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Tavistock Master Storm System
Drainage Plan

Prepared by

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292 Speedvale Avenue West, Unit 7 Guelph ON N1H 1C4 Canada

July 2007

File No: MSZ 11487

Executive Summary

In the past, the Village of Tavistock (Tavistock) has been subject to flooding during major storm events in 1992, 2002, 2005 and 2006. Flooding was experienced throughout the majority of Tavistock, with some areas worse than others.

A Master Plan approach is necessary to review and assess the storm conveyance system in its entirety to develop a plan to reduce flooding. The Township of East Zorra-Tavistock (Township) is conducting the Master Plan in conjunction with the Municipal Class Environmental Assessment (EA) in order to develop a plan to reduce flooding with the Tavistock limits) during large storm events.

The objectives of this Study are to:

- Review the existing storm sewer system and to identify areas that are considered 'high risk' for flooding;
- Review Township standards and comment/recommend any necessary changes/strategies that will aid in reducing flooding risks for existing and future developments;
- Review overland flow routes and identify area of surface restrictions and recommend improvements;
- Develop alternative solutions to reduce current flooding within the Village limits; and,
- Review the advantages of stormwater management (SWM) for Tavistock.

The first step in developing possible system improvements was to analyze the existing stormwater conveyance system. Township design standards have changed over time but this report focuses on comparing the existing system to the **current-day design standards**. This study does not compare stormwater system components with the actual design standard in place at the time of construction.

The current design standard requires that the minor local drainage systems must be able to convey the 1:5 year storm and the trunk storm sewers must be designed to convey the 1:10 year storm. The analysis shows that more than half of the storm sewer reaches within the Village cannot accommodate the runoff quantities from the design rainfall events**.**

Six alternative improvement measures were considered to address the study objective and they are as follows:

Alternative 1 – Do Nothing

The "Do Nothing" approach requires the Township to leave the existing storm water system as is and provide no suggestions as to how it can be improved. This does not address the study objective and was not considered any further.

Alternative 2 – Storm sewer Replacement

This alternative explores the option of replacing all pipes that do not meet current day standards.

Alternative 3 – Policy Review and Update

Alternative 3 reviews the current Township design standards and compares them to other municipalities of similar size. Based on this comparison changes to the current standards are recommended.

Alternative 4 – Lot Level Controls

Lot level improvement measures are controls that can be implemented on each individual lot. These controls can be implemented to provide storage or infiltration options by the landowner.

Alternative 5 – Conveyance Improvement Measures

Upsizing all trunk sewers that do not have the capacity to convey the 1:10 year storm, limiting flow into the local sewers with restrictor plates; and, the development of proper overland flow routes are all considered as part of Alternative 5.

Alternative 6 – Storage Facilities/Stormwater Management

Significant external stormwater flow from the north and northwest of the Village are large contributors to the storm sewer network. This alternative outlines the possibility of building two stormwater detention ponds to control the external drainage flow to a rate that the storm sewer does not surcharge.

An evaluation of the above alternatives was completed based on the following criteria

- Natural Environment
- Socio-Economical/Cultural Environment
- Financial Factors
- Technical Factors

It was determined that a combination of Alternatives 3 – 6 (inclusive) is the preferred alternative. Below is a summary of preferred alternative and what it consist of.

Policy Changes

- The contributing drainage area should allow for the post-development runoff flows from the 1:100 year storm to be attenuated to the 1:2 year pre-development flows.
- Water should not extend beyond local road ROW and desirably not overtop road curbs where practical.
- Basement floor elevations should be set above groundwater level.
- Roof leaders should discharge to surface in all cases.
- Flow should not cross roads except for in major storms.
- Sump pumps shall not under any circumstances be connected to the sanitary sewers. **No PDC should have a gravity connection** beneath the house footing. The PDC must pump water up and over the foundation wall as outlined in the current Township Development Standards.
- Theoretical hydraulic grade lines should be calculated for all new sewers.

Lot Level Controls (not limited to those outlined below)

- Disconnect all gravity PDC and reconnect in accordance with current standard.
- Rear yard storage – depressions or restrictor plates in rear yard catchbasins.
- Parking lot storage – depressions or restrictor plates in catchbasins.
- Direct roof leaders to rain barrels.
- Direct roof leaders to rear yard ponding area or soakaway pits.
- Direct sump pumps to pump to rear yard ponding area.
- Infiltration trenches along rear lot lines.
- Where possible create vegetated buffers along flow paths.

Conveyance

- Replace existing trunk sewers with sewers that can convey the 1:10 year flow.
- Provide restrictor plates on catchbasins to restrict flow to the 1:2 yr storm.
- Overland flow routes should be properly identified and, where necessary, improved to provide positive drainage for major storm events.

Storage

- Provide storage for the external areas to the north/northwest of Tavistock restricting flow into the sewers to a 1:2 year pre-development flow rate.

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1.0 Introduction

1.1 Study Purpose

In the past the Village of Tavistock (Tavistock), see Figure 1 – Location Map, has been subject to flooding during major storm events in 1992, 2002, 2005 and 2006. Flooding was experienced throughout the majority of Tavistock, with some areas worse than others. The storm of 2005 appeared to impact the northeast portion of Tavistock (Bender Subdivision) the most, while the 2006 event impacted the entire north side of the Tavistock (Bender & McTavish Subdivisions). A Master Plan approach is necessary to review and assess the storm conveyance system in its entirety within the Village of Tavistock limits, see Figure 2 – Municipal Boundary.

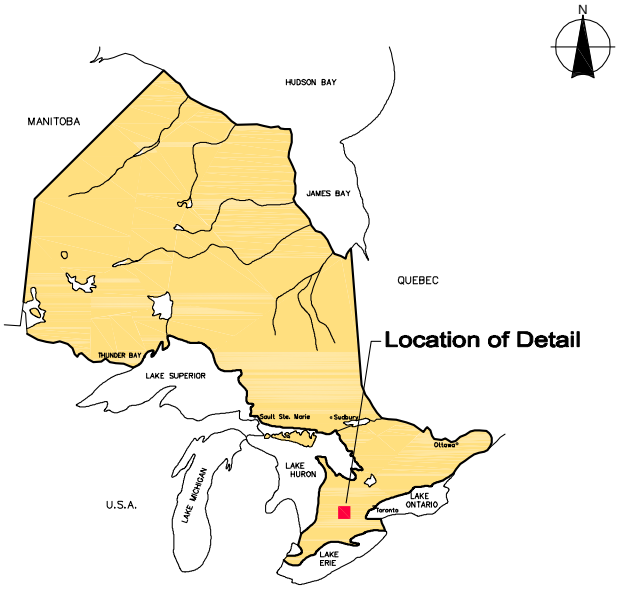
The Township of East Zorra-Tavistock (Township) is conducting the Master Plan in conjunction with the Municipal Class Environmental Assessment (EA) in order to develop a plan to reduce flooding with the Tavistock limits during large storm events.

This Master Plan addresses the Tavistock storm drainage system. This report does not review Tavistock's sanitary sewer system. The County of Oxford is carrying out studies on the sanitary sewer system. It should be noted that over stressing of a storm drainage system could impact the sanitary system.

The objectives of this Study are:

- To review the existing storm sewer system and to identify areas that are considered 'high risk' for flooding;
- To review Township standards and comment/recommend any necessary changes/strategies that will aid in reducing flooding risks for existing and future developments;
- Review overland flow routes and identify area of surface restrictions and recommend improvements;
- Develop alternative solutions to reduce current flooding within Village limits; and,
- Review the advantages of stormwater management (SWM) for Tavistock.

Map Reference:
Map Art Publishing
Ontario Road Atlas



KEY MAP OF ONTARIO

FIGURE 1 - SITE LOCATION MAP

TOWNSHIP OF EAST ZORRA-TAVISTOCK

TAVISTOCK MASTER STORM SYSTEM DRAINAGE PLAN

May 2007
Project Number: MSZ11487

Prepared by: B. Berry

Verified by: J. Phillips

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Revision #: 1

MSZ11487 SL.DWG

FIGURE 2

TOWNSHIP OF EAST ZORRA-TAVISTOCK

TAVISTOCK MASTER STORM SYSTEM DRAINAGE PLAN

VILLAGE OF TAVISTOCK MUNICIPAL BOUNDARY

Legend

- COUNTY BOUNDARY
- VILLAGE BOUNDARY

Air Photo Date: 2006
Air Photos Provided by: County of Oxford, County of Perth

N

0 100 200 300 400 500 600 700 800

Meters

1: 10,000
June 2007
Project Number: MSZ11487

Projection: UTM Zone 17
Datum: NAD83

Prepared by: B. Berry, C. Reynolds

Verified by: J. Phillips

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Revision #: 1

MSZ11487 SP.DWG

1.2 Class EA Planning Process

1.2.1 Municipal Class Environmental Assessment (EA)

The planning of major municipal infrastructure projects or activities is subject to the Environmental Assessment (EA) Act, R.S.O. 1990, and requires the proponent to complete an Environmental Assessment.

The Municipal Class EA process was developed by the Municipal Engineers Association, in consultation with the Ministry of the Environment (MOE). This process is an alternative method to Individual Environmental Assessments for recurring municipal projects that are similar in nature, usually limited in scale, have a predictable range of environmental impacts and are responsive to mitigating measures.

The Class EA solicits input and approval from regulatory agencies, the municipality and the public at the local level. This process leads to an evaluation of the alternatives in view of the significance of environmental impacts and the choice of effective mitigation measures.

A flow chart (see Figure 3) prepared by the Municipal Engineers Association (MEA), shows the Class EA procedure for municipal projects. There are three categories of assessment within the Class EA procedure dependent on the complexity and potential for environmental impact (Schedule A – negligible impacts, Schedule B – modest impacts, Schedule C – significant impacts).

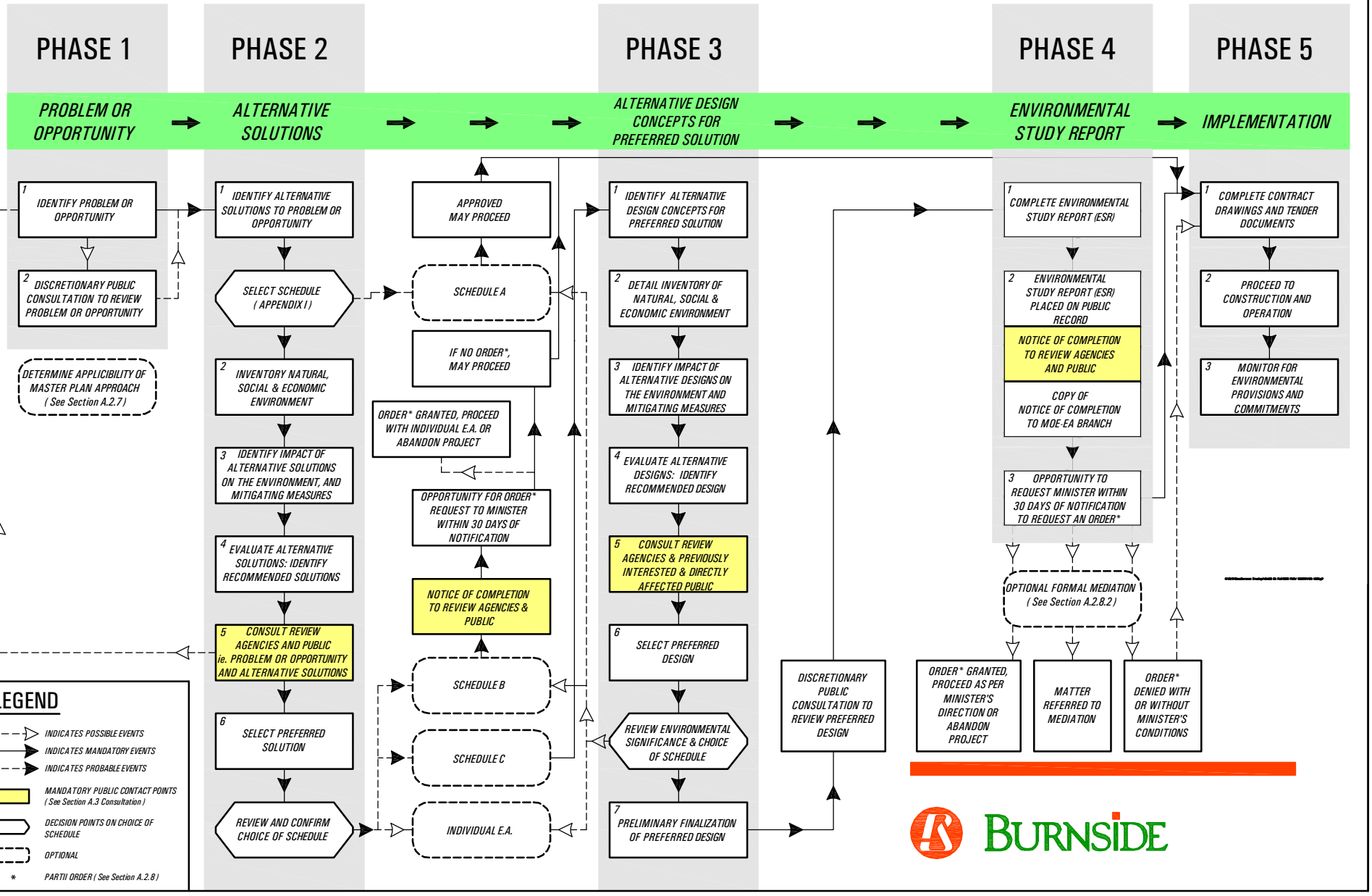
The Municipal Class EA also provides an opportunity for any member of the public or agency to request the Minister of the Environment to order a Class EA project to become subject to an Individual Environmental Assessment. This is known as a Part II Order (or "bump-up") request and is made in certain circumstances where concerns are unresolved during the Class EA planning process.

This study is considered to be a Schedule B activity. The construction and operation of the storm water management facilities have the potential for some adverse, yet mitigable, environmental impacts and requires the completion of only Phases 1 and 2 of the Class EA procedure (Figure 3). Public consultation is required at two stages under a Schedule B project. At the completion of Phase 2, if there are no outstanding concerns, then the Township may proceed to implementation.

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

FIGURE 3

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA



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11487 MUNICIPAL CLASS EA P & D DWG

1.2.2 Master Plan Process

The Municipal Class EA Guidelines (MEA, 2000), also provides guidance on the Master Plan process. A Master Plan is usually developed when a series of work is needed throughout the study area (i.e. when not one solution to the problem is ideal). The focus of a Master Plan is to review a system (in this case the storm water conveyance network) in it's entirety and develop the framework in which future improvements, works and development should be implemented This process facilitates the long range goals of the municipality. Often the proposed preferred alternatives outlined in the Master Plan are each individually subject to the Municipal Class EA process. With this in mind, it has been decided to complete the Master Plan in conjunction with the Municipal Class EA, Phase 1 and Phase 2, in order to comply with the needs of a Schedule B Municipal Class EA. Should any recommended alternative require Schedule C works to be completed, Phase 3 – 5 will need to be completed at a later date.

1.3 Public and Agency Consultation

1.3.1 Notification

As part of the Municipal Class EA procedure, public notices are published and information meetings may be held to keep the public informed of the process and allow for public involvement in the selection of a preferred alternative. Public consultation is an important and vital part of the environmental assessment process and is required in two stages under a Schedule B project.

The first public consultation consists of a "Notice of Commencement", which was published in the Tavistock Gazette on February 7, 2007 and February 14, 2007. A copy of the Notice of Commencement can be found in Appendix A.

The following Municipalities, regulatory agencies and Ministries form the circulation list for the Village of Tavistock's Master Storm Drainage Plan.

Municipalities

Township of Zorra
Township of Perth South
Township of Perth East
Township of Blandford-Blenheim
City of Stratford
Region of Waterloo
County of Oxford
County of Perth

Authorities

Upper Thames Conservation Authority

Ministries

Ministry of Culture
Ministry of the Environment
Ministry of Transportation
Ministry of Natural Resources
Ministry of Municipal Affairs and Housing

1.3.2 Flood Prevention Working Group

Township staff, members of the community and Council members formed a Flood Prevention Working Group. This working group has been an integral part of the flood prevention investigations and they have been consulted and kept up to date throughout the entire Master Plan process.

2.0 Data Collection and Review

The framework of the Master Plan involves the development of various activities that coincide with Phase 1 – Identification of the Problem or Opportunity and Phase 2 – Identification of Alternative Solutions of the Municipal Class EA process.

Extensive work in data collection was completed to assess the storm system capacity and to identify any natural environmental conditions that would influence the evaluation of alternative solutions. Below is a list of tasks that were completed to obtain background information:

- Obtain hardcopies and/or digital copies of subdivision and road construction/ reconstruction plans from the Township and the County of Oxford. Refer to Appendix B for a list of plans having been reviewed.
- Review storm sewer design sheets submitted to the Township as part of subdivision applications.
- Obtain aerial photos from the County of Oxford and County of Perth.
- Complete a total station survey of manholes, storm sewers and catchbasins as needed to supplement existing documentation (approximately 75 percent of Tavistock).
- Review previous drainage and servicing studies.
- Complete survey of possible down spout connections to the storm sewer.
- Gather and review Municipal Drain reports and review and examine drainage boundaries.
- Conduct a visual site reconnaissance of Tavistock to identify overland flow paths.
- Solicit public input on the location of any rear yard catchbasins.
- Review current development standards.
- Attend and join the Flood Prevention Working Group.
- Consult the Upper Thames Conservation Authority on major storms that cause flooding events.
- Review of the proposed Tavistock 2006 Municipal Drain Report which was implemented to help control external drainage areas from overloading the storm sewer system and causing surface flooding.

3.0 Existing System Characteristics

3.1 Current Design Criteria

Table 1 outlines a summary of the stormwater design standards for the Township of East Zorra-Tavistock. Please refer to Appendix C for a copy of the current Township of East Zorra-Tavistock Municipal Servicing Standards, Urban and Rural Developments (Township Development Standards) related to storm water conveyance.

Table 1 Current Township Development Standards

Standards		
Design Storm	Minor – Local Sewers	1:5 year
	Minor – Trunk Sewers	1:10 year
	Major	N/A
Method of Analysis		Rational Method
Inlet Time	Residential	10 min.
	ICI/apartments	10 min.
Rational Method Runoff Coefficients, C	Parks	0.20
	Residential	0.35
	Semi-detached	0.50
	Townhouse	0.55
	Apartment	0.75
	Industrial	0.70-0.75
Min. Pipe Size	Sewer main	250 mm
	Catchbasin connection	250 mm
Minimum Cover		1.5 m

The current Township Development Standards specifies the Intensity-Duration-Frequency (IDF) curve that is to be used to quantify rainfall for the 1:5 and 1:10 year storms. IDF curves express the statistical relationship between rainfall intensity and duration for storms with a given return period (i.e. 1:5 year storm, 1:10 year storm, etc.). In other words, a 1:5 year storm has an intensity quantity that has a 20 percent chance of occurring in each year.

IDF curves are commonly used with the Rational Method in the design of storm systems and are generally represented by an equation with the defining parameters A, B and C. The IDF curve specified in the Township Development Standards is the IDF curve for the nearby City of Woodstock. The IDF equation is given below and the specified parameters for the 1:5 and 1:10 year storms are outlined in Table 2.

Table 2 Township Development Standards – IDF Parameters

Parameter	1:5 Year Storm	1:10 Year Storm	1:100 Year Storm
A	754.695	848.498	1194.379
B	4.699	4.500	4.50
C	0.758	0.749	0.740
Intensity for 10 min TC	98.4 mm/hr	114.5 mm/hr	165.1 mm/hr
Intensity for 15 min TC	78.8 mm/hr	91.7 mm/hr	132.6 mm/hr

$$I = \frac{A}{(t+B)^C}$$

where I is rainfall intensity in mm/hr, t is time to peak concentration in minutes, and A, B, and C are parameters.

It is important to note that design standards may have changed over time that this report is based on comparing the existing system to the current day design standards. This study does not compare all system components with the actual design standard in place at the time of construction.

3.1.1 Private Drain Connections (PDCs)

In situations where the use of private drain connections (PDCs) is required, the Township development standard emphasizes that a condition must be included in the subdivision agreement stating "that each lot shall install a sump pump as part of the hook-up as per STD EZT-8". Refer to Appendix C Figure EZT-8 for a copy of the current connection standard.

It is our understanding that many residential units in the Bender and McTavish subdivisions have PDC that were installed in accordance with previous standards but do not conform to the current Township design standards.

3.2 Minor System Performance – Existing Conditions

The capacity of the existing minor storm system was assessed. The Rational Method as required by current Township standards was used to measure the performance of the system under existing conditions. An allowance for flow from PDCs and infiltration into the storm sewers was added to the flow calculated by the Rational Method. The impact of the proposed Tavistock Municipal Drain 2006 was considered in the assessment of the existing minor storm system. Scenarios with and without the impact of these proposed drainage works were assessed. Results identify areas of the minor system that have sufficient capacity to convey runoff from the design rainfall event and areas that do not.

Although the current Township design standards do not specifically require the minor system to be designed to convey additional flow from PDCs and infiltration, it is apparent that many PDC's are connected to the storm sewers in areas of the Village and are contributing an appreciable amount of flow. As a result of this occurrence, the analysis of minor system performance includes an allowance for flow from PDCs and infiltration. This is believed to be most representative of existing conditions.

At the time of this report, it is anticipated that the proposed Tavistock Municipal Drain 2006, as designed by Dietrich Engineering, will be implemented. The proposed municipal drain will alter the existing conditions by intercepting and redirecting runoff from land beyond the Village of Tavistock municipal limits that presently flow into the northeast part of the Village (Bender Subdivision). The drain will reduce the amount of flow conveyed by the existing minor storm system in this area and will retain overland flow from rainfall events up to 1:50 year return period and redirect that flow to the east, around Tavistock. Since the Tavistock Municipal Drain 2006 will positively impact (i.e. reduce flooding) the performance of the existing minor system, and as it is intended to be implemented in the near future, scenarios with and without the impact of the Tavistock Municipal Drain 2006 have been considered in the performance assessment of the existing minor storm system.

An overview of the existing storm system in the Village of Tavistock is shown in Figure 4.

3.2.1 Design Rainfall

The current design standard requires that the minor drainage systems must be able to convey the 1:5 year storm. The 1:5 year storm is a storm that has a 20 percent chance of occurring in any given year. Designing the minor storm systems to a 1:5 year storm is common practice in municipalities of similar size.

Trunk storm sewers must be designed to convey the 1:10 year storm, according to the current design standard. The 1:10 year storm is a storm that has a 10 percent chance of occurring in any given year.

Rainfall intensities for the 1:5 and 1:10 year storms used in the assessment of the existing minor storm system were estimated using the IDF curves identified in the Township Development Standards and previously detailed in Table 2.

FIGURE 4

TOWNSHIP OF EAST ZORRA-TAVISTOCK
TAVISTOCK MASTER STORM SYSTEM DRAINAGE PLAN

EXISTING MINOR STORM SYSTEM AND DRAINAGE AREA BOUNDARIES OVERVIEW

Legend

- MANHOLE LOCATION
- MANHOLE CATCHBASIN OR CATCHBASIN LOCATION
- CATCHBASIN LOCATION
- (45) STRUCTURE NUMBER
- FLOW DIRECTION
- PROPERTY FABRIC
- DRAINAGE AREA BOUNDARIES
- STORM SEWER
- PROPOSED TAVISTOCK MUNCIPAL DRAIN 2006 (BY DIETRICH ENGINEERING)

Sources:
Air Photo provided by County of Oxford and County of Perth, Photo date 2006

Lot Fabric provided by Township of East Zorra-Tavistock

Drainage Area boundaries from Reports:
Tavistock Drain 1974, Kelly and Smart Ltd.
Tavistock Drain 1979, K. Smart Associates Ltd.
Tavistock Drain 1985, K. Smart Associates Ltd.
Tavistock Drain 1987, K. Smart Associates Ltd.
Tavistock Drain 1993, K. Smart Associates Ltd.
Tavistock Muncipal Drain 2006, Dietrich Engineering Ltd.

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0 20 40 60 80 100 120 140 160 180 200 220 240

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June 2007
Project Number: MSZ11487

Prepared by: B. Berry, C. Reynolds   Verified by: J. Phillips

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REVISION #:   MSZ11487 OVERVIEW.DWG

3.2.2 Design Flow Rates

The design flow rates used to determine the adequacy of the existing storm sewer system were determined using the Rational Method and the current Township standards for rainfall events.

An additional allowance of 10 percent was added to the quantity determined by the Rational Method to include an allowance for PDCs (i.e. sump pump connections) and infiltration flows into the storm sewers. A number of areas within Tavistock have residential PDCs that are either connected directly and/or pumped into the storm sewer system.

Many of the storm sewers within the system are not sealed with gaskets at all of the joints. It was common practice in the past to use butt joint pipes, as opposed to a sealed bell and spigot system. This practice encouraged infiltration and enabled sewers to take in groundwater and reduce areas of higher groundwater within a particular community.

We suspect that a number of the older sewers within Tavistock have been constructed in that manner.

Flows due to PDCs and infiltration are considered to be base flows in the storm sewer system. In this case, the magnitude of the base flow within the sewer system was not quantified by low-flow monitoring, but instead an allowance was added to the design flows.

3.2.3 Runoff from External Areas

Several areas within Tavistock receive overland storm runoff from areas beyond the Village limits (external areas), due to the sloping topography of the land. The runoff from these external areas must be considered in the assessment of the existing minor storm system in order to have a representative picture of the existing conditions. External areas that contribute runoff to the Village's minor storm system were identified based on a review of the watershed boundaries presented in various drainage reports.

In order to accurately reflect the impact of external runoff on the minor storm system, the extent of each external contributing area was limited to the area that contributes flow within a time of concentration coinciding with the time that internal Tavistock runoff flows enter in the minor storm system.

The impact of runoff flows from external lands on the storm sewer system is based on time of concentration (i.e. time for external surface flows to enter Tavistock storm sewers). An inlet time of 10 minutes has been assumed for the urban catchment

areas. The external land whose runoff enters the sewer system in 10 minutes or less is assumed to contribute to the peak flow to which the sewers must accommodate.

Surface runoff from external drainage areas reaching the Tavistock sewer system at times greater than 10 minutes prolong the peak runoff flows. This report assumes that runoff from the area with large inlet times do not increase the peak flows that the sewers must accommodate, only extend the peak flow duration.

The time of concentration for external areas and, similarly, the extent of external areas contributing within a given time of concentration were estimated based on known slopes and land cover. Each external area was considered individually and care was taken to ensure that the selected area and time of concentration parameters best reflect the impact of runoff from that area on peak flows calculated using the Rational Method.

Several approaches were considered and it was decided that this approach best reflects the impact on calculated peak flows within the minor storm system for the cases encountered when using the Rational Method.

3.2.4 Minor System Capacity Analysis Results

The existing storm sewer network was analyzed to determine whether it has adequate capacity to accommodate design rainfall events (1:5 year return period for local sewers and a 1:10 year return period for trunk sewers), **as required by the present-day Township design standards**. Each length of storm sewer pipe was considered in the analysis, and the results show the lengths that have adequate capacity, and the lengths that do not.

Lengths of storm sewer pipe with adequate capacity to convey the 1:5 year storm for local sewers and the 1:10 year storm for trunk sewers are shown in green on the figures. Sewers without adequate capacity are shown in red. Thicker lines are used to differentiate the trunk sewers, which were analyzed to the 1:10 year storm, from the local sewers, which were analyzed to the 1:5 year storm.

When the overland runoff from the external lands at the northeast of the Village is intercepted and redirected by the proposed Tavistock Municipal Drain 2006, the percentage of pipe lengths with sufficient capacity to accommodate the design flow is approximately 39 percent. The analysis shows that more than half of the storm sewer reaches within the Village cannot accommodate the runoff quantities from the design rainfall events **as required by the present-day Township design standards.**

Figure 5 shows the results for the minor storm sewer system analysis assuming the proposed Tavistock Municipal Drain 2006 is constructed and operating as expected.

While parts of the existing system does not meet the current day design standards, the system may have met or exceeded the design standards in place at the time of construction. This study did not compare all system components with the actual design standard in place at the time of construction. Standards have changed over time, with the general trend being increased capacity on storm sewer systems and new methodologies such as no footing tiles connected to municipal storm systems. For the purposes of this study, comparison was made to the current design standards adopted by the Township.

3.3 Major Overland Flow Routes

Surface water flow is the movement of storm water as it is collected and channeled within a drainage basin. This type flow is most often noticeable when the capacity of the minor drainage system (i.e. subsurface storm pipes) is exceeded during a rain event. Overland flow routes are the path that the surface water flow follows on its way to an outlet. These paths can be designed to convey the major storm (i.e. a 1:100 year storm event) through the drainage basin while minimizing damage to private properties.

The major overland flow routes within Tavistock generally follow the path of the Municipal Drains that have been constructed. Flow paths have also been established along the road system of the newer residential subdivisions. A visual inspection of the major overland flow routes in Tavistock was conducted with the assistance of Township Staff. Figure 6 and Appendix D, illustrate the major flow routes that were inspected. As noted on Figure 6, sections of the overland flow routes are unable to accommodate the major design storm and contribute to the restricting of flows, ponding and overland flow backups within the Village limits. Areas requiring minor improvements are outlined on Figure 6 as well as those sections needing greater modifications to convey the major storm through Tavistock without contributing to the flooding of residential units.

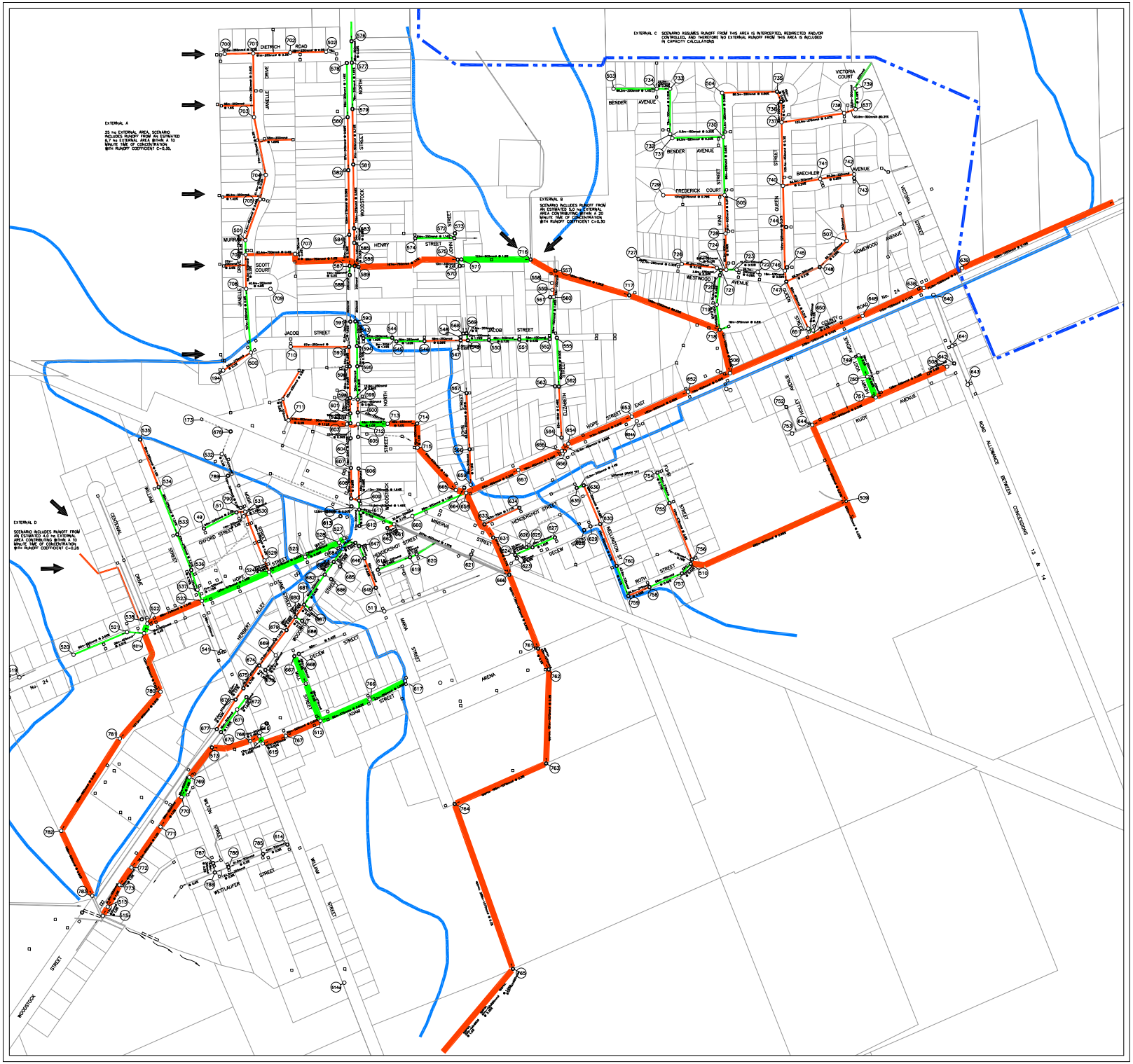

FIGURE 5

TOWNSHIP OF EAST ZORRA-TAVISTOCK
TAVISTOCK MASTER STORM SYSTEM DRAINAGE PLAN

MINOR STORM SYSTEM CAPACITY ANALYSIS

SUMMARY OF PIPE CAPACITY (POST TAVISTOCK MUNICIPAL DRAIN 2006)

Legend

- MANHOLE LOCATION
- MANHOLE CATCHBASIN OR CATCHBASIN LOCATION
- CATCHBASIN LOCATION
- STRUCTURE NUMBER
- FLOW DIRECTION
- EXTERNAL FLOWS
- PROPERTY FABRIC
- DRAINAGE AREA
- PROPOSED TAVISTOCK MUNICIPAL DRAIN 2006 (BY DIETRICH ENGINEERING)

STORM SEWER CAPACITY

"COLLECTOR" SEWER CAPACITY ANALYZED BASED ON THE 1:5 YEAR STORM
"TRUNK" SEWER CAPACITY ANALYZED BASED ON THE 1:10 YEAR STORM.

"COLLECTOR" STORM SEWERS 1:5 YEAR STORM

- SUFFICIENT CAPACITY TO CONVEY DESIGN STORM FLOWS
- INSUFFICIENT CAPACITY TO CONVEY DESIGN STORM FLOWS
- NO DATA

"TRUNK" STORM SEWERS 1:10 YEAR STORM

- SUFFICIENT CAPACITY TO CONVEY DESIGN STORM FLOWS
- INSUFFICIENT CAPACITY TO CONVEY DESIGN STORM FLOWS

FOR CAPACITY ANALYSIS CALCULATIONS, REFER TO "STORM SEWER CAPACITY CHECK", BURNSIDE FILE 11497 STM design check sheet TAVISTOCK.xls.

Sources:
Lot Fabric provided by Township of East Zorra-Tavistock

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0 20 40 60 80 100 120 140 160 180 200
Metres

1 : 2000
May 2007
Project Number: MS211497
Prepared by: B. Berry, C. Reynolds
Verified by: J. Phillips

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REVISION #: 1
MS211497-CAPACITY SCENARIO-4.DWG

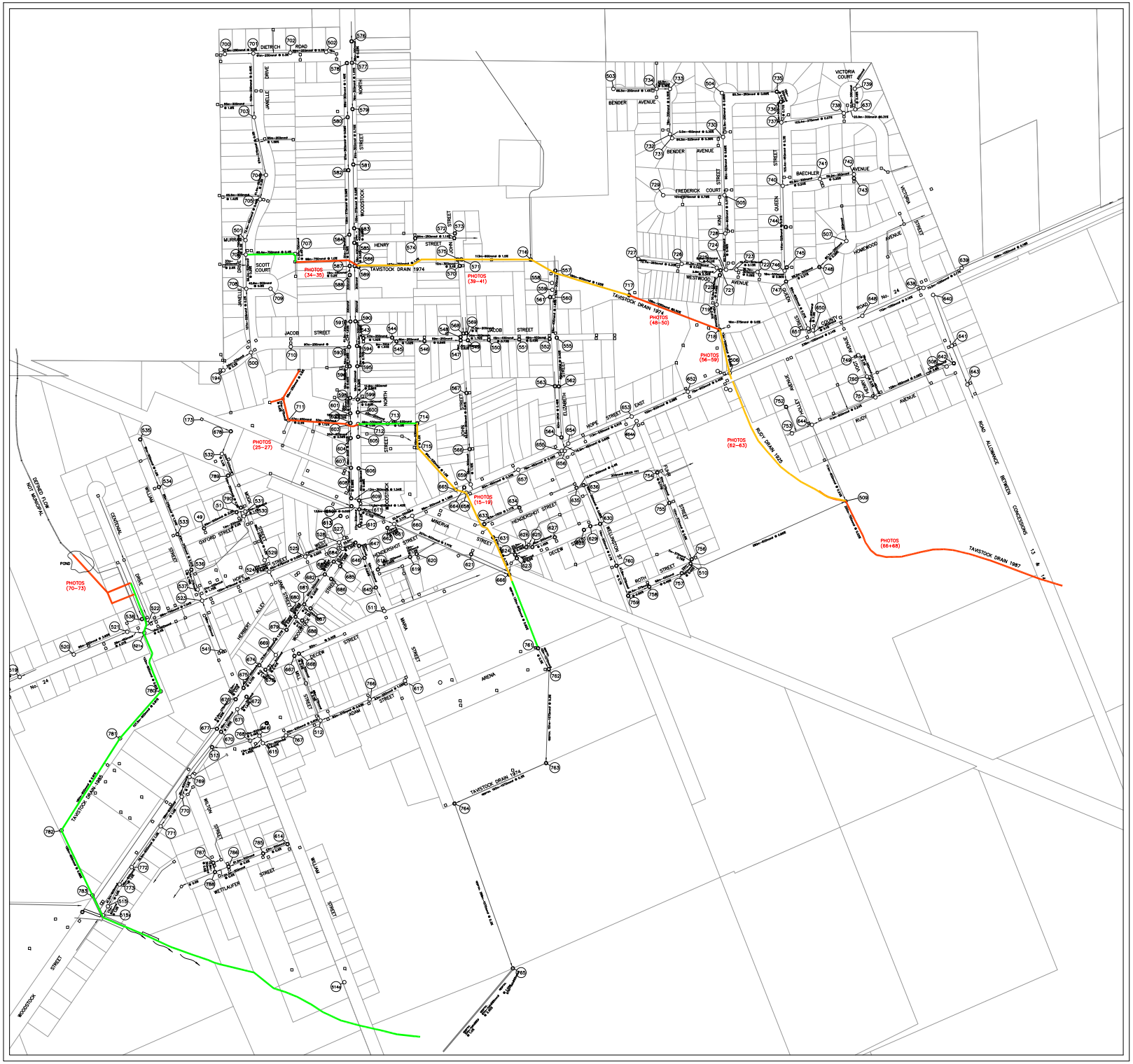

FIGURE 6

TOWNSHIP OF EAST ZORRA-TAVISTOCK
TAVISTOCK MASTER STORM SYSTEM DRAINAGE PLAN

EXISTING MAJOR OVERLAND FLOW ROUTE

Legend

- MANHOLE LOCATION
- MANHOLE CATCHBASIN OR CATCHBASIN LOCATION
- CATCHBASIN LOCATION
- STRUCTURE NUMBER
- FLOW DIRECTION
- EXTERNAL FLOWS
- PROPERTY FABRIC
- DRAINAGE AREA
- STORM SEWER NETWORK

SURFACE FLOW

- DEFINED ROUTE
- IMPROVEMENTS REQUIRED
- NO DEFINED ROUTE

N

0 20 40 60 80 100 120 140 160 180 200
Meters

1: 2000
June 2007
Project Number: MS211457

Prepared by: B. Berry, C. Reynolds
Verified by: J. Gravel

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REVISION: 0-1

MS211457-SURFACE FLOW.DWG

4.0 Alternative Improvement Measures

The following are the alternative improvement measures that are considered under this Municipal Class EA project to address the study objective as previously stated.

4.1 Alternative 1 - Do Nothing

The "Do Nothing" approach will require the Township to leave the existing storm water system as is and provide no suggestions as to how it can be improved. The "Do Nothing" alternative does not meet the current study objective and flooding would not be reduced within Tavistock.

4.2 Alternative 2 - Storm Sewer Replacement

Preliminary analysis shows that capacity in the existing storm sewers do not convey the required 1:5 year and 1:10 year design storms. The sewers surcharge sooner and force additional flow of water to the surface. This alternative considers the replacement of all local storm sewers unable to convey the design storm. Appendix D provides a table outlining the existing storm sewer sizes and the recommended replacement size based on the 1:5 year and 1:10 year storms as previously mentioned.

As shown in Appendix D and Figure 5, there is a high percentage of pipes that will need replacement. This alternative will help alleviate some of the stresses on the storm sewer network that are currently being experienced and decrease surface flows somewhat.

The storm sewer replacement alternative will not eliminate surface flooding and/or residential basement flooding. It will only improve the present system's conditions.

4.3 Alternative 3 - Policy Review and Update

The Township Development Standards related to storm water drainage have been reviewed as part of the Master Plan process. The purpose of this review is to:

- assess the current Township Development Standards and ensure they are consistent with design criteria in other municipalities of similar size;
- establish standards for future development and system expansion; and,
- develop standards for existing system alterations.

The main areas that the study review focuses on are:

- the prevention of basement flooding;
- the need for properly defined overland flow routes;

- design characteristics for the major and minor storm systems; and,
- roof leader and PCD discharge.

Based on the results of the study review, several improvements to the standards are recommended.

Table 3 outlines the current Township Development Standards, and how they compare to other municipalities. The Town of North Perth, Township of Guelph/Eramosa and the Township of Perth East were selected as the comparison group as they are municipalities that are similar in size and share similar characteristics to the Township. All municipalities have a few hamlets or villages and they also govern more rural areas.

For the most part, all of the municipalities seem to be on par with each other in regard to their Development Standards. However, there are a few areas in the current Township Development Standards that could be improved.

4.3.1 Recommended Drainage and Design Policy Updates

Minor changes to the development standards will aid in reducing/preventing any flooding in future development areas. Below is a list of recommendations that will help reduce future flooding.

- All new contributing drainage area should allow for the post-development runoff flows from the 1:100 year storm to be attenuated to the 1:2 year pre-development flows.
- Surface runoff flows should not extend beyond the street right-of-way.
- Basement floor elevations should be set above groundwater level.
- Roof leaders should discharge to surface in all cases.
- Flow should not cross roads except for in major storms.
- Sump pumps shall not under any circumstances be connected to the sanitary sewers. **No PDC should have a gravity connection** beneath the house footing. The PDC must pump water up and over the foundation wall as outlined in the current Township Development Standards.
- Theoretical hydraulic grade lines should be calculated for all new sewers.

The Rational Method runoff coefficients provided should be considered as a minimum value and should be substantiated by “lot coverage” calculations for impervious areas.

Table 3 Municipal Design Standard Comparison

Standard		Municipality			
		Town of North Perth	**Township of Guelph/Eramosa**	**Township of Perth East**	***Current*** **Township of East Zorra-Tavistock**
Design Storm	Minor	1:5 year	1:5 year	1:5 year	1:5 year 1:10 year trunk sewer
	Major	1:25 year SWM ponds = 1:25 year[1]	1:25 year SWM ponds = 1:25 year[1]	Arterial = 1:100 year Local = 1:50 year Local = 1:25 year Temp. Detour = 1:10 year Driveway = 1:5 year Open Channel = 1:100 year	1:100 year
Method of Analysis		Area < 130 ha Rational Method	Area < 130 ha Rational Method	Area < 130 ha Rational Method	Rational Method
Inlet Time	Residential	10 min.	10 min.	15 min.	10 min.
	ICI/apartments	10 min.	10 min.	10 min.	10 min.
Rainwater Leaders		Discharge to surface	Discharge to surface	N/A	N/A
Rational Method Runoff Coefficients, C	Parks	0.10-0.25	0.10-0.25	0.10-0.25	0.20
	Residential	0.30-0.50	0.30-0.50	0.40-0.60	0.35
	Estate Residential	0.25-0.40	0.25-0.40	0.30-0.50	N/A
	Semi-detached	0.40-0.60	0.40-0.60	0.50-0.70	0.50
	Townhouse	0.60-0.75	0.60-0.75	0.60-0.75	0.55
	Apartment	0.50-0.70	0.50-0.70	0.60-0.75	0.75
	Schools/Churches	0.50-0.75	0.50-0.75	0.55-0.80	N/A
	Industrial	0.50-0.90	0.50-0.90	0.60-0.90	0.70-0.75
	Commercial	0.50-0.90	0.50-0.90	0.60-0.90	0.70
	Paved Areas	0.70-0.95	0.70-0.95	0.70-0.95	0.60-0.80
Min. Pipe Size	Sewer main	300 mm	300 mm	300 mm	250 mm
	Catchbasin connection	N/A	N/A	250 mm	250 mm
	Entrance/road crossing culvert	450 mm	450 mm	N/A	N/A
Minimum Cover		1.3 m	1.3 m	1.5 m	1.5 m

1. General practice in the Township is to design the SWM pond for 100 year storm detention.

4.4 Alternative 4 - Lot Level Controls

Lot level improvement measures are controls that can be implemented on each individual lot. These controls can be implemented to provide storage or infiltration options. Depending on land use, some controls outlined may not be suitable for all development and certainly are not limited to those outlined below. All redevelopment lots, particularly industrial and commercial, as well as new developments should included storage controls and onsite storm water management techniques.

Storage Controls

- Rear yard storage – depressions or restrictor plates in rear yard catchbasins.
- Parking lot storage – depressions or restrictor plates in catchbasins.
- Direct roof leaders to rain barrels.

Infiltration Controls

- Direct roof leaders to rear yard ponding area or soakaway pits.
- Infiltration trenches along rear lot lines.
- Where possible create vegetated buffers along flow paths.

PDC Disconnection

- Prevent gravity PDC in all situations.
- Require all PDC to be constructed in conformance with the Township Development Standards.

4.5 Alternative 5 - Conveyance Improvement Measures

4.5.1 Sewers

The existing trunk sewers will be replaced with sewers that can convey the 1:10 year storm. To ensure that the minor storm system does not get overloaded prior to its replacement restrictor plates should be placed in catchbasins to control the amount of water entering the storm system. Flows equivalent to the 1:2 year storm should not be exceeded in the existing system. Detailed analysis will be required for restrictor plate sizing for the catchbasins.

All future and replacement trunk sewers should be sized to accommodate the 1:10 year storm plus an allowance for base flow (PDC and infiltration flows).

4.5.2 Overland Flow

With the installation of restrictor plates in existing catch basins, there is possibility for more water to remain on the surface than currently experienced. To ensure that more flooding does not occur from surface water, overland flow routes must allow continuous positive drainage away from buildings and to an acceptable outlet.

To ensure that damages do not result from the increased surface flows, overland flow routes should be properly identified and improvements implemented.

Figure 6 identifies the major overland flow routes that follow existing Municipal Drains. Improvements to these routes may be initiated under Section 78 of the *Drainage Act* R.S.O. 1990. or handled as private agreements with affected owners. Improvements to surface flow routes may also be completed through development agreements where developable lands lie on or near to the major flow route.

4.6 Alternative 6 - Storage Facilities/Stormwater Management

There are several types of storage facility options available including wet ponds, constructed wetlands, dry ponds, and infiltration trenches etc. These facilities allow for stormwater quantity and quality control for specific developments.

Since there is a large amount of external drainage coming from the north and northwest of the Village, as shown on Figure 7, storage facilities are an effective option to help detain, store and control the outlet flow of the stormwater from the external drainage areas into the existing Tavistock system.

The area highlighted in Figure 7 is an area that flows uncontrolled to, and through, the existing stormwater conveyance system. If storage facilities are provided for this external flow, they will allow for a controlled release of stormwater to the existing system. This will control the amount of water entering the storm sewers and running overland. At this stage of the planning process, two detention facilities are anticipated to provide adequate storage capacity for the existing system. Detailed analysis of the detention facility demand in the north and west areas of the Village may indicate that more than two facilities are required.

To help alleviate storage problems within the Village Limits any larger more open space can also be considered as a potential site for storage.

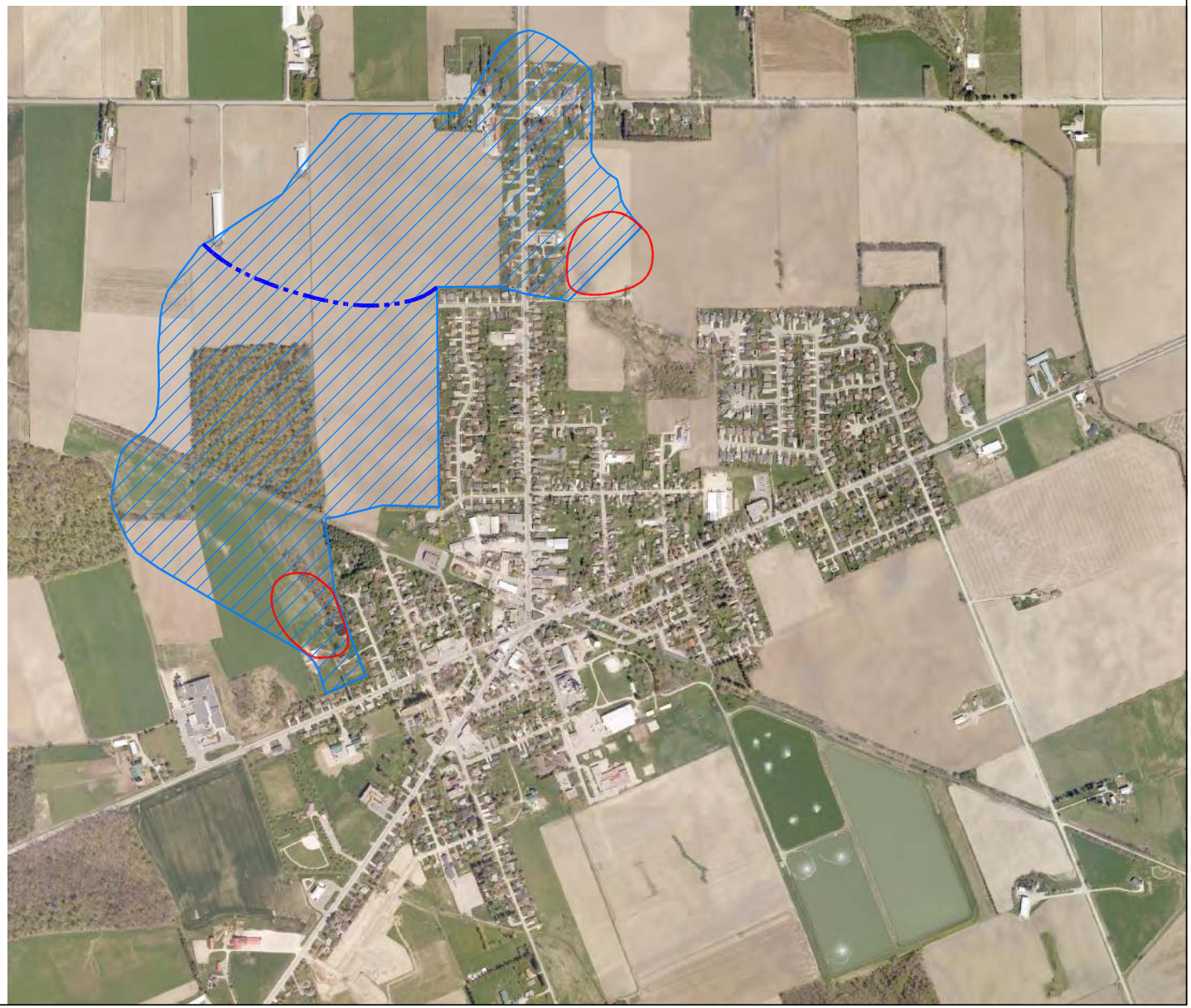


FIGURE 7

TOWNSHIP OF EAST ZORRA-TAVISTOCK

TAVISTOCK MASTER STORM SYSTEM DRAINAGE PLAN

EXTERNAL DRAINAGE AREA REQUIRING STORAGE

Legend

- EXTERNAL DRAINAGE AREAS
- APPROXIMATE DRAINAGE DIVIDE
- POTENTIAL SITE FOR STORMWATER MANAGEMENT FACILITY LOCATION

Air Photo Date: 2006
Air Photos Provided by: County of Oxford, County of Perth

N

0 100 200 300 400 500 600 700 800

Meters

1: 10,000
June 2007
Project Number: MSZ11487

Projection: UTM Zone 17
Datum: NAD83

Prepared by: B. Berry, C. Reynolds

Verified by: J. Phillips

BURNSIDE

Revision #: 1

11487 EXTERNAL DRAIN AREA.DWG

5.0 Description of the Existing Environment

The following sections discuss the natural, built, socio-economic and cultural characteristics within Tavistock.

5.1 Land Use

The study area of this Master Plan encompasses the entire area within the municipal boundary of Tavistock. Since this is an urban setting, the predominant land use is residential. According to Land Use Plan for the Village of Tavistock (Schedule E-2) of the County of Oxford Official Plan (2004), lands within the study area are zoned as Village Core, Service Commercial, Low and Medium Density Residential, Industrial, Major Institutional and Open Space. The municipal boundary of Tavistock is generally surrounded by flat agricultural lands.

5.2 Natural Environment

Due to its urban setting, Tavistock has limited natural areas. The main natural areas are the two community parks and one neighborhood park. Other natural areas include the streetscapes throughout the residential areas of Tavistock and a small low-lying woodland area on the north side of the community. An NHIC database search was conducted for the study area but did not reveal records of significant natural areas or historical records of rare species.

There are no major rivers or tributaries in Tavistock. However, there is one open ditch municipal drain (the Hohner Drain), which flows in a southerly direction towards a tributary of the Thames River. This drain receives stormwater flows from the existing system in Tavistock. The Hohner drain falls within the Regulation Limit of the Upper Thames River Conservation Authority.

5.3 Socio-Economic Features and Built Environment

At the time of the 2006 Census, 7,350 people lived in Township (Population Census of Canada, 2006). This is a slight increase from the 2001 population of 7,238 (Population Census of Canada, 2001). In 2001, the average earnings for full time workers in the Township was less than the Ontario average at $39,937 per year versus $47,299 for Ontario. However, the rate of employment in the Township was higher than the Ontario average at 70.7 percent versus 63.2 percent for Ontario. Manufacturing, construction, agriculture, and agricultural related resource activities were the industries employing the largest number of workers in the Township at the time of the 2001 Census.

5.4 Cultural Heritage and Archaeological Features

The Ministry of Culture was provided with a copy of the Notice of Commencement for the Master Plan. The Ministry responded to the notice indicating that if the preferred alternative will have potential to impact cultural heritage resources, they would prefer to see a heritage assessment completed prior to construction activities.

6.0 Evaluation and Mitigation

6.1 Evaluation Criteria

An evaluation of alternatives for stormwater management for the Township was completed using the criteria outlined in Table 4. The results of this evaluation, as presented in Table 4, form the basis for recommending the preferred solution.

Table 4 Evaluation Criteria

Criteria	Key Issues
Natural Environment	• Designated Sites/Species • Water Quality and Quantity • Floodplain Lands • Terrestrial Habitat • Aquatic Habitat
Socio-Economic/Cultural Environment	• Public acceptance • Land Requirements • Compatibility with Surrounding Land Uses • Heritage Resources • Effects on safety • Temporary Construction Impacts (Dust, Noise, Vibration, detours, loss of business)
Financial Factors	• Estimated Capital Costs • Estimated Operation & Maintenance Costs
Technical Factors	• Technical practicability • Topographic considerations • Reduction in flooding • Effects on downstream users • Effects on upstream developments • Approvals/Permits

Table 5 outlines the detailed evaluation of alternatives based on the above criteria.

Table 5 Evaluation of Alternatives

CRITERIA FOR EVALUATING ALTERNATIVES	ALTERNATIVE SOLUTIONS EVALUATED					
	Alternative 1 – Do Nothing	**Alternative 2 – Storm Sewer Replacement**	**Alternative 3 – Policy Review**	**Alternative 4 – Lot Level Controls**	**Alternative 5 – Conveyance Improvement Measures**	**Alternative 6 – Storage Facilities**
A Natural Environment *Rating:*	**Least Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**
1 Designated Sites/Species	No impact over existing conditions.	No impact over existing conditions. No designated sites or species in the study area.	No impact over existing conditions. No designated sites or species in the study area.	No impact over existing conditions. No designated sites or species in the study area.	No impact over existing conditions. No designated sites or species in the study area.	No impact over existing conditions. No designated sites or species in the study area.
2 Water Quality and Quantity	Current problem of flooding will not be addressed.	Potential temporary impacts on soils and surface water quality as a result of construction activities.	Improvement to potential future development.	Improvement over existing conditions.	Potential temporary impacts on soils and surface water quality as a result of construction activities.	Potential temporary impacts on soils and surface water quality as a result of construction activities.
3 Floodplain Lands	No impact over existing conditions.	No impacts over existing conditions. Consultation with conservation authority may be required and may require approvals and permits.	No impacts over existing conditions.	No impacts over existing conditions.	No impacts over existing conditions. Consultation with conservation authority may be required and approvals and permits may be required.	No impacts over existing conditions. Consultation with conservation authority may be required.
4 Terrestrial Habitat	No impact over existing conditions.	Terrestrial habitats are very limited within study area as it is an urban setting. No impacts over existing conditions.	No impacts over existing conditions.	Terrestrial habitats are very limited within study area as it is an urban setting. No impacts over existing conditions.	Terrestrial habitats are very limited within study area as it is an urban setting. No impacts over existing conditions.	Terrestrial habitats are very limited within study area as it is an urban setting. No impacts over existing conditions.
5 Aquatic Habitat	No impact over existing conditions.	There are no watercourses within the municipal boundaries of Tavistock. No impact over existing conditions.	No impact over existing conditions.	There are no watercourses within the municipal boundaries of Tavistock. No impact over existing conditions.	There are no watercourses within the municipal boundaries of Tavistock. No impact over existing conditions.	There are no watercourses within the municipal boundaries of Tavistock. No impact over existing conditions.

Table 5 cont...

CRITERIA FOR EVALUATING ALTERNATIVES	ALTERNATIVE SOLUTIONS EVALUATED					
	Alternative 1 – Do Nothing	**Alternative 2 – Storm Sewer Replacement**	**Alternative 3 – Policy Review**	**Alternative 4 – Lot Level Controls**	**Alternative 5 – Conveyance Improvement Measures**	**Alternative 6 – Storage Facilities**
B Socio-economic/Cultural Environment *Rating:*	**Least Preferred**	**Least Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**
1 Public Acceptance	Not acceptable to public. Improvements to existing conditions are expected.	Major disturbances throughout Tavistock will not be well accepted by the public.	Does not impact existing developments. Not anticipated to negatively impact public acceptance for future development.	Requires commitment from homeowners. May be some reluctance by homeowners to implement these controls.	Minor disturbances throughout Tavistock are anticipated to be accepted by public.	Not anticipated to negatively impact public acceptance for future development.
2 Land Requirements	No impact over existing conditions.	Development contained within the municipal boundaries of Tavistock. No inter-municipal agreements required.	N/A	N/A	Development contained within the municipal boundaries of Tavistock. No inter-municipal agreements required.	Proposed areas for storage facilities are agricultural lands. Requires consultation and a potential agreement between the Township of East-Zorra Tavistock and Township of Perth East. Land acquisition required.
4 Compatibility with Surrounding Land Uses (Agricultural, Residential)	Compatible.	Compatible with surrounding agricultural and residential land use.	N/A	N/A. Impacts are localized to individual residential lots.	Compatible with surrounding agricultural and residential land use.	May be compatibility concerns with adjacent lands outside municipal boundaries of Tavistock.
5 Heritage Resources (archaeological features, built heritage, and cultural heritage landscapes)	No impact over existing conditions.	No impact over existing conditions anticipated. May require a heritage assessment. Consultation with Ministry of Culture required prior to implementation.	N/A	No impact over existing conditions.	No impact over existing conditions anticipated. May require a heritage assessment. Consultation with Ministry of Culture required prior to implementation.	No impact over existing conditions anticipated. May require a heritage assessment. Consultation with Ministry of Culture required prior to implementation.
6 Effects on Safety	Significant flooding events attributed to existing conditions to stormwater management system present a continued safety concern.	Safety concerns are reduced due to reduction of flooding.	Safety concerns are reduced due to reduction of flooding.	Safety concerns are reduced due to reduction of flooding.	Safety concerns are significantly reduced due to reduction of flooding.	Safety concerns are reduced due to reduction of flooding.
7 Temporary Construction Impacts (Dust, Noise, detours, loss of business)	No impact over existing conditions.	Significant noise and dust impacts due to construction activities. Major detours and loss of business throughout Tavistock during construction.	N/A	Potential impacts on noise as a result of construction and operation activities.	Some noise and dust impacts due to construction activities. Minor detours and some loss of business along major routes in Tavistock during construction.	Some noise and dust impacts due to construction activities.

Table 5 cont...

CRITERIA FOR EVALUATING ALTERNATIVES	ALTERNATIVE SOLUTIONS EVALUATED					
	Alternative 1 – Do Nothing	**Alternative 2 – Storm Sewer Replacement**	**Alternative 3 – Policy Review**	**Alternative 4 – Lot Level Controls**	**Alternative 5 – Conveyance Improvement Measures**	**Alternative 6 – Storage Facilities**
C Economic Factors *Rating:*	**Most Preferred**	**Least Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**
1 Estimated Capital Costs, including Restoration and Total Estimated Cost	No capital costs for Township.	Very high capital costs.	Cost of review already included in Master Plan.	No cost to Township. Costs assumed by homeowner.	High capital costs.	Moderate capital costs.
2 Estimated Operation & Maintenance Costs	O&M costs will not change from current funding allocations.	O&M costs will not change from current allocation of funding.	N/A	N/A	Potential O&M costs to monitor overland flow routes and restrictor plates, similar to costs presently incurred.	Additional O&M requirements associated with monitoring and maintenance of storage facilities.
D Technical Factors *Rating:*	**Most Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**	**Partially Preferred**
1 Technical Practicability	N/A.	Technically feasible, but not practical for a community.	Proposed policy changes are all based on sound engineering practice and are practical to implement.	Lot level controls are technically very simple to implement.	Conveyance improvements can be implemented without a high degree of technical measures. There may be conflicts with existing utilities along the route.	Storage facilities can be implemented without a high degree of technical measures. There may be conflicts with existing utilities.
2 Topographic considerations	No topographic considerations required.	Existing topography appears to be suitable for upsizing of storm water sewer network.	N/A	Topographic conditions of individual lots will need to be addressed when determining appropriate controls.	Existing topography appears to be suitable for upgrading truck sewers.	Can be implemented using existing topography.
3 Reduction in flooding	Does not reduce flooding problems.	Upsizing of storm water network will reduce eliminate existing flooding conditions for minor storm conditions.	Modifications to the existing development standards will aid in the prevention of future flooding but will not eliminate or reduce existing flooding experienced.	Lot level controls will help to reduce potential surface water flooding and minimize impacts on existing lots.	Upgrading of existing trunk sewers reduce or eliminate existing flooding conditions.	Storage facilities will reduce surcharging currently experienced in the system and help to reduce flooding.
4 Approval / Permit Requirements	No approvals or permits required.	Will require permits and approvals.	Will require permits and approvals.	Will require permits and approvals.	Will require permits and approvals.	Will require permits and approvals.
Addresses Problem	No.	Partially	Partially.	Partially	Partially	Partially
RECOMMENDED SOLUTION	**Not recommended**. Does not address problem on flooding.	**Not Recommended**. Cost prohibitive and will require major disturbances within Tavistock.	**Recommend** in conjunction with other alternatives.	**Recommend** in conjunction with other alternatives.	**Recommend** in conjunction with other alternatives.	**Recommend** in conjunction with other alternatives.

Understanding the Rating System:

Most preferred; fully responds to, and/or has fewest impacts in, evaluation criterion.

Increase in preference

Least preferred; largely does not respond to, and/or has potential for unacceptable impacts in, evaluation criterion

6.2 Summary of Evaluation of Alternatives and Mitigation Measures

The following summarize the results of the evaluation of alternatives based on natural environment, socio-economic/cultural environment, economic factors and technical factors.

6.2.1 Alternative 1 – Do Nothing

This alternative does not meet the Study objectives and thus will not be evaluated any further.

6.2.2 Alternative 2 – Storm Sewer Replacement

Although this alternative could address the problem of flooding within Tavistock, upsizing the majority of the existing storm sewer network so that the local sewers convey the 1:5 year storm and the trunk sewers convey the 1:10 year storm would be cost prohibitive and would result in significant disruptions to businesses and the residents of Tavistock. Alternative 2 therefore considers only increasing the local sewers, however, the replacement costs remain extensive. Alternative 2 is therefore the least preferred alternative. Refer to Appendix F for a preliminary capital cost estimate.

6.2.3 Alternative 3 – Policy Review

Implementation of the proposed new policies will mitigate future flooding and provide a good basis for future development. The new policies are based on sound engineering practice. This alternative will have no impact on current agricultural and residential lands and, it will not alleviate current flooding conditions. Alternative 3 cannot alone solve the problem of flooding, however it can form a viable component of the overall solution. Therefore, this alternative is recommended in conjunction with another alternative that will address the immediate problems of flooding. Refer to Appendix F for a preliminary capital cost estimate.

Mitigation Measures

Mitigation measures may be required for future development activities conducted under the proposed new policy framework, however such measures cannot be defined at this time.

6.2.4 Alternative 4 - Lot Level Controls

Lot level controls will involve minor changes and can be completed by the homeowner at no cost to the Township. Impacts associated with these controls are localized and do no effect agricultural or other residential lands. Provided that these

controls are implemented adequately, they will ensure positive drainage away from the buildings and help to reduce potential surface water flooding. The recommended controls are based on sound engineering practice. Alternative 4 cannot alone solve the problem of flooding, however it can form a viable component of the overall solution. Therefore, this alternative is recommended in conjunction with another alternative that will address the issue of stormwater network capacity. Refer to Appendix F for a preliminary capital cost estimate.

Mitigation Measures

No mitigating measures required.

6.2.5 Alternative 5 – Conveyance Improvement Measures

The implementation of new trunk sewers and overland flow paths will not affect agricultural land since the proposed work is within the urban setting of Tavistock. Impacts to residential areas will only occur during construction of trunk sewers or creation of overland flow paths.

Increasing the size of the trunk sewers will allow for more water to enter the sub-surface stormwater system and reduce surface flooding and basement back ups. This alternative will improve future storm systems and minimize impacts on existing lots. Providing catchbasins with restrictor plates will ensure that storm sewer capacities are not exceeded. This will cause more water to be stored on the surface, however storm water quantities will not be increased from existing quantities and no impacts over existing conditions are anticipated for the natural environment within the one open ditch municipal drain receiving storm water flows from the system.

Provided that the necessary approvals can be obtained for this alternative, it can be implemented without a high degree of technical measures based on sound engineering practices. However, there may be conflicts with existing utilities along the route. Refer to Appendix F for a preliminary capital cost estimate.

Alternative 5 cannot alone solve the problem of flooding, however it can form a viable component of the overall solution. Therefore, this alternative is recommended in conjunction with another alternative that will address the issue of stormwater network capacity.

Mitigating Measures

- Construction working hours will be developed to minimize noise disruption outside of regular working hours.
- Advanced notification of construction will be provided to alert residents of any road closures or detours.

- Dust/sediment control measures will be put in place
- Detailed locations of all utilities will be determined prior to construction.

6.2.6 Alternative 6 – Storage Facilities / Stormwater Management

The two recommended stormwater management facility locations are proposed in agricultural land. One of these locations is not located within the Township of East Zorra-Tavistock nor is it located within the County of Oxford. Therefore, consultation and a potential agreement between the Township of East-Zorra Tavistock and the Township of Perth East will be required prior to implementation. Impacts to residential areas will only occur during construction.

This alternative will provide for the storage and control of external flows entering Tavistock storm sewers. This process will reduce surcharging currently experienced in the system and help to reduce flooding. This alternative will improve future storm systems and minimize impacts on the existing system.

This alternative can be implemented based on existing topography and with the goal of capturing and storing water prior to it entering the storm system network. Storm water quantities will not be increased from existing quantities and no impacts over existing conditions are anticipated for the natural environment. There may be conflicts with existing utilities. Refer to Appendix F for a preliminary capital cost estimate.

Ministry approval may be required prior to construction. Consultation with the conservation authority will need to be made once more details are available for this alternative.

Alternative 6 cannot alone solve the problem of flooding in Tavistock. The issues of under capacity within the existing storm sewer network and the interrupted overland flow route still need to be addressed. This alternative can form a viable component of the overall solution. Therefore, this alternative is recommended in conjunction with another alternative that will address the issue of stormwater network capacity.

Mitigating Measures

- Compensation will need to be provided for loss of land use.
- Construction working hours will be developed to minimize noise disruption outside of regular working hours.
- Advanced notification of construction will be provided to alert residents of any road closures or detours.
- Dust/sediment control measures will be put in place.
- Erosion control measures will be provided during construction.
- Intra-municipal agreements will need to be developed.

- Land acquisition will be required.
- Detailed locations of all utilities will be determined prior to construction.

7.0 Preferred Alternative

None of the alternatives will alone solve the problem of flooding within Village limits during large storm events. Therefore, the preferred alternative is combination of Alternatives 3, 4, 5 and 6. Together, these alternatives combined will be a far more effective means of reducing flooding than any single alternative. The following is a summary of the preferred alternative.

7.1 Summary

The combination of Alternatives 3 – 6 are considered as the preferred alternative. Below is a summary of what these alternatives consist of.

Policy Changes – Alternative 3

- The contributing drainage area should allow for the post-development runoff flows from the 1:100 year storm to be attenuated to the 1:2 year pre-development flows.
- Water should not extend beyond local road ROW and desirably not overtop road curbs where practical.
- Basement floor elevations should be set above groundwater level.
- Roof leaders should discharge to surface in all cases.
- Flow should not cross roads except for in major storms.
- Sump pumps shall not under any circumstances be connected to the sanitary sewers. **No PDC should have a gravity connection** beneath the house footing. The PDC must pump water up and over the foundation wall as outlined in the current Township Development Standards.
- Theoretical hydraulic grade lines should be calculated for all new sewers.

Lot Level Controls (not limited to those outlined below) – Alternative 4

- Disconnect all gravity PDC and reconnect in accordance with current standard.
- Rear yard storage – depressions or restrictor plates in rear yard catchbasins.
- Parking lot storage – depressions or restrictor plates in catchbasins.
- Direct roof leaders to rain barrels.
- Direct roof leaders to rear yard ponding area or soakaway pits.
- Direct sump pumps to pump to rear yard ponding area.
- Infiltration trenches along rear lot lines.
- Where possible create vegetated buffers along flow paths.

Conveyance – Alternative 5

- Replace existing trunk sewers with sewers that can convey the 1:10 year flow.
- Provide restrictor plates on catchbasins to restrict flow to the 1:2 yr storm.

- Overland flow routes should be properly identified and, where necessary, improved to provide positive drainage for major storm events.

Storage – Alternative 6

- Provide storage for the external areas to the north/northwest of Tavistock restricting flow into the sewers to a 1:2 year pre-development flow rate.

Preliminary estimates suggest that two ponds would provide sufficient storage capacity for Tavistock. However, since this component of the preferred alternative will involve land acquisition, the Township will need more time is to discuss this component with the appropriate parties and ascertain the details of how this component can be implemented.

This concludes Phases 1 and 2 of the Municipal Class EA process. The following sections outline the recommended implementation strategy.

8.0 Recommendations and Implementation Strategy

In keeping with the objectives of this study, a recommended strategy for improvements to alleviate the potential for flooding within Tavistock has been developed. The preferred alternative solution, presented in the previous section, is a multi-faceted approach that encompasses policy changes and capital works. It is recommended that the preferred alternative be implemented. While it is acknowledged that it may not be feasible to implement all elements of the preferred alternative immediately, an implementation strategy has been developed to help prioritize how the recommendations are put in place.

Recommendations related to policy and lot level controls do not entail capital expenditures. As such, these recommendations can be implemented in a timely manner without substantial cost.

8.1 Policy Changes

It is recommended that the policy changes discussed in Alternative 3 be implemented.

8.2 Lot Level Controls

It is recommended that a program encouraging residents to implement lot level controls, as discussed in Alternative 4, be put in place. The Township will implement controls when it has an opportunity (i.e. at time of request for land use change, etc.).

8.3 Capital Works

Recommendations involving capital works are listed in order of priority for implementation in the following subsections.

8.3.1 Improvements to Overland Flow Routes

Improvements to overland flow routes, as discussed in Alternative 5, will result in the greatest reduction of major flooding concerns relative to the effort and expense put forth. In the event of a major storm beyond the magnitude of a 1:5 or 1:10 year storm, the minor storm system will be overwhelmed even if it can provide sufficient capacity up to the design standards for minor systems. To reduce the risk of flood damage, it is therefore imperative that overland flow routes are able to convey the runoff from major storms and provide positive drainage away from buildings. Overland flow routes should be able to convey additional runoff that cannot be conveyed by the minor system, either because the minor system cannot provide sufficient capacity up to the design standard, or because the storm event encountered may be of a greater magnitude than the design storm for minor systems. For these

reasons, it is recommended that improvements to overland flow routes be a first priority.

8.3.2 Inlet Controls for Storm Sewers

Since the replacement of the storm sewer system is not expected to be immediate, restrictor plates, should be placed in all Tavistock catchbasins, limiting flow entering the storm sewer system to less than that generated by a 2 year rainfall event.

8.3.3 Construction of Storage Facilities / Stormwater Management

The construction of stormwater management facilities, as discussed in Alternative 6, will control the peak flows from external areas and prevent this water from flowing through the Village. This will reduce the flow that must be conveyed by the storm sewer network in the Village. With storage facilities designed to control major storms, this will also reduce flooding within the Village during major storm events. The implementation the proposed stormwater management facilities will result in a reduction of flooding risk for a large portion of the Village. For these reasons, it is recommended that the stormwater management facilities be implemented as soon as possible.

8.3.4 Improvements to Trunk Sewers

Several sections of trunk sewers within the Village have been identified as not being capable of conveying the 1:10 year design storm according to the current development standards. As discussed in Alternative 5, it is recommended that the underperforming sections of trunk sewers be replaced with larger sewers capable of conveying the 1:10 year storm. It is acknowledged that these improvements constitute a major capital expenditure. It is recommended that the improvements to trunk sewers be coordinated with future road reconstruction projects, and proceed on an ongoing, year-to-year basis until all underperforming trunk sewers have been replaced.

8.4 Improvements to Local Sewers

Numerous sections of local sewers within the Village have been identified as not being capable of conveying the 1:5 year design storm according to the current development standards. It is acknowledged that the replacement of these sewers constitute a major capital expenditure. It is recommended that the improvements to local sewers be coordinated with future road reconstruction projects, and proceed on an ongoing, year-to-year basis until all underperforming local sewers have been replaced.

BURNSIDE

Appendix A
Public Consultation

Notice of Study Commencement
Tavistock Storm System Master Plan

The Study

The Township of East-Zorra Tavistock is carrying out a study to evaluate the stormwater infrastructure for Tavistock. In addition to the existing Council approved Municipal Drain project, a review of the stormwater system will be undertaken to assess and recommend ways to reduce flooding within the Village limits. A number of alternatives will be examined and an assessment will be made regarding the overall impact of the proposed project on the social and natural environments in the area.

The Process

The Township, through our consultants, R.J. Burnside & Associates Limited, has initiated a Municipal Class Environmental Assessment for the above noted project. The study is being conducted in accordance with the approved requirements of a Schedule B project under the June 2000 Municipal Class Environmental Assessment (Class EA) document.

Comments Invited

Public input and comments are invited, for incorporation into the planning and design of this project and will be received until February 28, 2007. Subject to comments received and the receipt of necessary approvals, the Township intends to proceed with the planning, design and construction of this project. For further information on this project please contact the following project team member:

Paul MacIntyre,
Drainage Coordinator,
R.J. Burnside and Associates Limited,
332 Lorne Avenue East,
Stratford,
ON, N5A 6S4,
Telephone: 519-271-5111

Information will be collected in accordance with the Freedom of Information and Protection of Privacy Act. With the exception of personal information, all comments will become part of the public record.

This Notice first issued on February 7, 2007

R. J. Burnside & Associates Limited 292 Speedvale Avenue West Unit 7 Guelph ON N1H 1C4 Canada
telephone (519) 823-4995 fax (519) 836-5477 web www.rjburnside.com

February 12, 2007

«AddressBlock»

Attention: «First_Name» «Last_Name»
«Title»

Re: Township of East Zorra-Tavistock
Master Storm System Drainage Plan
Village of Tavistock
File No.: MSZ 11487

Dear Sir/Madame,

The Township of East Zorra-Tavistock, located south of Shakespeare along County Road 107, has retained R. J. Burnside and Associates Limited (Burnside) to undertake a Schedule B Municipal Class Environmental Assessment (EA). The community has been experiencing flooding during major storm events. In an effort to try and minimize future flooding, the Township of East Zorra-Tavistock is undertaking a Master Drainage Plan that will be completed in accordance with the Municipal Class Environmental Assessment process. The Notice of Study Commencement was published in the Tavistock Gazette on February 7, 2007 and will also be published in the February 14, 2007 issue.

At this time, we are seeking your input to determine if you would like to continue to be involved in this EA study, how this EA study might affect your mandated areas of responsibility, and how you would like our study team to address your concerns or comments. Your input is requested as soon as possible, but no later than February 28, 2007. Should we not hear from you by this time, we will assume that your agency is satisfied that this EA study may proceed without your involvement.

We trust the above is acceptable. Please call should you have any questions.

Yours truly,

R.J. Burnside & Associates Limited

Jackie Gravel, P. Eng.

Enc.

Cc: Jeff Carswell, Township of East Zorra-Tavistock

070123Notice of Commencement.doc
2007-02-12 11:55 AM

Title	First Name	Last Name	Company Name	Address Line 1	Address Line 2	City	State	ZIP Code
Clerk-Administrator	Keith	Reibling	Township of Blandfor-Blenheim	P.O. Box 100		Drumbo	ON	N0J 1G0
Clerk-Treasurer	Muriel	King	Township of Perth South	3191 Road 122		St. Pauls	ON	N0K 1V0
CAO	Ria	Colquhoun	County of Perth	Courthouse	1 Huron St.	Stratford	ON	N5A 5S4
Director of Public Works	Rob	Walton	County of Oxfrod, Public Works	415 Hunter St.	P.O. Box 397	Woodstock	ON	N4S 7Y3
CAO	Don	MacLeod	Township of Zorra	P.O. Box 306		Ingersoll	ON	N5L 3K5
Heritage Planner/Archaeologist	Neal	Ferris	Ministry of Culture	900 Highbury Ave.		London	ON	N6A 1L3
Manager	Bruce	Curtis	Ministry of Municipal Affairs and Housing	Community Planning and Development	659 Exter Road, 2nd Floor	London	ON	N6E 1L3
Coordinator, Hydrology & Regulatory Services	Jeff	Brick	Upper Thames Conservation Authority	1424 Clarke Road		London	ON	N5V 5B9
City Engineer	George	Bowa	City of Stratford	City Hall Annex	82 Erie Street	Stratford	ON	N5A 2M4
Environmental Assessment Coordinator	Ron	Griffiths	Ministry of the Environment	Techincal Support Section	733 Exeter Road	London	ON	N6E 1L3
Director	James	O'Mara	Ministry of the Environment	Environmental Approvals and Assessment Branch	2 St. Clarie Ave., West, Floor 12A	Toronto	ON	M4V 1L5
Commissioner, Transportation and Environmental Service	Thomas	Schidt, P. Eng.	Region of Waterloo	150 Frederick St.	P.O. Box 9051 Station 'C'	Kitchener	ON	N2G 4J3
Director of Public Works	Gary	Charbonneau	Township of Wilmot	60 Snyder's Road West		Baden	ON	N3A 1A1
Manager, Public Works	Bud	Markham	Township of Perth East	P.O. Box 455	25 Mill Street East	Milverton	ON	N0K 1M0
	Environmental Assessment Contact		Ministry of Natural Resources	353 Talbot Street West		Aylmer	ON	N5H 2S8
Manager	Kevin	Bentley	Engineering Office, Ministry of Transportation	South West Region	659 Exeter Road	London	ON	N6E 1L3

Ministry of Culture **Ministère de la Culture**
Programs & Services Branch
Southwest Archaeological Field Office
900 Highbury Avenue
London, Ontario N5Y 1A4

(519) 675-7742; Fax: 675-7777

Ontario

February 21, 2007

To: Paul MacIntyre
Drainage Coordinator
R.J. Burnside and Associates Limited
332 Lorne Avenue East
Stratford, Ontario N5A 6S4

RE: Village of Tavistock, Township of East Zorra-Tavistock, Master Storm System Drainage Plan, Municipal Class Environmental Assessment

Thank you for your letter of February 12, 2007 concerning the above-noted study. A principal concern of this office is the adverse effects that development activities might have on cultural heritage resources. Cultural heritage resources include built heritage, archaeological resources and cultural heritage landscapes. If the preferred alternative as a result of this study will have the potential to impact cultural heritage resources, then our office would recommend that a heritage assessment be conducted prior to the initiation of construction activities. If any significant heritage or archaeological remains are identified, then any negative impacts would have to be mitigated by either avoidance or excavation.

Consequently, our office would wish to continue to be involved in this project. In particular, it would be useful to be provided with detailed information and maps, outlining the extent and type of land disturbance anticipated. With this information we will be able to determine what portions of the project, if any, may exhibit potential for impacting heritage resources, and thus would require an assessment to inventory all heritage resources present, and determine what mitigation work, if any, may be required.

I trust that this is of assistance. Please do not hesitate to contact me if you require further information.

Sincerely,

John MacDonald
Heritage Planner/ Archaeologist
Southwestern Ontario Region

Corporation of the County of Perth

Public Works Department

Court House, 1 Huron Street, Stratford Ontario N5A 5S4

Tel: (519) 271-0531
Fax: (519) 271-6265

February 19, 2007

R. J. Burnside & Associates Limited,
292 Speedvale Ave West, Unit 7,
Guelph, On N1H 1C4

Atten: Jackie Gravel

RE: Township of East Zorra-Tavistock – Storm System Drainage Plan
Your File MSZ: 11487

Your letter of February 12, 2007 has been received. We have no comments or concerns at this time but would like to continue to receive further reports and information.

Regards,

Bentley Ehgoetz,
Director, Public Works
519-271-0531, ex. 225
behgoetz@perthcounty.ca

:caz

KEITH REIBLING, A.M.C.T., Clerk-Administrator
MAUREEN SIMMONS, A.M.C.T., Treasurer/Collector
GARY CRANDALL, C.R.S.I., Road Manager
JAMES WATSON, C.E.T., Chief Building Official
RICK RICHARDSON, Fire Chief
DARREN HALL, Facility Manager

P.O. Box 100
Telephone: (519) 463-5347
Fax: (519) 463-5881
website: www.twp.bla-ble.on.ca

TOWNSHIP OF BLANDFORD-BLENHEIM
47 Wilmot Street South
DRUMBO, ONTARIO
N0J 1G0

February 14, 2007.

Ms. Jackie Gravel, Eng.,
R.J. Burnside & Associates Limited,
292 Speedvale Avenue West, Unit 7,
Guelph On N1H 1C4

Dear Ms. Gravel:

Re: Township of East Zorra-Tavistock
Master Storm System Drainage Plan
Village of Tavistock
File No.: MSZ 11487

In response to your letter dated February 12th, 2007, respecting the above project, this letter is to advise that we have no concerns with the proposed drainage system plan. The waters from Tavistock enter the Thames River drainage system. The Thames River actually forms the westerly boundary for a considerable portion of our Township, but these waters do not flow into our Township.

Yours truly,
Keith Reibling
Keith Reibling,
Clerk-Administrator.

KR:ah

BURNSIDE

Appendix B
Reviewed Plans

List of Background Information
Tavistock Master Drainage Plan
MSZ11487

Prepared by: J. Phillips
Date: 27-Feb-07

W:\[11487 background info list.xls]Sheet1

Title	Organization	Job No.	Drawing No.	Format	Date	Stamped / Signed?	Revision	Notes
DRAINAGE WORKS								
TAVISTOCK DRAIN 1974	Kelly and Smart Limited			report & drawings		stamped & signed		-5 drawing sheets (2 copies) -watershed/ drainage area -plan & profile
TAVISTOCK DRAIN 1974 Village of Tavistock	Kelly and Smart Limited	7333	Dwg. 2 of 5	drawing		stamped & signed		-1 sheet -watershed/ drainage info
DRAINAGE MAP Village of Tavistock	K. Smart		1 of 1		Nov-75	no stamp		-1 sheet (2 copies) -watershed/ drainage areas -contours (5ft interval)
PLAN OF BOWLES DRAINAGE WORKS in the TOWNSHIP OF SOUTH EASTHOPE	E. H. Uderstadt (Land Surveyor)	D-EA-S-138		drawing	8-Aug-79			-watershed/ drainage area
PROFILES of BOWLES DRAINAGE WORKS		D-EA-S-138						
TAVISTOCK DRAIN 1979	K. Smart			report & drawings		stamped & signed		-9 drawing sheets -watershed/ drainage area -plan & profile
HORNER DRAIN	K. Smart			report & drawings	11-Apr-79			-3 drawing sheets -watershed/ drainage area -plan and profile
TAVISTOCK DRAIN 1985	K. Smart	85039		report & drawings		stamped & signed		
TAVISTOCK DRAIN 1987	K. Smart			drawings	28-Feb-87	stamped & signed		-10 sheets, 11x17 -Holley Ave., Henry Vogt Ave., Rudy Ave. -Roth St., Fuhr St. -watershed/ drainage area
TAVISTOCK DRAIN 1993	K. Smart	89110				stamped & signed		-11 drawing sheets -watershed/ draingage area -plan & profile
TAVISTOCK DRAIN 1993 County of Oxford Township of East Zorra Tavistock	K. Smart	89110		drawings	5-Apr-93	stamped & signed		-11 sheets -plan & profile -watershed/ drainage info
TAVISTOCK MUNICIPAL DRAIN 2006 Township of East Zorra Tavistock	Dietrich Engineering Limited	0539		report & drawings	17-Oct-06	stamped & signed	PRELIMINARY	-2 sheets -air photo -watershed/ drainage info
JANELLE DRIVE (rear yard swales and berms)	Burnside				Aug-06			-5 sheets -plan & profile -air photo -survey (incorrect benchmark)
SUBDIVISIONS								
BEN-DER HOLDINGS SUBDIVISION	Proctor & Redfern Limited			drawings	Jan-78			-8 sheets + cover -full subdivision design -STM catchment areas, STM, SAN, WM -plan & profiles

List of Background Information
Tavistock Master Drainage Plan
MSZ11487

Prepared by: J. Phillips
Date: 27-Feb-07
W:\[11487 background info list.xls]Sheet1

Title	Organization	Job No.	Drawing No.	Format	Date	Stamped / Signed?	Revision	Notes
BEN-DER HOLDINGS SUBDIVISION PHASE II	Proctor & Redfern Limited			drawings	Jul-79	stamped & signed	AS CONSTRUCTED	-7 sheets + cover
BEN-DER HOLDINGS SUBDIVISION PHASE III	Proctor & Redfern Limited			drawings	Oct-89	stamped & signed	AS CONSTRUCTED	-8 sheets + cover
BEN-DER HOLDINGS SUBDIVISION PHASE IV	Proctor & Redfern Limited			drawings	Feb-91	stamped & signed	AS CONSTRUCTED	-9 sheets
BEN-DER HOLDINGS SUBDIVISION PHASE V	Proctor & Redfern Limited			drawings	Apr-98		general revisions	-8 sheets + cover
McTAVISH SUBDIVISION Janelle St & Deitrich Road				STM design sheet catchment area				-storm sewer design chart -catchment area map -system designed for 2-yr storm
JANELLE DRIVE McTavish Subdivision			M3-79-3	drawing	2-Jul-86		AS CONSTRUCTED	-plan & profile drawings with
			M3-79-4	drawing	16-May-79		TENDER	STM / SAN / WM
			M3-79-5	drawing	14-Aug-79		AS CONSTRUCTED	
JANELLE DRIVE & DEITRICH ROAD McTavish Subdivision	Johnson Engineering Consultants			drawings	11-Aug-88			-2 sheets -detail & drainage -plan & profile
JACOB STREET	Daswon & Johnson		M3-76-1	drawing	24-Nov-76	stamped, not signed		-detail & drainage
			M3-76-2	drawing	7-Jul-77	stamped, not signed	AS CONSTRUCTED	-plan & profile

ROAD RECONSTRUCTION

RECONSTRUCTION OF WOODSTOCK STREET Highway 59	K. Smart	83089		drawings	29-Jan-86	no P.Eng stamp		-8 sheets + cover -stamped 'Approved for department purposes' -no STM / SAN / WM info
COUNTY ROAD 24	County of Oxford Engineering Department		67240-22 67240-23 67240-24 67240-25 67240-26 67240-27		27-Nov-86			-6 sheets -plan only, no profiles -shows STM with connections -Hope St. W
COUNTY OF OXFORD County Road 24 Hope Street West Tavistock	County of Oxford Engineering Department			drawings	22-Dec-86	stamped & signed	AS CONSTRUCTED	-21 sheets -STM installed
TAVISTOCK SIDESTREETS 1992 Wellington, Roth, and Fuhr Street Plan	K. Smart	90008		drawings	May-92	stamped, not signed		-3 sheets -no revision information -plan & profile -STM replaced / installed
TAVISTOCK SIDESTREETS 1992 Hendershot, Decew and Minerva Street Plan	K. Smart	90008	Dwg. 3	drawing	May-92	stamped, not signed		-1 sheet (?)
TAVISTOCK SIDESTREET RECONSTRUCTION 1994 William, Mogk and Oxford Streets Township of East Zorra Tavistock	K. Smart	94017		drawings	25-Jun-94	stamped, not signed		-4 sheets (2 copies) -plan & profile -STM replaced or installed
ADAM STREET RECONSTRUCTION Tavistock - Township of East Zorra-Tavistock	K. Smart	99129		drawings	30-Mar-00	stamped & signed	Rev. 2	-3 sheets -STM replaced / installed

List of Background Information
Tavistock Master Drainage Plan
MSZ11487

Prepared by: J. Phillips
Date: 27-Feb-07

W:\[11487 background info list.xls]Sheet1

Title	Organization	Job No.	Drawing No.	Format	Date	Stamped / Signed?	Revision	Notes
WILTON STREET and WETTLAUFER STREET RECONSTRUCTION Tavistock - Township of East Zorra	K. Smart	06-028		drawings	30-Mar-06	stamped, not signed		-2 sheets (2 copies) -STM replaced / installed -plan & profile

BURNSIDE

Appendix C
Current Development Standards

TOWNSHIP OF EAST ZORRA-TAVISTOCK

MUNICIPAL SERVICING STANDARDS

URBAN AND RURAL DEVELOPMENTS

K. SMART ASSOCIATES LIMITED
85 McIntyre Drive
Kitchener ON N2R 1H6

CONTENTS

THE CORPORATION OF THE
TOWNSHIP OF EAST ZORRA-TAVISTOCK

February 7, 2007

Moved By: Betty Yeoman

Seconded By: Dave Oliphant

THAT the Corporation of the Council of the Township of East Zorra-Tavistock hereby adopts the Municipal Servicing Standards, for the Township of East Zorra-Tavistock, as prepared by K. Smart Associates Limited, Kitchener, Ontario.

Mayor "Original Signed by Don McKay, Mayor"

TOWNSHIP OF EAST ZORRA-TAVISTOCK

MUNICIPAL SERVICING STANDARDS

CHAPTER 1

DEVELOPMENT PROCEDURES

DEVELOPMENT PROCEDURES

1. Submit preliminary Draft Plan of Subdivision to Township for consideration, discussion and comment.

2. Upon Township review, Draft Plan is submitted to County for approval along with application fees for County and Township services.

3. Submit Draft Plan plus all required reports to outline methods of storm drainage, sanitary waste disposal, water supply and other applicable services. Where private water supply and/or sewage disposal is provided the reports shall outline the lot's suitability to provide for individual wells and to accept septic tank tile bed installations.

4. Upon Draft Plan approval, the Developer may request in writing that the Township prepare a Subdivision Agreement. Subdivider provides cash deposit for Township costs of preparing Subdivision Agreement.

5. Township provides Developer with copy of Municipal Engineering Standards and policies re impost levies, park land fees, and other policies applicable to project. Preparation of design commences.

6. Developer prepares and submits two copies of plans, design calculations and any special provisions or specifications * of the municipal services to be provided.

7. Township returns one set of plans, specifications and design calculations to the Developer with any required revisions.

8. Developer resubmits plans, specifications and design calculations to the Township for final approval, together with applications for submission to all agencies and authorities.

* Applicable OPSS and OPSD to be listed but not to be submitted.

9. Provided that the final submission is satisfactory, Township initials plans and specifications approved for construction and signs approval application forms.

10. After receiving all agencies and authorities approval, the Developer shall satisfy the financial and other requirements of the Township as set out in the Subdivision Agreement after which the Township shall execute the Subdivision Agreement and authorize registration of the plan of subdivision.

11. Developer provides evidence of registration of plan and Township authorizes construction to start if not preservicing.

12. Construction by the Developer or a Contractor on his behalf of all municipal services in accordance with the approved Subdivision Agreement, plans and specifications, and supervised by the Developer's Engineer with periodic inspection by the Township and its Engineer.

13. Developer submits to the Township service testing reports and construction reports together with a request for preliminary approval of the services.

14. Township grants preliminary approval subject to any deficiencies being corrected by the Developer.

15. Upon completion of deficiencies and all other requirements of the Subdivision Agreement, the Township issues performance acceptance certificate and maintenance period commences.

16. During maintenance period Developer maintains all of the municipal services.

17. Developer corrects any final deficiencies in the services at the end of the maintenance period, and then applies for final acceptance and assumption of the road.

18. Township discharges the Developer's responsibilities as set out in the Subdivision Agreement.

TOWNSHIP OF EAST ZORRA-TAVISTOCK

MINIMUM MUNICIPAL SERVICING STANDARDS

CHAPTER 2

DEVELOPMENT STANDARDS

A. STORM SEWERS

General: Storm drainage minor systems with catchbasins for street and rear lot drainage and storm drainage major systems using open channels, creeks, roadways, swales and/or boulevard capabilities shall be designed using the Rational Method, based on the criteria included below. For development in Tavistock, storm drainage must give consideration to and work in conjunction with the Tavistock Storm System master plan. Unit Hydrograph methods may be used with prior approval of Township Engineer.

Intensity:
- Intensity/Duration Curves as per Standard EZT-2 attached.
- 5 year return period (minor system)
- 100 year return period (major system)
- 10 year return period (trunk sewers - determined by Township)

Inlet Time: As calculated; 10 minutes minimum

Runoff Coefficients:

Open Space, Parks	0.20
Agricultural Pasture, wooded	0.20
Agricultural Cultivated	0.35
Single Family Residential	0.35
Semi-Detached	0.50
Multiple Family Residential	0.55
Apartments and Industrial	0.75
Central Business District	0.90
Commercial or Industrial	0.70
Roadways	0.60 to 0.80

Pipe Material and n Value:

Concrete	n = 0.013
Polyvinylchloride	n = 0.013
Polyethylene	n = 0.013

Concrete or plastic drain tile for special uses.

Gaskets: Gasketted joints will be as required. Where open joints are allowed or requested, filter fabric joint wrapping is required.

A. STORM SEWERS (Cont'd)

Capacity:	Manning's Formula, flowing full at peak discharge.
Private Drain Connections:	- Special sizing considerations required where house connections are provided as outlined herein. - Minimum diameter - 100mm (4") - Minimum grade 1% (1/8" per foot)
Minimum Size:	250mm (10 inch diameter) catchbasin leads 250mm (10 inch diameter) mains 675mm (27 inch diameter) radius pipe
Minimum Cover:	1.5m (4.9 feet)
Minimum Velocity:	0.75m (2.5 feet) per second
Maximum Velocity:	4.5m (15 feet) per second
Manhole Diameter:	Minimum of 1200mm (48") As per Standard EZT-1 attached
Manhole Spacing:	90m (300 feet) or less desirable 120m (400 feet) maximum
Minimum Slope for Catchbasin Leads:	1%
Drop Manhole:	Required where inlet and outlet differ by more than 0.9m (3 feet)
Catchbasin Spacing:	- 90m (300 feet) - The highest catchbasin shall be located a maximum of 90m (300 feet) from the high point on the road. - Double catchbasins required at low points in roads.
Catchbasin Sump:	0.60m (2 feet) deep in 0.60 x 0.60m (2 foot x 2 foot) catchbasins 0.30m (1 foot) deep in 1.20m x 1.20m (4 foot x 4 foot) catchbasins, or 16 cubic feet of storage.
Invert Drops:	Where pipes enter and leave at the following angles: 90 Deg. = 60mm (0.2 feet) 45 Deg. = 30mm (0.1 feet) 0 Deg. = --mm (-- feet)

A. STORM SEWERS (Cont'd)

Infiltration:	0.05 litres per millimetre diameter per 30 metres (0.25 gallons per inch diameter per 100 feet) of sewer per hour where gasketted joints are required.
Videotaping:	Prior to acceptance of any new storm lines, a videotape plus report must be provided to the Township. Catchbasin leads and private connections do not require videotaping.

Storm water management techniques will be necessary where outlet flows exceed outlet capacities and/or where required as a condition of Draft Plan approval.

Post development storm water flows leaving the lands to be developed shall not exceed pre-development storm water flows for rainfall events with return periods of two (2) years to hundred (100) years inclusive.

If a proposed development intends to utilize an existing storm sewer as an outlet, proof that additional capacity exists within the storm sewer to accommodate flows from the proposed development must be provided.

Design computation sheets plus plans of drainage areas shall be submitted for review and approval.

Depressing catchbasins below the normal gutter grade, or constructing asphalt basins around catchbasins will not normally be permitted by the Township.

Where rear lot or side yard swales are used, a minimum grade of 1.0% with catchbasins at 90m (300') intervals is required. In no case will an overland run exceeding the above limits be allowed unless it is an open channel. Easements of a sufficient width to provide access for maintenance by the Township are required for all back lot storm pipe drains or open channels.

All storm drain materials, components, methods to be in accordance with applicable OPSD and OPSS.

Grade adjustment rings shall be used for final grade adjustments. A maximum of 6" shall be used in each catchbasin or manhole. If more grade adjustment is required, additional manhole or catchbasin sections shall be used. Bricks will not be accepted.

Where multiple rings are used, the upper grade ring is to be constructed of an approved rubber product.

Concrete benching is required at all manholes. Channels are to be smooth and true to line and grade. Channels may be formed of concrete or sewer pipe neatly cut off.

A. STORM SEWERS (Cont'd)

All storm manholes shall be:

1. Constructed with no more than 150mm (6") of grade adjustment rings. Bricks will not be accepted.
2. Constructed such that the upper grade ring, where multiple rings are used, is constructed of an approved rubber product.
3. Benched.

Safety gradings (landings) are to be provided in deep manholes. Manholes deeper than five (5) metres (sixteen (16) feet) measured from the top of frame to the lowest invert are to be installed with a safety grating. Details of the safety grating are to be submitted to the Township Engineer.

Energy dissipating structures will be required wherever the velocity of flow at a storm sewer or drain outlet exceeds 2.4 metres per second (8 f.p.s.). For low volumes and velocities hand-placed sacked concrete riprap protection may be sufficient. For greater volumes and velocities more formal concrete structures will be required.

Corrugated metal pipe shall be used to protect any drain outlet into an open channel. Angular and graded stone riprap protection, unless otherwise specified, shall be built around the corrugated pipe and shall be extended downstream a minimum distance of 1 metre (3 feet). The protection shall extend to the top of the backfilled trench and below the pipe to 300mm (12") along the streambed. The protection shall also extend 600mm (2') into undisturbed soils on either side of the backfilled trench. Where the outlet occurs at the end of an open ditch the stone riprap protection will extend all around the end of the ditch and to a point 1 metre (3') downstream on either side. Where heavy overflow is likely to occur, sufficient additional riprap shall be placed as directed by the Engineer to prevent the water cutting around the protection. A geotextile filter underlay shall be placed under all outlet protection. A concrete structure may be required to protect against heavy overflow if so indicated by the Township Engineer. The corrugated metal pipe shall have a hinged metal gate on the outlet end to prevent the entry of small animals. Maximum spacing between bars shall be two inches.

All design submissions shall include pipe strength and bedding calculations. In general, Granular "A" or 20mm (3/4") crushed stone shall be used for bedding with sand cover for a minimum of 300mm (1 foot) above the pipe ("Class B"). Depending on the soils and pipe strength calculations, bedding types that differ from the above may be approved.

Marston formulae Wt=1.0 x Ic x Ct x T/A for concentrated loading or Wd= C d x W x Bd for gravity earth loading shall be used. References to published tables or graphs may be used. OPSD tables may also be used. The Concrete Pipe Design Manual by ACPA may be used.

A. STORM SEWERS (Cont'd)

All open channels to have minimum side slopes of 3:1 and to be in accordance with EZT-3. Outlets of pipes into ditches to have outlet headwall in accordance with OSPD.

Where concrete drain tile or corrugated plastic tubing are permitted for any part of the drainage works (on open farmlands only) the most recent OMAF edition of "Recommended Practice for Construction of Subsurface Drainage Systems" shall govern the work.

Where non gasketted joints are permitted, the joints shall be fully wrapped with filter fabric to MTO standards.

All trench backfill to be approved by geotechnical engineer. Granular trench backfill may be waived if a minimum depth of 900mm (36") of Granular B base course is provided.

Township policy on private drain connection is as follows:

If PDC's are provided, a condition shall be included in the subdivision agreement that each lot shall install a sump pump ~~and backup sump pump~~ as part of the hook-up and as per STD EZT-8.

Where PDC's exist in the Township:

1. (a) During reconstruction - each owner should be contacted to determine if they have an existing connection when reconstruction of a road is started.

(b) The owner shall use a sump pump as per STD EZT-8.

(c) Any replacement drains installed by Township forces shall be kept at existing depth so as to pick up any other existing drains.

(d) Township will install PDC's at existing depth at time of construction if owner is planning to make hook-up immediately. The Owner shall use a sump pump as per STD EZT-8.

(e) Existing tile found to be blocked or substandard will not be connected to new system unless total replacement of private drain is made by homeowner at his expense in accordance with STD EZT-8.

A. STORM SEWERS (Cont'd)

Where private drain connections are required, a 100mm (4") diameter PVC SDR28 drain will be provided. In general the said private drain connections are to be located two (2) metres in from property line on the lowest side of the lot.

Private drain connections are to be installed at a minimum grade of 2%. Minimum cover at the street line is to be 1.5 metres. In general, Class "B" bedding as for the main stormline shall be used. Backfill requirements are to be the same as for main sewers.

Connections to the main drain shall be by means of approved tees or saddle connections. Ends of private drain connections shall be plugged with approved caps and shall be marked by stakes with tie wires. Where private drain connections are connected to catchbasins or manholes, they shall be at elevation equal to the spring line of the main drain.

Where private drain connections are provided the connection shall be in accordance with Detail Drawing EZT-8.

The preferred method for flow control is to use plugs that fit inside the pipes at the catchbasin walls. Opening sizes to be cut into the plugs are to be in accordance with design calculations.

The Township may waive the requirement that connections be made to the private drain connection provided at the street for sump pump drains if the existing property is served by an alternative gravity outlet that is acceptable to the Township.

Where a private drain outlet is required for a storm drainage system the following shall apply:

a) provide the necessary calculations and/or design notes in the Drainage Plan to satisfy the Township that a sufficient outlet is available.
b) install any storm drainage works within the necessary trench such that a minimum of settlement results.
c) topsoil and seed or gravel or hard surface the backfilled trench to give restoration equal to or better than the existing condition
d) grout the pipe to any catchbasin or manhole if such constitutes the outlet
e) backfill any laneway or roadway crossings in accordance with approved standards
f) save and replace separately topsoils from all working areas
g) compact all backfills
h) provide manholes for inspection and maintenance at 400 foot maximum spacing
i) where a new storm pipe is to join to an existing pipe that constitutes the outlet a manhole shall be used at the junction

A. STORM SEWERS (Cont'd)

To minimize the effects of siltation and sedimentation and erosion, the owner agrees to:

a) have all aspects of any storm drainage outlet works backfilled and restored as soon as pipe installation is completed and inspected. All boulevards that are gravelled, paved or seeded must be maintained until the expiration of all other maintenance periods for all other aspects of the public services.

b) ensure that each catchbasin has a sump of minimum depth of 0.3m (1') below the invert of the lowest pipe connected thereto and to further ensure that each catchbasin is maintained and kept free of sediment and debris during construction and until such time as the public services are assumed by the Township and as directed by the Township Engineer.

c) construct straw bale dykes and berms in accordance with a plan to be submitted to and approved by the Township Engineer.

B. ROADS (Applicable Cross Section is EZT-2)

Minimum 20m (66') road allowance

Minimum 50 Km/H (30 M.P.H.) design

Minimum 8.5m (28') travelled surface (gutter line to gutter line)

Minimum 80mm (3") Asphalt Thickness in 2 lifts HL3 Surface, HL4 to HL8 Binder (Surface coat not to be applied before 1 winter of consolidation).

Minimum 150mm (6") Granular "A" (Increased Thickness Per Soils Report).

Minimum 450mm (18") Granular "B" (Increased Thickness Per Soils Report), subject to the requirement of 900mm (36") if full granular backfill to sewer line is not used.

Minimum 10 mK (350') Vertical Curve (required if Algebraic grade difference is greater than 0.5%).

Minimum Intersection Radius 9m (30').

Maximum Road Grade (5%).

Minimum Road Grade (0.5%).

B. ROADS (Applicable Cross Section is EZT-2) (Cont'd)

Minimum Crown (2%)

Street name and traffic control signs in accordance with Ontario Traffic Control Manual Recommended Standards.

Minimum Cul-de-sac Property Radius 21m (69'). No centre islands will be allowed. Full cul-de-sac paving is required.

Minimum Pavement Radius i) Intersections 9m (30')
ii) Cul-de-sac 17m (55')
iii) Temporary cul-de-sac 15.5m (51')

Concrete curbs, gutter on both sides of roadway as per drawing EZT-2.

1.5m (5') sidewalk on one side of all streets, that are not cul-de-sacs except where noted differently by Township. Sidewalks shall not be constructed in front of a property until house construction is complete except where otherwise provided by the subdivision agreement.

All areas to be excavated or filled shall be stripped of topsoil and the topsoil stockpiled on site for re-use during final grading and seeding operations.

Bulbed corners or corners with less than 90 degrees on the interior angle are to be discouraged.

Sub Drains - to be provided unless found unnecessary by soils report.

Curb and Gutter - to be OPSD 600.04 on radius plus min. 3m past radii.
- to be OPSD 600.10 on other portions.

Driveways are to conform to Standard EZT-4 to EZT-6 and to be a minimum of 150 mm (6") Granular A and 6" Granular B or a total of 10" Granular A and are to have 50mm (2") HL3 surface or other approved hard surface. The profile shall match road cross section. Paving not to be done until house construction and landscaping is complete.

Soils Report - required.
- shall address pavement structure and subdrains.

Trees – Required in boulevard as approved by Township.

Boulevards - to be topsoiled (150mm minimum) and sodded. Boulevard construction not to be done until house construction is complete.

B. ROADS (Applicable Cross Section is EZT-2) (Cont'd)

All road work components, materials, methods to be in accordance with applicable OPSD and OPSS.

The specifications and drawings shall provide for the following:

a) rough grade the full width of the new road allowance prior to the installation and construction of the storm drainage system and prior to construction of curbs.
b) keep all boulevards clear and free of all materials and obstructions which might interfere with the installation of electric, telephone, gas or other utilities.
c) maintain, restore and/or regrade the roadway, shoulders, ditches and boulevards of any existing adjacent roads abutting the plan of subdivision and repair any damages made to existing public services on these roads both during and at completion of construction of internal roadways and to the satisfaction of the Township Engineer.
d) ensure that frost treatment is provided as required by the Township for all installations or plant below existing roads.
e) remove any contamination from, regrade, compact, and/or otherwise repair and replace the base course as directed by the Township Engineer prior to the placement of the asphalt pavement in order that the construction of the roadway shall not have suffered due to the use of the base course as a temporary roadway.

C. LOT GRADING AND DRAINAGE

Lot grading to be in accordance with Standard EZT-7 attached.

Lot Grading Drawings

1. Show title block, table of revisions and north arrow on plan.

2. Indicate pavement elevations obtained from approved road profile at 25m intervals or opposite all lot corners.

3. Existing and proposed elevations should be shown on every corner of each lot and block.

4. Show proposed ground elevations around buildings.

5. Show existing contours.

C. LOT GRADING AND DRAINAGE (Cont'd)

6. Proposed elevations should be shown where sudden change of grade occurs. In the case of terraces and retaining walls, elevations of the top and the bottom are required.

7. Swales are required along all side and rear lot lines.

8. Sodded swales and storm drains should be shown on the plan wherever they are needed.

9. Drainage pattern should be indicated on the plan by means of arrows. Double stem arrows to be used for swales.

10. Show detail of swale.

11. Show minimum basement floor elevations or underside of footing.

12. State the elevation and location of the controlling bench mark which is used.

Lot Grading Requirements

The data and tables on STD EZT-7 should be used as a guide in planning the various types of lot grading illustrated.

The lot grading plan shall provide for proper drainage of all adjacent lands which drain through the said lands.

Swales should not be over ninety (90) metres in length without catchbasin and storm drain.

General

Details of all terracing and slope treatment shall be submitted with lot grading plans and detailed cross-sections provided if required by the Township Engineer.

All regional flood and Conservation Authority fill lines must be indicated on lot grading plans where developments are adjacent to existing water courses.

Topsoil shall be stripped in all cut and fill areas and stockpiled for reuse during final lot grading operations.

A Lot Grading Plan, prepared and submitted for the development, will include any recreational or park areas.

C. LOT GRADING AND DRAINAGE (Cont'd)

Drainage swales are to be in accordance with Standard EZT-7.

Where the subdivision has lots or roads in a treed area, a tree saving plan shall be prepared.

D. EROSION CONTROL

The Township will require the Owner to provide an erosion control plan to be approved by the Township Engineer for all developments and subdivisions. Individual lot grading plans may be requested by the Township to provide an erosion control plan.

E. UTILITIES AND STREET LIGHTING

All primary Hydro shall be underground and placed in accordance with current Hydro One standards except that in Tavistock the work shall be done in accordance with Erie Thames Power (ETP). Secondary leads for lighting and services, Bell Telephone and other utilities shall also be underground and shall be placed in accordance with the current utilities regulations and standards and in accordance with Road Cross-Section Drawings EZT-2.

All developments shall be provided with adequate street lighting in accordance with the Township's specifications for street lighting which are attached as Chapter 6.

Satisfactory evidence that the Developer has made arrangements with ETP, Hydro One and the Township to provide for the installation of hydro and street lighting must be submitted to the Township prior to the execution of a Subdivision Agreement. Where such arrangements have not been made, the Developer shall provide separate drawings stamped by a Professional Engineer (Electrical), showing the details of the hydro and street lighting.

F. LANDSCAPING OF PARK AND RECREATIONAL AREAS

The Township shall request that the Park or Recreational Areas dedicated for the development be graded and seeded so that they are suitable for recreational use.

The area to be dedicated for park use shall be reviewed with the Township on submission of the Preliminary Draft Plan and any special requirements for grading and landscaping finalized at this time. The Township may also request that a different area than that proposed by the Developer be set aside for a park due to the physical features on site.

The subdivision agreement may require separate funds to be provided for park equipment and for tree planting in the park.

G. STREET NAME SIGNS

The Township will supply and erect all street name and traffic control signs. An invoice will be submitted to the developer (subdivider) for the costs of such.

H. FENCES

Highway fences shall be in accordance with OPSS 540 and OPSD 971.1010. Chain link fences shall be galvanized and have both top and bottom bars and shall be in accordance with OPSS 541 and OPSD 972.130.

CHAPTER 3

ONTARIO PROVINCIAL STANDARD SPECIFICATIONS AND DRAWINGS

(OPSS AND OPSD)

TO BE USED WHERE APPLICABLE IN

TOWNSHIP OF EAST ZORRA-TAVISTOCK

(NOT NECESSARILY COMPLETE LIST)

A. STANDARD SPECIFICATIONS (OPSS)

Number	Title
201	Construction Specification for Clearing, Close Cut Clearing, Grubbing and Removal or Surface and Piled Boulders
206	Construction Specification for Grading
310	Construction Specifications for Hot Mix Asphalt
351	Construction Specifications for Concrete Sidewalk
353	Construction Specifications for Concrete Curb and Gutter Systems
405	Construction Specifications for Pipe Subdrains
407	Construction Specifications for Maintenance Hole, Catch Basin, Ditch Inlet and Valve Chamber Installation
410	Construction Specifications for Pipe Sewer Installation in Open Cut
421	Construction Specifications for Culvert Installation in Open Cut
501	Construction Specifications for Compacting
511	Construction Specifications for Rip-Rap, Rock Protection and Granular Sheeting
514	Construction Specifications for Trenching, Backfilling and Compacting
516	Construction Specifications for Excavating, Backfilling and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers
517	Construction Specifications for Dewatering of Pipeline, Utility and Associated Structure Excavation
518	Construction Specifications for Control of Water from Dewatering Operations
540	Construction Specifications for Highway Fence
541	Construction Specifications for Chain Link Fence
570	Construction Specifications for Topsoil
571	Construction Specifications for Sodding
572	Construction Specifications for Seed and Cover
615	Construction Specifications for Pole Erection
617	Construction Specifications for Installation of Roadway Luminaries
701	Construction Specifications for Watermain Installation in Open Cut

B. STANDARD DRAWINGS (OPSD)

Number	Title
200.010	Earth/Shale Grading Undivided Rural
208.010	Benching of Earth Slopes
209.010	Rural Pavement Widening
216.03	Asphalt and Concrete Pavement with Pipe Subdrain
217.030	Minimum Vertical Clearances for Aerial Cable Systems
310.010	Concrete Sidewalk
310.030	Concrete Sidewalk Ramps at Intersections
400.020	Cast Iron, Square Frame with Square Flat Grate for Catch Basins, Herring Bone Openings
401.010	Cast Iron, Square Frame with Circular Closed or Open Cover for Maintenance Holes
401.020	Cast Iron, Circular Frame with Circular Cover for Maintenance Holes
403.010	Galvanized Steel, Honey Comb for Ditch Inlet
405.010	Maintenance Hole Steps, Hollow
600.010	Concrete Barrier Curb with Wide Gutter
600.030	Concrete Mountable Curb with Wide Gutter
608.010	Method of Termination for Concrete Curb and Gutter
605.040	Asphalt Spillways for Cut or Fill
610.010	Catch Basin Frame with Grate Installation at Curb and Gutter
701.010	Precast Maintenance Hole, 1200mm diameter
701.011	Precast Maintenance Hole, 1500mm diameter
701.012	Precast Maintenance Hole, 1800mm diameter
701.021	Maintenance Hole Benching and Pipe Opening Details
704.010	Maintenance Hole and Catch Basin Precast Concrete Adjustment Units
705.010	Precast Concrete Catch Basin, 600 x 600mm Depth – 4.0 Max.
705.030	Precast Concrete Ditch Inlet, 600 x 600mm Depth – 4.0 Max.
708.010	Catch Basin Connection for Rigid Main Pipe Sewer
708.020	Support for Pipe at Catch Basin or Maintenance Hole
802.010	Flexible Pipe Embedment and Backfill Earth Excavation
802.013	Flexible Pipe Embedment and Backfill Rock Excavation
802.014	Flexible Pipe Embedment in Embankment Original Ground: Earth or Rock
802.030	Rigid Pipe Bedding, Cover and Backfill Type 1 or 2 Soil – Earth Excavation
802.031	Rigid Pipe Bedding, Cover and Backfill Type 3 Soil – Earth Excavation
802.032	Rigid Pipe Bedding, Cover and Backfill Type 4 Soil – Earth Excavation
802.033	Rigid Pipe Bedding, Cover and Backfill Rock Excavation
802.034	Rigid Pipe Bedding and Cover in Embankment Original Ground: Earth or Rock

B. STANDARD DRAWINGS (OPSD) - Continued

Number	Title
803.030	Frost Treatment – Pipe Culverts Frost Penetration Line Below Bedding Grade
804.04	Concrete Headwall for Sewer or Culvert Pipe
804.05	Grating for Concrete Headwall
805.010	Height of Fill Table, Round Corrugated Steel Pipe and Round Structural Plate Corrugated Steel Pipe
806.02	Maximum Cover Table
806.07	Specified Minimum Wall Designation - PVC Pipe - Ring - Tite PS 320
807.01	Specified Minimum Class of Pipe – Reinforced Concrete Pipe Confined Trench Class: 50-D; 65-D; 100-D;140-D
809.010	Perforated Pipe Sub-Drain Installation at Main Storm Sewer Structures with Granular Backfill
810.010	Riprap Treatment for Sewer and Culverts Outlets
810.020	Riprap Treatment for Ditch Inlet
912.532	Dead End Barricade
971.101	Fence Highway Installation
972.130	Fence, Chainlink Installation - Roadway
1003.010	Cast-in-Place Maintenance Hole Drop Structure Tee
1006.010	Sewer Service Connections - for Rigid Main Pipe Sewer
1103.010	Concrete Thrust Blocks for Tees, Plugs and Horizontal Bends
1104.010	Water Service Connection Detail, 20 and 25mm Diameter Sizes
1104.030	25mm Blow Off Installation
1105.010	Hydrant Installation

Note: Where any OPSD or OPSS is in conflict with other Standards, Drawings or Specifications enclosed herein, the latter shall apply.

CHAPTER 4

SANITARY AND WATER DISTRIBUTION SYSTEMS

STANDARD SPECIFICATIONS

FOR THESE SPECIFICATIONS, PLEASE CONTACT:

RESTRUCTURED COUNTY OF OXFORD
PUBLIC WORKS DEPARTMENT
P. O. BOX 397
COURT HOUSE, 415 HUNTER STREET
WOODSTOCK ON N4S 7Y3
Phone: (519) 539-9800; Fax: (519) 537-3024

CHAPTER 5

SUBDIVISION SPECIFICATIONS FOR ELECTRICAL DISTRIBUTION SYSTEMS

FOR USE IN TAVISTOCK

SEE ERIE THAMES POWER

PLEASE CONTACT
ERIE THAMES POWER
IN TAVISTOCK FOR
THESE SPECIFICATIONS

FOR AREAS OUTSIDE OF TAVISTOCK
PLEASE CONTACT
HYDRO ONE

CHAPTER 6

EAST ZORRA-TAVISTOCK

SPECIFICATIONS FOR STREET LIGHTING

• Street Lighting

The Erie Thames Services is responsible for the design. The Developer is responsible for the supply and installation of a complete street lighting system within the development on all roadways, laneways and other areas designated by and in accordance with the requirements of the County, or Municipality.

The design of the street lighting system shall generally conform to the applicable ANSI/I.E.S. Standards and shall meet the following illumination requirements, bearing in mind the type of luminaries and poles specified in the materials section.

County and Municipal Illumination Standards: street planning shall conform to the following minimum average in service horizontal lux: Arterial Roads: 13lux, Collector Streets: 10lux, Local Streets: 6lux. The lowest lux value on the pavement shall not be less than one- third of the average value.

• Street Lighting Cables

Secondary street light cable from the transformer to the base of the street light pole hand- hole shall be: Non-metallic sheath cable 2 conductor No. 6 copper with No. 10 bar copper CSA type NMWU (6/2AWG CSA type NMWU).

Cable in street light pole from hand-hole to luminaries shall be: Non-metallic sheath cable 2 conductor No. 12 copper with No. 14 bare copper CSA type NMWU (12/2 AWG CSA type NMWU).

• Street Lighting Equipment

1. Poles: Poles shall be as per attached drawing. The mounting height of the luminaire shall be 7.6 meters above the pavement on local streets and 9.1 meters above the pavement for Collector and Arterial streets.

   Poles on all streets shall be direct buried complete screenings for backfill.

2. Luminaires: Luminaires shall be as per attached drawing. High Pressure Sodium (Flat Lens Style) and shall be 150 watt..

   Each luminaire shall be individually controlled by its own photocell.

3. Mast Arms: Mast arms shall be of aluminum construction in lengths of 2.4 meters. Length to be determined by City Illumination Standard.

- **Street Lighting**

Street lights shall be located where the County or Municipality deems appropriate. Locations shall respect proximity to fire hydrants, driveways and other underground services and shall not be closer than 3 meters to a transformer or switch unit. Street lights will generally be of a staggered design.

- **Street lighting Cables**

Street light cables shall be run from transformer locations to street light poles using, where possible common trenches with other utility cables. Lights are to be fed radially and 1 street light cable shall run from the transformer to the nearest pole (on each side if so designed) and may be looped to extend to up to 4 lights (or more depending on voltage drop on the wire) in total on 1 circuit. Each circuit must be supplied by a 20 amp breaker with a 22,000 Amp Fault Current Rating. Each circuit will be fed with three No. 6 AWG wires (1 Hot – Black, 1 Neutral – White, and 1 Ground - Green) from the transformer terminals to the breaker.

Where poles are not in place at the time of street light cable installation, the end of the cable shall be coiled and staked at the intended location in a similar manner to secondary cable except that at least 3 meters of cable shall be left above grade.

Where the cable is to continue on to other lights, the cable shall be looped and not cut at least 6 meters in total shall be left above grade.

Each luminaire shall be fused by means of a separable fused secondary connector kit utilizing a 6 Amp midget fuse. This connector is to be CSA approved and shall be installed with the line supply conductor connected to the female side of the plug and the luminaire connected to the male side of the plug. Each luminaire shall be controlled by its own photo-cell. Refer to attached drawing for street light installation details.

INSPECTION

All work with respect to the streetlight installation is subject to inspection at any time by Erie Thames personnel. An Erie Thames inspector must be present at all times while any work is being carried out. A minimum of 24 hours notice is required to schedule inspection.

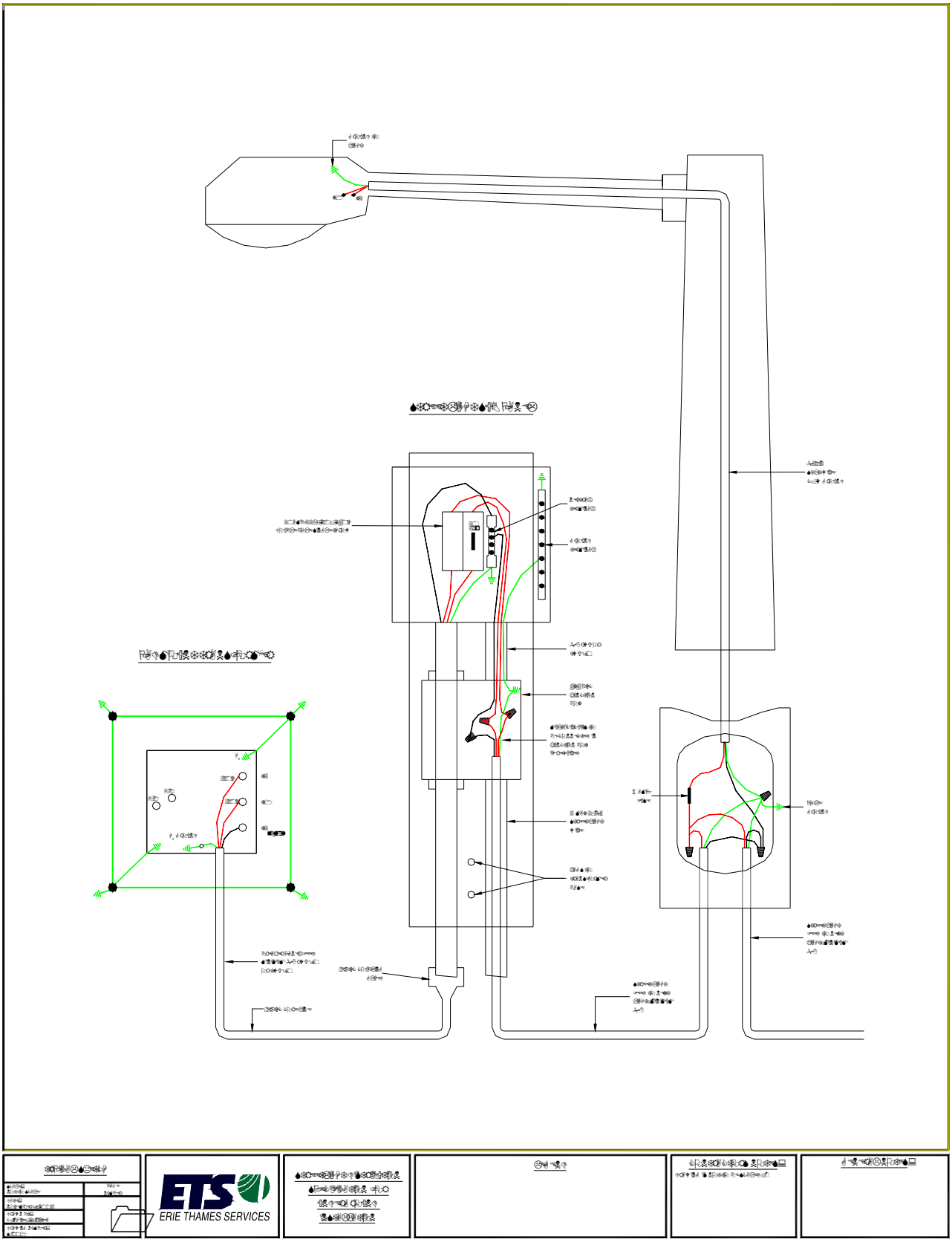


Figure 5 – Street Light Distribution Specifications for Underground Installation

CHAPTER 7

PREPARATION OF PLANS AND SPECIFICATIONS

A. PLANS

A.1 General

All plans are to be on paper of metric size equivalent to 24-inches by 36-inches. A title block is to be used and placed in the lower right hand corner of the sheet. All drawings are to be in metric and are to be signed and sealed by the Engineer at a location provided in the title block.

Chainages are to be taken along the centreline of the road allowances. Station 000 is to be located at the intersection of centreline of road allowances and/or the intersection of the centreline of the road allowance and the centreline of an easement, right-of-way, etc. In general, chainages shall be the chainage of the centre of road allowance and/or easement.

The Plans shall include:

a) Plan showing data to be on plan for Registration

b) A Lot Grading and Area Drainage Plan showing all road and lot drainage provisions.

c) A General Plan

d) A Storm Sewer Drainage Area Plan showing areas, coefficients, hectares.

e) Plan and Profile Drawings of all streets, service easements and drainage channels and outlets.

f) Plan showing typical road sections, drainage channel sections and servicing details and standards.

g) Cross-sections of the property and roadways if requested by the Township's Engineer.

The design calculations shall include:

a) Storm Sewer Design Sheet, and Storm Water Management Facilities Design if applicable.

b) Design notes on pipe strength and bedding requirements.

c) Soils Report and road thickness design notes.

d) Detailed cost estimates of all municipal services to be provided.

e) Design notes and calculations related to municipal water supply and distribution systems that are to be provided for the development.

f) An environmental appraisal of the site may be requested by the Township in areas that are particularly sensitive to development.

A "cover sheet" may be included with the contract drawings. However, this requirement is optional and not mandatory.

If a "cover sheet" is provided, the following should be included unless provided elsewhere:

(a) A key plan, to a scale of not less than 1:10000, indicating the general location of the area to be served.

(b) A site plan, to a scale of not less than 1:2000, indicating the services to be provided.

(c) The name of the project, the name and address of the owner and consulting engineer.

A.2 General Plans

All General Plans shall:

a) Be drawn at scale of 1:1250.
b) Show a key plan (Scale - 1:5000)
c) Show a north arrow
d) Show all existing and proposed lot numbers and blocks.
e) Refer all datum to a bench mark of Geodetic origin.
f) Show all existing services and utilities and abutting property limits in broken lines.

General Plans showing above-ground services shall:

a) Show all existing and proposed curbs, road allowances, road widths, street names, catchbasins, manholes, hydrants, road grades.

General Plans showing underground services shall:

a) Show all existing and proposed sewer lengths, sizes, types, grades (to two decimal points), direction of flow, catchbasins and manholes.
b) Show all existing and proposed watermain sizes along with valves and hydrants.
c) Show all house connections, both water and sanitary.

A.3 Strip Plans

The strip plans and profiles are to be on plan and profile paper. The scale is to be 1:500 horizontally and 1:50 vertically. The use of 1:100 vertical scale will be permitted if approved by the Township in special cases.

The following are to be shown on the PLAN:

(a) North arrow (pointing up).

(b) Show a title block with revision block directly above.

(c) The sewer and watermain profiles shall be drawn so that each street and easement may be filed separately.

(d) Refer all datum to a bench mark of Geodetic origin.

(e) Show all existing and proposed lot numbers and blocks.

f) Show all existing and proposed curbs, road allowances and street names and indicate them as such.

g) Show all existing and proposed watermain sizes, valves, hydrants and other utilities.

h) Show all existing and proposed sewer lengths, sizes, types, grades (to two decimal points), direction of flow, catchbasins and manholes.

i) Show all house connections, storm, water and sanitary.

j) Show all manholes with proper symbols and the sanitary manhole numbers followed by the letter A.

k) On all plans and profiles the type of bedding and maximum allowable width of trench if transition width is not used in the pipe strength design, shall be shown along the bottom of the profile.

l) All manholes and catchbasins shall be referred to an OPSD.

m) Road stations shall be shown in a plan view at a maximum of 50 metres.

n) The width of roadway; radii of curvature at street intersections; horizontal alignment main roadway.

o) Chainages of intersecting streets.

p) Original ground profile at centreline of roadway.

q) The centreline of the finished road grade (profile grade, shown by a solid line) and vertical curve details.

r) Stations and elevations at the beginning and end of vertical curves; grades on the profile; elevations on straight grades between P.I.'s at regular intervals (50m maximum); stations and elevations at centreline of all street intersections.

A.4 Erosion Control Plan

The plan scale is to be 1:500 horizontal and vertical.
The following are to be shown on the plan:

a) North arrow (pointing up)
b) Show a title block with revision block directly above
c) Show silt fence location
d) Show location of mud mats
e) Show location of sediment trap
f) Show temporary overland flow route
g) Provide notes to cover cleaning of catchbasin, sediment traps and roads
h) Provide note to maintain silt fence during construction

A.5 Miscellaneous Details

Detail drawings are to show details of special appurtenances, road allowance cross-sections, headwalls, open channel cross-sections, sewer outlet protection and other special structures.

B. SPECIFICATIONS

In general, contract specifications are to be printed on standard 8 1/2" x 11" paper (or metric equivalent). The following colour code should be adopted but is not mandatory:

Information to Tenderers	- Green
Form of Tender	- White
Standard Specifications	- Orange
Special Provisions (Supplementary Specifications)	- Yellow
General Conditions	- Blue

C. AS CONSTRUCTED DRAWINGS

C.1 General

On completion of the work and prior to the assumption of services by the Township, final "as-constructed" drawings will be supplied on a CD in PDF and AutoCad format along with a mylar reproductions of the construction drawings for above and below ground services (plan and profile) and details of special structures as required by the Township are to be submitted to the Township. The scales of these drawings are to be as indicated under SECTION "A".

All lettering and drafting are to be neat and legible, preferably by means of a lettering set.

C.2 Drawing Requirements

The final "as-constructed" drawings are to incorporate all the information as outlined under SECTION "A", with the addition of the following:

(a) The plans and profiles are to conform with what was actually constructed.

b) Private drain connections and water services are to have ties and elevations at the street line to the lot lines and benchmarks.

(c) Accuracy of information shown on the drawings are to be within:

*Ties to services (sewers, watermains, appurtenances, etc.)	1.00 ft. (300mm)
Elevations	0.05 ft. (15mm)

(*Ties shown to street lines and for lot lines wherever possible).

(d) Accuracy of plotting is to be within:

Plan	-2.0 ft. (600mm)
Profile	-0.2 ft. (60mm)
Details	-1.5 in. (40mm)

(e) A note on each plan and profile drawing stating that All elevations related to Contract Bench Mark No:_____ Elevation _____".

CHAPTER 8

OTHER STANDARD DRAWINGS

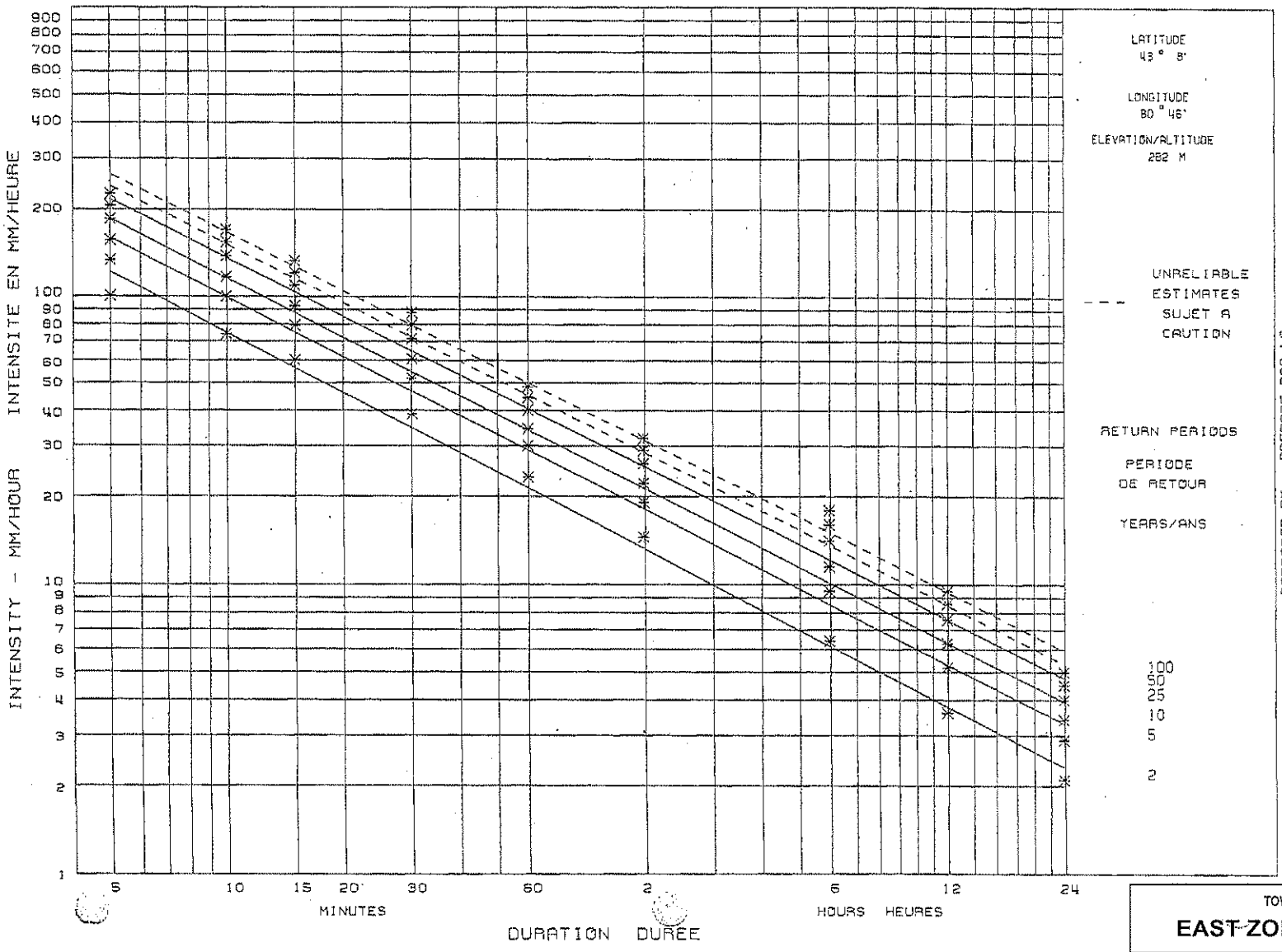
(IN ADDITION TO OPSD)

TABLE OF CONTENTS

SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR-
DONNEES SUR L'INTENSITE, LA DUREE ET LA FREQUENCE DES CHUTES DE PLUIE DE COURTE DUREE A WOODSTOCK ONT

GUMBEL-METHOD OF MOMENTS
METHODE DES MOMENTS

BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD- 1962 - 2003 16 YEARS/AN
BASEES SUR LES DONNEES DU PLUVIOGRAPHES POUR LA PERIOD



PREPARED BY - PREPARE PAR LE
ATMOSPHERIC ENVIRONMENT SERVICE - ENVIRONMENT CANADA
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE - ENVIRONNEMENT CANADA

IDF PARAMETER

	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
A	661.539	754.695	848.498	991.207	1091.849	1194.379
B	6.000	4.699	4.500	4.523	4.500	4.500
C	0.790	0.758	0.749	0.745	0.742	0.740

TOWNSHIP OF
EAST ZORRA - TAVISTOCK

RAINFALL INTENSITY CURVE

SCALE: N.T.S.
DATE: APRIL 2006

STD.EZT-1

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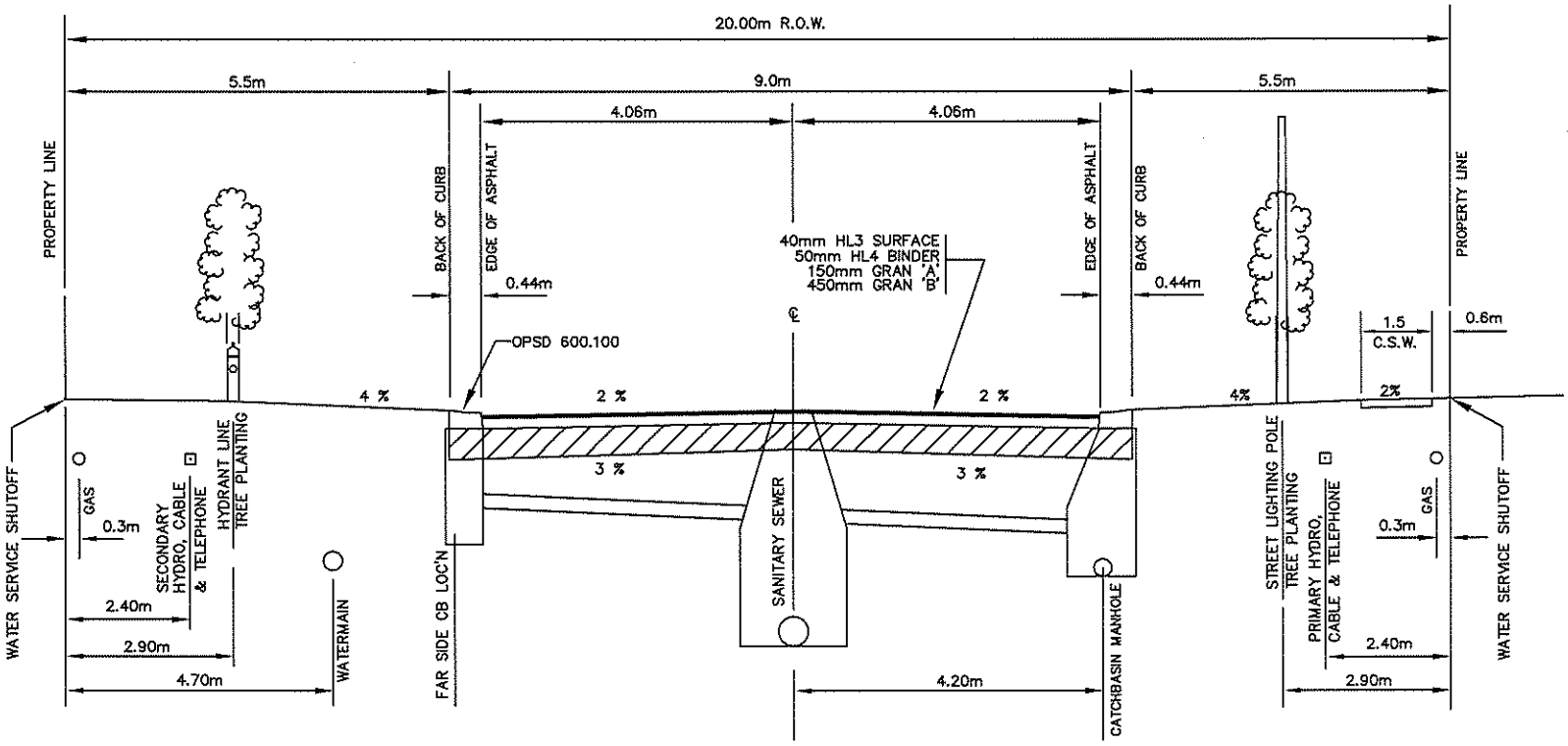

MINIMUM COVER

SANITARY	2.8m
STORM	1.5m
WATERMAIN	1.8m
GAS	0.8m
BELL	0.8m
HYDRO	0.8m
CABLE	0.8m

STANDARD STREET CROSS-SECTION

N.T.S.

NOTES

1. BOULEVARDS TO BE TOPSOILD AND SODDED, SLOPES 2% MIN. 8% MAX.
2. GRANULAR BASE TO BE CONFIRMED BY SOILS REPORT.
3. MINIMUM ROAD GRADE 0.5%
4. MAXIMUM ROAD GRADE 0.5%
5. TREES TO BE PLANTED EVERY 20m ALONG BOTH SIDES OF ALL ROAD ALLOWANCES WHERE REQUIRED.
6. STREET LIGHTING TO BE PROVIDED ON ONE SIDE OF ALL ROADWAYS.
7. ALL HYDRO, BELL AND OTHER UTILITIES TO BE UNDERGROUND.
8. CONCRETE SIDEWALK TO BE PROVIDED ON ONE SIDE OF ALL ROAD ALLOWANCES.
9. THIS STANDARD IS TO BE READ IN CONJUNCTION WITH OPSD 217.01. BUT IT APPLIES IF IN CONFLICT WITH OPSD 217.01

TOWNSHIP OF

EAST ZORRA - TAVISTOCK

STANDARD ROAD
CROSS SECTION
TYPICAL URBAN SECTION. 20m R.O.W.

SCALE:

DATE: APRIL 2006

STD.EZT - 2

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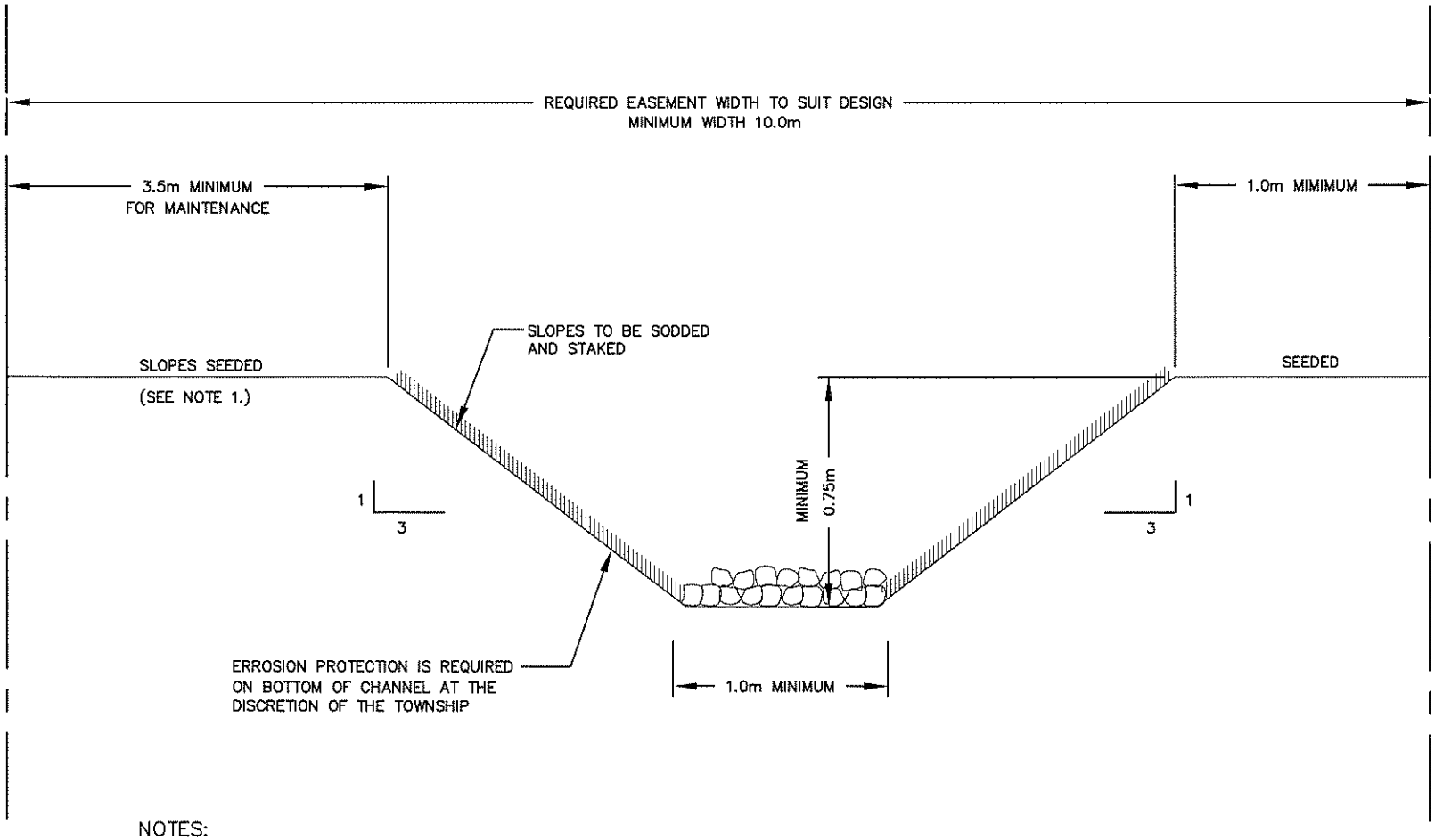

NOTES:

1. SLOPES ON BOTH SIDES OF THE DITCH TO BE MINIMUM 1% AND MAXIMUM 4%.

TOWNSHIP OF

EAST ZORRA - TAVISTOCK

OPEN CHANNEL SECTIONS

SCALE: N.T.S.	STD.EZT - 3
DATE: APRIL 2006	

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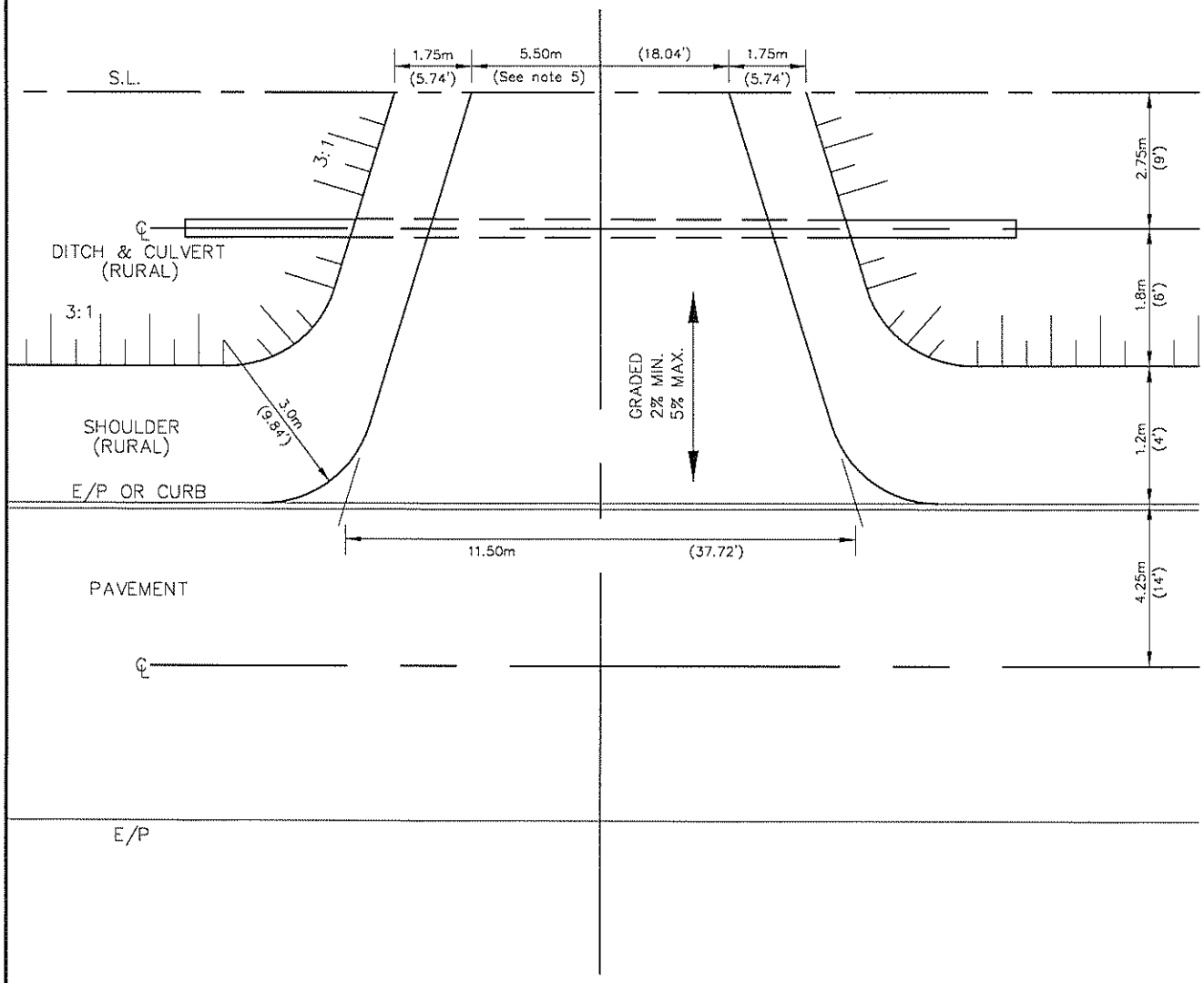

NOTES

1. DRIVEWAY CROSS-SECTION TO BE
   80mm (3.2") ASPHALT | 35mm (1 3/8") SURFACE
   45mm (1 3/4") BINDER
   150mm (6") GRANULAR 'A'
   300mm (12") GRANULAR 'B'
2. DRIVEWAY CULVERTS IF ANY TO BE 400mm (16") DIAMETER CMP MINIMUM, 1% SLOPE AND MINIMUM 0.30m (1") COVER.
3. MINIMUM LENGTH OF CULVERT TO BE 17.5m (57.4')
4. INCREASE TO THE ABOVE MINIMUM STANDARDS TO BE APPROVED BY THE TOWNSHIP ENGINEER.
5. FOR DRIVEWAY OFF COUNTY ROAD MINIMUM WIDTH AT STREET LINE 6.00m (19.69')

TOWNSHIP OF
EAST ZORRA - TAVISTOCK

DRIVEWAY ENTRANCE DETAIL
COMMERCIAL / INDUSTRIAL USES

SCALE: N.T.S.	**STD.EZT - 4**
DATE: APRIL 2006	

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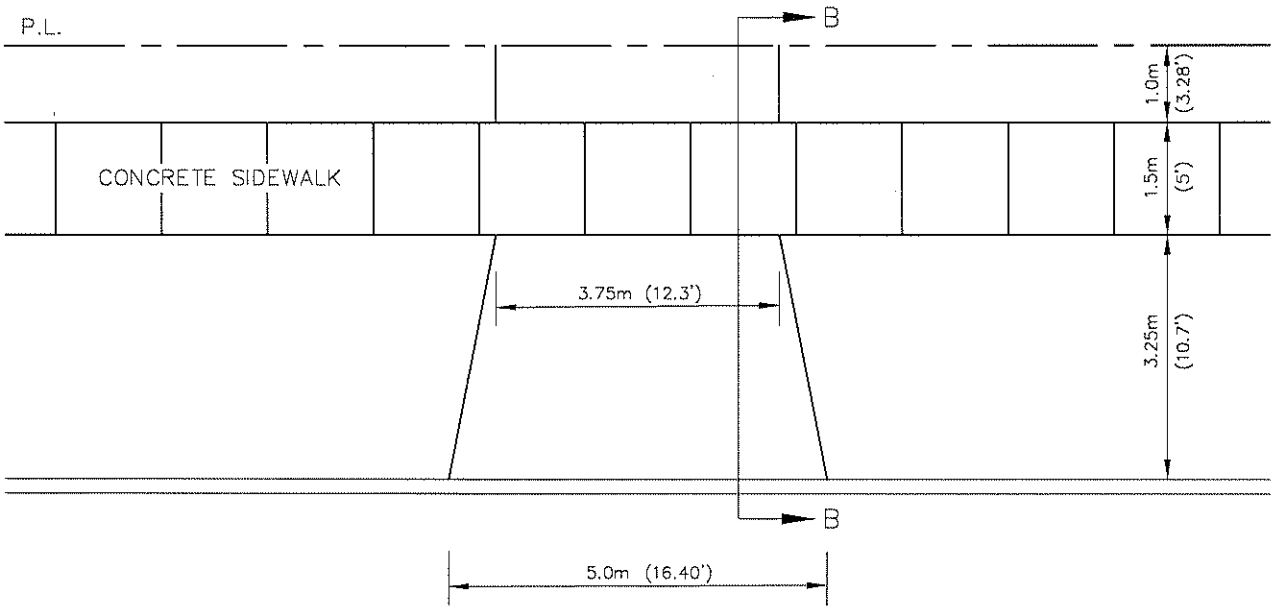
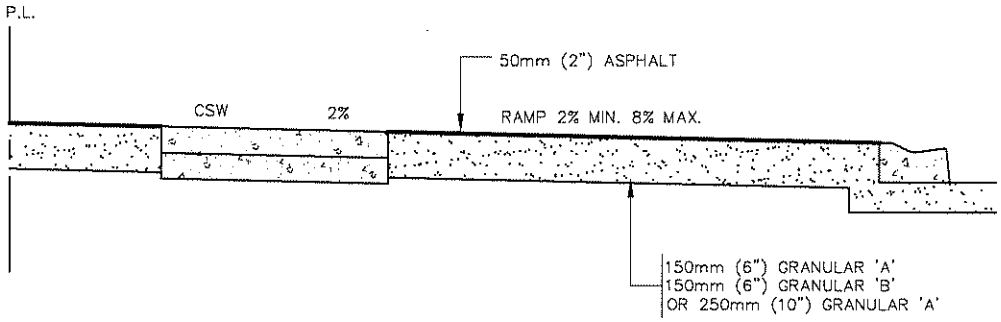


PLAN
1:100



SECTION B–B
1:50

NOTES

1. ALL DRIVEWAYS ARE TO BE ASPHALTED TO THE STREET LINE.
2. FOR DOUBLE DRIVEWAY PAVEMENT WIDTH TO BE AT STREET LINE 6.0m (19.69') AT CURB LINE 7.0m (22.97').

TOWNSHIP OF
EAST ZORRA - TAVISTOCK

DRIVEWAY ENTRANCE DETAIL
RESIDENTIAL
(URBAN)

SCALE: AS SHOWN	STD.EZT - 5
DATE: APRIL 2006	

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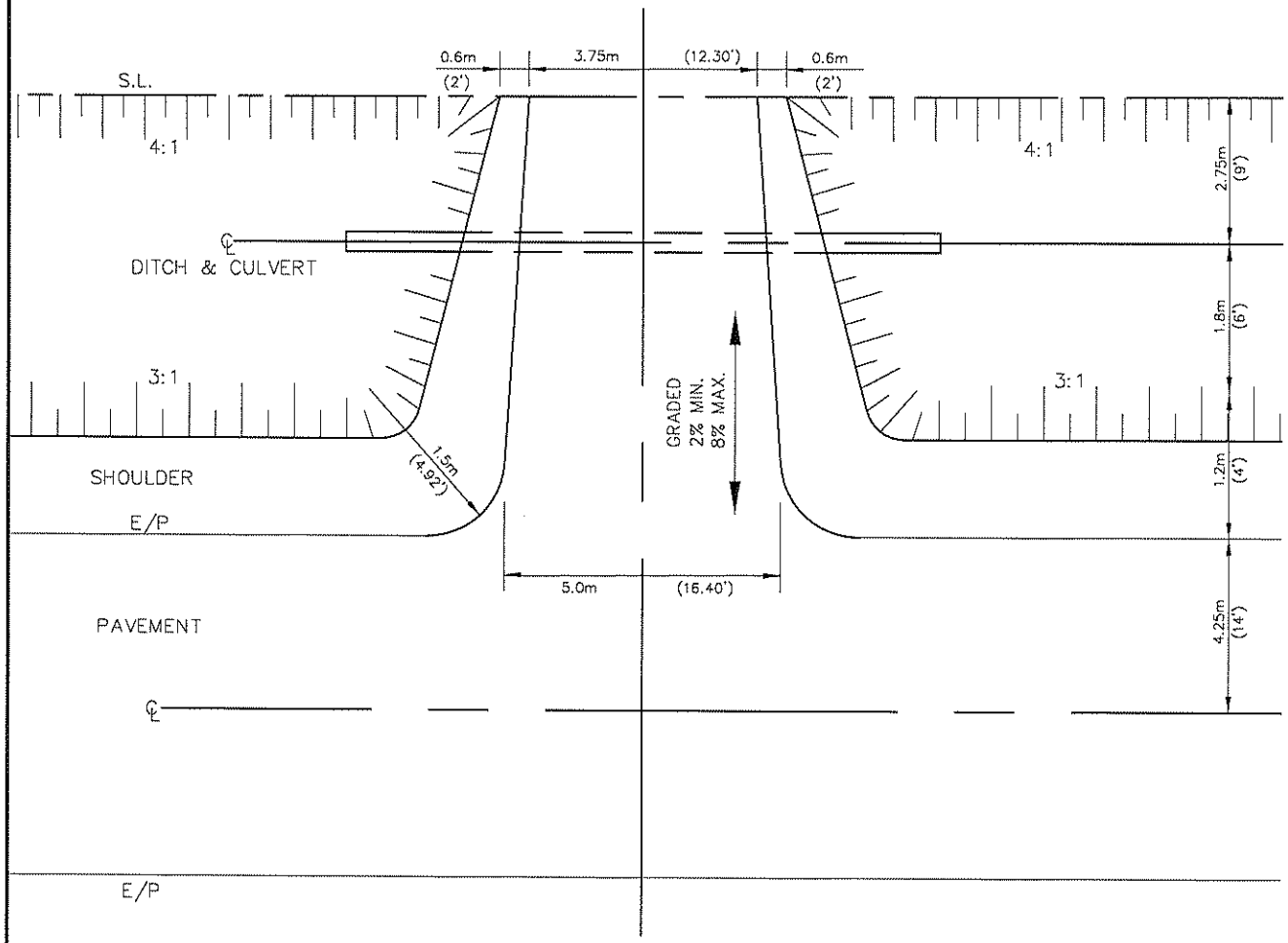

DETAIL FOR SINGLE DRIVEWAY

NOTES

1. DRIVEWAY CROSS-SECTION TO BE
   50mm (2") ASPHALT
   150mm (6") GRANULAR 'A'
   150mm (6") GRANULAR 'B'
2. DRIVEWAY CULVERTS TO BE 400mm (16") DIAMETER CMP MINIMUM, 1% SLOPE AND MINIMUM 0.30m (1") COVER AND SET 50mm BELOW DITCH GRADES.
3. MINIMUM LENGTH OF CULVERT TO BE 12m (39')
4. FOR DOUBLE DRIVEWAY AND/OR DRIVEWAY OFF A COUNTY ROAD, PAVEMENT WIDTH TO BE AT STREET LINE 6.00m (19.69'), AT EDGE OF PAVEMENT 7.50m (24.60') AND GRAVEL SHOULDERS TO REMAIN THE SAME. CULVERT LENGTHS TO BE 14m (45.90')
5. INCREASE TO THE ABOVE MINIMUM STANDARDS TO BE APPROVED BY THE TOWNSHIP ENGINEER.

TOWNSHIP OF
EAST ZORRA - TAVISTOCK

DRIVEWAY ENTRANCE DETAIL
RESIDENTIAL
(RURAL)

SCALE: N.T.S.	STD.EZT - 6
DATE: APRIL 2006	

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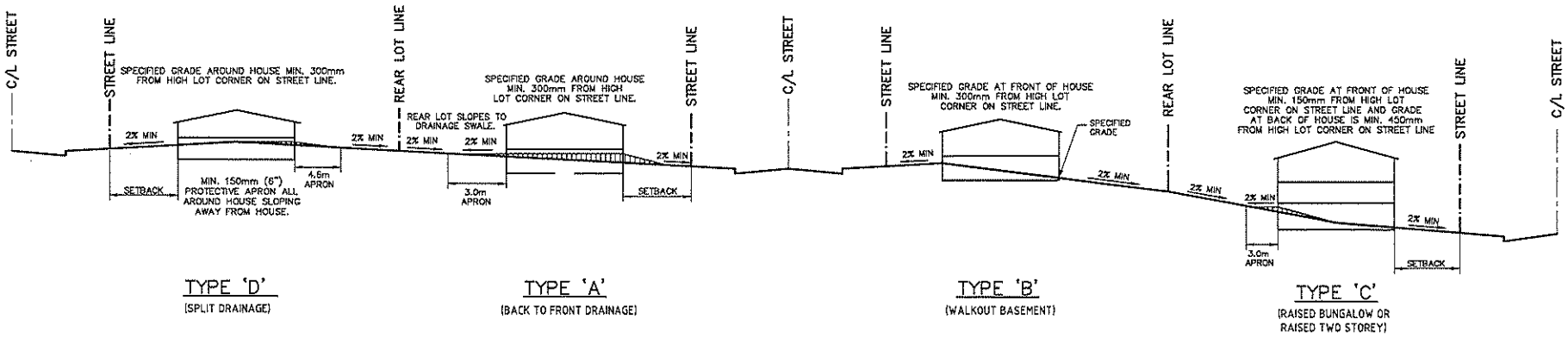
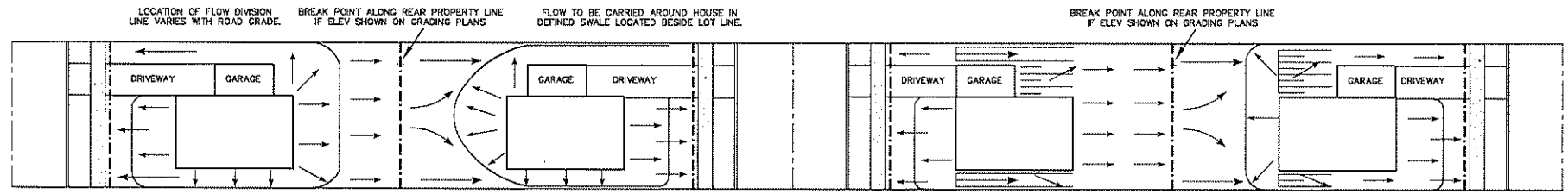


TYPE 'D'
(SPLIT DRAINAGE)

TYPE 'A'
(BACK TO FRONT DRAINAGE)

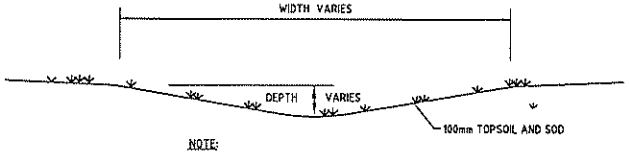
TYPE 'B'
(WALKOUT BASEMENT)

TYPE 'C'
(RAISED BUNGALOW OR RAISED TWO STOREY)



TYPE D TYPE A TYPE B TYPE C

TYPICAL PLAN VIEW DRAINAGE
N.T.S.

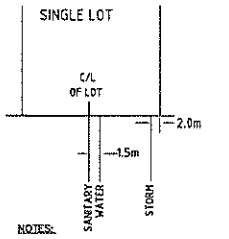


NOTE:

OPTIMUM SIDE SLOPE	- 1 VERTICAL TO 6 HORIZONTAL
MAXIMUM SIDE SLOPE	- 1 VERTICAL TO 3 HORIZONTAL
MINIMUM GRADIENT	- 2.0%
MAXIMUM GRADIENT	- 10%

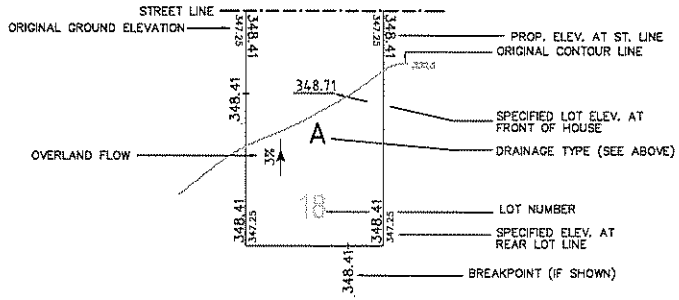
GRADE TRANSITIONS SHALL BE SMOOTH TO FACILITATE THE MOWING OPERATION

TYPICAL SECTION OF GRASS SWALE USED IN LOT GRADING
N.T.S.

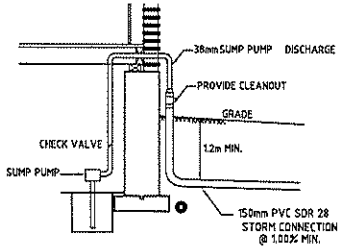


NOTES:
1. PROVIDE 50mm X 100mm MARKERS FOR SANITARY (RED), WATER (BLUE) AND STORM (GREEN)
2. STORM TO BE LOCATED ON LOW SIDE OF LOT.

TYPICAL LOT SERVICING
N.T.S.



TYPICAL LOT GRADING
N.T.S.



TYPICAL STORM SERVICE CONNECTION DETAIL
N.T.S.

DRAINAGE NOTES

1. SURFACE DRAINAGE SHALL BE DIRECTED AWAY FROM HOUSES.
2. SURFACE DRAINAGE WHICH IS CARRIED AROUND HOUSES IS TO BE CONFINED IN SWALES LOCATED AS FAR FROM THE HOUSE AS POSSIBLE (SEE SWALE CROSS SECTION).
3. DRIVEWAYS:

OPTIMUM GRADIENT	4%
MAXIMUM CROSS SLOPE	6%
MINIMUM CROSS SLOPE (WHERE GRADIENT IS LESS THAN 2%)	2%
MAXIMUM GRADIENT	8%

4. WALKWAYS:

MAXIMUM GRADIENT AND CROSS SLOPE	6%
MINIMUM GRADIENT CROSS SLOPE (WHERE GRADIENT IS LESS THAN 2%)	2%

5. FROM HOUSE TO LOT LINE (ALWAYS AWAY FROM HOUSE):

MINIMUM SLOPE	2%
OPTIMUM SLOPE	4%
MINIMUM DIFFERENCE	0.15m

6. ELSEWHERE ON THE SITE

OPTIMUM GRADIENT	4%
MINIMUM GRADIENT	2%

GENERAL NOTES

A. THE TOPOGRAPHY AND LOT ELEVATIONS INDICATED ON THESE PLANS ARE SUPPLIED FOR THE BUILDER'S INFORMATION ONLY. IT SHALL BE THE BUILDER'S RESPONSIBILITY TO VERIFY THE ACCURACY OF ALL INFORMATION OBTAINED BY HIM FROM THIS PLANS.

B. DRAINAGE SWALES SHALL BE CONSTRUCTED IN THE LOCATIONS AND TO THE GRADES, DEPTHS AND SECTIONS SPECIFIED.

C. SURVEY MONUMENTS ARE TO BE PROTECTED. NOTIFY ENGINEER BEFORE DISTURBING ANY BENCHMARKS OR CONTROL POINTS.

D. ANY VARIATION IN THE LOT GRADING STANDARDS MUST BE APPROVED BY A TOWNSHIP ENGINEER.

TOWNSHIP OF
EAST ZORRA - TAVISTOCK

LOT GRADING REQUIREMENTS

SCALE: N.T.S.
DATE: APRIL 2006

STD.EZT- 7

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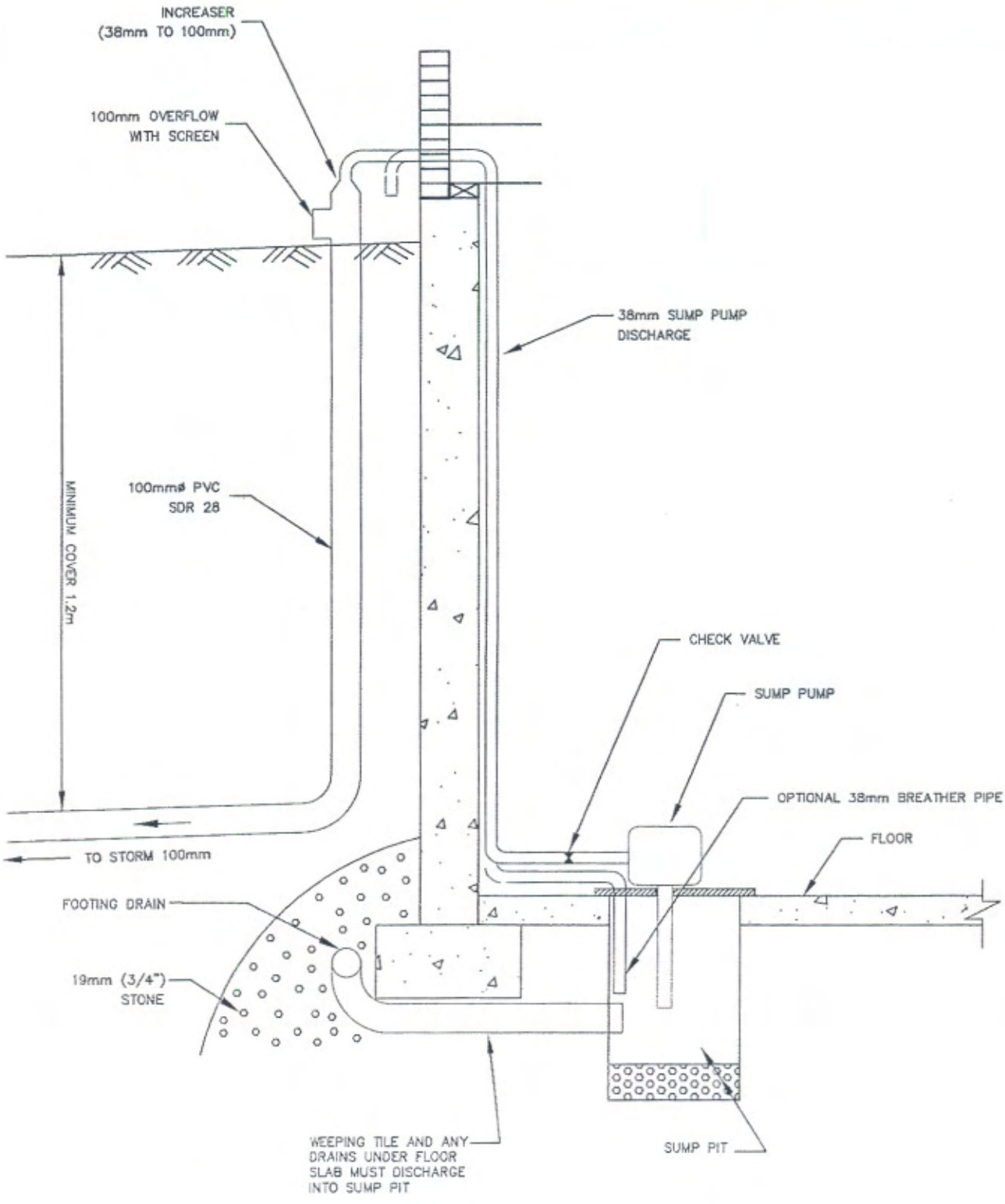

NOTES

1. A SEPARATE BUT PARALLELING 38mm DIA BREATHER PIPE FROM THE SUMP PUMP PIT MAY BE DESIRABLE.

TOWNSHIP OF
EAST ZORRA-TAVISTOCK

DETAIL FOR STORM CONNECTION

SCALE : 1:20

DATE: APRIL 2006

STD.EZT - 8

F.F. DENOTES FINISHED FLOOR

T.F. DENOTES TOP OF FOUNDATION

x 306.00 EXISTING ELEVATION

305.2 EXISTING GROUND CONTOUR ELEVATION

306.00 PROPOSED ELEVATION

MATCH EST. 305.9 MATCH EXISTING GROUND ELEVATION AT PROPERTY LINE
EST = ESTIMATED

DIRECTION OF SURFACE FLOW

PROPOSED SURFACE SWALE

LOCATION OF PUMP DISCHARGE

W W WATER SERVICE

SAN SANITARY SEWER SERVICE

ZONING SETBACK LIMITS

MAJOR STORM ROUTE

HYD HYDRANT SET

SIB IB RIB PROPERTY BARS

BM BENCHMARKS

SURVEY CONTROL POINTS

PROPOSED STORM

MH20 STORM MANHOLE

CBMH17 STORM CATCHBASIN MANHOLE

CBMH32 STORM TWIN CBMH

CB 25 STORM SINGLE CATCHBASIN (250mm LEAD)

CB 33 STORM TWIN CATCHBASIN (300mm LEAD)

EXISTING STORM

EXISTING SANITARY

F F EXISTING SANITARY FORCEMAIN

WV EX HYD EXISTING WATERMAIN, WATER VALVE AND FIRE HYDRANT

GV EXISTING U/G GAS AND VALVE

BB EXISTING U/G BELL AND BELL BOX

BP HP UTILITY POLES (BELL, HYDRO)

TOWNSHIP OF
EAST ZORRA - TAVISTOCK

PLAN LEGEND

SCALE:

DATE: APRIL 2006

STD.EZT-9

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BURNSIDE

Appendix D
Photos of Existing Overland Flow Paths

Tavistock Drain 1979

Photo 15

Looking north from intersection of Henderschot/Minerva along tile drain route(no defined flow route)

Photo 16

Looking south from Hope Street East along tile drain route(no defined flow route)

Tavistock Drain 1979

Photo 17
Looking north across Hope Street East along tile drain route(no defined flow route)

Photo 18
Looking south towards Hope Street East along tile drain route(no defined overland flow route)

Tavistock Drain 1979

Photo 19
Looking north towards along tile drain route(no defined overland flow route)

Photo 25
Looking southwest from top end of drain (no defined overland flow route)

Tavistock Drain 1979

Photo 26
Looking southwest from top end of drain (no defined overland flow route)

Photo 27
Looking southwest from top end of drain (no defined overland flow route)

Tavistock Drain 1974

Photo 34

Looking southeast from top end of 1974 drain. Overland flow route deviates from location of 1974 tile drain. Possible break into 1979 drain watershed

Photo 35

Looking west from Woodstock Street along path of tile drain (no defined overland flow route)

Tavistock Drain 1974

Photo 39
Rear yard west of John Street (ponding in rear yard) lawn lower than street crossing.

Photo 40
Looking west from John Street. Curb and sidewalk are higher than invert of overland flow route.

Tavistock Drain 1974

Photo 41
Looking east from John Street. Surface flows impeded by height of curb and roadway.

Photo 48
Looking easterly along rear yard swale south side of Westwood Street. Surface flows deviate from location of tile drain. Surface flows impeded by private fences, pools, gardens and out buildings.

Tavistock Drain 1974

Photo 49

Looking southeast along route of tile drain. No overland flow route

Photo 50

Looking northwest along route of tile drain. No overland flow route.

Tavistock Drain 1974

Photo 56
Looking south towards Hope Street East from Bender Park along rout of tile drain

Photo 57
Looking north towards Bender Park from Hope Street East route of tile drain

Tavistock Drain 1974

Photo 58

Hope Street East crossing (surface flows impeded by height of sidewalk, curb and roadway and by capacity of the subsurface road crossing and inlet structure)

Photo 59

Looking north along overland flow route from Hope Street East.

Rudy Drain 1925

Photo 62

Looking north along tile drain towards Hope Street East. (outlet of Hope Street crossing impeded by height of swale.)

Photo 63

Looking south along tile drain. (natural ponding area, no defined surface outlet.)

Tavistock Drain 1987

Photo 68

Looking south from junction of Tavistock Drain 1987 and Rudy Drain 1925. (no defined surface flow route.

Photo 66

Looking northwest from along Tavistock Drain 1987 from the 14th Line. (no defined surface flow route.

Watershed of Tavistock Drain 1985

Photo 70
Looking west from Centenial Drive(no defined surface flow route)

Photo 71
Looking west from Centenial Drive(no defined surface flow route)

Watershed of Tavistock Drain 1985

Photo 72
Looking northwest from Centenial Drive towards private pond (no defined surface flow route)

Photo 73
Looking south along back of lots west side of Centenial Drive. (no defined surface flow route)

BURNSIDE

Appendix E
Recommended Minimum Storm Sewer Pipe Sizing

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
Dietrich Road	502	702	250	375
	702	TEE	250	375
	CB 188	TEE		
	TEE	701	250	375
External A1	HB 187	700	150	250
	700	701	250	450
Janelle Drive	701	TEE	250	525
External A2	HB	CB	150	250
	CB	TEE	200	375
	TEE	703	250	600
	703	TEE	375	675
	CB	TEE	200	250
	TEE	704	375	675
	704	TEE	450	675
External A3	HB	CB	150	
	CB	TEE	200	375
	TEE	705	450	750
	705	501	450	675
External A4				

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	CB	501	200	300
	501	706	750	750*
External A5	HB	194	150	300
	194	500	375	525
	500	708	525	450*
	709	708	200	
	708	TEE	525	600
External A6	HB	CB	150	250
	CB	TEE	200	300
	TEE	706	525	675
	706	707	750	900
	707	inlet TEE	750	900
	inlet TEE	589	750	825
Woodstock Street	576	577	300	250*
North	577	579	300	250*
	579	581	300	375
	581	583	375	450
	583	585	400	450
	585	586	400	525
	578	580	300	250*
	580	582	300	375
	582	584	300	450

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	584	587	375	525
	588	587	450	375*
	587	586	600	675
	586	589	600	675
Tavistock Drain 1974	589	575	750	900
	570	575	300	250*
	575	571	750	975
	571	716	900	900*
Henry Street	574	572	250	250*
	573	572	200	250
	572	716	300	
External Area B	External	716		
Rudy Drain	Rudy	716		
	716	TEE	900	975
Jacob Street	543	544	250	250*
	544	545	300	250*
	545	546	250	250
	546	547	250	300

R.J. Burnside and Associates Limited
MSZ 11487

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	547	549	250	375
	568	569		
	569	549	200	250
	549	550	400	300*
	550	551	400	375*
	551	552	400	450
Elizabeth Street	552	560	400	375*
	560	TEE	300	375
	557	TEE		
	TEE	717	900	1050
	717	718	1050	1350
Bender Avenue	503	734	250	250*
External C1	External	734		
	734	733	300	375
	733	732	300	300*
	732	731	450	450*
	731	730	525	525*
King Street	504	730	250	250*
	730	505	525	525*
Fredrick Court	729	505	375	450

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
King Street	505	728	600	675
	728	724	600	675
Westwood Avenue	722	723	300	
	723	724	300	250*
	724	721	750	900
Westwood Avenue	727	726	250	
	726	725	375	450
	725	721	750	450*
	721	720	825	750*
between Westwood	720	719	825	750*
Ave. and Hope St.	719	718	825	750*
	CB	718	375	375*
to Hope Street	718	506	1050	1350
John Street	567	566	200	300
	566	659	300	450
	659	TEE		
Hope Street	658	TEE	450	
	TEE	657	450	600
	657	655	450	600
	655	TEE	450	525

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
Elizabeth Street	555	562	200	250
	562	564	250	300
	564	TEE		
Hope Street	TEE	654	450	600
	654	653	525	750
	653	652	600	750
	652	506	600	750
Hope Street	506	TEE	1050	1800
Queen Street	504	735	250	375
	735	736	250	375
	736	737	300	450
External C2	External	Inlet		
Victoria Court	Inlet	739	200	250
	739	637	300	250*
	637	738	300	375
	738	737	375	450
Queen Street	737	740	450	600
Baechler Avenue	742	741	250	300
	741	740	300	375
Queen Street	740	746	525	675
	746	747	525	675

Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
Homewood Avenue	CB5	507	250	300
	507	748	250	375
	748	747	300	450
	747	651	600	750
	651	650	600	450*
to Hope Street	650	TEE	600	450*
Hope Street	TEE	648	1050	1950
	648	638	1050	1800
	638	639	1050	1800
	639	outfall	1050	1800
END of				
Tavistock Drain 1974				
Rudy Avenue	642	508	250	
	508	751	450	750
Henry Vogt Avenue	749	750	300	250*
	750	751	450	450*
Rudy Avenue	751	644	600	675
	753	TEE	250	
	752	TEE	250	
	TEE	644	250	
	644	509	675	750

R.J. Burnside and Associates Limited
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Tavistock Master Storm Drainage System Plan

Notes

- 250 mm minimum pipe diameter
- Shaded areas are trunk sewers (sized for 1:10 yr storm)
- All other pipes are sized for 1:5 yr
- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
Wellington Street	635	636	300	250*
	636	630	300	375
	628	629		
	629	630		
	630	760	300	375
	760	759	375	450
Roth Street	759	758	375	450
	758	757	450	450*
	757	510	450	525
Fuhr Street	754	755	375	375*
	755	756	375	450
	756	510	375	450
	510	509	600	675
Tavistock Drain 1987	509	southerly	750	975
Woodstock Street	591	593	300	
Jacob Street	710	593	250	300
Woodstock Street	593	596	300	375
	596	598	300	375

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Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	602	601	300	250*
	601	598	300	
	598	599	450	
	590	594	300	250*
	594	595	300	250*
	595	599	300	250*
	599	600	450	525
	600	713	250	
	CB202	CB203	250	375
	CB203	711	375	450
Tavistock Drain 1979	711	TEE	450	600
	TEE	603	450	525
	603	712	450	525
	712	713	530	525*
	713	714	530	675
	714	715	530	750
	715	665	530	750
	665	658	530	750
Hope Street East	661	660	250	
	660	658	300	250*
	658	TEE	750	900

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Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
Hendershot Street	634	633	150	250
	633	TEE		
	TEE	631	750	900
Minerva Street	631	666	750	825
Decew Street	627	625	250	250*
	625	624	300	300*
	624	623	300	375
	623	CB	300	
	CB	666		
Woodstock Street	603	604	300	
	604	607	300	250*
	607	608	300	450
	608	609	300	450
	606	609	300	375
	609	611	450	450*
Tim Hortons	CB141	610		
Woodstock Street	610	611	600	
	612	611	300	250*
Hope Street	611	661	600	600*

Tavistock Master Storm Drainage System Plan

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Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	662	661	200	250
	661	TEE	600	
Hendershot Street	618	619	200	250
	619	620	200	250
	620	TEE	200	250
	TEE	666	600	
Decew Street	621	666	300	
Woodstock Street	682	683	300	300*
	683	684	300	250*
	684	CBMH	300	300*
	CBMH	647	300	300*
Maria Street	647	646	300	
	646	645	300	375
	645	mid1	300	
	666	761	840	1200
	761	762	1070	1350
	762	763	1070	1350
	763	764	1070	1350
	764	765	1070	1350

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Tavistock Master Storm Drainage System Plan

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- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	765	outfall	685	1050
END of				
Tavistock Drain 1979				
Woodstock Street	682	681	300	300*
(South)				
	687	681	250	250*
	681	680	300	375
	688	680	250	250*
	680	679	300	375
	679	674	300	450
	669	673	300	
	673	674	300	250*
	674	675	300	525
	675	676	300	525
	676	677	375	450
	672	671	300	250*
	671	670	300	250*
Adam Street	617	766	250	250*
	766	512	375	375*
Decew Street	CB172	668	250	

Tavistock Master Storm Drainage System Plan

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- * No Change Required

Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
	668	667	300	
	667	MH	300	300*
	MH	512	375	300*
Adam Street	512	767	525	600
	767	615	600	675
	615	616	600	600*
	616	768	600	750
	768	513	600	675
Woodstock Street	513	769	600	675
(Tavistock Drain 1993)	769	770	600	600*
	770	771	600	675
	771	772	600	675
	772	773	600	675
	773	515	600	675
	515	515x	600	675
END of				
Tavistock Drain 1993				
Hope Street West	527	528	450	375
	528	525	675	525
	525	524	675	600
Oxford Street	49	51	200	250
	51	531	200	250
Mogk Street	531	529	375	525
	529	524	450	525

Tavistock Master Storm Drainage System Plan

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Street Name	From	To	Exisitng Diameter (mm)	Required Min. Std. Pipe Diameter (mm)
Hope Street West	524	523	675	675*
William Street	535	534	300	375
	534	533	375	375*
	533	536	375	375*
	536	537	375	375*
	537	523	525	450*
	541	523	300	
Hope Street West	523	522	750	825
External D	pond	538	300	450
	522	521x	900	750*
Hope Street West	520	521	450	250*
	521	521x	450	250*
Tavistock Drain 1985	521x	780	900	975
	780	781	900	975
	781	782	900	1200
	782	783	900	1050

BURNSIDE

Appendix F
Preliminary Capital Cost Estimates

Capital Cost Estimates

Alternative	Preliminary Estimated Capital Cost
1. "Do Nothing"	$0
2. Storm Sewer Replacement	$17,000,000
3. Policy Review	Administrative costs by Township staff
4. Lot Level Controls	Completed by homeowners
5. Conveyance Improvement Measures	$11,000,000
6. Storage	$1,000,000