shall be carefully controlled to avoid adverse impact to the adjoining areas. A 0.6 m strip shall be left undisturbed along the subdivision boundaries abutting adjacent properties. Such strip must be indicated on the approved Lot Grading Plan.

Temporary silt fencing shall be installed (in low areas where runoff discharges onto other properties) along the inside of the 1.0 metre undisturbed barrier strip and maintained for the duration of the contract until such time as seeding or sodding takes place. This fencing shall be noted on the grading plan, or the Siltation Control plan.

Indicate all semi-detached lots with SD on all drawings.

For rural estate developments, lot grading plans shall show proposed locations for building envelopes, private sewage disposal system envelopes (plus alternate bed location), private water supply systems and driveways.

All culverts shall be designed and shown on the lot grading plans identifying culvert diameter, gauge, minimum length and type.

11. 2.01 LOT GRADING DESIGN

Lot drainage is to be self-contained within the subdivision limits even if it was not prior to development. All blocks and/or industrial site drainage are to be self-contained. Drainage over lands abutting the subdivision may be permitted in exceptional cases and where appropriate easements or drainage agreements can be entered into with abutting landowners at the discretion of the County.

The lot grading design shall provide for the temporary drainage of all blocks of land within the subdivision that are intended for further development under Site Plan Agreements.

The maximum lot surface grade for rear yards shall be 6%. A slope of 3:1 (3 parts horizontal to 1 part vertical) shall be used to take up any additional grade difference. Otherwise, an approved retaining wall is required. In any case, the total grade differential of rear lots is not to exceed 15% including retaining wall and 3:1 slopes. However, the rear yards are to have a minimum usable (continuous slope not exceeding 6%) depth of 6 metres from the rear of the house, irrespective of the 15%.

All slopes are to be constructed on the lower property.

All boulevard areas shall be graded with a constant slope from the curb to the street limit (minimum slope to be 2%; maximum slope to be 8% and all water boxes, manhole covers, valve boxes, etc. shall be set flush with the finished sod surface. Where sidewalks are required within the boulevard the maximum slope from curb to property line shall be 4%.

All lot surfaces shall be constructed to a minimum grade of 2% (excluding rear yard swales).

The front yards of all residential lots shall be graded to drain towards the street.

The grade of any front walkway shall not exceed 8 %.

A 0.5m to 1.0m wide grassed path sloping at 2% away from the house shall be constructed along one side of the building (typically the garage side) to allow proper access to rear yards.

All lots may require the use of rear lot catchbasins. Rear lot catchbasins are to be used only as last resort and must be entirely contained on the lot.

All lots may use a back to front drainage pattern in order to avoid potential drainage issues (e. wet basements) but shall not accept runoff from any adjacent lots.

Rear yard catchbasins and outlet pipes shall be located such that the catchbasin is located entirely on one lot and the outlet pipe is located on the same lot at 0.6 metre offset from property line. The centre of the catchbasin should be located 0.6m from property line.

Driveway grades shall be between 2% and 5%. The County may allow driveway grades up to 8% only in exceptional cases where physical conditions prohibit the use of lesser grades.

Residential Driveways with reverse slope are generally not permitted unless there are absolutely no other alternatives. These will be dealt with on a site specific basis. Water must always drain away from the building.

Industrial/Commercial loading docks may utilize an approach with reverse fall if drained by a catchbasin that is part of an overall integrated storm system.

In preparing grading plans for house sitings, the engineer shall establish maximum driveway grades which, allowing a 100mm construction tolerance for foundation control, will ensure the County's maximum and minimum grades will be met.

11.3.00 SWALES

All rear yard drainage shall be directed away from the houses in

defined swales which outlet at the curb, sidewalk, or a catchbasin.
Driveways shall not be used as outlets for any swales.

Drainage flows from one lot shall not enter onto another lot unless confined to swales and are part of an overall subdivision grading plan (swales from one lot to another, should flow directly) or the outlet is established on title in the form of a drainage agreement or easement to the satisfaction of the County.

The maximum flow allowable to any side yard swale shall be that from 4 rear yards or 0.1 hectares, whichever is less.

The maximum area contributing to a rear yard swale that may be discharged directly onto a road allowance shall be that of 4 rear yards or 0.1 hectare, whichever is less.

The maximum length of a rear yard swale between outlets shall be 75 metres. All rear yard drainage swales shall be located on one side of the common lot line between the abutting lot and not along the property line. All side yard swales, except for infill lots, shall be located on the common property line.

Rear and Side yard swales shall have a minimum slope of 2.0%. Maximum and minimum depths for all swales shall be 0.5m and 0.15m respectively. Maximum side slope on any swale shall be 3:1.

Slopes for rear and side yard swales for infill lots or stormwater quality swales, less than the minimum standard of 2.0%, may be deemed acceptable by the County, in exceptional cases only.

All drainage swales shall be located on one side of the common lot line between adjacent lots and not along the property line. The maximum distance from the centreline of a swale at any point, to the nearest property line shall not exceed 1.5m.

11.4.00 RETAINING WALLS AND FENCES

All retaining walls are to be dry-stone (interlocking, stacking type) or reinforced concrete when used to take up grade differentials, or adjacent to public property. Retaining wall plans shall be designed, stamped and signed by a qualified structural engineer and be approved by the County.

Timber retaining walls are generally not permitted but, may be considered only for internal grading of blocks or lots and between properties, and will be designed by a qualified engineer. Timber retaining walls will be constructed of dressed, pressure treated lumber

only.

All retaining walls shall be constructed entirely on the higher property, adjacent to the property line, and an easement shall be established on the lower property to provide access to the wall for maintenance purposes.

A minimum separation of 0.5 metres shall be maintained from the tiebacks to the foundation of any structure.

All retaining wall details must be noted on the engineering drawings and accepted by the County.

All retaining walls shall have fall protection installed as may be required, in accordance with the Ontario Building Code.

The Developer's engineer shall be responsible for the design, location, and inspection during construction, and certification of all retaining walls.

Any fencing that is to be installed abutting public lands (ie walkways and parklands) shall be constructed in accordance with OPSP 972.130. Bottom wire to be set 150mm above finished grade and placed entirely on private property.

11.5.00

CERTIFICATION (S)

Prior to application for a building permit, individual site plans for each lot or group of lots shall be prepared and shall be submitted to the Developers Engineer for approval. These site plans shall include all of the following:

- Dimensioned property limits,
- House location, (Actual footprint of proposed house)
- Finished floor elevation,
- Basement elevation,
- Underside of footing elevations,
- Lot grades at all corners and at intermediate locations as required to define the grading of the lot,
- All yard catchbasins with rim elevations, driveway location and percent grade,
- Rear yard percent grade, all 3 to 1 slopes and retaining walls,
- Fencing, guards and all utilities.
- Engineered fill areas.
- Driveway grades and locations.

For Rural Estate Developments the proposed location of any private sewage disposal system, any private water supply system, driveway entrance culverts (including size, length, location) and driveway grades, shall also be shown.

Individual lot grading plans are required as a condition of the issuance of a building permit for any lot within the subdivision. The Developer's Engineer shall review, approve, certify, stamp and sign that the plan conforms to the approved subdivision grading plans and the County of Brant grading standards and criteria. (A standard form is shown at the back of this section) Following approval and certification by the Developer's Engineer, the site plans shall be forwarded to the County of Brant, Building Division. The Developer's Engineer will certify that the location and elevation of rear lot catchbasins, if installed, are according to plan, prior to issuance of Building Permits. This is also one of the criteria for the services to receive Provisional acceptance.

The top of the foundation wall shall be certified as being in accordance with the approved lot grading plan prior to commencement of framing. The Developer's Engineer shall provide the County with a certificate (as noted at end of section) confirming that foundations are in conformity with the footing and top of foundation wall elevations shown on the approved grading plan.

Certification of foundation elevations by the Developer's Engineer shall be taken to mean conformity with the approved grading plan with a tolerance of 50mm and will include verification of top of foundation wall, any steps in the foundation (if applicable) and the garage sill. Non-conformance of foundation elevations shall be brought to the County's attention for further direction prior to proceeding with any further construction.

The Developer's Engineer shall inspect and certify that the lots to be sodded are in conformity with the approved grading plan (within a 50mm tolerance) and are approved for sodding.

At the time of inspection, it is recommended that all foundations be marked to illustrate final grade and intermediate grade stakes shall be provided. Subject to any changes required as a result of this inspection, the Developer's Engineer shall provide the County with lot grading certificates (as noted at end of section) advising that the lot grading conforms to the approved grading plan.

Prior to the release of any lot from the conditions of the Subdivision Agreement, or final Letter of Credit reduction, the Developer's Engineer shall provide final certification to the County of Brant in the form of as-built elevations on the grading plan in hard copy and digital format to the satisfaction of the County.

11.6.00 AREA ROUGH GRADING PLAN

Prior to any earthworks or grading, all sediment and erosion controls shall be installed in accordance with Section 8.1.04.

11.6.01 GENERAL

Where earth cuts and fills in excess of .5m are required, rough grading must be performed in conjunction with the road construction and prior to the placement of the base course asphalt.

The area rough grading plan must identify all areas where the depth of fill sections and cut sections are in excess of .5m.

11.6.02 CONSTRUCTION REQUIREMENTS

Prior to commencement of rough grading, the Developer must enforce a siltation and erosion control program to the satisfaction of the County, and any other affected agency.

Prior to placement of imported fill material on registered lots where private sewage disposal systems are required, the Developer's Engineer must certify in writing, to the County, that the imported fill material placed on Registered lots meets or exceeds the original ground's capability to support a private sewage disposal system

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 12

SIGNS

November/2018

12.0.00 GENERAL

The Developer will supply and install all street name sign, warning signs and parking signs at the sole cost of the Developer.

All signs placed by others may be subject to acceptance by the County.

12.1.00 The County of Brant requires that Sign Evaluation Study be undertaken by a qualified professional which evaluates the regulatory and advisory/warning signage along the municipal road system that will be impacted by the development. The Sign Evaluation Study shall have regard for the Ontario Traffic Manual (as amended), County of Brant Transportation Master Plans and applicable County By-laws and other documents as deemed relevant by the County. All Sign Evaluation Studies are to be to the satisfaction of the County of Brant.

12.2.00 The Developer will supply and install a minimum of two signs at each storm water management facility (SWMF) to include SWMF number, location and applicable wording to the satisfaction of the County of Brant.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 13

TREE PLANTING

November/2018

13.1.00 RESPONSIBILITY

Trees are to be planted in such a manner that ensure they will not be in conflict with County or utility infrastructure or obstruct sightlines of driveways or intersections. Landscaping in other areas shall be in accordance with the requirements of the County of Brant.

Landscaping plans and specifications shall be prepared, and submitted to the County for acceptance. The landscaping plan shall show the proposed treatment of boulevards, parklands and all other dedicated lands, as well as school sites. The Developer shall carry out the work detailed in the landscaping plan and specifications concurrently with the development of adjacent lands, to the satisfaction of the County.

The Landscaping Plan must be in conformity with the approved grading plan for the development in order that the storm water management plan is not negatively affected.

13.2.00 LOCATIONS

At least one tree shall be planted within or along the frontage of each semi-detached and single family lot. For multi-family lots, blocks and parkland one tree shall be planted for every 500m². Corner lots may require a minimum of two trees per lot. However, no tree shall be planted closer than 17.5 m to the face of any traffic control sign (e.g. Stop, Yield, speed limit, etc.), and for intersections without signs, not closer than 15 m to the intersection measured from the edge of pavement of the intersecting street.

13.3.00 TIMING OF CONSTRUCTION

All trees are to be planted during the dormant season in unfrozen soil, and at least two years prior to final acceptance of the subdivision by the County of Brant. Some varieties of trees are recommended for spring planting only. These varieties shall be indicated as such on the landscape plan.

13.4.00 TYPES

Trees to be planted shall be selected from the County of Brant Recommended Planting Species. Front yard trees are to be selected based on their environmental tolerance and disease resistance, as well as their ultimate size. The species of trees, and the percentages of each, to be used in the development shall be submitted in writing for acceptance by the County of Brant, prior to the commencement of the planting program.

Coniferous trees will not be permitted in the County of Brant right of way.

13.5.00 QUALITY AND SOURCE

All trees used for plantings shall be first-quality, nursery grown stock of minimum 50mm caliper for all trees, balled and burlapped. All trees shall be free from physical damage, insects, pests and diseases, and must have at least three-quarters of the root system intact. Planting shall be done in accordance with the Ontario Landscape Contractors Standards.

13.6.00 SCREENING

A screening of trees suitable for the purpose may be required to be planted adjacent to the rear or side property lines of land abutting collector or arterial roads. The screening shall be planted on the affected property, and not on the road allowance. The species and spacing of the proposed tree screen shall be submitted in writing, for accepted by the County, prior to commencement of the planting program. All tree screening shall be installed during the spring or fall dormant season, and at least two year prior to final acceptance of the subdivision by the County of Brant.

13.7.00 INSTALLATION

All trees shall be staked, using two steel T-bars per tree, and tied with non-marking straps or ties.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 14

PARKLANDS

November/2018

- 14.1.00** The Developer shall be responsible for preparing detailed grading and landscaping plans for all lands being dedicated for park purposes. These plans must be submitted for acceptance by the County, prior to finalization of the Development Agreement. These plans shall show all existing trees and features that are in conformity with the end use of the park and that are slated to remain. All dead trees and other features not in conformity to the end use of the park shall be removed from the site for disposal.

The plans shall also show the layout of sports facilities, play areas, parking lots, pathways, signage, servicing (water, sewer and hydro) and all furniture and accessories required by the County.

14.2.00 GRADING

The park shall be graded in accordance with the approved Grading Plan, with particular care being taken to avoid damage to all trees and/or features that are slated to remain.

TOPSOIL

Topsoil shall be a fertile loam material that is free of roots, vegetation or other debris of a size and quantity that would prevent proper placement of the topsoil. The topsoil shall not contain material greater than 25mm in size, such as stones and clods.

Acceptable topsoil shall be placed at a minimum depth of 150mm.

SOD

Sodding of parklands shall conform to OPSS 571 excluding maintenance requirements; section 571.07.05. Maintenance requirements of completed sod are listed else where in these design criteria.

PLANTINGS

All plantings shall be shown in a detailed landscaping plan. Planting shall be selected from the County of Brant List of Acceptable Plant Species.

Trees – as a minimum tree plantings shall conform to the requirements of section 13 of these design criteria.

Shrubs – all shrubs shall be planted in continuous shrub beds. Preferred areas for shrub placement shall be park entry features and greenbelt areas.

Alternative Ground Cover – may be used in areas of slope stabilization and within greenbelt areas of parklands. All alternative ground cover planting shall be subject to acceptance by the County.

All plantings shall be included in a Planting List. The Planting list shall contain the following information for all plantings: quantity, symbol, botanical name, common name, size, minimum spacing and any additional information as required by the County.

SPORTS FIELD FACILITIES

Layout of sports facilities shall be shown on the plans as required by the County. In general sports fields are to be laid out with a northeast/southwest orientation along the playing axis.

PLAY AREAS

In cases where the Developer includes playground installation as part of the parkland development he may be eligible for Recreational Facilities and Equipment Development Charges credits.

Play areas shall be shown on the plans using the following criteria:

- Show all safety setbacks and non-encroachment zones conforming to current CSA guidelines for playgrounds.
- Show a minimum of 20m buffer area between any residential properties and the play area.
- A minimum of 2 park benches shall be provided for each play area.

The Developer's Engineer should contact the County to obtain the most current details and specifications for playground installations prior to tendering for construction. A list of approved playground equipment/structures and manufacturers is available from the County of Brant, Parks and Recreation Division.

PARKING

Parkland which includes Sports field facilities shall include adequate parking in accordance with the County of Brant Zoning By-law.

PATHWAYS

Major Pedestrian Pathways shall act as a link through parklands to schools, community centre and other transportation routes. Major Pedestrian Pathways shall be designed to accommodate maintenance vehicles with 150mm of compacted Granular "A" base material and 50mm HL-3A surface; with a minimum pavement width of 2.5m and minimum radius of 15m. There shall be a minimum buffer of 3.0m between pathways and adjacent properties or greenbelt areas.

Major pathways shall be light as require by the County.

14.3.00 TIMING OF CONSTRUCTION

All park blocks and boulevards shall be graded, topsoiled and sodded prior to provisional acceptance by the County.

14.4.00 MAINTENANCE

Maintenance of parkland shall be detailed in the registered Subdivision and Development Agreement. As a minimum, the Developer shall be responsible for the grass mowing and watering on all parkland, for a period of at least 90 days after provisional acceptance. The Developer shall maintain all features of the parklands during this period.

14.5.00 SERVICES

Water, sewer and hydro services shall be designed and constructed within the plan of subdivision, so as to provide service connections to parkland along street frontage that are convenient and accessible for future parkland development.

The Developer's Engineer shall verify with the County servicing requirements for any parklands. Typically servicing shall consist of one 19mm water service to property line offset 10m from any side property line.

14.6.0 FENCING

Perimeter property line fence to be a minimum of 1.5m high and constructed of black vinyl coated 38mm diamond mesh, 9 gauge chain link fence. Fencing shall have minimum post diameter of 50mm

(2") and minimum top rail diameter of 40mm (1-5/8"). Fencing shall be placed 150mm from property line on County property.

14.7.0 PARKLANDS

All parklands are to be designed to meet the specifications as per the County of Brant's Accessible Design Standards document.

COUNTY OF BRANT

**DEVELOPMENT AND ENGINEERING
STANDARDS**

SECTION 15

STREET LIGHTING

November/2018

15.1.00 GENERAL

Street lighting system wiring for roadways in the County of Brant shall be underground and shall meet the following requirements, in addition to those listed here, of the appropriate hydro authority and the Electrical Safety Authority (ESA). The Developer shall provide proof of ESA inspection prior to energization of the street lighting system.

15.1.01 STANDARD LOCATION FOR POLES

For urban cross-sections, poles shall be located at lot lines and/or a distance of not greater than 40 metres, and 1.8 metres behind the back of the curb.

For rural cross-sections, poles shall be located behind the ditch, preferably at lot lines. Due to the variability that may occur in rural subdivision design, the location of the poles may vary between developments. However, the guiding principles for the location shall be:

- a. No closer than 1m to the property line
- b. In a consistent offset from the property line for each street
- c. At a location where the luminaire height is within the manufacturers guidelines.

Poles and base-mounted transformers shall be preferably located at alternate lot lines. Poles and base-mounted transformers shall have a minimum separation of 3.0m.

15.1.02 POLES

Street light poles shall meet the requirements of OPSD 2210.02 and shall be from the manufacturer Ontario Stresscrete, or equivalent, spun round concrete of Class A strength or better with ground lug in handhole. Poles on local or collector roads shall be 10m overall and arterial roadway poles shall be 13.7m.

15.1.03 BRACKETS

1. Brackets on local roads shall be 1.8 metres long with a 0.9 metre rise.
2. Brackets on arterial roads shall be 3 metres with a 1.2 metre rise.
3. All brackets shall be tapered elliptical aluminium (or steel), single member type complete with pole plate GTE Sylvania #RE6L4, or equivalent.

15.1.04 LUMINAIRES

1. All street lighting installations shall be energy efficient LED lighting.
2. Street light system designs must be completed by a Lighting Consultant or Professional Engineer licensed to practice professional engineering in the Province of Ontario, who has expertise in this field of endeavour.
3. All lamps shall be rated for a minimum like of 100,000 hours.
4. All luminaries shall have an individual photocell. Luminaires are to be in accordance with the Brant Municipal Enterprise LED Conversion Project.

15.1.05 CONTROLS

Each circuit shall be controlled by 30/60 ampere single pole normally open relay complete with twistlock photo control (Ferranti packard EPAC). Relay shall have separate coil and load fuses. Control on residential collector or local roadways shall be integral to the luminaire.

15.1.06 Cable assemblies from transformer vault to pole handholes shall consist of 2 single conductor #2 AWG conductor XLPE/PVC 600 volt and one single conductor #6 AWG bare copper manufactured to IPCEA S-66-524 latest edition. For residential collector and local roadways, cable shall be 2 #10 AWG copper NMW-10.

From pole handhole to luminaire conductors shall be #12 AWG TWU solid copper.

Splices shall be made only in handholes with Brant County Power approved connectors compression conductors and Scotch brand tape.

15.1.07 DUCT

On arterial roadways, cables from the transformer vault shall be installed in 50mm flexible polyethylene duct suitable for direct buried uses, or in 50mm rigid Type I duct encased in 20 MPa concrete for road crossings and existing and proposed driveways. Cover on duct or concrete shall not be less than 0.75m.

15.1.08 GROUNDING

Ground rods shall be provided for each pole.

15.1.09 FUSING

Each street lighting feeder shall be protected at the transformer by a suitably sized in-line fuse, type K7K (ATM), in a waterproof fuseholder.

15.1.10 EXCEPTION

The County of Brant does permit the use of decorative streetlights. Please consult Public Works staff for acceptable models. Model selection is limited in order that the County can manage inventories.

NOTE: Where decorative streetlights are used two extra streetlights shall be supplied to the County to be placed in the County inventory.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 16

**MULTIPLE UNIT DWELLINGS,
COMMERCIAL, INDUSTRIAL
OR INSTITUTIONAL LANDS**

November/2018

16.1.00 SITE PLAN AGREEMENT

In cases where a subject property is affected by site plan control in the applicable zoning by-law, Developers of all multiple unit dwellings, commercial or institutional lands may be required to enter into Site Plan Agreement with the County of Brant prior to the commencement of construction of any building or service within the parcel of land. Refer to Section 6 for additional information regarding agreements.

The Developer shall contact the Development Services Department for information concerning site plan agreements.

16.2.00 PROFESSIONAL ENGINEER

The Developer shall retain a qualified Professional Engineer to prepare all engineering drawings and to supervise the construction of all engineering services. The Engineer shall act as the Developer's representative in all matters pertaining to the design and construction of the services in the development

16.3.00 THE COUNTY OF BRANT'S RESPONSIBILITY

The County of Brant is responsible for all roads, storm sewers, sanitary sewers and watermains that are constructed or proposed for construction on all public road allowances and within registered easements within the County of Brant.

Connection to any of those services or utilities requires County approval.

Engineering Drawings shall be prepared for the site indicating the location, size, grade, invert elevations, material and bedding requirements for all sanitary and watermain servicing and connections, and submitted to the County of Brant for approval. Engineering drawings shall also be prepared for all sanitary sewers, storm sewer and watermains that are required to be constructed within road allowances or registered easements to service the subject property. These drawings are to be prepared in accordance with these standards.

The County of Brant is also responsible for the collection of revenue for water consumption. Therefore, the metering arrangement for the subject property shall also require County approval.

16. 4.00 ENGINEERING DRAWINGS

16.4.01 REQUIREMENTS

Engineering drawings may be required as detailed in a site plan agreement for each development and may include, but not be limited to:

- a) Site Grading Plan, siltation and erosion control
- b) Site Services Plan & Profile
- c) Landscaping Plan
- d) Electrical Services Plan
- e) Any servicing external to the site that may be required

Additional engineering drawings shall be prepared where required, or when requested, by the County.

All engineering drawings shall be prepared from one base plan, prepared at a scale of 1:200, and shall contain information as listed in sections 3 and 4 of the County of Brant's Site Plan Submission Requirements which are available at the County of Brant Customer Service Office at 66 Grand River Street North, Paris.

16.4.02 SITE GRADING PLAN

The site grading plan shall show the following information:

- a) Centreline grades at 20m intervals along all existing streets bounding the property and existing grades.
- b) A legend indicating existing and proposed elevations.
- c) Contours at maximum 0.5m intervals to indicate the existing elevations of the site. These contours are to extend to a minimum distance of 30m beyond the property limits to indicate the grading and drainage patterns of the adjacent lands.
- d) Cross sections, as required, to clarify the proposed grading, particularly in relation to adjacent lands.
- e) Proposed elevations on paved areas, around proposed buildings, along swales, along roadways, parking areas, driveways, catchbasin top of grate elevations, and any other elevations necessary to establish the grading and drainage patterns for the development. Arrows are to be

used to indicate direction of the surface drainage. Large heavy arrows are to be used to indicate overland flow routes.

- f) All manholes, catchbasins, hydrants and valves to be shown by a symbol with a legend provided.
- g) All sidewalks and walkways.
- h) All building elevations to be established and referenced to a Finished First Floor top of foundation wall and a Finished Basement Floor elevations.
- i) A typical roadway cross section to indicate the pavement structure and granular base design.
- j) Roadway-driveway dimensions and curb radii.
- k) The location and detail of all curbs adjacent to roadways.
- l) The location of embankments, retaining walls, stairs.
- m) All proposed and existing trees, shrubs adjacent to roadways.

16.4.03 SITE SERVICES PLAN & PROFILE

The Site Services Plan & Profile **must** include the following information:

- a) All existing underground services on the streets and easements adjacent to the property.
- b) The location, size, grade, invert elevations of all storm and sanitary service connections to the property.
- c) The location and size of all watermain connections to this property.
- d) The basement floor elevations and top of foundation elevations of all buildings to be constructed.
- e) The location, size, length, grade, for all sanitary, storm and water services to be constructed within the development.

- h) The location, invert elevation and rim elevations for all sanitary and storm manholes and catchbasins to be constructed.
- i) The location of all hydrants, valves and water meters within the development.
- j) The location and size of all sanitary, storm and water service connections to the individual units.
- k) The location of all roof water leaders that are to be connected to the storm sewer. There will be no direct connection of Foundation Drains to the Storm or Sanitary Sewer System.
- l) All construction notes required describing the construction details or requirements.
- m) Profiles indicating water service, storm service, sanitary service and utilities for all internal streets in multiple unit dwelling developments ; profiles and/or cross-sections to clearly identify service and utility crossings for all commercial, industrial or institutional lands.

16.4.04 LANDSCAPING PLAN

The Landscaping Plan shall be completed by a qualified professional. The Landscaping plan shall show all landscaping details as required by the Site Plan Agreement.

All manholes, catchbasins, hydrants, valves, streetlights and other servicing features that appear above grade shall also be shown on the Landscaping Plan.

16.4.05 ELECTRICAL SERVICES PLAN

A qualified Electrical Consulting Engineer shall prepare the Electrical Services Plan. The Electrical Services Plan shall show all details of the electrical distribution system and the street lighting system.

The Electrical Services Plan shall be submitted concurrently to the Hydro Authority and the County of Brant.

16.5.00 DESIGN REQUIREMENTS

16.5.01 SITE GRADING DESIGN

- a) The stormwater management of the site is to be self-contained, where it is not feasible to manage stormwater within the site, drainage agreements/easements (registered on title) with neighbouring landowners may be an option. These exceptional cases may be considered by the County.
- b) The grading of the site is to be compatible with the elevation of the surrounding lands and in conformity with sections 10 and 11 of these criteria.
- c) **The maximum lot surface grade for landscape areas shall be 10%.** A slope of 3:1 (3 parts horizontal to 1 part vertical) shall be used to take up any additional grade difference. The minimum slope for all landscape areas shall be 2%.

Swales shall have a minimum grade of 2%. Maximum and minimum depth of all swales shall be 0.5m and 0.15m respectively. Maximum side slope on any swale shall be 3:1.

Slopes for swales for infill lots or stormwater quality swales, less than the minimum standard of 2%, may be deemed acceptable by the County, in exceptional cases only.

All drainage swales shall be located on one side of the common lot line between adjacent lots and not along the property line.

Driveways shall not be used as outlets for any swales.

- d) The maximum length for any drainage swale shall be 90m.
- e) All driveways shall have positive drainage toward the roadway from the property line only and a break in grade is required at the property line.
- f) Maximum ponding depth within parking areas shall not exceed 0.3m (300mm) in depth.

16.5.02 INTERNAL ROADWAY DESIGN

- a) The minimum pavement design for all multiple unit development roadways shall be:
- b) 40mm of HL3, 50mm of HL4, 150mm of Granular A and additional approved granular product so as to create a minimum Granular Base Equivalency (GBE) of 600. All urban road cross-sections shall have sub-drains located lower than the lowest elevation of granular material in the road base.
- c) All driveways in multiple unit development projects shall be paved with asphalt from the edge of the roadway to the garage. The minimum pavement design for all driveways, parking and non-truck lanes
 - Asphalt - 40 mm HL3 surface course
 - 50mm HL4 base course
 - Granular base 150mm of Granular 'A' plus additional granular material to create a GBE of 600mm.
- d) The minimum width of a multiple unit development roadway for two-way traffic shall be 9.2m measured from gutter line to gutter line. Smaller widths may be accepted subject to providing adequate access for emergency and collection vehicles as well as providing areas for adequate parking. Vehicle turning diagrams are to be shown on the Traffic Plan, indicating the size and the type of vehicle.
- e) All roadways serving multiple unit development projects shall be designed to facilitate passage of emergency and service vehicles. Curb returns having a 7.62m radius and inside bends having at least a 15.24m radius are required. On dead end streets provisions shall be provided for vehicle turning.
- f) The minimum grade for any multiple unit development roadway shall be 0.5% and the maximum grade shall be 6%.
- g) The minimum grade for any driveway in a multiple unit development project shall be 2% and the maximum grade shall be 8%. This maximum grade is not recommended and should be employed only in exceptional cases where physical conditions prohibit the use of lesser grades.

- h) The use of recycled asphalt is permitted in site plan developments in place of gravel for rear parking or storage areas. If granular material is to be used, a 2m x 2m asphalt pad is to be provided around any structure (manhole or catchbasin) to mitigate the potential of granular material entering the underground infrastructure.

16.5.03 SITE SERVICES DESIGN

- a) All storm sewers shall be designed in accordance with the requirements of the Ontario Building Code and Sections H and I.
- b) All storm sewers shall be located within the limits of the roadway with storm service connections being provided as required.

Residential Roof leaders shall not be connected to the storm sewer; they must be surface discharged via a splashpad. Commercial, Industrial & Institutional Roof Water Leaders may only be connected to the storm sewer if a comprehensive stormwater management plan for the site is acceptance by the County.

There shall be no direct connection of weeping tiles or foundation drains to the storm or sanitary sewer system.

- c) All storm sewer connections shall be sized according to the requirements of the Ontario Plumbing Code and shall be installed on a minimum grade of 0.5%.
- d) Yard catchbasins shall be provided, where required, for drainage of landscaped areas.
- e) Catchbasin manholes may be used for roadway drainage.
- f) Maximum spacing of catchbasins for roadway drainage shall be 60m.
- g) All watermain shall be designed in accordance with the requirements of the Ontario Plumbing Code. The watermain design shall be submitted to the County of Brant, for acceptance of the watermain layout and the hydrant locations.

16.5.04 LANDSCAPING DESIGN

The landscaping requirements shall be detailed in the Site Plan Agreement.

16.5.05 ELECTRICAL DESIGN REQUIREMENTS

The requirements for the design of the electrical distribution system and the street lighting shall be agreed upon with the Hydro Authority prior to commencement of the design.

16.6.00 AS CONSTRUCTED DRAWINGS

Once all construction is complete, the design drawings shall be amended to incorporate all changes/alterations made during construction, to properly represent the final as-constructed conditions. As-constructed drawings shall be submitted in both digital and mylar formats to the satisfaction of the County of Brant.

The requirement for submission of as constructed drawings shall be detailed in the development agreement. All multiple unit dwellings shall submit as constructed drawings.

16.7.00 CERTIFICATION

Upon completion of construction the Developer's Engineers shall provide certification to the County of Brant that all works have been constructed in accordance with the approved plans and specifications and in accordance with good engineering practices as per County of Brant policy DVS-2007-01.

16.8.00 FINAL INSPECTION

The Developer's Engineer shall carry out a final inspection of the works, upon completion of all construction. All deficiencies found during final inspection shall be immediately corrected by the Developer. This final inspection is carried out for the benefit of the County of Brant, and shall in no way relieve the Developer of his/her obligations under the applicable Agreement.

The Developer's Engineer shall provide a certificate indicating that all site works have been constructed in accordance with the

approved plans.

COUNTY OF BRANT

**DEVELOPMENT AND
DEVELOPMENT STANDARDS**

SECTION 17

SANITARY SEWERS

November/2018

This document outlines the minimum requirements for the design of sanitary sewer systems.

Design computations for sanitary sewer systems must be completed on a standard calculation sheet in the format recommended by MOE guidelines.

17.1.0 GENERAL REQUIREMENTS

Sanitary sewers are not in any case permitted to accept foundation or weeping tile drainage or roof drainage.

All sanitary sewer and appurtenances are to be designed and constructed in accordance with the current County of Brant and Ministry of the Environment standard drawings and specifications.

All sewers shall be designed for an embankment condition

In cases of new subdivisions, the consulting Engineer is required to establish the geodetic invert elevations and ties of all sanitary sewer connections at street line and to make this information available on the as-built plans to the County of Brant.

17.2.00 DESIGN FLOW

17.2.01 Average Dry Weather Flow

Type of Development	Unit Sewage Flow	
	m ³ /person/day	m ³ /person/s
Residential ¹	.300	3.472 x 10 ⁻⁶
	m ³ /ha/day	m ³ /ha/s
Schools	12.1	1.400 x 10 ⁻⁴
Light Commercial Areas	28.0	3.241 x 10 ⁻⁴
Community Services	18.0	2.083 x 10 ⁻⁴
Light Industrial Areas	28.0	3.241 x 10 ⁻⁴
Hospitals	1.8m ³ /bed/day	2.083 x 10 ⁻⁵ m ³ /bed/s

¹Residential flows to be calculated based on 3.1 persons per unit. The County of Brant Official Plan shall be referenced in relation to residential densities.

These population densities are guidelines only. Individual studies shall be made for special commercial establishments, major commercial areas and special industrial and major industrial areas.

The design of sanitary sewers should be based on the ultimate sewage flows.

17 2.02 Peak Sanitary Flow Factor

The peak sanitary flow will be derived by applying the ratio established by the Harmon formula to the average sanitary flow for **residential and community services area** as follows: Refer to peaking factor table at the end of this section.

$$M = 1 + (14 / (4 + P^{0.5})) ; 2 < M < 5$$

Where M = ratio of peak flow to average flow
 P = the tributary population in thousands

For **commercial and industrial land uses**, the peaking factor will be determined from a modified Harmon formula as follows:

$$M_e = 0.80 * \{1 + (14 / (4 + P_e^{0.5}))\}$$

Where M_e = ratio of peak flow to average flow
 P_e = equivalent tributary population in thousands

When tributary area consists of **combined** residential, industrial and commercial land uses, the peaking factor shall be calculated using the modified Harmon formula where K_{av} shall be determined as follows:

$$M_{av} = K_{av} * \{1 + [14 / (4 + (P+P_e)^{0.5})]\}$$

$$\text{Where } K_{av} = \{AR + 0.80 * (AI + AC) / (AR+AI+AC)\}$$

AR = residential area
AI = industrial area
AC = commercial area

17. 2.03 Infiltration Allowance

Except under unusual circumstances, infiltration allowance shall be determined at $2.3 \times 10^{-4} \text{ m}^3/\text{s/ha}$ for all land use types.

17. 2.04 Design Flow

Design Flow = Av. Dry Weather Flow $\times$ Av. Peak Sanitary Flow Factor + Infiltration Allowance

17. 3.0 PIPE SIZE

To determine the pipe size and its capacity, Manning's Formula shall be used. Manning's Formula is expressed as:

$$Q = 1/n * R^{2/3} * S^{1/2} * A$$

Where Q = design flow (m^3/sec)
 n = coefficient of roughness (dimensionless)
 R = hydraulic radius (m)
 S = slope (m/m)
 A = section area of flow (m^2)

For all smooth walled pipe, the coefficient of roughness shall be 0.013.

For Residential Areas, minimum diameter shall be 200 mm.

The minimum grade on a 200 mm sanitary sewer is 0.40% if minimum 13 units are connected. Where there are only a few dwelling units connected to the upper section of a 200 mm sanitary sewer, the minimum grades shall be adjusted as follows:

1 to 5 units	0.65%
6 to 8 units	0.55%
9 to 12 units	0.45%

If the minimum flowing full velocity cannot be achieved on the uppermost run of sewer in a system using a 200mm pipe, then 150mm pipe at a minimum slope of 1% may be permitted.

For Commercial and Industrial Areas, minimum diameter shall be 200 mm at minimum grade of 0.5%.

The capacity of all sanitary sewer shall be determined on the basis of the pipe flowing full, but the design flows should not exceed 90% of full capacity.

17.4.0 FLOW VELOCITIES

The flow velocity may be determined from standard tables at the back of this section or by $V = Q/A$

Where Q = design flow (m^3/sec)
 A = cross section area of flow (m^2)

The maximum velocity shall not be greater than 3m/sec with the pipe flowing full, and the minimum velocity shall not be less than 0.60 m/sec.

The actual velocity for a 200mm pipe (or greater) shall not be less than 0.5m/s

17.5.0 SEWER PIPE

17.5.01 Materials

Sanitary sewers shall be constructed of polyvinyl chloride (PVC) minimum SDR 35 pipe up to and including diameters of 450mm. All sanitary sewers shall meet OPSS and AWWA standards. Alternative pipe materials such as concrete and HDPE may be considered for sizes larger than 450mm. The type and classification of all sanitary sewer pipes and the sewer bedding type shall be clearly indicated on all profile drawings for each sewer length.

17.5.02 Pipe Bedding

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. All pipes are to be designed assuming a trench condition. Details of the types of bedding are to be as illustrated in the Ontario Provincial Standard Drawings. In general, Granular A compacted to 95% Proctor Density to Springline with a minimum 300mm sand cover above the crown shall be used for sewers in new developments or as per geotechnical report (whichever is greater).

17.6.0 PIPE DEPTH

The top of the sewer pipe shall be a minimum of 2.4 m below the centerline of the road. Insulation is required on pipes and services less than 1.5m deep, where the extent of insulation is to be designed by an engineer or to an acceptable standard.

17.7.0 PIPE LOCATION

The sewer line shall be located in accordance with typical road section drawing CBSD 7-101.

17.8.0 TYPE OF PIPE AND JOINT ACCEPTABLE FOR SANITARY SEWERS

17.8.01 Concrete Pipe

For Residential and Commercial areas, concrete pipe may be used for pipe sizes greater than or equal to 450mm diameter.

All concrete pipe and fittings shall conform in all respects to the requirements of the current standards of the American Society of Testing and Materials (ASTM) as follows:

- a) Class 2 and Class 3 Non-Reinforced Concrete Pipe, CSA A257.1.
- b) Reinforced Concrete Pipe, Classes 50-D to 140-D inclusive, CSA A257.2.

Gaskets for concrete pipe shall meet the requirements of current ASTM Designation C443.

Maximum allowable Joint Deflection is 66% of manufacturer's recommendations.

17.8.02 Polyvinyl Chloride (P.V.C.) Pipe

P.V.C. pipe may be used, provided the requirements of OPSS, CSA and A.S.T.M. designation D-3034-77 are met for sizes up to and including 375mm diameter and A.S.T.M. designation F-679 for sizes 450mm to 675mm diameter.

For residential areas, P.V.C. pipe from 200mm to 675mm diameter may be used.

For commercial and industrial areas, P.V.C. pipe from 300mm to 675mm diameter may be used.

All joints using flexible Electrometric seals shall conform to current requirements of A.S.T.M. designation D-3212.

Maximum allowable Joint Deflection is 66% of manufacturer's recommendations

The allowable minimum curve radius recommended by the manufacturer shall not be exceeded. Deflection in the joint is not allowed.

Saddle type connections are not permitted. Tee connections are permitted, but the designer must take into consideration the tangent lengths of the tee connections when calculating the minimum achievable radius.

Ultra-rib pipe shall not be permitted for installation in the County of Brant.

17.8.03 Curved Sewers

Generally, curved sanitary sewers should be avoided. In case where suitability and efficiency of design suggest doing so, the County will determine approval condition on a site-specific basis.

17.8.04 Reinforced Concrete Pipe

Radius pipe (also referred to as beveled or mitered pipe) may be used for short radius bends. The pipe shall meet the requirements of CSA 257.2 or A.S.T.M C-76 for reinforced concrete radius pipe for sizes 525mm - 3050mm diameter.

NOTE: for flat curves (long radius), straight pipe with joint deflections is permissible. Maximum joint deflection shall be 13mm to conform to CSA 257.3 or A.S.T.M C-443.

17.9.0 MAINTENANCE HOLES TYPES

Maintenance holes may be constructed of pre-cast or poured concrete. O.P.S.D. details shall be used for maintenance hole design where applicable. Although these Standard Drawings provide details for maintenance holes up to certain maximum depths and sizes, the consulting Engineer shall analyse, individually, each application of the standards relative to soil conditions, loading and other pertinent factors to determine structural suitability. In all cases where the Standard Drawings are not applicable, the maintenance holes shall be individually designed and detailed. Working drawings must be provided for poured in place structures.

A reference shall be made on all profile drawings to the type and size of all sanitary maintenance holes. In the case of the standard 1200mm pre-cast maintenance hole, the size of the maintenance hole may be omitted and reference need only be made to the standard O.P.S.D. number.

Pre-cast maintenance holes shall conform to A.S.T.M. Specification C-

478M latest revision.

17.9.01 MAINTENANCE HOLE DESIGN

- (a) All maintenance hole chamber openings shall be located on the side of the maintenance hole parallel to the flow for straight run maintenance holes, or on the upstream side of the maintenance hole at all junctions.
- (b) The direction of flow through any maintenance hole shall not be permitted at acute interior angles.
- (c) Safety grating are required at the mid-point depth of maintenance hole, when the depth is between 5.0 and 10.0m. Additional safety grates are required at third-point depths, when the maintenance hole is equal to or greater than 10.0m to 15.0m deep. All incoming pipes are to be below safety gratings, where possible.
- (d) The obvert of the inlet pipe(s) shall not be lower than the obvert of the outlet pipe.

The minimum drop across maintenance holes shall be as follows:

<u>Change of Direction</u>	<u>Minimum Drop (mm)</u>
0 degree to 15 degrees	15
16 degree to 45 degrees	50
46 degrees to 90 degrees	100

- (e) Where the difference in elevation between the obvert of the inlet and outlet pipes exceeds 0.6m, a drop structure shall be placed on the inlet pipe, with the invert of the drop pipe located at the spring line of the outlet pipe. Design shall be in conformity with OPSD 1003.020.
- (f) All sewer maintenance holes shall be benched to the obvert of the outlet pipe on a vertical projection from the spring line of the sewer.
- (g) The minimum width of benching in all maintenance holes shall be 250mm.
- (h) Maintenance holes in boulevards shall be located, wherever possible, a minimum of 1.5m from the face of curb or other utilities or street furniture.

The maximum spacing between maintenance holes shall be as follows:

<u>Pipe Size</u>	<u>Maximum Maintenance Hole Spacing</u>
200-450mm	90 metres
500mm to 900mm	100 metres
900mm and over	as approved by the County

Maintenance holes are required at all mainline pipe junctions, and at any changes in grade, alignment or pipe sizes.

- (i) Sampling manholes are required to be installed on private property adjacent to the property line fronting the sanitary sewer for all commercial, industrial and multi-residential developments with six (6) or more units, or as deemed required by the County on a case by case basis.
- (j) Sewer pipe connection to new or existing sanitary manholes must be made via Kor-N-Seal adaptors or approved equivalent.

17.9.02 GRADES FOR MAINTENANCE HOLE FRAME AND COVERS

All maintenance holes located within the travelled portion of the roadway shall have the rim elevation set flush with the surface of the base course asphalt. The adjustment of the frame and cover shall be completed in accordance with the details provided in the Ontario Provincial Standard Drawings. The maximum number of adjustment units allowed is three (3) and a maximum height adjustment of 300mm, in accordance with OPSS. Frames and covers shall be raised to surface course asphalt placement. Watertight maintenance hole lids are required when sanitary maintenance holes are located within overland storm routes, stormwater storage areas in parking lots and/or under sanitary surcharge condition.

17.10.0 CONNECTIONS FROM SEWER TO STREET LINE

- (a) Single family and semi-detached dwellings in residential areas, shall have a minimum 100mm diameter street line connection. All other connections shall be minimum 150mm in diameter. All connections to be perpendicular to the sanitary sewer main. ABS solid wall pipe per A.S.T.M. D2751, and P.V.C. pipe may be used for lateral connections. For P.V.C. lateral connections, Green pipe will be used and minimum SDR28 shall be used. The minimum cover at property line shall be 2.15m. If necessary, risers shall be provided for connection with the main sewer. 2% minimum grade shall be maintained for connection pipes.
- (b) In multiple family blocks in residential areas, the connection shall meet the following requirements.

Diameter of Drain (mm)	Slope of Drain	
	2.0%	4.0%
(Max. No. of Fixture Units per conn.)		
100	480	575
150	840	1000
200	1920	2300
250	3500	4200
300	5600	6700
375	10000	12000

Maximum Dwelling Units Dentsities	
4-Plex	25 units/hectare
Townhouse	37 units/hectare
Maisonette	45 units/hectare
Appartments	124 units/hectare

Loading – 20 fixtures units/dwelling unit

To Use the Chart

- i) Determine dwelling density and total area of block
- ii) Calculate total number of fixture units from:
Area x Dwelling units/hectare x 20
- iii) Select connection size and grade from chart.

The minimum requirement shall be 100mm diameter at 2% grade.

Depending upon the flow generated, a Maintenance Hole may be provided to service the lateral connection.

- (c) In ICI areas, the minimum connection size shall be 150mm diameter PVC installed on a minimum grade of 2%. The minimum cover at property line shall be 2.15m respectively. If necessary, risers shall be provided for connection with the main sewer. An inspection Maintenance Hole shall be located at property line on the service.
- (d) Joints and bedding shall be equivalent to the joints and bedding specified for sewer pipe.
- (e) The location of the end of all lateral connections shall be marked by a 50mm x 100mm wooden stake, 2 meters long, projecting one meter above the ground, with the top 300mm painted with fluorescent green colour conforming to C.G.S.B. (Canadian General Standards Board)

603-401.

- (f) Connection to existing Sanitary Service Pipe shall be via Fernco Couplers or approved equivalent. Tapping to existing mainline sewer shall be via Fernco Flexible Tap saddle.

17.11.0 SEWAGE FORCEMAINS

17.11.01 Type of Pipe and Joint Acceptable for Sewage Force mains

a) Poly-vinyl Chloride (P.V.C.) Pipe

For sizes up to 600mm, P.V.C. minimum SDR18 pipe with gasketed joints may be used. The current requirements of CSA B137.3 shall apply to all classes of P.V.C. pipe.

b) Polyethylene (P.E.) Pressure Pipe

Polyethylene pressure pipe with joints made by thermal fusion or by mechanical means may be used. The polyethylene resin compound used in the pipe shall conform to current ASTM Designation D1248. The pipe shall be manufactured to CGSB 41-GP-25M specifications.

c) Reinforced Concrete Pressure Pipe

For sizes 400mm and over, reinforced concrete pressure pipe with gasketed joints may be used as indicated below:

Pre-tensioned concrete cylinder pipe conforming to AWWA C-303

Pre-stressed concrete lined cylinder pipe conforming to AWWA C-301

17.11.02 Pipe Size

The force main shall be sized to have flow velocity in the range of 0.8 to 2.5 m/s with the lower limit being preferred for the initial phase. However, the minimum size shall not be less than 100mm.

17.11.03 Pipe Depth

The top of the force main shall have a minimum of 1.7m cover. On open ditch or unimproved road, increased cover shall be provided to allow for future road improvement or lowering when urbanization takes place.

17.11.04 System Design

- a) All force mains and thrust blocks shall be designed to withstand the maximum operating pressure plus the transient pressure to which they will be subjected.
- b) All force mains shall be equipped with a suitably valved connection to permit connection of a portable pump should pumping stations need to be by-passed during emergencies or major modifications.
- c) Air release valves suitable for use with sewage shall be positioned at all force main high points. The valves shall be of low-pressure double acting type.
- d) All plugs, tees, and bends will have approved thrust blocks and appropriate mechanical restraints.
- e) The bedding requirements for the force mains will depend upon the type and class of pipe used. As a minimum requirement, force main pipe shall be laid on 150mm of granular 'A' bedding material. However, each installation shall be reviewed on a site specific basis.
- f) The type of backfill material will usually be determined from the location of mains within the R.O.W. Under road pavement, granular backfill will be provided.
- g) A vault with sump and a clean out valve is required at any point there is potential for solids to gather.

17.11.05 Private Forcemains

It is the preference of the County that all structures be connected to the County's sanitary sewer system by means of gravity connections.

There are situations where gravity access to existing County sanitary sewers is not feasible. Where these instances arise, an application must be made to the County requesting the installation of a private sanitary forcemain. Each situation will be reviewed on an individual basis. A permit for the installation of a private forcemain will only be allowed with the written approval of the County.

This approval will detail authorized installation plans and specifications including areas of responsibility which will be attached to the deed for the property in question.

SANITARY SEWERS -PREFERRED DESIGN RANGE

		Concrete Pipe	P.V.C. Pipe	Polyethylene (P.E.) Pipe
RESIDENTIAL	Dia.	>450mm	200mm to 675mm	
	Joint	Bell & Spigot	Gasket joint	
COMMERCIAL	Dia.	>450mm	300mm to 675mm	
	Joint	Bell & Spigot	Gasket joint	
INDUSTRIAL	Dia.	>450mm	300mm to 675mm	
	Joint	Bell & Spigot	Gasket joint	
LATERALS	Dia.	Not Allowed	>100mm	
	Joint	Not Allowed	Gasket joint	
FORCEMAINS	Dia.	>400mm pressured	<600mm	<600mm
	Joint	Bell & Spigot with gasket	Plas-tyton gasket joint	Butt fusion

LIST OF APPROVED MANUFACTURERS AND PRODUCTS FOR WASTEWATER SYSTEMS

PRODUCT	MANUFACTURER	APPROVED DATE	DESC-MAKE-MODEL
FITTINGS CONCRETE	Centennial		Reinforced and non
	Con-Cast		Reinforced and non
	Hanson	06/09/1998	Reinforced and non
	Munro Concrete Fittings	09/15/1999	300mm to 1800mm wastewater and storm
FITTINGS PVC	Rehau Industries Inc.		
	Royal Flex-lox Pipe	06/13/1990	
	IPEX		
	Le Ron Plastics	06/12/1996	Gasketed and ribbed fittings
	Plastic Trend	08/14/1996	Plastic Trend Sewer Fittings 150 and 200mm
	Preper	08/18/1997	Rubber Coupling for Sewer Pipe
	Mission	09/15/1999	Rubber Adjustable Sewer Repair Couplings
FITTINGS VC	Logan Vitrified Clay		
FITTINGS POLYETHELYNE	KWH Pipe Canada Ltd.		
	Ken Taylor Ind.	06/09/1998	Polyethylene Adjustment Shims
CASTINGS	Domestic Foundry Ltd.	04/17/1991	Municipal Castings All Models except #DF307
MH ADJUSTERS	Brooklin Concrete	11/04/1992	Multi-Loc adj ring
	Centennial		Bricking & Precast
	W.E. Wilkinson Ltd.		Bricking & Precast
	Hanson	06/09/1998	Precast
	IPEX	11/02/2000	Lifesaver Maintenance Hole Adjustment Ring 24" and 27" dia.
MH FRAME AND COVER	Bibby Foundry		
	McCoy Foundry	04/12/1995	OPSD 401.01

MH SAFETY STEPS	MSU Mississauga Ltd.		
	Centennial	10/26/2000	
	W.E. Wilkinson Ltd.		
	M.A. Industries	09/15/1999	PE Maintenance Hole Steps
MH SAFETY GRATES	Centennial		
	MSU Mississauga Ltd.		
MH PRECAST SECTIONS	W.E. Wilkinson Ltd.		
	Centennial		
	Con-Cast		
	Monroe Concrete		
	Hanson	06/09/1998	
MH APPURTENANCES	Aqua Spec Ltd.	01/03/2000	Inside drop MH system for retrofit or special applications Modular MH invert flume
CB PRECAST SECTIONS	Centennial		
	W.E. Wilkinson Ltd.		
	Con-Cast		
	Monroe Concrete		
	Hanson	06/09/1998	
CB FRAME & GRATE	Bibby Foundry		
	McCoy Foundry Co.		
PIPE CONCRETE	Centennial		Reinforced & non
	Hanson	06/03/1998	Reinforced & non
	Con-Cast		Reinforced & non
	Munro Concrete Pipe	09/15/1999	300-1800mm Wastewater and storm
	Price Brothers	11/02/2000	Prestressed Concrete Pressure Pipe Sizes 400mm to 1200mm
PIPE POLYETHYLENE	Philips	12/15/1993	Poly-tite 200 to 600mm Series 1000 & 8600
	KWH Pipe Canada Ltd.		Force main Pipe
	Big "O"	04/12/1995	Gasketed sewer pipe 100 to 600mm
	Soleno	06/03/1998	Storm Sewer Pipe up to 900mm

PIPE VC SADDLES	Logan Vitrified Clay		
	Clow Canada Ltd.		D-50 125mm & 150mm
	Crowle Fittings		Cast Iron Saddles
	Mission	09/15/1999	Rubber Flexible Saddles
SEALENTS	Presfab Inc.		Ring-O-Pave Safe Match
	Rehau Industries Inc.		Bond-Loc-joint
	Centennial	12/12/1990	Kor-N-Seal
COUPLINGS	Mission	08/31/2000	Rubber adjustable sewer repair couplings
	Fernco	1980	

PEAKING FACTORS FOR SANITARY SEWERS

POPULATION	M	POP.	M	POP.	M	POP.	M	POP.	M	POP.	M
25	4.37	475	3.99	925	3.82	2600	3.50	6200	3.16	9800	2.96
50	4.31	500	3.97	950	3.81	2800	3.47	6400	3.14	10000	2.95
75	4.28	525	3.96	975	3.81	3000	3.44	6600	3.13	10200	2.95
100	4.24	550	3.95	1000	3.80	3200	3.42	6800	3.12	10400	2.94
125	4.22	575	3.94	1050	3.79	3400	3.40	7000	3.11	10600	2.93
150	4.19	600	3.93	1100	3.77	3600	3.37	7200	3.09	10800	2.92
175	4.17	625	3.92	1150	3.76	3800	3.35	7400	3.08	11000	2.91
200	4.15	650	3.91	1200	3.75	4000	3.33	7600	3.07	11200	2.91
225	4.13	675	3.90	1300	3.72	4200	3.31	7800	3.06	11400	2.90
250	4.11	700	3.89	1400	3.70	4400	3.30	8000	3.05	11600	2.89
275	4.09	725	3.89	1500	3.68	4600	3.28	8200	3.04	11800	2.88
300	4.08	750	3.88	1600	3.66	4800	3.26	8400	3.03	12000	2.88
325	4.06	775	3.87	1700	3.64	5000	3.25	8600	3.02	12200	2.87
350	4.05	800	3.86	1800	3.62	5200	3.23	8800	3.01	12400	2.86
375	4.04	825	3.85	1900	3.60	5400	3.21	9000	3.00	12600	2.85
400	4.02	850	3.84	2000	3.59	5600	3.20	9200	2.99	12800	2.85
425	4.01	875	3.84	2200	3.55	5800	3.18	9400	2.98	13000	2.84
450	4.00	900	3.83	2400	3.52	6000	3.17	9600	2.97		

HARMON FORMULA $M = 1 + (14 / (4 + P^{0.5}))$; $2 < M < 5$

M = Ratio of the peak rate of flow to the average rate of flow.

P = Tributary population in thousand

FOR PIPE FLOWING FULL

GRADE %	150mm		200mm		250mm		300mm		375mm	
	V	Q	V	Q	V	Q	V	Q	V	Q
6.00	2.134	.039	2.585	.084	2.999	.152	3.387	.247	3.930	.448
5.00	1.948	.036	2.359	.077	2.738	.139	3.092	.226	3.587	.409
4.00	1.742	.032	2.100	.068	2.449	.124	2.765	.202	3.209	.366
3.50	1.630	.030	1.974	.064	2.291	.116	2.587	.189	3.002	.342
3.00	1.509	.028	1.828	.059	2.121	.108	2.395	.175	2.779	.317
2.50	1.377	.025	1.668	.054	1.936	.098	2.186	.160	2.537	.289
2.00	1.232	.023	1.492	.048	1.732	.088	1.955	.143	2.269	.259
1.80	1.169	.021	1.416	.046	1.643	.083	1.855	.136	2.153	.246
1.60	1.102	.020	1.335	.043	1.549	.079	1.749	.128	2.029	.231
1.50	1.067	.020	1.292	.042	1.500	.076	1.693	.124	1.965	.224
1.40	1.031	.019	1.248	.041	1.449	.073	1.636	.119	1.898	.216
1.30	.993	.018	1.203	.039	1.396	.071	1.579	.115	1.829	.209
1.20	.954	.017	1.156	.038	1.341	.068	1.515	.111	1.758	.200
1.10	.914	.017	1.107	.036	1.284	.065	1.450	.106	1.683	.192
1.00	.871	.016	1.056	.034	1.224	.062	1.383	.101	1.604	.183
0.98	.862	.016	1.045	.034	1.212	.061	1.369	.100	1.588	.181
0.96	.853	.016	1.034	.034	1.200	.061	1.355	.099	1.572	.179
0.94	.844	.015	1.023	.033	1.187	.060	1.341	.098	1.554	.177
0.92	.835	.015	1.012	.033	1.174	.060	1.326	.097	1.539	.176
0.90	.826	.015	1.001	.033	1.162	.059	1.312	.096	1.522	.174
0.88	.817	.015	0.990	.032	1.149	.058	1.297	.095	1.505	.172
0.86	.808	.015	.979	.032	1.135	.058	1.282	.094	1.488	.170
0.84	.798	.015	.967	.031	1.122	.057	1.267	.093	1.470	.168
0.82	.798	.014	.623	.031	1.09	.56	1.252	.091	1.453	.166

Diameters shown in table are nominal. Q & V are base on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity & Discharge For 150mm to 375mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	150mm		200mm		250mm		300mm		375mm	
	V	Q	V	Q	V	Q	V	Q	V	Q
0.80	0.779	.014	0.944	.031	1.095	.056	1.237	.090	1.435	.164
0.78	0.769	.014	0.932	.030	1.081	.055	1.221	.089	1.417	.162
0.76	0.759	.014	0.920	.030	1.067	.054	1.205	.088	1.399	.160
0.74	0.749	.014	0.908	.030	1.053	.053	1.189	.087	1.380	.157
0.72	0.739	.014	0.895	.029	1.039	.053	1.173	.086	1.361	.155
0.70	0.729	.013	0.883	.029	1.024	.052	1.157	.084	1.342	.153
0.68	0.718	.013	0.870	.028	1.010	.051	1.140	.083	1.323	.151
0.66	0.706	.013	0.857	.028	0.995	.050	1.123	.082	1.303	.149
0.64	0.697	.013	0.844	.027	0.980	.050	1.106	.081	1.284	.146
0.62	0.686	.013	0.831	.027	0.964	.049	1.089	.080	1.263	.144
0.60	0.675	.012	0.817	.027	0.948	.048	1.071	.078	1.243	.142
0.58	0.663	.012	0.804	.026	0.932	.047	1.053	.077	1.222	.139
0.56	0.652	.012	0.790	.026	0.916	.046	1.035	.076	1.201	.137
0.54	0.640	.012	0.775	.025	0.900	.046	1.016	.074	1.179	.134
0.52	0.628	.012	0.761	.025	0.883	.045	0.997	.073	1.157	.132
0.50	0.616	.011	0.746	.024	0.866	.044	0.978	.071	1.135	.129
0.48	0.603	.011	0.731	.024	0.848	.043	0.958	.070	1.112	.127
0.46	0.591	.011	0.716	.023	0.830	.042	0.938	.068	1.088	.124
0.44	0.578	.011	0.700	.023	0.812	.041	0.917	.067	1.064	.121
0.42	0.565	.010	0.684	.022	0.794	.040	0.896	.055	1.040	.119
0.40	0.551	.010	0.667	.022	0.774	0.39	0.874	.064	1.015	.116
0.35	0.515	.009	0.624	.020	0.724	.037	0.818	.060	0.949	.108
0.30	0.477	.009	0.578	.019	0.671	.034	0.757	.055	0.879	.100
0.25	0.436	.008	0.528	.017	0.612	.031	0.691	.050	0.802	.091
0.20	0.390	.007	0.472	.015	0.548	.028	0.618	.045	0.718	.082

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 150mm to 375mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

Grade %	450MM		525MM		600MM		675MM	
	V	Q	V	Q	V	Q	V	Q
6.00	4.438	.729	4.92	1.099	5.38	1.569	5.82	2.148
5.00	4.051	.665	4.49	1.003	4.91	1.432	5.31	1.961
4.00	3.623	.595	4.02	.897	4.39	1.281	4.75	1.754
3.50	3.389	.556	3.76	.839	4.11	1.198	4.44	1.641
3.00	3.138	.515	3.48	.777	3.80	1.109	4.11	1.519
2.50	2.865	.470	3.17	.709	3.47	1.013	3.75	1.387
2.00	2.562	.421	2.84	.635	3.10	.906	3.36	1.240
1.80	2.431	.399	2.69	.602	2.94	.859	3.19	1.177
1.60	2.292	.376	2.54	.568	2.78	.810	3.00	1.109
1.50	2.219	.364	2.46	.550	2.69	.785	2.91	1.074
1.40	2.144	.352	2.38	.531	2.60	.758	2.81	1.038
1.30	2.066	.339	2.29	.512	2.50	.730	2.71	1.000
1.20	1.985	.326	2.20	.491	2.40	.702	2.60	.961
1.10	1.900	.312	2.11	.471	2.30	.672	2.49	.920
1.00	1.812	.298	2.01	.449	2.19	.641	2.37	.877
0.98	1.794	.295	1.99	.444	2.17	.634	2.35	.868
0.96	1.775	.291	1.97	.440	2.15	.628	2.33	.859
0.94	1.757	.289	1.95	.435	2.13	.621	2.30	.850
0.92	1.738	.285	1.93	.430	2.11	.614	2.28	.841
.90	1.719	.282	1.91	.426	2.08	.608	2.25	.832
0.88	1.700	.279	1.88	.421	2.06	.601	2.23	.823
0.86	1.680	.276	1.86	.416	2.04	.594	2.20	.813
0.84	1.661	.273	1.84	.411	2.01	.587	2.18	.804
0.82	1.641	.269	1.82	.406	1.99	.580	2.15	.794

Diameters shown in table are nominal. Q & V are based on imperial I.D.s
1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY

Velocity and Discharge
for 450mm to 675mm
CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	450mm		525mm		600mm		675mm	
	V	Q	V	Q	V	Q	V	Q
0.80	1.620	.266	1.80	.401	1.96	.573	2.12	.784
0.78	1.600	.263	1.77	.396	1.94	.566	2.10	.775
0.76	1.579	.259	1.75	.391	1.91	.558	2.07	.754
0.74	1.559	.256	1.73	.386	1.89	.551	2.04	.749
0.72	1.537	.252	1.70	.381	1.86	.543	2.01	.744
0.70	1.516	.249	1.68	.375	1.84	.536	1.99	.734
0.68	1.494	.245	1.66	.370	1.81	.528	1.96	.723
0.66	1.472	.242	1.63	.364	1.78	.520	1.93	.712
0.64	1.449	.238	1.61	.359	1.76	.512	1.90	.702
0.62	1.427	.234	1.58	.353	1.73	.504	1.87	.691
0.60	1.403	.230	1.56	.348	1.70	.496	1.84	.679
0.58	1.380	.227	1.53	.342	1.67	.488	1.81	.668
0.56	1.356	.223	1.50	.336	1.64	.479	1.78	.656
0.54	1.331	.219	1.48	.330	1.61	.471	1.74	.644
0.52	1.306	.214	1.45	.324	1.58	.462	1.71	.632
0.50	1.281	.210	1.42	.317	1.55	.453	1.68	.620
0.48	1.255	.206	1.39	.311	1.52	.444	1.64	.608
0.46	1.229	.202	1.36	.304	1.49	.434	1.61	.595
0.44	1.202	.197	1.33	.298	1.46	.425	1.57	.582
0.42	1.174	.193	1.30	.291	1.42	.415	1.54	.568
0.40	1.146	.188	1.27	.284	1.39	.405	1.50	.555
0.35	1.072	.176	1.19	.265	1.30	.379	1.41	.519
0.30	0.992	.163	1.10	.246	1.20	.351	1.30	.480
0.25	0.906	.149	1.00	.224	1.10	.320	1.19	.439
0.20	0.810	.133	0.90	.201	0.98	.286	1.06	.392

Diameters shown in table are nominal. Q & V are based on imperial I.D.s
1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY

Velocity and Discharge
for 450mm to 675mm
CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	750MM		825MM		900MM		975MM	
	V	Q	V	Q	V	Q	V	Q
6.00	6.24	2.845	6.65	3.665	7.05	4.626	7.43	5.727
5.00	5.69	2.597	6.07	3.349	6.43	4.223	6.78	5.228
4.00	5.09	2.323	5.43	2.995	5.75	3.777	6.07	4.676
3.50	4.77	2.173	5.08	2.802	5.38	3.533	5.68	4.374
3.00	4.41	2.012	4.70	2.594	4.98	3.271	5.25	4.050
2.50	4.03	1.836	4.29	2.368	4.55	2.986	4.80	3.697
2.00	3.60	1.643	3.84	2.118	4.07	2.671	4.29	3.306
1.80	3.42	1.558	3.64	2.009	3.86	2.534	4.07	3.137
1.60	3.22	1.469	3.43	1.894	3.64	2.389	3.84	2.957
1.50	3.12	1.422	3.32	1.834	3.52	2.313	3.72	2.863
1.40	3.01	1.374	3.21	1.772	3.40	2.235	3.59	2.766
1.30	2.90	1.324	3.09	1.707	3.28	2.153	3.46	2.666
1.20	2.79	1.272	2.97	1.640	3.15	2.069	3.32	2.561
1.10	2.67	1.218	2.85	1.571	3.02	1.981	3.18	2.452
1.00	2.55	1.161	2.71	1.498	2.88	1.889	3.03	2.338
0.98	2.52	1.150	2.69	1.482	2.85	1.870	3.00	2.315
0.96	2.50	1.138	2.66	1.467	2.82	1.850	2.97	2.291
0.94	2.47	1.126	2.63	1.452	2.79	1.831	2.94	2.267
0.92	2.44	1.114	2.60	1.436	2.76	1.811	2.981	2.243
0.90	2.42	1.102	2.57	1.421	2.73	1.792	2.88	2.218
0.88	2.39	1.090	2.55	1.405	2.70	1.772	2.84	2.193
0.86	2.36	1.077	2.52	1.389	2.67	1.751	2.81	2.168
0.84	2.33	1.064	2.49	1.372	2.64	1.731	2.78	2.143
0.82	2.31	1.052	2.46	1.356	2.60	1.710	2.75	2.117

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY

Velocity and Discharge
for 750mm to 975mm
CIRCULAR PIPE

FOR PIPES FLOWING FULL

GRADE %	750mm		825mm		900mm		975mm	
	V	Q	V	Q	V	Q	V	Q
0.80	2.28	1.039	2.43	1.339	2.57	1.689	2.71	2.091
0.78	2.25	1.026	2.40	1.323	2.54	1.668	2.68	2.065
0.76	2.22	1.013	2.37	1.306	2.51	1.646	2.64	2.038
0.74	2.19	.999	2.33	1.288	2.47	1.625	2.61	2.011
0.72	2.16	.986	2.30	1.271	2.44	1.603	2.57	1.983
0.70	2.13	.972	2.27	1.253	2.41	1.580	2.54	1.956
0.68	2.10	.958	2.24	1.234	2.37	1.557	2.50	1.928
0.66	2.07	.944	2.20	1.217	2.34	1.534	2.46	1.899
0.64	2.04	.929	2.17	1.198	2.30	1.511	2.43	1.870
0.62	2.01	.915	2.14	1.179	2.26	1.487	2.39	1.841
0.58	1.94	.885	2.07	1.140	2.19	1.438	2.31	1.781
0.56	1.91	.869	2.03	1.121	2.15	1.413	2.27	1.750
0.54	1.87	.854	1.99	1.100	2.11	1.388	2.23	1.718
0.52	1.84	.838	1.96	1.080	2.07	1.362	2.19	1.686
0.50	1.80	.821	1.92	1.059	2.03	1.334	2.15	1.653
0.48	1.76	.805	1.88	1.038	1.99	1.308	2.10	1.620
0.46	1.73	.788	1.84	1.016	1.95	1.281	2.06	1.586
0.44	1.69	.770	1.80	.993	1.91	1.253	2.01	1.551
0.42	1.65	.753	1.76	.971	1.86	1.224	1.97	1.515
0.40	1.61	.735	1.72	.947	1.82	1.194	1.92	1.479
0.35	1.51	.687	1.61	.886	1.70	1.117	1.80	1.383
.30	1.39	.636	1.49	.820	1.58	1.034	1.66	1.281
0.25	1.27	.581	1.36	.749	1.44	.944	1.52	1.169
0.20	1.14	.519	1.21	.670	1.29	.845	1.36	1.046

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 750mm to 975mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1050mm		1200mm		1350mm		1500mm	
	V	Q	V	Q	V	Q	V	Q
6.00	7.81	6.978	8.53	9.963	9.23	13.639	9.90	18.064
5.00	7.13	6.370	7.79	9.095	8.43	12.451	9.04	16.490
4.00	6.37	5.698	6.97	8.135	7.54	11.136	8.09	14.749
3.50	5.96	5.330	6.52	7.609	7.05	10.417	7.54	13.796
3.00	5.50	4.934	6.03	7.045	6.53	9.644	7.00	12.773
2.50	5.02	4.504	5.51	6.431	5.96	8.804	6.39	11.660
2.00	4.49	4.029	4.93	5.752	5.33	7.875	5.72	10.429
1.80	4.26	3.822	4.67	5.457	5.06	7.471	5.42	9.894
1.60	4.02	3.604	4.41	5.145	4.77	7.043	5.11	9.328
1.50	3.89	3.489	4.27	4.981	4.62	6.820	4.95	9.032
1.40	3.76	3.371	4.12	4.813	4.46	6.588	4.78	8.726
1.30	3.62	3.248	3.97	4.637	4.30	6.349	4.61	8.408
1.20	3.48	3.121	3.82	4.456	4.13	6.100	4.43	8.078
1.10	3.33	2.988	3.65	4.266	3.95	5.840	4.24	7.735
1.00	3.18	2.849	3.48	4.057	3.77	5.568	4.04	7.375
0.98	3.15	2.820	3.45	4.026	3.73	5.512	4.00	7.300
0.96	3.11	2.791	3.41	3.985	3.69	5.456	3.96	7.226
0.94	3.08	2.762	3.38	3.943	3.65	5.399	3.92	7.150
0.92	3.05	2.732	3.34	3.901	3.61	5.341	3.88	7.073
0.90	3.02	2.703	3.31	3.859	3.58	5.283	3.84	6.996
0.88	2.98	2.672	3.27	3.815	3.54	5.224	3.79	6.918
0.86	2.95	2.642	3.23	3.772	3.50	5.164	3.75	6.839
0.84	2.91	2.611	3.19	3.728	3.45	5.103	3.71	6.759
0.82	2.89	2.580	3.15	3.683	3.41	5.042	3.66	6.678

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 1050mm to 1500mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1050mm		1200mm		1350mm		1500mm	
	V	Q	V	Q	V	Q	V	Q
0.80	2.85	2.548	3.12	3.638	3.37	4.980	3.62	6.596
0.78	2.81	2.516	3.08	3.592	3.33	4.918	3.57	6.513
0.76	2.78	2.484	3.04	3.546	3.29	4.854	3.52	6.429
0.74	2.74	2.451	3.00	3.499	3.24	4.790	3.48	6.344
0.72	2.70	2.417	2.96	3.451	3.20	4.725	3.43	6.258
0.70	2.67	2.383	2.91	3.403	3.15	4.659	3.38	6.170
0.68	2.63	2.349	2.87	3.354	3.11	4.592	3.33	6.081
0.66	2.59	2.314	2.83	3.304	3.06	4.524	3.28	5.991
0.64	2.55	2.279	2.79	3.254	3.01	4.455	3.23	5.900
0.62	2.51	2.243	2.74	3.203	2.97	4.384	3.18	5.807
0.60	2.47	2.207	2.70	3.151	2.92	4.313	3.13	5.712
0.58	2.43	2.170	2.65	3.098	2.87	4.241	3.08	5.616
0.56	2.39	2.32	2.61	3.044	2.82	4.167	3.03	5.519
0.54	2.34	2.093	2.56	2.989	2.77	4.092	2.97	5.419
0.52	2.30	2.054	2.51	2.933	2.72	4.015	2.92	5.318
0.50	2.25	2.014	2.46	2.876	2.66	3.937	2.86	5.215
0.48	2.20	1.974	2.41	2.818	2.61	3.858	2.80	5.109
0.46	2.16	1.932	2.36	2.759	2.56	3.777	2.74	5.002
0.44	2.11	1.890	2.31	2.698	2.50	3.694	2.68	4.892
0.42	2.07	1.846	2.26	2.636	2.44	3.609	2.62	4.779
0.40	2.02	1.802	2.20	2.572	2.38	3.522	2.56	4.664
0.35	1.89	1.685	2.06	2.406	2.23	3.294	2.39	4.363
0.30	1.75	1.560	1.91	2.228	2.06	3.050	2.21	4.039
0.25	1.59	1.424	1.74	2.034	1.88	2.784	2.02	3.687
0.20	1.43	1.274	1.56	1.819	1.69	2.490	1.81	3.298

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 1050mm to 1500mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1650mm		1800mm		1950mm	
	V	Q	V	Q	V	Q
6.00	10.55	23.291	11.18	29.374	11.795	36.362
5.00	9.63	21.262	10.21	26.814	10.768	33.196
4.00	8.62	19.017	9.13	23.984	9.631	29.691
3.50	8.06	17.789	8.54	22.435	9.009	27.773
3.00	7.46	16.469	7.91	20.770	8.341	25.714
2.50	6.81	15.034	7.22	18.961	7.614	23.473
2.00	6.09	13.447	6.46	16.959	6.810	20.994
1.80	5.78	12.757	6.13	16.089	6.461	19.918
1.60	5.45	12.028	5.78	15.169	6.091	18.777
1.50	5.28	11.646	5.59	14.687	5.898	18.182
1.40	5.10	11.251	5.40	14.189	5.698	17.566
1.30	4.91	10.841	5.21	13.673	5.490	16.925
1.20	4.72	10.416	5.00	13.138	5.275	16.262
1.10	4.52	9.973	4.79	12.577	5.050	15.568
1.00	4.30	9.509	4.57	11.992	4.815	14.844
0.98	4.26	9.413	4.52	11.871	4.767	14.696
0.96	4.22	9.316	4.47	11.750	4.718	14.545
0.94	4.18	9.219	4.43	11.627	4.669	14.394
0.92	4.13	9.120	4.38	11.502	4.619	14.240
0.90	4.09	9.021	4.33	11.377	4.568	14.082
0.88	4.04	8.920	4.28	11.249	4.517	13.925
0.86	4.00	8.818	4.23	11.121	4.466	13.768
0.84	3.95	8.715	4.18	10.991	4.413	13.604
0.82	3.90	8.610	4.13	10.859	4.361	13.444

Diameters shown in table are nominal. Q & V are based on imperial I.D.s
1m³/s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 1650mm to 1950mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1650mm		1800mm		1950mm	
	V	Q	V	Q	V	Q
0.80	3.85	8.505	4.08	10.726	4.307	13.278
0.78	3.80	8.398	4.03	10.591	4.253	13.111
0.76	3.76	8.289	3.98	10.454	4.198	12.942
0.74	3.71	8.180	3.93	10.316	4.142	12.769
0.72	3.66	8.068	3.87	10.175	4.086	12.596
0.70	3.60	7.955	3.82	10.033	4.029	12.421
0.68	3.55	7.841	3.76	9.889	3.971	12.242
0.66	3.50	7.725	3.71	9.742	3.912	12.060
0.64	3.45	7.607	3.65	9.593	3.852	11.875
0.62	3.39	7.487	3.59	9.442	3.792	11.690
0.60	3.34	7.365	3.54	9.289	3.730	11.499
0.58	3.28	7.242	3.48	9.135	3.667	11.305
0.56	3.22	7.116	3.42	8.974	3.604	11.110
0.54	3.17	6.987	3.35	8.912	3.539	10.910
0.52	3.11	6.857	3.29	8.647	3.472	10.704
0.50	3.05	6.724	3.23	8.480	3.405	10.497
0.48	2.98	6.588	3.16	8.308	3.336	10.284
0.46	2.92	6.449	3.10	8.133	3.266	10.069
0.44	2.86	6.307	3.03	7.955	3.194	9.847
0.42	2.79	6.162	2.96	7.772	3.121	9.621
0.40	2.72	6.014	2.89	7.584	3.046	9.390
0.35	2.55	5.625	2.70	7.094	2.849	8.783
0.30	2.36	5.208	2.50	6.568	2.638	8.133
0.25	2.15	4.754	2.28	5.996	2.408	4.723
0.20	1.93	4.252	2.04	5.363	2.154	6.640

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 1650mm to 1950mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	2100mm		2250mm		2400mm	
	V	Q	V	Q	V	Q
6.00	12.393	44.309	12.976	53.258	13.547	63.262
5.00	11.313	40.448	11.846	48.620	12.366	57.747
4.00	10.119	36.179	10.595	43.485	11.061	51.653
3.50	9.465	33.841	9.911	40.678	10.346	48.314
3.00	8.763	31.331	9.176	37.661	9.579	44.732
2.50	8.000	28.603	8.376	34.378	8.744	40.833
2.00	7.155	25.582	7.492	30.750	7.821	35.523
1.80	6.788	24.269	7.107	29.170	7.420	34.650
1.60	6.400	22.882	6.701	27.503	6.995	32.665
1.50	6.196	22.153	6.488	26.629	6.773	31.629
1.40	5.986	21.402	6.268	25.726	6.544	30.559
1.30	5.769	20.626	6.040	24.790	6.306	29.448
1.20	5.542	19.815	5.803	23.817	6.058	28.290
1.10	5.306	18.971	5.556	22.804	5.800	27.085
1.00	5.059	18.088	5.298	21.745	5.530	25.824
0.98	5.009	17.909	5.244	21.523	5.475	25.567
0.96	4.957	17.723	5.190	21.302	5.419	25.306
0.94	4.905	17.537	5.136	21.080	5.362	25.040
0.92	4.853	17.351	5.081	20.854	5.305	24.773
0.90	4.800	17.162	5.026	20.628	5.247	24.503
0.88	4.746	16.969	4.970	20.399	5.188	24.227
0.86	4.692	16.775	4.913	20.165	5.129	23.952
0.84	4.637	16.579	4.855	19.927	5.069	23.671
0.82	4.581	16.379	4.797	19.689	5.008	23.386

Diameters shown in table are nominal. Q & V are based on imperial I.D.s
1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 2100mm to 2400mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	2100mm		2250mm		2400mm	
	V	Q	V	Q	V	Q
0.80	4.525	16.178	4.738	19.446	4.947	23.102
0.78	4.468	15.975	4.679	19.204	4.884	22.807
0.76	4.411	15.771	4.618	18.954	4.821	22.513
0.74	4.352	15.560	4.557	18.703	4.757	22.214
0.72	4.293	15.349	4.495	18.449	4.693	21.916
0.70	4.233	15.134	4.432	18.190	4.627	21.607
0.63	4.172	14.916	4.368	17.928	4.561	21.299
0.66	4.110	14.695	4.304	17.665	4.493	20.982
0.64	4.048	14.473	4.238	17.394	4.424	20.659
0.62	3.984	14.244	4.171	17.119	4.355	20.337
0.60	3.919	14.012	4.103	16.840	4.284	20.006
0.58	3.853	13.776	4.034	16.557	4.212	19.669
0.56	3.786	13.536	3.964	16.270	4.139	19.328
0.54	3.718	13.293	3.893	15.978	4.064	18.978
0.52	3.648	13.043	3.820	15.679	3.988	18.623
0.50	3.578	12.793	3.746	15.375	3.911	18.264
0.48	3.505	12.532	3.6700	15.063	3.832	17.895
0.46	3.431	12.267	3.593	14.747	3.751	17.517
0.44	3.356	11.999	3.514	14.423	3.668	17.129
0.42	3.279	11.724	3.433	14.090	3.584	16.737
0.40	3.200	11.441	3.350	13.750	3.498	16.335
0.35	2.993	10.701	3.134	12.863	3.272	15.280
0.30	2.771	9.907	2.902	11.911	3.029	14.145
0.25	2.530	9.046	2.649	10.872	2.765	12.912
0.20	2.263	8.091	2.369	9.723	2.473	11.549

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

N = 0.013

BRANT COUNTY
Velocity and Discharge for 2100mm to 2400mm CIRCULAR PIPE

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 18

WATERMAINS

November/2018

18.0.00 GENERAL REQUIREMENT

These Design Standards specify the minimum criteria in the design of watermains within the County of Brant residential drinking-water systems.

Other approving authorities, such as the Ministry of the Environment may have servicing standards in addition to, or that exceed, the minimum criteria outlined in these Design Standards. The designer should, therefore, ensure that the requirements of all other approving authorities have been met prior to finalizing the design.

All watermains and appurtenances shall be designed and constructed in accordance with the current County of Brant Development and Engineering Standards, M.O.E. guidelines, Ontario Provincial Standards and Specifications and AWWA standards and specifications.

18.1.00 DESIGN WATER DEMANDS

a) Design Water Demand

The system shall be designed to meet the greater of either of the following demands:

- i) Maximum daily demand plus fire flow
- ii) Maximum hourly demand

Fire flows will be considered in accordance with the requirements of the latest edition of "Water Supply for Public Fire Protection" A Guide to Recommended Practice by Fire Underwriters Survey.

b) Average Daily Demand by Development Type

Type of Development	Average Daily Demand	
	m ³ /person/day	m ³ /person/s
Residential ¹	.300	3.472 x 10 ⁻⁶
	m ³ /ha/day	m ³ /ha/s
Schools	12.1	1.400x 10 ⁻⁴
Light Commercial Areas	28.0	3.241 x 10 ⁻⁴
Community Services	18.0	2.083 x 10 ⁻⁴
Light Industrial Areas	28.0	3.241 x 10 ⁻⁴
Hospitals	1.8m ³ /bed/day	2.083 x 10 ⁻⁵ m ³ /bed/s

¹Residential flows to be calculated based on 3.1 persons per unit. The County of Brant Official Plan shall be referenced in relation to residential densities.

Individual studies shall be made for special commercial establishments, major commercial areas, special industries, major industrial areas and large high-density residential areas.

c) Design Factors

The following are the design factors for water distribution system:

- i) Average daily demand per capita = 0.300 m³/c/d
- ii) Maximum daily demand factor = 2.75
- iii) Maximum hourly demand factor:
 - Residential = 4.00
 - Industrial = 2.00
 - Commercial = 2.00
 - Community Services = 2.00

d) Fire Flow Requirements

- i) General Residential Areas = 37.9 l/s for 1 hour duration
- ii) General I.C.I. Areas = 56.8 l/s for 2 hour duration
- iii) Special Case Industrial Areas = 75.8 l/s for 2 hour duration

18.2.00 HYDRAULIC DESIGN

.1 Pipe Design Flow

Hazen-Williams equation may be used

$$Q = 0.084818 \text{ CAR}^{0.63} S^{0.54}$$

Where:

Q = Design Flow (m³/sec.)

C = Coefficient of roughness (dimensionless)

R = Hydraulic radius (m)

S = Slope of energy grade line (m/m)

A = Section area of flow (m²)

.2 Minimum Pipe Size

For all areas within the County of Brant, minimum pipe size shall be 150mm diameter.

.3 System Pressures

Watermains shall be designed on the basis of providing a minimum pressure of 280 kPa (40 psi) at ground level at all points in the works under normal operating conditions.

The system shall be designed to maintain a minimum pressure of 140 kPa (20 psi) at ground level at all points in the distribution system under maximum day demand plus fire flow conditions.

The normal operating pressure in the distribution system shall be within 350 kPa to 480 kPa (50 to 70 psi)

The maximum pressure in the distribution system shall not exceed 700 kPa (102 psi) to avoid damage to household plumbing. Service connection to watermain in excess on 700kPa will not be permitted.

.4 Transient Pressures

The distribution system shall be designed to withstand the maximum operating pressure plus the transient pressure to which it may be subjected.

As a minimum allowance in the distribution system, pipes and joints shall be able to withstand the maximum operating pressure plus the surge pressure that would be created by stopping of a column of water moving at 0.6 m/s (2 ft/sec)

.5 Maximum Velocity

The maximum velocity in the watermain under all flow conditions shall not exceed 5.0m/s

.6 Hydrostatic Test Pressure

All watermain shall be field tested to 1035 kPa as per OPSS 441.

.7 Friction Factors

The following Hazen-Williams “C” values shall be used for the design of water distribution systems, regardless of material:

Diameter – Nominal	C- Factor
150 mm (6 in)	100
200 mm – 250 mm (8 to 10 in)	110
300 mm – 600 (12 to 24 in)	120
Over 600 mm (over 24 in)	130

In calculating maximum velocities for transient pressure estimations or for checking pump runout conditions, a C – factor of 140 shall be used for new pipe conditions.

In evaluating existing systems for expansion, the C - factors should be determined by actual field tests, where available.

.8 Hydraulic Flow Testing

Hydraulic flow testing is required for proposed change in use or new developments, not including single residential. Scope and requirements of the testing shall be to the satisfaction of the County of Brant at the owner's expense, unless existing information is satisfactory.

18.3.00 EXTERNAL PIPE LOADING

External pipe loading shall be calculated and based on a trench width equal to the outside diameter of the pipe, plus 800mm. For purposes of pipe design, the Design Engineer shall consider the pipe to be installed in sand or granular “A” bedding, with load factor of 1.9.

18.4.00 MATERIALS

All watermain materials used including pipes, valves, fire hydrants and materials used for the rehabilitation of watermain shall meet all applicable quality standards set by the American Water Works Association (AWWA) and, in addition, the consumer safety standards

NSF/ANSI Standard 60: Drinking water Treatment Chemicals – Health Effects and NSF/ANSI Standard 61: Drinking Water System Components – Health Effects.

18.4.01
.1 **Pipe**
 PVC Pipe

PVC watermain pipe shall be manufactured in accordance with the latest version of A.W.W.A. Specification C900 or C905 "Polyvinyl Chloride (PVC) Pressure Pipe, (4") - 100mm and larger for Water and C.S.A. Standard B137.3."

Bionax PVCO pipe as supplied by IPEX for use in construction of watermains where the characteristics of the pipe are a fit to the service connections.

Only cast iron Outside Diameter (CIOD) having a pressure class of 235psi is acceptable. Installation and connection of appurtenances must be made in strict accordance with the manufacturer's instructions.

All PVC watermain pipe shall be designed and constructed in accordance with these Development and Engineering Standards.

.2 **Concrete Pressure Pipe**

Concrete pressure pipe shall be A.W.W.A. Standard pretensioned concrete cylinder pipe meeting the requirements of A.W.W.A., C-303 specifications or A.W.W.A. Standard pre-stressed concrete pressure pipe meeting the requirements of A.W.W.A., C-301 specifications. The pipe shall be constructed using Type 50 cement. Prior to the manufacture of any concrete pipe or fittings, three (3) sets of piping layout and detail shop drawings shall be submitted to the County for review and acceptance. The drawings shall be in sufficient detail to show general construction of all parts and quality of materials and workmanship to be used in construction.

Specifically, this information shall include complete dimensions and weights of pipe, details of manufacturing methods, materials to be used, including material specifications, strengths, design calculations, spacing and sizes of struts, and other details such as are necessary to permit appraisal of the pipe to be supplied.

All concrete pressure pipe and fittings shall be designed and constructed in accordance with these Development and Engineering Standards.

All concrete used for the exterior coating of the pipe and fittings shall be manufactured using Type 50 Cement.

All pipe joints will be diapiered using Type 50 Cement

.3 Ductile Iron, Hyprotec Coated Pipe

Ductile iron, Hyprotec coated pipe shall be manufactured in accordance with A.W.W.A. Specification C150 and A.W.W.A. Specification C151. Ductile iron, Hyprotec coated pipe shall be cement-lined in accordance with A.W.W.A. Specification C104. All ductile iron, hyprotec coated pipe shall be Class 52. Used pipe shall not be allowed in any installation.

Ductile iron, Hyprotec coated pipe shall be supplied with "Tyton" rubber gasket joints manufactured in accordance with A.W.W.A. Specification C111. Ductile iron, Hyprotec coated pipe with "Tyton" joints is to be supplied with bonding straps or lock wedges to maintain electrical continuity.

Ductile iron, Hyprotec coated pipe shall only be used in areas as determined by the County.

18.4.02 Fittings

.1 Ductile Iron Watermain

Fittings shall be cast iron or ductile iron and shall conform to A.W.W.A. Specification C110. All fittings shall be cement lined in accordance with A.W.W.A. Specification C104 and shall be mechanical joint type conforming to A.W.W.A. C111 or "Tyton" rubber gasket joints conforming to A.W.W.A. Specification C-104. All fittings and bolts will be protected using corrosion protection measures as listed in these Development and Engineering Standards.

.2 C900 or C905 PVC Watermain

Fittings for PVC DR25 watermain pipe sized 100mm to 600mm

- all fittings shall conform to and meet the A.W.W.A. Specification C900 or C905 and C.S.A. Standard B137.3. Fittings to be UL listed and FM approved.

Fittings for PVC DR18 watermain pipe sized 100mm to 300mm

- all fittings shall conform to and meet the A.W.W.A. Specification C900 or C905 and C.S.A. Standard B137.3. Fittings to be UL listed and FM approved.

Fittings for PVC DR25 watermain pipe larger than 600mm or PVC DR18 watermain pipe larger than 300mm shall be cast iron or ductile iron and shall conform to A.W.W.A. Specification C110. All fittings shall be cement lined in accordance with A.W.W.A. Specification C104 and shall be mechanical joint type conforming to A.W.W.A. Specification C111 or "Tyton" rubber gasket joints conforming to A.W.W.A. Specification C104. All fittings and bolts will be protected using corrosion protection measures as listed in these Development and Engineering Standards.

18.4.03 Valves and Valve Boxes

.1 100mm - 300mm

Valves shall be mechanical joint, unless otherwise specified, with non-rising stems and as per Table 18.1. All valves shall conform to A.W.W.A. Standard C-500 for gate valves and A.W.W.A. Standard C-509 for resilient-seat gate valves. The following valves are approved for use by the County:

McAvity	20075-0
Mueller	A-2360
Clow	F6100
AVK	Series 25 Resilient Seated Gate Valve
Bibby	N200 Series

.2 350mm and Larger

Valves 350mm and larger shall be butterfly valves and shall conform to the following:

- a) A.W.W.A. Standard C-504
- b) Valves to be short body flanged type
- c) Valves to be Class 150B
- d) Valves to have a nonshock shutoff pressure of 135 psi
- e) Upon request by the City, the manufacturer must supply the test records covering section, 2.3, 3.8.3, 5.2, 5.3, 5.4, and 5.5. of latest version of A.W.W.A. Standard C504
- f) Valve to come complete with a manual combination handwheel/square nut type operator. Operator **must be watertight** and conform to A.W.W.A. Standard C504-94.
- g) Valves to as per Table 18.1.
- h) Manufacturer shall present an affidavit of compliance to this specification. The following butterfly valves have been approved for use: Mueller Line seal III, Pratt 2 F II, Keystone F504 or 506, M&H 4500 and American Darling.

- i) American Darling is only acceptable on ductile iron pipe and concrete pressure pipe installations.

Table 18.1
Valve Opening Directions

System	Direction to Open
Paris	Counter Clockwise
Paris (former Brantford Twp.)	Clockwise
St. George	Counter Clockwise
Cainsville	Clockwise
Airport	Clockwise
Mount Pleasant	Clockwise

.3 Check Valves

All valves shall conform to and meet the latest version of A.W.W.A. C508 for Swing Check Valves.

The following valves are approved for use by the County:

Ludlow	
Meuller	A-2600-6
Val-Matic	Series 500
Clow	Ken-Flex(FIG.-506)

.4 Combination Air Release/Air Vacuum Valves

All valves shall conform to and meet the A.W.W.A. C512 for Combination Air Release/Air Vacuum Valves.

The following valves are approved for use by the County:

Val-Matic	Model #101 and #102
ARI	Model D-040 (metal clad)

.5 Valve Boxes

Valve boxes shall be 130mm (5 1/4") slide type. The following have been approved by the County for use:

Mueller	A759TF
Bibby	VB625

.6 Valve Extension Stem

Extension stems shall be installed when the distance between the top of the nut on the valve and the proposed final grade exceeds 1.2m. Extension stems shall be a 25mm solid square bar.

Extension stems shall be one of the following types:

Canada Valve	order by name and height
Bibby	VB950 through to VB959

18.4.04 Fire Hydrants

All Fire Hydrants shall conform to the latest revisions of C.S.A. Specification B89.6 and A.W.W.A. C-502. Hydrants shall have two (2) 63.5mm nozzles with C.S.A. standard thread and one (1) 100mm C.S.A. standard quick-connect (STORZ) pumper port. Hydrant barrel shall be suitable for a depth of 1.7m. Drain ports are not to be plugged. Hydrants must open right/clockwise and shall have a bronze to bronze seat. Hydrants shall be mounted with breakaway flange at a maximum height of 100mm above finished grade. The hydrant leads shall be equivalent in size to the hydrant inlet (150mm). A minimum landscape buffer of 1.0m shall be provided around all municipal fire hydrants.

The following hydrants have been approved for use by the County:

Canada Valve	Century
McAvity	M-67

Hydrants are to be painted based on how they are serviced, with the storz nozzle cap to remain black:

- Red (private)
- Blue (cistern)
- Yellow (municipal)

18.4.05 Sample Station / Automatic Flushing Devices

Automatic flushing devices shall be placed at permanent dead ends and any temporary dead ends within the water distribution system for which the County does not expect to be extended within 2 years.

The following have been approved for use by the County:

<u>Automatic Flushing Device</u>	
Hydra-Guard	HG-3 with dechlorination device

Sampling Station

Cromer Industries Corp test Tap Sampling Station

Tracer Wire and Test Boxes

.1 Tracer Wire

- i) Tracer wire shall be installed on all non-ductile iron watermain, hydrant laterals and water services except where such water service pipe is of copper material. The wire shall be installed in such a manner as to be able to properly trace all watermain, hydrant laterals and water services without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.
- ii) Tracing wire shall be T.W.U. (#8-7 multi-strand), number eight gauge, stranded, insulated copper wire with 60 mil of black, cross-linked polyethylene (XLPE) insulation specifically manufactured for direct burial applications.
- iii) All tracer wire welds onto existing cast or ductile iron pipe shall be completely sealed using County approved corrosion protection measures as listed in these Development and Engineering Standards.
 - i. All spliced or repaired wire connections in the tracer wire system shall be made using a Dryconn waterproof connector (Dryconn King 9 Dark Blue) or SmartGel Waterproof Connection or approved equivalent, and made waterproof using an approved buried service wire closure. The buried service wire closure shall be either a Klik-It II Number C8816 Buried Service Wire Closure or a Raychem GHFC-2-90 H-Frame Gel Closure or approved equivalent.

.2 Test Boxes

Test points shall be provided for tracer wire located behind each Fire Hydrant. Test points shall terminate in a Test Box as shown in CBSD 18-404 for a standard fire hydrant arrangement.

The following test boxes have been accepted for use in the County:

NDS Standard Series

Model # WB113BW

18.4.06 Tapping Sleeves

The following tapping sleeves have been approved for use by the County for taps 100mm and larger on the following watermain:

**.1 Ductile Iron
Ductile Iron Hyprotec Coated
PVC and Cast Iron Watermains**

Robar	6606 Stainless Steel Tapping Sleeve
Smith Blair	622 Stainless Steel Tapping Sleeve

.2 Asbestos Cement Watermain

Robar	6606 stainless steel tapping sleeve
Smith Blair	622 Tapping sleeve

.3 Concrete Pressure Pipe

Tapping Sleeves to be used on Concrete Pressure Pipe will have the following material specifications:

Body: Mild steel ASTM A36

Flange: Combination flange with ANSI 150 lb. drilling recessed for tapping valves MSS SP-60

Gasket: 1" dia. on gland flange (EPDM). Grout seal – ¾" x ¾" Rubber gasket

Studs & nuts: stainless steel type 304

Coating: An average of 20 ml thick of Thermoplastic A-571 is applied on sleeve, gland and straps with extra thickness in the waterway of gland.

Anti-Corrosion Warranty: 50 years

The following tapping sleeves have been approved:

Robar	6606 stainless steel tapping sleeve
Smith Blair	622 Tapping sleeve

18.4.07 Service Saddles

Service Saddles are to be CSA Classified to NSF/ANSI Standard 61. Service saddles shall be stainless steel and double bolted.

The following service saddles have been approved for use by the County:

Cambridge Brass	403 stainless steel, double bolted saddle
Robar	2626 stainless steel, double bolted saddle
Robar	2616 Stainless Steel, one piece saddle

18.4.08 Corporation Stops

Corporation ball stops are to be CSA Classified to NSF/ANSI Standard 61. Corporation ball stops for 19mm, 25mm, 38mm, or 50mm dia. water services shall have A.W.W.A. inlet thread and compression style outlet. Where an anode connection is shown, an electrical ground connection tailpiece shall be used.

The following “Ball type” corporation stops are approved for use by the County:

19mm	Mueller	300 TM-series
	Cambridge Brass	301-series
	Ford	FB-series
25mm	Mueller	300 TM-series
	Cambridge Brass	301-series
	Ford	FB-series
38mm	Mueller	300 TM-series
	Cambridge Brass	301 - series
	Ford	FB-series
50mm	Mueller	300 TM-series
	Cambridge Brass	301 - series
	Ford	FB-series

18.4.10 Service Pipe

Service pipe shall be Type 'K' soft copper pipe or Ipex Blue904 or Muncipex Service Line, nominal diameter of 25mm, 38mm or 50mm. Kinked, crushed or distorted tubing shall not be used. Solder type fitting shall not be used between the watermain and the water meter. All service pipe material shall be acceptable under Part 7 of Division B of the Building Code (O. Reg. 350/06) made under the Building Code Act, 1992 and shall conform to AWWA Standard C800: Underground Service Line Valves and Fittings. All water service laterals within the road allowance are to be perpendicular to the municipal watermain.

18.4.11 Curb Stops and Service Boxes

.1 Curb Stops

Curbstops are to be CSA Classified to NSF Standard 61.

The following “Ball type” curbstops have been approved by the County:

19mm	Cambridge Brass Ford Mueller	202-series FB-series 300 TM-series
25mm	Cambridge Brass Ford Mueller	202-series FB-series 300 TM-series
38mm	Cambridge Brass Ford Mueller	202-series FB-series 300 TM-series
50mm	Cambridge Brass Ford Mueller	202-series FB-series 300 TM-series

All Ball curbstops shall come complete with an electrical grounding clamp and shall be placed in landscaped areas with a minimum 1.0m separation from hard surfaces.

.2 Service Boxes

i) Services Boxes 25mm

The service boxes shall be for 1.7m to 2.0m bury, but shall be extended if special depths are encountered. Service boxes will come complete with type 304 stainless steel rods and stainless steel cotter pins.

The following service boxes have been approved for use by the County:

Mueller	A726
Clow	D1-9
Domestic	Eclipse
Bibby	VSB1

ii) **Services Boxes 38mm and 50mm**

The service boxes shall be 1.7m to 2.0m bury, but shall be extended if special depths are encountered. Service boxes will come complete with type 304 stainless steel rods and stainless steel cotter pins.

The following service boxes have been approved for use by the County:

Mueller	A753
Clow	D2-9
Bibby	VSB2

18.5.00 CORROSION PROTECTION MEASURES

.1 Cathodic Protection

i) **Water Services**

Each copper water service shall be protected as per Table 18.2. Services larger than 50mm are to be treated like any metallic watermain.

Sacrificial nuts shall be placed on all bolts on bolted connections on watermain pipe, fittings, valves, etc.

The use of zinc or magnesium anodes shall be as approved by the Design Engineer.

Table 18.2

Watermain Size/Service	Anode Size (kg)	Spacing
Copper service	5.5	At each curb stop and each mainstop

.2 Tape Corrosion Protection System

All buried metal pipe and appurtenances, except those made of copper, brass or stainless steel, shall be tape wrapped using the Denso 3-step Corrosion Protection System. This system consists of Denso Paste, Denso Profiling Mastic and Denso LT Tape. Tape Corrosion Protection shall be in addition to cathodic protection. Information in regards to else products and their use is available from the following:

Denso North America Inc.
90 Ironside Crescent, Unit 12
Toronto, Ontario
M1X 1M3
Telephone: (416) 291-3435
Fax: (416) 291-0898

.3 Polyethylene Encasement Protection

Polyethylene Encasement as per AWWA (8 mil High Density), is an acceptable form of corrosion protection for all Ductile Iron pipe and cast iron pipe and appurtenances including thrust restraint devices with in valve chambers only.

The installation of sacrificial zinc anodes will also be required, as will the use of the County approved Tape Corrosion Protection System on all exposed metal including: nuts, bolt or areas in which the protective coating has been removed during the construction process.

18.6.0 JOINT RESTRAINT

.1 Mechanical Restraints

All fittings and all joints within a calculated restraint distance shall be restrained with mechanical restraints. The following mechanical joint restraints have been approved for use:

- | | | |
|------|--|---|
| i) | Mega-Lug
Series 2000PV
Series 1100 | PVC
Ductile Iron |
| ii) | Uni-flange
Series 1300 & 1350
Series 1400
Series 1500 | PVC and Ductile Iron
Ductile Iron
PVC |
| iii) | Smith Blair "Cam-Lock" | |

	111/120 Series	PVC and Ductile Iron
iv)	Grip Ring restrainers for PVC and Ductile Iron.	
v)	Clow Series 300	PVC.
vi)	Signa One-Lok Wedge Action Restraint Series SLC & PVM Series SLD	PVC Ductile Iron
vii)	Star Pipe Products Pipe Restraint Series 1100C Stargrip Series 3000	PVC Ductile Iron
	Allgrip Series 3600 PVC Grip Series 3500 PVC Grip Series 4000 Mid Field Lok Series DI Mid Field Lok Series DV	PVC and Ductile Iron PVC PVC Ductile Iron PVC
viii)	Georg Fischer Wage N.V. Multi/Joint 3000 Plus	PVC and Ductile Iron

.2 Thrust Blocks

Thrust blocks for pipe sizes 150mm to 350mm shall be placed at all tees, crosses, valves and bends as per OPSD 1103.010 and 1103.020. Concrete used for thrust blocks shall have a minimum 28-day compressive strength of 20MPa. Concrete for thrust blocks shall be placed against undisturbed native material. Joints and couplings shall remain free from concrete.

Joint restraints for pipe sizes 350mm and greater shall be noted on the construction drawings.

18.7.00 SYSTEM LAYOUT

Watermain shall be contained within the paved portion of the roadway at a minimum depth of watermain shall be 1.8m below finished grade. A minimum clear horizontal distance of at least 2.5m shall be maintained between watermain and any sewer installation.

Watermain shall be looped to reduce dead ends. Permanent dead ends shall not be permitted without special approval.

When a dead end is so approved an Automatic Flushing Device shall be installed to the satisfaction of the County.

Valves shall be placed with a maximum spacing of 200m. There shall be 2 valves provided at 'tee' intersection and 3 valves provided at 'cross' intersections. Valves shall be located at the extension of the property line at the intersection.

In cases where the watermain cross sewers, above or below the sewer, a minimum vertical distance of 0.5m between the outside of the watermain and the outside of the sewer shall be provided to allow for proper bedding and structural support of the watermain and sewer pipe. Watermain joints shall be placed equal distance away from the sewer crossing.

Hydrants shall be spaced no more than 150m, measured along road centrelines. In all cases, a 75m radius from each hydrant shall overlap with the arc from an adjacent hydrant. Hydrants shall be connected to the watermain with an anchor tee and controlled independently by a 150mm gate valve. 19mm Clear stone shall be placed to provide adequate barrel drainage. Acceptable thrust restraint shall be provided at all hydrants.

Computer analysis of the proposed water distribution system shall be performed by the Developer's Engineer to verify fire flows within the proposed development and effects on existing servicing.

18.8.00 INSTALLATION DETAILS

.1 Bedding

All watermains and appurtenances shall be bedded using Bedding Sand in accordance with OPSS 1004.05.04.02 or Granular 'A' as in accordance to OPSS 1010. For the purpose of this specification, all materials placed between the trench bottom and 12" (300mm) over the main shall be considered as bedding.

Trenches shall be excavated, only where bedding is required, to a depth of 150mm below the specified elevation of the bottom of the proposed watermain.

Bedding material shall be placed for the full width of the trench and shall be mechanically compacted to 95% of maximum dry density, as determined by A.S.T.M. Designation D698.

.2 Backfill

Backfill shall be considered as starting at 300mm over the watermain. All materials below this point shall be considered as bedding.

Backfill material shall be placed for the full width of the trench and shall be mechanically compacted to 95% of maximum dry density, as determined by A.S.T.M. Designation D698.

18.9.00 WATERMAIN DISINFECTION AND COMMISSIONING

The Developer's Engineer shall be familiar with the County of Brant General Watermain Disinfection Procedure and ensure diligent compliance with all requirement of the procedure. The County of Brant General Watermain Disinfection Procedure is available at the County of Brant Administration Office at 26 Park Avenue, Burford, Ontario.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 19

MINIMUM TESTING REQUIREMENTS

November/2018

MATERIAL	AREA/ USAGE	TEST	SAMPLING FREQUENCY & TEST REQUIREMENTS	TEST LOCATION IDENTIFICATION
Native Material	Sewer Trench	Compaction	Min. every 30m, .6m max. lift, 95% (514.07.08)	Street, distance from downstream M.H., distance above pipe or below final grade ie: Street A, MH23 + 30m, 1.8m above pipe
	Watermain	Compaction	Min. ever 30m, .6m max. lift, 95% (514.07.08)	Street, station, offset, distance above pipe or below finished grade ie: Street A, 0 + 310, 5.5m Rt, 1m above pipe
	Subgrade	Compaction	Min. every 30m alternating lanes 95% (514.17.08), 98% desirable in top 1m	Street, Station, offset ie Street A, 0 + 105, 3.5m Lt
	Watermain Road Crossings	Compaction	Each Crossing, 95% (514.07.08)	Street, Station
	Utility Trenches*	Compaction	Each Crossing, 95% (514.07.08)	Street, Station
* Utility crossings are to be installed prior to base asphalt				
	Service Trenches**	Compaction	Random Selection 25% of lots 95% (501.08.02)	Lot Number
** If Storm and Sanitary Services are installed with mainline sewer, this requirement is waived. Only water service trenches will have to be reported separately				

Granulars A & B	Roadway	Compaction	Min. every 30m alternating lanes 100% (501.08.02)	Street, Station, offset ie: Street A, 0 + 105, 3.5m LT
		Moisture Content	Min. every 30m alternating lanes	Street, Station, offset ie: Street A, 0 + 105, 3.5m LT
		Gradation Percent Crushed PN# (site specific)	- Granulars are to be sampled at source and gradation checked prior to delivery AND - min. 1 check per 100m of road for an 8.5m road - gradation to conform to OPSS 1010	Street, Station offset ie: Street A, 0 + 105, 3.5m LT
	Utility Trenches	Compaction	Each Crossing 100% (510.08.02)	Street, Station
	Curbline Bedding	Compaction	Every 30m	Street, Station Lt or Rt or North, South, East, West
	Driveway Apron	Compaction Contamination	33% of Driveways at random, 100% (510.08.02) - Check to ensure there is 150mm of un-contaminated material	Lot or house #, distance from curb or garage

MATERIAL	AREA/ USAGE	TEST	SAMPLING FREQUENCY & TEST REQUIREMENTS	TEST LOCATION IDENTIFICATION
Asphalt HL3 & HL4 1101 1103 1150	Roadway	Compaction	30m each lane 96% (310.07.02.11.01) 97% w/nuclear device (310.07.02.11.02)	Street, Station, Lt or Rt or North, South, East, West or adjacent lot ie: Street A, 0 + 225, South lane
	Roadway	Asphalt Temperature	every 150m each lane, 115C to 165C (310.07.02.07, 1150.05.02.01)	As Above
		Ambient Temperature	Each Sample min. + 2 deg. C for HL4 min. + 7 deg. C for HL3	
	Roadway	Marshall Tests (1150.07.03)	1 per 500 tonne from samples taken	As Above
	Roadway	Extraction Tests (1150.07.03)	1 per 500 tonne from samples taken	As Above

Asphalt HL3, HL3a, HL4	Driveway Apron	Marshall Tests	2 per day of paving	Lot or house #, distance from curb or garage
	Driveway Apron	Extraction Tests	2 per day of paving	As Above
	Driveway Apron	Compaction	96% (310.07.02.11.01) 97% w/nuclear device (310.07.02.11.02) 33% of Driveways at random	As Above
	Driveway Apron	Temperature	115C to 165C, with Samples	As Above
All Asphalt Test results are to correspond to all OPSS Standards, ie 1003, 1101, 1150 (AADT > 5000). If there are failures, further testing will be done on the samples to determine the limits of the failures. Corrective action will depend on nature and extent of failures.				

COUNTY OF BRANT DEVELOPMENT AND ENGINEERING STANDARDS
SECTION 19 – MINIMUM TESTING REQUIREMENTS

PAGE 5

MATERIALS	AREA/ USAGE	TEST	SAMPLING FREQUENCY & TEST REQUIREMENTS	TEST LOCATION IDENTIFICATION
Concrete (OPSS 1350)	Sidewalk	Compressive Strength	- 3 location per 500m of sidewalk - min 3 cyls. per location for 7 & 28 day breaks	Station, Lt. or Rt. or adjacent lot or house number
		Slump	First 3 trucks or until consistent, at sampling & every 3 rd truck	As Above
		Air Content (7% +/- 1.5%)	First 3 trucks or until consistent, at sampling & every 3 rd truck	As Above
	Curb and Gutter	Compressive Strength	- 3 locations per 500m of Curbing - min. 3 cyls. per location for 7 & 28 day breaks	As Above
		Slump	First 3 trucks or until consistent, at sampling & every sample location	As Above
		Air Content (7% +/- 1.5%)	First 3 trucks or until consistent, at sampling & every sample location	As Above
	Structures	Compressive Strength	2 sets (3 samples ea) per pour	As Above
		Slump	First 3 trucks and every 3 rd truck after and with samples	As Above
		Air Content (7% +/- 1.5%)	First 3 trucks and every 3 rd truck after and with samples	As Above

Notes:

- 1) Additional Testing may be required by the County depending upon site conditions.
- 2) Results of compaction tests for sewer trenches will be submitted to the County in a Tabular Form
- 3) Sub grade will be proof rolled in the presence of the Developers Engineer and Soils Consultant. The Soils Engineer shall issue a certificate of compaction and approval prior to the placement of granular materials, stating that the trenches, services and road subgrade have been backfilled, compacted and tested in accordance with the County's testing criteria and is suitable for the placement of granular materials.
- 4) The Soils Engineer shall issue a certificate of compaction and approval of granular materials prior to the placement of Hot Mix Asphalt.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 20

TRAFFIC IMPACT STUDY

November/2018

20.1.00 INTRODUCTION

20.1.01 Traffic Impact Study

One of the County of Brant's key objectives is to operate and maintain a safe and efficient roadway system. The review and management of development-generated traffic is an integral part of operating and maintaining a safe and efficient roadway system. The Traffic Impact Study (TIS) guidelines outlined in this section have been established to meet this objective. The Traffic Impact Procedures establish a range of Traffic Impact Study categories based on the characteristics of the development and the estimated peak hour traffic volumes. The guidelines also outline the analysis approach and methods.

A Traffic Impact Study identifies existing traffic volumes and conditions, proposed development traffic volumes and conditions and their combined impacts on the existing and future roadway system.

A Traffic Impact Study is an important tool in the overall development planning process (Residential, Commercial, Industrial, Institutional, etc.) It assists developers and public agencies in making land use decisions, such as Official Plan amendments, rezonings, subdivisions, site plans and planning approvals. It provides information, which identifies the impacts of proposed developments on the existing, short range and long-range roadway/circulation networks. It also identifies mitigation measures for the impacts identified.

Traffic impact studies benefit the County by:

- Providing decision makers with a basis on which to assess transportation implications of proposed development applications;
- Providing a rational basis on which to evaluate the appropriateness of the scale of development for a particular site, and determining required improvements, on and off the site, to provide safe and efficient access and traffic flow;
- Providing a basis for assessing existing or future localized transportation system deficiencies which require improvement;

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- Addressing transportation-related issues associated with development proposals that may be of concern to neighboring residents, businesses and property owners; and
 - Providing a basis for negotiations for improvements and funding participation in conjunction with a development or zoning application or petition.

A traffic impact study may vary in scope and complexity depending on the type and size of the proposed development.

20.1.02 Need and Justification

The County of Brant has prepared these guidelines in order to streamline the approval process and provide a standardized framework for consultants to follow, when submitting traffic/transportation studies for review, and should be complemented with good transportation engineering judgment.

20.1.03 Purpose of Guidelines

The purpose of these guidelines is to ensure that traffic impact studies prepared for The County of Brant review meet the following criteria:

- Objective assessment – the study will evaluate the impacts of proposed new development in a rational manner;
- Consistency – the study will utilize assumptions consistent with the County of Brant's accepted methodologies and parameters, and thus be comparable to other traffic studies in the County;
- Recognized by developers and consultants – the guidelines will provide a standard approach to be followed and will reduce confusion and delay in processing development proposals;
- Promote understanding of process – the steps outlined in these guidelines will enable proponents, reviewers and elected officials to understand the process more effectively; and
- Ease of review by staff – a standardized set of guidelines will aid the efficiency of staff in reviewing Traffic Impact Studies.

20.2.01 General Traffic Impact Study Requirements

- **Need for Traffic Impact Study**

There are a number of criteria under which a traffic impact study is required. In general, a traffic impact study shall be conducted whenever a proposed development will generate more than 100, additional (new) peak hour, peak direction trips to or from the site during the adjacent roadway's peak hour or the development's peak hour. The specific analysis requirements and level of detail are summarized in Table 1 and are determined by the following categories:

CATEGORY 1.

Developments, which generate 100 to 499 trips during either the morning or afternoon peak hour shall prepare a traffic impact study may also be required for sites generating less than 100 peak hour, peak direction trips when one or more of the following conditions are anticipated or present:

- The existence of any current traffic problems or concerns in the local area such as an offset intersection, a high number of traffic accidents, etcetera.
- The development/re-development is located in an area of high roadway congestion and/or a high expected rate of population or employment growth;
- The development, its access or type of operation is not envisaged by local land-use or transportation plans;
- The development or re-development proposal requires amendment of the applicable official plan(s).
- As part of the proposed development, a new traffic signal is proposed to be installed on a County roadway; and
- If, in the opinion of the County, the development/re-development has the potential to create unacceptable operational and safety impacts on the County road network. Examples include the following:
 - ▶ Inadequate horizontal or vertical sight distances at access points;

-
- ▶ The proximity of the proposed access points to other existing driveways or intersections;
 - ▶ Lack of existing left or right turn lane(s) on the adjacent roadway at the proposed access point(s).
 - ▶ The vehicular traffic generated by the development /re-development would result in volume/capacity ratios at a signalized intersection becoming critical (i.e. greater than 0.85 overall or for a shared through/turning movement, or greater than 1.0 for an exclusive turning movement).
 - ▶ The vehicular traffic generated by the development would result in a significant increase in truck traffic.

CATEGORY 2.

Developments, which generate 500 to 999 trips during either the morning or afternoon peak hour.

CATEGORY 3.

Developments, which generate 1,000 to 1,499 trips during either the morning or afternoon peak hour.

CATEGORY 4.

Developments, which generate more than 1,500 trips during either the morning or afternoon peak hour.

20.2.02 Staff Consultation

It is highly recommended that, prior to commencing a traffic impact study, a pre-consultation meeting be arranged with County staff in order to review the level of detail and confirm the scope of the traffic impact study, arrange contacts with the various affected road jurisdictions and to determine data requirements and their availability. In addition to the County's requirements, adjacent municipal and Provincial (MTO) roadway authorities may require additional information or analysis to satisfy their requirements for a development/re-development proposal. The proponent should contact these road authorities, as required, to determine their requirements.

20.2.03 Study Updates

Generally, a Traffic Impact Study will have a "shelf life" of three years. However, major changes within the study area may reduce the "life" of the document if they were not considered in the

impact assessment. Where the timing of subsequent development approvals exceeds five years, a new study will generally be required.

20.2.04 Qualifications to Conduct a Traffic Impact Study

When the scale of the development/re-development warrants a Traffic Impact Study, it is the proponent's responsibility to retain a qualified transportation consultant experienced in transportation planning and traffic engineering.

The consultant shall be a member of the Institute of Transportation Engineers and registered as a Professional Engineer in the Province of Ontario. The report must be dated, signed & stamped, accordingly. The signing Engineer is verifying that appropriate assumptions and methodologies have been utilized in the completion of the Traffic Impact Study and that they are the individual who is taking corporate/professional responsibility for the work.

Alternatively, at the discretion of the Manager of Infrastructure Services or designate, the County may retain a consultant at the proponent's expense.

20.2.05 Traffic Impact Study Outline

The following sections and Table 1 outline the format and requirements of the traffic impact study. Adjacent municipal or provincial roadway authorities may require additional information or analyses beyond the County's requirements outlined in these guidelines. The contents and extent of the traffic impact study generally depend on the location and size of the proposed development/redevelopment and the conditions prevailing in the surrounding area.

20.2.06 Description of the Proposal and the Study Area

A description of the development proposal, its location and the proposed traffic impact study area is required to permit County staff to identify the site location, its anticipated operation and area of potential impact. In addition, this valuable information allows timely review of key study assumptions ranging from the study area limits and horizon years to the trip assignment assumptions.

20.3.01 Description of the Development or Redevelopment Proposal

The traffic impact study should provide a full description of the proposed development. This may include the following elements, as applicable:

- Municipal address
- Existing land uses or permitted use provisions in an Official Plan, Official Plan Amendments, Zoning Bylaw, etc.
- Proposed land uses and relevant planning regulations to be used in the study;
- Total building size and building locations
- Floor space including a summary of each type of use/number of residential units;
- Anticipated date of occupancy;
- Approximate hours of operations;
- Planned phasing of the development;
- Near-by intersections and accesses to adjacent developments including type of control;
- Proposed access points and type of access (full turns, right-in right-out, turning movement restrictions, etc.) and;
- Nearby transit facilities/stops

It is a requirement to provide a site plan, of a suitable scale, for consideration in the review of the traffic impact study. If the proposed development/redevelopment is to be constructed in phases, describe each phase and the proposed timing of implementation.

20.3.02 Study Area

The minimum study area will be determined by project type and size in accordance with the criteria in Table 1.

The County reserves the right to establish the study area as may be deemed necessary.

A description of the existing transportation system in the study area, using a combination of maps and other documentation should identify relevant information, such as the following:

- All adjacent and nearby roads, indicating the number of lanes and posted speeds;
- All adjacent and affected intersections, indicating type of control, lane configurations, lane widths, and any turning or similar restrictions;

- If appropriate, on-street parking spaces/standing/stopping restrictions in the vicinity of the development site and those which would affect the operation of key intersections being analyzed;
- Transit routes;
- Heavy vehicle prohibitions and restrictions and;
- Other transportation facilities as appropriate

20.3.03

Potential future transportation improvements that are currently being considered and may facilitate the traffic demand produced by the development/redevelopment should be identified. These improvements should be described to a level of detail sufficient to assess their implications for travel to/from the development. In each case, the status and anticipated date of implementation shall be identified.

20.4.00 Horizon Year and Time Periods for Analysis

20.4.01 Horizon Year

The horizon year for impact analysis is determined by the traffic development characteristics at the site as summarized in Table 1.

Horizon years should also be identified for any interim phases of development and additional horizon years, may be required depending on the magnitude of the development.

20.4.02 Peak Periods

The critical time period for traffic generated by a given project is directly associated with the peaking characteristics of both the development related traffic and the transportation system traffic. Typically, the AM and PM peak traffic period will constitute the “worst case” combination of site related and background traffic. However, in the case of retail, entertainment, religious, institutional, sports facility uses, the Saturday, Sunday or site peak may require analysis. As part of the pre-consultation meeting prior to commencing the study, the consultant should determine, in conjunction with County staff, the selected time periods for analysis.

20.4.03 Existing Traffic Conditions

To provide a representative picture of the existing traffic conditions, exhibits showing the existing traffic volumes and turning movements for roadways and intersections in the study area (including

pedestrian volumes and heavy truck movements) should be included.

Traffic volumes may be acquired from the County, local municipalities or previous transportation planning, traffic operation or traffic impact studies undertaken in the study area. Traffic counts more than two years (2) old, or counts that appear not to reflect existing conditions, should be updated to ensure that they reflect current traffic levels.

A field observation (peak one hour count at minimum) should be undertaken to verify that traffic volumes through an intersection reflect actual demand, and to determine the necessary adjustments to level-of-service calculation to ensure actual conditions are fairly represented.

20.5.00 Background Traffic Growth

20.5.01 Background Traffic

The background growth traffic should be established in consultation with County staff through one of the following methods:

- Estimation of roadway growth factors from a calibrated traffic forecast model;
- Regression analysis of historical traffic growth; or
- A growth rate based on area transportation studies. In some situations, alternative assumptions or methods, such as the application of development absorption rates, may be appropriate. In the absence of these methods, rates provided by the municipality should be used.

20.5.02 Other Area Developments

All significant developments under construction, approved or in the approval process, within the study area, and likely to occur by the specific horizon years, should be identified and recognized in the study. The land-use type and magnitude of the probable future developments in the horizon years should be identified through consultation with County staff.

20.5.03 Transportation Network Improvements

Changes to the present or planned transportation network should be determined from the approved County, Provincial and local capital improvement programs. A realistic assessment of timing and certainty should be made. The impacts of the transportation

system changes should be identified. In particular, diversion of volumes from other facilities to new or improved facilities should be estimated.

20.5.04 Transit Considerations

In areas with transit service, any existing transit service should be identified as having significant potential impact and possible changes in modal split should be evaluated.

An exhibit showing the background traffic volumes and turning movements for roadways and intersections in the study area should be included.

20.5.05 Estimation of Travel Demand

All trip generation, trip distribution, assignment and modal split assumptions should be in accordance with standard/accepted techniques and based on local parameters. Sources should be well documented, and any assumptions which may be considered less-than conservative should be rigorously justified. Any "soft" parameters where there is a significant uncertainty or a range of possible values should be subjected to sensitivity analysis unless a demonstrated "worst case" situation is assumed.

20.5.06 Trip Generation

Consultation with County staff is recommended to ensure that appropriate and agreed upon trip generation rates are being employed in the traffic impact study. Available trip generation methods include:

Trip generation surveys from similar developments in the County, which have similar operating characteristics as the proposed development. Modifications should be made to the trip generation rates to account for differences in the surveyed and proposed development sites;

- "First principles" calculations of anticipated trips to/from the site; and
- ITE Trip Generation rates, provided that differences in site nature and size are accounted for.

Typical trip generation rates or equations are usually derived from counts taken at driveways of various land uses. However, for many commercial land uses, not all of the trips generated at the driveway(s) represent new trips added to the adjacent street

system. The number of trips generated may include pass-by trips and internal “synergy” trips.

Where appropriate, it may be justified to change the trip generation of the proposed development to account for:

Trips generated by land use activities being replaced by the proposed development. Unless otherwise accounted for, these trips will normally be subtracted from the trip generation estimates.

Pass by trips – pass-by trips are made by traffic already on the roadway(s) that enter the site as an intermediate stop on the way from an origin to a primary destination. For example, a driver may stop at a convenience market on his/her way home from work. If this market is located along the roadway the driver normally uses to get home, then the trip “generated by the market” is not a new trip added to the roadway system.

It should be recognized that pass-by reduction is only applicable to evaluation of traffic operations at intersections removed from the site; pass-by trips must be accounted for in the turning movements into/out of the site;

- Internal “synergy” trips – represents trips which are shared between two or more uses on the same site, i.e. a motorist visiting a retail store and a grocery store on the same site; and Transportation Demand Management (TDM) strategies. All trip generation assumptions and adjustments assumed in the calculation of “new” vehicle trips should be documented and justified in terms of previous research or surveys.

Sensitivity analysis should be undertaken where trip generation parameters have the potential to vary considerably, and most probable values cannot be readily identified.

A table should be provided in the study report identifying the categories and quantities of land uses, with the corresponding trip generation rates or equations and the resulting number of trips. For large developments that will be phased in over time, the table should identify each significant phase separately.

20.5.07 Trip Distribution

The directions from which traffic will approach and depart the site can vary depending on several location-specific factors, including:

-
- Size of the proposed development;
 - Type of proposed development;
 - Surrounding, and in some cases competing, land uses, population and employment distributions; and
 - Prevailing conditions on the existing street system

The trip distribution assumptions should be supported by one or more of the following:

- Origin-destination surveys;
- Comprehensive travel surveys
- Existing/anticipated travel patterns;
- Output from the EMME/2 transportation planning model; and
- Market studies

Engineering judgment should be utilized to determine the most applicable of the above methodologies for each particular application.

20.5.08 Trip Assignments

Traffic assignments should consider logical routings, available and projected roadway capacities, and travel times. Traffic assignments may be estimated using a transportation-planning model or “hand assignment” based on knowledge of the proposed/future road network in the study area. The County will provide traffic information from any relevant studies that it may possess.

20.5.09 Summary of Traffic Demand Estimates

A summary of the future traffic demands (each combination of horizon year and peak period for both site generated and total future traffic conditions) should be provided in the form of exhibits. Pass-by traffic assumptions should be clearly identified and illustrated on an exhibit, which summarizes the reassignment of pass-by traffic.

20.6.00 Evaluation of Impacts of Site Generated Traffic

An evaluation of signalized and unsignalized intersections which will be affected by site-generated traffic volumes for all relevant time periods and scenarios is required, and summaries are to be provided in a tabular format.

The objective should be to ensure that no new “problem” movements are created by the development, and that “problem” movements, which exist with the addition of site-generated traffic, are not worsened by this addition.

In an appendix to the traffic impact study, all assumptions used in the analysis (concerning lane configuration/use, pedestrian activity, saturation flows, traffic signal cycle length, phasing and timing, utilization of the inter-green phase and other relevant parameters) shall be documented. Existing signal timings should be used for existing intersections. Signal-timing modifications may be considered as a measure to address capacity or level of service deficiencies.

20.6.01 Capacity Analysis at Intersections

The summary should include the level-of-service, including average vehicle delay and volume to capacity (v/c) ratios for overall intersection operations and individual critical movements, for all analysis periods and time horizons. Full documentation of the results of all level of service analyses should be provided in an appendix.

The County accepts both the Highway Capacity Manual (HCM) and Canadian Capacity Guide (CCG) methodologies of intersection analysis. Specific software packages include CCG/CALC2, HCS Version 3.0 or higher, Synchro 4.0 or higher, InterCap or HCM/Cinema. Should a consultant wish to utilize a software package other than these listed above, prior approval from the County must be obtained. The analysis should incorporate adequate crossing time for pedestrians and should use conventional signal timing plans.

The analysis should include the identification of signalized intersections where:

- Volume/capacity (V/C) ratios for overall intersection operations, through movements or shared through/turning movements increased to 0.85 or above;
- V/C ratios for exclusive movements increased to 0.95 or above; or
- Queues for an individual movement are projected to exceed available turning lane storage. Identification of unsigned intersections where:
- Level of service (LOS) based on average delay per vehicle, on individual movements exceeds LOS “E” or

- The estimated 95th percentile queue length for an individual movement exceeds the available queue storage.

Conventional signal timing plans should be used and all proposed adjustments to traffic signal timing, phasing and cycle lengths should be evaluated in terms of pedestrian crossing time, effect on queue lengths, adequacy of existing storage and effects on the existing signal co-ordination.

20.6.02 Safety Analysis

Identification of potential safety or operational issues associated with the following, as applicable:

- Weaving
- Merging
- Corner clearances
- Sight distances
- Vehicle-pedestrian conflicts
- Traffic infiltration
- Access conflicts
- Cyclist movements
- Heavy truck movement conflicts
- Etc.

20.7.0 Capacity Access Analysis Requirements

20.7.01 Access Geometrics

The number and location of access points should be reviewed to ensure only the minimum number necessary are provided to serve the project without negatively impacting the flow of traffic along abutting streets. Access points should be located on minor roads where feasible and justification for more than one access must be based on capacity of site traffic, not design preference.

The locations should be adequately spaced from adjacent street and driveway intersections. The number of exit lanes, radii and vehicle storage should be appropriate to accommodate traffic demands placed on them. The throat length at the road should be sufficiently long to minimize conflicts with street traffic and within the site.

Access points should be evaluated in terms of capacity, safety and adequacy of queue storage capacity. Access points should be free of all encumbrances and provide appropriate sight triangles. Proposed loading facilities and access to these facilities should be

evaluated to ensure that they are adequately sized, designed and provided with suitable access so that they will not adversely affect traffic operations on County roads.

Access standards should be in conformance with those outlined in the "Geometric Design Guide for Canadian Roads", 1999 edition, issued by the Transportation Association of Canada (TAC).

20.7.02 Turn Lane Requirements

The requirements for left turn and right turn lanes should be examined. Adequate spacing should be provided between access points to avoid potential turn lane overlaps. All design standards must be in conformance with those outlined in the TAC Manual.

20.7.03 Traffic Collision Analysis

Where the development is adjacent to an area with identified problems, existing collision data (available from the County) should be reviewed and an assessment of the impact of the proposed development provided. Such information may be helpful to minimize any additional problems through the design or location of access points.

20.8.0 Sight Distance Evaluation

At each access and at each intersection where a new road is proposed, the sight distance requirements should be determined based on appropriate standards (TAC Manual) and the availability of sight distance determined from actual field measurements.

20.9.0 Transportation System Mitigation Measures

This section outlines the process of identification of operational transportation system improvements and other measures required to ensure that acceptable operation of the transportation system is maintained. The improvements must incorporate recommendations and standards outlined in previous County transportation or corridor studies.

20.9.01 Required Roadway Improvements

The physical and operational road network deficiencies that have been identified in the traffic impact study must be addressed. Solutions provided must be feasible and economical to implement.

Functional design plans or detailed design drawings may be required for identified physical improvements to ensure their feasibility.

20.9.02 Required Traffic Signal Improvement

Any traffic signal operational deficiencies that have been identified in the Traffic Impact Study must be addressed and mitigated, provided that implementation is feasible.

20.9.03 Preliminary Cost Estimates

A preliminary cost estimate must be provided for all identified infrastructure improvements.

20.10.0 Recommendations

It is important to structure recommendations for improvements within appropriate time perspectives. Recommendations should be sensitive to the following issues:

- Timing of short-range and long-range network improvements that are already planned and scheduled;
- Anticipated time schedule of adjacent developments;
- Size and timing of individual phases of the proposed development;
- Logical sequencing of various improvements or segments;
- Right-of-way needs and availability of additional right-of-way within the appropriate time frames;
- Local priorities for transportation improvements and funding;
- Cost-effectiveness of implementing improvements at a given stage of development; and
- Necessary lead-time for additional design and construction.

Since improvements can often be implemented in more than one order, the recommendation should address an implementation sequence that would provide maximum compatibility with the overall roadway system configuration needed for network effectiveness.

20.11.0 Documentation and Reporting

The structure and format of the Traffic Impact Study should follow the guidelines outlined in this document, as applicable. The following is a suggested study structure:

- Site/Development Description (site plan if applicable)
- Study Area (map identifying the study area and site)

-
- Existing Conditions (exhibit required)
 - Analysis Periods
 - Background Traffic Demand – Existing and Future Background (exhibits required)
 - Site Generated Traffic (exhibits required)
 - Total Traffic Demand – Future Background plus Site Generated Traffic (exhibits required)
 - Improvement Alternatives Required to Mitigate Traffic Impacts
 - Traffic Impacts for Future Background and Total Traffic with and without mitigation measures (tabular summaries)
 - Access Considerations and
 - Recommendation

This format will facilitate review, discussion and communication. Relevant maps, graphs and tables should be placed adjacent to the relevant text.

The Traffic Impact Study should consist of a main document, supplemented by technical appendices containing detailed analyses as required. The County reserves the right to request digital copies of the analysis.

The Development Planner will determine the required number of copies of the Final Traffic Impact Study (complete with supporting documentation) to be submitted to Development Services Department staff for circulation.

All information submitted to County staff in connection with any Traffic Impact Study will be considered to be in the public domain.

Table T-1

Analysis Category	Development Characteristic	Study Horizons	Minimum Study Area (a)	Minimum Study Area (b)
I	Small Development 100-499 peak trips	1. Opening Year 2. 5 YEARS AFTER OPENING	1. Site access drives 2. Adjacent signal controlled intersections within ½ Km and/or major street intersections without signal control and driveways within 200 m	The study area should extend far enough, within reason, to contain all municipal, regional and provincial roadways that will be noticeably affected by the travel generated by the proposed development. In general, the analysis area should include all roads, ramps and intersections through which peak hour site traffic composes at least 5% of the existing capacity on an intersection approach. Roadways in the area of the development that have a traffic growth in excess of 5% and intersections where volume to capacity ratios for overall intersections or through or shared through/turning movements increased to over 0.85 or where the volume to capacity ratios for exclusive turning movements increased to 1.0 or above should be evaluated.
II	Moderate Development 500-999 peak hour trips	1. Opening Year 2. 5 years after opening	1. Site access drives 2. All signal controlled intersections within 1km and/or major street intersections without signal control and major driveways within 1km.	
III	Large Development 1,000-1,500 peak hour trips	1. Opening Year 2. 20 years after opening	1. Site access drives 2. All signal controlled intersections within 2km and/or major street intersections without signal control and major driveways within 2km.	
IV	Regional Development >1,500 peak hour trips	1. Opening Year 2. 20 years after opening	1. Site access drives 2. Key signal controlled intersections and major street intersections without signal control within 5km.	

NOTES:

Assume full occupancy and build-out for single-phase developments. Multi-phase developments may require assessment of up to three (3) horizon years corresponding to key phases as directed by the manager of infrastructure services.

For minimum study area use criteria (a) or (b) whichever is greater.

An enlarged study area may be required when the minimum study areas identified in table 1 do not provide sufficient information to meet the intent of the traffic impact study guidelines.

The onus will be on the proponent/consultant to demonstrate that a traffic impact study is not required.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 21

HYDRO

November/2018

21.1.01 GENERAL

Hydro requirements shall be in accordance with those set out by the local operating Hydro authority, such as Energy+ Inc. or Hydro One.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 22

PHOTOMETRICS

November/2018

22.1.01 QUALIFIED DESIGNERS

A photometric plan for exterior lighting shall be prepared by a licensed electrical lighting specialist competent in lighting & photometrics or a licensed professional electrical engineer.

22.1.02 DESIGN PARAMETERS

Exterior lighting system shall be designed to ensure readings of 0.0 footcandles at all property lines (no spill over of light at property lines).

At the discretion of the County, a maximum of 0.2 footcandles may be deemed acceptable at property lines within the County right-of-way.

22.1.03 DRAWINGS

Drawings must be legible and have sufficient information to show light levels throughout the site and in particular at all property lines.

COUNTY OF BRANT

**DEVELOPMENT AND
ENGINEERING STANDARDS**

SECTION 23

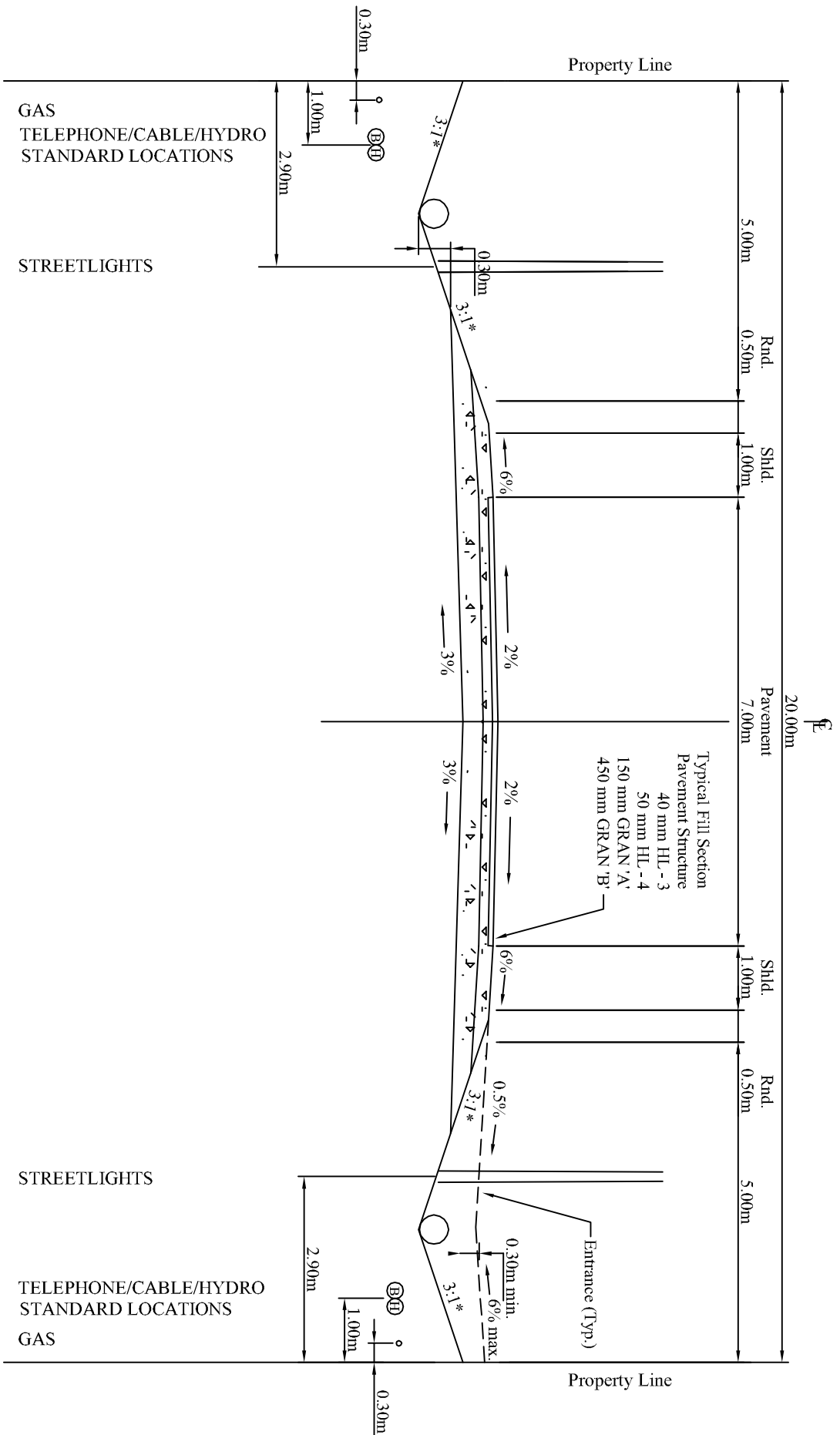
**COUNTY OF BRANT
STANDARD DRAWINGS**

November/2018

List of Standard Drawings

Drawing No.	Drawing Title
7-101	Typical Urban Local Residential Cross Section (20m Road Allowance)
7-102	Typical Rural Cross Section with 4:1 Side Slopes (20m Road Allowance) for Subdivisions
7-103	Typical Rural Cross Section (20m Road Allowance) for Subdivisions
7-104	Typical Rural Collector Cross Sections (26m Road Allowance) for Subdivisions
7-105	Typical Rural Arterial Cross Section (30m Road Allowance) for Subdivisions
7-106	Typical Urban Residential Collector Cross Section (26m Road Allowance)
7-106.1	Typical Urban Residential Collector Cross Section with Parking (26m Road Allowance)
7-107	Typical Urban Residential Arterial Cross Section (30m) Road Allowance)
7-201	Typical Cul-De-Sac Centre Bulb
7-202	Typical Cul-De-Sac Offset Bulb
17-301	Typical Service Locations (Single Family Lot) For Subdivisions
17-302	Typical Service locations (Semi-detached Lot) For Subdivisions (Outside Entrances)
17-303	Typical Service Locations (Semi-detached Lot) For Subdivision (Mutual Drive)
18-100	Standard Water Connection Detail for 19mm (3/4") and 25mm (1") Water Services and Service Bedding
18-101	Standard Water Connection Detail for 38mm and 50mm Water Services
18-102	Watermain Servicing Lowering Detail
18-201	Legend
18-202	Watermain and Hydrant Lead Bedding
18-203	Valve & Valve Box Installation for 100mm to 350mm Watermain
18-204	Watermain Location Detail
18-206	Standard 50mm Copper Blow-off Installation
18-207	Anode Installation
18-208	CDR 250mm x 380mm Series Box & Cover Test Point
18-212	Installation of 50mm SM Styrofoam Insulation
18-213	Backfill Requirements for Utility Crossings Underneath Existing Watermains
18-214	Watermain Encasement Over Box Culvert
18-401	Watermain Bedding Detail
18-402	Private Drain Lowering Detail
18-404	Hydrant Installation C/W Anchor Tee, Valve and Test Point For P.V.C. Watermain
18-406A	Typical Riser Installation for McAvity Hydrant
18-406B	Typical Extension Installation for Century, B-50-B-18 And B-50-B-24 Hydrant
18-500	50mm Watermain Looping for Cul-De-Sacs

18-600	Source Assembly for New or Temporary Watermains
18-601	Temporary Sample Port
18-602	Air Release Valve Chamber for Watermain size less than 750mm dia.
18-603	Typical Air Release Valve
18-700	Meter Chamber for Water Services: Parks and Irrigation Systems
18-701	Meter Chamber for 16 to 50mm dia. Water Services
18-702	Meter Chamber for 16 to 50mm dia. Water Services Profile
18-703	Meter Chamber for 75 and 100mm dia. Water Services
18-704	Meter Chamber for 75 and 100mm dia. Water Services Profile



NOTE: DEPTH OF ROAD COMPONENT LAYERS SHALL BE GOVERNED BY A SITE SPECIFIC GEOTECHNICAL REPORT AS DEPTHS NOTED ARE A MINIMUM REQUIREMENT

*: 4:1 SLOPES MAY BE UTILIZED AT THE DISCRETION OF THE COUNTY



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

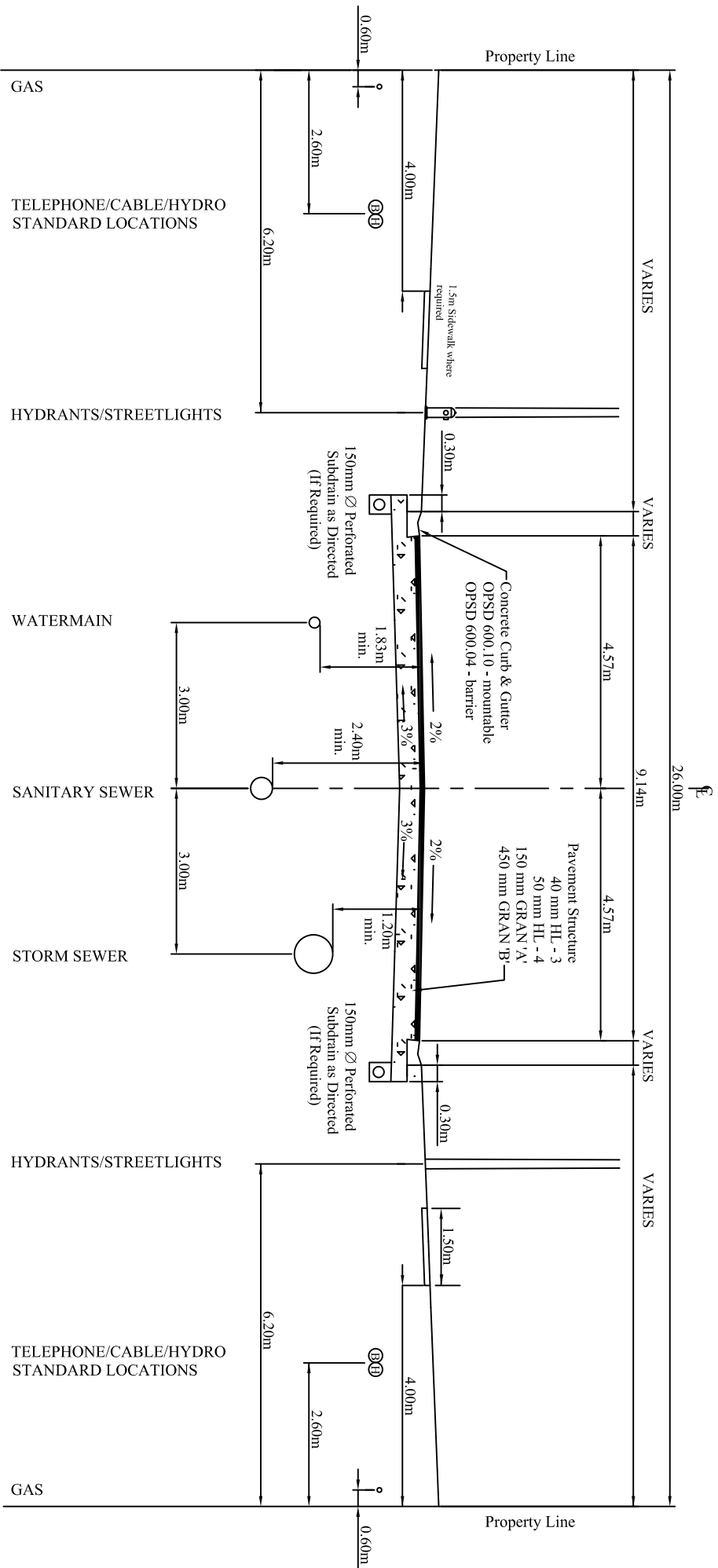
TYPICAL RURAL CROSS SECTION
(20m ROAD ALLOWANCE) FOR SUBDIVISIONS

REVISED: APRIL, 2009

SCALE: N.T.S.

DRAWING NUMBER

7-103



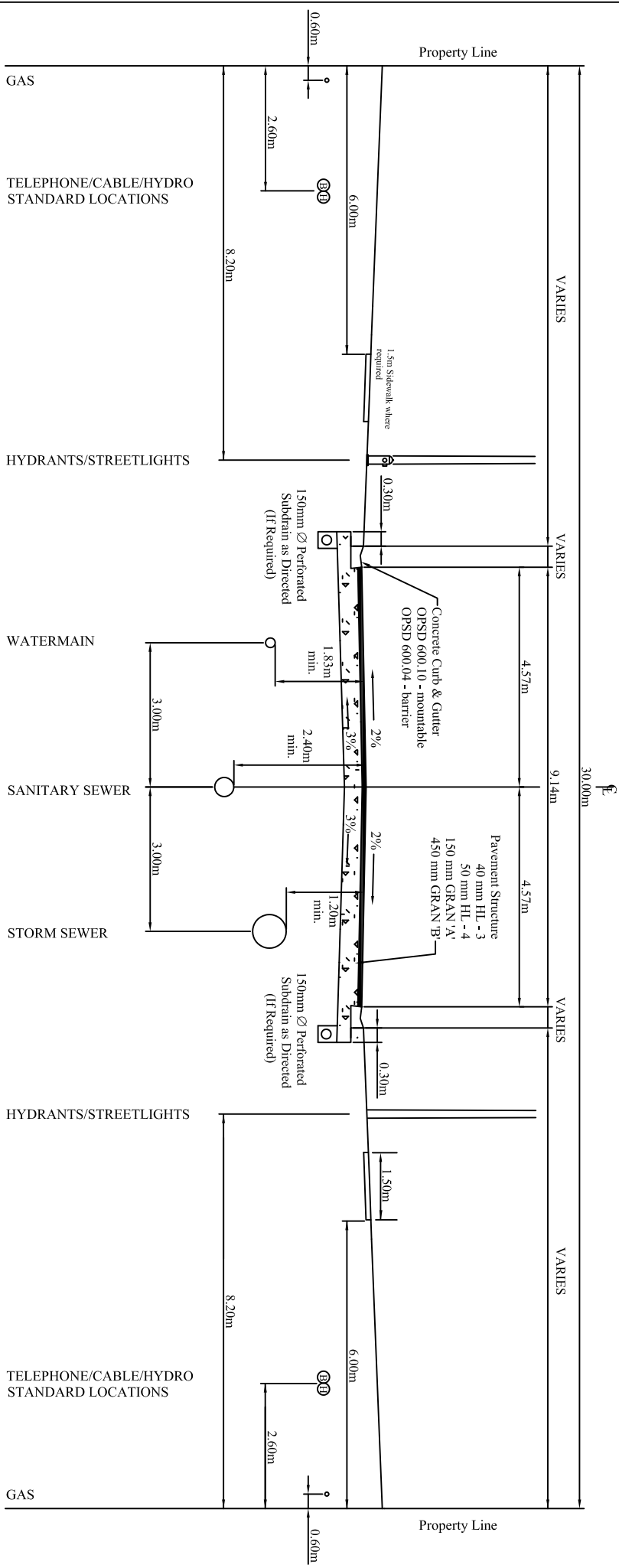
NOTE: DEPTH OF ROAD COMPONENT LAYERS SHALL BE GOVERNED BY A SITE SPECIFIC GEOTECHNICAL REPORT AS DEPTHS NOTED ARE A MINIMUM REQUIREMENT.

NOTE: WATER BOXES ARE TO BE LOCATED IN LANDSCAPED NOT HARD SURFACED AREAS (IE. DRIVEWAYS, SIDEWALKS, ETC.)

- *: DRAWING IS PROVIDED FOR REFERENCE ONLY AND DETAILED DESIGN WILL DETERMINE FINAL CROSS SECTION CONFIGURATION.
- *: PARKING IS TO BE PROVIDED ON ONE SIDE OF ROAD.

	COUNTY OF BRANT PUBLIC WORKS DEPARTMENT	
	TYPICAL URBAN RESIDENTIAL COLLECTOR CROSS SECTION (26m ROAD ALLOWANCE)	
	REVISED: FEBRUARY 2014	DRAWING NUMBER
	SCALE: N.T.S.	7-106



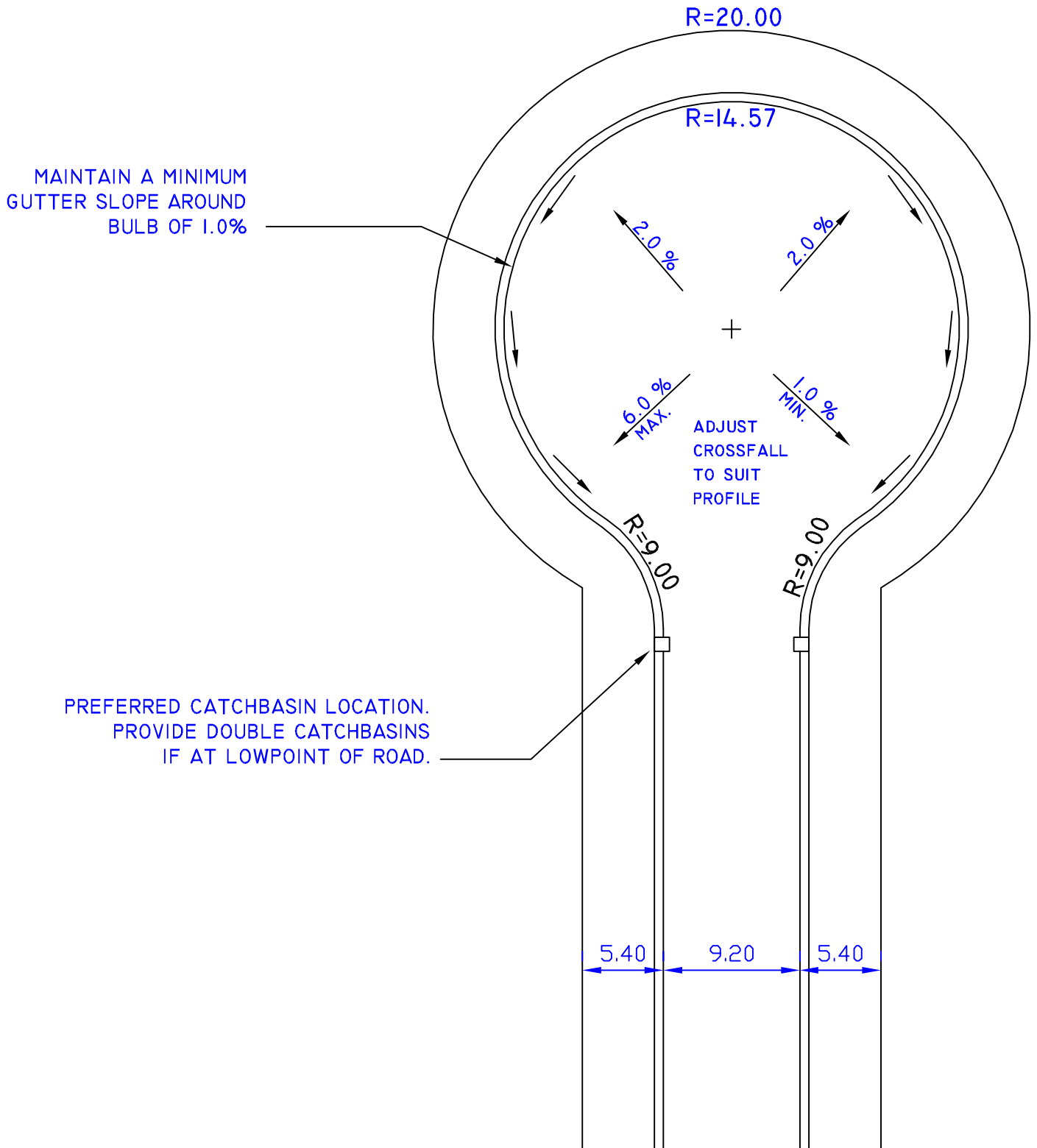


NOTE: DEPTH OF ROAD COMPONENT LAYERS SHALL BE GOVERNED BY A SITE SPECIFIC GEOTECHNICAL REPORT AS DEPTHS NOTED ARE A MINIMUM REQUIREMENT.

NOTE: WATER BOXES ARE TO BE LOCATED IN LANDSCAPED NOT HARD SURFACED AREAS (IE. DRIVEWAYS, SIDEWALKS, ETC.)

*: DRAWING IS PROVIDED FOR REFERENCE ONLY AND DETAILED DESIGN WILL DETERMINE FINAL CROSS SECTION CONFIGURATION.

COUNTY OF BRANT PUBLIC WORKS DEPARTMENT		REVISID: FEBRUARY 2014
COUNTY OF BRANT TYPICAL URBAN RESIDENTIAL ARTERIAL CROSS SECTION (30m ROAD ALLOWANCE)		SCALE: N.T.S.
		DRAWING NUMBER 7-107



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



TYPICAL CUL-DE-SAC CENTRED BULB

REVISED: **APRIL 2009**

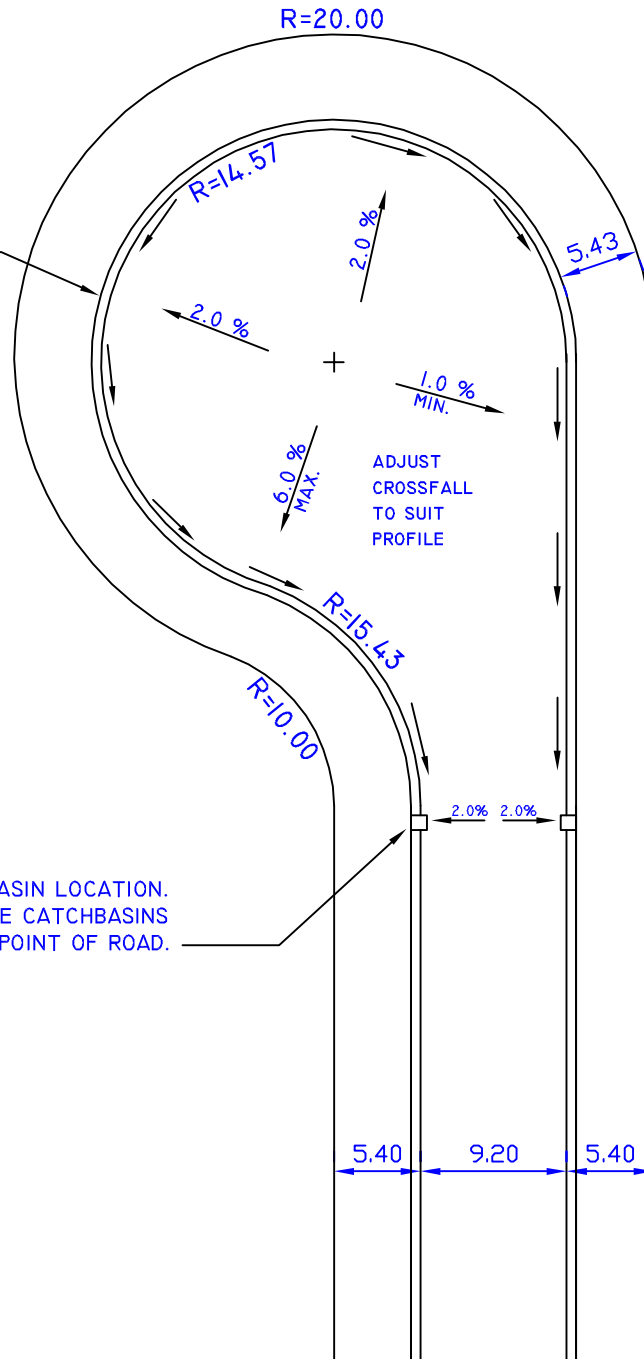
SCALE: **N.T.S.**

DRAWING NUMBER

7-201

MAINTAIN A MINIMUM
GUTTER SLOPE AROUND
BULB OF 1.0%

PREFERRED CATCHBASIN LOCATION.
PROVIDE DOUBLE CATCHBASINS
IF AT LOWPOINT OF ROAD.



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



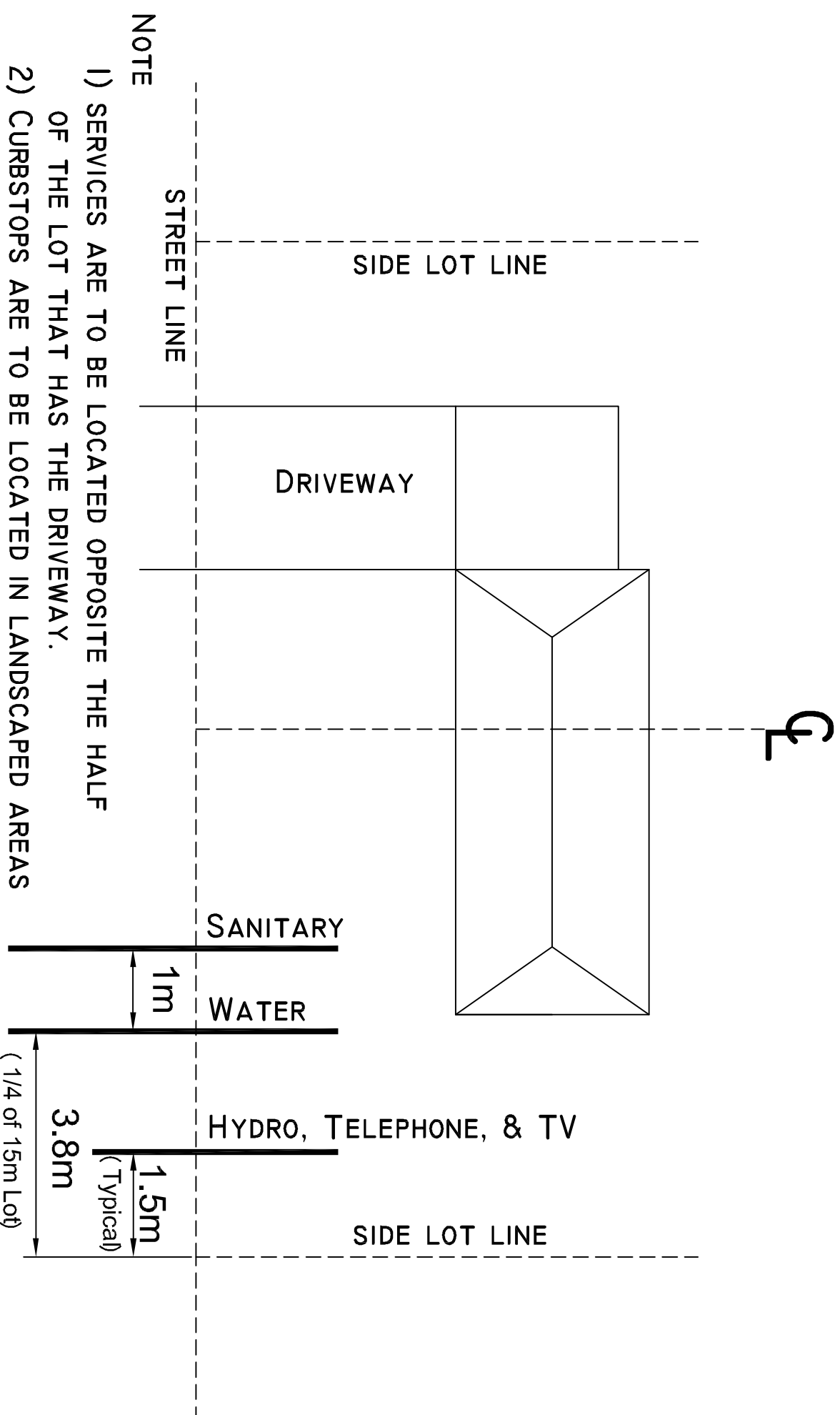
TYPICAL CUL-DE-SAC OFFSET BULB

REVISED: **APRIL 2009**

SCALE: **N.T.S.**

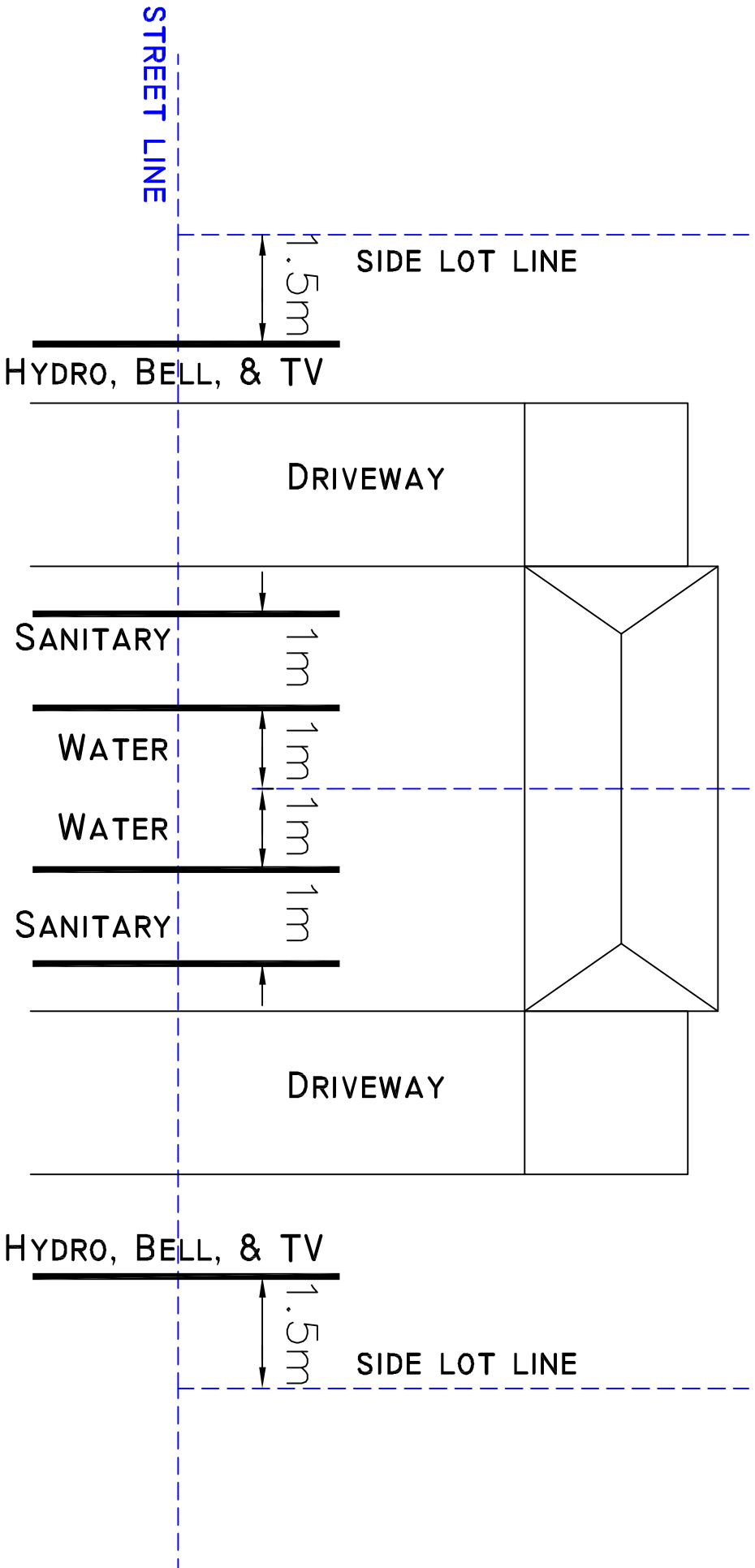
DRAWING NUMBER

7-202



COUNTY OF Brant Simply Grand 		COUNTY OF BRANT PUBLIC WORKS DEPARTMENT	
TYPICAL SERVICE LOCATIONS (SINGLE FAMILY LOT) FOR SUBDIVISIONS		REVISIED: FEB 2009	
SCALE: N.T.S.		DRAWING NUMBER 17-301	

6



NOTE: CURBSTOPS ARE TO BE LOCATED IN LANDSCAPED AREAS ONLY.



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

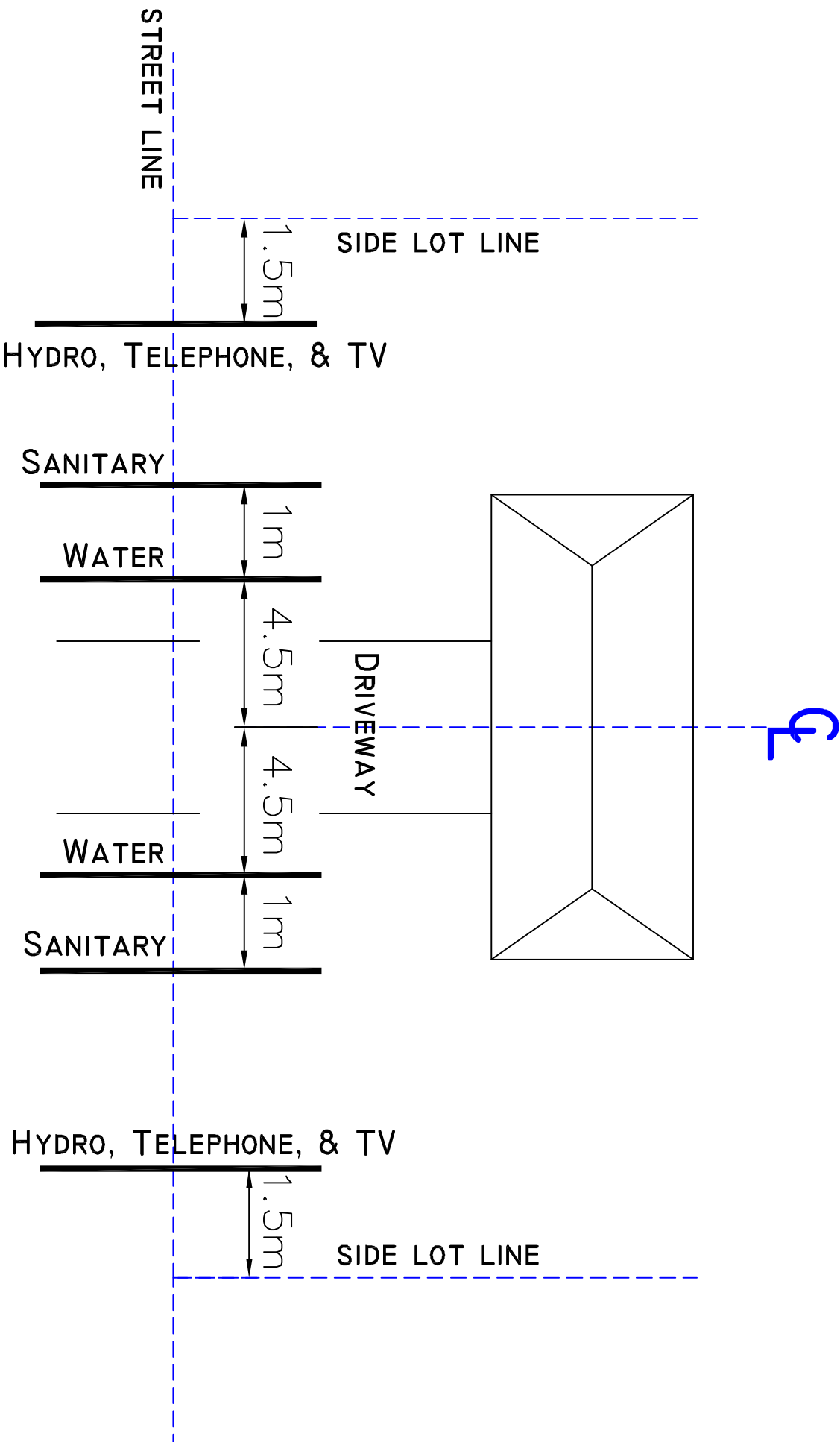
TYPICAL SERVICE LOCATIONS (SEMI-DETACHED LOT)
FOR SUBDIVISIONS (OUTSIDE ENTRANCES)

REVISED: APRIL, 2009

SCALE: N.T.S.

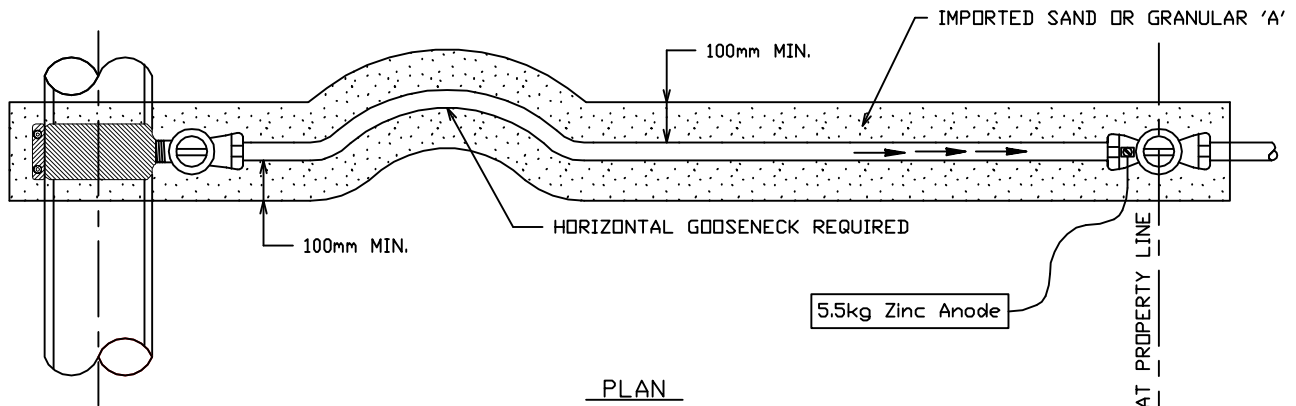
DRAWING NUMBER

17-302



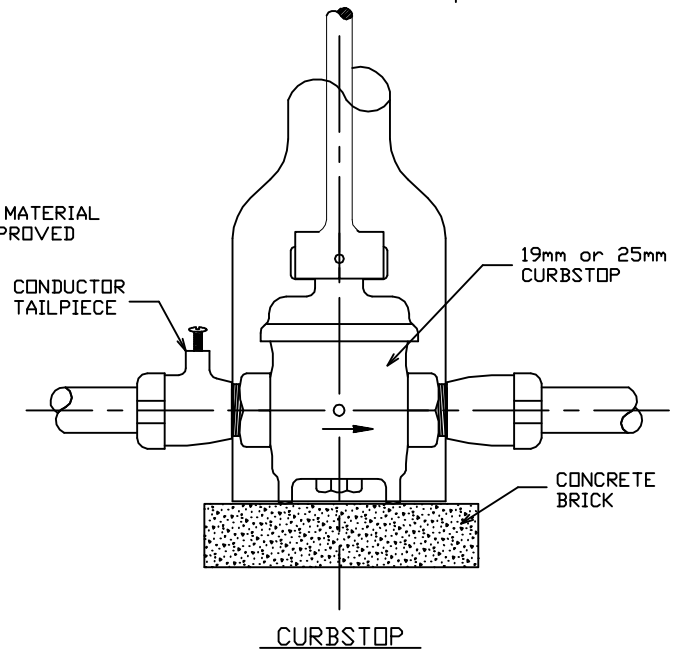
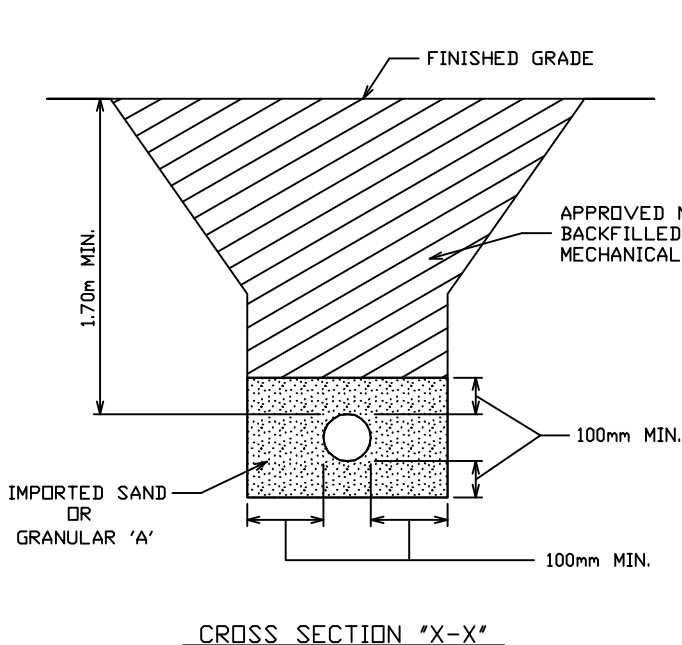
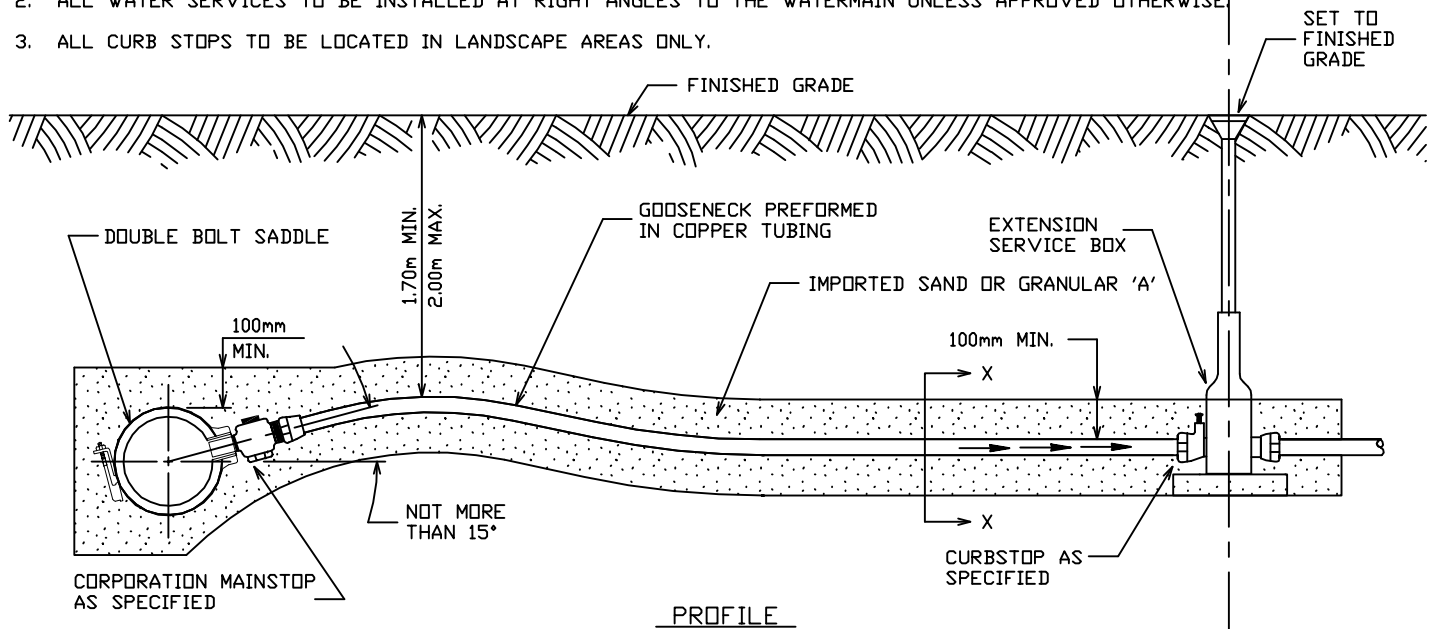
NOTE: CURBSTOPS ARE TO BE LOCATED IN LANDSCAPED AREAS ONLY.

 COUNTY OF Brant Simply Grand		COUNTY OF BRANT PUBLIC WORKS DEPARTMENT	
TYPICAL SERVICE LOCATIONS (SEMI-DETACHED LOT) FOR SUBDIVISION (MUTUAL DRIVE)		REVISED: APRIL 2009	
DRAWING NUMBER 17-303		SCALE: N.T.S.	



NOTES:

1. ANY JUNCTION MADE IN SERVICE PIPE BETWEEN CORPORATION MAINSTOP AND CURBSTOP IS TO BE MADE BETWEEN THE CURBLINE AND STREET LINE WITH A CORPORATION COUPLING.
2. ALL WATER SERVICES TO BE INSTALLED AT RIGHT ANGLES TO THE WATERMAIN UNLESS APPROVED OTHERWISE
3. ALL CURB STOPS TO BE LOCATED IN LANDSCAPE AREAS ONLY.



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



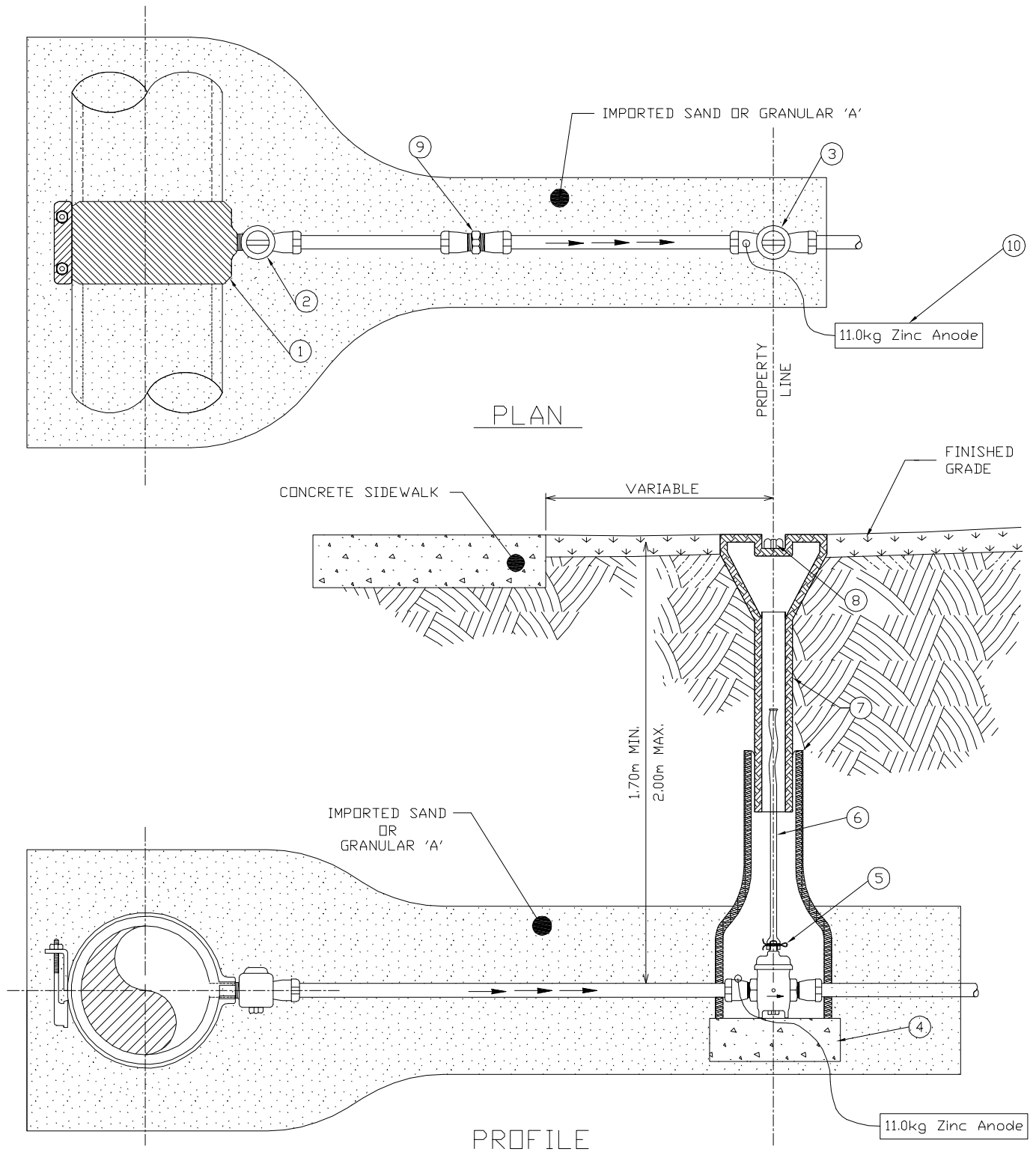
STANDARD WATER CONNECTION DETAIL FOR
19mm (3/4") AND 25mm (1") WATER SERVICES AND
SERVICE BEDDING

REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER

18-100



1. DOUBLE BOLT SADDLE
2. MAINSTOP
3. CURBSTOP
4. CONCRETE BLOCK
5. PIN (STAINLESS STEEL)

6. STAINLESS STEEL ROD
7. EXTENSION BARREL - TWO PIECES
8. PLUG (BRONZE)
9. COUPLING - COPPER TO COPPER (AS APPROVED)
10. 11.0KG ZINC ANODE

- NOTES:**
- 1) ALL WATER SERVICES ARE TO BE INSTALLED AT RIGHT ANGLES TO THE WATERMAIN UNLESS OTHERWISE APPROVED.
 - 2) CURBSTOPS ARE TO BE LOCATED IN LANDSCAPED AREAS ONLY

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



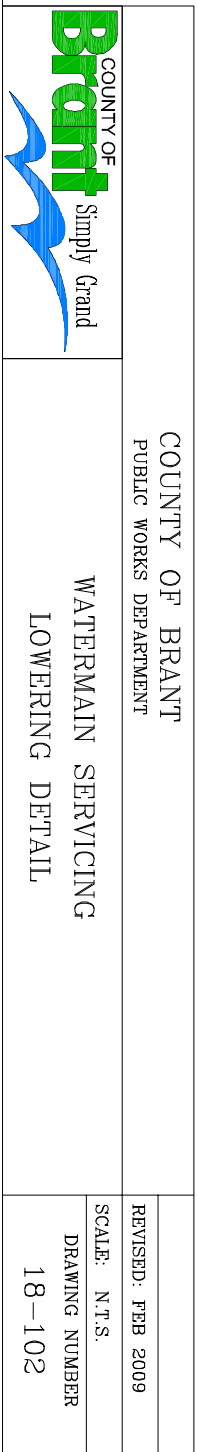
STANDARD WATER CONNECTION DETAIL FOR
38mm & 50mm WATER SERVICES

REVISED: FEB. 2009

SCALE: N.T.S.

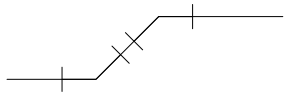
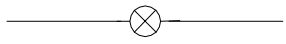
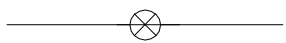
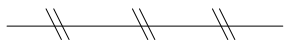
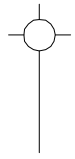
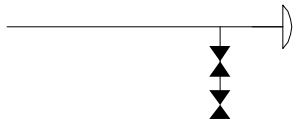
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18-101



LEGEND

SYMBOLS

		REDUCER
		VALVE
		BENDS
		OBSOLETE WATER SERVICE
		COPPER WATER SERVICE
		ABANDONED
		FIRE HYDRANT
		BLOW-OFF
		ANODE
		TEST POINT

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



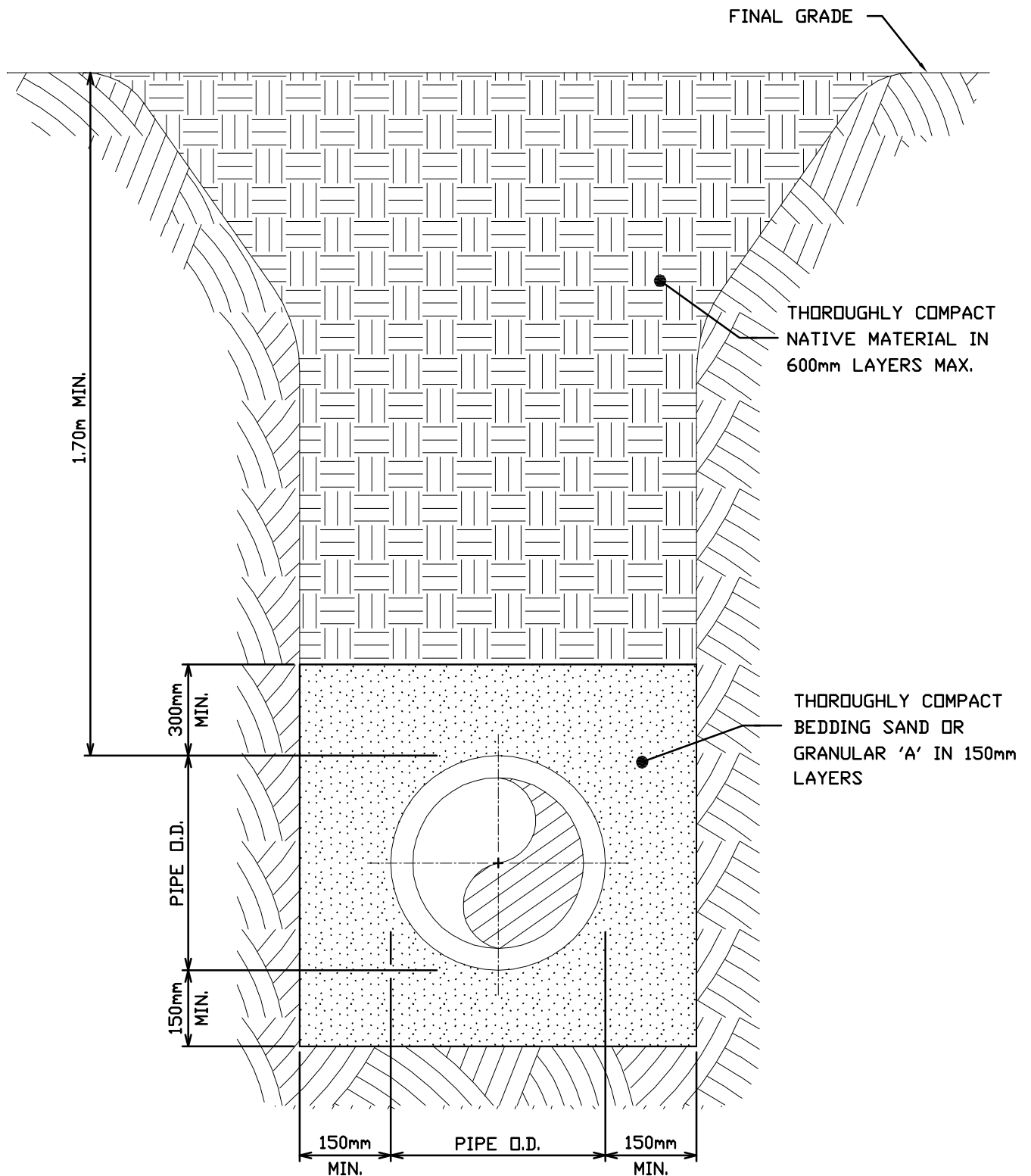
LEGEND

REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER

18-201



NOTE:

INCREASE IN BEDDING REQUIREMENT AS PER COUNTY ACCEPTED GEOTECHNICAL REPORT.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

REVISED: FEB. 2009

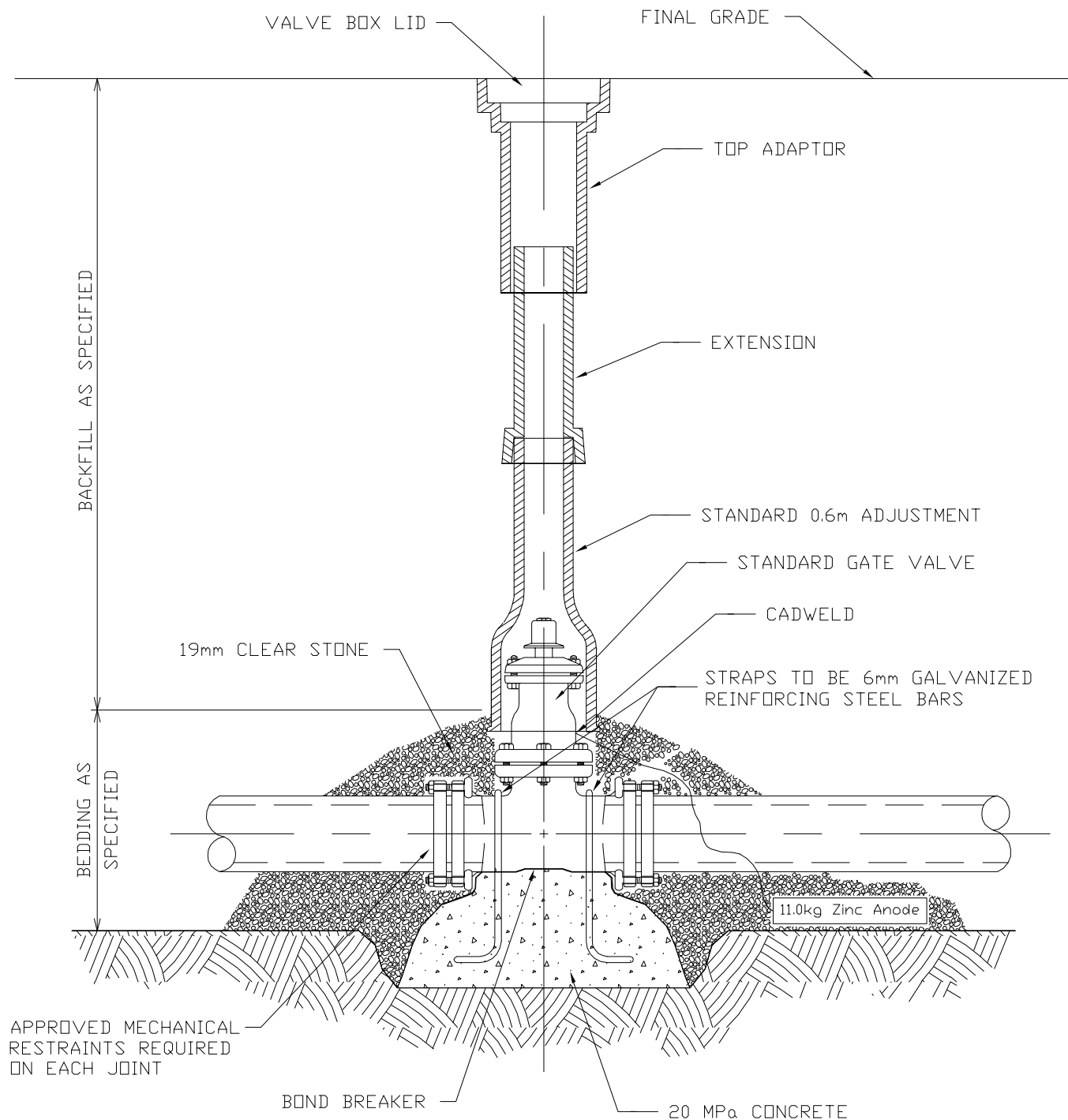
SCALE: N.T.S.

DRAWING NUMBER

18-202



WATERMAIN & HYDRANT
LEAD BEDDING



NOTES:

1. VALVE BOX TO BE ADEQUATELY BRACED WHILE BACKFILLING AND MUST REMAIN PLUMB.
2. VALVE BOX EXTENSION TO BE USED ONLY IF REQUIRED.
3. BOND BREAKER TO BE USED BETWEEN CONCRETE AND VALVE.
4. ALL CONCRETE TO BE 20 MPa AT 28 DAYS.
5. MINIMUM COVER OVER REINFORCING STEEL TO BE 75mm.
6. CORROSION PROTECTION SHALL BE AFFIXED AS PER STANDARD SPECIFICATIONS FOR WATERMAIN CONSTRUCTION.

COUNTY OF BRANT
WATER ENGINEERING DEPARTMENT

DATE:

REVISED: FEB. 2009

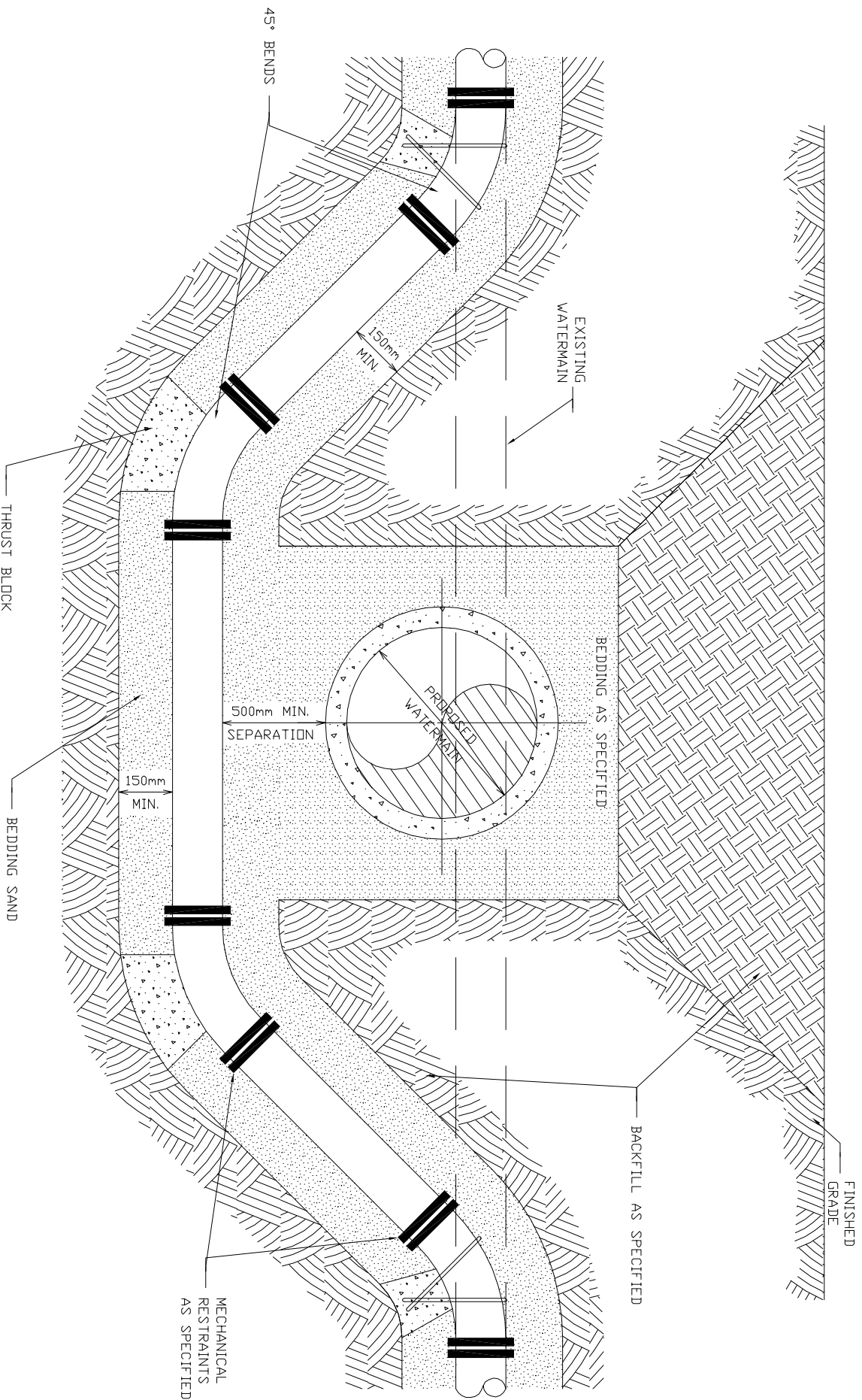
SCALE: N.T.S.

DRAWING NUMBER

18-203



VALVE & VALVE BOX INSTALLATION
FOR 100mm TO 350mm WATERMAIN



NOTE:
RESTRAINTS MUST BE USED ON ALL BENDS.



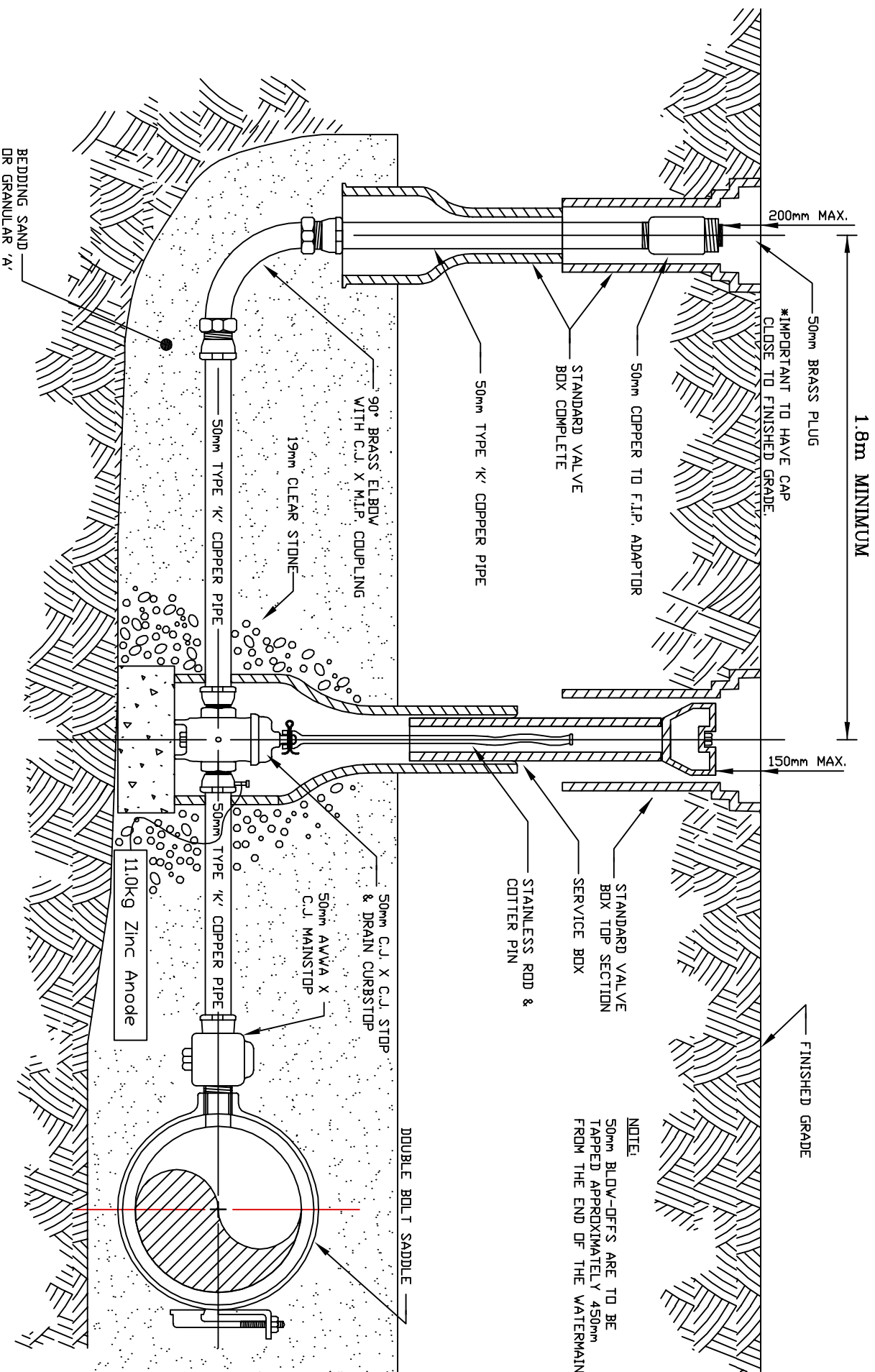
COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

WATERMAIN LOCATION DETAIL

REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER
18-204



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

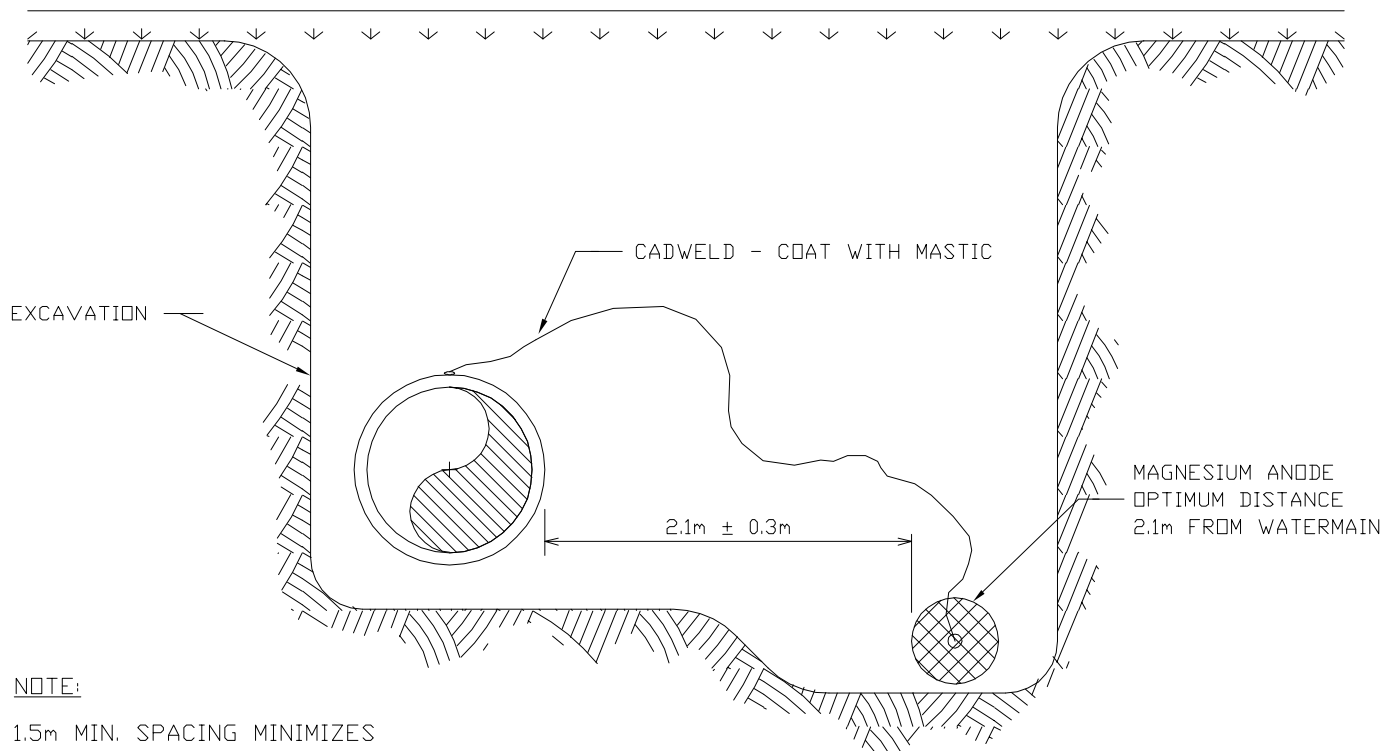
STANDARD 50mm COPPER
BLOW-OFF INSTALLATION



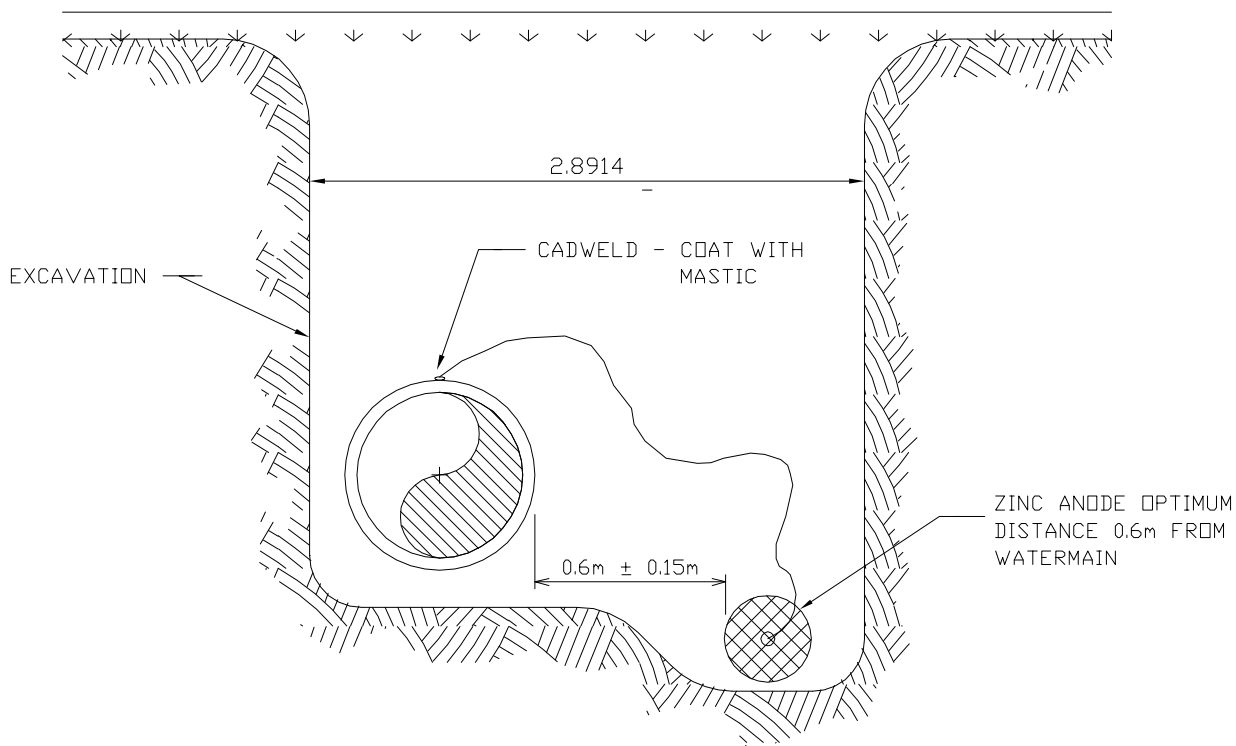
REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER
18-206



MAGNESIUM ANODE INSTALLATION



ZINC ANODE INSTALLATION

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



ANODE INSTALLATION

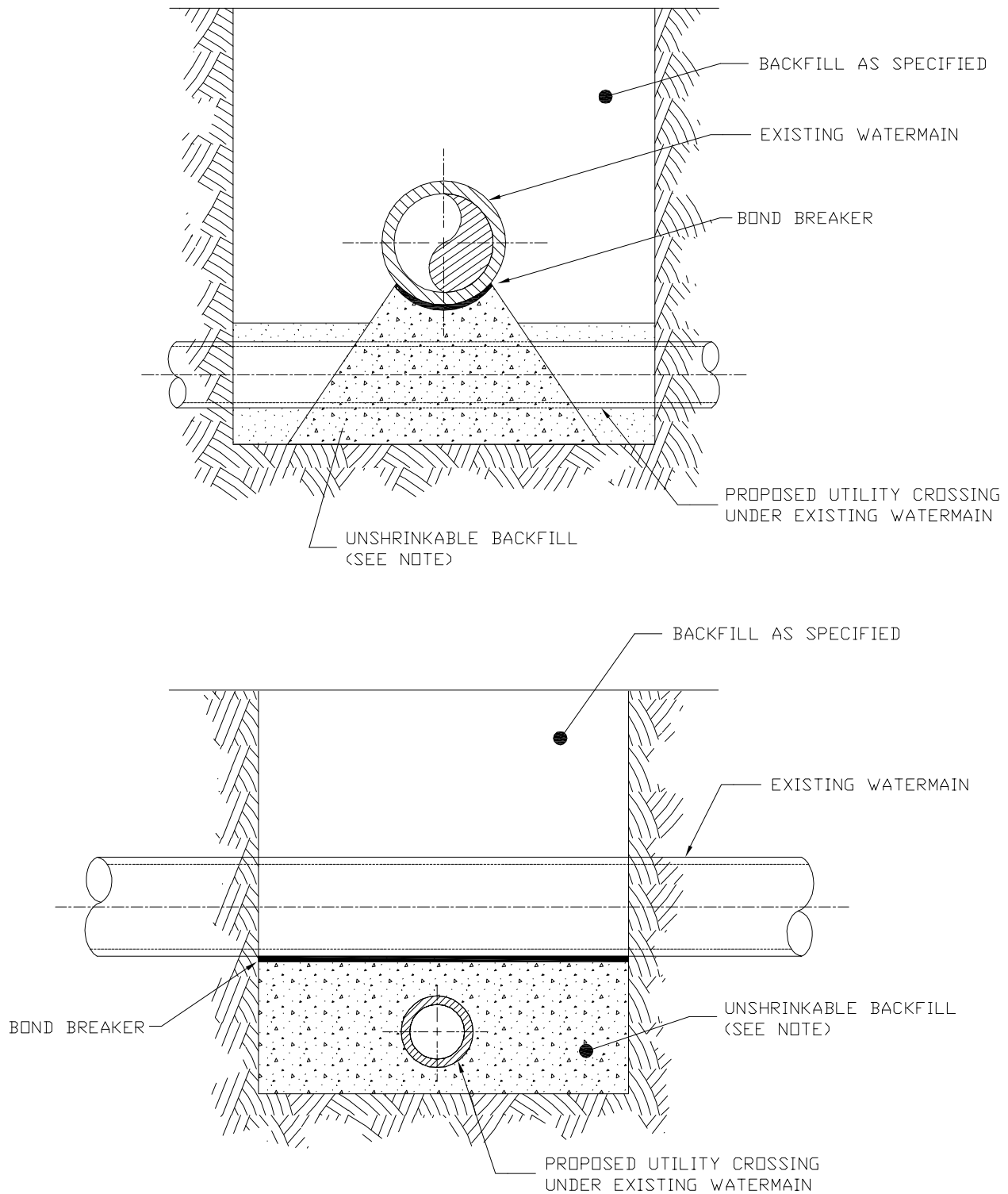
REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER

18-207





NOTE: 1) WEAKLY CEMENTED FILL:

MEANS ANY COMBINATION OF GRANULAR MATERIALS WITH LOW PERCENTAGES OF CEMENT SUCH THAT THE STRENGTH IS IN THE ORDER OF 0.4 MPA AT 28 DAYS.

2) BOND BREAKER TO BE PLACED BETWEEN THE WATERMAIN AND THE UNSHRINKABLE FILL.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

REVISED: FEB. 2009

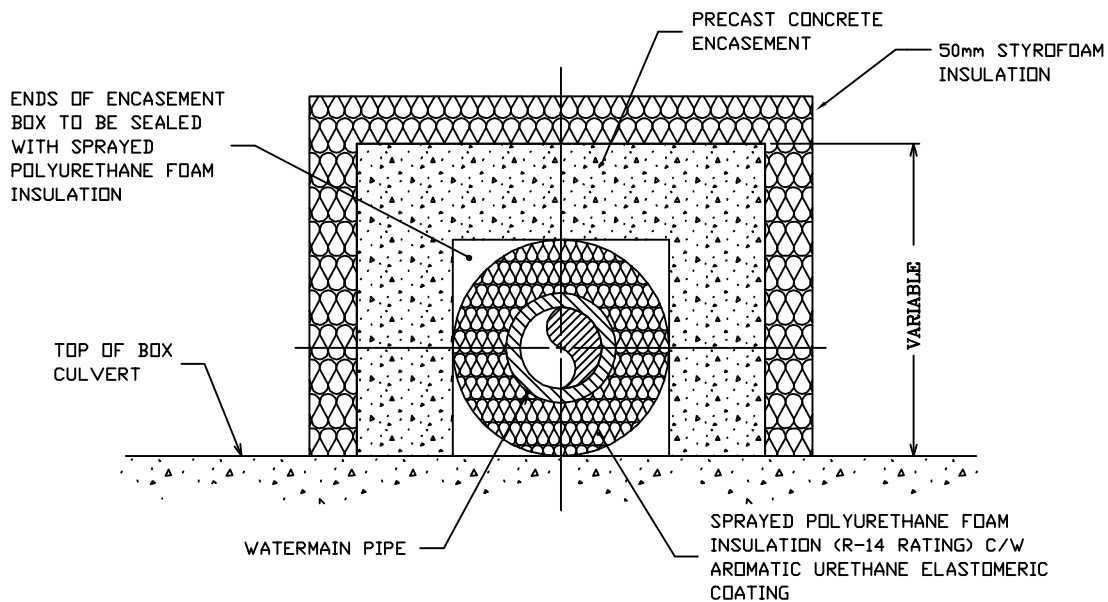
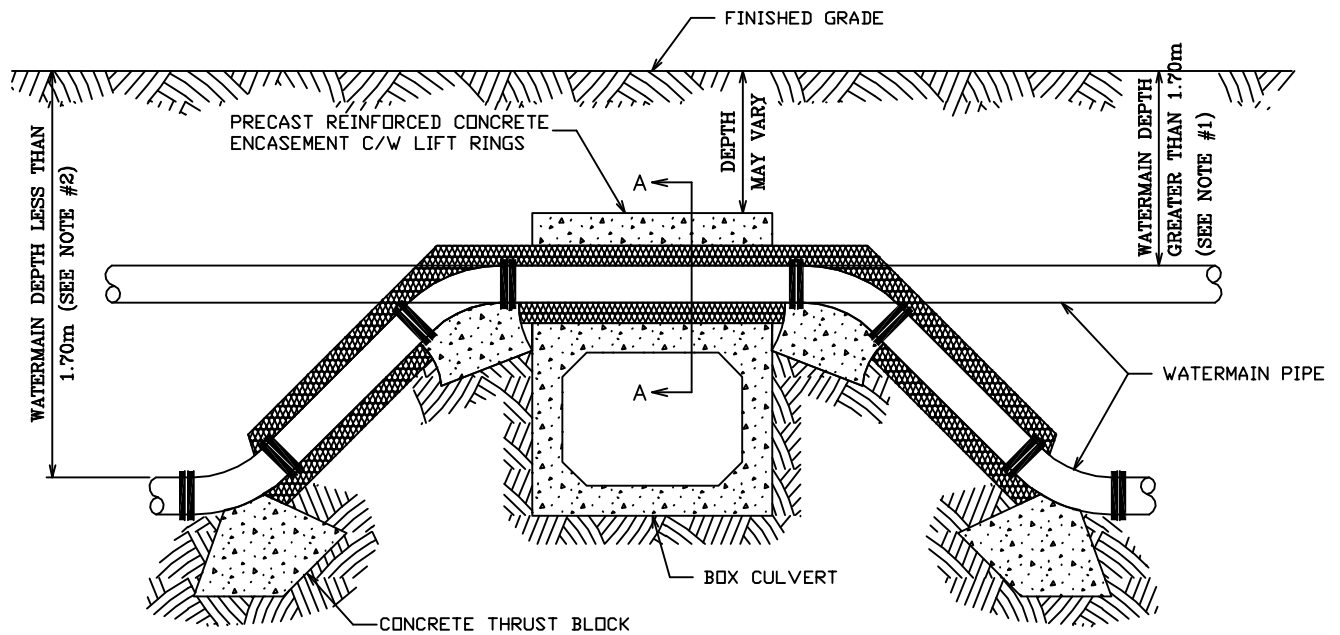
SCALE: N.T.S.

DRAWING NUMBER

18-213



BACKFILL REQUIREMENTS FOR
UTILITY CROSSINGS UNDERNEATH
EXISTING WATERMAINS



SECTION A-A

NOTES:

1. WATERMANS WITH DEPTHS GREATER THAN 1.70m SHALL BE INSULATED (SPRAY POLYURETHANE) IN PRECAST CONCRETE ENCASEMENT ONLY.
2. WATERMANS WITH DEPTHS LESS THAN 1.70m SHALL HAVE 45° BENDS AND INSULATED (SPRAYED POLYURETHANE) IN PRECAST CONCRETE ENCASEMENT AND DOWN TO BOTTOM OF BENDS ON EITHER SIDE OF THE BOX CULVERT.
3. INSTALLATION OF 45° BENDS SHALL BE RESTRAINED WITH MECHANICAL RESTRAINERS AND THRUST BLOCKS.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

REVISED: FEB. 2009

SCALE: N.T.S.

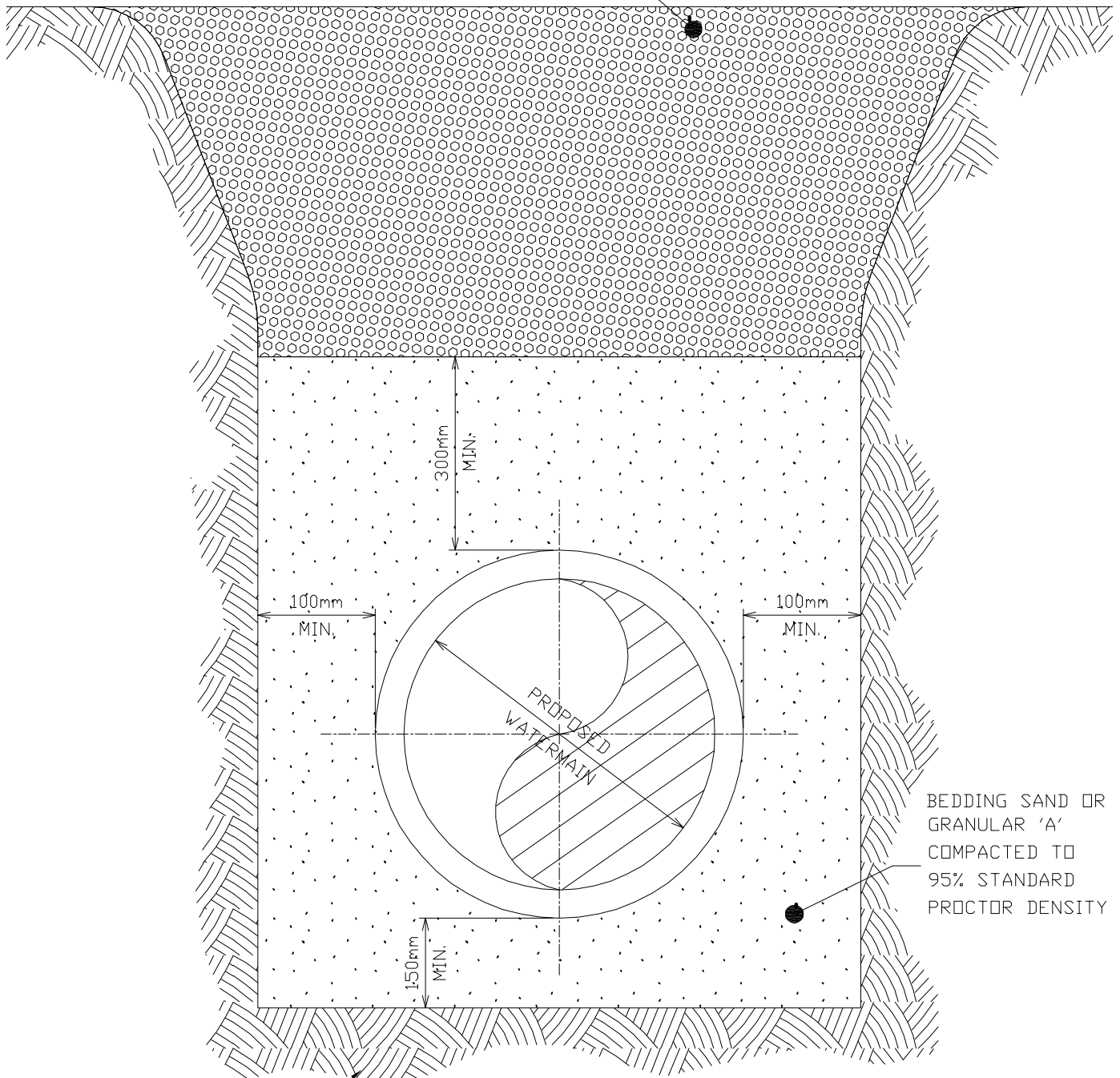
DRAWING NUMBER

18-214



WATERMAIN ENCASEMENT
OVER BOX CULVERT

BACKFILL AS SPECIFIED



BEDDING SAND OR
GRANULAR 'A'
COMPACTED TO
95% STANDARD
PROCTOR DENSITY

UNDISTURBED SOIL

NOTE:

INCREASE IN BEDDING REQUIREMENT TO BE AS PER COUNTY
ACCEPTED GEOTECHNICAL REPORT

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

REVISED: FEB. 2009

SCALE: N.T.S.

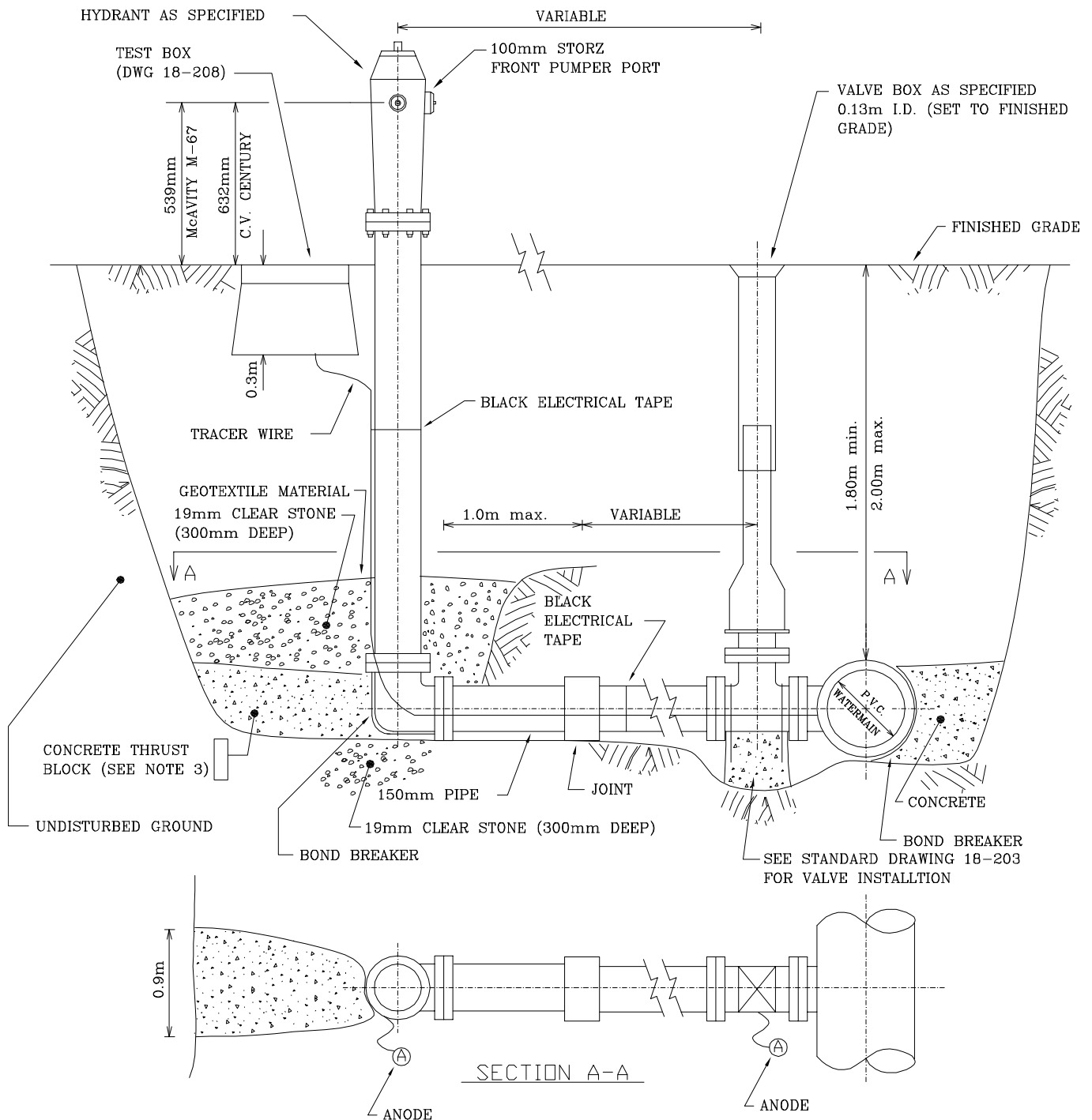
DRAWING NUMBER

18-401



WATERMAIN BEDDING DETAIL





NOTES:

1. MIN. STRENGTH OF CONCRETE 20MPa UNLESS SPECIFIED OTHERWISE.
2. ALL CONCRETE BLOCK TO BE POURED AGAINST UNDISTURBED GROUND.
3. IN ADDITION TO CONCRETE THRUST BLOCK, MECHANICAL RESTRAINTS SHALL BE USED AT ALL JOINTS ALONG THE HYDRANT LEAD.
4. ALL HYDRANT LEADS MUST HAVE A JOINT BETWEEN MAIN AND HYDRANT BOOT. THE FIRST JOINT MUST BE NO FURTHER THAN 1.0m FROM THE HYDRANT BOOT.
5. HYDRANT RISER SECTIONS SHALL BE GENERALLY AVOIDED. IF HYDRANT RISERS ARE REQUIRED, THEY SHALL BE INSTALLED AT THE BOOT OF THE CANADA VALVE(CENTURY) AND THE TOP OF THE McAVITY M-67. HYDRANT RISER SHALL IN NO CASE EXCEED 0.90m IN HEIGHT.
6. PROVIDE 300mm OF CLEAR STONE BELOW BOOT.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT

REVISED: FEB. 2009

SCALE: N.T.S.

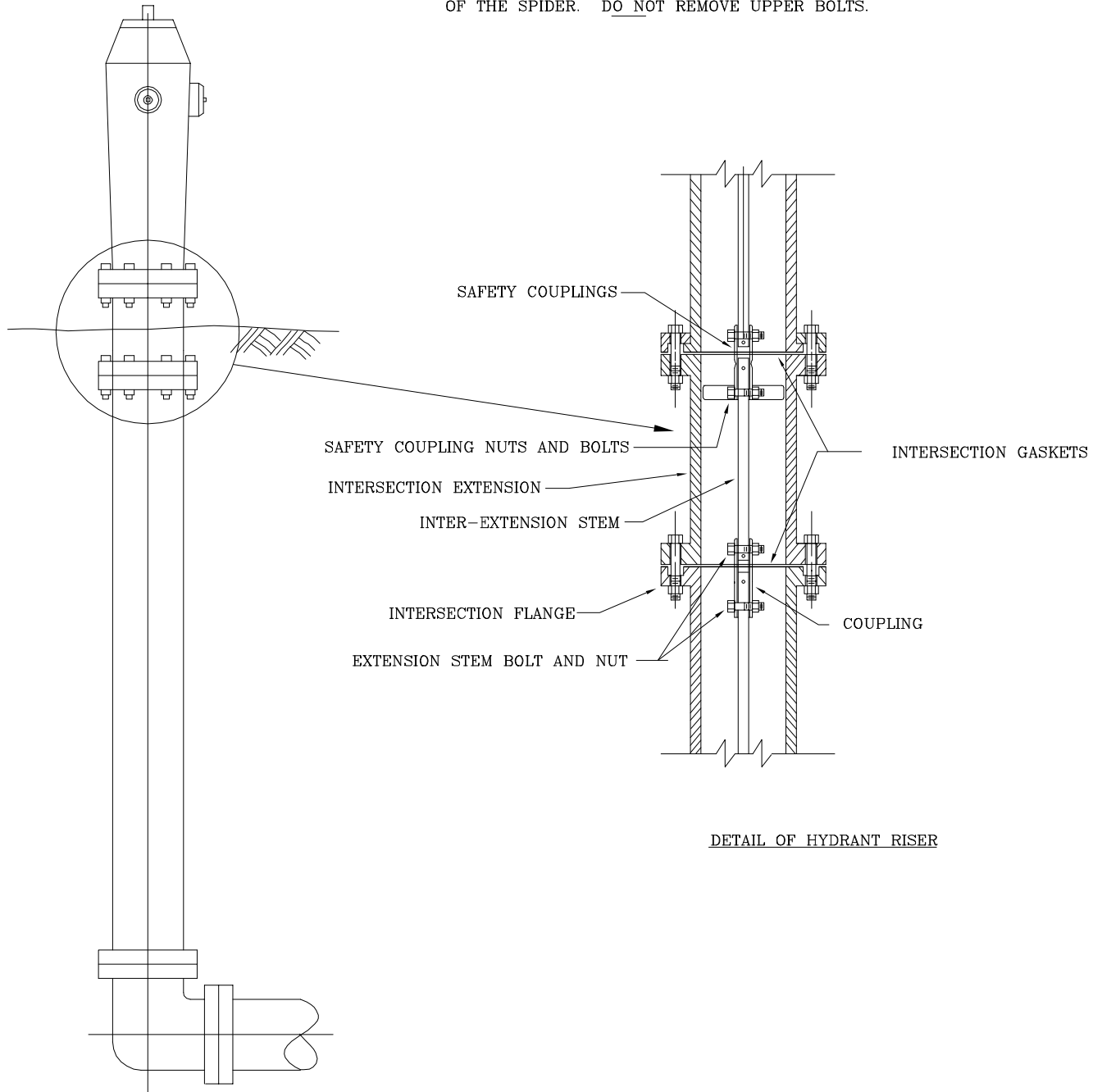
DRAWING NUMBER

18-404



HYDRANT INSTALLATION C/W
ANCHOR TEE, VALVE AND TEST POINT
FOR P.V.C. WATERMAIN

IMPORTANT: DISCONNECT ONLY THE LOWER BOLTS
OF THE SPIDER. DO NOT REMOVE UPPER BOLTS.



McAVITY HYDRANT C/W HYDRANT RISER

INSTRUCTIONS TO INCREASE LENGTH OF BURY

1. UNSCREW BODY CAP COVER SCREWS, AND REMOVE.
2. UNSCREW BODY CAP ANTI-CLOCKWISE.
3. REMOVE BODY CAP ASSEMBLY.
4. REMOVE SAFETY FLANGES.
5. LIFT OFF THE HYDRANT BODY.
6. REMOVE SAFETY STEM COUPLING FROM OPERATING STEM LOWER.
7. JOIN THE INTERMEDIATE EXTENSION STEM TO THE LOWER OPERATING STEM WITH BOLTS AND NUTS.
8. JOIN THE UPPER OPERATING STEM TO THE INTERSECTION EXTENSION STEM AND REASSEMBLE.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



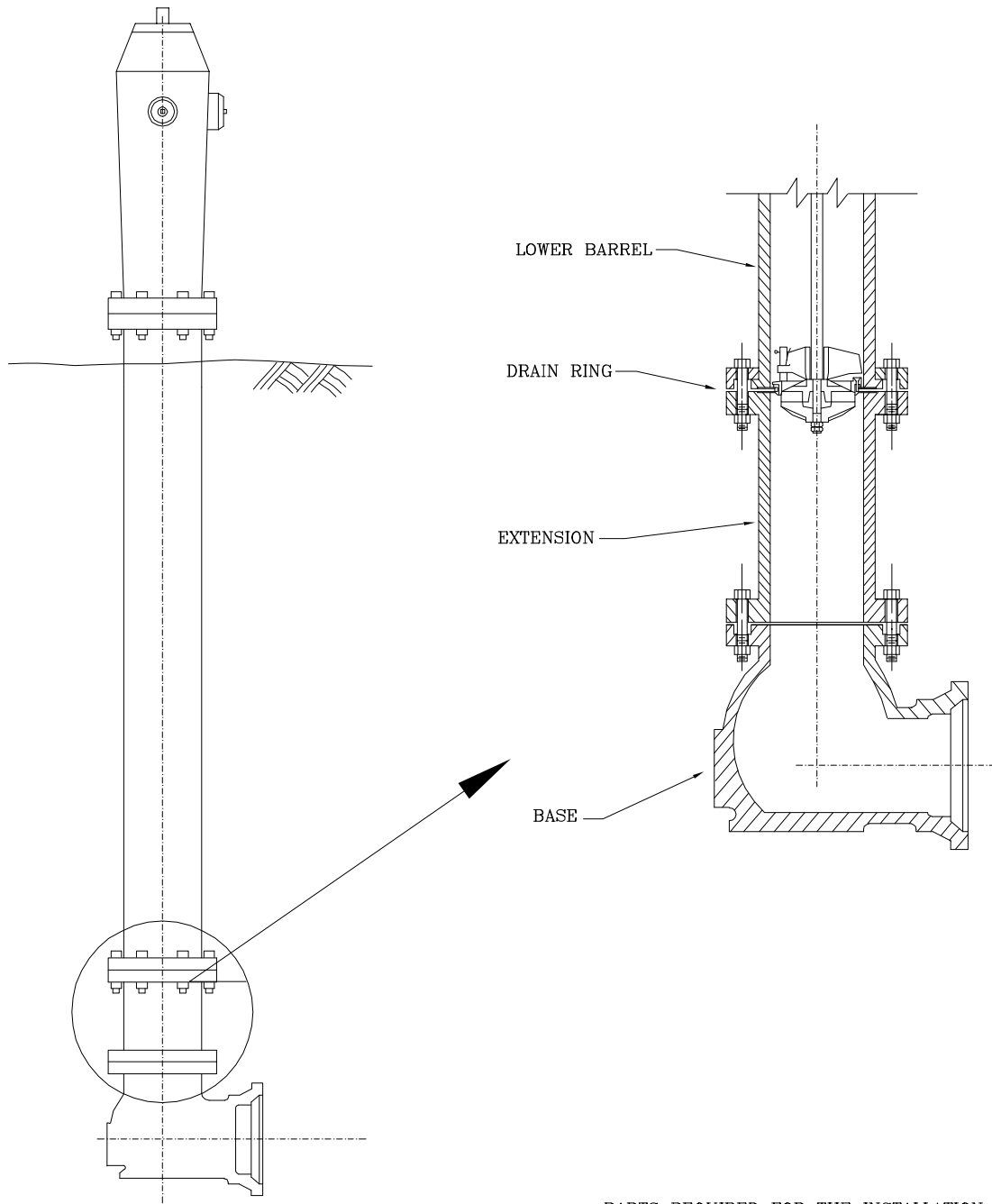
TYPICAL RISER INSTALLATION
McAVITY HYDRANT

REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER

18-406A



CANADA VALVE HYDRANT

PARTS REQUIRED FOR THE INSTALLATION OF EXTENSION:

1. ONE 8 HOLE BARREL EXTENSION X LENGTH,
COMPLETE WITH GASKETS AND BOLTS.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



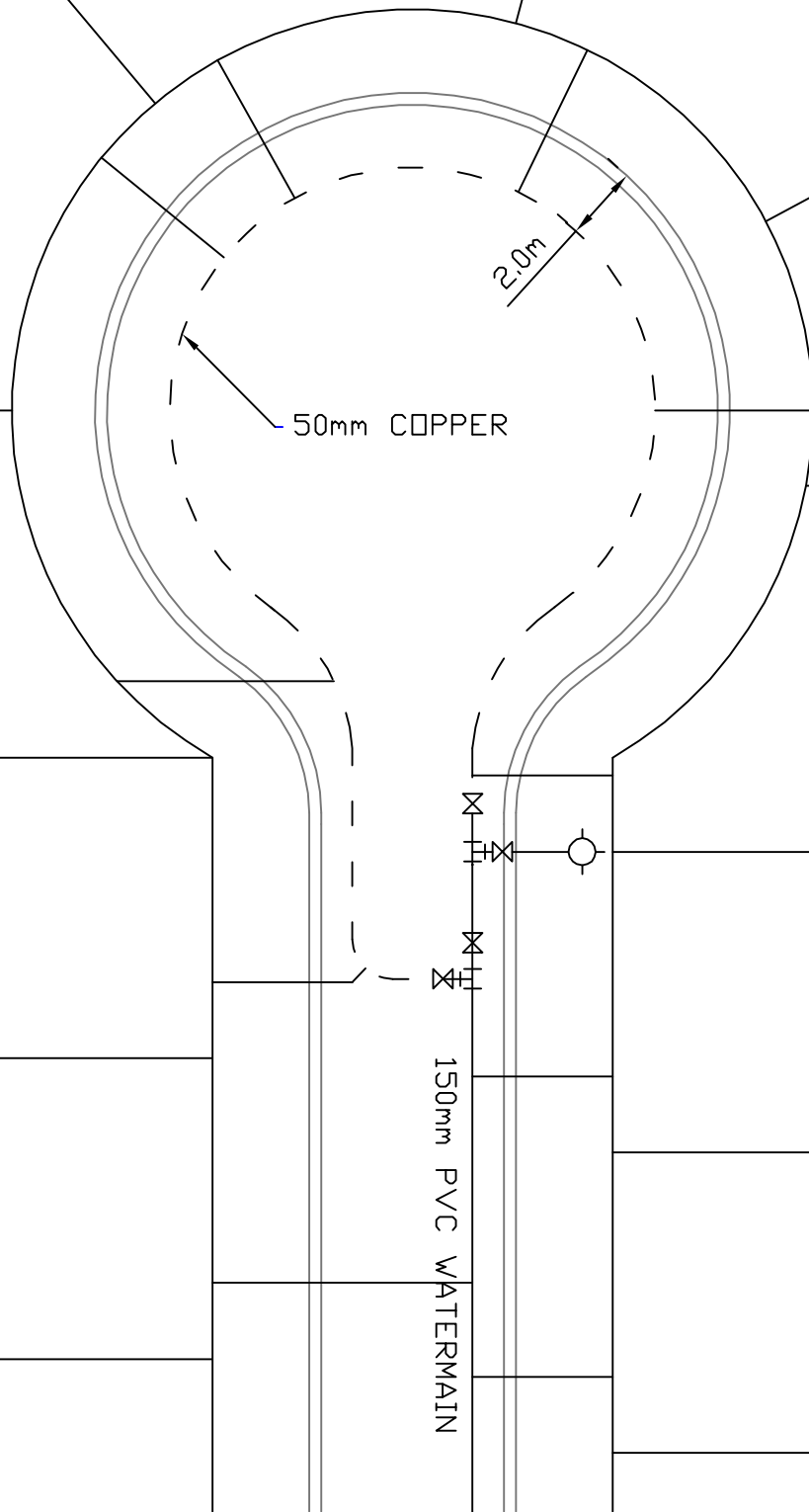
TYPICAL EXTENSION INSTALLATION
FOR CENTURY, B-50-B-18
AND B-50-B-24 HYDRANT

REVISED: FEB. 2009

SCALE: N.T.S.

DRAWING NUMBER

18-406B



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



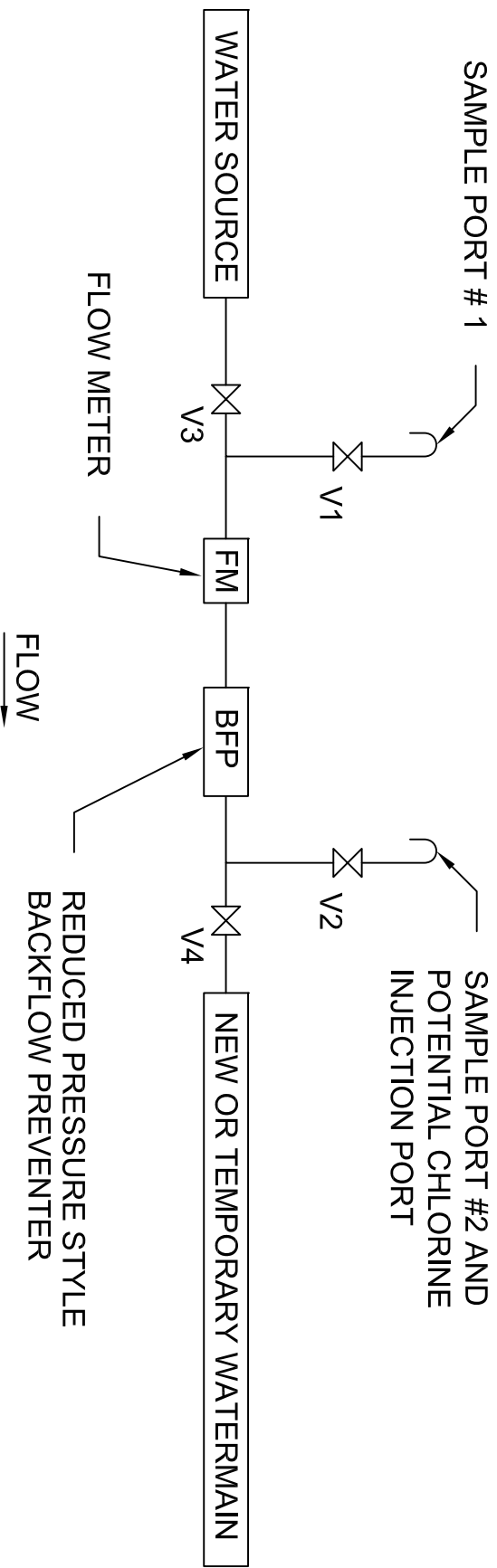
50mm WATERMAIN LOOPING FOR CUL DE SACs

REVISED: **APRIL 2009**

SCALE: **N.T.S.**

DRAWING NUMBER

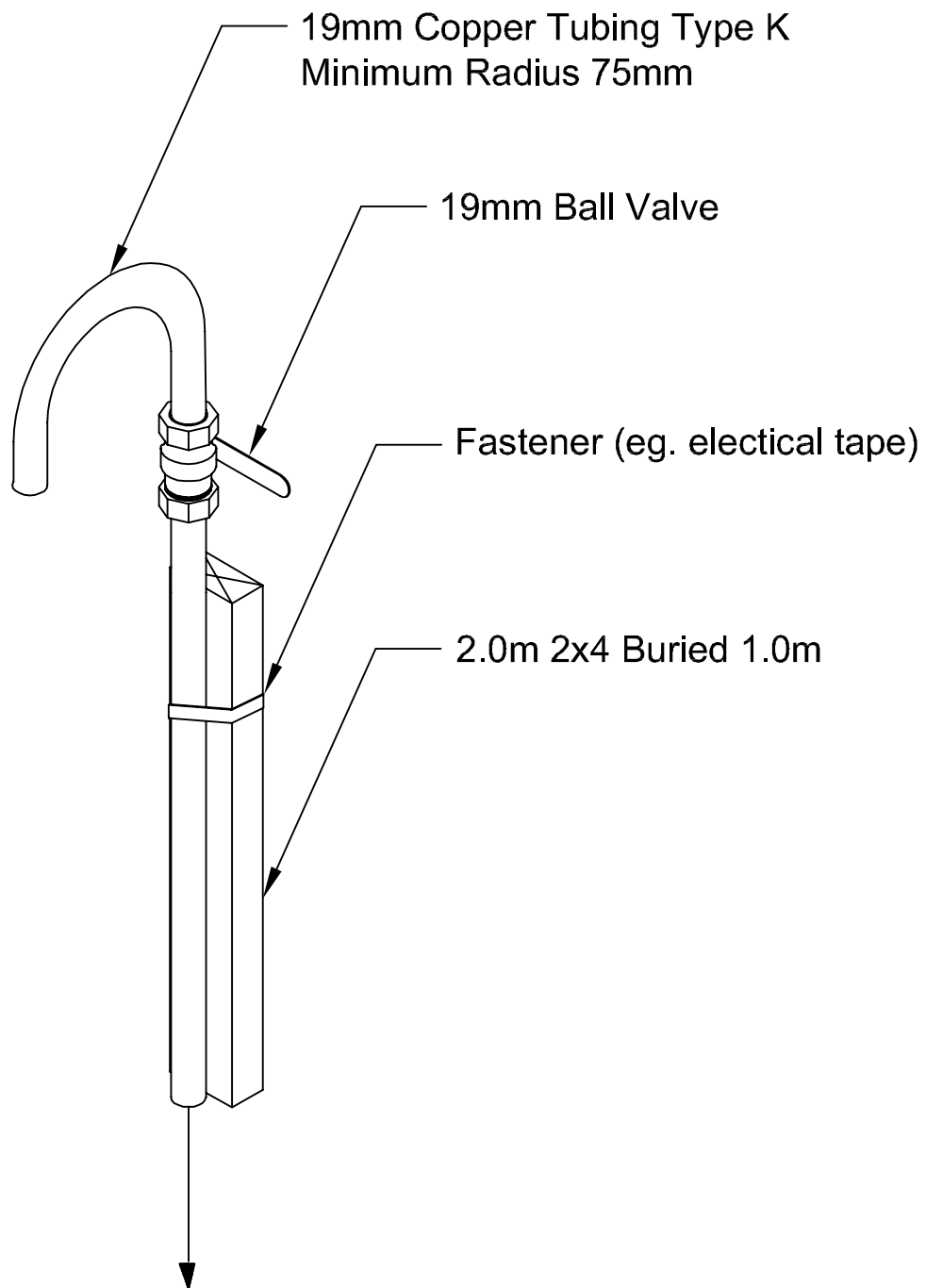
18-500



NOTES:

1. SIZE OF PIPE AND APPURTENANCES TO BE SPECIFIED IN THE PROJECT'S MUNICIPAL WATER INFRASTRUCTURE DISINFECTION PROCEDURE
2. TYPE OF VALVES TO BE SPECIFIED IN THE PROJECT'S MUNICIPAL WATER INFRASTRUCTURE DISINFECTION PROCEDURE

COUNTY OF BRANT PUBLIC WORKS DEPARTMENT		REVISED: OCT. 2017
COUNTY OF Brant Simply Grand		SCALE: N.T.S.
SOURCE ASSEMBLY FOR NEW OR TEMPORARY WATERMANS		DRAWING NUMBER
		18-600



To Watermain being Tested.
Connection Detail as per CBSD 18-100.

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



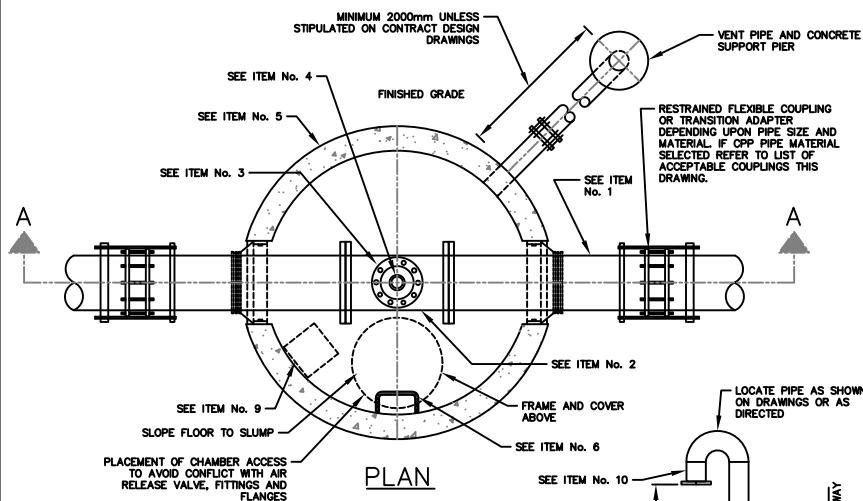
TEMPORARY SAMPLE PORT

REVISED: **MAR. 2009**

SCALE: **N.T.S.**

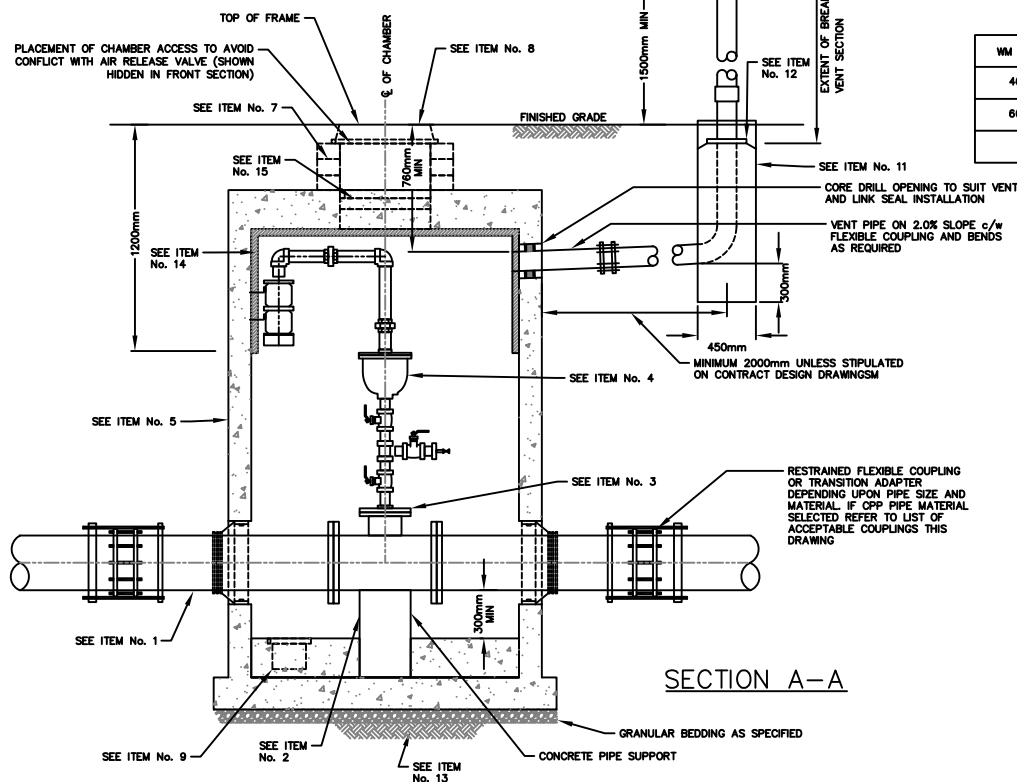
DRAWING NUMBER

18 - 601



ITEM	
1	WATERMAIN (SEE TABLE)
2	REDUCING TEE c/w 150mm ϕ FLANGED BRANCH OUTLET
3	BLIND FLANGE TAPPED TO SUIT AIR VALVE SIZE (SEE TABLE)
4	AIR RELEASE, VACUUM AND/OR COMBINATION VALVE AS PER DESIGN. INTERIOR AND EXTERIOR OF VALVE SHALL BE FUSION BONDED EPOXY COATED ANSI/NSF 61 APPROVED.
5	CIRCULAR PRECAST CHAMBER
6	CHAMBER STEPS
7	APPROVED ADJUSTMENT UNITS
8	FRAME AND COVER
9	SUMP c/w FRAME AND GRATE
10	150mm ϕ 304 SS VENTILATION HOOK-UP WITH WELDED JOINTS AND FLANGE AND 304 SS INSECT SCREEN
11	CONCRETE SUPPORT PIER 25MPa CONCRETE
12	BREAK AWAY CONNECTION WITH WELDED FLANGE OR PLATE WITH 4-LIGHT DUTY CONCRETE ANCHORS WHICH WILL ENSURE THAT THE PIPE WILL SHEAR AT THE CONCRETE INTERFACE
13	UNDISTURBED GROUND
14	INTERIOR CHAMBER INSULATION
15	ACCESS RISER RIGID INSULATION

WM SIZE	GATE VAL.	AIR VAL.	CHAMBER SIZE
400	50 I.P.T.	50 THREADED	1800mm ϕ
600	50 I.P.T.	50 THREADED	1800mm ϕ



ACCEPTABLE CPP COUPLINGS FOR THIS APPLICATION:	
1.	VICTAULIC W77
2.	TANDEM RESTRAINED M11 STYLE COUPLING INSTALLATION (ENGINEERING DRAWINGS TO BE SUPPLIED)
3.	LOKFAST (HANSON/MUNRO)
4.	HOLDFAST (HANSON/MUNRO)
5.	HARNESSE CLAMP (HANSON/MUNRO)

AIR RELEASE CHAMBER

NOTE:

- ALL VALVES TO BE RESILIENT SEAT TO AWWA C509. FUSION BONDED EPOXY (FBE) SHOP COAT FINISH ON INTERIOR AND EXTERIOR OF VALVE TO AWWA C550. INTERIOR COATING TO BE FBE ANSI/NSF 61 APPROVED
- INTERIOR OF ALL STEEL (NOT STAINLESS STEEL) PIPE SHALL BE LIQUID EPOXY COATED TO AWWA C210 AND BE ANSI/NSF 61 APPROVED. ALL EXTERIOR SURFACES SHALL BE LIQUID EPOXY COATED TO AWWA C210
- INTERIOR OF ALL DUCTILE IRON PIPE AND FITTINGS IN CONTACT WITH POTABLE WATER SHALL BE CEMENT MORTAR LINED TO AWWA C104
- FOR 25mm AND 50mm AIR VALVES MUST USE I.P.T. THREADED OUTLET WITH STAINLESS STEEL NIPPLES AS REQUIRED
- AIR RELEASE VALVE TO AWWA C512. FUSION BONDED EPOXY (FBE) SHOP COAT FINISH ON INTERIOR AND EXTERIOR OF VALVE TO AWWA C550. INTERIOR COATING TO BE FBE ANSI/NSF 61 APPROVED.
- ALL NUTS, BOLTS AND WASHERS TO BE STAINLESS STEEL UNLESS OTHERWISE NOTED.
- ALL PIPING, FITTINGS, VALVES, APPURTENANCES AND MECHANICAL RESTRAINTS TO BE c/w DENSO PASTE, DENSO MASTIC AND DENSO TAPE, APPLIED TO MANUFACTURER'S RECOMMENDATIONS

COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



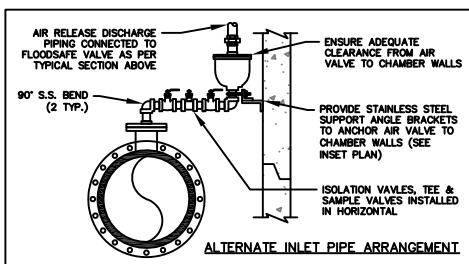
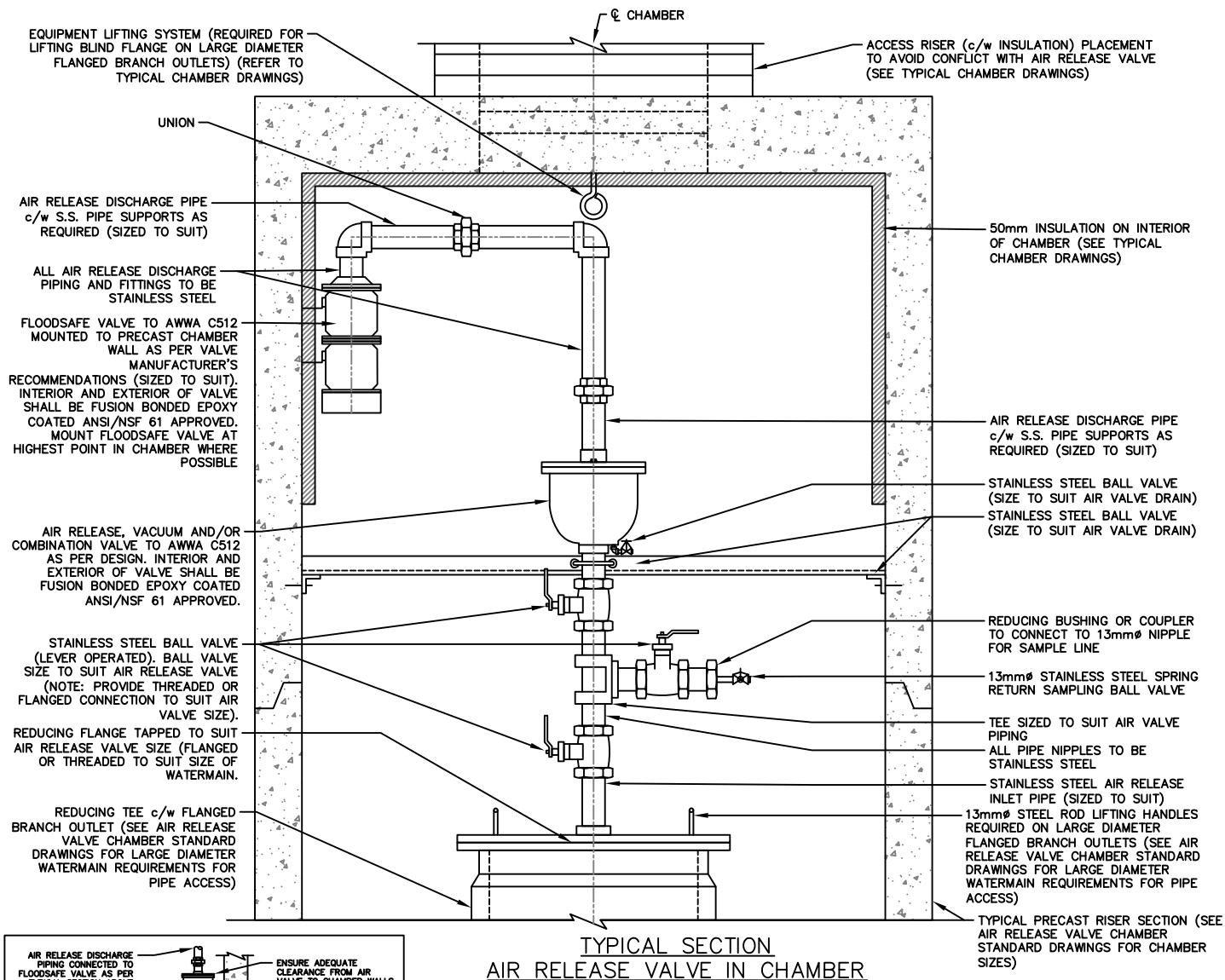
AIR RELEASE VALVE CHAMBER FOR
WATERMAIN SIZE LESS THAN 750mm ϕ

REVISED: OCT. 2017

SCALE: N.T.S.

DRAWING NUMBER

18-602

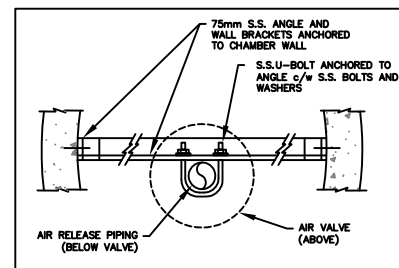


NOTE:

WHERE CLEARANCE FROM UNDERSIDE OF CHAMBER TOP SLAB IS INSUFFICIENT, AN ALTERNATE AIR VALVE INLET PIPING CONFIGURATION MAY BE INSTALLED WITH TWO 90° BENDS AS SHOWN. ALTERNATE CONFIGURATION MUST BE CONNECTED TO FLOODSAFE VALVE TO AWWA C512 MOUNTED TO PRECAST CHAMBER WALL AS PER VALVE MANUFACTURER'S RECOMMENDATIONS (SIZED TO SUIT). INTERIOR AND EXTERIOR OF VALVE SHALL BE FUSION BONDED EPOXY COATED ANSI/NSF 61 APPROVED. MOUNT FLOODSAFE VALVE AT HIGHEST POINT IN CHAMBER WHERE POSSIBLE.

NOTE:

1. ALL VALVES TO BE RESILIENT SEAT TO AWWA C509. FUSION BONDED EPOXY (FBE) SHOP COAT FINISH ON INTERIOR AND EXTERIOR OF VALVE TO AWWA C550. INTERIOR COATING TO BE FBE ANSI/NSF 61 APPROVED
2. INTERIOR OF ALL STEEL (NOT STAINLESS STEEL) PIPE SHALL BE LIQUID EPOXY COATED TO AWWA C210 AND BE ANSI/NSF 61 APPROVED. ALL EXTERIOR SURFACES SHALL BE LIQUID EPOXY COATED TO AWWA C210
3. ALL THREADED PIPE, FITTINGS, VALVES AND APPURTENANCES MUST BE STAINLESS STEEL 304L SCHEDULE 40 TO ASTM A776. STAINLESS STEEL BALL VALVES TO BE LEVER OPERATED
4. REFER TO STANDARD AIR RELEASE VALVE CHAMBER DRAWINGS FOR WATERMAIN DIAMETERS, CHAMBER SIZES AND DETAILS
5. ALL PIPING, FITTINGS, VALVES, APPURTENANCES AND MECHANICAL RESTRAINTS TO BE c/w DENSOL PASTE, DENSOL MASTIC AND DENSOL TAPE, APPLIED TO MANUFACTURER'S RECOMMENDATIONS



COUNTY OF BRANT
PUBLIC WORKS DEPARTMENT



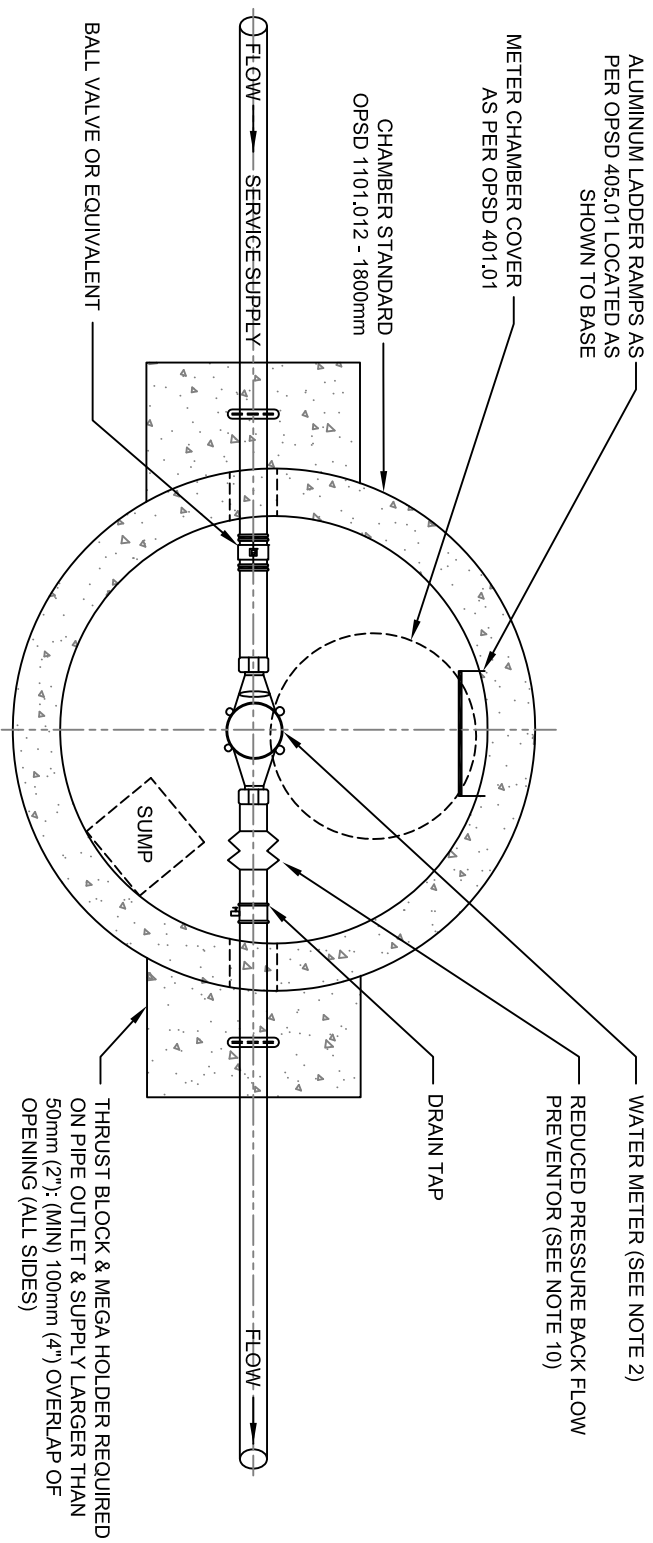
TYPICAL AIR RELEASE VALVE

REVISED: OCT. 2017

SCALE: N.T.S.

DRAWING NUMBER

18-603



PLAN

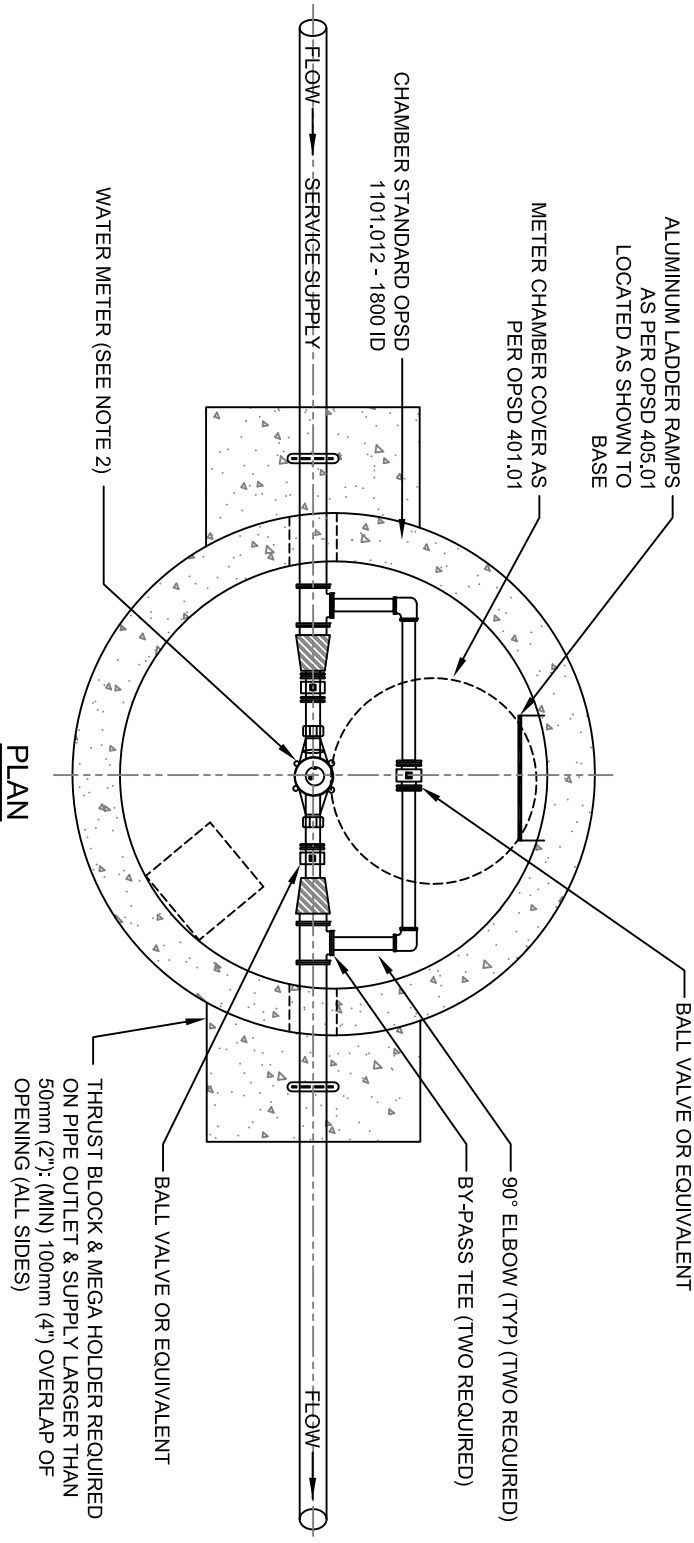
METER CHAMBER for WATER SERVICES

Parks/Irrigation Systems

NOTES:

1. ALL DIMENSIONS IN mm UNLESS OTHERWISE NOTED
2. WATER WATERS SUPPLIED BY COUNTY MUST BE PAID FOR IN ADVANCE AND INSTALLED BY OWNER
3. PROVIDE INSTALLATION FOR REMOTE READING, INCLUDING 50mm CONDUIT FROM CHAMBER WALL TO A 100mmx100mm (4"x4") PRESSURE TREATED WOODEN POST TO BE SUPPLIED AND INSTALLED BY OWNER/APPLICANT. ABOVE GRADE HEIGHT OF POST 1.0m (MIN); BELOW GRADE DEPTH OF POST 0.9m (MIN)
4. MINIMUM 2.0m GROUND COVER OVER WATER PIPE REQUIRED
5. ALUMINUM LADDER RUNGS AS PER OPSD 405.01 TO BE PLACED AS SHOWN TO BASE
6. MINIMUM HEIGHT FROM TOP OF THE PIPE TO UNDERSIDE OF CHAMBER IS 1.5m
7. CHAMBER SHALL BE WATERTIGHT
8. ALL VALVES AND CONNECTIONS MUST BE SUFFICIENTLY TIED BACK AND MADE SECURE
9. MAXIMUM DISTANCE OF CHAMBER FROM PROPERTY LINE IS 3.0m

COUNTY OF BRANT PUBLIC WORKS DEPARTMENT		REVISED: OCT. 2017
METER CHAMBER FOR WATER SERVICES: PARKS AND IRRIGATION SYSTEMS		SCALE: N.T.S.
COUNTY OF Brant Simply Grand		DRAWING NUMBER 18-700



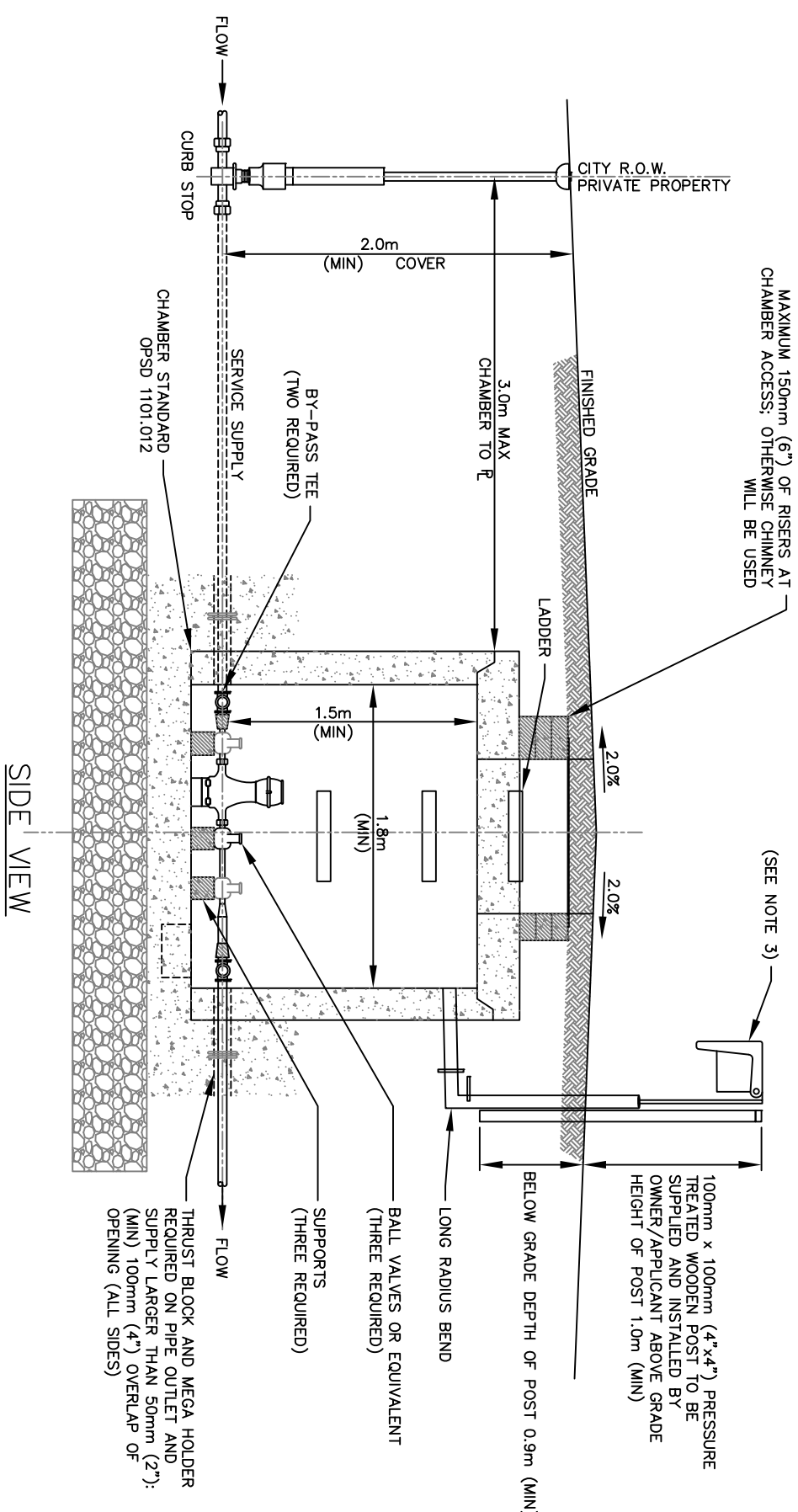
METER CHAMBER for WATER SERVICES

Maximum Water Meter Size 50mm (2") Ø
Minimum Water Meter Size 16mm (5/8") Ø

NOTES:

1. ALL DIMENSIONS IN mm UNLESS OTHERWISE NOTED
2. WATER MATERS SUPPLIED BY COUNTY MUST BE PAID FOR IN ADVANCE AND INSTALLED BY OWNER
3. PROVIDE INSTALLATION FOR REMOTE READING, INCLUDING 50mm CONDUIT FROM CHAMBER WALL TO A 100mmx100mm (4"x4") PRESSURE TREATED WOODEN POST TO BE SUPPLIED AND INSTALLED BY OWNER/APPLICANT. ABOVE GRADE HEIGHT OF POST 1.0m (MIN); BELOW GRADE DEPTH OF POST 0.9m (MIN)
4. MINIMUM 2.0m GROUND COVER OVER WATER PIPE REQUIRED
5. ALUMINUM LADDER RUNGS AS PER OPD 405.01 TO BE PLACED AS SHOWN TO BASE
6. MINIMUM HEIGHT FROM TOP OF THE PIPE TO UNDERSIDE OF CHAMBER IS 1.5m
7. CHAMBER SHALL BE WATERTIGHT
8. ALL VALVES AND CONNECTIONS MUST BE SUFFICIENTLY TIED BACK AND MADE SECURE
9. MAXIMUM DISTANCE OF CHAMBER FROM PROPERTY LINE IS 3.0m

COUNTY OF BRANT PUBLIC WORKS DEPARTMENT		REVISED: OCT. 2017
COUNTY OF BRANT Simply Grand		SCALE: N.T.S.
METER CHAMBER FOR 16 TO 50mm Ø WATER SERVICES		DRAWING NUMBER 18-701



METER CHAMBER for WATER SERVICES

Maximum Water Meter Size 50mm (2") ϕ
 Minimum Water Meter Size 16mm (5/8") ϕ

SIDE VIEW

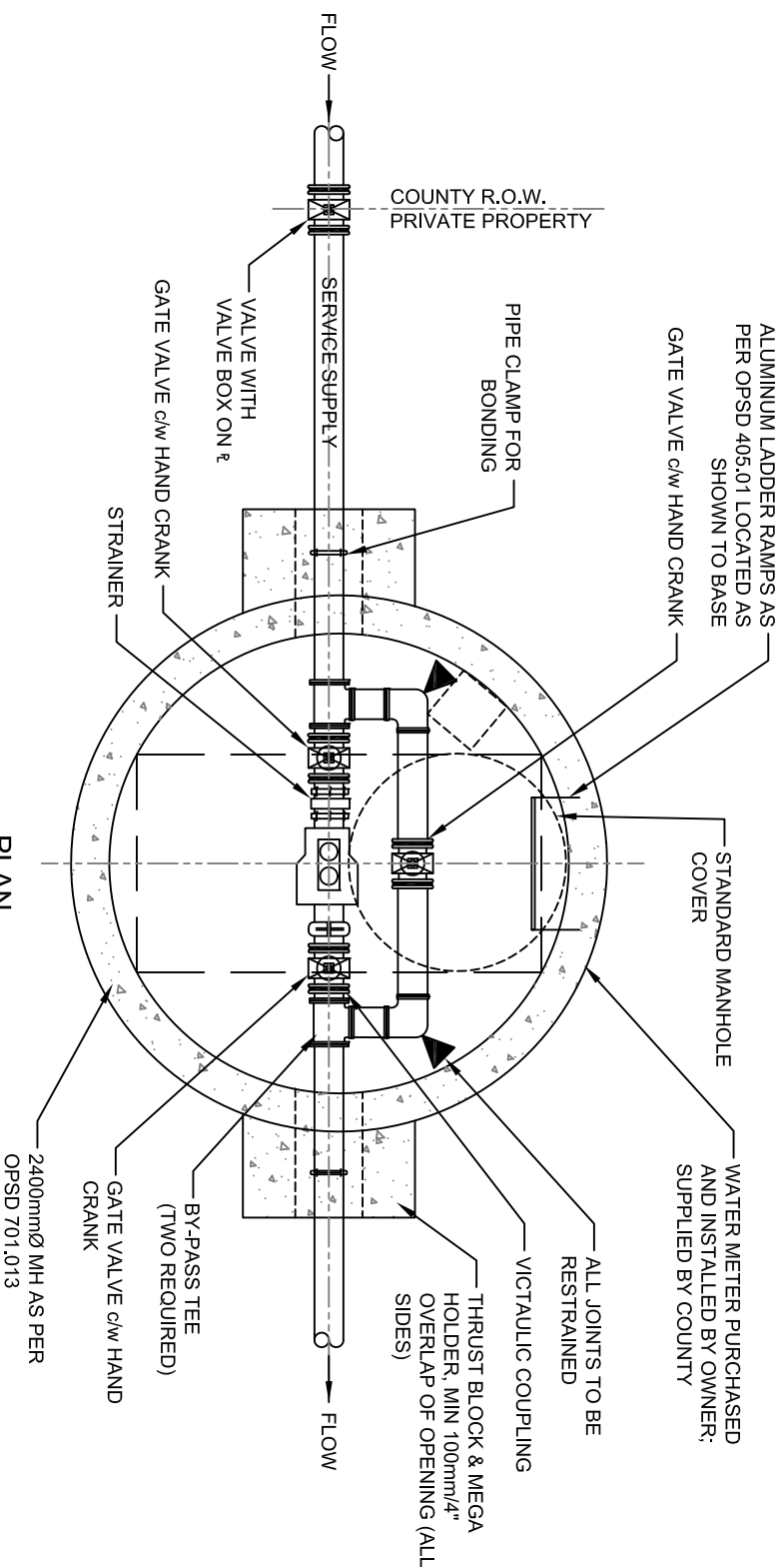
COUNTY OF BRANT
 PUBLIC WORKS DEPARTMENT



METER CHAMBER FOR 16 TO 50mm ϕ WATER SERVICES
 PROFILE

REVISED: OCT. 2017

SCALE: N.T.S.
 DRAWING NUMBER
 18-702



WATER METER CHAMBER for 75 & 100mm Ø METER

NOTES:

1. ALL DIMENSIONS IN mm UNLESS OTHERWISE NOTED
2. A METER SIZING DATASHEET MUST BE SUBMITTED AND REVIEWED BY THE COUNTY'S ENGINEERING DEPARTMENT TO DETERMINE APPROVED METER SIZE FOR ALL INSTALLATIONS. METERS SUPPLIED BY THE COUNTY AND INSTALLED AND PAID FOR BY THE OWNER.
3. PROVIDE INSTALLATION FOR REMOTE READING - INCLUDING 37mm CONDUIT FROM CHAMBER WALL TO A 100mm x 100mm (4" X 4") PRESSURE TREATED WOODEN POST TO BE SUPPLIED AND INSTALLED BY OWNER/APPLICANT. ABOVE GRADE HEIGHT OF POST 1.0m (MIN); BELOW GRADE DEPTH OF POST 0.9m (MIN)
4. MINIMUM 2.0m GROUND COVER OVER WATER PIPE REQUIRED
5. ALUMINUM LADDER RUNGS AS PER OPSD 405.01 TO BE PLACED AS SHOWN TO BASE
6. MINIMUM HEIGHT FROM TOP OF PIPE TO UNDERSIDE OF CHAMBER IS 1.5m
7. CHAMBER SHALL BE WATERTIGHT
8. ALL VALVES AND CONNECTIONS MUST BE SUFFICIENTLY TIED BACK AND MADE SECURE
9. MAXIMUM DISTANCE OF CHAMBER FROM PROPERTY LINE IS 3.0m

COUNTY OF BRANT PUBLIC WORKS DEPARTMENT		REVISID: OCT. 2017
COUNTY OF Brant Simply Grand		SCALE: N.T.S.
METER CHAMBER FOR 75 & 100mm Ø WATER SERVICES		DRAWING NUMBER 18-703

