Hamilton

Comprehensive Development Guidelines and Financial Policies Manual

2019

Table of Contents

A. SUBDIVISION 9

A.1. GENERAL 9
A.1.1. The Planning Act & Approval Authority 9
A.1.2. Purpose of Subdivision Control 9
A.1.3. Subdivision Agreement 9

A.2. PRE-SUBMISSION CONSULTATION 10

A.3. DRAFT PLAN PROCESS 10
A.3.1. Application 10
A.3.2. Circulation 11
A.3.3. Neighbourhood Information Meeting 11
A.3.4. Staff Report for Draft Approval 11
A.3.5. Public Meeting 11
A.3.6. Resolution of Issues 12
A.3.7. Post Draft Approval 12
A.3.8. Modifications to Draft Plan 12
A.3.9. Street Naming 12

A.4. PRELIMINARY GRADING REQUEST 12

A.5. SERVICING REQUEST 13

A.6. RELEASE FOR REGISTRATION 13

A.7. REPORTS AND STUDIES 13
A.7.1. Planning Justification Report 13
A.7.2. Environmental Impact Statement (EIS) 13
A.7.3. Geotechnical Investigation and Soils Report 13
A.7.4. Servicing Design Brief or the Preliminary Servicing Report 14
A.7.5. Design Review Panel – Urban Design Brief 15
A.7.6. Watermain Hydraulic Analysis Report 16
A.7.7. Stormwater Management (SWM) Report 16
A.7.8. Hydro-geological Studies 16
A.7.9. Traffic Impact Study (TIS) 17
A.7.10. Environmental Site Assessment (ESA) 17
A.7.11. Archaeological Assessment 17
A.7.12. Tree Protection 17
A.7.13. Heritage Impact Assessments and Conservation Plan 18
A.7.14. Noise Impact Report 19

A.8. ENGINEERING SUBMISSIONS 19
A.8.1. First Submission 19
A.8.2. Second and Subsequent Submissions 20
A.8.3. Final Submission 20
A.8.4. “As-Constructed” Submission 21
A.8.5. Other Approvals 23

A.9. PLANS AND DRAWINGS 24
A.9.1. Drafting Requirements 24
A.9.1.2 Title Sheet 25
A.9.1.3 General Plan of Services 25
A.9.1.4 On-Street Parking 26

A.9.1.5 Pre Grading Plan 26
A.9.2. Grading Plan 27
A.9.2.1 Water Distribution Plan 28
A.9.2.2 Phasing Plan 28
A.9.2.3 Erosion and Sedimentation Control Plan 28
A.9.2.4 Plan Profile Drawings 28
A.9.2.5 Sanitary Drainage Area Plan 31
A.9.2.6 Storm Drainage Area Plan 31
A.9.2.7 Composite Utility Plan 32
A.9.3. Digital Engineering Submissions / "As-Constructed" Drawings 32
A.9.4. Geodetic Control 33

A.10. CONSTRUCTION 33
A.10.1. Road Closure 33
A.10.2. Asphalt Overlays on Existing Roads 33
A.10.3. Requirements for Tendering 34
A.10.4. Pre-Construction 34
A.10.5. Compaction and Material Testing 35
A.10.6. Interim Water Quality 36
A.10.7. Spill Management Reporting 36
A.10.8. Mud Tracking & Construction Access Plan 37
A.10.9. Standing Water 37
A.10.10. Rodent Control Plan 37

A.11. RELEASE OF BUILDING PERMITS 38

A.12. INSPECTIONS AND TESTING 38
A.12.1. Lot Grading Inspection and Certification 38
A.12.2. Erosion and Sediment Control Inspection 40
A.12.3. Disconnection of Services 40
A.12.4. Video Camera Inspection 40

A.13. INSPECTION 40
A.13.1. General 40
A.13.2. Definitions 41
A.13.3. Initial Inspection of Municipal Servicing 42
A.13.4. Acceptance of Works – Start of Maintenance 42
A.13.5. Obligations during Maintenance Period 43
A.13.6. Assumption of Works 43

A.14. FEES AND SECURITIES 44
A.14.1. Cost Estimate 45
A.14.2. Engineering Fees 45
A.14.3. Parkland Dedication - Cash in Lieu 45
A.14.4. Insurance 46
A.14.5. Security Requirements 46
A.14.6. Lot Grading Securities for Subdivision Agreements 46
A.14.7. Lot Grading Securities for Severance Applications 47

A.15. EASEMENTS 47

B. SITE PLANS 49

B.1. GENERAL 49

B.2. FORMAL CONSULTATION 49

B.2.1. Design Review Panel – Urban Design Brief 49

B.3. SITE PLAN APPROVAL PROCESS 50

B.4. CONDITIONS REQUIRED FOR ISSUANCE OF SITE PLAN APPROVAL 50

B.5. SECTION 41 DEVELOPMENT AGREEMENT / SITE PLAN APPROVAL 50

B.6. BUILDING PERMITS 50

B.7. HERITAGE IMPACT ASSESSMENTS AND CONSERVATION PLANS 50

B.8. ENGINEERING REQUIREMENTS FOR SITE PLAN APPROVAL 51

B.8.1. Report Formats / Submission Requirements 51
B.8.2. Purpose 51
B.8.3. Engineer's Qualifications 51
B.8.4. Coordination of Drawings 51
B.8.5. Submission Requirements 51
B.8.6. Site Servicing Plan 52
B.8.7. Grading and Drainage Control 52
B.8.8. Environmental Impact Statement (EIS) 52
B.8.9. Stormwater Management (SWM) 52
B.8.10. Environmental Site Assessment (ESA) 53
B.8.11. Geotechnical Investigation 53
B.8.12. Fire Flow Analysis 53
B.8.13. Water and Wastewater Generation Assessment 53

C. ROADS 54

C.1. GENERAL 54

C.2. GEOMETRIC STANDARDS 54

C.3. ROAD PAVEMENT DESIGN 59

C.4. TRAFFIC CALMING / CLOSURES 60

C.4.1. Road and Lane Closures 60
C.4.2. Traffic Calming 60

C.5. ROUNDABOUTS 61

C.6. ROAD SUBDRAINS 62

C.7. DAYLIGHT TRIANGLES AND ROAD WIDENING 62

C.8. CURBS 63

C.9. BOULEVARDS 63

C.10. SIDEWALKS 64

C.10.1. Sidewalk Transitions 64
C.10.2. Private Sites 64

C.11. WALKWAYS 65

C.12. MULTI-USE TRAILS 66

C.13. PRIVATE ROADS 68

C.14. BIKE LANES (DELINEATED ON ROAD) 70

C.15. CUL-DE-SACS 70

C.16. INTERSECTIONS & PEDESTRIAN CROSSINGS 70

C.17. ON-STREET PARKING REQUIREMENTS 71

C.18. TRAFFIC CONTROL – SIGNS & PAVEMENT MARKINGS 72
C.18.1. Street Name Signs 72
C.18.2. Signage 72
C.18.3. Open Space Signs 73
C.18.4. Pavement Markings 73
C.18.5. Traffic Signals 73

C.19. DRIVEWAY ENTRANCES 73

C.20. NOISE ATTENUATION 74
C.20.1. Requirements for Approval of Noise Attenuation 74
C.20.2. Noise Barriers 77

C.21. ENTRANCE FEATURES 78

C.22. FENCING 79

C.23. STREETSCAPE AND LANDSCAPING 80

C.24. BUS STOP LANDING PAD 80

C.25. STREET FURNITURE 80

D. WATERMAINS 81

D.1. DESIGN GUIDELINES 81
D.1.1. General Requirements 81
D.1.2. Location 81
D.1.3. Size and Layout 81
D.1.4. Depth of Cover 82
D.1.5. Domestic and Fire Flows Demand Design Flow 82
D.1.6. System Pressures 82
D.1.7. Sewer Conflicts and Crossings 83
D.1.8. Thrust Blocks and Mechanical Joint Restrainers 83
D.1.9. Hydrants 83
D.1.10. Valves 84
D.1.11. Tapping Valves and Sleeves 85
D.1.12. Backflow Prevention 85
D.1.13. Cul-de-sac and Dead-end Mains 86
D.1.14. Water Services (Public Portion) 86
D.1.15. Pumping Station Design 87

D.2. MATERIAL SPECIFICATIONS 87
D.2.1. Pipe Material and Bedding 87
D.2.2. Bedding Requirements 87

D.3. CONSTRUCTION SPECIFICATIONS 87

D.4. COMMISSIONING / ACCEPTANCE AND ASSUMPTION PROCESS 88
D.4.1. Charging and Testing of New Watermains 88
D.4.1.8 Temporary Charging of New Watermains 88
D.4.1.9 Testing of New Watermains 88
D.4.1.10 Pressure and Leakage Testing 88
D.4.1.11 Swabbing 89

D.4.1.12 Disinfection and Bacteriological Testing 89
D.4.2. Acceptance and Assumption of Watermains 89

E. SANITARY SEWERS 91

E.1. DESIGN GUIDELINES 91
E.1.1. General Requirements 91
E.1.2. Location 91
E.1.3. Depth of Sewer 91
E.1.4. Design Flows 92
E.1.5. Peak Sanitary Flow Factor 92
E.1.6. Infiltration Allowance 93
E.1.7. Capacities, Velocities and Sizes 93
E.1.8. Maintenance holes 94
E.1.9. Sanitary Laterals (Public) 95
E.1.10. Pumping Station & Vertical Assets 96

E.2. MATERIAL SPECIFICATIONS 97
E.2.1. Pipe Materials, Classification and Bedding Requirements 97

E.3. CONSTRUCTION SPECIFICATIONS 97

E.4. COMMISSIONING / ACCEPTANCE AND ASSUMPTION PROCESS 97
E.4.1. General Requirements 97

F. STORM SEWERS 99

F.1. DESIGN GUIDELINES 99
F.1.1. General Requirements 99
F.1.2. Location 99
F.1.3. Depth of Sewer 99
F.1.4. Design Flows 100
F.1.5. Storm Sewer Pipe Design 102
F.1.6. Maintenance holes and Catch Basins 102
F.1.7. Storm Laterals (Public) 104
F.1.8. Catch Basins and Connections 105
F.1.9. Rear Yard Catch Basins 105
F.1.10. Pumping Station & Vertical Assets 105

F.2. MATERIAL SPECIFICATIONS 106
F.2.1. Pipe Materials, Classification and Bedding 106

F.3. CONSTRUCTION SPECIFICATIONS 106

F.4. COMMISSIONING / ACCEPTANCE AND ASSUMPTION PROCESS 107
F.4.1. General Testing Requirements 107

G. STORMWATER MANAGEMENT 108

G.1. INTRODUCTION 108

G.2. STORMWATER MANAGEMENT DESIGN CRITERIA 108
G.2.1. Minor System 108
G.2.1.1 Storm Sewers 108
G.2.1.2 Combined Sewers 109
G.2.1.3 Inlet Systems – Catch Basins 110
G.2.1.4 Foundation Drains 110

G.2.1.5 Roof Leaders 111
G.2.2. Rear Yard Catch Basins 111
G.2.2.1 Outlet Treatment 111
G.2.2.2 Swales 112
G.2.3. Major System 112
G.2.3.1 Roadway Conveyance 112
G.2.3.2 Overland Flow Routes 113
G.2.3.3 Roadway Crossings 113
G.2.4. Natural Watercourse Systems 114
G.2.4.1 Design Approach and Principles 114
G.2.4.2 Setbacks 115
G.2.4.3 Access / Maintenance 115
G.2.5. Stormwater Quantity and Quality Controls 115
G.2.5.1 Source Controls 118
G.2.5.2 Conveyance Controls 120
G.2.5.3 End-of-Pipe Techniques 120
G.2.5.4 Cash-in-Lieu of On-site Stormwater Management 123
G.2.6. Spill Prevention and Control 123

G.3. EROSION AND SEDIMENT CONTROL 123
G.3.1. Erosion and Sediment Control Plan 123
G.3.2. Regulation 124
G.3.3. Proponent / Builder Responsibility 125

G.4. DEVELOPMENT IMPACT MONITORING 125
G.4.1. Need 125
G.4.2. Purpose 126
G.4.3. Types of Monitoring Plans 126
G.4.4. Process / Protocol 126
G.4.5. Monitoring Periods 127
G.4.6. What is monitored? 127
G.4.7. Enforcement 128

G.5. ANALYTICAL METHODS 129
G.5.1. Hydrology 129
G.5.1.1 Rainfall 129
G.5.1.2 Rational Method 130
G.5.1.3 Event Based Hydrologic Models 130
G.5.1.4 Continuous Models 131
G.5.2. Hydraulic Capacity 132
G.5.3. Stormwater Management Design – Analytic Requirements / Methods 134
G.5.3.1 Flood Management 134
G.5.3.2 Erosion Control 135
G.5.3.3 Quality Management 136
G.5.4. Natural Channel Design 139
G.5.4.1 Design Documentation for Natural Channel Design 141
G.5.4.2 Stormwater Management Facility Designs 142
G.5.4.3 Temporary Stormwater Facilities 150
G.5.4.4 Infills 151

G.6. SEDIMENT AND EROSION CONTROL METHODS 152
G.6.1. Specific Methods and Local Requirements 152
G.6.2. Sediment Control 152

G.6.3. Erosion Control 153
G.6.4. Drainage Protection 154

G.7. Topsoil Stockpile Protection 155
G.7.1. On-Site Reporting Requirements 155

G.8. DOCUMENTATION 156
G.8.1. Stormwater Management 156
G.8.1.1 Functional SWM Report 156
G.8.1.2 Detailed SWM Report 157
G.8.2. Operations and Maintenance Manual 158

G.9. COMMISSIONING / ACCEPTANCE & ASSUMPTION PROCESS 160
G.9.1. Outlet to Existing Ponds and Development Phasing 160
G.9.2. Facilities Infrastructure 161
G.9.3. Landscaping 161
G.9.4. Clean-out / Dredging 161

H. STREETLIGHTING 162

H.1. Approval 162

H.2. Design 162

H.3. Construction 162

H.4. Material Selection 163

H.5. Cost Sharing 163

H.6. Acceptance, System Energization and Assumption 163

I. UTILITIES 164

I.1. Utility Co-ordination 164

I.2. Utility Installation Municipal Consent 164

J. LOT GRADING 166

J.1. Purpose 166

J.2. GENERAL 166
J.2.1. Design Criteria for Plans of Subdivision 166
J.2.2. Design Criteria for Infill Developments or Lots of Record 167
J.2.3. Design Criteria for Low Impact Development & Rural Lot Grading 167

J.3. REAR YARD CATCH BASINS 168

J.4. SWALES 168
J.4.1. Swales across sidewalks 169

J.5. ROOF LEADERS AND SUMP PUMPS 169
J.5.1. Roofwater Leaders 169
J.5.2. Sump Pumps 169

J.6. GROUNDWATER 169

J.7. PLOT PLANS 170
J.7.1. Plot Plan 170
J.7.2. Acceptable Lot Grading – As Constructed 171

J.7.3. Lot Grading Certificate 171

J.8. MULTI-RESIDENTIAL / CONDOMINIUM 172

J.9. RETAINING WALLS 173

K. CANADA POST INSTALLATION 174

L. FINANCIAL POLICIES 176

L.1. Cost Sharing for Over-sizing of Infrastructures 176
L.1.1. Sanitary Sewers, Storm Sewers and Watermains 176
L.1.2. Roadworks 177

L.2. Cost Sharing for Street Frontage 178
L.2.1. New Roads Servicing Rate 179
L.2.2. City Lands 179
L.2.3. Fencing Adjacent to City Lands 180
L.2.4. Value of Land for Road Allowances 180
L.2.5. Storm Water Management Facilities 181
L.2.6. Availability and Timing of Funding by the City 181

L.3. Cost Recovery Policies 182
L.3.1. Cost Recovery in favour of Proponent 182
L.3.2. Cost Recoveries in favour of the City 184
L.3.3. Cost Recovery on Corner Lots with Daylight Triangle/Radius 185
L.3.4. Payment for Future Urbanization of Existing Rural Roads 186

M. Appendices 193

M.1. Appendix A - Watermain Hydraulic Report 193
M.1.1. Appendix A.1 Required Fire Flows 197
M.1.2. Appendix A.2 - Typical Water Hydraulic Analysis Report 198
M.1.3. Appendix A.3 – Watermain Design Brief Requirements 199
M.1.4. Appendix A.4 - Guide to Technical Documents Required for Various Applications 201
M.1.5. Appendix A.5 - Enhanced Comments Table 203

M.2. Appendix B – Pre-Construction Meeting 204

M.3. Appendix C – Disconnection of Services 207

M.4. Appendix D – Security Reduction Request 208

M.5. Appendix E – List of Approved Plant Species 211

M.6. Appendix F –Sanitary Sewer Design Sheet / Combined Sewer Design 217

M.7. Appendix G – IDF Curves / Design Storms 219

M.8. Appendix H – Erosion and Sediment Control Inspection Report 239

M.9. Appendix I – Current Streamflow and Rainfall Monitoring 242

M.10. Appendix J – List of Approved Hydrologic and Hydraulic Models 245

M.11. Appendix K – Protocol for Repayment of City Share 246

M.12. Appendix L – Master Planning (Watershed / Subwatershed) 247

M.13. Appendix M - Stormwater Management Plans 248

M.14. Appendix N - Acknowledgement for Concurrent Building Permit Review Process 254

M.15. Appendix O - Fire Hydrant Flushing and Monitoring Program for Interim Water Quality Maintenance 255
M.16. Appendix P – Site Works Certification Form for Landscape Works 256
M.17. Appendix Q – Site Works Certification Form – Engineering 258
M.18. Appendix R – Sidewalk and Roadway Lighting Guideline 261

A. SUBDIVISION

A.1. GENERAL

All requests for subdivision development shall strictly conform to all processes provided by provincial regulations, statues and policies that may apply to any land use proposal. A list of related legislation pertaining to land use planning can be found online.

A.1.1. The Planning Act & Approval Authority

The approval process for subdivisions is governed by Section 51 of the Planning Act and Ontario Regulation 544/06.

The City of Hamilton is the approval authority for a Plan of Subdivision.

A.1.2. Purpose of Subdivision Control

A subdivision is created when land is divided into two or more lots or blocks for the purpose of sale, and to establish new public streets. A Plan of Subdivision is a legal survey which shows how the property has been subdivided. It also includes further information and conditions regarding how a parcel of land may be developed. Lots or blocks created by a Plan of Subdivision can be used for various purposes (i.e. residential, commercial, etc.) based on the designation of the land within the Official Plan and Zoning By-law.

Subdivision approval ensures that:

- The land is suitable for its proposed new use;
- The proposal conforms to all local planning documents and Provincial legislation;
- The community is protected from development which is inappropriate or might put an undue strain on facilities, services or finances; and,
- No adverse impacts are foreseen by the development that may negatively affect the health, welfare or the environment of the community or adjacent lands.

A.1.3. Subdivision Agreement

Upon approval of lands through a Draft Plan of Subdivision, the Growth Management Division shall, upon request from the Proponent, prepare the City of Hamilton Subdivision Agreement.

A.2. PRE-SUBMISSION CONSULTATION

A Pre-submission Consultation also known as a Formal Consultation shall be required for all persons making an application to the City under the Planning Act as per By-Law No. 08-297.

The purpose of such Formal Consultation is to review a draft development proposal for the lands affected by the proposed application(s) and identify the need for and the scope of other information and materials considered necessary by the City and other affected agencies to allow full consideration of the development application. In the course of the review process for an application which has been deemed to be a complete application, additional reports, studies and drawings not identified in a pre-consultation meeting may be required.

Refer to Section A.7 - Reports and Studies for details on reports and studies which may be required.

A.3. DRAFT PLAN PROCESS

The application process summarised herein can be found in detail in the City's Guide to Application for Approval of a Draft Plan of Subdivision or Condominium Description.

A.3.1. Application

The complete submission shall include (all measurements to be in metric units):

- The application fees as indicated in the City's Fee Schedule;
- One (1) electronic copy of the completed application form without signatures (native PDF locked file format);
- 35 copies of the completed application form with signatures (including two (2) with original signatures);
- 35 copies of the draft plan (25 for condominium), folded to 8½" x 11";
- 20 reduced copies of the draft plan on 8½" x 11" paper;
- Five (5) copies of all information / reports / plans and native PDF locked file versions identified in a Formal Consultation Document as required information to deem an application complete; and,
- Five (5) copies of the information / reports / plans, and native PDF locked file versions, indicated as needed when completing Sections 10.2 and 11 of the application form.

A Draft Plan of Subdivision application may be completed and submitted to the Planning and Economic Development Department whenever land is to be divided into two or more parcels or lots or a new public street is to be established. This Plan must be prepared by an Ontario Land Surveyor. A Draft Plan of Subdivision is a proposal to subdivide property. It generally shows the proposed lots and streets; topographic information; natural heritage features, such as creeks and vegetation; and infrastructure such as Stormwater management ponds.

Upon receiving the Draft Plan of Subdivision application, the City will process the application. The application process includes opportunities for public input. Following the completion of this process, if a Draft Plan of Subdivision is approved by City Council, the approval will include a number of conditions that must be fulfilled by the applicant. The applicant will be required to sign a Subdivision Agreement with the City that outlines all of the conditions of approval. Once the conditions have been fulfilled and the Subdivision Agreement has been signed, the subdivision can be registered and it is known as a Registered Plan of Subdivision.

A Draft Plan of Subdivision approval is valid for three years. If three years elapses and the Draft Plan of Subdivision has not been registered, the applicant must apply for an extension of Draft Plan Approval for up to three years. Additional or up to date conditions of Draft Approval may apply.

A.3.2. Circulation

Within 15 days of an application being deemed complete, a notice of the application for a Draft Plan of Subdivision and a preliminary circulation is sent to the prescribed persons (owners within 120 m of the site), public bodies, relevant internal departments and the Ward Councillor (response requested within 21 days). Public input is requested and only written responses received prior to preparation of the report will be published as part of the staff report. The report will identify the public issues raised, staff comments on the issues and any other outstanding issues.

A.3.3. Neighbourhood Information Meeting

If significant public interest or opposition related to the proposed amendment is apparent, an informal community information meeting with the neighborhood may be requested or arranged. The Ward Councillor may also initiate community information / ward meeting prior to the formal public meeting.

A.3.4. Staff Report for Draft Approval

Public input is requested and only written responses received prior to preparation of the report will be published as part of the staff report. The report will identify the public issues raised, staff comments on the issues and any other outstanding issues.

A.3.5. Public Meeting

At the meeting, Development Planning staff will present their recommendation on the Draft Plan of Subdivision Application. A staff report containing the staff recommendation and any required conditions of approval will be presented. Any member of the public has the opportunity to voice their concerns or opinions regarding the proposed Draft Plan of Subdivision at this meeting. They must express their opinions at the Public Meeting if they wish to appeal the case to the Ontario Municipal Board (OMB) after Council makes a decision. The applicant may also address the Committee. In accordance with the Planning Act, a Public Meeting is held by the Planning Committee, consisting of Councillors. A recommended decision on the application will be made to Council at this meeting. At the Public Meeting, the Committee will either recommend

approval of the Draft Plan and conditions of approval, deny the application or refer it back to staff for further review.

A.3.6. Resolution of Issues

Once notice has been given, all eligible persons (those who made written or oral submissions on the application) or the applicant, may appeal the decision of Council, or conditions of the approval, to the OMB within 20 days. An appeal must be made by a written notice to the Secretary of the OMB and to the Clerk of the City of Hamilton. The OMB's decision is final and may not be appealed unless there is an error in law and the proponent requests a judicial review.

A.3.7. Post Draft Approval

If the application was approved by Council, and no appeals are received, then the Draft Plan of Subdivision is considered to be approved the day after the last day of appeal.

A.3.8. Modifications to Draft Plan

If the Proponent deems it necessary to make a modification to the draft plan they are required to file for a “Request for Modifications” through the Planning Department. The Proponent will prepare a submission with the proposed modifications and will include the following information:

- A letter describing any Modifications made to the draft plan;
- The appropriate number of copies of the modified plan as requested by the City;
- A digital copy of the modified submission; and,
- Modification fees provided to the City of Hamilton and the appropriate Conservation Authority.

The modified submission would then follow the same process as a Draft Plan of Subdivision in Section A.3 - Neighbourhood Information Meeting.

A.3.9. Street Naming

The naming of streets in the new development shall adhere to the Street Naming and Renaming Policy and Guidelines. Final Engineering drawings should include the final names of all streets.

A.4. PRELIMINARY GRADING REQUEST

Prior to the start of any preliminary grading, Proponents shall have an executed Subdivision Agreement with the City. Refer to Part 3 – Prior to Preliminary Grading which outlines all requirements.

A.5. SERVICING REQUEST

Prior to the start of any servicing construction Proponents shall have an executed Subdivision Agreement with the City. Refer to Part 4 – Prior to Servicing which outlines all requirements.

A.6. RELEASE FOR REGISTRATION

Release for Registration shall comply with the Subdivision Agreement, Part 6 – Release of the Agreement.

A.7. REPORTS AND STUDIES

A.7.1. Planning Justification Report

Proponents should contact the Planning Department for the requirements of this report.

A.7.2. Environmental Impact Statement (EIS)

The need to complete an EIS will be identified at a pre-consultation meeting. The study shall be prepared in consultation with the Environmentally Significant Areas Impact Evaluation Group (ESAIEG) and to the satisfaction of the City and the appropriate Conservation Authority.

A.7.3. Geotechnical Investigation and Soils Report

Soil test borings shall be placed at intervals not exceeding 150 m and to a depth of not less than 3.5 m below the proposed pavement grade or refusal to rock.

Prior to the submission of detailed design two boreholes with nested monitoring wells shall be drilled and monitored for three seasons in the vicinity of each proposed Stormwater management pond. The proponent shall consult with City staff regarding the borehole location and monitoring process.

Soil classification and water levels shall be recorded and noted on the plans and profiles submitted.

The geotechnical consultant shall provide recommendations on the proposed pavement structure, including confirming the minimum pavement design requirements outlined in Section C.3 - Road Pavement Design are satisfactory.

Recommendations shall also be prepared for the bedding material and cover of sewers.

One paper copy of the geotechnical report shall be submitted together with an electronic copy in native PDF format.

A.7.4. Servicing Design Brief or the Preliminary Servicing Report

During the Formal Consultation process, the need for a Preliminary Engineering Report (referred to as Functional Servicing Report (FSR)) will be identified. For more details on Planning Applications please refer to City's website.

The Consulting Engineer shall review and reference any existing servicing studies, traffic studies, secondary plans class EA documents, master servicing plans, master drainage plans, watershed and sub-watershed studies that pertain to the project. A complete up-to-date listing shall be provided by the City upon written request.

A Preliminary Engineering Report, if required, shall be submitted to the City Planning and Economic Development Department with the relevant application. It shall include, but not be limited to, the following:

Contour Plan

Existing ground contours at sufficient intervals to permit assessment of surface drainage patterns. This plan should be at a scale not smaller than 1:1000, and in the case of a subdivision application, can be combined with a draft plan of subdivision.

Sanitary Sewer System

- Existing sanitary sewer outlet information (size, slope, location);
- Drainage areas complete with existing ground contours at sufficient intervals to permit assessment of surface drainage patterns;
- Proposed flows and functional design of sanitary sewers; and,
- Identification of potential constraints, if any, and how they have been addressed. Any mitigation measures proposed shall be detailed.

Storm Drainage System

- Existing storm sewer outlet information (size, slope, location);
- Drainage areas complete with existing ground contours at sufficient intervals to permit assessment of surface drainage patterns to a minimum of 15 m beyond the limits of the subject lands;
- Proposed flows and functional design of storm sewers;
- Designation of major and minor drainage systems, assessment of any storm water management facilities together with functional design; and,
- Identification of potential constraints, if any, and how they have been addressed. Any mitigation measures proposed shall be detailed.

Watermain Distribution System

- Existing watermain information (sizes, locations, looping, pressure boundaries);
- Functional watermain distribution system design; and,

- Identification of potential constraints, if any, and how they have been addressed.

Roadways

- Identification of collector roads where additional pavement widths and special pavement design is warranted;
- The need for assessment of the impact of the development on any adjacent roads;
- Location of sidewalks;
- Road geometry at key location (horizontal and vertical);
- Identification of safe routes to schools and parks using roadways or paths;
- Identification of traffic calming features (i.e. Livable Roads as per the Transportation Master Plan) ; and,
- Identification of potential constraints, if any.

On-Street Parking Plan

- The location of driveways, driveway ramps and curb openings for all lots; and,
- The location of utilities: concrete transit pads, community mailboxes pads, and fire hydrants; where the location has been determined by the appropriate authorities.

A.7.5. Design Review Panel – Urban Design Brief

The Design Review Panel (DRP) is a voluntary technical panel established to provide expert and impartial design advice to Planning Division staff on urban design matters. The panel is strictly an advisory body and makes recommendations, it does not have the authority to approve or refuse projects or make policy decisions, or recommendations on land use. DRP applies to complex Zoning By-law Amendment (rezoning) and Major Site Plan applications, civic projects, new policy initiatives, and studies with urban design components in the following Design Priority Areas: The Downtown Hamilton Secondary Plan Area, Areas of Major Change and Corridors of Gradual Change within the Setting Sail Secondary Plan Area, and Primary Corridors as identified in the Urban Hamilton Official Plan. Additionally the Director of Planning and Chief Planner may refer any transformational project that requires fundamental changes to the land use and has the potential to significantly impact the physical environment functionally and aesthetically. Outside of these options, anyone can opt into the DRP if they wish.

DRP review is requested at the Formal Consultation Stage. For rezoning applications, this review occurs after a complete application is made. For site plan applications, this review must occur before the Development Review Team meeting to ensure concerns are identified as early in the process as possible. Please refer to the DRP section on the City of Hamilton website at https://www.hamilton.ca/develop-property/policies-guidelines/design-review-panel for information regarding the submission requirements, timing, contacts, etc.

A.7.6. Watermain Hydraulic Analysis Report

The report shall address water distribution systems, pressure zones, water consumption – estimated consumption, current capacities of trunk systems, phasing, net impact due to the proposed change in land use or development, need for expansion and upgrades. The requirements for this report are outlined in detail in Appendix A – Watermain Hydraulic Report.

In the case where there are unknowns (such as form of development, type of construction, etc.) the Consulting Engineer will clearly state what assumptions were made in the preparation of the appropriate study. As decisions are made and variables become known, the Consulting Engineer will be required to verify that the assumptions made in preparing the studies are still representative of the development. The study will have to be revised if the assumptions are no longer valid.

The report shall also include fire flow requirements calculated using the Fire Underwriters Survey (FUS 1999). Proponents should be aware that this can impact the form of development and / or the type of construction. It is recommended that Proponents undertake this study as early as feasibly possible in the approval process.

A.7.7. Stormwater Management (SWM) Report

Refer to Section G.8.1.5 - Functional Stormwater Management Report which provides generic terms of reference.

A.7.8. Hydro-geological Studies

In general, the report, prepared by a qualified professional shall address impacts of the proposed development in accordance with subwatershed and master drainage plan study recommendations on: ground water levels, flow paths, and recharge and discharge zones; karst features; and, water balance / water budget.

The report shall also provide recommendations to mitigate groundwater impacts, including monitoring, and a groundwater contingency plan to ensure that an appropriate mitigation strategy is available to be implemented in the cases where:

- An aquifer is breached during excavation;
- Groundwater is encountered during any construction within the subdivision, including but not limited to house construction;
- Sump pumps are found to be continuously running; and,
- Water supply and sewage disposal systems and any surface and groundwater related infrastructure are negatively impacted.

For rural areas, a hydro-geological report shall be submitted in accordance with City of Hamilton Guidelines For Hydro-Geological Studies and Technical Standards for Private Services.

A.7.9. Traffic Impact Study (TIS)

A Traffic Impact Study shall be submitted, where required, in accordance with City of Hamilton Traffic Impact Study Guidelines.

Traffic Impact Studies assess potential impacts of traffic changes caused by proposed development on municipal roads and to identify any infrastructure improvements or mitigation measures needed to ensure the road network will operate acceptably and safely upon completion of the proposed development.

They may vary in scope and complexity depending on the type and size of the proposed development and typically consider all modes of travel including cars, trucks, transit, cyclists and pedestrians. Recommendations from a study shall be consistent with the City's goals as expressed in the Strategic Plan, Transportation Master Plan and other planning documents.

A.7.10. Environmental Site Assessment (ESA)

The requirement for the submission of an ESA shall be determined at the Formal Consultation meeting. The purpose of the ESA is to:

- Identify any potentially contaminating activity in the area;
- Identify areas of potential environmental concern on the property; and,
- Determine if a Phase Two Environmental Site Assessment is needed (for some types of property uses and circumstances, a Phase Two Environmental Site Assessment is mandatory).

The study shall be prepared in consultation with the Environmentally Significant Areas Impact Evaluation Group (ESAIEG) and in compliance with Ontario Regulation 153/04.

A.7.11. Archaeological Assessment

The City shall request an Archaeological Assessment as required, which shall make reference to the City's Archaeology Management Plan and be prepared in compliance with the Ministry of Tourism, Culture and Sport standards. The archaeological assessment must clear the subject site prior to the commencement of grading or servicing installation when an assessment is part of the Draft Approval Conditions. The need for an Archaeological Assessment will be determined at the pre-consultation stage.

A.7.12. Tree Protection

The City shall request a Tree Protection Plan as required, which shall make reference to the City's Tree Protection Guidelines. The need for a Tree Protection Plan may be identified as a draft condition that must be cleared prior to the commencement of grading or servicing installation when included in the Draft Conditions of Approval. The need for a tree protection plan will be evaluated at the pre-consultation stage.

The Tree Protection Guidelines require the applicant to provide information and analysis of trees early in the planning process, to ensure that trees worth retaining are identified. This evaluation will then be used along with Engineering and grading information to guide the layout of the development proposal.

The Guidelines apply to privately-owned lands subject to Planning Act approvals, (such as draft plans of subdivision / condominium, site plan approvals, part lot control, and consent applications), and/or Niagara Escarpment Plan permit. There is a four-step process to ensure tree protection for Planning Act applications proposed within regulated areas:

1. General Vegetation Inventory (GVI) - required for all portions of the site;
2. Tree Protection Plan (TPP) - required only for lots and blocks containing existing quality vegetation that requires further study as identified and approved by the City during the General Vegetation Inventory;
3. Implementation (installing tree protection measures during construction and monitoring); and,
4. Landscape Plan (re-planting and transplanting).

The applicant has the option of submitting the full TPP at the time of application, eliminating the need to prepare and submit a GVI. The City may accept this approach, as it provides detailed information on trees early in the Formal Consultation process and allows grading and servicing plans to reflect tree protection requirements. However, if the TPP is submitted at the time of application, it should be understood that, despite the amount of work already completed by the applicant, it is still possible that the City will request changes to the site layout. At the time Formal Consultation, City staff and the applicant would discuss using this approach to determine if it is feasible for that particular site.

The Proponent must employ a recognized tree management professional (e.g. certified arborist, registered professional forester, or landscape architect who will assess and evaluate the vegetation on a proposed development site. Depending on the nature of the vegetation and the development proposal, an application may not be required to go through all four steps.

A.7.13. Heritage Impact Assessments and Conservation Plan

A Cultural Heritage Impact Assessment (CHIA) is a report that documents a clear and traceable evaluation of the effects of a proposed new development or redevelopment on cultural heritage resources and/or their setting. The need for a Heritage Impact Assessment will be determined at the pre-consultation stage which should be prepared to the satisfaction of the Development Planning, Heritage and Design Division.

Reference should be made to the Official Plan, the City of Hamilton Info-sheet: Cultural Heritage Impact Assessments, March 2014, which is available from the Cultural Heritage Planner in the Development Planning Section of the Planning Division.

A.7.14. Noise Impact Report

Where it is a requirement of final clearance of the Draft Plan for the Proponent to undertake a noise study for submission to, and approval by the City, and where an approved noise study requires mitigation measures that will affect the grading of the Land, the Proponent shall include the specific measures to be implemented on the Final Grading Plan.

All Noise Studies shall be prepared by a qualified noise consultant. Refer to Section C.20 - Noise Attenuation for detailed requirements.

A.8. ENGINEERING SUBMISSIONS

A.8.1. First Submission

The first Engineering submission shall consist of:

- Two (2) copies of the final survey plan;
- One electronic set of drawings (native PDF format);
- Three (3) sets of detailed Engineering drawings;
- Two (2) sets of sanitary sewer and storm sewer calculation sheets;
- Two (2) copies of a Stormwater management report and a digital copy of the model (if applicable);
- One (1) paper copy and one electronic copy (native PDF format) of a geotechnical report;
- Two (2) copies of any other relevant reports or drawings (traffic impact, noise impact, archaeological assessment, tree preservation, EIS, hydro-G, etc.);
- A checklist showing how the draft plan conditions have been addressed;
- Payment of Stage 2 City Subdivision Processing Fees, based on current fee at the time of Engineering submission (see User Fee Bylaw);
- Schedule in Gantt chart format outlining expected timelines for approval and servicing; and,
- Other plans that may be required through the process such as SWM facility landscape and streetscape plans – three (3) sets.

The design of municipal services shall be based upon the specifications and standards in effect at the time the Engineering drawings are approved. The City's Planning and Economic Development Department, Development Engineering Section, shall approve all Engineering drawings but such approval shall in no way relieve the Engineer of the responsibility to design adequate and safe services. The original marked up first submission City copy of the Engineering drawings shall be returned to the proponent.

All sanitary sewers, storm sewers, watermains and their appurtenances and all roadways being constructed within the City of Hamilton, shall conform to the City of Hamilton Standard Specifications.

A.8.2. Second and Subsequent Submissions

Upon review of the first submission of Engineering drawings and reports by the City, the Engineer shall amend the drawings and reports to incorporate the comments and shall submit:

- Three (3) complete sets of revised Engineering drawings as outlined in first submission; Note: the revision block on all drawings is to be updated to include the revision number, comment about the revision and the revision date.
- Two (2) sets of street lighting drawings, if available at second submission;
- Two (2) sets of draft (unsigned) composite utility plans, if available at second submission;
- Two (2) paper copies of the watermain hydraulic analysis;
- Original marked up First Submission City copy;
- A draft copy of the Engineering Cost Estimates (Schedule of Works);
- Two signed (2) copies of the Alteration to Drinking Water System Form I application and supporting documentation;
- Two (2) signed copies of the Environmental Compliance Approval (ECA) application packages plus a full digital submission of the ECA application that includes a copy of all required supporting drawings, information, and calculations;
- Copies of all available approvals (MTO, HCA, MNR, NEC) and/or whatever is applicable; and,
- The consultant shall submit a letter accompanying the drawings indicating the extent of the changes and which drawing(s) have been changed. This letter, signed and stamped by an Engineer, must certify that there are no other design changes. City to provide comments in electronic format to assist with resubmission.

A.8.3. Final Submission

- Four (4) sets of the construction drawings (full size, paper, rolled);
- One (1) set of construction drawings in native PDF format;
- Two (2) set of the construction drawings (reduced to 11” x 17”, paper);
- Two (2) copies of the general services plan (full size, paper) folded and one (1) digital* copy of the General Services Plan (in .DWG/DXF format);
- One (1) digital* copy of the grading plan, general services plan, storm and sanitary drainage area plans (in .DWG/DXF format) and in PDF format (as a native pdf, not a scanned copy) and the storm and sanitary sewer calculation sheets (in Excel format), signed and sealed by the Consulting Engineer;
- One (1) set of the storm and sanitary drainage area plans (full size, paper) folded;
- One (1) set of the storm and sanitary sewer calculations (paper);
- One (1) copy of the unpriced contract documents and form of tender;
- One (1) copy of the priced and signed contract documents and form of tender;
- Six (6) copies of final plan of subdivision (M-Plan reduced to 8.5” x 11”);

- Four (4) copies of the grading plan (include any other sheets that may have grading related details, notes, etc., on them) folded; and
- One (1) digital copy of the Storm Water Management Report and the Operations and Maintenance Manual (as a native pdf, not a scanned copy) if applicable.* - on separate disc, signed and sealed by the Consulting Engineer.

A.8.4. "As-Constructed" Submission

All Engineering drawings included in the final design drawings (except lot grading plans) shall be up-dated to incorporate the following as-constructed information:

Sewers

- Sewer length measured from centreline to centreline of maintenance hole cover;
- Percent grade of sewer;
- Invert elevations at maintenance holes, plugs and bulkhead and,
- Material type to be specified.

Private Drains

- Location of private drain at main sewer dimensioned (chainage) from a maintenance hole;
- Location of private drain at streetline referenced by a measurement from a lot corner;
- Where risers are used indicate with 'R'; and,
- Material type to be specified.

Watermains

- Chainage of watermain appurtenances (tees, bends, reducers, hydrants, etc.) starting with 0+00 at a main valve or from a hydrant if no main valve;
- Specify manufacturer's name and model number for all valves and hydrants;
- Watermain inverts for 400 mm diameter and larger; and,
- Material type to be specified.

Water Services

- Location of all private water service at the main (mainstop) to be indicated by chainage; and,
- Location of curb stop to be referenced by a measurement from a lot corner.
- Material type to be specified.

Storm Water Management Ponds

- Invert elevations, storage volumes and discharge rates; and,

- Confirm that the SWM facility is not compromised and all discrepancies are indicated on the "As-Constructed" drawings.

General

- Rock profile, where applicable;
- All references to "proposed" to remain on drawings, unless the works were not constructed and the corresponding notes shall be crossed out (it will be assumed that all works were constructed unless otherwise noted); and,
- A certificate to be added to each drawing displaying the following information:

  "This certifies that the work shown on this drawing related to underground works has been completed in the field as required by the City of Hamilton Subdivision Agreement. All underground services shown are as-constructed."

  _____ _____

  Date Engineer

One (1) copy of the as-constructed drawings shall be submitted to the City for review. Upon acceptance of the information on the drawings, the Engineer shall stamp and sign the drawings and provide Mylar copies of all drawings (including a copy of the original lot grading plan and detail sheets) to the City for its permanent record.

The Engineer shall also provide the drawings in electronic file format (.DWG or .DXF and as a native PDF).

A.8.4.1 Construction Inventory

The City is tracking quantities and costs of works constructed in residential subdivisions throughout Hamilton in order to compile statistical information and establish average construction costs for municipal works. This information will assist in determining average rates for the City's share of servicing costs, forecasting to determine City contributions for future works as part of its Staging of Development Programming and budgeting for future growth requirements under the City's Development Charge Studies. This information is required from the Applicant's Consulting Engineer at the time when the approved engineering drawing package is submitted to the City, prior to start of construction.

The construction inventory sheet is in MS Excel file format. The inventory sheet contains the type and size of municipal works to be inventoried by the City. To complete the inventory sheet simply indicate the total amount (length or number) of an item on the list that is within a development as well as the total cost excluding overhead of that item. Only complete the items on the list that are within a development. All other items on the list may be left blank. A copy of the City's Construction Inventory Sheet in MS Excel may be downloaded from the City's website.

The information provided and all the average work costs will be available to the public in our yearly reports

A.8.5. Other Approvals

Municipal Consent Process for New Development

The Consulting Engineer is also required to co-ordinate the municipal consent process for utility installation on new developments. See Section I.2 - Utility Installation Municipal Consent for the Municipal Consent procedure. Generally, at the time of initial Engineering submission to the City, the Consulting Engineer shall notify the utility companies of the proposed development. Upon the second submission to the City, the Consulting Engineer shall provide Hydro with a set of Engineering drawings. Hydro will complete their plant design and circulate to the other utility companies so that their plant design can be added.

The utility companies shall forward their completed plant design in digital format (.DWG/.DXF) to the Consulting Engineer, who shall prepare a Composite Utility Plan as required with the second submission. This may also be included in the lot grading plans.

MOE-CC Applications for Sewers

The Engineer shall submit MOE-CC application forms for Environmental Compliance Approval for sanitary sewers and storm sewers. Two additional sets of Engineering drawings, individually folded, shall be provided to the City to accompany the MOE-CC application through the Transfer of Review Program between the City and the MOE-CC.

Projects that involve Stormwater management facilities are direct submissions to MOE-CC; i.e. they are not processed through the Transfer of Review Program; however the application forms shall be submitted to the City for signature as the operating authority. The Proponent shall be responsible for any fees payable to the MOE-CC for this review.

For more information and requirements on the Transfer of Review program please refer to the ministry's Guide to Applying for an Environmental Compliance Approval, 2012.

MOE-CC's Municipal Drinking Water Licensing Program (Form 1)

Water servicing approvals are processed under the MOE-CC's Municipal Drinking Water Licensing Program.

Under provincial license, the system provides the municipality with a Municipal Drinking Water Permit from which the municipality issues Drinking Water Works Permit Amendments for the works to be constructed by the Proponent.

For more information and requirements on this program please visit the Ministry of Environment website and the City's Drinking Water Quality management System webpage.

A.9. PLANS AND DRAWINGS

A.9.1. Drafting Requirements

The detailed Engineering drawings submitted by the Proponent's Engineer shall be subject to the following:

- All drawings shall be in metric and shall be neat, legible and completed in ink (if applicable);
- Lettering shall be done using a lettering template with a minimum font size of 8 pt.;
- Sheet size shall be metric A1 (594 mm x 841 mm) or Imperial (24" x 36"). External sanitary and storm drainage area plans for overall catchment areas may be submitted on larger size sheets for convenience of presentation;
- Plan-profile drawings shall be to a scale of 1:500 horizontal and 1:100 vertical, except when drawings for existing roadways are required, when a larger scale would be more suitable;
- All drawings shall contain a key plan, north arrow, title block showing the name of the Engineer together with the sheet title and current revision status;
- All drawings shall be sealed, signed and dated by the Engineer responsible for the design; and,
- All elevations are to relate to a geodetic datum acceptable to the City, and the bench mark shall be described on all the drawings.

The detailed Engineering drawings shall consist of the following:

- Title Sheet;
- General Plan of Services;
- On-Street Parking Plan;
- Pre-Grading Plan (if applicable);
- Grading Plan;
- Water Distribution Plan;
- Phasing Plan (if applicable);
- Erosion and Sedimentation Control Plan;
- Plan-Profile Drawings;
- Composite Utility Plan (subsequent submissions only);
- Sanitary Drainage Area Plan (including external areas);
- Storm Drainage Area Plan (including external areas); and,
- Other drawings as required; e.g.: tree protection plan, street tree planting plan, SWM facility details, roundabout details, street lighting plan, pavement marking, signalization, traffic calming.

A.9.1.2 Title Sheet

A Title Sheet shall be included for every subdivision that includes more than one street that is being constructed as part of the plan of subdivision. All Title Sheets shall contain the following information:

- Name of Municipality (City of Hamilton);
- Key Plan showing the location of the proposed development;
- Name of the Development including 25T number;
- Name of the Owner;
- Name of the Engineer; and,
- List of drawings.

A.9.1.3 General Plan of Services

A General Plan of Services shall be prepared for every Engineering submission that includes construction of more than one street as part of a development application.

If possible, the plan should be presented on one page, ideally at a scale of 1:500 shall be used. For larger subdivisions, an appropriate scale shall be selected, but in no case shall the scale be smaller than 1:1000.

The following information shall be shown on the General Plan of Services:

- All road allowances, lots and blocks in the plan of subdivision and those immediately neighbouring the subdivision;
- Proposed sanitary and storm sewers including diameter of pipe and direction of flow, maintenance holes, culverts, road catch basins and rear yard catch basins (if applicable);
- Proposed watermains (including diameter of pipe) and appurtenances;
- Proposed curbs and sidewalks;
- Existing services surrounding the subdivision, including length, size and type, and their relation to the proposed work;
- Description of the nearest geodetic benchmark. Site benchmarks should also be shown and described;
- General Notes describing the construction of services - for larger subdivisions it is preferable to have the notes on a separate page. These notes are constantly being updated and the Engineer should use only the notes applicable to the subdivision that are current at the time of design and construction. The most recent OPSD and City Specifications shall be referenced in the notes;
- Typical road cross-sections with pavement design; and,
- Waste container placement in public spaces shall comply with Accessibility for Ontarians with Disabilities Act (AODA) requirements and collection service accessibility.

A.9.1.4 On-Street Parking

New residential development shall provide adequate, convenient on-street parking within the right-of-way for all residences with direct access, while ensuring road safety, in accordance with the following criteria.

The Proponent shall submit an On-Street Parking Plan for all lots or blocks within the plan intended for street-fronting residential development. Submission of the On-Street Parking plans is subject to the following timing:

- Prior to Draft Approval (part of what's deemed as a Complete Submission); and,
- Post Draft Approval (the final parking plan is approved as part of approval of the Engineering submission).

The On-Street Parking Plan shall show the following:

- The location of proposed spaces;
- The location and width of driveways, driveway ramps and curb openings for all lots and blocks; and,
- The preliminary location of approved above-ground utilities (street furniture): concrete transit pads, community mailboxes pads, and fire hydrants (where the location has been determined by the appropriate authorities).

A.9.1.5 Pre Grading Plan

The pre grading plan shall be prepared on a standard metric A1 size sheet or an Imperial 24" x 36" sheet at a scale of 1:500. This plan will display the elevations prior to final grading, it will be stamped and signed by a professional Engineer and shall show the following:

- Elevations of all lots and blocks of the lands to be developed;
- Elevations of adjoining lands for a minimum of 15 m beyond the limit of the lands to be developed;
- Proposed pre grade elevations at the corners of each lot and block and at intermediate point of change in grade;
- The overland flow route design and calculations are to be shown to understand impacts on the proposed and surrounding lands during this stage;
- Proposed pre grade elevations at 15 m spacing along the frontage of large blocks and at a reasonable spacing along the sides and rear of the block;
- Proposed pre grade elevation along the centerline of the road at 15 m spacing;
- The location of all existing trees, septic tanks and tile fields, wells, above ground utility structures (street furniture) and other structures as necessary;
- A key plan showing the proposed development and, for larger subdivisions, the location of the lots on the sheet in relation to the overall development; and,
- Description of the nearest geodetic benchmark.

A.9.2. Grading Plan

The overall grading plan shall be prepared on a standard metric A1 size sheet or an Imperial 24” x 36” sheet at a scale of 1:500, stamped and signed by a professional Engineer and shall show the following:

- All lots and blocks of the lands to be developed as well as adjoining lands for a minimum of 15 m beyond the limit of the lands to be developed and further if necessary to determine future and proposed drainage patterns;
- Existing contours at 0.5 m intervals over the entire development including sufficient area of adjacent lands to establish the overall drainage pattern. If the parcel is flat or 0.5 m contours do not adequately show topography, 0.25 m contour spacing should be provided;
- Proposed elevations at the corners of each lot and block and at intermediate point of change in grade;
- Proposed elevations at 15 m spacing along the frontage of large blocks and at a reasonable spacing along the sides and rear of the block;
- Proposed centre line road elevations at:
  - All changes in grade; and,
  - Opposite lot corners of the lands to be developed;
- The location of all existing trees, septic tanks and tile fields, wells, above ground utility structures (street furniture) and other structures as necessary;
- The location of existing and proposed retaining walls with proposed top and bottom elevations at appropriate intervals with sections and sub drain outlet locations (if required);
- The location of drainage ponds or swales, and direction of surface drainage on each proposed lot and block and on all adjoining lands;
- The location of rear yard catch basins and inlets, top of grate elevations and overland flow routes;
- Proposed building envelopes with the following information:
  - Front of house apron elevation (garage floor elevation);
  - Back of house apron elevation, if different from front;
  - Minimum basement floor elevation (shall be calculated based on the elevation of the sanitary private drain); and,
  - Roof leaders shall discharge onto splash pads, satisfactory to the City Engineer and then to a grassed or landscaped area at a minimum distance of 0.60 m away from the building face;
- Adjacent lots having a combined side-yard setback totalling 2.0 m or less shall have roof leaders restricted to front or rear yard discharge locations with drainage directed away from the house to minimize erosion and ponding;
- A key plan showing the proposed development and, for larger subdivisions, the location of the lots on the sheet in relation to the overall development;
- Description of the nearest geodetic benchmark;

- Typical lot drainage patterns; and
- Noise attenuation with details.

A.9.2.1 Water Distribution Plan

The water distribution plan shall illustrate water distribution methods (watermain system throughout the development) and pressure zones based on the estimated water consumption. This plan will display all valves and hydrants as well as all service connections to each lot. Ideally at a scale of 1:500 shall be used, but for larger subdivisions, an appropriate scale shall be selected; in no case shall the scale be smaller than 1:1000.

A.9.2.2 Phasing Plan

The phasing plan shall illustrate the staging of works (linear infrastructure, lot grading, all temporary works) as required for each stage of the works. A phasing plan will be required if all dwellings shall not be constructed in the same time frame. Every phase of construction must be clearly defined and adequate interim Stormwater management and traffic control practices must be described. All phasing plan drawings shall be prepared at a scale of 1:1000.

A.9.2.3 Erosion and Sedimentation Control Plan

The Erosion and Sedimentation Control Plan prepared in accordance with the "Erosion & Sediment Control Guideline for Urban Construction" dated December 2006 may be submitted with the Final Grading Plan or as a separate plan.

If possible, the plan should be presented on one page, ideally at a scale of 1:500 shall be used. For larger subdivisions, an appropriate scale shall be selected, but in no case shall the scale be smaller than 1:1000.

It shall show details of controls for road and rear yard catch basins and location of sediment control fencing. Further it will indicate the location of topsoil stock piles including the height, volume and slope.

Any special measures required on a site specific basis to mitigate sediment contamination of affected creeks, adjacent properties, storm sewer systems and storm water management facilities shall be detailed. Consultation with the Conservation Authority is recommended when draining surface run-off to areas regulated under the Conservation Authorities Act.

A.9.2.4 Plan Profile Drawings

Plan profile drawings shall be prepared for all existing and proposed streets, walkways and easements where sewers, watermains and/or road construction is required as a consequence of the proposed development and include:

- All plan-profile sheets for proposed streets shall be drawn at a scale of 1:500 horizontal and 1:100 vertical;

- Plan-profile sheets for reconstruction or construction on existing roads within an urban area may be drawn at a scale of 1:250 horizontal and 1:50 vertical, at the discretion of the Engineer, depending on the detail required to be shown on the drawing;
- The profile portion of the drawing shall be a vertical projection of the plan portion, wherever possible;
- All road allowances, lots, blocks, easements, reserves are to be shown and identified in accordance with the notation on the Final Survey Plan. Lot and Block frontages and bearings are to be shown and must correspond with the Final Survey Plan;
- Dimensions of the road allowance and at least one set of dimensions from the property lines to proposed curbs, sidewalks, sewers, and watermains shall be shown on each sheet;
- A key plan identifying the land to be developed and the relationship of the proposed street within the land shall be provided; and,
- Two short streets may be shown on one plan-profile drawing.

a) Plan View Requirements:

- The street name or easement number shall be prominently centered over the top of the plan portion of the drawing;
- Generally, the plan view shall be drawn such that the north arrow is pointing towards the top of the page and/or to the right of the page;
- All existing sewers, watermains, curbs, sidewalks, etc. shall be shown and labelled as "existing". All proposed sewers, watermains, curbs, sidewalks, etc. need not be labelled as "proposed" but shall be distinguished from the existing services by line type and size / style of lettering;
- Only the size and type of the proposed and existing sewer and watermain shall be labelled (e.g. 250 mm Sanitary);
- Where connecting to an existing watermain 400mm dia. And larger, elevation of the watermain and material type shall be identified prior to tender.
- Where intersecting streets (or easements) are shown in plan view, only the size and type of sewer and direction of flow of the intersecting sewers shall be shown;
- All sewer maintenance holes shall be numbered. Sanitary maintenance hole numbers shall be distinguished from storm maintenance holes by the suffix or prefix "A", (e.g. MH A2);
- Road catch basins and connections shall be shown. Rear yard catch basins and connections shall be shown with adequate details regarding top of grate elevation, location of catch basins and connection in relation to rear and side property lines, standard drawing detail, inverts, length and grade of connection;
- Hydrants, valves and other appurtenances on the watermain shall be shown and labelled with details regarding standard drawing details and location;

- Locations of sanitary private drains and storm private drains (if applicable) and private water services for each lot and block created by the development application shall be shown;
- Details and specifications for the proposed curbs and sidewalks shall be shown. All transitions from different types shall be properly labelled and dimensioned. Curb radii at intersections shall be shown and curb radius and angle of intersection of other horizontal curves shall be adequately indicated;
- Match lines for continuation of the street shall be clearly marked;
- Borehole locations and numbers shall be shown;
- Cross reference drawing numbers of adjoining plans; and,
- Cross reference to general notes drawing number.

b) Profile View Requirements

The following profiles shall be shown:

- Existing ground over centerline of road / easement;
- Proposed centerline road / easement;
- Sanitary and storm sewers;
- Watermains;
- Proposed sewers shall be detailed for each section including size and type of sewer, length and grade, pipe material specifications and class of bedding;
- Maintenance holes shall be numbered and distinguished to correspond to the numbering in plan view. Maintenance hole details such as standard drawing number and any required information such as diameter of base, top of maintenance hole cover elevation, drop-pipe requirements, safety gratings shall be shown. Construction details are to be referred to the applicable City of Hamilton Drawings or Ontario Provincial Standard Drawings (OPSD);
- Proposed watermains 300 mm diameter and smaller shall include all related appurtenances, and shall specify size and pipe material. For 400 mm diameter and larger mains, chainages, invert, length and grade of each section, size, pipe material and a schematic detail of each valve chamber showing the orientation of appurtenances shall be provided;
- All sewer inverts at maintenance holes shall be given and adequately described;
- Proposed centerline road grade, chainages of P.V.I.s, intersections, and vertical curve data shall be adequately shown and described;
- Borehole logs shall be plotted with brief description of soils and water level, as well as rock elevations (if applicable). If the borehole log interferes with other details such as a maintenance hole, the exact location of the borehole may be altered sufficiently for clarity; and,
- 5 and 100 year hydraulic grade line (HGL) elevation shall be plotted on the profile.

A.9.2.5 Sanitary Drainage Area Plan

The Sanitary Drainage Area Plan shall be drawn at the same scale as the General Plan of Services. It shall include the following information:

- All streets, lots, blocks, easements and other lands within the plan of subdivision;
- Proposed sanitary sewers, including size, length and grade, maintenance holes, maintenance hole numbers, direction of flow, and details of the receiving sewer;
- The drainage areas within the lands to be subdivided or developed and the limits of external areas draining into the proposed system. The area contributing to each maintenance hole shall be clearly outlined and the area in hectares and population density in persons per hectare, shall be indicated on all drainage areas;
- If the contributing area to a maintenance hole is made up of areas with different population densities, the sub-areas showing the individual area in hectares and the population density shall be clearly shown; and,
- If the external drainage area is large, it may necessitate the preparation of a separate external drainage area plan. External drainage area plans may be prepared at a smaller scale, but shall show the existing ground contours to beyond the limit of the drainage area. Planned street patterns (if available) shall be shown to determine the route of the future sewers.

A.9.2.6 Storm Drainage Area Plan

The Storm Drainage Area Plan shall be drawn at the same scale as the General Plan of Services and shall include the following:

- All streets, lots, blocks, easements and other lands within the plan of subdivision;
- Proposed storm sewers, including size, length and grade, maintenance holes, maintenance hole numbers, direction of flow, major over land flow routes, and details of the outlet sewer or receiving watercourse and/or Stormwater management facility;
- The drainage areas within the subdivision and the limits of external areas draining into the proposed system. The area contributing to each maintenance hole shall be clearly outlined and the area in hectares and runoff coefficient shall be indicated on all drainage areas;
- If the contributing area to a maintenance hole is made up of areas with different runoff coefficients, the sub-areas showing the individual area in hectares and the runoff coefficient shall be clearly shown;
- If the external drainage area is large, it may necessitate the preparation of a separate external drainage area plan. External drainage area plans may be prepared at a smaller scale, but shall show the existing ground contours to beyond the limit of the drainage area. Planned street patterns (if available) shall be shown to determine the route of the future sewers; and,
- Contour lines to adequately show drainage patterns with a minimum of 1 metre contours.

A.9.2.7 Composite Utility Plan

In order to ensure that conflicts are avoided among utilities, street trees, municipal services and driveways, the Consulting Engineer shall be responsible for coordinating the preparation of the Composite Utility Plan (CUP). The CUP shall indicate the location of all underground and aboveground services, and utilities. In lieu of a separate CUP plan, these services may be included in the lot grading plan.

The CUP shall be prepared at a scale of 1:500. The following utilities, services and appurtenances shall be shown on the CUP:

- Catch basins including RLCB and maintenance holes in the road ROW; and,
- Valve chambers and hydrants.

Underground boulevard services, such as:

- Rear yard catch basin leads; and,
- Utility Crossings.

Aboveground services, structures and utilities such as:

- Bridges, culverts;
- Curb and gutter;
- Driveway locations;
- Hydro poles and light standards (poles);
- Traffic signals;
- Transformers;
- Pedestals, junction boxes, major utility hubs / vaults, street light disconnection boxes, flush to grade handwells and handholds;
- All utility related easements;
- Community mailboxes
- Retaining walls; and,
- Walkways and sidewalks.

A.9.3. Digital Engineering Submissions / “As-Constructed” Drawings

The digital as-constructed submission shall be provided to the City in digital format with all drawings in georeferenced coordinates. Vector format .DXF or .DWG files will be required.

Constructed sewer information which is georeferenced shall be provided to the City either as a .SHP file, an alternate digital format agreeable to the City or on a spreadsheet format which may be easily integrated into the City’s asset management software.

A.9.4. Geodetic Control

All design and construction shall be referenced to a minimum of two benchmarks. The Consulting Engineer shall contact the City to obtain a description of current benchmarks adjacent to the proposed work. Benchmarks used during construction shall be clearly identified on the design drawings with the number and the Benchmark Elevation.

All drawings are to be prepared in UTM NAD83 (Original) Coordinate System, Zone 17, and Central Meridian 81 West Longitude to simplify the eventual digital submission requirements.

A.10. CONSTRUCTION

A.10.1. Road Closure

Any anticipated road and lane closures required for underground or above ground works shall be identified by the Engineer at the initial submission of the Engineering drawings. Temporary Road Use Permit Application information can be found on the City's website.

The Development Engineering Section shall confirm the feasibility of road and lane closures and any requirements that are necessary, including temporary works, the preparation of detour routes and sign boards, and notification. The approval of a road closure is subject to the approval of the General Manager, Public Works. The cost of implementing a road closure shall be borne by the Proponent.

A.10.2. Asphalt Overlays on Existing Roads

If multiple road cuts are required on existing roadways for construction of underground services, the Proponent can expect to provide full reconstruction of the pavement structure as a condition of development approval, unless it can be demonstrated that servicing can be completed without adversely affecting the service life of the road. As a minimum, a full width overlay of asphalt will be required where there are three or more service trenches including rear lot catch basin leads.

When overlaying an existing road (edge of pavement to edge of pavement) the roadway shall be milled and overlaid from 1.0 m past the first cut to 1.0 m past the last cut.

If a service trench is required for a service parallel to the road, then the entire road shall be overlaid from 1.0 m past the start of the service trench to 1.0 m past the end of the service trench. If the service being installed is off-set from the centerline of the road such that the service trench affects only a portion of the road, then the City may, at its discretion, allow half the road to be overlaid. For extra wide roads, the minimum asphalt overlay shall be one lane width.

The decision to reconstruct or mill the entire roadway or to put an asphalt overlay shall be site specific depending on the grade and condition of the existing road.

A.10.3. Requirements for Tendering

The Engineer shall call tenders for the works (if requested by the City) and shall analyse the bids received and make recommendations to the Proponent and the City regarding the awarding of the works to the Contractor.

Where the City of Hamilton is responsible for the payment of items that include a “City Share” of the cost that is not based on a "Flat Rate" basis for sanitary and storm sewers and watermains and the "New Roads Servicing Rate" for roadworks, the following tendering procedure shall be used:

Any project where the City’s share of the cost is in excess of $50,000.00 + HST shall be tendered by an open tender (i.e. public notice in the Spectator). Where there is a City share component for the project the Proponent should not tender the Works subject to the funding by the City until given authorization by the Development Engineering Section. The City will not pay for increase in costs arising from incomplete designs.

The tenders shall close at the Consultant's office (if local) or at City Hall if the Consultant is from out of town. The out-of-town Consultant shall make arrangements to book a room at City Hall for the tender opening. A City representative will be present at the opening of the tenders to witness the bids received and shall be provided with copies of the Schedule of Quantities of the three low bidders immediately.

The Proponent may select the Contractor of his choice for the project, but the City will pay for its share of the works only on the basis of the overall low bidder (unless there is a justified reason to choose another bid e.g. disqualification of bidder due to no bid bond, known bad track record, etc.).

The Engineer will prepare and certify on the City's Share of the Works, based on the prices submitted by the low bidder that has been accepted by the City.

A.10.4. Pre-Construction

The Engineer shall arrange for a pre-construction meeting to be held prior to start of construction. A checklist (ref. Appendix B – Pre-Construction Meeting) of items to be covered at the pre-construction meeting shall be provided. At this time, the City shall be provided with the following documents:

- One (1) priced and signed copy of the contract documents and Form of Tender;
- One (1) blank copy of the contract documents and Form of Tender (without prices);
- Two (2) copies of the General Plan of Services;
- Three (3) complete sets of construction drawings;
- Mud Tracking & Construction Access Plan; and,
- Rodent Control Plan (see A.10.10).

The Consulting Engineer shall obtain a Construction Schedule from the Contractor and provide the City with a copy. The City shall be regularly informed as to the progress of construction and of any deviation from the original schedule.

A.10.5. Compaction and Material Testing

Compaction testing for trench backfill, road sub-grade, granular courses and asphalt including material testing of concrete, asphalt, granular materials etc., is required for all development projects in the City of Hamilton. It shall be the Proponent's responsibility to provide material and compaction testing by a qualified geotechnical testing company.

The geotechnical consultant shall certify to the City that works have been carried out as specified. In the event of a deviation from specifications, the geotechnical consultant shall provide an explanation and make recommendations to the City for either acceptance or any mitigation measures that could be carried out. The participating parties shall perform all necessary tests and comply with the following regulations to ensure the integrity of the design of all road works:

- Sieve analysis of granular base material for compliance with specifications;
- Granular base course material supplier shall be approved by the City prior to use;
- Compaction tests on the subgrade, granular base courses and asphalt courses to assure satisfactory compaction has been achieved. Asphalt mix designs and supplier shall be approved by the City prior to use;
- Confirmation of the sub-grade elevations prior to construction of road base. No Base course material shall be placed on the sub-grade until approval is given by the City. Such approval will only be given when:

The degree of compaction has been achieved as per City of Hamilton Form 900 in the City of Hamilton Construction and Material Specification Manual.

  - The sub-grade has been graded to within 13mm of the proposed cross-section; and,
  - The Proponent's Consultant has taken sufficient elevations and provide written certification for grades and for all area compaction levels to the City;
- "Proof rolling" of the sub-grade prior to the placement of the granular road base courses. All soft and spongy sections shall be excavated and filled with suitable material. Upon completion of excavation and grading operations, the sub-grade shall be thoroughly rolled with a loaded try axle or an alternative as recommended by the Geotechnical Consultant. Any minor irregularities or depressions developing under such rolling shall be corrected at the contractor's expense;
- Concrete tests (air, slump, and compressive strength) shall be performed to assure concrete meets specifications. Concrete supplier shall be approved by the City prior to use;
- Initial visual inspection of the road works; and,
- A final visual inspection of the road works prior to the expiration of the Guaranteed Maintenance Period.

Notwithstanding the aforementioned requirements, the Geotechnical Consultant shall not be relieved in any way from full responsibility to carry out any further tests which may be required to assure services meet specifications.

In cases where blast rock is proposed as a backfill material, for which test results cannot be obtained, the Proponent shall engage a qualified geotechnical soils consultant to be present on a full-time basis to monitor the compaction procedures during backfill, and provide the City with a written certificate at the completion of backfill operations that an equivalent of 95% Standard Proctor Density has been achieved for the backfill of the trenches.

All imported fill to a site shall meet MOE-CC Ontario Regulation 153, Table 1 for residential sites.

A.10.6. Interim Water Quality

In order to verify proposed DWS alterations through the Form 1 process, the Owner Representative must have assurance that the proposed design will ensure adequate interim water turnover and water quality during construction phasing. To address potential concerns, below are options to mitigate problems:

- Performance Based Flushing;
- Temporary Pipe Looping; and,
- Automatic Flushing Station Installation.

Should the Performance based Flushing option be implemented, the following conditions will apply:

- Flushing and testing will commence once the new watermain has been connected to the network. It will be carried out at a frequency based on performance and to ensure water quality requirements;
- The Proponent will pay invoices for flushing and testing based on actual costs incurred by the City. Such costs shall be based upon rates established by the Hamilton Water Division; and,
- Flushing and testing will cease once tests confirm that water quality requirements have been met as per the Safe Drinking Water Act.

Temporary pipe looping and automatic flushing station implementation shall be discussed with the City and implemented on a case by case basis.

A.10.7. Spill Management Reporting

Reference shall be made to the City of Hamilton Emergency Preparedness Plan Spills Notification Protocol. It is the responsibility of the person having control of the spilled Substance(s) or the person who causes or permits the Spill to immediately notify and provide the required information to:

- City of Hamilton – Assigned Construction Inspections Coordinator;
- City of Hamilton – Environmental Monitoring Enforcement Section – 905-540-5188; and
- Ontario Ministry of Environment – Spills Action Centre – 1-800-268-6060.

A.10.8. Mud Tracking & Construction Access Plan

A mud mat will be required at each point of access to the construction site, and will be composed 200 mm clear stone material or an approved equivalent. The mud mat's dimensions shall be at a minimum 3.0 m wide, 15.0 m long and 300 mm thick.

The Proponent or the Engineer will submit a plan describing the following applicable criteria:

- Location of all new or existing accesses to be used throughout construction;
- Impact of appropriating / modifying an existing entrance;
- Identify lane closures or restrictions and their expected duration;
- Secondary method of removing mud and dirt from vehicles entering or leaving construction site;
- Method and timing of cleaning up any mud and dirt that is tracked onto public right-of-way;
- Culvert sizing to preserve existing drainage; and,
- The locations of nearby hydrants intended to be accessed for the purposes of road cleaning.

The Proponent shall be responsible for all the removal of all mud and debris that is tracked onto the roadways from vehicles entering or leaving construction sites. The Proponent shall, upon verbal and/or written request by the City, immediately proceed with clean-up operations at their expense. Should the Proponent fail to maintain the road as directed, the City will have the cleaning carried out, draw on the Proponent's security for costs and/or lay charges.

A.10.9. Standing Water

City of Hamilton By-Law 03-173 prohibits and regulates the accumulation of standing water at specified times of the year. Standing water on construction sites is an area of concern by the City and all development projects will be monitored by the City for compliance of the By-Law.

Proponents should ensure that standing water does not accumulate on the land between April 1 and October 31 of each year.

A.10.10. Rodent Control Plan

Prior to preliminary grading, the Owner agrees at his sole cost to prepare a pest control plan, focusing on rats and mice which shall be developed and implemented for any demolition, and for the construction / development phase of the project and continue until the project is complete. The plan must outline steps involved in the potential control of vermin during all the development / construction and must employ integrated pest management practices. The plan must be formulated by a professional exterminator licensed by the MOECC and shall include monitoring, removing potential food and water

sources, and eliminating or preventing areas for harbourage. The plan can include trapping and / or baiting but special consideration should be aimed at ensuring any / all bait stations are tamper resistant and deceased rats are removed to prevent secondary poisoning of other animals. The plan is to be implemented when work activity at the site begins including but not limited to demolition, bush clearing, grading etc. This requirement is made under Section 26 of the Hamilton Property Standards By-law, No. 10-221 and to the satisfaction of the Medical Officer of Health.

A.11. RELEASE OF BUILDING PERMITS

For houses in new subdivisions, building permits will not be issued by the City for any lot, block, unit or severed parcel within the Land by the City:

- Until the Plan of Subdivision, has been registered;
- Until such time as the Engineer has certified that sewers and watermains, including fully serviceable and operative fire hydrants, together with a roadway, which includes granular base and base asphalt, have been installed in accordance with municipal standards to the satisfaction of the City;
- Until such time as the Engineer has certified that the lots, blocks, units or severed parcels have been pre-graded in accordance with the requirements of the Subdivision Agreement for pre-grading;
- Until a Detailed Grading Plan (Plot Plan) indicating the building foot print, the main floor and top of foundation wall elevations, and the proposed grading according to the Overall Grading Plan has been prepared by an Ontario Land Surveyor or a qualified Professional Engineer and filed with the Director of Building Services, or designate;
- All trees to be preserved on the lot, block, unit or severed parcel have been satisfactorily protected in accordance with the standards established by the City; and,
- Unless otherwise prescribed in the Subdivision Agreement.

Notwithstanding the forgoing provisions of this section, a building permit may be issued in accordance with the Model Home By-Law 03-163, provided the Engineer certifies that:

- An approved grading plan;
- An existing charged hydrant is located within 150 m; and,
- An acceptable street access has been provided to within 90 m, of the construction site's property boundary.

A.12. INSPECTIONS AND TESTING

A.12.1. Lot Grading Inspection and Certification

The City of Hamilton’s approval process to achieve final approval and release of securities held for the lot grading involves the following procedures:

- Plot Plans are prepared by an Ontario Land Surveyor, Architect, Landscape Architect or Engineer in accordance with the approved subdivision grading plan as part of the building permit process;
- Once footings have been placed or formed, an Ontario Land Surveyor shall certify in a suitable form, and make available to the City, that:
  - The top of footing elevation(s) conforms with the top of footing elevation(s) shown on the approved Plot Plans;
  - The foundations are sited entirely on the correct lot; and,
  - The building setbacks conform to the zoning by-law;
- Foundation elevations will be considered 'non-conforming' if they differ from design elevations by more than 150 mm. Non-conforming foundation elevations shall be brought to the attention of the City for further direction/discussion prior to proceeding with any further construction;
- After at least one winter has passed and the lot has been sodded, an Engineer shall submit an as-built plot plan and certify in writing, that the lot is in general conformance with the overall grading shown on the approved grading plan, in accordance with Section A.9.1.4 - Pre Grading Plan. Grading certification shall include water service inspection and rear yard catch basin inspection. Video inspection of rear yard catch basin lead shall take place after houses on both adjacent lots are constructed. Following acceptance of the certification, the City inspector provides new homeowners with an information package including the Lot Grading and Drainage Brochure;
- Following certification of all lots, a security reduction request can be submitted for reduction of securities collected under 'First Stage' amounts with the initial application approval process, in accordance with Section A.13.3 - Disconnection of Services and A.14.6 - Lot Grading Securities for Subdivision Agreements;
- For Lots which cannot be certified due to poor grading or changes in house style, the Engineer will notify the City, Proponent, and Builder in writing. An Engineer, on behalf of the Proponent, will prepare a new over-all grading plan to address the lots which have not been built according to the original plan, and will submit a revised plan to the City with the required review fees;
- An Engineer will re-inspect any deficient lots or for those lots which cannot be certified by a visual inspection and prepare a revised as-built grading plan, in order to obtain lot certification. If necessary, the builder will be instructed to address any deficiencies in order to have the particular lots certified. If the builder will not correct the work as instructed by the Engineer, this responsibility will fall directly upon the Proponent;
- The 'Stage 2' security (A.14.6 - Lot Grading Securities for Subdivision Agreements) deposit will be retained by the City to ensure completion of final lot grading and sodding and will only be released upon the City's acceptance of a final lot grading certificate, including an as-built plot plan, water service verification and video camera inspection, in accordance with the approved grading and plot plans; and,
- All remaining grading securities are released in accordance with the conditions of the Development Agreement.

A.12.2. Erosion and Sediment Control Inspection

All on site Erosion and Sediment Control Facilities are to be inspected by the Consultant on a regular basis. Refer to Section G.7.1 - On-Site Reporting Requirements.

A.12.3. Disconnection of Services

For rehabilitation of sewer services see Appendix C – Disconnection of Services Information Sheet.

Should the owner of a building decide to disconnect the services due to removal, the owner shall obtain a video inspection of the main sewer.

A.12.4. Video Camera Inspection

The Proponent is responsible to provide a video inspection of the sanitary sewers. The City shall be provided with 48 hours' notice as to when the video inspection is being carried out so that they may witness the video inspection.

The video inspection shall be carried out in accordance with City of Hamilton Construction and Materials Specifications – Form 500 Specification for Sewer Pipe Materials and CCTV Inspection. A copy of the initial video inspection and deficiency list, if any, shall be made available to the Consulting Engineer and the City when the testing company has completed the video inspection. The Consulting Engineer shall take the necessary steps to have any deficiencies rectified.

Prior to the expiration of the Maintenance Period, the Proponent shall initiate a second video inspection of the sanitary and storm sewers. All rear lot catch basin leads shall be video inspected at the time of grading certification.

A.13. INSPECTION

A.13.1. General

The Proponent's Consulting Engineer has full responsibility for the actions of the Contractor and the quality of the work. The Proponent's Engineer is responsible for providing full time inspection services during the construction of all municipal services in the project.

City staff shall only provide a part-time monitoring of the construction activities to ensure general conformance to the Subdivision Agreement and the City's policies and standards.

Employees, contractors or agents of the City may, at any time and from time to time prior to assumption of the Works by the City, enter upon the Land without notice to the Owner to:

- Inspect any of the Works. Such inspection by the City shall in no way relieve or replace the City's requirement for the Owner's Engineering Consultant to provide full time inspection of the Works under this Agreement;
- Conduct any tests that in the opinion of the Senior Director of Growth Management Division are necessary to confirm or verify quality of materials and construction; and,
- Make emergency repairs in the event the Works do not function or do not function properly, or in the opinion of the Senior Director of Growth Management Division, require necessary immediate repairs to prevent damage or hardship to any persons or to any property. Such undertaking of repairs by the City shall in no way be deemed as acceptance or assumption of the Works by the City.

A.13.2. Definitions

Underground works includes:

- Sanitary sewers and associated appurtenances;
- Watermains and associated appurtenances (valves, hydrants, water boxes);
- Storm sewer and associated appurtenances;
- Infiltration systems;
- Base asphalt; and,
- Curb and Gutter.

Aboveground works includes:

- Surface asphalt;
- Driveway ramps;
- Islands and roundabouts including sodding;
- Boulevards including sodding;
- Sidewalks;
- Fences;
- Entrance features;
- Street lighting;
- Storm water management facilities;
- Utilities;
- Grading;
- Retaining walls;
- Walkway blocks; and,
- Noise barriers.

A.13.3. Initial Inspection of Municipal Servicing

The initial visual inspection of the sewers shall consist of inspecting of all maintenance holes and catch basins to assure the structures are complete (i.e. ladder rungs, correct frame and cover, temporary bulkheads removed, silt controls in catch basins), and free of debris.

The initial visual inspection of the watermains shall consist of the inspection and operation of all main valves, hydrants and secondary valves. All valves and hydrants shall be left in the “open” position, unless noted otherwise. Valves 400 mm and larger shall be operated by Public Works – Hamilton Water.

The City will provide one field inspection to confirm correction of deficiencies, however subsequent inspections may be invoiced to the Proponent on an hourly basis.

A.13.4. Acceptance of Works – Start of Maintenance

The "Start of Maintenance" date shall be established by the City and the services placed on the maintenance period providing the following conditions have been satisfied:

- The plan of subdivision has been registered;
- The construction of services has been certified as substantially complete;
- Geotechnical reports confirming acceptable compaction testing and materials;
- The Engineer has submitted as-constructed information in a form satisfactory to the Growth Management Division; and,
- The required inspections reveal that there are no major deficiencies in the sewer and watermain systems constructed under the Subdivision Agreement.

Maintenance periods will be established for the following phases of construction:

- Completion of all underground services; and,
- Completion of above ground works (after placement of the surface course asphalt).

The Proponent shall maintain all underground services for a period of not less than two years from the date of "Acceptance of Works" as issued by the City. Should the Proponent be required to repair or replace a portion of the underground works, the City, at its sole discretion may require that the full two year period will commence from the date of the accepted repair or replacement.

The Proponent shall maintain all above ground works for a period of not less than one year from the date of "Acceptance of Works" as issued by the City. The one year maintenance period shall not commence until the placement of the surface course asphalt.

A.13.5. Obligations during Maintenance Period

The Proponent shall make good in a permanent manner satisfactory to the City, any and all damage to the work during the maintenance period. Any deficiencies or defects noted during the maintenance period are the responsibility of the Proponent and all complaints and concerns will be deferred to the Consultant for resolution.

Should the Proponent fail to carry out these repairs within the required time frame of being notified in writing, the City may have the required repairs carried out and the Proponent shall be invoiced for the works.

Obligations are outlined in the Subdivision Agreement.

A.13.6. Assumption of Works

Prior to assumption of the underground works by the City, a final visual inspection and CCTV inspection shall be conducted. In addition, a mandrel test shall be performed by the Contractor on all PVC sewers (sanitary and storm) in accordance with OPSS 410.07.15.05.

The final visual inspection of the watermain works shall consist of inspecting and operating all main valves, hydrants and secondary valves. Valves 400 mm and larger shall be operated by the City Waterworks Section. In addition the Proponent is required to conduct a connectivity test for PVC watermains.

The final visual inspection of the sewers shall consist of inspecting all maintenance hole and catch basins and their adjustments.

Prior to the "end of the maintenance" period for the **above ground works**, the Engineer shall request a final visual inspection with the City. When all deficiencies have been corrected to the satisfaction of the City, the assumption date will be established.

The assumption of the above ground works shall also include any Stormwater management facilities servicing the development. Assumption of the Stormwater management facilities shall not occur before 95% build-out of the catchment area. The request for assumption of the Stormwater management pond shall be accompanied by:

- Topographic survey of the pond after clean-out and certification of volumes by a professional Engineer;
- Certification of planting materials by a landscape architect;
- Copy of Operation and Maintenance Manual and inspection reports;
- Other requirements of the ECA;
- Copy of MOE-CC ECA Approval Letter; and,
- The visual inspections shall be conducted by the Contractor, accompanied by the Engineer and the City.

A.14. FEES AND SECURITIES

The security deposit(s) required by the Subdivision Agreement shall be issued by a financial institution in the form of an irrevocable letter of credit, cash or such other equivalent security satisfactory to the City Solicitor.

The Proponent may apply for a reduction in securities held by the City (ref. Appendix D – Security Reduction Requests), once the works have been constructed. Each request for security reduction will be accompanied by a Certificate from the Engineer, outlining the value of the completed works as well as the value of incomplete works. The value of the incomplete works shall be estimated on the basis of the signed Contract of Works for the project.

Any interim requests for reduction in securities shall be accompanied by a proof of payment to the Contractor based on the latest payment Certificate issued by the Engineer to certify the value of incomplete works. A security reduction processing fee will be applied after the third security reduction.

After satisfactory completion of **all on-site works** and receipt of **all required certifications,** the total amount of the security held by the City shall be released, **except for landscaping which shall be held until June following the end of the first growing season.**

a. Reductions of security held under Site Plan Agreements are permitted to an amount equal to the total value of the works outstanding, but not less than 10% of the total value of the works required under the Agreement;

b. Security reductions / releases are dealt with on a request basis;

c. A Two Hundred and Eighty Dollar ($344.65) administration fee (2017 fee schedule) is required for each security ***reduction*** request;

   Note: The administration fee is not charged for a one-time full release of securities. Refer to the current fee schedule.

d. Reduction / release requests are reviewed and processed by the Growth Management Division upon the production by the Applicant, at the Applicant's sole expense, of an Engineer's Certificate, as per Appendix "XX", which indicates:

   i. a description of what works have been completed;
   ii. a detailed list of incomplete work and associated estimate of the cost to complete the work.

Note:

- Reductions of security held under Site Plan Agreements are permitted to an amount equal to the total value of the works outstanding, plus 10% of the total value of the works required under the Agreement.

- The engineer and/or landscape architect shall certify all works completed (see Appendix P – Site Works Certification Form for Landscape Works).

- The items listed in Appendix Q – Site Works Certification Form for Engineering are meant to serve as a starting point and in no way represent a standard for any particular site plan. The professional engineer and/or landscape architect must complete these forms in the manner that best reflects the application.

A.14.1. Cost Estimate

The Engineer shall prepare a cost schedule for inclusion in the City's Subdivision Agreement (Schedule of Works - Estimate of Costs and Description of Works to be carried out by the Owner). This cost schedule shall identify all the works required to service a Proponent's proposed plan, the estimated cost of the works and the City's share of that cost in accordance with the City's approved Financial Policies.

A.14.2. Engineering Fees

All fees associated with design review, Agreement preparation, construction supervisions, and security reductions are outlined in the Planning & Economic Development Department, Growth Management – User Fees and Charges. Design review fee applies to each and all phases of the draft plan of subdivision.

A.14.3. Parkland Dedication - Cash in Lieu

Parkland Dedication and cash-in-lieu thereof, is governed by By-law 09-124.. For commercial land uses the parkland dedication requirement is 2% of the Net land area. For low density residential uses at less than 20 units/ha and other uses such as institutional, the parkland dedication requirement is 5% of the Net land area. For residential uses at densities above 20 units/ha, the parkland dedication is calculated based on a density formula; 1 ha/300 units for densities between 20 and 75 units/ha, 0.6 ha/300 units for densities between 75 and 120 units/ha, and 0.5 ha/300 units for densities above 120 units/ha (except in Hamilton's downtown core where 5% of Net land area applies). Industrial uses are exempt from parkland dedication.

Where no parkland has been dedicated previously or cash-in-lieu of parkland dedication paid for the property on which a development is proposed, and the site is improved with one or more buildings that are proposed to be demolished or have been recently demolished, the parkland dedication/cash-in-lieu for the proposed development may qualify to be partially offset based on the building floor area or number of residential units demolished. See section 3(2) of the By-law for details.

For additional information, refer to By-law 09-124.

A.14.4. Insurance

Before construction may commence, a Proponent is required to enter into a standard form, Subdivision Agreement with the City as well as meet required financial and insurance obligations specified in the Agreement.

A.14.5. Security Requirements

A Proponent is required to enter into a, Subdivision Agreement which specifies the security requirements for the works. Security requirements will be based on estimates from A.14.1 Cost Estimate and are currently defined as:

- 100% - Erosion Sediment Control;
- 50% - Grading;
- 75% - Estimated Construction and Engineering Costs; and,
- 100% of external works (External Works and Consent Agreements).

Additionally, special features such as retaining walls or landscaping may be secured exclusively and have unique criteria governing the reduction of securities.

In no case shall the amount of the security be reduced to less than:

- The cost of the uncompleted Works or deficiencies as estimated by the Engineering Consultant, plus ten percent (10%) of the estimated cost of Works;
- Outstanding as constructed drawings valued at $5,000 per sheet initially and reduced to $1,000 per sheet upon submission of preliminary as-built information;
- Value of the OLS certificate; and,
- In no case will the value be less than $10,000, until final release of securities.

A.14.6. Lot Grading Securities for Subdivision Agreements

Security for lot grading under Subdivision Agreements and Consent Agreements will be administered according to the following procedure.

First Stage

The developer will be held responsible for final grading as per section 1.26 of the subdivision agreement. Securities held under the subdivision agreement will not be reduced to less than $5,000 per uncertified lot or $10,000.

Second Stage Fees: Security Collected under Building Permit Application

A cash security deposit of $1,500 will be collected as a condition of building permit application from the owner of each lot within a development. The security deposit will be

retained by the City to ensure completion of final lot grading and sodding. The security will only be released upon the City's acceptance of a final lot grading certificate, including an as-built plot plan.

A.14.7. Lot Grading Securities for Severance Applications

First Stage Fees: Security Collected under Initial Application Approval Process

A lump security deposit of $10,000 will be collected from the Proponent under the appropriate development Agreement (i.e. Consent Agreement).

The security deposit will be retained by the City to ensure completion of final lot grading and sodding and will only be released upon both the City's acceptance of a final lot grading certificate.

Second Stage Fees: Security Collected under Building Permit Application

A cash security deposit of $1,500 per lot will be collected from the owner of each lot within a development as a condition of building permit application. The security deposit will be retained by the City to ensure completion of final lot grading and sodding and will only be released upon the City's acceptance of a final lot grading certificate.

A.15. EASEMENTS

As a general principle, the City discourages installation of municipal works on private property through easements. In the instance where a municipal sewer or watermain must be located on private property, the Consulting Engineer shall obtain approval from the City during the preliminary Engineering stage of development. The sewer or watermain shall be located within an easement in favour of the City free of any legal encumbrances and the Proponent shall carry out all steps necessary to transfer the easement to the City. The intention is to maintain reasonable access to maintain and repair infrastructure.

Minimum easement width requirements are:

- 9 m for one sewer (sewer centered on the easement);
- 12 m for dual sewer installation;
- 6 m for a watermain (watermain centered on the easement);
- 10 m for one sewer with a watermain (3 m easement limit to watermain, 2.5 m clearance between watermain and sewer and 4.5 m sewer to easement);
- 12 m for dual sewer installation with a watermain; and,
- Minimum of 4.5 m for significant swales (see Section G - Stormwater Management).

The above easement widths are minimum requirements and may be increased depending on the depth and size of the pipes within the easement and/or soil conditions, topography or operational needs.

In general, the City shall not require easements for private catch basin connections or private sewers and watermains.

B. SITE PLANS

B.1. GENERAL

Site Plan Approval is a required process that must be followed for most Industrial, Commercial and Institutional (ICI) and multi-residential developments including major building renovations or additions. It is the development review process, authorized under Section 41 of the Planning Act, and involves the city's review and approval of detailed plans for site development that address issues such as landscaping, grading, servicing, building elevations, and location of access driveways and parking lots. For major developments, this process often includes an Agreement between the city and the landowners that requires the landowner to provide land (i.e. road widening, daylighting tringles) or services to the city. The first step in site plan approval is the submission of a complete application after consultation with the Planning Division. An optional formal consultation will help determine the scope of the application and what materials need to be submitted for review (i.e. site plan, elevations, grading plan, studies, reports, etc.) when moving forward with the site plan.

Applicants shall refer to the City's Site Plan Guidelines.

B.2. FORMAL CONSULTATION

All Site Plan applications, except for those within the Design Priority areas will be automatically exempt from the Formal Consultation requirement, unless in the opinion of the Manager, Development Planning, Heritage and Design, Formal Consultation is warranted. A Formal Consultation exemption letter will not be required.

B.2.1. Design Review Panel – Urban Design Brief

The Design Review Panel (DRP) is a voluntary technical panel established to provide expert and impartial design advice to Planning Division staff on urban design matters. The panel is strictly an advisory body and makes recommendations, it does not have the authority to approve or refuse projects or make policy decisions, or recommendations on land use. DRP applies to complex Zoning By-law Amendment (rezoning) and Major Site Plan applications, civic projects, new policy initiatives, and studies with urban design components in the following Design Priority Areas: The Downtown Hamilton Secondary Plan Area, Areas of Major Change and Corridors of Gradual Change within the Setting Sail Secondary Plan Area, and Primary Corridors as identified in the Urban Hamilton Official Plan. Additionally the Director of Planning and Chief Planner may refer any transformational project that requires fundamental changes to the land use and has the potential to significantly impact the physical environment functionally and aesthetically. Outside of these options, anyone can opt into the DRP if they wish.

DRP review is requested at the Formal Consultation Stage. For rezoning applications, this review occurs after a complete application is made. For site plan applications, this review must occur before the Development Review Team meeting to ensure concerns are identified as early in the process as possible. Please refer to the DRP section on the

City of Hamilton website at https://www.hamilton.ca/develop-property/policies-guidelines/design-review-panel for information regarding the submission requirements, timing, contacts, etc.

B.3. SITE PLAN APPROVAL PROCESS

Applicants shall refer to the City's Site Plan Guidelines – Appendix 5 Site Plan Control Process Flow Chart. Site Plan Approval submissions shall be prepared in accordance to Submission Requirements and Application Form for Site Plan Control.

Further to the existing City of Hamilton Site Plan control documents, applicants must adhere to the following requirements:

- Conform to regulation under the current Condominium Act, where relevant;
- Schedule a pre-consultation meeting with City Staff;
- Disclose and rationalize all non-compliant Engineering and/or design elements. Proposed non-compliant Engineering and/or design solutions shall be stamped/signed by a professional consultant; and,
- Follow the City of Hamilton's current submission requirements and submit complete applications, which include all required Engineering reports and drawings.

B.4. CONDITIONS REQUIRED FOR ISSUANCE OF SITE PLAN APPROVAL

Conditions for Site Plan Approval will be issued as part of the Conditional Site Plan approval process. Refer to Submission Requirements and Application Form for Site Plan Control.

B.5. SECTION 41 DEVELOPMENT AGREEMENT / SITE PLAN APPROVAL

Site plan approval is a development review process authorized under Section 41 of The Planning Act, R.S.O., 1990 c.P. 13 and implemented by municipal Bylaw 15-176. Conditional approval will be granted by the Manager of Development Planning, Heritage and Design by the Planning division after a full review and evaluation of the proposal.

Refer to Submission Requirements and Application Form for Site Plan Control.

B.6. BUILDING PERMITS

Building permits will be issued after Site Plan Approval has been granted and may require the posting of securities. As part of the Concurrent Review Process, there is a waiver that must be signed, see Appendix N – Acknowledgement for Concurrent Building Permit Review Process. Refer to Submission Requirements and Application Form for Site Plan Control.

B.7. HERITAGE IMPACT ASSESSMENTS AND CONSERVATION PLANS

A Cultural Heritage Impact Assessment (CHIA) is a report that documents a clear and documented evaluation of the effects of a proposed new development or redevelopment on cultural heritage resources and/or their setting. The need for a Heritage Impact

Assessment will be determined in consultation with the Cultural Heritage Planner and should be prepared to the satisfaction of the Development Planning, Heritage and Design Division.

Reference should be made to the Official Plan, the City of Hamilton Info-sheet: Cultural Heritage Impact Assessments, March 2014, which is available from the Cultural Heritage Planner in the Development Planning Section of the Planning Division.

Section 2.4 Heritage Resources of the Site Plan Guidelines provides further discussion.

B.8. ENGINEERING REQUIREMENTS FOR SITE PLAN APPROVAL

B.8.1. Report Formats / Submission Requirements

Submission requirements will vary between sites and projects depending on the scale and context of the proposal. The requirements are outlined on the site plan control application and will be determined in consultation with the Development Planning, Heritage and Design Division. Complete submissions shall be accompanied by a covering letter prepared by a qualified professional indicating where deviations from City Standards or policies have occurred, the cause for the deviation and the efforts made to uphold the intent of the policy.

B.8.2. Purpose

These guidelines will assist designers, Proponents and builders as well as the public agencies which are involved in the site plan application review process. The guidelines will provide clarity for the development process, and ensure that all developments are mutually supportive of Hamilton's desire to create an attractive, liveable and functional community.

B.8.3. Engineer's Qualifications

Drawings and reports shall be prepared by a qualified professional in accordance to Submission Requirements and Application Form for Site Plan Control.

B.8.4. Coordination of Drawings

It is imperative that the consulting Engineer is responsible for co-ordinating all related drawings, details and specifications through the prime consultant to ensure they are compatible with the approved site plan, architectural plans, and landscaping plans, etc. Drawings that are not compatible with the other disciplines may result in undue delays in clearing the conditions of the Site Plan Approval.

B.8.5. Submission Requirements

Submission requirements will vary between sites and projects. Additional requirements may be determined by the Formal Consultation. Unconventional requirements should be discussed with Formal Consultation staff prior to submission.

B.8.6. Site Servicing Plan

Site servicing design drawings shall be prepared in accordance with Sewer & Water Permit Process.

B.8.7. Grading and Drainage Control

Site grading must consider relationships with adjacent properties. Changes to site grades must not adversely impact adjacent properties, especially with respect to drainage.

- Site grading should match the grades of adjacent properties. If grading on adjacent properties is required, consent of that owner is required.
- Site grading and drainage should produce zero negative impacts on adjacent properties, roads and ditches. Site grading must prevent uncontrolled Stormwater from draining onto adjacent properties. In addition all site grading and drainage shall conform to the Drainage Act and any associated regulations.

B.8.8. Environmental Impact Statement (EIS)

The requirement for the submission of an EIS shall be determined at the Formal Consultation meeting. The study shall be prepared in consultation with the Environmentally Significant Areas Impact Evaluation Group (ESAIEG) and to the satisfaction of the City and appropriate conservation authorities.

B.8.9. Stormwater Management (SWM)

Uncontrolled Stormwater runoff may result in flooding, soil erosion and pollution of watercourses. Stormwater management is practiced throughout Hamilton to control runoff using on-site techniques, off-site Stormwater management facilities or a combination of practices. The type of Stormwater management approach required will vary throughout the City depending upon the project location, size of the site and project type, as well as the need to control Stormwater quantity, velocity or quality of runoff.

Stormwater management shall be designed in accordance with Section G - Stormwater Management.

General Standards

- Drainage must remain internal to the site unless otherwise approved.
- Every parking area, where storm sewers are available, shall be drained in accordance with Section 9 of By-Law No. 06-026.
- Townhouses, commercial and industrial buildings cannot connect roof leaders to the storm sewers unless the applicant provides a site design, including an appropriate Stormwater management study prepared by a qualified Engineer (City of Hamilton Site Plan Control, Draft Grading Plan Requirements).

B.8.10. Environmental Site Assessment (ESA)

The requirement for the submission of an ESA shall be determined at the Pre-Submission Consultation meeting. The study shall be prepared in consultation with the Environmentally Significant Areas Impact Evaluation Group (ESAIEG) and to the satisfaction of the City and appropriate conservation authorities.

B.8.11. Geotechnical Investigation

The requirement for the submission of a Geotechnical Investigation shall be determined at the optional Pre-Submission Consultation meeting or the Formal Consultation meeting.

Where pipes within private property are to be conveyed to the City and constructed within an easement, a geotechnical investigation shall be required to make recommendations on pipe bedding and backfill.

B.8.12. Fire Flow Analysis

The requirement for a hydrant flow test will be identified at the Formal Consultation. Fire Flow calculations for the development shall be prepared in accordance with the Fire Underwriters Survey, 1999 to the satisfaction of the City.

Additionally, a fire flow test is required at all new private fire hydrants.

B.8.13. Water and Wastewater Generation Assessment

A report must be prepared in accordance with Ontario Building Code, Chapter 8.

Wastewater Generation Calculation is to include calculations for any existing uses; plus calculations for any future uses, all based on the Ontario Building Code (OBC), Part 8 Guide for Sewage Systems.

C. ROADS

C.1. GENERAL

For development purposes, when designing, roads consideration must be given to the City of Hamilton Urban Official Plan and Transportation Master Plan. The following road classifications shall apply:

Arterial Road Describes a road, which functions as a strategic link in the overall road network of the City. Arterial roads carry relatively large volumes of short and long distance traffic in and through the City and provide some access to abutting properties.

Collector Road Describes a road whose function is to provide a connecting road link between arterial and local roads. Collector roads generally carry lower traffic volumes then arterial roads and may provide direct access to abutting properties.

Local Road Provides direct access to abutting properties and carries traffic predominantly of a local nature.

Classification of roads as major or minor collectors and local residential roads shall be identified in the City's Official Plan or the Secondary Plan for each planning neighbourhood. Where no Secondary Plan has been prepared, the General Manager of Planning and Economic Development shall determine the classification of the roadways, based on the function of the proposed roadway within the neighbourhood as described above.

All residential roads within the urban boundary of the City of Hamilton shall be designed and constructed to urban standards with full municipal services: i.e. concrete curbs with subdrains, asphalt on granular pavement, concrete sidewalks, catch basins, storm sewers and street lighting. Residential roads within Urban Settlement Areas may not have full municipal services and therefore would not be required to be fully urbanized.

Emergency Accesses are not considered to be suitable secondary accesses.

C.2. GEOMETRIC STANDARDS

The geometric design of municipal roads in the City of Hamilton shall conform generally with the standards set out in the latest edition of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads.

Arterial roads except for those roads under provincial jurisdiction are the responsibility of the City of Hamilton, and all geometric design elements should correspond to the TAC Geometric Design Guide for Canadian Roads. The City's Development Engineering Section should be contacted to verify design criteria for arterial roads.

Horizontal and vertical alignment shall conform to the minimum geometric standards outlined below; however, the design shall be checked for conformity with the TAC Geometric Design Guide for Canadian Roads.

Vertical curves are required for changes in grade greater than 2.0% for local roads and minor collector roads and 1.0% for major collector roads (except at the crown of the road through intersections and at the point where the crossfall of the through road meets with the grade of the intersecting stop street). The minimum length of each grade shall be 6 m. Cul-de-sacs shall be designed such that there is a minimum 0.75%* gutter grade around the longest curb.

*If it is not achievable please outline the rationale in your original submission.

For intersection grading, the 2% pavement cross-fall on the through roadway shall be maintained through the intersection. The crown and cross-fall on the intersecting roadway shall match the projected gutter line pavement elevation of the through roadway. For intersections where both roads are either arterial or collector roads, a minimum crossfall and crown shall be maintained on all approaches.
The minimum curb return radii at intersections shall be 9 m. Larger radii may be required to accommodate transit and truck traffic at selected intersections. (I.e. major collector, truck route)

The Consulting Engineer shall design road grades taking into consideration the existing (and/or proposed) grades of adjoining properties, lot grading patterns, existing and/or proposed sewer profiles, major overland flow routes and elevations of intersecting streets, etc.

As a requirement of final clearance, the Consulting Engineer may be required to incorporate traffic-calming (Section C.4 - Traffic Calming / Closures) methods in the design of the roadways. These shall be discussed on an individual basis with the City Planning and Economic Development Department and shall be discussed in Traffic Impact Studies or Formal Consultation.

Collector and Arterial Roads will be designed in accordance with any applicable Environmental Assessment and in consultation with the City.

Detail of curb line radii and driveway access locations should be indicated on plans.

The following Table C.1 outlines the Geometric Road Design criteria for various urban and residential road classifications. It should be noted that the minimum right of way will be 20 m and be designed in accordance with PED100.01

Table C.1- Geometric Road Design Table

Geometric Detail	Local Road Urban Residential	Minor Collector Urban Residential	Major Collector Urban Residential
Min. ROW (m)	20	20	26

Geometric Detail	Local Road Urban Residential	Minor Collector Urban Residential	Major Collector Urban Residential
Design Speed (km/hr)	50	50	60
Posted Speed (km/hr)	50	50	60
Min. Visibility Curves in Sag (K)	12	12	15
Min. Visibility Curves on Crests (K)	8	8	12
Min. Horizontal centreline Road Radius (m) **	90	95	160
** Except at 90° corners at crescents and courts, unless otherwise required for traffic calming.			
Min. curb radius at intersection (m)	9	9	12
Pavement asphalt Width (m) Residential	8.0	8.0	11.0
Sub-grade cross-fall	3%	3%	3%
Pavement cross-fall	2%	2%	2%
Min. Grade (%)	0.75%	0.75%	0.75%
Max. Grade (%)	6.0%	6.0%	5.0%
Max. Grade for Through Roads at Intersections (%)	3.5%	3.5%	3.0%
Max. Grade at Stop Roads at Intersections (%)	2.5%	2.5%	2.0%
Intersection Angle (degrees)	80 to 90	85 to 90	85 to 90
Min. Tangent Length approaching intersections **	20 m	20 m	30 m
** From curb line of intersecting street, unless otherwise required for traffic calming.			
Cul-de-sacs Pavement	18.0 m Radius (with sidewalk required around bulb) 13.0 m Radius		

Geometric Detail	Local Road Rural Residential Crescents and Cul-de-sacs	Minor Collector Rural Residential Straight-through Roads	Major Collector Rural Residential
Min. ROW (m)	20	20	26

Geometric Detail	Local Road Rural Residential Crescents and Cul-de-sacs	Minor Collector Rural Residential Straight-through Roads	Major Collector Rural Residential
Design Speed (km/hr)	50	60 to 80	80 to 100
Posted Speed (km/hr)	50	50 to 70	60 to 80
Min. Visibility Curves in Sag (K)	12	18	25
Min. Visibility Curves on Crests (K)	130	175	250
Min. Horizontal centreline Road Radius (m) **	100	150	2000
** Except at 90° corners at crescents and courts, unless otherwise required for traffic calming.			
Minimum edge of pavement radius at intersection (m)	9	12	15
Pavement asphalt Width (m) **	6.7 plus shoulders	6.7 plus shoulders	9.0 plus shoulders
** Rural roads to be designed with roadside ditches for drainage. No curb and gutter required.			
Sub-grade cross-fall	3%	3%	3%
Pavement cross-fall	2%	2%	2%
Min. Grade (%)	1.0%	1.0%	1.0%
Max. Grade (%)	6.0%	6.0%	5.0%
Max. Grade for Through Roads at Intersections (%)	3.5%	3.0%	3.0%
Max. Grade at Stop Roads at Intersections (%)	2.5%	2.0%	2.0%
Intersection Angle (degrees)	80 to 90	80 to 90	85 to 90
Min. Tangent Length approaching intersections	20	20	30
Cul-de-sacs ROW Pavement	 18.0 m Radius 13.0 m Radius		

Geometric Detail	Local Road Industrial/Commercial Crescents and Cul-de-sacs	Minor Collector Industrial/Commercial	Major Collector Industrial/Commercial
Min. ROW (m)	26	26	26
Design Speed (km/hr)	60	60	60
Posted Speed (km/hr)	50	50	60
Min. Visibility Curves in Sag (K)	12	15	15
Min. Visibility Curves on Crests (K)	8	12	12
Min. Horizontal centreline Road Radius (m) **	110	160	160
** Except at 90° corners at crescents and courts, unless otherwise required for traffic calming.			
Pavement asphalt Width (m) Industrial	9.25	11.0	14.0
Sub-grade cross-fall	3%	3%	3%
Pavement cross-fall	2%	2%	2%
Min. Grade (%)	0.75%	0.75%	0.75%
Max. Grade (%)	6.0%	6.0%	5.0%
Max. Grade for Through Roads at Intersections (%)	3.5%	3.5%	3.0%
Max. Grade at Stop Roads at Intersections (%)	2.0%	2.0%	1.5%
Intersection Angle (degrees)	80 to 90	80 to 90	85 to 90
Cul-de-sacs ROW Pavement	 20.75 m Radius 15.0 m Radius		

C.3. ROAD PAVEMENT DESIGN

The following table summarizes the minimum requirements for pavement structure for different road classifications:

	Top Course Asphalt	Binder Course Asphalt or Concrete Base	Granular "A" (mm)	Granular "B" (Type II) (mm)
RESIDENTIAL ROADS (RURAL AND URBAN)				
Local	40mm Superpave 9.5, (Traffic Category C), PG 58-28 asphalt cement	80mm Superpave 19.0, (Traffic Category C), PG 58-28 asphalt cement	150	300
Collector	40mm Superpave 9.5, (Traffic Category C), PG 58-28 asphalt cement	100mm Superpave 19.0, (Traffic Category C), PG 58-28 asphalt cement in two lifts	150	300
COMMERCIAL/INDUSTRIAL ROADS				
Local	50mm Superpave 12.5 FC1, (Traffic Category D), PG 58H-28 asphalt cement	110mm Superpave 19.0, (Traffic Category D), PG 58H-28 asphalt cement, in two lifts	150	375
Collector	50mm Superpave 12.5 FC1 or FC2, (Traffic Category D), PG 58H or V-28 cement	110mm Superpave 19.0, (Traffic Category D), PG 58H-28 asphalt cement, in two lifts	150	450
ARTERIAL ROADS				
Arterial	50mm Superpave 12.5 FC1 or FC2, (Traffic Category D or E), PG 58H or V-28 asphalt cement	110mm Superpave 19.0, (Traffic Category D or E), PG 58H or V-28asphalt cement, in two lifts	150	450

The final asphalt course on any roadway shall not be placed until:

- Written approval from the Development Engineering Section is received;

- A minimum of one year has passed after the placement of the binder course asphalt;
- At least 80% of the dwellings in the land are constructed;
- Deteriorated base asphalt and/or granular base and concrete curbs and gutters have been repaired and/or replaced to the satisfaction of the City; and,
- The base course shall be power swept and/or power flushed and free of mud and debris.

When the surface course is to be placed on a previously laid binder course a tack coat shall be applied immediately prior to placing the surface course asphalt.

Generally, surface course asphalt shall not be placed before the first day of May or later than the first day of November. Any deviation of this date shall require the prior approval of the Manager of Construction (Growth Management Division). Use of warm mix asphalt is strongly encouraged.

C.4. TRAFFIC CALMING / CLOSURES

C.4.1. Road and Lane Closures

Any anticipated road and lane closures required for underground or above ground works shall be identified by the Engineer at the initial submission of the Engineering drawings.

The Development Engineering Section shall confirm the feasibility of road and lane closures and any requirements that are necessary, including temporary works, the preparation of detour routes and sign boards, and notification. The approval of a road closure is subject to the approval of the General Manager, Public Works. The cost of implementing a road closure shall be borne by the Proponent.

C.4.2. Traffic Calming

The intent of traffic calming measures is to improve the well-being of the community, the environment, and the economy.

As a requirement of final clearance, the Engineer may be required to incorporate traffic calming methods in the design of the roadways. Traffic calming measures shall be discussed on an individual basis with the City Planning and Economic Development Department as early in the application process as possible and discussed in Traffic Impact Studies.

The subject roadway must be a local or minor collector roadway. All traffic calming measures proposed should be identified and recommended within the Traffic Impact Study for the project site. The Proponent should refer to the City of Hamilton Policy PW07150a for needs and justification and appropriate methods of Traffic Calming.

When traffic calming is to be implemented, the following general guidelines should be adopted:

- "Through traffic" should be deterred from local streets and routed to major collectors and/or arterial roads;
- Traffic calming features should be included where the roadway(s) are within in 200 m of a school or park (i.e. raised crosswalks, bump outs, speed humps);
- Emergency vehicle access must be preserved; and,
- Automobile access should be maintained on all streets. Neighbourhood traffic calming projects should encourage and enhance pedestrian, bicycle and transit access to neighbourhood destinations.

All traffic calming measures proposed shall be in compliance with the Transportation Association of Canada (TAC) Manual and will be subject to City approvals.

C.5. ROUNDABOUTS

A roundabout is a type of circular intersection at which traffic enters a one-way stream around a central island incorporating splitter islands at each leg of the intersection. The splitter islands guide traffic into and out of the roundabout and provide a refuge for pedestrians. Its primary functions are for traffic calming, allocation of right-of-way and increased traffic capacity. Generally, roundabouts are used to connect collectors and/or arterial roads; however, in some instances they can be used at the junction of a local road with a collector or arterial road.

The City of Hamilton's "Installation of Modern Roundabouts Policy, 2008" states that if new signals are being considered for an intersection, the potential for a roundabout must also be examined. Reference to this policy shall be made with regards to screening criteria.

Modern roundabouts will be installed wherever possible, where a study confirms they are feasible, appropriate and advantageous in terms of traffic flow, traffic safety, community design functions or environmental considerations, under the following conditions:

- Capacity or safety problems have been identified at existing intersections necessitating substantial improvements;
- Traffic signals or all-way stops are warranted or expected to be warranted in the near future at existing or proposed intersections;
- As part of a larger capital project, suitable intersections are identified as potential sites; and,
- When, through planning approvals, new intersections are to be created.

Additional design and procedure information can be found in NCHRP Report 672 - Roundabouts: An Informational Guide prepared by the National Cooperative Highway Research Program (NCHRP). All designs for proposed roundabouts shall be in compliance with the NCHRP Report 672. For typical layout of a roundabout intersecting collector roads refer to Figure C-1. All roundabouts shall include provision for an irrigation system including but not limited to the water service and electrical service. All roundabouts shall be landscaped. Colorado Spruce is the preferred option when

planting evergreen trees. Additionally all plant materials shall be salt tolerant. Clump plantings shall comprise of one species. Soil depth in planting shall be 300mm-500mm.

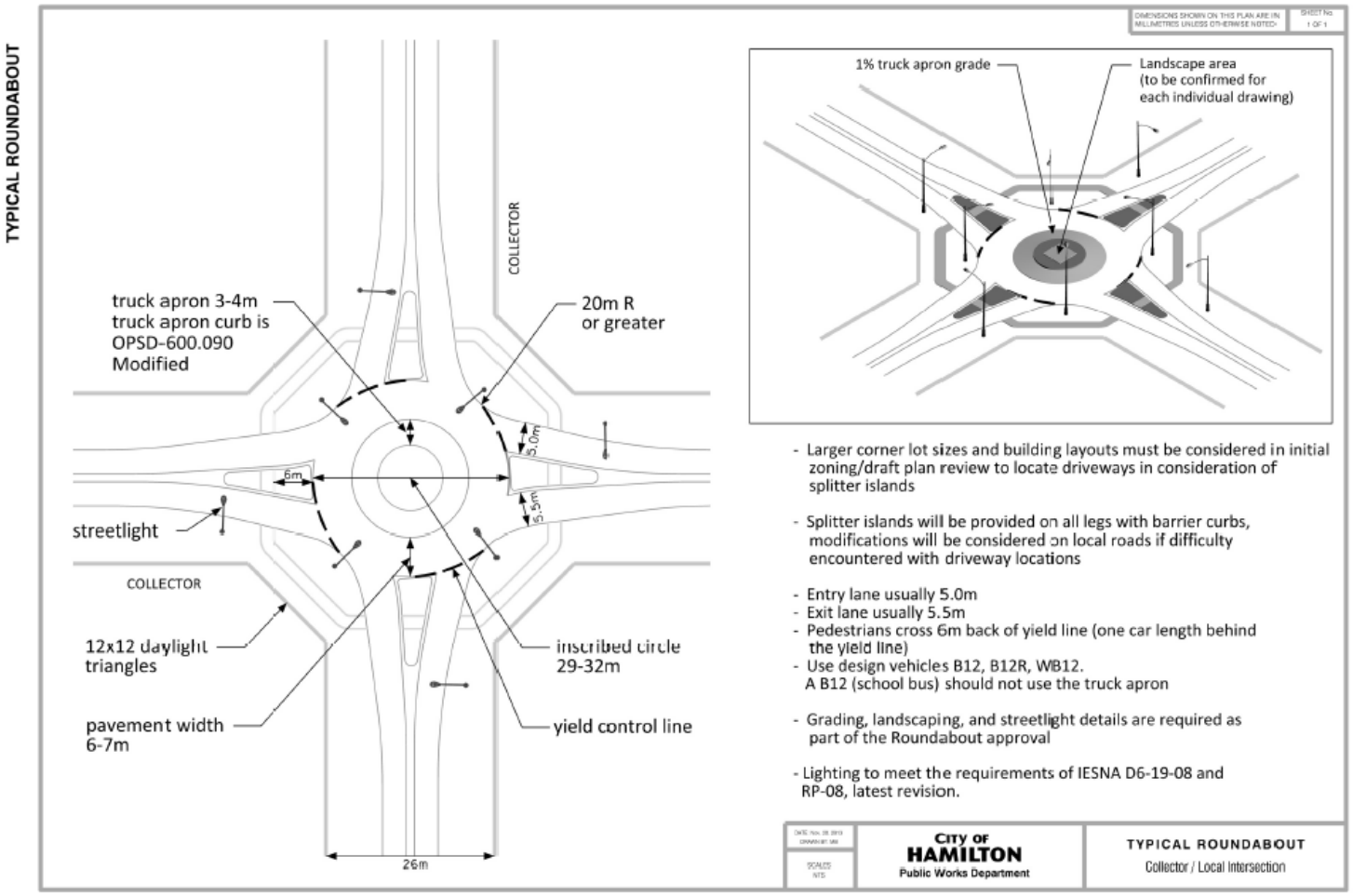

Figure C-1 Typical Roundabout RIGHT-OF-WAY CROSS SECTION

Right-of-way cross sections for municipally assumed roads shall conform to standard drawings from the Construction & Material Specifications Manual.

C.6. ROAD SUBDRAINS

Subdrains shall be installed continuously below the curb unless soil conditions warrant otherwise. Any request for reduced subdrain installation shall be accompanied with a geotechnical report outlining the soil conditions and what impact the reduction of subdrains shall have on the life of the pavement.

C.7. DAYLIGHT TRIANGLES AND ROAD WIDENING

The City has adopted through its Official Plan designated road allowance widths which accommodates space for vehicular, pedestrian, transit and cycling movements, and utilities. A road allowance widening is an acquisition of land adjacent to an existing road when added to its present road allowance establishes its designated road allowance

width as stated in the City's Official Plan. Land required for road allowances are typically a requirement of development approval as a condition of Site Plan, Consent, or Plan of Subdivision.

The Official Plan also requires the conveyance of property for appropriate daylight triangles and corner rounding on existing roads when a property is to be developed or redeveloped, as a condition of site plan approval, consent, or plan of subdivision approval. In accordance with City Standards based on the intersecting roadways of the functional road classification, daylight triangles at intersections shall generally be as follows:

- Local to local roads: 4.5 m x 4.5 m triangle;
- Collector to local or collector Roads: 9 m x 9 m triangle;
- Arterial to collector or arterial (Urban): 12 m x 12 m triangle; and,
- On various major road corridors 15 m x 15 m triangles are required.

C.8. CURBS

All roadways shall be constructed with barrier curb and gutter (OPSD 600.040 or OPSD 600.070) in accordance with current City Standards.

In the event that weather conditions do not permit concrete curb and gutter construction, a wider paved roadway will be permitted. The width of the roadway shall be extended a minimum of 0.5 m on each side. The cross section of the widened pavement shall conform to the cross section of the roadway. Curb and gutters shall be constructed within one year of the completion of the binder course asphalt. A minimum of 1.0 m of the paved roadway shall be removed upon installation of the curb and gutter (i.e. minimum 0.5 m asphalt repair adjacent to curb and gutter) and binder asphalt placed to the specified thickness.

Curb depressions are required at every driveway and at each intersection for wheelchair ramps. Curbs shall not be cut by mechanical means to provide a curb depression. Temporary curb cuts provided during construction of dwellings using mechanical means shall be removed prior to installation of final asphalt course and replaced with a proper driveway curb depression. Should any driveway depressions be improperly located, then repairs may be made by removing those sections and replacing them with required curb and gutter sections. The concrete capping of a depressed curb shall not be permitted.

Generally, concrete curbs and gutters shall not be placed after November 15th. Any deviation of this date shall require the prior approval of the Manager of Construction (Growth Management Division).

C.9. BOULEVARDS

All boulevards areas will be sodded with No. 1 nursery sod including a minimum thickness of 150 mm preferred of topsoil. The topsoil shall be screened clear of all stones in excess of 25 mm, debris and woody material and shall be free of noxious

weeds, etc. to the satisfaction of the City. The topsoil overlaid with sod will provide a total topsoil / turf thickness of approximately 175 mm and maintain a 2% cross-fall within the boulevard.
Sod shall comprise Fine Fescue / Kentucky Bluegrass nursery sod containing 60% - 70% Kentucky Bluegrass and 30% - 40% Creeping Red, Chewings or Hard Fescue as specified by the Nursery Sod Growers Association of Ontario (NSGAO). Sod shall be placed with sufficient density such that surface soil is not visible and shall be placed to match existing adjacent elevations at all edges. All sod shall be machine rolled after placement.

C.10. SIDEWALKS

Concrete sidewalks shall conform in composition and dimensions to the City of Hamilton Construction and Material Specifications Manual and the current Ontario Provincial Standards. The sidewalk width shall be in accordance with the City's Pedestrian Mobility Plan, Table 16 - Context Area Sensitive – Recommended Sidewalk Clear-Zone Widths, with maximum cross-fall of 2%. Refer City of Hamilton Standard Drawing RD-103. In no instance should sidewalk widths be less than 1.5 m.

Sidewalks are required on both sides of all roads in accordance with City Policy and Hamilton Pedestrian Mobility Plan.

Generally, concrete sidewalks shall not be placed after November 15th. Any deviation of this date shall require the prior approval of the Manager of Construction.

C.10.1. Sidewalk Transitions

On continuation of existing streets where sidewalks have already been installed at a different location, the City's Development Engineering Section shall be consulted to determine the off-set from the curb and transition between sidewalks. Proponent must comply with the most current wheel chair ramp and curb ramp requirements and include tactile warning surfaces

C.10.2. Private Sites

Sidewalk design for private sites shall incorporate the following design elements:

Barrier-Free Design and Urban Braille

- Sidewalks shall have a minimum 1.5 m unobstructed width to allow for people in wheelchairs to move easily and for snow accumulation in winter months;
- Pedestrian routes shall be level and have non-slip and non-glare textured surfaces. It is preferable to have grades on pedestrian routes between 1% and 3%;
- Pedestrian crossings shall be flush with the adjoining sidewalk and marked with bright white lines or made with contrasting materials and colours;
- Ramped curbs and ramped building entrances should be avoided and minimized through attention to grade changes in site design;

- Ramps shall be provided to Ontario Building Code requirements where grade changes cannot be avoided. A clear pathway shall be provided with handrails and a non-slip surface;
- Shall be constructed with 125 mm Concrete and 150 mm Granular 'A' base; and,
- Sidewalks shall be constructed as per City of Hamilton Standard Drawing RD-103 and shall comply with the City's Barrier Free Design Guidelines.

Site Circulation

A well-defined and continuous pedestrian system shall be developed on each site with connections to the public street, parking areas, surrounding buildings and pedestrian amenity areas. Primary pedestrian connection shall be distinguished from secondary pedestrian connections through such measures as differing sidewalk widths and paving materials.

Multiple Units

Sidewalks shall typically be included along both sides and at minimum one side of the internal road and lead to the municipal sidewalk.

Refer to City of Hamilton Site Plan Guidelines, 2003 for more information.

C.11. WALKWAYS

Public walkways shall be identified at the time of draft plan of subdivision and shall be conveyed to the City as a public highway. They shall be constructed within the limits of the project by the Proponent. The minimum width of a public walkway right-of-way shall be 6m.

Walkways typically shall consist of a 2.0 m wide concrete sidewalk centered in the walkway right of way. Remaining portions between the sidewalk and fence shall be sodded. If the walkway also acts as a major overland flow route and/or access to a SWM facility, requirements, including right-of-way width, shall be to the satisfaction of the City.

All public walkways shall have a 1.5 m high black vinyl coated heavy duty commercial grade (9 gauge metal) chain link fence placed 100 mm inside the City property line. Separating the walkway from private property, in accordance with OPSD 972.130 with a mesh size of 38 mm where it abuts single family dwellings.

Vehicle barriers shall be installed at each end of the public walkway as per City and Public Works Department Standards to discourage vehicular traffic through the walkway. The vehicle barrier would be a bollard. Generally, there are two bollards at each end of the walkway.

Walkway lighting, where required, shall be designed and installed in accordance with Appendix R – Sidewalk and Roadway Lighting Guideline.

C.12. MULTI-USE TRAILS

Development Guidelines and Maintenance Standards for multi-use trails are provided in the Hamilton Recreational Trails Master Plan with focus on 2.3 Trail Design Construction Considerations, 2.7 Trail Hierarchy and Surfacing, and 3.4 Managing Trails and Maintenance Expectations. These standards are intended to apply to City of Hamilton sponsored and co-sponsored "off-road" multi-use recreation trails. Where trails are operated by Hamilton trails systems partners, the standards which apply will be those developed and approved by that partner. The partners will be encouraged to utilize the City of Hamilton standards where appropriate to ensure integration of both systems.

The Proponent has the option to design, Engineer and construct all Multi-use trails, including finished surfacing, which have been identified in the approved Draft Plan of Subdivision.

Multi-use trails shall be graded and constructed for that stage of the subdivision by the Proponent within one year of registration or servicing whichever occurs first.

The Proponent shall ensure that all tree protection fencing and siltation control fencing is located in such a manner as will allow the grading, construction and surfacing of the Multi-use trails as an integral part of the subdivision grading process.

- All detailed grading and construction details for Multi-use trails shall be approved by the City;
- Multi-use trails are primarily a recreational facility but can be used as a non-vehicular traffic route providing city wide, off road transportation routes for walking and cycling;
- Multi-use trails shall be fully accessible and barrier free where possible;
- Multi-use trails connect parks and open space within subdivisions and provide connections to other neighbourhoods of the city;
- Multi-use trails also serve as maintenance vehicle access routes through parkland; and,
- These trails shall be located throughout the City, including Parks, Stormwater management lands or other lands which facilitate the development of the city wide community trail system. Trails shall be identified for all new development, as approved by the City.

The trails shall be designed in accordance with the following requirements:

Grade

- 5% maximum (8% may be allowed for limited distances of steep slopes); and,
- Primary accessible trail routes shall be 5% maximum.

Cross Slope

- 2% preferred;
- 2% maximum where trail grade exceeds 4%, and,
- 4% maximum.

Width

- Class A – trail width of 6.0 m;
- Class B – trail width of 3.0m to 4.0 m;
- Class C – trail width under 2.0 m; and,
- 1.0 m grassed shoulder shall be provided on either side of the trail.

Excavation

The existing topsoil layer shall be removed to the depth required to reach underlying granular or other soils which can be compacted to a minimum of 95% Standard Proctor Density. A minimum excavation depth of 300 mm is required to provide for granular base course material installation. Soil deemed unsuitable by the City shall be removed to additional depths as required and replaced with Engineered fill, compacted to 95% Standard Proctor Density. Excavation shall not be permitted in woodlands or other areas where damage to tree roots or other vegetation would occur in accordance with applicable approvals. Filling ~~only~~ with an approved trail surfacing detail may be acceptable in some unique scenarios and will be considered on a case by case basis.

Drainage

Concentrated surface runoff shall not be directed across or along the trail surface. Swales or culverts shall be provided within the trail corridor.

Surfacing

Trail surfaces have been classified in three categories as follows:

- Type 1 – asphalt concrete (Year-Round Use);
- Type 2 – granular/limestone on granular (Seasonal Use); and,
- Type 3 – native soil/woodchips (Seasonal Use).

Typical Pavement Designs (Design Guide for Bikeways, Page 14)

Table C.2- Multi-Use Trail Design Table

Type 1	Type 2
50 mm HL3 asphalt 150 mm Granular 'A' 150 to 300 mm Granular 'B' as required OR 100 mm Concrete 100 mm Granular 'A'	40 mm limestone screening 100 mm Granular 'A' 300 mm Granular 'B' as required OR 2 aggregate lifts on surface treatment binder 100 mm Granular 'A' 150 to 300 mm Granular 'B' as required

Signage

All Multi-use trails shall be provided with signage acceptable to the Public Works Department.

Barriers

Short staggered swing gates and standard park gates are required at all intersections with roadways or other vehicle routes to control traffic and promote user safety.

C.13. PRIVATE ROADS

When private roads are required which will not be dedicated to the City in the future, the following standards shall apply:

The following minimum standards apply to private road pavement structures:

Table C.3- Private Road Design Table

	Residential	Commercial
Asphalt	40 mm Surface Asphalt 50 mm Binder Asphalt 300mm Granular 'A' base	40 mm Surface Asphalt 100 mm Binder Asphalt 300 mm Granular 'A' base
Concrete	125 mm Concrete 150 mm Granular 'A' base	200 mm Concrete 150 mm Granular 'A' base

Geotechnical report recommendations will supersede the above minimum standards only in the event that recommendations are equivalent to or greater than the above minimum pavement structures.

Drainage shall be intercepted in advance of the public right-of-way.

Fire Access

The geometric design of private roads shall conform to standards set out in the Ontario Building Code. Specifically with respect to fire access, the following key parameters can be found in Section 3.2.5.6 “Access Route Design” of the Ontario Building Code:

A portion of a roadway or yard provided as a required access route for fire department use shall:

- Have a clear width not less than 6 m, unless it can be shown that lesser widths are satisfactory;
- Have a centerline radius not less than 12 m;
- Have an overhead clearance not less than 5 m;
- Have a change of gradient not more than 1 in 12.5 over a minimum distance of 15 m;
- Be designed to support the expected loads imposed by firefighting equipment and be surfaced with concrete, asphalt or other material designed to permit accessibility under all climatic conditions;
- Have turnaround facilities for any dead-end portion of the access route more than 90 m long; and,
- Be connected with a public thoroughfare.

All standards of the Ontario Building Code shall apply to the design of private roads and compliance with all elements of the Ontario Building Code is required for private road design.

Emergency Access is not considered to be a suitable secondary access.

Waste Collection

In order to receive municipal waste collection service, private roads in the City must be a minimum of 6.0 m wide and have the necessary road surface strength to accommodate waste collection vehicles. Road layout must be designed to permit the continuous forward movement of collection vehicles, including the radius of a cul-de-sac turning circle. Collection vehicles will not operate in reverse to collect waste from individual stops.

The Proponent is to employ all means reasonable to accommodate municipal waste collection to the proposed development. Municipal waste collection requirements and minimum standards can be found in the Solid Waste Collection Design Guidelines for Developments. The site function accommodating waste collection vehicles must be proven utilizing AutoTurn or similar software. In addition, all city by-laws and provincial regulations must be adhered to.

C.14. BIKE LANES (DELINEATED ON ROAD)

Bicycle lanes shall have the same structural standard as the road base. Bicycle lanes have a variety of design consideration including buffers, marking options, etc. For typical cross-section refer to Ontario Traffic Manual Book 18.

For additional details relating to bike lane design and planned routes refer to the City of Hamilton Cycling Master Plan.

C.15. CUL-DE-SACS

The maximum number of dwelling units that will be allowed to be serviced with one road access is 100. If a proposed plan of subdivision is for more than 100 dwelling units (including potential units in multi-residential blocks). A road providing secondary access shall be provided to the satisfaction of the City.

The minimum gutter grade is to be 0.75%. The design road grade on the cul-de-sac shall be such that the drainage is directed away from the end of the cul-de-sac and towards the beginning of the bulb area unless otherwise approved by the City. If this is not achievable, Proponent needs to outline the rationale and submit with the first engineering submission.

All cul-de-sac construction works that are temporary in nature are to be constructed to a permanent standard.

For details and specifications regarding cul-de-sacs, refer to Section C.2 - Geometric Standards.

All local roads which permanently terminate at one end (dead end streets) shall be provided with a turning circle (cul-de-sac) of sufficient area to enable the turning of garbage trucks, snow removal equipment and emergency vehicles. For residential purposes, an 18.0 m minimum radius is required for road allowance with a minimum pavement radius of 13.0 m. For industrial and commercial purposes, a 20.75 m minimum radius is required for road allowance with a minimum pavement radius of 15.0 m.

For typical layouts refer to City of Hamilton Standard Drawings RD 116.01-116.04.

C.16. INTERSECTIONS & PEDESTRIAN CROSSINGS

In accordance with the Barrier – Free Design Guidelines (Sections 6.5 and 5.1.5), wherever possible, crosswalks shall have suitable wheelchair curb ramps at each end of the crosswalk as per OPSD 310.030. In addition, tactile warning strip requirements at wheelchair curb ramps are required as per the Ontario Traffic Manual, Book 15.

The crosswalk shall not contain maintenance hole covers, storm gratings or other obstacles that limit free movement and where catch basins are necessary they should be positioned wherever possible on the upstream side of the crosswalk.

Pedestrian crossings shall be designed in accordance with the Ontario Traffic Manual, Book 15.

C.17. ON-STREET PARKING REQUIREMENTS

New residential development shall provide adequate, convenient on-street parking within the right-of-way for all residences with direct access, while ensuring road safety, in accordance with the following criteria.

The Proponent shall submit an On-Street Parking Plan for all lots or blocks within the plan intended for street-fronting residential development. Submission of the On-Street Parking plans are subject to the following timing:

- Prior to Draft Approval (part of what's deemed as a Complete Submission); and,
- Post Draft Approval (the final parking plan is approved as part of approval of the Engineering submission).

Temporary signage shall be erected by the Owner prior to first occupancy to indicate the locations of all on-street parking restrictions on all municipal streets.

Number of On-Street Parking Spaces

The number of parking spaces shall reflect land use efficiency. It shall be of a minimum ratio of 0.4 parallel on-street parking spaces for every one residential unit and for each phase of development, while providing reasonable walking distance. Parking space plans shall be disclosed and provided at the draft plan stage. Consideration will be given to adjusting the minimum ratio when there are double wide driveways for single family dwellings.

Location of On-Street Parking Spaces

Parking spaces should be located at the prescribed ratio in accordance with the following to ensure road safety and efficient land use:

- Within the street block containing the units and/or on either side of an abutting intersection street within the flankage of the corner lot;
- On one side of the street only;
- A minimum of 0.5 m setback from either side of the driveway ramp / curb opening;
- A minimum of 9 m from an intersection (15 m where there are traffic signals), as measured from the point of intersection formed by the projection of the curb lines or edges of pavement where there is no curb;
- Not permitted across from a "T" intersection;
- Not permitted within 1 m of a bus stop;
- Not permitted within 3 m of a fire hydrant;
- Not permitted along school frontages;

- Not permitted along park frontages; and,
- Not permitted in front of a midblock pedestrian walkway or trail which continues on the opposite side of the street.

Size of On-Street Parking Spaces

On-Street parking spaces shall be shown in accordance with the following:

- The width of each parking space shall be 2.4 m;
- Where there are two or less tandem parking spaces provided, the length of each on-street parking space shall be 5.5 m; and,
- Where there more than two tandem parking spaces provided, the length of each internal on-street parking spaces shall be 6.7 m.

Alternatives to the Provision of On-Street Parking

In cases where the required parking cannot be achieved, the following alternatives will be taken in consideration:

- Increasing lot size;
- Increasing the length of driveways (may include lots with detached garages);
- More high-density development with its own parking facilities;
- Community parking area;
- Proximity to transit; and,
- Walkability.

C.18. TRAFFIC CONTROL – SIGNS & PAVEMENT MARKINGS

C.18.1. Street Name Signs

The Owner shall pay the cost of all street name signs required for each street intersection created by registration, or stage of registration, of the Draft Plan. The City shall supply and erect all street name signs at locations satisfactory to the City.

C.18.2. Signage

The City of Hamilton shall install all signs on all roads within the City. The Proponent will be required to make cash payment for signs in the Subdivision Agreement.

The 2017 fees are $1,600.00 per intersection for all way stop signage. For a neighbourhood traffic circle the fee is $7,500.00 and for single lane roundabouts the fee is $15,500.00. These fees are subject to change without notice. The fees include both traffic and nameplate signs.

C.18.3. Open Space Signs

Open Space signs shall be provided as required in conformance with the Parks & Open Space Development Guide.

C.18.4. Pavement Markings

Unless otherwise agreed to by the City, the Proponent is responsible for all costs associated with design (base road surveying, Engineering, traffic signal design and pavement marking) and construction of intersections controls for development related projects.

C.18.5. Traffic Signals

The City's Traffic Signals Systems staff, will supply and install signal hardware including signal utility poles, signal heads, arms, controller, wiring, pavement markings and signs. The cost of this labour and materials is the applicant's responsibility.

For subdivision requiring the design of traffic signals and pavement markings the consultant retained shall be to the satisfaction of the City's Public Works Department and will be responsible to complete the design submission to approximately 85% completion at which point the City staff will finalize the design. Pavement markings shall be prepared to the satisfaction of the Manager of Traffic Operations and Engineering.

Refer to City of Hamilton Traffic Signal and Pavement Marking Design Drawings (2009).

C.19. DRIVEWAY ENTRANCES

Driveway aprons shall be concrete throughout the subdivision.

Driveway curb depressions shall be built to accommodate the driveway width plus 0.45 m on each side of the driveway measured at the gutter line. The maximum width of the curb depression, measured at the gutter line, shall be 4.5 m for a single driveway and 7.0 m for a double driveway.

The maximum permissible design grade for any driveway shall be 7.0%. The minimum driveway grade shall be 2.0%.

The following minimum standards apply to driveway entrances within the Municipal Right-of-Way:

Table C.4- Driveway Apron Design Table

	Residential	Commercial
Concrete	125 mm Concrete 150 mm Granular 'A' base	200 mm Concrete 150 mm Granular 'A' base

The above standards shall be provided at all driveway entrances located within the Municipal Right-of-Way unless otherwise specified in a geotechnical report. Geotechnical report recommendations will supersede the above minimum standards

only in the event that recommendations are equivalent to or greater than the above minimum pavement structures.

Driveway entrances to multi-family blocks and commercial entrances shall be in accordance with City access permit requirements and shall be asphalt as per City Standard Drawings. Non-residential driveway approaches shall have:

- A depressed curb along the road and the entire width of the approach;
- Sidewalks shall be poured through the driveway approach;
- Concrete curb returns on the sides of the asphalt approach are not permitted in the road allowance; and,
- Minimum 6.0 m curb return radius.

On arterial roads that have not been constructed to the ultimate urban cross-section at the time of approval of the Engineering drawings, there shall be a provision for the installation of a driveway culvert at the roadside ditch. The minimum length of driveway culvert shall be 9.0 m for single driveways and 11.0 m for double driveways and the minimum diameter shall be 450 mm.

Sidewalks are poured through driveways unless it is a signaled intersection. Driveways must not be located within intersections or possible crosswalk locations.

Refer to standard drawings RD-106 – RD-109.

C.20. NOISE ATTENUATION

C.20.1. Requirements for Approval of Noise Attenuation

Where it is a requirement of final clearance of the Draft Plan for the Owner to undertake a noise study for submission to, and approval by the City, and where an approved noise study requires mitigation measures that will affect the grading of the Land, the Owner shall include the specific measures to be implemented on the Final Grading Plan.

All Noise Studies shall be prepared by a qualified noise consultant, who upon request by the City, may be required to demonstrate the following:

- Demonstration of thorough knowledge/understanding of MOE-CC NPC-300 requirements (e.g. certificate showing that the individual has successfully completed a Ministry of Environment (MOE-CC) course in Acoustical Technology in Land Use Planning, or its equivalent);
- Sample of three substantive Noise Studies completed by the individual within the last two years, preferable for sites in the City of Hamilton, demonstrating knowledge of appropriate study content, calculation methods, and noise attenuation recommendations;
- Thorough knowledge of the Noise Assessment Policy for Roads;
- Proof that the individual is a Professional Engineer (P. Eng.), or Registered Professional Planner (R.P.P.); and,

- Proof of Professional Liability Insurance carried by the consultant in an amount satisfactory to the City, as amended from time to time.

It is the responsibility of the individual consultant to advise the City of any change in status related to the above qualifications.

Where the requirement for a Noise Study is identified a traffic volume forecast shall be based on a minimum forecast of ten years after the construction of the development, with the intent being ten years post occupancy of the homes impacted by road noise.

A Noise Study shall include the following:

Table C.5- Noise Study Report Requirements

Required Item:	Required Content:
Title Page	details of Proponent location of site development application reference number(s) for the site “Prepared by” (including signature) qualification to submit report (e.g. P.Eng.)
Table of Contents	list of sections list of figures and tables list of appendices, which should include: General Procedures and Adjustments, Sample Sound Calculations, Road Traffic Data / Level of Service Volumes
Introduction	purpose of study location of site development application reference number(s) for the site brief description of the proposal including lot layout, lot numbers, and unit numbers surrounding / abutting land uses overview of physical features identification of all potential noise sources (the noise consultant is responsible for confirming the noise sources identified by the City at the Formal Consultation Meeting and identifying any additional sources) scaled plan showing all noise sources noted above
MOE-CC Criteria	sound level criteria as noted MOE-CC Publication NPC-300 Noise Assessment Criteria in Land Use Planning (for OLA’s and indoor areas)
Detailed Noise Analysis	all assumptions used in the Noise Study to calculate noise levels (traffic data, posted speed, # of lanes, etc.) noise prediction method (e.g. follow MOE-CC requirements) a table and a concise summary of predicted noise levels for outdoor and indoor living areas at appropriate

Required Item:	Required Content:
	receiver locations (shown on plan) with and without noise mitigation recommendations concerning the need for noise attenuation measures, such as, noise barriers, central air, forced heating and other building components, as required by unit / block recommendations concerning of the need for noise warning clauses
Assessment of Non-Barrier Alternatives (if required)	identification and assessment of non-barrier alternatives rationale for proposing non-barrier methods
Noise Mitigation Requirements (if proposed)	If a barrier is proposed for noise attenuation: rationale for proposing a noise barrier instead of non-barrier alternatives economic, planning and Engineering justification for the use of a wall or berm barrier height table typical and worst-case cross-sections, at an appropriate vertical and horizontal scale, which clearly show the barrier, the noise source, the noise receiver, and property limits cross-sections must clearly show that the proposed noise wall a plan of the area subject to noise attenuation measures, showing location of cross-sections, final grades, and elevations of the edge of pavement, noise source, noise receiver and noise attenuation features drainage details that could affect the implementation of noise control measures specification of the type, surface density and location of the proposed barrier consideration of the impact on existing trees from construction of a noise wall or berm (e.g. damage to root zone, trees destroyed) and reference to a related Tree Saving Plan If indoor noise attenuation measures are proposed: provide building component, acoustic insulation, window glazing tables
Warning Clauses (if required) NPC300	If required, provide recommendations for the inclusion of warning clauses on title (as per standard wording as provided in Section 14.1 in the MOE-CC Publication Noise Assessment Criteria in Land Use Planning: Requirements, Procedures and Implementation (October 1997) or any amendment thereof.
Implementation Requirements	dictated through the approval process may entail a certification from the noise consultant that the required noise mitigation measures are in the

Required Item:	Required Content:
	building plans and are installed appropriately
Conclusions and Recommendations	summary of all recommendations required for noise attenuation statement indicating the feasibility of the implementation
Figures	Figure – location of site Figure – plan, subdivision / site plan Figure – identify site in relation to noise control lines for John C. Munro Hamilton International Airport Figure – identification of receptors, proposed mitigation (noise barriers) on subdivision plan / site plan that includes proposed final grading details Figure – details of noise barrier (s) / cross-sections

When the need for a Noise Study is identified, a minimum of four copies of the noise study shall be submitted by the Proponent.

When the Noise Study is considered acceptable by the City, the owner / applicant will be notified and the appropriate conditions will be identified by City staff through the development application approval process.

The recommendations of an approved Noise Study submitted prior to registration of a Plan of Subdivision will be considered relevant for three years. If the subdivision plan is not registered within that time, the Proponent will be responsible for re-evaluating noise levels using current data and updating the Report prior to registration.

C.20.2. Noise Barriers

Noise barriers shall be implemented as a condition of development approval and supported by the completion of an approved noise study in accordance with MOE-CC requirements. Noise barriers can be constructed with earth berms (preferable), walls / fences, or a combination of the two. If the required height of the barrier exceeds 3 m, it is recommended that a berm / wall combination be used. Material specifications for noise control require that the minimum surface density be 20kg/m3 be of continuous construction and be free of gaps and cracks within or at the ends.

Barriers required as a condition of development approval adjacent to the LINC or Red Hill Valley Expressway must be constructed using Durisol brand barriers if walls are being proposed; whereas walls adjacent to provincial freeways must be a concrete type of material. Noise barriers abutting other City roads can be made of wood.

Noise barrier design shall consider the materials used in adjacent developments along the corridor.

All noise barriers with the exception of barriers along the LINC and Red Hill Valley Expressway shall be placed on private property.

Recognizing the complementary function of noise barriers (i.e. for privacy), a minimum effective noise barrier height of 1.8 m shall be required by the City, unless otherwise approved.

The following criteria shall be used to determine the location of a noise barrier unless otherwise justified:

- Where the noise barrier is a wall, it shall be located entirely on private property;
- Where the noise barrier is a berm or a berm / wall combination, it will be located entirely on private property, unless otherwise approved by the City;
- Side slopes of berms adjacent to a roadway will have a boulevard side slope no steeper than 3:1 (horizontal : vertical) unless otherwise approved by City staff, and,
- Where noise attenuation structures are interrupted, such as in the case of a walkway and/or property line, staggering of the barrier and/or barrier returns are required with a minimum two to one length to opening ratio.

The materials, design and detailed location of any proposed barrier shall be to the satisfaction of the City. Environmental Services Division, Public Works Department shall approve all plant material and irrigation systems.

Where a noise wall(s) is to be located adjacent to the Redhill Valley Parkway or the Lincoln M. Alexander Parkway, it shall be located within the City road allowance and shall be of a concrete type material.

Where a noise wall(s) is located adjacent to a Provincial highway, the noise wall shall be of a concrete type material.

A noise barrier(s) shall be installed prior to occupancy to the satisfaction of the City, unless otherwise approved.

C.21. ENTRANCE FEATURES

Entry features shall be implemented according to any relevant Secondary Plans, Neighbourhood Guidelines, and/or other Area Specific Guidelines. A Proponent may submit for approval a design proposal for entrance features which may consist of walls, gates, fences, trees, shrubs, flowers and other related components. The Proponent will be required to enter into an Agreement with the City for the construction and maintenance of entrance features within the Subdivision Agreement. Such Agreement shall include perpetual maintenance fee to reflect future costs. It is highly recommended to install entry features on private property.

The Proponent shall maintain the entrance feature indemnifying the City for all claims until the development has been assumed or as otherwise specified in the Agreement.

The Proponent shall provide a payment for perpetual maintenance fees and securities in accordance with the Subdivision Agreement for entrance features on public land.

The City reserves the right to remove all or any element of the entrance feature at its discretion.

Entrance features shall be located within the public road allowance in centre median islands, or on private property where located adjacent to daylighting triangles. The features shall be designed to maintain proper sight distances and turning movements at driveway assesses and intersections. The design of the entrance shall be submitted for approval to the City.

All tree planting for entrance features will meet all tree and soil habitat zone requirements identified in the Forestry By-Laws pertaining to Street Tree Planting, as well as the specifications for trees, shrubs & flowers located in Appendix E – List of Approved Plant Species.

C.22. FENCING

Fencing shall conform to the City of Hamilton Fence By-law, By-law No. 10-142. Fencing details shall be provided in accordance with the City of Hamilton Site Plan Guidelines, Appendix 18 – Fencing Details, 2003.

Where required as a condition of development approval, the Proponent shall construct a 1.5 m high black vinyl coated heavy duty commercial grade (9 gauge metal) chain link fence adjacent to City owned property. The fence shall be installed so that the fence posts are located approximately 100 mm within City owned property and private property and shall be in accordance with OPSD 972.130 with a mesh size of 38 mm where it abuts single family dwellings.

Fences required to provide a separation between private and public property include:

- Parks, Open Space, Woodlots, ESAs, creek blocks, etc.;
- Walkways;
- Public Infrastructure (i.e. Pumping stations); and,
- Fencing regulation and requirements for the protection of public infrastructure take priority over other types of fencing.

Storm Water Management Facilities:

- All facilities between private and public property; and,
- All temporary facilities must be fenced.

Privacy/Decorative Fences

Fencing shall generally be required as condition of approval:

- Privacy fences where Residential lands abut commercial or industrial lands, or institutional developments; and,
- Decorative Fence where Residential lands with reverse frontages or “window” roads abutting arterial roads.

Every fence on a corner lot:

- Within a front yard shall have a maximum height of 0.91 m (3 ft);
- Within an interior side yard shall have a maximum height of 2.44 m (8 ft);
- Within an exterior side yard or rear yard shall have a maximum height of:
  - 0.91 m (3 ft) if less than 1.5 m (5 ft) from the exterior side lot line or less than 4.0 m
    (13 ft) from the nearest edge of the travelled portion of the road;
  - 1.82 m (6 ft) if at least 1.5 m (5 ft) from the exterior side lot line but less than 4.57 m
    (15 ft) from the exterior side lot line;
  - 2.44 m (8 ft) if at least 4.57 m (15 ft) from the exterior side lot line;
- Within a corner visibility triangle or driveway visibility triangle shall have a maximum height of; and,
- Shall not be located or constructed so as to block access to private or public driveways and parking spaces.

C.23. STREETSCAPE AND LANDSCAPING

For private sites refer to the City of Hamilton Site Plan Guidelines, 2003 for the relevant policies, otherwise streetscape shall be based on standard R.O.W sections and the City of Hamilton Street Tree Planting Policy.

Requirements from approved Secondary Plans and Special Policy Areas may specify additional details.

C.24. BUS STOP LANDING PAD

All bus stop landing pads, where required shall meet the Transit Bus Stop Accessibility Criteria Guidelines.

C.25. STREET FURNITURE

All street furniture shall meet the criteria outlined in the Co-ordinated Street Furniture Guidelines.

D. WATERMAINS

D.1. DESIGN GUIDELINES

D.1.1. General Requirements

All watermains and appurtenances shall be designed and constructed in accordance with the current City Standards, MOE-CC guidelines, Ontario Provincial Standards and Specifications and American Water Works Association standards and specifications. Should conflict between these specifications and these guidelines occur the Manager of Development Engineering will determine the applicable standard.

Available information regarding existing pressures and flows at key nodes in the neighbourhood shall be made available to the Consulting Engineer by the City. A request for this information shall be made to the Development Engineering Section.

D.1.2. Location

Generally, watermains shall be located in the pavement 1.0 m from the edge of asphalt. Property line off-set for watermains shall be in accordance with the City's approved road cross-section. In all normal cases, the watermain should be located such that there is a minimum of 2.5 m horizontal separation from the nearest sewer.

Under unusual conditions, where a significant portion of a watermain will be in rock, or where it is anticipated that severe dewatering will occur or where congestion with other utilities will prevent a clear horizontal separation of 2.5 m from a sewer, the City's Development Approvals Section should be consulted to obtain permission to install the watermain closer to the sewer and to confirm process for approval. Under such conditions, the elevation of the crown of the sewer must be a minimum of 0.5 m below the invert of the watermain. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and joints that are equivalent to watermain standards of construction and shall be pressure tested in accordance with Section D.4 - Commissioning / Acceptance and Assumption Process.

D.1.3. Size and Layout

The following are the minimum size requirements:

Residential Areas – 150 mm diameter minimum (50 mm diameter copper around cul-de-sac)

Industrial Areas – 200 mm diameter minimum

Developments, and phases of developments, shall provide two watermain feeds where practical. Generally, if more than 100 lots are serviced by one watermain feed, a second watermain feed shall be required. The watermain distribution layout shall be discussed

with the City's Development Engineering Section prior to finalizing the Engineering submission. The City may waive this requirement where two watermain feeds are not practical (or cost prohibitive).

A watermain hydraulic analysis report will be required in accordance with MOE-CC's Watermain Design Criteria to confirm acceptable sizing of watermains, along with duly filled "Watermain Design Checklist" available from the City's Public Works Department. The Consulting Engineer shall also complete Part 2 of Form 1.

The report shall also identify and put in place interim procedures to maintain water quality prior to full build out. The procedures may consist of the following (as described in Section A.10.6 - Interim Water Quality):

- Temporary looping;
- Temporary flushing station; and,
- Maintenance flushing program.

D.1.4. Depth of Cover

The minimum depth of cover for all new watermains shall be 1.6 m measured from the top of the pipe to the road elevation. For rural cross-sections, where the watermain may be located near the roadside ditch, the design shall be reviewed to ensure that there is a minimum of 1.6 m cover over the watermain. The maximum depth of cover allowed for existing or proposed watermains is 3.0 m. Depth of cover at valves shall be reviewed on an individual basis to ensure that the operation of the valves is not compromised by excessive depth.

D.1.5. Domestic and Fire Flows Demand Design Flow

The domestic demand design flows shall conform to the latest edition of the Ontario Ministry of the Environment's "Guidelines for the Design of Water Storage Facilities, Water Distribution Systems, Sanitary Sewer Systems and Storm Sewers".

Fire flows shall be determined in accordance with the Fire Underwriters Survey (FUS 1999).

D.1.6. System Pressures

The maximum operating pressure shall not exceed 700 KPa. Where pressures in localized areas are above this level, pressure reducing valves shall be installed.

The distribution system shall be sized to meet peak demands. Under simultaneous maximum day and fire flow demands, the pressure shall not drop below 140 KPa.

D.1.7. Sewer Conflicts and Crossings

Generally, the watermain shall cross above sewers with sufficient vertical separation (250mm minimum) to allow for proper bedding and structural support including gap for maintenance.

When there is conflict with the elevation of the sewer and the watermain such that the

watermain cannot pass over the sewer, then the watermain shall be designed such that

it passes under the sewer subject to the following conditions:

- Minimum vertical separation of 500 mm between the bottom of the sewer pipe and the top of the watermain;
- The watermain shall be lowered below the sewer using vertical thrust blocks and restrained joints;
- The length of the watermain pipe shall be centred at the point of crossing so that
- the joints are equidistant and as far as possible from the sewer; and,
- The sewer shall be adequately supported to prevent joint deflection and settling, a detail or specifications shall be provided.

D.1.8. Thrust Blocks and Mechanical Joint Restrainers

All horizontal and vertical bends, tees and plugs shall be restrained with concrete thrust blocks in accordance with City Standard drawings.

Concrete for thrust blocks shall be 30 MPa laid to undisturbed ground. Where thrust blocks cannot be laid to undisturbed ground due to excessive sewer excavation or fill conditions, mechanical joint restrainers may be used in conjunction with concrete thrust blocks.

Mechanical joint restrainers shall be used on all pipe that have not been pressure tested.

All fittings and valves shall be restrained for a minimum of 18 m in each direction. All fittings at dead ends shall be restrained for a minimum of 18 m.

All fittings on water services 100 mm diameter or greater shall be restrained for a minimum of 18 m and shall extend to the property line.

D.1.9. Hydrants

All hydrants shall be three-way hydrants and shall be spaced in accordance with the Fire Underwriter Survey (FUS). Generally hydrants will be spaced a maximum of 150 m apart on streets with low density development, and at 110 m spacing on collector streets, high density residential streets, commercial and industrial streets. On cul-de-sacs, the fire hydrant shall be located within 75 m of the dwelling lot furthest from the street entrance. In the event that a hydrant is located on the long side of the watermain,

it may be required to have a secondary valve close to the watermain as well as one at the hydrant.

On rural roads hydrants shall be spaced at a maximum 150 m distance apart unless specifically identified on the FUS. Hydrant connections (with secondary valves and blind flanges) may be installed only where the lands have not been developed.

Hydrants shall be located within the City's road allowance at the extension of the lot line between two lots to avoid potential conflicts with driveways. If the location of driveways has been determined in advance, the hydrant location shall be reviewed in conjunction with any driveway locations to ensure that conflicts do not occur. All hydrants shall:

- Be in accordance with the approved watermain materials list;
- Be three-way, two nozzles which are 180° to each other and parallel to the street and a 100 mm pumper "STORZ" connection facing the street;
- Open counter-clockwise (left);
- Have a 25 mm top operating nut size;
- Be painted red (barrel, bonnet and hose nozzle caps) and the "STORZ" connection painted black;
- Be controlled by a secondary valve close-coupled to the hydrant;
- Where a hydrant is located on the opposite side of the road as the watermain, an additional valve shall be required on the hydrant lead at the watermain;
- Be installed plumb in accordance with the City Standard drawing WM-203.01;
- If an extension is required to adjust the length of the barrel, it shall be placed between the lower section of the barrel and the boot connection; and,
- Be complete with anti-tampering device.

D.1.10. Valves

The number of gate valves required shall be based on the layout of the development. At an intersection, the number of gate valves required is generally one less than the intersecting watermains, i.e. if there is a four-way cross, at least three valves shall be installed. On long stretches of watermain without intersections, a valve should be installed for every 100 units serviced or with maximum distance between two valves being no more than 600 m whichever is lessor, and shall be located on the projection of a lot line. At intersections, the valve shall be located at the projection of the intersecting street line. All gate valves shall:

- Be in accordance with the approved watermain materials list;
- Open clockwise (right) in the Hamilton District;
- Open counter-clockwise (left) in the Ancaster, Dundas, Flamborough, Glanbrook and Stoney Creek Districts;
- Be installed in chambers if 400 mm and larger; and,
- Have a 25 mm operating nut size in Hamilton district and 50 mm in the Ancaster, Dundas, Flamborough, Glanbrook and Stoney Creek.

Chambers are not required for main line gate valves and tapping valves off mains smaller than 400 mm diameter (even if located within the road pavement). All gate valves 400 mm and larger and tapping valves off mains 400 mm and greater shall be installed in a concrete chamber in conformity with current City Standards.

Air valves and blow-off valves shall be installed in a chamber, regardless of size except for temporary dead-end blow-offs.

Valve chambers shall contain a sump and drained by a 150 mm diameter storm drain to the storm sewer, where possible. An approved backwater valve or approved equivalent shall be installed on the storm drain. If there are no storm sewers or where the storm sewer is not deep enough to drain the valve chamber, a 600 mm diameter sump shall be installed in the bottom of the valve chamber.

The top of valve boxes and valve chamber covers shall be set flush with the finished grade. For chambers and valve boxes located in shoulders of roads, an asphalt paved shoulder shall be constructed in accordance with RD-111.

For proposed water services 100mm in diameter and greater, which will be connected to the municipal watermain on the opposite side of the street of the property being serviced, defined as “long side” servicing, an additional gate valve must be installed on the service at the municipal main. This is in addition to the valve required at the property line and is in accordance with the requirements of Form 400 of the City’s Construction and Material Specifications Manual.

D.1.11. Tapping Valves and Sleeves

Connection of a new watermain to the existing water distribution system shall be made using a tee and sleeve. In the event that the water distribution system cannot be taken out of service, a tapping valve and tapping sleeve shall be utilized, subject to approval by the City. The City’s Development Engineering section shall confirm if the water distribution system can be taken out of service.

Tapping valve and tapping sleeve shall be in accordance with the approved watermain materials list.

D.1.12. Backflow Prevention

In accordance with the City of Hamilton Backflow Prevention By-law 10-103, a backflow prevention device must be installed and maintained on all existing and/or proposed water services to industrial, commercial, high-rise institutional and multi-residential buildings to prevent the flow of contaminants into the municipal drinking water system.

Selection of the required backflow prevention device, specific to a property, is to be determined through a “Cross Connection Survey”, carried out by a qualified individual, under the terms and timelines, as described within the By-law.

Backflow prevention devices must be installed no more than 3.0 m downstream of the ~~a~~ properties water meter, or in the case of a fire protection system, where the fire protection service enters the building and in a location acceptable to the City. Where a

water meter is installed with an underground chamber, due to Water By-law requirements, the backflow preventer must also be located within the 3.0 m maximum spacing which may necessitate the installation of an additional chamber or secure structure to house the device. It must be noted where a “reduced pressure” type backflow device is specified for use, through the survey process, it must not be located within a chamber due to its workings.

Where a fire protection system exists or is proposed within a building, the service must also be protected against backflow in accordance with the CSA standards, and the backflow device must be either a double check detector assembly or a reduced pressure detector assembly with a detector meter which is capable of measurements in cubic meters.

Proposed backflow prevention devices to be installed within buildings will be reviewed and approved under a Permit issued by the City of Hamilton Building Department. Installation of devices within chambers etc., outside the building structure, will be approved under the Water Permit issued by the Growth Management Division.

All Backflow Prevention Devices must be selected and maintained in accordance with the City of Hamilton's Backflow Prevention By-law # 10-103, the manufacturer’s specifications, and the guidelines set out in the most recent version of the AWWA Canadian Cross Connection Control manual and the CSA. B64.10 / 07 / B64. 10.1-07 Standards. A general note to this effect should be included on all plans submitted for Water Permit issuance through the Growth Management Division.

D.1.13. Cul-de-sac and Dead-end Mains

Permanent cul-de-sacs shall provide for looping of the watermain in accordance with details shown in PED-110.01. It is recommended that fire hydrants are located at the end of temporary dead-end mains; however, a 50 mm blow-off is an acceptable alternate. The Proponent should provide a Fire Hydrant Flushing and Monitoring Program for Interim Water Quality Maintenance. For your convenience a template letter is provided as Appendix O - Fire Hydrant Flushing and Monitoring Program for Interim Water Quality Maintenance.

D.1.14. Water Services (Public Portion)

Water services for single detached residential lots shall be a minimum of 25 mm diameter unless otherwise determined by Ontario Building Code calculations, Type K copper pipe located 1.0 m to the left of the centerline of the lot. Water services shall be separated from sanitary and storm private drains by a minimum distance of 2.5 m.

All private water services shall be connected to a main stop at the watermain and shall be terminated at the street line with a curb stop and box, all in compliance with the Waterworks By-Law No. R84-026.

Water services shall be installed perpendicular to the watermain, where possible.

Final inspection of water service shall be completed and be included in the lot grading certification.

Depth of cover shall be minimum 1.6 m including dips at ditches and connections at main.

D.1.15. Pumping Station Design

Where a development will require a booster pumping station, or an elevated tank for functional servicing on a permanent or temporary basis, it should be brought to the attention of Development Engineering as soon as possible.

Where facilities of this nature are included in developments they will be subject to the same design standards as applied to projects undertaken by the City. It is expected that the all facilities, including those required to support phasing, will be designed for long-term, permanent operation. Relaxed criteria for temporary facilities will not be given consideration.

D.2. MATERIAL SPECIFICATIONS

D.2.1. Pipe Material and Bedding

Acceptable material for watermains shall be in accordance with current City of Hamilton Construction and Material Specification Manual.

For PVC mains a continuous #12 gauge solid TWU tracer wire must be supplied along the full length of the pipe to provide electrical continuity for purposes of locating the main and cathodic protection of metallic fittings in accordance with Form 400.

Substitution of pipe material from the approved drawings must be approved by the City and Engineer prior to use.

Transition from one pipe material to another shall be made of a fitting (i.e. tee bend).

D.2.2. Bedding Requirements

- Ductile Iron Granular A (WM-200.02)
- PVC-Granular A (WM-200.01)
- Copper-Type K Soft Granular D (WM-200.01)

D.3. CONSTRUCTION SPECIFICATIONS

For Construction Specifications refer to City's Construction and Material Specifications Manual. The following inspection and testing works shall be carried out during construction of both municipal services and private services intended to service multi-unit developments:

- Sieve analysis of pipe bedding material for compliance with the specifications. Representative samples are to be obtained by the Geotechnical consultant during

water operations. Pipe bedding material supplier shall be approved by the City prior to use;

- Compaction tests shall be performed to assure that pipe bedding and backfill material has been compacted properly. (Refer to Section A.10.5 - Compaction & Material Testing);
- Regular inspection of work in progress of the watermain installation and noted defects corrected immediately; and,
- Ensuring that hydrants that are not fully operational are black-bagged.

D.4. COMMISSIONING / ACCEPTANCE AND ASSUMPTION PROCESS

The following shall be conducted in accordance with the City's Construction and Material Specifications Manual.

D.4.1. Charging and Testing of New Watermains

All new watermains shall be tested prior to connection to existing watermains, using temporary caps or plugs.

All connection points between the new watermain and the existing water distribution system must be kept physically separated until the watermain has successfully passed bacteriological tests.

D.4.1.8 Temporary Charging of New Watermains

A reduced pressure zone backflow preventer is required on the temporary supply line used for filling and flushing of all watermains. The City will provide a hydrant adapter and backflow preventer with the permit from Public Works, Hamilton Water.

D.4.1.9 Testing of New Watermains

New watermains shall be tested in accordance with Form 400 in the following sequence:

- Pressure and leakage test;
- Swabbing; and,
- Disinfection and bacteriological testing to the satisfaction of the City prior to connection to existing watermains.

D.4.1.10 Pressure and Leakage Testing

Prior to the pressure and leakage test, the contractor may elect to swab the main to assist in the removal of air pockets.

The test pressure shall not be less than 1035 KPa (150 psi) for ductile iron and PVC pipe.

The leakage allowance shall be less than 0.128 L/mm of pipe diameter/km of pipe/2 hour period within the shortest valved section. The duration of the pressure test shall not be less than two hours.

D.4.1.11 Swabbing

All new watermains shall be cleaned by passing a minimum of three polyethylene swabs through the pipe. Additional swabbing will be required if the water is not clear after the third swab.

D.4.1.12 Disinfection and Bacteriological Testing

The Consulting Engineer shall ensure that the Contractor assists City staff in the testing of the watermain. The Contractor is to provide all materials, equipment and personnel for pressure and leakage testing, swabbing, and disinfection and bacteriological testing of the watermains. City staff shall arrange for water samples to be collected and tested for potability at the City lab.

After pressure and leakage testing, and swabbing of the new main, disinfection of the new main shall proceed. Sodium hypochlorite or other approved chlorine compound in sufficient quantity to obtain an initial free chlorine residual of minimum 50 mg/L and a minimum of 25 mg/L 24 hours after introduction into the pipe.

After successfully disinfection, the main shall be flushed. Chlorinated water may be discharged into the sanitary sewer system. In rural areas where no sanitary sewers are available, chlorinated water must be de-chlorinated and tested prior to discharging into a ditch or watercourse.

After final flushing and a “sitting period” of 24 hours, water samples for bacteriological testing will be collected by the City and submitted for testing by the City Laboratory at Woodward Avenue. Samples will only be accepted by the City lab Monday through Friday from 8:30 a.m. to 3:30 p.m.

Samples shall be collected at the end of each branch or stub, at 350 m intervals, and a minimum of two samples taken for each main twice, 24 hours apart. When the samples prove satisfactory, the mains may be placed in service and connection to the existing water distribution system can be arranged. The Consulting Engineer shall co-ordinate connection of new watermains to the water distribution system with the City. All affected properties must be given a minimum of 48 hours advance notice by the Consulting Engineer prior to the disruption of the water distribution system.

D.4.2. Acceptance and Assumption of Watermains

Prior to acceptance the following shall be required:

- Receipt of approved as-constructed drawings;
- A conductivity test shall be performed on all tracer wire for PVC watermain installations; and,

- After the completion of the roadworks (minimum base course asphalt) an initial visual inspection of the watermain works shall be completed with the Contractor, Consulting Engineer and City. A report outlining deficiencies shall be provided by the City.
- The Engineer has submitted as-constructed information in a form satisfactory to the Growth Management Division.

Prior to assumption the following shall be required:

- Receipt of approved as constructed drawings;
- Final visual inspection of the watermain works shall be completed. A pre-inspection by the Consulting Engineer of the water valves and dewatering of valve chambers is necessary, before the City will inspect the works;
- A conductivity test shall be performed on all tracer wire for PVC watermain installations;
- The Engineer has submitted as-constructed information in a form satisfactory to the Growth Management Division; and,
- Removal of anti-tampering devices.

E. SANITARY SEWERS

E.1. DESIGN GUIDELINES

E.1.1. General Requirements

The following criteria are recommended minimum requirements for the design of sanitary sewers within the City. Sound Engineering judgment of the Consulting Engineer shall always prevail in the actual design.

Sanitary sewers shall be designed to service the lands within the Plan of Subdivision including all external drainage areas. Foundation drains, weeping tiles and roof drainage are not permitted to be discharged into the sanitary sewer.

In the case where the outlet is a combined sewer, sewers within the development lands shall be designed for separate sanitary and storm sewers and an inter-connection shall be made at the limit of the development. In all instances where the outlet for development is a combined sewer, the Consulting Engineer shall contact the City's Planning and Economic Development Department during the preliminary Engineering stage to determine the constraints, if any, that may limit discharge into the combined sewer system.

The Engineer shall submit sanitary sewer design sheets in accordance with the sample design sheet attached as Appendix F – Storm Sewer Design Sheet / Combined Sewer Design. All sanitary sewer design sheets must be stamped and signed by a Professional Engineer. An electronic copy of the spread sheet in Excel format shall be submitted to the City upon approval of the design.

E.1.2. Location

Municipal sanitary sewers shall be located within the City's public right-of-ways. In the instance where a municipal sewer must be located on private property, the Engineer shall obtain approval, for such alternative location, from the City's Planning and Economic Development Department during the preliminary Engineering stage of development and the sewer shall be located within an easement in favour of the City.

The sanitary sewer shall normally be centered within the road allowance or easement. When sanitary and storm sewers are constructed in a common trench, the designer shall demonstrate that the storm and sanitary sewers can meet operational and maintenance requirements and in no case shall there be less than 450 mm separation. Designers should ensure sufficient clearance between the storm maintenance hole and the sanitary pipe.

E.1.3. Depth of Sewer

The minimum depth of cover for sanitary sewers shall be 2.75 m below the centerline elevation of the proposed road; however, the Consulting Engineer shall investigate the profile of the sanitary sewer to the upper reaches of the sanitary drainage area, taking

into consideration potential conflicts with storm sewer crossovers and possible future road profiles along the route of the future sanitary sewer.

If the profile of the sanitary sewer necessitates placement of fill in excess of 0.6 m on lands outside the proposed development, the Consulting Engineer shall be required to demonstrate that reasonable care has been taken to ensure that the design of the sanitary sewer has been optimized so as to minimize the impact of fill on those lands.

E.1.4. Design Flows

The design flow for sanitary sewers shall be based on the following formula:

Design Flow = Average Dry weather flow x Peak Factor + Infiltration Allowance

Sanitary sewers shall be designed for 360 litres per day per capita. The average dry weather flows for sanitary sewers shall be based on the population densities of the area serviced by the sewer. The Engineer shall obtain the current neighbourhood secondary plans for the catchment area and assign densities based on the designations for the lands in the neighbourhoods. If no secondary plans are available for future external areas, the Consulting Engineer shall, in consultation with the City Planning and Economic Development Department, assign average densities that reflect a probable development pattern for the future lands.

The following guidelines are provided for the use of the Consulting Engineer in assigning densities:

Single detached	60 ppha
Semi-detached	75 ppha
Townhouses and Maisonettes (30 upha)	110 ppha
Medium Density apartments (60 upha)	250 ppha
High Density apartments (100 upha)	varies (subject to detailed plans)
Parks	12 to 25 ppha
Schools and Institutional Uses	75 to 125 ppha
Commercial	varies 125 to 750 ppha
Industrial and Central Business Districts	varies 125 to 750 ppha

E.1.5. Peak Sanitary Flow Factor

The peak factor shall be obtained using the Babbitt Formula:

$$M \mid \frac{5}{P^{0.2}}$$

where M = peak factor where 2{M{5

P = number of persons in thousands contributing to the sewer

E.1.6. Infiltration Allowance

An allowance shall be made in the sanitary sewer design for infiltration into the sewer system.

For areas where the weeping tiles of the dwelling are designed to be drained by gravity, or where a separate foundation drain collector sewer is proposed, the infiltration factor shall be 0.4 litres per second per hectare.

For areas where there are no storm sewers, or shallow storm sewers which require the weeping tiles of the dwelling to be drained by sump pump, the infiltration factor shall be 0.6 litres per second per hectare.

E.1.7. Capacities, Velocities and Sizes

Sanitary sewers shall be designed to flow at a maximum of 75% full design capacity of the pipe for sizes up to and including 450 mm diameter. Pipes shall be designed to capture all external catchment areas. Trunk sanitary sewers (525 mm diameter and above) shall be designed to flow at a maximum of 60% full design capacity of the pipe.

Manning's formula shall be used in determining the capacity of the sanitary sewers as follows:

$$Q = AV$$

and

$$V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = \frac{A}{P}$$

where

Q	=	Capacity of the pipe flowing full (m3/sec)
V	=	Velocity (m/sec)
R	=	Hydraulic radius (m)
A	=	Cross-sectional Area of pipe (m2)
P	=	Wetted perimeter (m)
S	=	Gradient of pipe (m/m)
n	=	Manning's factor = 0.015 for pipe sizes less than 600 mm diameter

= 0.013 for pipe sizes equal or greater than 600 mm diameter

The minimum design velocity for the sanitary sewer shall be 0.75 m/sec flowing full and maximum velocity shall not exceed 2.75 m/sec. However, the Engineer shall investigate the actual velocity in the sewer for instances where the design flows are low (example: in cul-de-sacs), and make a reasonable attempt to obtain self-flushing velocities.

The minimum sanitary sewer size shall be 250 mm diameter. A size of 200 mm diameter may be permitted on the last run of sanitary sewer, where there will be no further upstream contribution, such as in cul-de-sacs or crescents. A minimum grade on a 200 mm sanitary sewer shall be 0.75%.

For **Industrial or Commercial** applications the minimum size for the sanitary sewer shall be 375 mm.

Generally, no decrease of pipe size from a larger upstream pipe to a smaller downstream pipe shall be allowed, regardless of increase in grade, velocity and capacity. The design of the sewers shall be such that there is no decrease in velocity and capacity from the upstream pipe to the downstream pipe. In cases where this is unavoidable, care should be taken to ensure that an appropriate drop is incorporated in the maintenance hole to dissipate the excess energy.

E.1.8. Maintenance holes

Maintenance holes shall be provided at each change in pipe alignment (vertical and horizontal), and at any change in pipe size or material and where the maximum distance between maintenance holes has been reached. Generally, maintenance holes shall not be located in road sags (low points); where it is necessary, a water-tight maintenance hole frame and cover shall be used.

Generally, the maximum distance between maintenance holes shall be as follows:

- 120 m for pipe sizes 200 mm to 1050 mm diameter; and,
- 150 m for pipe sizes 1200 mm diameter and larger.

The maximum change in direction from upstream to downstream pipes for pipe sizes 675 mm and larger is 45°. Where the change in direction is greater than 45°, additional maintenance holes shall be required to reduce the angle.

For maintenance holes constructed at the end of a line that is to be extended in the future, proper bulkheads shall be designed. The size of the bulkhead shall be specified on the Engineering drawings.

If the sanitary sewer is intended to be extended in the future and the spacing of the maintenance holes does not allow for the optimum use of the maintenance holes, then a temporary maintenance hole shall be constructed at the end of the sanitary sewer main line with a notation that it will be removed and relocated with the future extension of the sanitary sewer.

Maintenance holes may be constructed with either precast or poured in place concrete. The size of the maintenance holes shall be based on the pipe size, the deflection angle of the pipes and the number of pipes at the junction maintenance hole (see OPSD 701.021). When any dimension of a maintenance hole differs from the standards, the maintenance hole shall be individually designed and detailed.

Where possible, pre-benched maintenance holes should be specified. Benching details for non-standard cases shall be detailed on the plan-profile sheets. Generally, the benching shall be brought to the spring line of the outlet pipe in accordance with OPSD 202.021.

The upstream pipe(s) obvert shall generally not be lower than the pipe obvert on the downstream side of the maintenance hole.

Suitable drops shall be provided across maintenance holes to compensate for loss in energy due to change in flow velocity and for the difference in depth of flow in the sewers. In order to reduce the amount of drop required, the Engineer shall try to restrict the change in velocity between the inlet and outlet pipes to less than 0.6 m/sec.

The minimum drops across maintenance holes shall be as follows:

Alignment Change	Drop Required
0°	grade of sewer
1° to 45°	0.03 m
45° to 90°	0.06 m

The maximum drop allowed across a maintenance hole is 0.6 m calculated from the invert of the upstream pipe to the invert of the downstream pipe (in accordance with OPSD 1003.01). In junction maintenance holes where there is a pipe entering the side of the maintenance hole, the drop shall be calculated from the invert of the higher pipe to the top of the benching in the maintenance hole. For drops greater than 0.60 m a drop structure is required as per OPSD 1003.01. Generally, the size of the drop pipe shall be one size smaller than the connecting sewer with a minimum size of 200 mm and a maximum size of 300 mm. The invert of the drop pipe shall be shown on the plan-profile sheet and shall be a min. of 0.06 m higher than the invert of the lowest pipe.

Safety gratings shall be installed in maintenance holes that are greater than 5.0 m in depth from the top of the maintenance hole grate to the lowest invert and shall conform to OPSD 404.020.

Maintenance hole frames and covers shall conform to OPSD 401.010 (closed cover) except where watertight covers are required, then OPSD 401.030 shall be used.

E.1.9. Sanitary Laterals (Public)

Sanitary laterals connections shall be individual services. Shared sanitary laterals within the road allowance shall not be permitted. Sanitary laterals shall be located 1.5 m to the right of the centre of a single detached residential lot. Locations for semi-

detached, street townhouses, and maisonettes units shall be specified by the Consulting Engineer.

The connection to the mainline sewer shall be made with an approved prefabricated wye or an approved saddle for larger diameter sewers. For connections required to an existing sanitary mainline sewer, the main sewer shall be cored and an approved saddle used.

The minimum size for sanitary laterals shall be 150 mm diameter. Sanitary Service connections for multiple residential, commercial, industrial and institutional blocks shall be sized individually.

The sanitary lateral shall be extended from the mainline sewer to 1 m beyond the street property line. A stake, painted black, shall be placed at the end of the sanitary lateral, extending 1.0 m above grade.

The colour of the sanitary lateral shall be any colour except white. (White shall be used for storm laterals only).

The top of the sanitary lateral at the street line shall be minimum 2.2 m below the centerline elevation of the road at that point.

In cases where dual (i.e. sanitary and storm) laterals are installed, the storm lateral shall be located north or east of the sanitary lateral.

In cases where the main line sewer is a combined sewer, dual lateral connections shall be installed as specified in SEW-301.

Bedding and cover for PVC laterals shall be granular A as per SEW-302. For sewers deeper than 3.7 m, a riser shall be installed to an elevation of 2.75 m below the final road elevation in accordance with SEW-300. The riser shall be encased in 15 MPa wet concrete to a height of 1 metre above the main sewer.

E.1.10. Pumping Station & Vertical Assets

Where a development will require a pumping station~~s~~ for functional servicing on a permanent or temporary basis, it should be brought to the attention of the City as soon as possible.

Where facilities of this nature are included in developments they will be subject to the same design standards as applied to projects undertaken by the City. It is expected that all facilities, including those required to support phasing, will be designed for long-term, permanent operation. Relaxed criteria for temporary facilities will not be given consideration.

E.2. MATERIAL SPECIFICATIONS

E.2.1. Pipe Materials, Classification and Bedding Requirements

Acceptable material for sanitary sewers shall be in accordance with the current City's Construction and Materials Specification Manual – Approved Products List.

Substitution of pipe material from the approved drawings must be approved by the City and Consulting Engineer prior to use.

Transition from one pipe material to another must be made at a maintenance hole or with an approved coupler.

The class, type of pipe and pipe bedding shall be indicated on the profile for each section of the sanitary sewer.

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. Bedding as per OPSD 802.010, 013, and 014 for flexible pipe and OPSD 802.030, 031, 032, 033 and 034 for rigid pipe shall be used in all new construction and the class of pipe shall be selected to suit this bedding detail and characteristics.

Bedding and cover material to be granular A compacted to 95% SPMDD. Maximum depth of cover shall be in accordance with OPSD 806.06, 807.01, and 03.

E.3. CONSTRUCTION SPECIFICATIONS

For Construction Specifications refer to City's Construction and Material Specifications Manual. The following inspection and testing works shall be carried out during and after construction of both municipal services and private services intended to service multi-unit developments:

- Sieve analysis of pipe bedding material for compliance with the specifications. Representative samples are to be obtained by the Geotechnical consultant during sewer operations. Any material that does not meet the City Standard must be removed from the site;
- Compaction tests shall be performed to assure that pipe bedding and backfill material has been compacted properly. (Refer to Section A.10.5 - Compaction & Material Testing); and,
- Sewer installation shall be regularly inspected and noted deficiencies must be corrected immediately

E.4. COMMISSIONING / ACCEPTANCE AND ASSUMPTION PROCESS

E.4.1. General Requirements

The following shall be conducted in accordance with the City's Construction and Material Specifications Manual.

Prior to acceptance the following shall be required:

- Receipt of as constructed drawings;
- All sewers and maintenance holes must be flushed and cleaned prior to testing. A mandrel test shall be performed on all flexible pipe sewer mains in accordance with OPSS 410 which consists of a successful pass of the mandrel ("pig") pulled through the main. Notwithstanding OPSS 410, allowable deflections shall be a maximum of 5% for all pipe diameters tested;
- Video inspection of all sewer mains to assure no defects exist. (Refer to Section A.12.4 - Video Camera Inspection);
- After the completion of the roadworks (minimum base course asphalt) an initial visual inspection of the sewer works shall be completed with the contractor, Consulting Engineer and City. A report outlining deficiencies shall be provided by the City; and,
- Unique to Sanitary Sewers, infiltration / exfiltration testing will be carried out on all sanitary sewers, using either water or low air pressure in accordance with OPSS 410.07.15.02.

Prior to assumption the follow shall be required:

- Second mandrel test (and flushing) will be required prior to assumption;
- TV camera inspection for all sewers; and,
- Final visual inspection for all sewers.

F. STORM SEWERS

F.1. DESIGN GUIDELINES

F.1.1. General Requirements

Storm sewers shall be designed to service all the lands within a proposed development as well as any external drainage areas that are dependent on the sewers within the proposed development.

In the case where the outlet sewer is a combined sewer, the development shall be designed for separate sanitary and storm sewers and an inter-connection shall be made at the limit of the development. In all instances where a development discharges into a combined sewer, the Consulting Engineer shall contact the City Planning and Economic Development Department during the preliminary Engineering stage to determine the constraints, if any, that may limit discharge into a combined sewer system.

The Consulting Engineer shall submit storm sewer design sheets in accordance with the sample design sheets attached as Appendix F – Storm Sewer Design Sheet / Combined Sewer Design. All storm sewer design sheets must be stamped and signed by a Professional Engineer. An electronic copy of the spread sheet in Excel format shall be submitted to the City upon approval of the design.

F.1.2. Location

Storm sewers shall normally be constructed in a common trench with the sanitary sewer and shall be located parallel to and to the north and west of the sanitary sewer wherever possible. When sanitary and storm sewers are constructed in a common trench, the designer shall ensure sufficient clearance between the storm maintenance hole and the sanitary pipe. Designers shall demonstrate that the storm and sanitary sewers can meet operational and maintenance requirements and in no case shall there be less than 450 mm separation.

F.1.3. Depth of Sewer

The cover of storm sewers shall be dependent on the storm sewer outlet. Generally, unless specified otherwise in the Functional Servicing Report (FSR), the minimum depth of cover over the storm sewer shall be 2.75 m below the centerline of the proposed road elevation (unless a more shallow minimum depth is justified in the FSR), for storm sewers designed to provide standard urban servicing.

However, as in the case with the sanitary sewer design, the Consulting Engineer shall investigate the profile of the storm sewer to the upper reaches of the storm sewer catchment area, taking into consideration potential conflicts with sanitary sewer crossovers and possible future road profiles along the route of the storm sewer.

If the profile of the storm sewer necessitates the placement of fill in excess of 0.6 m on lands outside the development, the Consulting Engineer shall be required to

demonstrate that reasonable care has been taken to ensure that the design of the storm sewer has been optimized so as to minimize the impact of fill on those lands.

F.1.4. Design Flows

The design flow, in each maintenance hole length of sewer, shall be computed on the standard City of Hamilton design sheet according to the Rational Method equation as follows:

$$Q \mid \frac{CiA}{360}$$

Where

Q = Peak rate of runoff (m3/s)

C = Coefficient of imperviousness

i = Rainfall Intensity (mm/hr)

A = Drainage Area (ha)

The Drainage Area (A) shall be determined from the largest scale contour maps available for the area. The Consulting Engineer shall obtain from the City's Planning and Economic Development Department, the overall storm drainage area maps that were used for the design of the trunk storm sewer systems. These maps shall then be refined based on existing development patterns that have evolved since the trunks were installed and on any additional detailed information available for the area.

The Rainfall Intensity (i) shall be based on the 5 year IDF relationship for the Mount Hope rainfall gauge, (ref. Appendix G – IDF Curves / Design Storms). The rainfall intensity is to be determined using:

$$i \mid \frac{A}{(t_c\ 2\ B)^C}$$

Where

ö, ö, ö = constants provided within Appendix G – IDF Curves / Design Storms

Storms;

ï = rainfall intensity (mm/hr)

ò ä = time of concentration in minutes

The Initial Time of Concentration ò$_{a}$ shall be 10 minutes, and the time for conveyance of storm flows shall be based on full pipe flow velocities. To calculate the initial external time of concentration for external lands that are scheduled for future development, the Consulting Engineer shall obtain the current neighbourhood secondary plans for the catchment area and determine the proposed street pattern and the most probable route of the storm sewer.

The top end of the storm sewer system shall then be assigned an initial time of concentration of ten minutes and the time for conveyance of the storm flows shall be determined using an average velocity in the storm sewers system of 2 m/sec. unless circumstances require a higher velocity.

All external areas shall be designed on the basis of developed conditions unless otherwise advised by the City's Planning and Economic Development Department.

Coefficient of imperviousness shall be determined from the types of land uses within the drainage area. Recommended values are as follows:

Table F.1- Coefficient of Imperviousness Table

Land Use	Recommended Coefficient
Parks	0.25
Single Family Residential	0.50 – 0.65
Semi Detached Residential	0.65
Townhouses, Maisonettes, Row Houses, Apartments etc.	0.75
Institutional	0.75
Industrial and Central Business District	0.80
Commercial	0.90
Paved Areas	0.90 – 1.00

For Blocks of land within a plan of subdivision where a site plan has not been proposed at the time of design, the Engineer shall use a conservative assumption for the land use and coefficient of imperviousness.

For external areas, the Consulting Engineer shall assign coefficients based on the current neighbourhood secondary plans. If no secondary plans are available for future external areas, the Consulting Engineer shall, in consultation with the City Planning and Economic Development Department, assign average coefficients that reflect a probable development pattern for the external area.

Sound Engineering judgement shall always prevail in the actual design.

F.1.5. Storm Sewer Pipe Design

New storm sewers shall be designed to flow at a maximum of 85% full design capacity of the pipe. Pipes shall be designed to capture all external catchment areas.

Manning's formula shall be used in determining the capacity of the storm sewers as follows:

$$Q = AV$$

and

$$V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = \frac{A}{P}$$

where Q = Capacity of the pipe flowing full (m^3/sec)

V = Velocity (m/sec)

R = Hydraulic radius (m)

A = Cross-sectional Area of pipe (m^2)

P = Wetted perimeter (m)

S = Gradient of pipe (m/m)

And n = Manning's factor = 0.013

The minimum design velocity for the storm sewer shall be 0.8 m/sec flowing full and maximum velocity shall not exceed 3.65 m/sec.

The minimum size of the storm sewer main shall be 300 mm diameter.

A minimum separation of 150 mm will be required between sanitary and storm sewer pipes where one sewer pipe crosses over the other.

Generally, no decrease of pipe size from a larger upstream pipe to a smaller downstream pipe shall be allowed, regardless of increase in grade, velocity and capacity.

F.1.6. Maintenance holes and Catch Basins

Maintenance holes shall be provided at each change in pipe alignment (vertical and horizontal), and at any change in pipe size or material and where the maximum spacing for a pipe run has been reached.

Generally, the maximum spacing for maintenance holes shall be as follows:

- 120 m for pipe sizes 300 mm to 1050 mm diameter; and,
- 150 m for pipe sizes 1200 mm and larger.

The maximum change in direction from upstream to downstream pipes for pipe sizes 675 mm and larger is 45°. For 675 mm and larger size of pipes where the change in direction is greater than 45°, additional maintenance holes shall be required to reduce the angle.

For maintenance holes constructed at the end of a line that is to be extended in the future, proper bulkheads shall be designed and the size of the bulkhead shall be specified on the Engineering drawings.

If the storm sewer is intended to be extended in the future and the spacing of the maintenance holes does not allow for the optimum use of the maintenance holes, then a temporary maintenance hole shall be constructed at the end of the storm sewer main line with a notation that it will be removed and relocated with the future extension of the storm sewer.

Maintenance holes may be constructed with either precast or poured in place concrete. The size of the maintenance holes shall be based on the pipe size, the deflection angle of the pipes and the number of pipes at the junction maintenance hole (see OPSD 701.021). When any dimension of a maintenance hole differs from the standards, the maintenance hole shall be individually designed and detailed.

Benching details for non-standard cases shall be detailed on the plan-profile sheets. Generally, the benching shall be brought to the spring line of the outlet pipe in accordance with OPSD 202.021.

The obvert of the upstream pipe(s) shall generally not be lower than the obvert of the pipe on the downstream side of the maintenance hole. If the cover over the storm main is being compromised because of this rule, then the design shall be on the basis of the 0.8 x diameter of the pipes are at the same elevation.

Suitable drops shall be provided across maintenance holes 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. In order to reduce the amount of drop required, the Consulting Engineer shall try to restrict the change in velocity between the inlet and outlet pipes to less than 0.6 m/sec.

The minimum drops across maintenance holes shall be as follows:

Alignment Change	Drop required
0°	grade of sewer
1° to 45°	0.03 m
45° to 90°	0.06 m

The maximum drop allowed across a maintenance hole is 0.6 m calculated from the invert of the upstream pipe to the invert of the downstream pipe (in accordance with OPSD 1003.01). In junction maintenance holes where there is a pipe entering the side

of the maintenance hole, the drop shall be calculated from the invert of the higher pipe to the top of the benching in the maintenance hole. For drops greater than 0.60 m a drop structure is required as per OPSD 1003.01. Generally, the size of the drop pipe shall be one size smaller than the connecting sewer with a minimum size of 200 mm and a maximum size of 300 mm. The invert of the drop pipe shall be shown on the plan-profile sheet and shall be a min. of 0.06m higher than the invert of the lowest pipe.

Safety gratings shall be installed in maintenance holes that are greater than 5.0 m in depth from the top of the maintenance hole grate to the lowest invert and shall conform to OPSD 404.020.

Maintenance hole frames and covers shall conform to OPSD 401.010 (open cover).

Roof water Leaders Discharge

All single-detached and semi-detached residential dwellings shall have roof water leaders that discharge to the ground via splash pads.

F.1.7. Storm Laterals (Public)

Storm laterals in the City of Hamilton shall be subject to the same criteria as sanitary laterals, as detailed in Section E.1.9 – Sanitary Laterals (Public).

The minimum size of storm laterals shall be 150 mm diameter. Shared storm laterals within the road allowance shall not be permitted.

In cases where dual sanitary and storm laterals are installed, the storm lateral shall be located to the north or east of the sanitary lateral. Locations for semi-detached, street townhouse and maisonette units shall be specified by the Consulting Engineer.

Storm service connections for blocks within a plan of subdivision (for commercial, institutional, industrial or multi-family block townhouses) shall be designed by the Engineer based on the specific land use of the block.

Freehold housing units in townhouse blocks or similar shall have individual private storm drains.

The storm lateral shall be extended from the main line sewer to 1 m beyond the street property line and a stake placed at the end of the lateral.

Laterals shall be white in colour to distinguish them from sanitary laterals, which can be any colour except white.

All underside footing elevations must be located a minimum of 0.30 m above the 100 year hydraulic grade line. In cases where the above criteria cannot be met, sump pumps shall be specified for each lot so affected. Foundation drains that connect into sump pumps shall discharge directly into the storm sewer.

The hydraulic grade line shall be plotted on all plan and profile drawings. Also refer to Section G - Stormwater Management of the Guidelines.

F.1.8. Catch Basins and Connections

Catch basins shall be designed to take into consideration the lot areas draining on to the roadway, the pavement widths, road grades and intersection drainage.

Catch basins shall be generally located upstream of any pedestrian sidewalk crossings, and if possible, should be avoided in driveway curb depressions. Double catch basins shall be installed at all the low points in a road. However, at intersections where the cross-fall of one road creates a low point on the other intersecting minor road, the back-fall shall be provided on the minor road to the end of the curb return radii to facilitate proper drainage of the intersection. Single catch basins only shall be required at the end of the curb return for drainage in this case. Catch basin maintenance holes are not permitted within the road right of way.

Catch basins spacing shall be determined as follows, unless prescribed otherwise by a detailed Stormwater management design:

Pavement Width	Maximum Spacing
8.5 m or less	90 m
9 m to 11m	75 m
11.5 m or greater	60 m

Where the road grades are between 3% and 5% the maximum spacing shall be reduced by 15% and for road grades between 5% and 6%, the maximum spacing shall be reduced by 30%.

Single / double catch basins as per OPSD 705.010 / 705.020 respectively. With a goss trap and a 250 mm diameter connection frame and cover for catch basins shall conform to OPSD 400.100 for local and collector roads and OPSD 400.070 for arterial roads.

F.1.9. Rear Yard Catch Basins

Rear yard catch basins receiving drainage from rear yard swales are deemed private and the ownership and maintenance is the responsibility of the property owner. The rear yard catch basin and lead shall be located on one lot and not on the lot line. All rear yard catch basins shall be sumpless with no goss trap. Rear yard catch basins shall conform to OPSD 705.010 with a beehive grate and connect to the storm sewer with a 250mm diameter lead. Where the rear yard catch basin drains future external land, the catch basin and lead is deemed public. A minimum 9 m easement is required in favour of the City of Hamilton and discharge pipe shall be designed as a storm sewer.

F.1.10. Pumping Station & Vertical Assets

Where a development will require a pumping station for functional servicing on a permanent or temporary basis, it should be brought to the attention of Development Engineering as soon as possible.

Where facilities of this nature are included in developments they will be subject to the same design standards as applied to projects undertaken by the City. It is expected that the all facilities, including those required to support phasing, will be designed for long-term, permanent operation. Relaxed criteria for temporary facilities will not be given consideration.

F.2. MATERIAL SPECIFICATIONS

F.2.1. Pipe Materials, Classification and Bedding

Acceptable material for storm sewers shall be in accordance with the current Pipe Material and Bedding Specifications, refer to City's Construction and Material Specifications Manual – Approved Products List.

Substitution of pipe material from the approved drawings must be approved by the City and Consulting Engineer prior to use.

Transition from one pipe material to another must be made at a maintenance hole or with an approved coupler at the discretion of the City.

The class, type of pipe and pipe bedding shall be indicated on the profile for each section of the sanitary sewer.

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. Bedding as per OPSD 802.010, 013, and 014 for flexible pipe and OPSD 802.030, 031, 032, 033 and 034 for rigid pipe shall be used in all new construction and the class of pipe shall be selected to suit this bedding detail and characteristics.

Bedding and cover material to be granular A compacted to 95% SPMDD. Maximum depth of cover shall be in accordance with OPSD 806.06, 807.01, and 03.

F.3. CONSTRUCTION SPECIFICATIONS

For Construction Specifications refer to City's Construction and Material Specifications Manual. The following inspection and testing works shall be carried out during and after construction of both municipal services and private services intended to service multi-unit developments:

- Sieve analysis of pipe bedding material for compliance with the specifications. Representative samples are to be obtained by the Geotechnical consultant during sewer operations. Any material that does not meet the City Standard must be removed from the site;
- Compaction tests shall be performed to assure that pipe bedding and backfill material has been compacted properly. (Refer to Section A.10.5 - Compaction & Material Testing); and,
- Sewer installation shall be regularly inspected and noted deficiencies must be corrected immediately.

F.4. COMMISSIONING / ACCEPTANCE AND ASSUMPTION PROCESS

The following shall be conducted in accordance with the City's Construction and Material Specifications Manual.

F.4.1. General Testing Requirements

Prior to acceptance the following shall be required:

- Receipt of as-constructed drawings;
- All sewers and maintenance holes must be flushed and cleaned prior to testing. A mandrel test shall be performed on all flexible pipe sewer mains in accordance with OPSS 410 which consists of a successful pass of the mandrel ("pig") pulled through the main. Notwithstanding OPSS 410, allowable deflections shall be a maximum of 5% for all pipe diameters tested;
- Video inspection of all sewer mains to assure no defects exist. (Refer to Section A.12.4 - Video Camera Inspection); and,
- After the completion of the roadworks (minimum base course asphalt) an initial visual inspection of the sewer works shall be completed with the contractor, Engineer and City. A report outlining deficiencies shall be provided by the City.

Prior to assumption the follow shall be required:

- Second mandrel test (and flushing) will be required prior to assumption;
- TV camera inspection for all sewers; and,
- Final visual inspection for all sewers.

G. STORMWATER MANAGEMENT

G.1. INTRODUCTION

Stormwater management design criteria contained in this document has been developed as a companion document to the City's Storm Drainage Policy best management practices, and relevant Provincial standards.

G.2. STORMWATER MANAGEMENT DESIGN CRITERIA

G.2.1. Minor System

The minor storm drainage system shall be designed to convey stormwater runoff from the one in five year return period according to the design principles and criteria outlined in Section F.1.4 – Design Flows and F.1.5. – Storm Sewer Pipe Design; thereby providing safe and convenient use of streets, lot areas, and other areas. Components of the minor storm drainage system could include swales, subsurface inceptor drains, curb and gutters, catchbasins, maintenance holes, pipes or conduits and service lateral lines in those areas where a piped storm drainage system is required.

G.2.1.1 Storm Sewers

Approved Master Drainage Plans (MDP's) which have established storm sewer sizing criteria other than one in five year standard will govern (Figure G-1). In the absence of approved MDP's, storm sewers shall be designed to a minimum one in five year, unsurcharged standard (i.e. 85% of pipe capacity). For any storm sewer to be assumed by the City the minimum allowable pipe diameter is 300 mm.

Figure G-1 Storm Sewer Sizing Criteria Decision Tree

Interfacing between new storm sewers designed to the minimum one in five year, unsurcharged standard and existing storm sewers of variable sizing standard shall

require hydraulic analysis of the existing and proposed storm sewers. Flow capacity of the proposed storm sewer shall be determined based on the receiving existing sewer remaining unsurcharged. The proposed storm sewer flow capacity would either be the one in five year standard or designed to allow the existing storm sewer to remain unsurcharged. Should the proposed storm sewer flow capacity be required to be less than the one in five year standard, to prevent downstream surcharging, inlet capacity for the storm sewer shall be designed accordingly. Should the existing downstream system be already surcharged, the proposed upstream storm sewer should not increase the level of surcharging downstream.

Hydraulic analysis of the proposed and existing storm sewer system shall provide hydraulic grade lines for the inlet capacity and/or one in five year standard and one in 100 year standard. Hydraulic analysis should demonstrate that no negative impact on the receiving storm sewer system results from the proposed storm, sanitary or combined sewer. The extent of the downstream off-site analysis needs to be verified with City staff prior to initiation, to ensure that downstream conditions are adequately accounted for in the analysis. The City shall provide the consultant with the 100 year hydraulic grade line for the existing storm infrastructure system when available. The designer has to prove that the downstream receiving system has capacity.

The 100 year HGL in the storm sewer system is to remain below the surface to ensure that there is no interference with the overland flow system as a result of surcharge from the storm sewer system. If it is demonstrated that it is not feasible to ensure the 100 year HGL remains below surface, for example as a result of a shallow system subject to physical constraints, a dual drainage model will be required to demonstrate that the minor and major system is capable of conveying the 100 year design flows ensuring protection of private property from flooding and limiting flow depths to ensure public safety and reasonable access.

Should downstream storm sewer surcharging be a concern under existing conditions, the Proponent may be required to restrict inlet capacity to ensure no negative impact on the receiving system. In addition, the Proponent is to ensure that adequate overland flow capacity is available in the development and in the receiving major system, incorporating the influence of the restricted inlet capacity of the storm sewer system.

G.2.1.2 Combined Sewers

Existing combined sewers may need to be upgraded when it is demonstrated that deficient capacity exists and/or the sewer requires capital maintenance. Discussions with City of Hamilton staff would be required prior to consideration of any combined sewer upgrades.

Interfacing between the existing (original) combined sewers and the upgraded combined sewer should be designed to the one in ten year, unsurcharged standard (i.e. 85% of pipe capacity) using the Rational Method. Hydraulic analysis should demonstrate that no negative impact to the receiving combined sewer system would result from the proposed combined sewer upgrades to the satisfaction of City staff.

G.2.1.3 Inlet Systems – Catch Basins

The minor system shall be designed so that conveyance capacity complements inlet capacity. Undersizing the inlet capacity can lead to under-utilized storm sewers and frequent roadway flowing, whereas oversizing the inlet capacity can lead to sewer system surcharging and possible basement flooding or floor fractures. As a minimum requirement, the City requires that double catch basins be installed at all low points in the road and single catch basins at low grade points.

In older, existing developed areas, catch basins may over-capture storm runoff which can result in flooding. In these potential retrofit cases, the drainage design for redevelopment should consider the use of inlet control devices to reduce the risk of system surcharge, or upgrade the hydraulic capacity of the system. Analysis of the storm sewer and overland flow system, in conjunction with discussions with the City, will determine if inlet control devices or upgrades to the system hydraulic capacity, shall be required, in order that the inlet capacity more closely matches the storm sewer capacity.

G.2.1.4 Foundation Drains

Foundation drains should be connected to a storm sewer or a combined sewer where present, but never a sanitary sewer.

Where no sewer outlet is available the Proponent should reference existing Watershed Studies, Subwatershed Studies and Master Drainage Plans for foundation drain requirements for the proposed development area. Should a Proponent propose that sump pumps discharge to the surface the City of Hamilton would require the following criteria to be met to its satisfaction:

- When the side yard has less than 1% grade, the foundation drain shall be directed to the storm sewer;
- That discharge to the surface would occur when a minimum of 1.8 m between the house and side lot line, with the exception of existing homes with less than 1.8 m available, via discussion with the City;
- Positive drainage from the rear of the house to the rear of the lot would exist (i.e. two way drainage); and,
- That positive adequate drainage be provided on the lot to convey sump pump discharge.

The Proponent should provide supporting hydraulic analysis for gravity foundation drains connected to the storm sewer to the satisfaction of the City. The Proponent should establish the basement floor elevation, a minimum of 0.3 m above the 100 year hydraulic grade line using hydraulic analysis techniques described in Section G.5.2 - Hydraulic Capacity. The City shall provide the consultant with the 100 year hydraulic gradeline for the existing storm infrastructure system when available. Foundation drains using sump pumps shall use a ‘gooseneck’ connection, in situations where the foundation drain at its highest elevation is placed above the foundation wall, no hydraulic grade line analysis is required in this instance.

G.2.1.5 Roof Leaders

All roof leaders shall be discharged to the surface.

G.2.2. Rear Yard Catch Basins

The City may elect to maintain rear yard catch basins and connections of 375 mm minimum diameter at 0.5% or sewers with a flow capacity of 130 l/s considered to be the minimum sized storm infrastructure requiring City access on Private property. Where the City elects not to maintain rear yard catch basins, those catch basins will be deemed private and the ownership and maintenance requirements are registered on title as part of the Development Agreement process. The catch basin and drain should be located on one lot and not on the lot line.

In order to protect private property and public safety in situations where the lead from rear lot catch basins may have collapsed or where the catch basin has become obstructed or plugged, the proposed lowest adjacent opening elevation (i.e. basement window sill) shall always be above the maximum ponding level above the catch basin, at which point there would be overland relief. Maximum desirable ponding level above a rear lot catch basin is 0.33 m, subject to rear lot grading. Where it is demonstrated that it is not feasible to limit ponding to 0.33 m it shall be demonstrated that full capture of runoff from the 100 year event or a safe overland flow route can be achieved.

G.2.2.1 Outlet Treatment

New storm sewer outfalls, which discharge into a natural watercourse, shall be designed to prevent erosion. They shall also be blended into the natural surroundings, in an aesthetically pleasing manner to the extent possible, given the size and location.

An access road with a minimum width of 4 m and cross fall of 2% should be provided to outfalls. Should the outfall be within a fenced area, gate access shall be provided.

Outfalls shall be provided with safeguards to prevent entry by unauthorized personnel into the outfall. Current City Standards use the Ontario Provincial Standard Drawings (OPSD), which should be followed to determine what outfall sizes require grating to prevent unauthorized entry.

The invert of the outlet, if possible, shall be located at, or above, the normal low flow (baseflow) water elevation of the natural watercourse (seasonally high baseflow, i.e. spring period). This can be determined through physical reconnaissance during the spring period and/or hydraulic calculations based on recorded or simulated spring baseflow. Pipe exit velocities shall not impart additional erosion potential to the streambed or banks. In addition, the outfall shall be adequately protected from erosive forces in the receiving watercourse to prevent scouring and undermining.

Although Conservation Authorities have not established outlet setback requirements for outfalls, the Proponent should position the outlet to minimize the outlet angle to normal creek flow and the outlet should be, if possible, located flush with the creek bank for

minor creeks with no valley flow and at the intersection of the overbank area / valley wall for major creeks.

Storm sewer outfalls to regulated watercourses require a permit from the respective Conservation Authority, who must be consulted on this matter. Storm sewer outfall design is to be submitted to the City as part of the full Engineering submission.

As the City of Hamilton borders Lake Ontario, storm sewer outfalls will at times be located at the lakefront. The design of these storm outfalls should consider the potential problem of dynamic breaches (ref. Ontario Ministry of Natural Resources Natural Hazard Technical Guidelines, March 2003) and the potential obstruction of the outlet. The outfall's invert should be located above the 100 year lake elevation if possible. The Proponent shall be required to consult with a professional coastal Engineer and provide appropriate protection measures. Storm sewer outfall design is to be submitted to the City as part of the full Engineering submission, and may require the appropriate Conservation Authority approval.

G.2.2.2 Swales

The maximum runoff typically allowed in a swale between two buildings and within rear lot swales is based on the grading guidelines in Section J - Lot Grading. Any swale deemed "significant" by the City staff, which require future maintenance, may be acquired as a permanent easement by the City and designated as an overland flow route. Swales conveying 0.70 m3/s or more for the 100-year storm shall be considered significant by the City. This flow rate is based on a 1.0 m wide grassed swale with 3:1 side slopes flowing at a depth of 0.33 m at a slope of 1%. The City, on a case-by-case basis, may consider a swale to be significant. Easements should be a minimum width of 4.5 m, when swales are considered significant, to allow the City access for maintenance.

G.2.3. Major System

G.2.3.1 Roadway Conveyance

Major roadways and local streets often convey runoff during severe storm events and, as such, shall be incorporated as elements of the major drainage system. For new development, road grades shall be constructed to provide positive conveyance to major watercourses or storm sewer inlets. The depth and extent of street flooding in new developments shall be limited in order to protect property and public safety, and allow emergency vehicle access, and shall not exceed flood depths according to the following road classification for the governing 100-year storm event as follows:

1. Arterial and Emergency Routes – 0 mm depth above road crown; and,

2. All other road classifications – 150 mm depth above road crown.

The roadway major system interface between existing and proposed development shall, whenever possible, be positively graded to convey roadway overland drainage to the flow capacity of the existing roadway system while maintaining roadway flooding depths

to the foregoing standards. Should overland flows from the proposed development be above the receiving existing overland flow system, storage of overland flow or other methods of reducing flows to the receiver flow capacity will be required. Should a positively graded major system interface not be possible under normal site grading conditions, as demonstrated by the Proponent, then alternative grading and/or methods of conveying the overland flow, such as, but not inclusive to, sag roadways (saw tooth grading), overland relief points and enlarged storm sewers, shall be reviewed with the City. It shall be demonstrated to the City that street flooding depths are maintained at/or below the foregoing roadway standards. Swale flooding depths are also to be maintained within these guidelines and the proposed minor system is to be designed as per these guidelines, such that the downstream major and minor storm systems are not negatively affected.

Road reconstruction projects within the City of Hamilton should not negatively impact the existing overland flow system. Should road reconstruction projects propose to increase pavement area resulting in overland flow depths above acceptable guidelines, alternative forms of Stormwater management should be investigated such as minor system or off-line storage.

G.2.3.2 Overland Flow Routes

All overland flow from rear yards shall be conveyed to roadways via swales or rear yard catch basins with connecting leads. The overland flow routes, through and from lots, shall be designed such that water levels remain below the finished grade adjacent to the swale. Swales located within the areas other than residential land use shall be designed to convey the 100 year event within the confines of the overland easement and shall maintain flow velocities below the erosion threshold for the swale.

Roads that are proposed to be used as an overland flow route shall be designed as stated within the foregoing Section G.2.3. In all situations the City would prefer overland flow compared to total capture into the storm sewer however, there will be instances where capture of the major system may be required. For example, overland flow routes crossing arterial roads, considered unacceptable. In these cases, (for arterial roads) it must be demonstrated that major system flows up to Regional event can be captured and conveyed either through a culvert or storm sewer to an approved outlet location. Regional storm flow overtopping depth and velocity on roads should be considered in accordance with Ministry of Natural Recourses and Forestry's "Technical Guideline-River & Stream Systems: Flooding Hazard Limit.

Overland flow routes such as natural channel systems shall adhere to the criteria outlined within Section G.2.4 – Natural Watercourse Systems.

G.2.3.3 Roadway Crossings

New roadway culverts and bridges should have sufficient conveyance to pass the Regulatory flow (larger of Hurricane Hazel or 100 year event), in order to avoid adverse backwater effects (ref. MTO Directive B-100). If, due to economics or other mitigating circumstances, this is not feasible, a backwater analysis must be undertaken to

determine the limits of upstream flooding and provide necessary mitigating design modifications.

Arterial and collector roadways in new developments should be, where possible, the only road classifications permitted to cross a watercourse having a drainage area in excess of 125 ha. Spacing and location of roadway crossings other than arterial or collector roads may be considered by the City when documented within the Stormwater Management Plan.

Freeboard and clearance (as defined in the governing Ministry of Transportation Ontario (MTO) manuals and the Ontario Bridge Code) requirements for watercourse crossings should be based on current MTO criteria.

Where a permit is required from a Conservation Authority, watercourse crossings will not be permitted to increase upstream flooding on private lands, unless appropriate waivers can be secured.

Allowable Regional storm event (Hurricane Hazel) flooding depths on roadways should be determined based on the standards within the Ontario Ministry of Natural Resources, River & Stream Systems: Flooding Hazard Limit Technical Guidelines, latest revision.

G.2.4. Natural Watercourse Systems

Where watercourse alterations are proposed as part of a development, the design of such alterations shall incorporate and consider the following:

G.2.4.1 Design Approach and Principles

- Channel design is to be based on natural channel forming processes to achieve a dynamically stable system. The channel evaluation methodology and design approach is to be consistent with the most current Provincial guidelines (ref. Ontario Ministry of Natural Resources, River & Stream Systems: Flooding Hazard Limit Technical Guidelines, March 2006, and Adaptive Management of Stream Corridors in Ontario. MNR, 2001);
- Alteration to a regulated watercourse will require a permit from the respective Conservation Authority (Development, Interference with Wetlands and Alterations to Shorelines and Watercourses) and potentially clearance / authorization from the Federal Department of Fisheries and Oceans (Fisheries Act) and Ontario Ministry of Natural Resources (Lakes and Rivers Improvement Act);
- Remedial works shall incorporate fish habitat protection / mitigation or compensation in accordance with the requirements of the Federal Department of Fisheries and Oceans (DFO) and Ontario Ministry of Natural Resources (MNR), related to stream type and significance; and,

- Remedial works shall incorporate the requirements of the governing Official Plan, as well as the requirements of provincial Ministries and other public agencies for protection of associated natural features such as:

  Environmentally Significant Areas (E.S.A.)
  - City of Hamilton
  - Conservation Authorities

  Niagara Escarpment
  - Niagara Escarpment Commission (NEC)

  Heritage Sites
  - Ontario Ministry of Tourism, Culture and Recreation

G.2.4.2 Setbacks

Conservation Authorities have established various watercourse setback policies which regulate development boundaries. The Proponent should always verify that the most current Conservation Authority's setback policies are being adhered to. Each of the four Conservation Authorities, Hamilton Conservation Authority (HCA), Niagara Peninsula Conservation Authority (NPCA), Grand River Conservation Authority (GRCA), and Conservation Halton (CH), requires development to adhere to their specific setback policies.

The size of setbacks from the watercourse edge to developable lands is typically a function of the significance of the valley form, the sensitivity of the watercourse and the type of development (building or other).

The Conservation Authorities may establish setbacks using Understanding Natural Hazards, MNR, 2001 to define the erosion hazard limit using stable slope allowances. Proponents should be aware that watercourse setbacks will typically be established by a Conservation Authority using the greater of the fisheries, valley and floodplain setbacks.

G.2.4.3 Access / Maintenance

- Creek block dedications adjacent to private land in new developments shall be fenced to prevent human access and encroachment. Fencing shall be on public property, 150 mm from the property line. Private access gates to creek block areas are not allowed; and,
- Natural channel design shall consider channel and utility maintenance requirements by incorporating access routes. Access routes may be located within the appropriate top of bank setback limit or adjacent to the low flow area in appropriately designated areas.

G.2.5. Stormwater Quantity and Quality Controls

Current Stormwater management practice advocates the consideration of Stormwater Management Practices (SWMP's) on a hierarchical basis, whereby more pro-active

techniques are considered first. The SWMP's are grouped under the following headings in order of preferred application:

- Lot Level Techniques, Source Controls and Alternative Development Standards;
- Transport or Conveyance Controls; and,
- End-of-Pipe Controls.

The philosophy behind this hierarchy is that Stormwater management techniques are usually more effective when applied at the source. The City of Hamilton supports Source Water Protection and Water Balancing using available appropriate Stormwater management techniques, such as infiltration technologies cited herein.

The City of Hamilton supports the progressive implementation of a wide range of Stormwater management techniques. This range is expected to increase and change over time, as long-term monitoring results indicating the level of success of various techniques, become available.

The City of Hamilton supports the integration of Stormwater management facilities with passive recreational opportunities, where the intended function of either is not impaired in accordance with the Parkland Dedication Policy. Where proposed, a review of the potential for integration of such facilities with recreational use will be required through consultation between the City of Hamilton, the general public and the Development Proponent.

Table G.1 and G.2 provide the current perspective of the City of Hamilton regarding available Stormwater management practices, as well as special supporting documentation which is required for implementation of each technique.

Table G.1 – Comprehensive List of Available SWMP's

Stormwater Management Technique	City of Hamilton Perspective	Special Supporting Documentation Required to Verify Suitability
Lot Level Techniques, Source Controls, and Alternative Development Standards		
Alternative Development Standards (i.e. Green roofs, biofilters)	On a case-by-case basis	Yes
Reduced lot grades	Not currently endorsed (ref. Lot Grading Standard)	N/A
Roof leader discharge to surface	Encouraged	Address winter icing concerns
Roof leader discharge to soakaway pits Rear yard ponding	Discouraged in residential land use due to maintenance and impacts on use of rear yards, including WNV	Geotechnical and on-site soil assessment

Stormwater Management Technique	City of Hamilton Perspective	Special Supporting Documentation Required to Verify Suitability
Rooftop storage	Discouraged, due to lack of municipal control. Green roofs can be discussed with the City.	Maintenance Agreement and Restrictive Covenant with owner to prevent alteration to system
Parking lot storage	Only where in Municipal control	Maintenance Agreement and Restrictive Covenant with owner to prevent alteration to system. Easements to be included in covenant with owner.
Porous pavement	Porous pavement applicable in specialized applications. Subject to proper documentation by the Proponent.	Technical documentation required
Pervious pavement	Pervious paving stone applicable in mitigation for thermal impacts; typically appropriate in low volume areas such as overflow parking	Technical documentation required

Table G.2 – Comprehensive List of Available SWMP's

Stormwater Management Technique	City of Hamilton Perspective	Special Supporting Documentation Required to Verify Suitability
Conveyance Controls		
Pervious pipe systems	Pervious pipe applicable in specialized applications, subject to proposed documentation by the Proponent	Geotechnical and on-site soils assessment
Pervious catch basins	Pervious catch basins applicable in specialized applications. subject to proposed documentation by the Proponent	Geotechnical and on-site soils assessment
Grassed swales (semi-urban road sections)	Encouraged where applicable (ref. Official Plan)	N/A
Oversized pipes (Superpipes)	Appropriate in redevelopment of existing areas	Need to demonstrate no other suitable alternative
End-of-Pipe Controls		
Structural		
Wetlands Hybrids Wet ponds	Applicable for water quality/quantity treatment	N/A
Dry ponds	Applicable for water quantity	N/A

Stormwater Management Technique	City of Hamilton Perspective	Special Supporting Documentation Required to Verify Suitability
	control only	
End-of-Pipe Controls		
infiltration basins	Limited applicability in the City of Hamilton	Geotechnical and on-site soil assessment
infiltration trenches	Limited applicability in the City of Hamilton	Geotechnical and on-site soil assessment
filter strips	Part of 'Treatment 'Train' only	N/A
buffer strips	Part of 'Treatment 'Train' only	N/A
sand filters	Limited application	Geotechnical and maintenance assessment
oil/grit separators	Applicable primarily for Commercial / industrial land use, shall not be used as a stand-alone SWMP	Maintenance Agreement with City
Non-Structural		
Cash-in-Lieu of On-Site Stormwater Management	Appropriate and supported particularly for infills and in watersheds of low environmental significance	Regional or site specific study of receiver sensitivity and available retrofit opportunities in accordance with DC-By-Law.

G.2.5.1 Source Controls

As noted, the City of Hamilton supports the implementation of source controls where feasible. The feasibility and overall benefit to be derived from implementing source controls would typically be determined in a Subwatershed Study or other form of Master Plan. Where such studies do not exist or are not applicable to the proposed development, the Proponent shall consider the application of source controls as a Best Management Practice (BMP).

Alternative Development Standards (ADS)

ADS are supported by the City of Hamilton on a case-by-case basis. The City of Hamilton Stormwater Master Plan, Class Environmental Assessment Report (City-wide), 2007 supports ADS, such as green roofs, biofilters, and pervious pipe systems. Proponents proposing ADS should consult with the City of Hamilton prior to the detail design stage.

Reduced Lot Grading

The City of Hamilton currently does not endorse reduced lot grading.

Roof Leader Discharge to Surface

Roof leader discharge to rear yard ponding areas is discouraged within the City of Hamilton due to West Nile Virus. Soakaway pits are applicable where infiltration is promoted. Subwatershed Studies on Master Plans may establish the feasibility of soakaway pits and should be followed in establishing subdivision detail design to the satisfaction of City staff. Soakaway pits identified within Subwatershed Studies or Master Plans may be used to serve single residential lots and typically only roof drainage, therefore, no pre-treatment is required.

Rooftop Storage

Rooftop storage has been used extensively in other jurisdictions for large flat roof topped commercial, industrial and institutional buildings for reducing post-development flow rates to storm sewer systems. The City of Hamilton discourages rooftop storage for new and infill development due to the lack of municipal control with a preference to other end-of-pipe controls such as Stormwater management facilities, but shall consider it based on discussion with the respective Development Proponent. The City of Hamilton would require rooftop storage designs be completed in accordance with MOE-CC 2003 guidelines and that the Proponents, agree to a restrictive covenant with the City of Hamilton. Green roof technologies may be discussed with City staff, but it should be noted that this technology is not considered typical rooftop storage.

Parking Lot Storage

Commercial, industrial and institutional developments have used parking lot storage to control post development flows to receiving storm sewer systems. The control structure be located within the development property boundary. Parking lot storage design shall be in accordance with the MOE-CC 2003 guidelines, although ponding depths shall be limited to 0.25 m. Ponding depths within loading bay areas should be designed to a preferred maximum of 0.30 m, although consideration for pond depths up to 1.0 m will be provided by the City due to site hydraulics, as long as the proposed ponding is not detrimental to the site conditions or adjacent properties.

Ponding on parking lot during frequent storms (up to five year) should be avoided.

Porous and Pervious Pavement

Porous and pervious pavements shall be used only for specialized applications as discussed in the MOE-CC 2003 guidelines. Both porous and pervious pavements have the benefit of improving infiltration and reducing thermal impacts of runoff. The Proponent shall provide design documentation to the satisfaction of City staff. A flow restrictor pipe shall be considered for all outlet control structure designs. An orifice plate can also be considered where a standalone restrictor pipe cannot meet flow target.

G.2.5.2 Conveyance Controls

Pervious Pipe Systems

The City of Hamilton may permit pervious pipe systems for special applications in accordance with the MOE-CC 2003 guidelines. In the event that pervious pipe systems are approved, Proponent must ensure there is sufficient clearance from the drinking water systems. Further, it has to be proven that the road base will not be affected by trapped water.

Pervious pipe systems exfiltrate water through the pipe wall and improve groundwater recharge. Existing pervious pipe systems in other jurisdictions have been documented as prematurely failing due to clogging, and as such, the Proponent shall provide technical documentation in support of the design, construction and maintenance requirements to the satisfaction of City staff.

Pervious Catch basins

As per pervious pipe systems, the City may allow pervious catch basins when the Proponent provides supporting documentation to the satisfaction of City staff. Pervious catch basins shall be implemented in accordance with the MOE-CC 2003 guidelines.

Enhanced Grassed Swales

The City supports the use of enhanced grassed swales, where applicable, for Stormwater quality treatment, provided that minimum length, velocity, flow depth and slope criteria are met for full functionality. The MOE-CC 2003 guidelines provides design criteria for enhanced grass swales and should be incorporated into the swale design.

Oversized (Super) Pipes

Super pipes provide subsurface storage to reduce post development peak flow rates to receiving storm sewer systems. The City of Hamilton may permit the use of oversized pipes to provide quantity control only for redevelopment, infill areas, and some smaller developments, when no other practical alternative exists. The Proponent shall incorporate the MOE-CC 2003 guidelines into the super pipe design.

G.2.5.3 End-of-Pipe Techniques

Wetlands

Constructed wetlands based on suitable soil conditions are suitable for providing Stormwater quality control / enhancement for drainage areas 5 ha or greater in size. The MOE-CC 2003 guidelines shall be adhered to in developing the wetland design. The application of BMP's would typically be developed through a Subwatershed Study and the detailed design established through a Stormwater Management Plan for proposed development.

Wet Ponds

Wet ponds are similar to wetlands, but typically are less land intensive. Wet ponds also require a minimum 5 ha drainage area to function effectively. Subwatershed plans typically provide the require guidelines for the Stormwater Management Practices in conjunction with the MOE-CC 2003 guidelines, but should a subwatershed plan not exist, the MOE-CC 2003 guidelines shall be followed.

Dry Ponds

Dry ponds require a minimum 5 ha drainage area. Dry ponds only provide erosion and flood control. Dry ponds do not have a permanent pool component, therefore, any water quality protection / enhancement, would only be as function of the facility's detention time and therefore would not be considered as effective as a wetland or wet pond. The MOE-CC 2003 guidelines provide design criteria for dry ponds, which should be incorporated into dry pond designs.

Hybrid Wet Pond / Wetland

Hybrid wet pond / wetlands systems consist of a wet pond, in series with a wetland. The permanent pool is approximately 50% within each element. The hybrid requires a forebay sized only to serve the wet pond. The MOE-CC 2003 guidelines design criteria for hybrid wet pond / wetland systems should be followed.

Oil / Grit Separators

Oil / grit separators are most appropriate for commercial/industrial land use and shall not be used as stand-alone SWMP, but rather as part of a "treatment train" approach to achieve the required quality treatment. Literature review of independent performance testing suggests that the removal efficiencies of oil/grit separators are only attainable under very specific circumstances, which are highly dependent on study design, specific site conditions, particle size distribution the varying flow conditions under which the tests are conducted. In light of this documentation, the City of Hamilton is prepared to accept, based on the US TARP (Technology Acceptance and Reciprocity Partnership) Tier I Conditional Interim Certification by NJDEP (New Jersey Department of Environmental Protection), that stand-alone OGS devise is only capable of achieving a TSS removal efficiency of 50%. It is the Engineering consultant's responsibility to contact the manufacturer to confirm the status of certification provided by NJDEP.

Infiltration Methods (General)

In general, there are relatively few areas within the City of Hamilton where Stormwater infiltration is critical to maintain downstream ecosystem integrity. Furthermore, the database regarding the impact of Stormwater infiltration on groundwater quantity and quality is currently limited. The application of this best management practice would typically be subject of a subwatershed study or other form of detailed local master plan.

Notwithstanding, various plans such as the Community of Stoney Creek Stormwater Quality Management Strategy Master Plan, 2004 outline areas of hydrogeological

sensitivity. Proponents of developments located within such areas shall provide site-specific soils investigations, confirming the potential effectiveness of infiltration techniques and the impacts on groundwater recharge and quality.

In the absence of such studies, the Proponent is encouraged to consider infiltration methods only where soil conditions warrant, and particularly in condominium-style residential developments. In either event, the Proponent propose infiltration methods as part of the Stormwater management plan, the potential impacts to the groundwater shall be clearly demonstrated in terms of quantity and quality; this may require the implementation of a groundwater monitoring program. Proponents should review the Groundwater Resources Characterization and Wellhead Protection Partnership Study available upon request from the Sustainable Initiatives Division of the Public Works Department.

Infiltration Trenches

Subsurface / surface trenches refer to infiltration systems, which typically can be implemented for small drainage areas (<2 ha) and are best suited for residential land use. Infiltration systems are best suited for high density housing such as townhouses, where several homes can drain to one trench. Townhouse condominium complexes will require infiltration trench maintenance requirements and ownership details to be included within the property title Agreement. The City of Hamilton shall require an easement from City property to the infiltration trench(s) to ensure maintenance of the trench is being provided by the townhouse condominium corporation. Soil conditions should provide suitable infiltration capacity. The MOE-CC 2003 guidelines should be incorporated into the infiltration system design.

Filter Strips

Filter strips are only considered appropriate for low-density development, roads and small drainage areas (<2 ha). Vegetated filter strips should be located adjacent to watercourses and drainage swales, as these systems can receive the sheet flow produced by the filter stripe 2003 guidelines should be adhered to in the design of the filter strip.

Buffer Strips

Buffer strips comprise natural areas located between development and the receiving water system or natural area. Buffer strips should be established and define at the subwatershed planning level with input from the Conservation Authority.

Sand Filters

Sand filters shall be limited to a drainage area less than 5 ha. Sand filters shall require a form of pre-treatment and shall not be used as a stand-alone SWMP. The type of filter shall consider the surrounding soil condition and the possibility of being connected to the proposed storm system.

The MOE-CC 2003 guidelines outline the conditions and criteria for filters.

G.2.5.4 Cash-in-Lieu of On-site Stormwater Management

In principle, cash-in-lieu on-site of Stormwater management would involve a Development Proponent providing a designated financial contribution towards off-site Stormwater management infrastructure, elsewhere in the City, in lieu of providing on-site Stormwater management. The prerequisites to such an approach include a low sensitivity receiver, or limited rehabilitation opportunity and typically small or infill development form. The Proponent is to provide a report that outlines where the cash-in-lieu can be applied.

G.2.6. Spill Prevention and Control

Spill prevention and control measures shall be implemented for all industrial and commercial developments that process, store or refine liquid products that would be considered a contaminant within the receiving Stormwater system, to ensure that spills or leaks do not impact downstream water quality. Examples of spill control BMP's used for the prevention of the discharge of pollutants to the Stormwater system are:

- Oil / grit separators;
- Spill containment tanks;
- Stormwater facility shutoff valves;
- Vehicle loading area covering;
- Vehicle loading procedures; and,
- External storage area containment.

Industrial and commercial developments shall develop a spill prevention and control plan incorporating appropriate preventative spill measures, identification of spill areas, material handling procedures and spill response procedures. The Proponent shall outline the methods of spill reporting, assessing, monitoring and coordination of spill clean-ups. In addition, the Proponent should note that the spill control BMP's effluent is regulated by the Sewer Use By-Law. The Proponent shall submit the spill prevention and control plan to the City's Compliance and Regulations Section of the Public Works Department.

G.3. EROSION AND SEDIMENT CONTROL

G.3.1. Erosion and Sediment Control Plan

New urban developments can accelerate natural sediment loading rates to the surrounding water bodies, particularly during construction, when the ground cover has been removed. In order to control the impacts of sediment loading from development (i.e. poor water quality and aesthetics, restricted channel conveyance etc.), it is required that erosion and 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 (ref. Erosion and Sediment Control Guidelines for Urban Construction, GTA Conservation Authorities, 2006) and provincial guidelines (ref. Ontario Guidelines on Erosion and Sediment Control for Urban Construction Sites 1987).

As a minimum, Proponents shall prepare Erosion and Sediment Control Plans that incorporate recommendations and protection measures pertaining to:

- Planning site construction to fit the terrain;
- Construction scheduling / timing of grading;
- Minimizing soil exposure and re-establishment of vegetative cover;
- Provision of temporary cover for stripped areas scheduled to be dormant for over 30 days;
- On-site erosion and sediment techniques (e.g. diversion of runoff away from stripped areas);
- On-site control measures;
- Site Supervision procedures;
- Monitoring and Maintenance;
- Site Restoration; and,
- Special Considerations (i.e. in-stream construction / crossings, fisheries timing constraints.

The foregoing should be clearly defined within both the Functional and Final Design Stormwater Management Reports, as well as on the detailed Engineering design drawings.

G.3.2. Regulation

Topsoil preservation by-laws that were enacted in the former Municipalities have been amalgamated into a common by-law for the City of Hamilton under a Site Alteration By-law No. 03-126. Landowners need to be aware of, and comply with, the most current by-law.

Sediment and Erosion Control Plans, once approved by the City and appropriate Conservation Authority, will form part of the Development Agreement.

The Development Proponent will be required to hire a qualified environmental inspector who will submit monthly status reports to the City's Development Engineering Section until the development is 80% built out. The reports must be signed by a qualified Professional Engineer. Details of the requirements of the inspection report are available in Appendix H – Erosion and Sediment Control Inspection Report. An inspection is also required immediately after (i.e. within 24 hours) a major storm event (considered a 15 mm total rainfall depth over 24 hours or less). Environment Canada through its website

provides daily rainfall amounts for the City of Hamilton. The City will develop a monitoring program with the Proponent and ensure compliance through the Subdivision Agreement. Developments that are less than 1 ha in size are not required to provide monthly status reports to the City. When considering a block development this condition may be covered by the Site Plan.

The City will require a Letter of Credit for erosion and sediment control infrastructure. City inspectors will regularly inspect sites for erosion and sediment control deficiencies.

The requirement for monthly inspection reports may be relaxed or modified under certain conditions (e.g. when the site is dormant over an extended period), provided the Development Proponent can provide adequate justification to City staff to support such a request.

G.3.3. Proponent / Builder Responsibility

Once a development is serviced with utilities and roads (i.e. ready for building contractors), the focus of erosion and sediment control shifts from the general site development to the specific lot-level controls. It is the responsibility of the Proponent, as per the Subdivision Agreement, to ensure that excess sediment is not allowed to be transported off lots and into gutters, catch basins, storm sewers and watercourses, or tracked off-site by vehicles. Inspections and reporting shall be tailored to reflect the changes in construction practices and locations on the site. Inspections and reporting shall be the responsibility of the Proponent, with builders responsible to the Proponent.

G.4. DEVELOPMENT IMPACT MONITORING

G.4.1. Need

All land use change without (and often with) mitigation work, causes an impact to the runoff regime. Stormwater management measures are intended to reduce or eliminate adverse impacts to surface water, groundwater and receiving systems resulting from changes to runoff quality and quantity. The theoretical performance and function of Stormwater management works has been relatively well documented. However, unique conditions are associated with each development, such as: topography, land use, soils, groundwater levels, design approach, construction methods, etc. All of these factors can combine to reduce the predictability of the performance of Stormwater management infrastructure, leading to the need for at least a minimum level of monitoring, prior to, and possibly after, assumption by the City. In that regard, Development Proponent shall submit a Development Impact Monitoring Plan to the City for approval (ref. Sections G.4.2 - Purpose to G.4.6 - What is Monitored?). Conservation Authorities and the Niagara Escarpment Commission, in addition to the City, may have input on Monitoring Plans.

G.4.2. Purpose

The purpose of the Development Impact Monitoring Plan is to:

- Evaluate the performance of the Stormwater and Environmental Management System (i.e. design and Stormwater quantity and quality mitigation techniques). This does not include the storm sewer system; and,
- Provide the necessary information to adjust and/or optimize the plan recommendations through a process of monitoring various environmental parameters established within a Monitoring Plan for a development site. Based on monitoring results, necessary adjustments to the site's environmental management controls would be made to meet the environmental objectives for the site.

G.4.3. Types of Monitoring Plans

Generally, Monitoring Plans are either one or two types. The first is a stand-alone plan prepared for a single development and its associated infrastructure. The details of this type of plan would be part of the Preliminary and Final Stormwater Management Design Reports. The scope is normally limited to direct on-site infrastructure that is part of the development; this is paid for by the Proponent.

The second type of Monitoring Plan would be part of a Drainage Master Planning document, such as a Watershed Plan, Subwatershed Plan or Class Environmental Assessment, usually in support of a major land use change of broader scope. Such a plan is normally administered by the City. Its scope typically includes numerous environmental indicators and infrastructure elements.

G.4.4. Process / Protocol

Each Development Proponent will be responsible to ensure that a Monitoring Plan is in place, satisfactory to the City. In the event that the subject development is part of an area which already has a master Monitoring Plan in place, the Proponent shall document how the subject development and its infrastructure complies with the plan.

Where applicable, monitoring requirements shall comply with those specified in the Master Drainage Plan or the Sub-Watershed. For developments where specific criteria are not outlined the City, in consultation with the appropriate conservation authority, will work with the Proponent to develop a monitoring protocol on a case by case basis. These requirements will be dependent on the specific needs and environmental constraints associated with the receiving watercourse.

Where the subject development is 'non-greenfield' (i.e. typically infill or 'brownfield') and is not part of an area covered by a Drainage Master Plan, the Proponent shall consult with the City staff during the pre-consultation stage to determine if monitoring is required. Should monitoring be required, the Proponent shall prepare a Monitoring Plan as part of the Preliminary and Final Stormwater Management Plan, in consultation with the City. The Monitoring Plan should be established to determine the potential development impacts on-site and within the receiving system to the satisfaction of the

City. It should be noted that the Monitoring Plan for infill development shall not be as extensive as per required for the 'greenfield' development. Costs of the monitoring program would be borne entirely by the Proponent.

Under the 'greenfield' approach, no reporting or direct follow-up involvement with the individual Proponent will be required, as the full share cost of the program will have been secured. Under the 'infill' approach, the Proponent will be responsible to submit annual reports prepared by a qualified Professional Engineer, to demonstrate that the monitoring has been completed to the satisfaction of the City.

G.4.5. Monitoring Periods

Development Agreements will typically provide insight and direction on timeframes for construction, warranties and assumption. Important factors for development impact monitoring include pre-construction, construction and post-construction or substantially developed requirements. During construction, the monitoring requirements would strictly relate to those specified in the Erosion and Sediment Plan (ref. Section G.3 - Erosion and Sediment Control). Hence, development impact monitoring applies only to the pre- and post-construction state, normally considered to come into effect two or three years after start-up of construction. A one year maintenance period typically follows placement of top course asphalt within a development. The securities, typically 10% of construction costs, during the maintenance period would be required to address Stormwater infrastructure deficiencies (this is not in addition to the 10% held by the City currently for maintenance). This timeframe can obviously change depending on market and contractor progress. The specifics will need to be detailed in the associated Stormwater management reporting.

G.4.6. What is monitored?

The actual specifics of what is monitored and the length of the monitoring program, relate largely to the characteristics of the development and in-situ conditions, including the sensitivity of the local receiving system and the availability of existing information. The ultimate decision with regard to monitoring scope requirements rests with the City and commenting agencies, through the review of the Preliminary and Final Stormwater Management Reports. DFO will require Monitoring Plans should a project constitute a Harmful Alteration, Disruption or Destruction (HADD) of fish habitat and are typically a minimum length of two to three years. While not intended to be exhaustive or mandatory, the following general list provides some guidance.

Hydrometerologic

- Rainfall – Continuous
- Streamflow – Storm Response
- Groundwater – Levels
- Baseflow – Flowrate (Spot)
- Water Quantity

- Inflow / Outflow at stormwater management facilities – Wet Event Response, Facility Storage-Discharge Relationship

Water Quantity

- Inflow/Outflow At Stormwater Management Facilities – Wet Event Response Facility Storage - Discharge Relationship

Water Quality & Aquatic Habitat

- Benthic Invertebrates – Community Structure
- Water Temperature – Continuous
- Surface and Groundwater Chemistry Standard Parameters including Nutrients, Metals and Bacteria
- Sediment – Total Suspended Solids
- Fisheries – Electrofish Selected Reaches

Fluvial Geomorphology

- Stream Cross-sections (Controls)
- Sediment Transport (Substrate
- Composition
- Erosion pins (Tractive Force, Critical Shear Stress)
- Bank Properties (Height, Angle, Material, Vegetation, Root Depth, Undercuts and In-situ Shear Strength)
- Long Profile Survey (Energy Gradient, Top and Bottom Riffles, Max Pool Depth)

Natural Heritage System

- Community Structure / Health – Ecological Integrity, Habitat Boundary Integrity, Problem Species, Overall Species and Habitat Diversity, Buffer Effectiveness, Human Activity Impacts Local Hydrology (water levels, soil moisture, etc.)

G.4.7. Enforcement

As part of the requisite development Agreements, the City will hold a portion of the Letter of Credit as security to ensure that the whole of the monitoring program is completed, as detailed in the accompanying Stormwater Management Report. Proponents shall conduct the monitoring program, should the development not be part of a Master Monitoring Plan established within a Watershed Study, Subwatershed Study or Master Drainage Plan. Should the Proponent's annual reporting not be considered appropriate or compliant, the City will exercise the Letter of Credit and have the monitoring program completed by accredited professionals. The 10% securities would be used by the City to adjust the drainage system, as necessary, including channels

and Stormwater management facilities for the monitoring period as defined by the City, the Conservation Authorities and DFO.

G.5. ANALYTICAL METHODS

Analytical methods can be subdivided into two categories, Hydrology and Hydraulics, representing the establishment of flows and flow levels, respectively. Hydrology typically precedes the determination of hydraulics for all new development and redevelopment, as flows are required to establish the hydraulic characteristics of open and closed systems.

For both hydrology and hydraulics, there are numerous available analytical methods. The analytic methods provided in this document represent established techniques that are considered acceptable by the City of Hamilton. The Proponent is not limited to the methods herein, although discussion with the City of Hamilton and review agencies would be required to confirm the appropriateness of using alternative hydrologic and hydraulic analytical techniques prior to their use.

G.5.1. Hydrology

G.5.1.1 Rainfall

Intensity – Duration – Frequency (IDF)

The IDF Curves / Hyetographs for the former municipalities' design storm events have been replaced with new IDF Curves / Hyetographs, based on current rainfall information. Rainfall data from both the Hamilton Airport and Royal Botanical Gardens (RBG) has been reviewed. Based on maintaining simplicity, the more conservative Hamilton Airport IDF relationship has been adopted (ref. Appendix G – IDF Curves / Design Storms). Notwithstanding the foregoing, both Hamilton Airport and RBG rainfall data should be considered for Watershed, Subwatershed and Master Drainage Plans, but not for design of storm sewer infrastructure.

Table 1 in Appendix I - Current Streamflow and Rainfall Monitoring in Hamilton Harbour Watershed provides the location of current City of Hamilton rainfall gauges, specifying the duration of rainfall record for each gauge. The table also provides stream flow monitoring locations. In addition to the stream flow monitoring locations in Table 1, water levels within the Binbrook Reservoir (Wetland River) are continuously monitored by the NPCA.

Temporal Distributions

Typically, there is not a single temporal distribution that should be used exclusively within the City. Each distribution has its own unique characteristics, which can be used to fulfill different hydrological analysis requirements. It is the responsibility of the Proponent to establish which distribution should be employed in establishing the design events for a development of redevelopment to the satisfaction of the City. Consideration should be given to the drainage area(s) size, characteristics and objective functions when determining which temporal distribution to use. To this effect, a document

containing various design storms and temporal distributions considered acceptable for use within the City of Hamilton is available upon request. The City will approve the selected rainfall distribution at the Functional Design Stage. A document outlining various durations of the AES, SCS and Chicago design storms is also available upon request.

The SCS storm distributions utilize mass rainfall curves to derive the design storm. SCS Type II design storms typically provide the highest peak flow for rural catchments in comparison to the Chicago distribution. The Chicago distribution developed from an Intensity-Duration-Frequency (IDF) relationship generally provides greater peak flows for urban areas than the SCS Type II distribution.

The AES 1-Hour Strom Distribution can be used in developing a hyetograph with knowledge of the total rainfall, time to peak and decay constant. This storm distribution is not as widely used as the SCS Type II and Chicago storm distributions and should be compared to the other distributions in determining the controlling storm design.

The selection of the duration of the rainfall event should also consider the drainage area characteristics and Stormwater management approach. In addition, approval agencies other than the City of Hamilton should be consulted in determining both the type of temporal distribution and the storm event duration. The City of Hamilton will have to approve the selected temporal distribution based on a sensitivity analysis before finalizing the functional SWM report.

G.5.1.2 Rational Method

The Rational Method of determining design flows should only be used as an approximation of flows for relatively small drainage areas (i.e. less than 5 ha) due to the conservativeness of the approach. Flows determined using the Rational Method are typically higher than those resulting from complex hydrologic models.

The Rational Method can be used for storm sewer design regardless of the total contributing area, using the City of Hamilton's storm sewer design sheet and the new IDF relationship for Mount Hope Airport rainfall gauge (ref. Appendix G – IDF Curves / Design Storms).

G.5.1.3 Event Based Hydrologic Models

A list of event based hydrologic models considered appropriate has been provided within Appendix J – List of Approved Hydrologic and Hydraulic Models. The list will be periodically reviewed (every 5 years) to include either new hydrologic models or models considered appropriate at the time of preparation. Should a Proponent wish to use another model, documentation as to the validity of the model should be provided to City staff for review prior to use.

Both the Flood Plain Management in Ontario Technical Guidelines, Ontario Ministry of Natural Resources, 2001 and the Drainage Management Manual Parts 3 and 4, Ministry of Transportation, 1997 provide general guidelines on the selection of hydrologic models. The Ministry of Transportation document lists the characteristics of each model,

from which the Proponent can evaluate the appropriateness of certain event based hydrologic models.

Sound hydrologic modelling standards of practice should be followed in developing an event based on hydrologic model. The following standards of practice are intended to guide general model preparation for most hydrologic programs and techniques, however, this list should not be considered exhaustive:

- The modeller should provide the purpose for developing the hydrologic model, such as determining flow rates, runoff volumes, flow routing effects for proposed development, existing land use conditions etc.;
- The modeller should provide the study objectives and how they relate to the hydrologic modelling;
- The modeller should provide the basis for the storm design information, outlining how the design storm has been selected;
- The modeller should provide drainage area plans outlining both internal and external catchments, modeling schematics and tables providing drainage area parameters;
- Background information on the selection of the drainage area parameters should be provided to assist the City in understanding on the assumptions leading to the drainage area parameters;
- Background data on overland and minor storm systems should be provided with plans clearly presenting and labelling both systems;
- Data should be provided on routing through natural and manmade storage systems, with detailed plans and calculations outlining how the stage / discharge relationship has been developed;
- Sensitivity analysis should be conducted on a minimum number of parameters which varies with model complexity;
- Verification or validation of results should be provided through various methods such as calibration to recorded streamflow, unit flow rates and runoff volume comparisons using the techniques such as the MTO index method or equivalent. The application of the validation technique (number and type) will depend on the availability of data and the sensitivity of the analysis; and,
- The modeller should provide all input and output details in a logical manner, with an explanation for potential errors.

G.5.1.4 Continuous Models

Continuous models (ref. Appendix J – List of Approved Hydrologic and Hydraulic Models) differ from event based hydrologic models in that rather than using a synthetic design storm based on IDF data, a long term time series of historical meteorological data is used for the input driving function. In addition to historical rainfall data, continuous models typically require seasonal state variables. Continuous models are usually more complex than event based hydrologic models, as typically the models consider more processes including temperature, evapotranspiration, snow conditions and groundwater. Notwithstanding, the modelling standards of practice for event based

on hydrologic models also apply to continuous models. Continuous models are typically used but are not limited to higher level studies such as watershed and subwatershed studies. Continuous modelling may also be used for studies with a scope requiring historical data inclusion.

In addition to the standards of practice for event based hydrologic models, the Proponent should demonstrate that the historical meteorological time series selected has been obtained from the nearest rainfall gauge to the Proponent's study area. This will often lead to a trade-off between duration of record and proximity. Typically, the minimum duration for meaningful continuous simulation is 20 to 25 years. Historical rainfall data is available from the City, Conservation Authorities and Environment Canada.

The Proponent in selecting a continuous hydrologic model usually intends to develop frequency flows for the historical data period. The Proponent should specify the assumptions and methodology for determining the frequency flows and typical year hydrographs. The Proponent should provide validation of the selected probability distribution by using statistical tests.

The Proponent should select the continuous model giving consideration to development and/or redevelopment characteristics to the satisfaction of the City. In addition approval agencies (i.e. Conservation Authorities, MNR, MTO and others) other than the City should be consulted to determine modelling requirements.

G.5.2. Hydraulic Capacity

Drainage systems can be subdivided into both closed and open systems. The hydraulic capacity of the receiving minor and major storm system is to be determined to verify that drainage can be safely conveyed as proposed. For each system various analytical techniques can be employed. Appendix J – List of Approved Hydrologic and Hydraulic Models lists hydraulic analytical techniques acceptable to the City; however, the list should not be considered exhaustive. The Proponent is not limited to the methods herein, although discussion with the City and review agencies (Conservation Authorities, MNR, MTO and others) would be required to confirm the appropriateness of using alternative hydraulic analytical techniques.

The hydraulic capacity of a storm system can be determined through hydraulic modelling and for certain applications through the use of standard 'hand calculations'. As for hydraulic modelling, standards of practice relate to the use of various techniques. The following standards of practice are intended to provide direction:

- The Proponent should clearly identify the study objectives and how they relate to the hydraulic modelling;
- The Proponent should provide the purpose for the hydraulic modelling;
- The modeller should provide the model selection criteria and how the model matches the criteria;
- The Proponent should provide plans clearly presenting the closed and/or open hydraulic system;

- For plans describing open systems, the Proponent should note cross-sections, study limits, land use, crossing details, spill areas, ineffective flow areas, and flooding limits and elevations for the appropriate design event(s);
- For plans describing closed systems such as storm sewers, the Proponent should note the storm sewer network details including maintenance hole numbers, storm sewer size, length, study limits, land use, slope and sewer and ground elevations;
- For combined hydrologic / hydraulic models such as SWMM, the Proponent should provide plans that not only describe the close system but also the contributing drainage areas and overland flow system;
- For all hydraulic models, the Proponent should provide the downstream and, if applicable, the upstream boundary conditions for each storm modeled and the assumptions used to define the boundary conditions;
- For all hydraulic models, the Proponent should document the parameters established for hydraulic losses such as Manning's 'n', inlet and outlet losses and other appropriate losses;
- The Proponent should summarize the selection of procedures for determining the computer energy grade line and water surface elevations;
- The Proponent should document the hydraulic results in summary form for the relevant storm events;
- The Proponent should prepare the model of an open system such that it fully contains the modelled flows without exceeding the hydraulic cross-section. Should it not be possible to contain the flows within the defined geometry of the open storm system, the Proponent should provide details on the spill characteristics. In the event of a spill, a rationale should be provided on whether or not to include a flow loss in the calculation;
- The Proponent should document potential impacts on existing infrastructure and possible mitigative measures;
- Sensitivity analysis should be conducted on a limited number of parameters depending on the model type and complexity;
- The Proponent should, if possible, verify hydraulic results for an existing closed / open storm system by documenting historical flood elevations for specific storm events and comparing the hydraulic modelling results to the historical data; calibration of losses should be included, if sufficient data exists; and,
- The Proponent should provide the input and output data in a logical manner with an explanation of the potential error.

The hydraulic capacity of storm sewers is to be determined using the City of Hamilton Storm Sewer Design Sheet (ref. Appendix F – Storm Sewer Design Sheet / Combined Sewer Design). The Proponent is required to abide by the relevant hydraulic modelling codes of practice (i.e. specifically No.'s 1,3,6,8, and 9). In addition the Proponent should document, in both plans and text, hydrology for the storm sewer design. The storm sewer design should be conducted using the City of Hamilton's 5 year IDF storm data of the City's approved storm event for the study area (regardless of the return period used previously to size downstream storm sewers).

G.5.3. Stormwater Management Design – Analytic Requirements / Methods

G.5.3.1 Flood Management

All newly developing or redeveloping areas must assess their potential impacts on local and regional flooding, mitigate accordingly. In areas where no watershed plan has been completed, it is the policy of the City of Hamilton to require that runoff peak flows are controlled to pre-development levels or less, unless the Proponent can demonstrate through appropriate modelling and analysis that uncontrolled flow will not cause detrimental impacts on flood conditions on downstream properties and watercourse systems. Before the City will accept any increase in runoff rates, it must also receive endorsement from the agencies having jurisdiction. In certain site-specific circumstances, the City may require that post development flows be controlled to less than pre-development levels. As such, discussion regarding the over-control of post development flows would be required with the City.

Where Watershed Subwatershed or Master Drainage Plans 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.

In some areas post-development discharge from development areas are required to meet the unitary flow criteria where it has been established through a Subwatershed or Master Drainage Study to ensure protection of any sensitive natural systems. It is incumbent on the Proponent to demonstrate through appropriate modelling methodologies that the design satisfies the unitary flow criteria where applicable.

Sizing flood management controls (i.e. Stormwater management quality control facilities) is typically an iterative procedure. The Proponent should develop a stage / storage / discharge curve for a Stormwater management control facility by determining the required runoff volume to be detained for various storm events.

The procedure for runoff determination typically requires the modeller to use either an event based or a continuous hydrologic model. The modeller should determine which modeling methodology to use. The first step in methodology selection should be whether or not a watershed, subwatershed or similar previous study has been completed and the type of modeling used. If no previous study has established the modeling requirements, the following should be considered in selection of a methodology:

- The sensitivity of the watercourse from fisheries and erosion perspectives;
- The availability of long-term meteorological continuous data;
- The availability of stream flow data; and,
- The potential for Stormwater management long-term monitoring.

For an event based hydrologic model, the Proponent typically stores the volume of the post development flow hydrograph above the pre-development hydrograph. For continuous modeling, the Proponent can size a facility by comparing controlled post

development flows to the pre-development flows using frequency analysis. In addition, the post development continuous model can be compared to the pre-development model for various rainfall events. This requires the modeller to compare the size and shape of a flow hydrograph from a Stormwater quantity facility to the pre-development hydrograph for the same storm events.

In providing the City of Hamilton details on flood management, the Proponent should follow standard codes of practice. The following standards are intended as a guide of requirements; however, this list should not be considered exhaustive:

- The Proponent should provide the background hydrology behind the pre-development post-development and controlled post-development scenarios (ref. hydrologic modelling G.5.1.3. and G.5.1.4);
- The Proponent should provide details on the stage / storage / discharge relationship of the flood control facility. Methodology of determining the relationship shall be provided;
- The Proponent should provide cross-sections of the facility and details of the inlet(s) and outlet(s);
- The facility should have an overflow weir which is typically required for the uncontrolled Regulatory storm event;
- The facility should have a maintenance access for both the inlet(s) and outlet(s); and,
- The Proponent should provide landscaping details.

G.5.3.2 Erosion Control

Depending on the downstream water level and the nature of the soil strata affected, streambanks can be subject to increased erosion potential. In these cases the Proponent(s) will be required to provide appropriate protection in accordance with the Watershed, Subwatershed or Master Drainage Plan, as well as the policies of the appropriate Conservation Authorities, and possibly the Niagara Escarpment Commission.

In areas where no Subwatershed 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 modelling and/or analysis that stream stability will not be adversely affected by the proposed development.

Erosion control and management involves one of the following:

- Extended Detention storage for the Simplified or Detailed Design Approach or the 25 mm storm event as outlined in the Provincial Guidelines (ref. Stormwater Management Planning and Design Manual, MOE-CC, 2003), in the absence of specific direction from a Subwatershed or Watershed Plan;
- Assessment of downstream erosion susceptibility and critical flow values in conjunction with event modelling; and,

- 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. Ontario Ministry of Natural Resources, River & Stream Systems: Flooding Hazard Limit Technical Guidelines, March 2006).

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.

The Proponent should consider the following standard codes of practice in providing erosion control documentation:

- The Proponent shall provide the rationale and background information for the methodology used in assessing the required erosion controls;
- The Proponent should provide downstream erosion threshold parameters based upon field investigation and background information;
- The Proponent should demonstrate how the erosion controls have adequately addressed downstream erosion conditions;
- The Proponent should, in the case of an erosion control Stormwater management facility, provide:
  - Stage-storage-discharge details and calculations;
  - Outlet control details;
  - Facility plan and cross-sections; and,
  - Watercourse configuration at outlet; and,
- The Proponent should document any proposed mitigation measures and provide the calculations performed in determining the measures.

G.5.3.3 Quality Management

Water quality treatment performance shall conform to Provincial requirements (ref. Stormwater Management Planning and Design Manual, MOE-CC, 2003; Water Management Policies, Guidelines Provincial Water Quality Objectives (Blue Book), MOE-CC, 1994), City of Hamilton and Conservation Authority Requirements. For areas where a Watershed, Subwatershed or Master Drainage Plan has been prepared and approved, the guidelines and criteria cited within the plan shall be adopted by the Development Proponent.

Specific guidelines for SWMP application have been developed by the Province based on the type of fisheries habitat downstream of the proposed development. Three levels

of protection are given, with the goal of maintaining or enhancing existing aquatic habitat, based on the suspended solids removal performance developed through continuous simulation modeling for the different end-of pipe Stormwater management facilities. These levels of protection are based on a general relationship between the end-of-pipe Stormwater 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:

Level 1 - Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term removal of 80% of suspended solids. Areas outleting to Hamilton Harbour shall provide level 1 treatment.

Level 2 - Normal protection corresponds to the end-of-pipe storage volumes required for the long-term removal of 70% of suspended solids. Areas outleting other than Hamilton Harbour shall provide level 2 treatment.

Level 3 - Basic protection corresponds to the end-of-pipe storage volumes required for long-term removal of 60% of suspended solids.

Proponents shall contact the appropriate Conservation Authority to establish current watershed habitat classifications. Within the City of Hamilton, the following habitat classifications apply:

Table 6.3
Watershed Habitat Classification

Watershed	Conservation Authority	Habitat Classification
Bronte Creek	Conservation Halton	Enhanced
Grindstone Creek	Conservation Halton	Enhanced
Big Creek	Grand River Conservation Authority	Contact GRCA[1]
Fairchild Creek	Grand River Conservation Authority	Contact GRCA[1]
Ancaster Creek	Hamilton Conservation Authority	Enhanced
Battlefield Creek	Hamilton Conservation Authority	Normal
Borer's Creek	Hamilton Conservation Authority	Enhanced
Chedoke Creek	Hamilton Conservation Authority	Enhanced
Fifty Creek	Hamilton Conservation Authority	Normal
Red Hill Creek	Hamilton Conservation Authority	Enhanced
Spencer Creek	Hamilton Conservation Authority	Enhanced
Stoney Creek	Hamilton Conservation Authority	Normal
Sulphur Creek	Hamilton Conservation Authority	Enhanced
Tiffany Creek	Hamilton Conservation Authority	Enhanced
Forty Mile Creek	Niagara Peninsula Conservation Authority	Headwaters - Normal

Table 6.3 Watershed Habitat Classification		
Twenty Mile Creek	Niagara Peninsula Conservation Authority	Main Channels - Enhanced, some Tributaries· Normal
Welland River	Niagara Peninsula Conservation Authority	Main Channels - Enhanced, some Tributaries· Normal
[1] As GRCA does not have subwatershed plans for Big and Fairchild Creeks within the City of Hamilton, projects that may have an impact on fish habitat and/or local water quality or quantity should be submitted to the GRCA for review on a case-by-case basis.		

As a general consideration, maintenance of the natural hydrologic cycle, including infiltration, is encouraged where soil conditions permit. Therefore the use of Stormwater 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.

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 of the following may be required to determine the appropriate level of mitigation:

- Hydrogeological conditions related to groundwater contributions to watercourse baseflow and potential impacts from proposed development;
- Groundwater recharge areas within and adjacent to proposed development;
- Private wells within and adjacent to proposed development and the potential impacts to private wells remaining following development completion; and,
- Stormwater management measures that may maintain and/or enhance watercourse baseflow conditions.

In areas where (i.e. quantity control), quality management also has standard codes of practice which are used within the water resources management industry. The following should be considered general guidelines in providing Stormwater quality management for the City's review; however, it should not be considered exhaustive:

- The Proponent must provide the background hydrologic data for the Stormwater quality management control being proposed (ref. Section G.5.3 - Stormwater Management Design - Analytic Requirements/Methods ,inclusive of subsections)
- The Proponent must indicate the criteria that the quality management control is being developed from, whether it is Ministry of the Environment 2003 guidelines, a Subwatershed Study or other;

- The Proponent must provide plans of the quality management measure(s) with cross sections of the facility(ies), details of inlets, outlets, maintenance access, berm construction and landscaping;
- The Proponent must provide calculations for Stormwater quality control facilities such as the following:
  - Volumetric sizing;
  - Stage / storage / discharge relationship;
  - Volume calculations at various facility stages;
  - Outlet control calculations - drawdown time;
  - Forebay settling calculations;
  - Forebay dispersion length;
  - Minimum forebay deep zone bottom width;
  - Length / width ratios; and,
  - Maintenance requirements.
- The Proponent must provide dimensions for all facility attributes and provide verification that the facility meets minimum Ministry of the Environment 2003 guidelines;
- The Proponent must provide a landscape plan for all applicable facilities, which would include background text and comparison to Ministry of the Environment 2003 guidelines;
- The Proponent must provide soils information for the facility site and, in the case of proposed infiltration, document the quantity and quality impacts to groundwater recharge;
- The Proponent must minimize external drainage area overland flow impacts on the proposed Stormwater quality control facility;
- The Proponent must indicate proposed flow by-pass conditions and impacts on Stormwater quality;
- The Proponent must provide a maintenance and operation manual with the detail design of the facility, which outlines requirements for the City;
- The Proponent must develop a monitoring program for all applicable Stormwater quality control facilities, which not only fulfills Ministry of the Environment requirements, but also the requirements of the City, Conservation Authorities and other relevant approval agencies; and,
- The Proponent must address winter operations for the proposed Stormwater quality control facility (ref. Stormwater Management Planning and Design Manual, MOE-CC, 2003).

G.5.4. Natural Channel Design

Natural channel design involves numerous disciplines such as certified geomorphologists, water resources Engineers, terrestrial specialists and fisheries biologists to interpret existing channel conditions and to develop, through an integrated design approach, a 'successful' channel design.

The channel design has to incorporate hydrology, stream hydraulics, fluvial morphology and fisheries habitat assessment. Each discipline has to determine design parameters which will be beneficial in the integrated design approach. Design approaches should consider the following characteristics as a guideline (not exhaustive) to developing a natural channel design:

Watershed and Channel Characteristics

- Run-off characteristics;
- Flow regimes; and,
- Channel geometry.

Stream Conditions

- Floodplains
- Alignment and meandering;
- Bed-forms, riffles and pools;
- Stream bank cover;
- Slopes;
- Soils;
- Erosion and tractive forces; and,
- Channel roughness.

Chemical Characteristics

- Sediment load;
- Suspended sediment;
- Oxygen demand;
- Nutrients; and,
- Toxic substances.

There are numerous guidelines which consider the foregoing characterization in developing a natural channel design, such as the following examples:

- 1994 MNR Natural Channel Design Manual;
- Rosgen;
- Annable;
- Newbury;
- 2001 MNR; and,
- Adaptive Management of Stream Corridors in River & Stream Systems: Flooding Hazard Limit Technical Guidelines, March 2006, Ontario Ministry of Natural Resources.

The Proponent should demonstrate that due care has been taken in establishing the natural channel design to the satisfaction of the City.

G.5.4.1 Design Documentation for Natural Channel Design

The following code of practice is considered a minimum for documentation of natural channel design and is not intended to be exhaustive:

- The Proponent should provide the background existing and proposed hydrologic data (ref. Section G.5.3 - Stormwater Management Design - Analytic Requirements / Methods);
- The Proponent should provide plans outlining the following:
  - Existing and proposed plan and profile;
  - Existing and proposed channel sections;
  - Details for proposed typical channel sections;
  - Sediment and erosion controls;
  - Staging plans;
  - Seeding and landscaping plan; and,
  - Floodline delineation - existing and proposed
- The Proponent should document how the proposed natural channel design matches and/or enhances existing channel characteristics;
- The Proponent should document how the proposed channel will function within the watercourse block / valley system;
- The Proponent should document existing and proposed channel hydraulics, including storage discharge relationships;
- The Proponent should, document potential impacts on both the existing terrestrial and fisheries conditions; and,
- The Proponent should provide a monitoring program outlining monitoring requirements for the various design disciplines.

In addition to the natural channel design code of practices, the following should be incorporated into the channel design:

- Access will be required from both ends, 3 m wide with cross fall not to exceed 4%;
- Special consideration must be given to the vegetation; landscape plan must be designed by a member of OALA (Ontario Association of Landscape Architects) in good standing;
- Design must comply with the No Standing Water By-law;
- Area must be posted as naturalized area and wording within the purchase and sales Agreement should reflect this requirement; and,
- No access gates permitted.

G.5.4.2 Stormwater Management Facility Designs

"Greenfield" Development

The following design guidance is considered to complement the MOE-CC Stormwater Management Planning & Design Manual, March 2003. The type of Stormwater management facility to be designed is normally determined through a Master Servicing Plan.

Facility Storage Requirements

Permanent pool volume and quality control (including extended detention) requirements shall be based on the MOE-CC Stormwater Management Planning & Design Manual, or as specified within Master Servicing Plans, Master Drainage Plans or Master Stormwater Management Plans.

Quantity control shall be based on criteria established in Master Servicing Plans, Master Drainage Plans or Master Stormwater Management Plans. Should no documentation exist to establish the level of quantity control, discussion with the City will be required to determine the requirements.

Forebay

The forebay is to be separated from the wet pond/wetland area by a berm. The top of berm is to be 0.3 m above the permanent pond with erosion protection above the permanent pool. The berm is to have a 3.0 m top width, with 3:1 maximum side slopes. The forebay length to width ratio shall be a minimum 2: 1, with length designed in accordance with MOE-CC Stormwater Management Planning & Design Manual, 2003.

Consideration for forebay bottom lining shall be made if groundwater contamination has been determined to be an issue (as recommended by a geotechnical consultant).

The Proponent shall outline that access to the forebay is to be provided for the purpose of maintenance. In addition, the Proponent should determine how sediment removal would be conducted (i.e. equipment, forebay design). Prior to sediment removal, the forebay is to be dewatered. Dewatering procedures shall be provided as part of the Operation and Maintenance Manual.

Length / Width Ratio

The minimum length to width ratio is 3:1. Berming within the Stormwater management facility may be used to increase the flow path to meet this criterion and should only be considered where the physical constraints of the Stormwater management facility clearly limit the facility configuration.

Standard Water Depths

The permanent pool water elevation/level within the facility is considered the normal facility operational water level.

Table G.3- Standard Water Depths

	Wet Pond Facility	*Wetland Facility*

For a hybrid facility, the wet pond and wetland elements use the respective guidelines stated above.

Deeper permanent pool areas at outlet structures will be considered by the City where site specific conditions have identified the requirements for this design consideration. For wetlands, a localized deep pool shall be designed at the outlet structure. The use of extended detention storage for quantity control of the water quality storm event will be allowed by the City.

Side Slopes

Centred on the edge of the permanent pool, the slope shall be a minimum of 3 m width at 7: 1. This width of shelf is considered a minimum requirement as a safety measure to limit the potential for public access to the permanent pool.

Above Planting Shelf: 5:1 max. slope (7: 1 preferred).

Below Planting shelf: 4:1 max. slope.

Berming

Berming around the perimeter of a facility shall be designed with a minimum top width of 3.0 m (where trail or maintenance access is not located on berm). The top of berm elevation shall be established at a minimum 0.3 m above the 100 year storm quantity control water level or the highest water level. Geotechnical considerations should be discussed in the design of the facility berming. Retaining walls within the Stormwater block are typically not acceptable to the City, since the land designated for Stormwater management systems should be established on the basis of no man-made retaining systems, although in special circumstances such as Stormwater management retrofits, the City may consider the use of retaining walls.

Inlet Structures

Minor flows up to the 5 year design storm event should be directed to the sediment forebay of a SWM facility and flows in excess of the 5 year event (major flows) are to

bypass the sediment forebay and discharge to the main cell of the SWM Pond. This practice reduces the re-suspension of deposited sediments within the sediment forebay.

Storm sewer system inlets into the Stormwater management facility shall be designed so that the pipe invert matches the permanent pool elevation. Inlets submerged within the permanent pool may be accepted in scenarios where it can be demonstrated that the system will operate under free flow (non-surcharged) conditions subject to the 5 year storm.

Headwalls and grating shall conform to OPSD, with railings as required.

Erosion protection shall be provided between the inlet headwall and forebay bottom to prevent localized scouring. Erosion protection shall match the headwall width at the inlet and shall extend a minimum 1.5 m on either side of the headwall at the forebay bottom. Protection material shall consist of rip rap or river stone underlain with geotextile. The protection size and depth shall be based on Engineering consultant recommendations and subject to review and acceptance by the City.

Major System Flow Routes

Where flood protection is required, major system flow routes shall be designed to safely convey the 100 year peak overland flow into the facility, but shall not be directed into the sediment forebay area. Overland flow routes shall be flat bottomed channels with maximum 3:1 side slopes, maximum flow depth of 0.3 m and 0.1 m of freeboard. Overland flow routes should be designed using standard hand calculations and/or hydraulic analytical techniques (ref. Appendix F – Storm Sewer Design Sheet / Combined Sewer Design) acceptable to the City. Overland flow route erosion protection shall consist of a soil reinforcement system with a natural vegetated surface treatment, based on the Engineering consultant and/or the City's recommendations, and subject to City approval.

Outlet Structures

Reverse slope pipe and perforated riser pipe outlet structures shall be used for both wetland and wet pond facilities unless the Proponent can demonstrate to the City and approval agencies that alternative outlet structures could be used. For Stormwater management facilities located downstream of areas with a high susceptibility for the occurrence of spills, a shut-off on the outlet structure may be required. Maintenance pipes shall be installed to allow the facility to drain by gravity flow whenever possible. Maintenance access roadways shall provide access to outlet structures.

Headwalls and grating shall conform to OPSD, with railings as required.

A weir outfall / spillway shall be considered for discharge of less frequent events in combination with the ditch inlet type of structure. Spillway erosion protection shall be consistent with attributes described herein. Erosion protection for outfalls shall generally consist of a combination of rip rap or river stone and vegetation, with the size and depth of stone based on consultant and/or City recommendations and subject to City approval. Outfalls to Environmentally Significant Areas may require site-specific

treatment as dictated by the City and/or as stipulated within Master Servicing Plans, and/or Environmental Reports.

Emergency Overflow Spillway

Each Stormwater management facility shall provide an emergency overflow spillway where possible to allow drainage to safely exit the facility should the outfall structure fail to function or should the storm event have a frequency lower than the 100 year or maximum design storm return period. The overflow spillway shall convey the Regional Event or design storm event post-development controlled peak flow. A 0.10 m freeboard to the top of the spillway invert shall be at the facility's 100 year or maximum water level.

The design of the spillway shall be based on calculations provided by the consultant and/or the City and are subject to review and approval by the City. Erosion protection shall be provided on the entirety of the spillway. Erosion protection may consist of a soil reinforcement system with a natural vegetated surface treatment or alternative protection measures as specified within the consultant recommendations and approval by the City. When access roads cross the top of the spillway, the surface treatment and base will be consistent with the maintenance access road design. Side slopes at the top of the spillway shall be 3: 1 maximum and shall be a maximum 10% if used as a roadway.

Maintenance Access Roadways

Maintenance access roadways shall be provided from the City's road allowances to inlet and outlet structures and to the base of sediment forebays. Where feasible, two access points to the City's road allowance shall be provided and access roads shall be looped to access points. Dead end access roads shall be voided and shall be designed with a hammerhead turn around, with a minimum hammerhead width of 17.0 m, roadway width of 4.0 m and 12.0 m centreline turning radius. A turning area of 12.0 m diameter may be provided instead of a hammerhead. The following dimensions should be considered in the maintenance access design:

Min. Roadway Width: 4.0 m	Max. Gradient = 10%
Max. Crossfall = 2%	Min. Centreline Radius = 12.0 m
Min. 300 mm OPSS Compacted	Geotextile underlying Granular ‘B’
Granular ‘B’, Normal (or equivalent)	Granular ‘B’ dressed with screening

Stormwater blocks between residential/commercial/industrial lots for the sole purpose of maintenance access shall have a minimum width of 6.0 m with a 4.0 m wide road surface.

A curb depression shall be provided at the road allowance and removable, lockable, vehicle barriers shall be installed at the right-of-way limit to prohibit public vehicular access.

Setbacks

A minimum setback of 5.0 m (4.0 m without maintenance access) from a Stormwater management facility property line to the commencement of the facility grading shall be established~ Maximum side slopes within the setback areas will be 10:1. Marginal setback area compromises will be allowed to facilitate irregular facility shapes. When a Stormwater management facility is to be located within the Regional storm floodplain, Conservation Authorities may require more than a 5 m setback from the Stormwater management facility grading commencement to property limits.

Sediment Drying Area

A sediment drying area shall be provided immediately adjacent to the maintenance access road and to the sediment forebay to facilitate ease of access for sediment removal from the forebay and sediment storage. The area should be graded to allow partial drainage to the forebay at a minimum slope of 2.0%. The sediment drying area shall be designed to facilitate a 1.0 m maximum storage depth and an angle of repose of 4:1 of the excavated sediment, the volume of which shall be the minimum MOE-CC requirement. The drying area shall be rehabilitated at the time of maintenance.

Fencing

Fencing shall be required where residential areas are located adjacent to the Stormwater management block. Where the Stormwater block abuts open space, ESA lands, industrial and commercial lands, or a right-of-way, fencing will not be required. Fencing will be 1.5 m high, chain link fence, in accordance with City Standards. Fencing shall be located' at an offset of 0.10 m within the Stormwater block. Heavy duty black vinyl fence is City Standard.

Warning Signage

Warning signage shall be installed adjacent to pedestrian traffic routes located within and/or adjacent to the Stormwater management block. The number and location of signs shall be established by the City. Signs will have the wording laid out in figure one and two below, or as per the current Development Engineering Guidelines and will be supplied and installed by the Proponent.

Figure One:

Figure Two*:

*Note: Figure 2 applies to a fenced in area where public access is not allowed.

Signage shall conform to the following specifications:

- Measure 24 in by 36 in;
- Lettering size shall be 1.25 in to 3.5 in;
- Colours shall be City of Hamilton Blue & Cream, White, Red and Black;
- Gauge shall be 0.021 mm;
- Shall be laminated; and,
- Stainless steel lag bolt with washer is required 1.5 in into a wood post.

The diagram below is an example of post installation. Requirements may change on a case by case basis and are dependent on environmental conditions.

M.8. Appendix H – Erosion and Sediment Control Inspection Report

M.9. Appendix I – Current Streamflow and Rainfall Monitoring

M.10. Appendix J – List of Approved Hydrologic and Hydraulic Models

M.11. Appendix K – Protocol for Repayment of City Share

Protocol for Repayment of City Share

All of City's share of the cost of municipal works to be constructed under the subdivision agreement are subject to the following:

i) Council approved capital budget for the works;

ii) The subdivision agreement must be registered;

iii) There shall be no outstanding liens related to the works that are subject to payment to the City's share; and,

iv) Prior to repayment the consulting engineer, who must be a Professional Engineer licensed to practice in Ontario, for the developer must submit a complete submission consisting of:

   1) A letter of request for payment of the City's share of construction cost for the related development certified by the developer's consulting engineer;

   2) A progress payment certificate to the City broken down in the same format as the approved "Schedule of Works" related to the subdivision agreement with each request for payment of the City share of construction. The payment certificate must show the approved as-constructed cost of completed works which require payment by the City; and,

   3) Proof of payment from the contractor who installed the works that are subject to payment by the City.

v) Invoice on developer's letterhead and signed by developer, including all taxes and HST registration number.

M.12. Appendix L – Master Planning (Watershed / Subwatershed)

M.13. Appendix M - Stormwater Management Plans