Stormwater Management Strategy Study
Executive Summary

February 2007

DILLON CONSULTING

Clarifica Inc.

UPPER THAMES RIVER CONSERVATION AUTHORITY

STORMWATER MANAGEMENT STRATEGY
EXECUTIVE SUMMARY REPORT

Town of Ingersoll

February 2007

INTRODUCTION

The Town of Ingersoll shown on ***Figure 1*** is facing continuing development pressures to meet community housing and servicing needs. Since the first stormwater management study undertaken in 1982, development pressure has intensified, particularly in the recently annexed lands at the southerly Town limit and along the outer fringes of the community. In the past, the Town has implemented a set of stormwater management criteria for new developments, based mainly on the 1982 report that focused on quantity control. However, stormwater management policies, criteria, design and construction techniques have changed considerably over the past two decades.

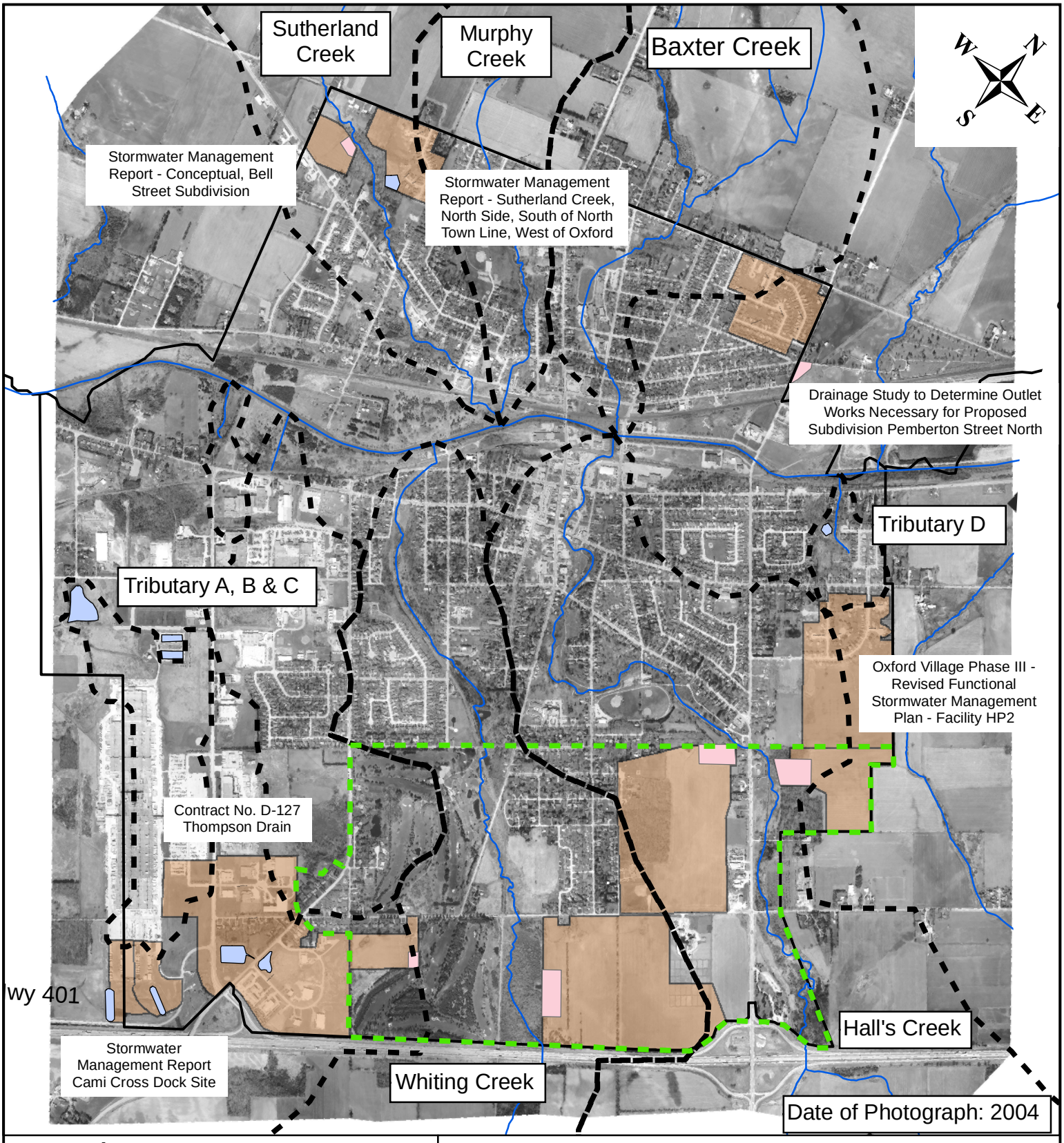
Continued growth in the watershed could result in local flooding, deteriorated water quality, adverse impacts on the flow regime, and deterioration in the local aquifer, increased erosion rates and channel migration. Now, also there is an increase in public awareness and understanding of the negative impacts of uncontrolled urban development on our environment, and the rising expectation for corrective actions to be taken to maintain and/or improve ecosystem conditions.

Accordingly, there is a need to undertake a comprehensive stormwater management study based on the latest provincial standards to ensure orderly development and to provide protection to the human and natural environment. The Town of Ingersoll and the Upper Thames River Conservation Authority are partnering on a Stormwater Management Strategy project to develop a stormwater model and prepare Interim Stormwater Policies and the Terms of Reference for future updating of the Stormwater Management Strategy.

PAST STUDIES

The first and only comprehensive stormwater management study undertaken in the past for Ingersoll was by MacLaren Engineers, Planners and Scientist. A brief report summarizing the results of the study was released in January 1982 and it described the flows and water levels for the five watercourses: Hall, Whiting, Sutherland, and Murphy Creeks and Baxter Drain. The report concluded that if the total imperviousness in any proposed development area were kept below 45%, no stormwater management technique would be required to control the peak flows. However, the report did not address water quality, erosion or environmental constraints.

A number of site-specific stormwater management studies were prepared over the past 20 years for the Town. These studies were based on various hydrologic models and all recommended some form of stormwater management control either by lot level, storage or infiltration facilities.



Legend

- Creek
- Watershed
- Town Limits
- Existing SWMPs
- Future SWMPs
- SWMP Drainage Areas
- Seconday Plan Boundary

Figure 1: SWMP Key Plan

TOWN OF INGERSOLL

Drawn By: C.S.

Date: Feb. 1, 2007

Curry Road

DILLON CONSULTING

0 250 500 1,000 1,500 2,000 Meters

An extensive erosion/geomorphology inventory was carried out in 2001 by the Conservation Authority to assess the existing conditions of the major watercourses flowing through Ingersoll. The outcome of the study resulted in a list of remediation or maintenance priorities, ranked High, Medium or Low. The number of High priority erosion sites ranged from nine on the Murphy Drain to 15 on Hall's Creek. The survey indicated that there are a significant number of sites listed as High priority, which would require attention. Also, it is important to note that any future increase in frequency of flows and velocities caused by development would further aggravate the existing erosion at the local watercourses.

DEVELOPMENT OF INTERIM STORMWATER MANANEGMENT POLICIES

The Town has initiated the development of a set of Interim Stormwater Management policies that could form the base of the Stormwater Management Strategy. It is important that the proposed broad-based policies related to stormwater and flood control should build and expand on Provincial and County of Oxford Official Plan stormwater management policies. In addition, for the new Policies to be formally recognized, consideration should be given to:

- their adoption in principle by City Council and UTRCA staff;
- their recognition and incorporation into the Stormwater Management Strategy Plan;
- the development of the required municipal by-law where needed; and
- their consideration in the development review process.

When adopted, these recommended policies would define the Stormwater Management path that Ingersoll should follow.

Stormwater management policies, criteria, design and construction techniques have changed considerably over the past two decades. Continued growth in the watershed could result in local flooding, deteriorated water quality, adverse impacts on the flow regime, and deterioration in local aquifers, increased erosion rates and channel migration.

Of added importance for urban runoff control is the fact that water supply for the area is drawn from groundwater sources. The recent countywide groundwater study identified the need for maintaining both groundwater quantity and quality. Corresponding policies are required to promote the development of appropriate land uses and stormwater management facilities.

The potential impact of drainage from uncontrolled development on the environment is well documented in the literature. A summary of the detrimental effects observed in Ontario that are applicable in Ingersoll is presented in ***Table 1***.

Until the Town of Ingersoll completes its ongoing Stormwater Management Strategy and undertakes a series of follow-up studies the Interim Stormwater Management policies and criteria will require periodic updating as new information is collected.

Table 1. Summary of Potential Impacts of Drainage on the Environment

Type of impact	Effects
Hydrologic impacts	• Increase in frequency and magnitude of peak flows, increased risk of flooding • Decrease of base flows, detrimental effect on fish • Change in groundwater level, effect on water supply
Soils erosion impacts	• Increased rates and volumes of soils erosion • Increased amount of soil transported to watercourses, increased risk of flooding and damaging aquatic habitat
Hydraulic impacts	• Increased flood levels, increased risk of flooding • Change in flow velocities and change in bank erosion
Geomorphologic impacts	• Change in flow depth, and channel dimensions • Change in sediment loads • Change in channel formations
Water quality impacts	• Change in water quality • Change in sediment quality
Terrestrial and aquatic biota impacts	• Loss of fish habitats • Loss of riparian vegetation • Losses or reduction in native plants • Losses of animal species • Disruption between components of the terrestrial ecosystem
Socio-economic impacts	• Loss of life and property • Loss of agricultural resources • Loss of archeological and historic importance of native cultures • Increased cost of erosion control, flood control, water supply and treatment • Loss of recreational facilities • Loss of aesthetics • Loss of biodiversity

The Interim Stormwater Management Goal, Objectives and Policies presented below are based on general stormwater and environmental information available for the area and on similar studies undertaken in Southern Ontario. The Goal in stormwater management should represent a qualitative statement of a desired future condition, while the Objective should describe a measurable accomplishment toward the achievement of the goal, to be completed within a specified, realistic schedule.

The final policy document should reflect the results of the ongoing analysis of the Ingersoll watersheds.

Through the review of background data and discussions with local stakeholders, several management components were identified that may contribute to the potential environmental impacts of stormwater. These management components were grouped into the following three groups:

- Technical Management Component
- Institutional Management Components
- Funding Management Components

It is recommended first that the Town adopt a Vision and Goal Statement to assist in the identification of the Goals of Stormwater Management. The following is a suggested Vision Statement:

- ***Stormwater will be managed in a manner that recognizes rainwater as a potential resource to maintain or where necessary to improve the health of the local watercourses.***

The following stormwater management Goal statement is recommended:

- ***To reduce and ultimately eliminate, where feasible, the adverse impacts of urban runoff on the built and natural environment, to restore the beneficial aspects of rainwater and to achieve a measurable improvement in water quality in the Town's surface and ground water resources and in the overall environment, in a timely and sustainable manner that balances environmental, social and economic considerations.***

To support the above Vision and Goal and to provide further direction to it, the following Stormwater Management objectives were developed:

- ***Rainwater is to be treated as a resource. A hierarchy of source, conveyance and "end-of-the-pipe" control measures should be developed to manage stormwater. Source control measures should be considered first in this hierarchy in a manner that is balanced with the other two measures in terms of environmental, social and economic impacts, costs and benefits.***

- ***Stormwater management activities should be undertaken in a co-ordinated manner between the Town of Ingersoll and the Upper Thames River Conservation Authority, other government agencies, community groups and upstream municipalities.***

- ***For new development or re-development, the costs associated with avoiding/preventing negative impacts of stormwater on the environment should be borne equitably among the beneficiaries, i.e. the developers.***

- ***Where SWM facilities will be retrofitted within existing development areas, both the generators of the stormwater and the beneficiaries (i.e., landowners and the general public) of a clean environment should contribute equitably to the financing of these management initiatives.***

Based on the Goals and Objectives described above, a set of Interim Stormwater Management Policies has been developed. These policies can be organized on the basis of the same three management components adopted before: technical, institutional and funding policies.

The long-term plan for Ingersoll is to complete a comprehensive Stormwater Management Strategy for the Town to address future development and long-term Stormwater and Watercourse Management issues. The basis of the Strategy is to ensure that:

- Adequate flood protection is provided to area residents;
- Water quality will be protected and enhanced where feasible;
- Groundwater and base flow characteristics will be preserved;
- Local watercourses will not undergo undesirable and costly geomorphic changes; and
- Appropriate diversity of aquatic life and opportunities for human uses will be maintained.

The recommended policies are organized on the basis of the identified three SWM management categories (Technical, Institutional and Funding) and are summarized in ***Table 2***. The policies represent broad statements of intent with respect to the direction for SWM in the Town and should not be regarded as guidelines or targets, nor can they be quantified. The policies are intended to be applicable to the entire Town and potentially the entire watershed draining through the Town. Although the Town cannot adopt policies to apply beyond its jurisdiction, it can encourage and support the adoption of similar policies in an adjacent municipality.

The purpose of the document is to provide a base for discussions with Town and Conservation Authority staff.

- The Interim policies should be utilized and if necessary modified/updated at the time of future updates of the Stormwater Management Strategy Plan;
- The Final policies adopted under the Stormwater Management Strategy Plan should be reflected in future Official Plan and/or Strategic Plan documents; and
- The Final policies should be circulated to Town and Conservation Authority staff and outside stakeholders for their awareness and information.

Table 2 - Summary of recommended Interim Stormwater Management Policies

MANAGEMENT COMPONENT	POLICIES
TECHNICAL MANAGEMENT 1.Protect Natural Environment	Preservation, maintenance and restoration of natural systems
	Stormwater shall be regarded as a resource
	Use of naturalized/bio-engineered design
	SWM to be managed on a watershed basis
	Stormwater runoff to simulate natural hydrology
	Set watercourse targets
	SWM not to impact aquatic habitat
	Source water protection
2. Control Stormwater Quantity	Reduction in peak flows to reduce flooding and erosion
	Post to pre development peak flow and volume control
	Use of the major-minor system
3. Control Stormwater Quality	Discharges free from debris, oil, scum
	Reduce volume of sediment and pollutants entering the receiving water system
	Contaminants to be controlled through by-laws and public awareness
	Water quality targets for outfalls to be set
	Surface and sub-surface water quality not to be degraded
	Development review to require hydro-geological analysis for high risk areas
4. Control Erosion	Erosion and sediment control to be applied
5. Control Groundwater	Infiltration/groundwater problems to be identified and mitigated, where feasible.
6. Infrastructure	Discharges from existing development to be prioritized
	Drainage system capacities developed in an integrated manner
	Develop source control program
	When replacing infrastructure use best technology
	Consider emerging and state of art technologies
	Pilot projects to be pursued
	Existing infrastructure to be utilized fully
	Identify infrastructure contributing to infiltration and groundwater problem
	All new foundation drains discharge to rear-yard swale or surface management system, connection to storm/sanitary sewer prohibited
	Priority of stormwater management problems originating within the Town
INSTITUTIONAL MANAGEMENT 1. Need for Public Awareness	Promote public awareness
	Use community based approach
	Solicit stakeholder input in planning and management
	Stormwater to be managed on a watershed base and coordinated with appropriate regulating agency
	Town to be responsible for the resolution of problems within its boundaries
	Ponds and wetlands in public ownership
2. Update Standards	All agencies to adhere to the guidelines and strategies
FUNDING MANAGEMENT 1. Budget Limitations	Dedicated funding to finance SWM initiatives
	Establish capital and operating budgets
	SWM solution to be cost effective and affordable
2. Resource Allocation and Cost Recovery	Owners/proponents to be responsible for the cost of SWM including 30-year maintenance program
	Review all projects for consistency with policies
	Pursue pricing techniques to encourage innovation

INTERIM STORMWATER MANAGEMENT DESIGN CRITERIA

Until the completion of the Stormwater Management Strategy Plan for the Town, it is recommended that a set of interim design criteria summarized in ***Table 3*** should be used for quantity, quality, erosion, and base flow control. The use of this unified approach applicable within the Town's watersheds, (and preferable should apply to areas outside the Town's municipal boundaries) would ensure that the design of stormwater management practices would meet the flood, water quality, erosion control and groundwater recharge policies.

Table 3. Summary of Design Criteria

Control	Criteria	Comments
Flood and water quantity control	Control peak discharges from the 2, 5, 25, 50, 100 and 250-year storms to pre-development rates	• Should consider the cumulative effects of development and controls. • 24 hour storm effect to be evaluated when sizing facility volume
Water quality	Volume control for storage facilities, or control of a volume of water for a minimum 24 hours from a 25 mm rainfall	• Compute storage from MOE Manual or generate hydrographs for the single event design storm
Stream channel erosion	Control of peak flows and runoff volume	• Detailed, simplified or distributed runoff control method • 24 hour-48 hour extended detention of post-development 25 mm storm event. • Bank protection for a 25 mm runoff peak flow
Baseflow	Infiltrating the first 5 mm rainfall	• Where feasible, the pre-development hydrologic cycle components should be maintained.

HYDROLOGIC MODELING OF LOCAL WATERCOURSES

There are five watersheds draining the study area, three from the north of the Thames River: Baxter, Murphy and Sutherland Creeks. From the south, two named watersheds are draining to the Thames River: Hall's and Whiting Creeks as well as four small tributaries. The origins of the five named watersheds are located outside the boundaries of Ingersoll. ***Table 4*** lists drainage areas of the five major watersheds.

Table 4. Watershed Drainage Areas

Watercourse	Drainage area – km²	Drainage area within the Town
Baxter Creek	11.90	8%
Murphy Drain	2.00	24%
Sutherland Creek	5.00	20%
Hall's Creek	22.45	14%
Whiting Creek	10.25	30%

Modeling was done for existing and future conditions. Results show that generally, the flows for the two land use scenarios were very similar, except for the Whiting Creek, but even there the increase in the future land use flows downstream of the Town boundary was only 15% over the existing land use flows. A comparison of the July 2000 storm event as recorded in Ingersoll with long-term rainfall data (63 years) recorded at the St. Thomas showed that the July storm was most severe over a 6 to 12 hour period, when it exceeded the 100-year St. Thomas rainfall data.

The implication of these results is that future developments, with adequate runoff control, would not increase the peak flows for the 2 to 250 - year flows. Future Ingersoll Stormwater Strategy updates will have to assess in more detail the water quality and other environmental impacts of future developments. The purpose is to determine the required urban runoff controls and to complete the Stormwater Management Strategy Plan for the Ingersoll area that will permit future development, to harmonize the community's need for housing and services with the need for sustaining the long-term health of the environment.

STORMWATER MANAGEMENT STRATEGY IMPLEMENTATION

A set of suggested implementation measures applicable to both "Greenfield" and "Brownfield" developments and redevelopments were prepared that will confirm and supplement the Interim Stormwater Management Policies, and will permit future development to proceed in a manner, which harmonizes the community's need for housing, industry and services with the need for sustaining the long-term health of the environment.

Future investigations into developing stormwater management policies for infill, retrofit, and redevelopment areas may also be required. As part of the investigation a long-term Growth Plan should be prepared for the Town and adjacent areas located outside the Town's present boundaries. Also, these future investigations will identify additional watercourses to be studied.

In addition to the development related main activities a number of general follow-up studies were also recommended. High priority should be given to the environmental investigations, the selection of appropriate stormwater management alternatives and the preparation of a BMP Guideline document.

Stormwater Management Strategy Study
Final Report

February 2007

DILLON CONSULTING

Clarifica Inc.

UPPER THAMES RIVER CONSERVATION AUTHORITY

STORMWATER MANAGEMENT STRATEGY
Town of Ingersoll

February 2007

TABLE OF CONTENTS

Page

OTTHYMO COMPUTER PRINTOUTS FOR EXISTING, FUTURE LAND USE AND FOR JULY 2000 STORM WITH FUTURE LAND USE (under separate cover).

List of Tables

List of Figures

1. INTRODUCTION

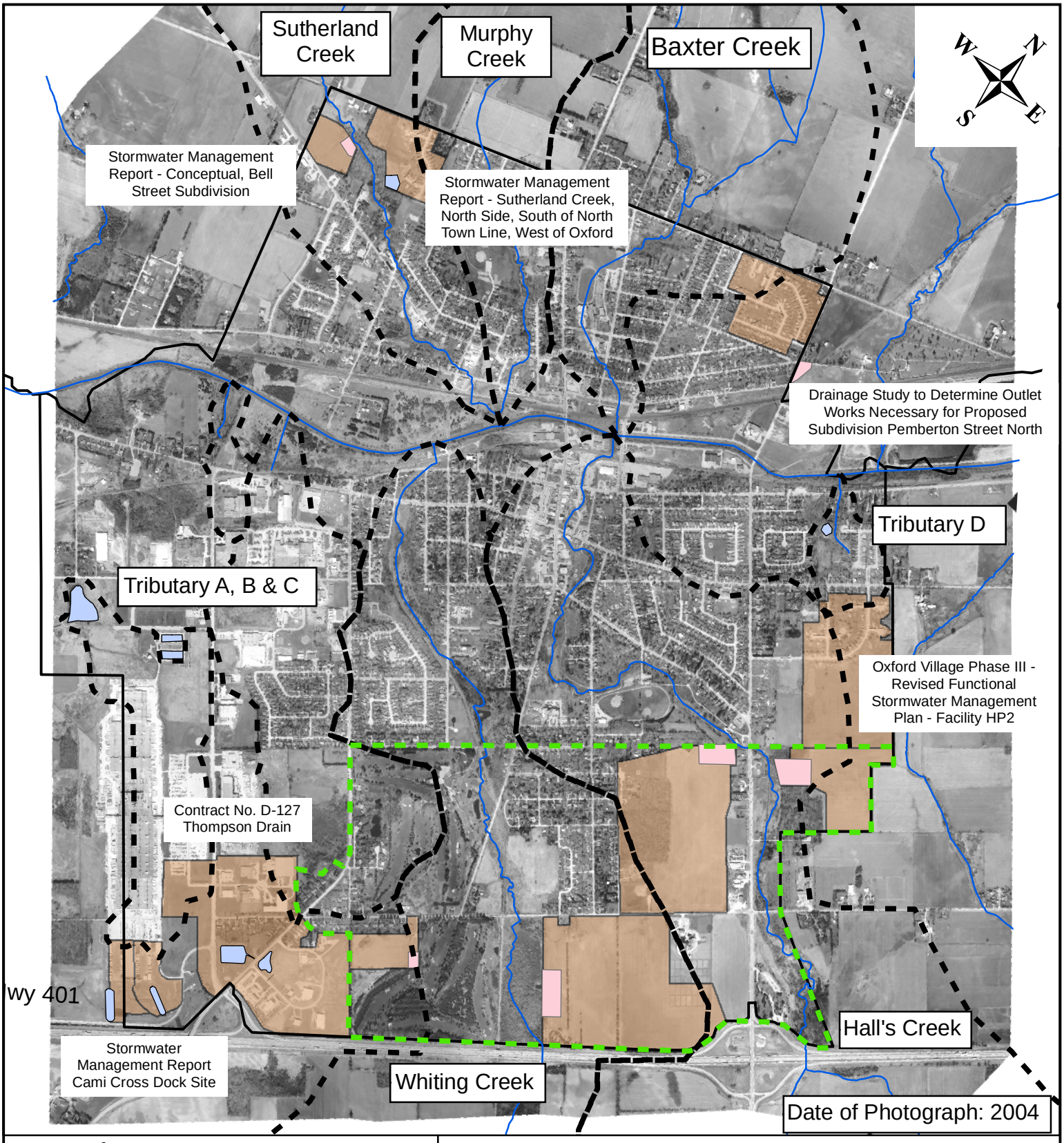
1.1 BACKGROUND

The Town of Ingersoll shown on ***Figure 1*** is facing continuing development pressures to meet community housing and servicing needs. Since the first stormwater management study undertaken in 1982, development pressure has intensified, particularly in the recently annexed lands at the southerly Town limit and along the outer fringes of the community. In the past, the Town has implemented a set of stormwater management criteria for new developments, based mainly on the 1982 report that focused on quantity control. Historically quality control of stormwater runoff has been implemented in an ad hoc manner.

Figure 1 is based on a 2004 aerial photo of the Town and it shows the existing and proposed stormwater management facilities. Continued growth in the many tributary watersheds of the Thames River within the Town of Ingersoll could result in local flooding, deteriorated water quality, adverse impacts on the flow regime, and deterioration in the local aquifer, increased erosion rates and channel migration. Public education has resulted in an increase in awareness and understanding of the negative impacts of uncontrolled urban development on our environment, and the rising expectation for corrective actions to be taken to maintain and/or improve environmental conditions.

Accordingly, there is a need to undertake a comprehensive stormwater management study based on the latest provincial standards to ensure orderly development and to provide protection of the natural environment, public and private property. The Town of Ingersoll and the Upper Thames River Conservation Authority have partnered on a Stormwater Management Strategy project. The purpose of this project is to develop a stormwater model, prepare Interim Stormwater Policies and the Terms of Reference for further updating of the Stormwater Management Strategy.

Our report addresses the three basic tools required to undertake a successful Stormwater Strategy project: 1) development of a set of Interim Stormwater Management Policies, 2) preparation of a hydrologic model to estimate flows for different development and control scenarios, and 3) preparation of a comprehensive set of Terms of Reference for tasks needed to update the Stormwater Strategy study. All three tasks must satisfy not only the past requirements to manage stormwater, such as flood control, and water quality enhancement, but must address recently introduced important environmental components such as stream morphology and water balance. The maintenance of water balance and groundwater recharge is especially important for the Ingersoll area, as the County of Oxford is totally dependent upon groundwater for its water supplies. Changes in future runoff characteristics caused by development could also result in significant changes in the local watercourses if left uncontrolled. A comprehensive stream morphology investigation is needed to ensure that the five local watercourses and tributaries will be protected from the potential adverse effects of development.



Legend

- Creek
- Watershed
- Town Limits
- Existing SWMPs
- Future SWMPs
- SWMP Drainage Areas
- Seconday Plan Boundary

Figure 1: SWMP Key Plan

TOWN OF INGERSOLL

Drawn By: C.S.

Date: Feb. 1, 2007

Curry Road

DILLON CONSULTING

0 250 500 1,000 1,500 2,000 Meters

The following report presents the Interim Stormwater Management Policies, followed by a summary presentation of the hydrologic modeling. Based on the results of these two tasks, a set of Terms of Reference is presented for future follow-up studies to complete the Stormwater Management Strategy Plan.

1.2 PAST STUDIES

A number of past reports were reviewed during the study to obtain relevant information required by the hydrologic model, such as aerial photos, mapping, land use, planning, infrastructure design and hydrology. For an annotated bibliography see ***Appendix A.***

MacLaren Engineers, Planners and Scientist undertook the first and only comprehensive stormwater management study for the Town of Ingersoll in 1981. A brief report summarizing the results of the study was released in January 1982 describing flows and water levels for the five watercourses: Hall, Whiting, Sutherland, and Murphy Creeks and Baxter Drain. The hydrologic analysis was based on an early version of the HYMO program, developed in the US during the 1970s for mainly rural areas. In absence of local rain gauge data, the St. Thomas data was used as a rainfall input. Generally, the St. Thomas data showed lower rainfall intensity duration values than the London Airport data used in the current study.

The MacLaren report concluded that if the total imperviousness in any proposed development area were kept below 45%, no stormwater management technique would be required to control the peak flows. The report did not address water quality, erosion or environmental constraints.

A number of site-specific stormwater management studies supporting development activities have been prepared over the past 20 years for the Town. These studies were based on various hydrologic models and all recommended some form of stormwater management control either by lot level, storage or infiltration facilities.

Since the release of the 1982 report there was a steady improvement in our capability to model the rainfall/runoff relationship for both rural and urban areas. These new improved hydrologic computer programs were calibrated for Southern Ontario conditions and therefore provide more reliable estimates for both peak flows and for runoff hydrographs.

Another reference document that provided input to the study was by Wood and Goldt of the Upper Thames River Conservation Authority. The authors prepared a detailed Reference Manual for the Use of Precipitation Design Events applicable to the Upper Thames River Watersheds. Rainfall and rainfall on snowmelt data compiled in both synthetic design storms and historical storm events, such as the July 2000 storm are described in the report.

An extensive erosion/geomorphology inventory was carried out in 2001 by the Conservation Authority to assess the existing conditions of the major watercourses flowing through Ingersoll. Altogether the following 168 sites were inventoried along the main watercourses:

Baxter Drain	28
Hall Creek	56
Murphy Creek	22
Sutherland Creek	36
Whiting Creek	26

The following data items were noted in the field during GPS surveys of erosion areas. The items were input using the capabilities of GPS database entry. Running field notes were taken to supplement the surveys and to note general morphology conditions of items along the survey path. The inventory incorporated the following features:

- Existing erosion works
- Slope protection
- Channel flow depth at site
- Estimate of bankfull flow height or depth (related to 1 to 2 yr flow)
- Average height of bank
- Estimated slope ratio
- Estimated length of erosion site (measured by GIS software length)
- Top slope property use setback
- Top slope structure (permanent) setback
- Filled bank
- Instream debris
- Potential aquatic barrier
- Channel constriction
- General channel degradation
- Outside meander
- Evidence of toe erosion
- Digital Picture #
- Site Description / Comments

In addition a number of observations and conclusions have been added to the database by the Conservation Authority staff. These comments represent a provisionary and subjective assessment by the field team that may assist in future with establishing priorities for works.
The outcome of these observations resulted in a list of remediation or maintenance priorities, ranked High, Medium or Low for the following categories:

<u>Priorities:</u>

- Property Damage / Safety
- Stream Morphology
- Fisheries
- Natural Heritage / Riparian
- Technical Feasibility / Cost
- Private lands

- Municipal Priority
- Other Agency Priority

It is intended by the field team to undertake further consultation in future to validate the High, Medium and Low rankings. The number of High priority erosion sites ranged from nine on the Murphy Drain to 15 on Hall's Creek. The Conservation Authority's assessment noted that any future increase in the frequency of flows and resultant velocities caused by development would further aggravate the existing erosion concerns with the local watercourses.

2. APPROACH TO DEVELOPMENT OF INTERIM STORMWATER MANAGEMENT POLICIES

2.1 THE NEED FOR SWM POLICIES

The traditional approach to stormwater management has been to collect and convey storm runoff from urban areas as quickly as possible, to minimize the potential for flooding and property damage. Constructing storm sewers along most city streets and discharging the runoff to the nearest receiving streams have generally achieved this. Over the past twenty-five years, quantity control has been the main consideration. However since the mid-1980s, investigations in Canada, U.S. and Europe have identified that the uncontrolled discharge of stormwater from urban areas is a significant contributor to deteriorated surface water quality. In many instances, it has been demonstrated that stormwater contains elevated levels of suspended solids, heavy metals, pesticides, herbicides, nutrients, road salts and other contaminants that are harmful to the environment. Thus, the current practice has been toward control of both sanitary sewage and stormwater discharges to surface waters. The emerging trend is to recognize stormwater runoff as a natural resource to be put to beneficial use, such as groundwater replenishment, recreation, and aesthetic purposes.

Since the first Ingersoll stormwater management study undertaken in 1982, development pressure has intensified, particularly in the recently annexed lands at the Southerly Town limit and along the other fringes of the community. In the past, the Town has implemented a set of stormwater management criteria for new developments, based mainly on the 1982 report that focused on quantity control. Since 1992, subdivision developments requiring stormwater management facilities have been primarily implemented in an ad hoc manner through compliance with MOE policy and existing County and Conservation Authority policies. More recently area plans, such as the South Annexed Area Plan, included a detailed stormwater management component. Continued growth in the subwatersheds could result in local flooding, deteriorated water quality, adverse impacts on the flow regime, and deterioration in local aquifers, increased erosion rates and channel migration. Stormwater management policies, criteria, design and construction techniques have changed considerably over the past two decades.

Of added importance for urban runoff control is the fact that the Town's water supply for the area is drawn from groundwater sources. The recent countywide groundwater study identified the need for maintaining both groundwater quantity and quality. Corresponding policies are required to promote the development of appropriate land uses and stormwater management facilities.

2.2 GOAL AND OBJECTIVES

The following three-step approach was adopted for the development of policies:

1. Development of a stormwater management goal statement and related objectives;
2. Development of stormwater management policies; and
3. Consultation with the public.

First the need for stormwater management policies is described and a set of Interim Stormwater Management Goals and Objectives are presented followed by a set of recommended Interim Stormwater Management Policies. A parallel ongoing analysis of the Ingersoll watersheds will provide additional information and a better understanding of the existing and future stormwater issues facing the Town. It is intended that this Interim document will be reviewed and updated in the future following the completion of the Ingersoll watershed analysis.

The Town has requested the development of a comprehensive Stormwater Management Study based on the latest provincial standards to ensure orderly development and to provide protection to the human and natural environment. As part of the study, a set of Interim Stormwater Management policies is to be prepared that could form the base of the Stormwater Management Strategy. It is important that the proposed broad-based policies related to stormwater and flood control build and expand on Provincial, Conservation Authority and County of Oxford Official Plan stormwater management policies. In addition, for the new Policies to be formally recognized, consideration should be given to:

- their adoption in principle by Town Council and UTRCA, with approval of Town Council;
- their recognition and incorporation into the Stormwater Management Strategy Plan;
- the development of the required municipal by-law where needed; and
- their consideration in the development review process.

When adopted, these recommended policies would define the Stormwater Management path that Ingersoll should follow.

3. RECOMMENDED APPROACH TO DEVELOP STORMWATER MANAGEMENT POLICIES FOR THE TOWN OF INGERSOLL

Development of stormwater management policies is influenced by the:

- Potential impacts of drainage on the environment;
- Existing legal principles and legislation, Common and Statute Law principles and requirements;
- Legislative mandates, such as policies, guidelines and manuals; and
- Budget constraints, which necessitates a phased approach in developing first a set of interim policies until all background studies needed for the establishment of the policies are completed

3.1 POTENTIAL IMPACTS OF DRAINAGE

The potential impact of drainage from uncontrolled development on the environment is well documented. A summary of the detrimental effects observed in Ontario that are applicable in Ingersoll is presented in ***Table 1***.

Table 1. Summary of Potential Impacts of Drainage on the Environment

Type of impact	Effects
Hydrologic impacts	• Increase in frequency and magnitude of peak flows, increased risk of flooding • Decrease of base flows, detrimental effect on aquatic resources • Change in groundwater level, effect on water supply
Soils erosion impacts	• Increased rates and volumes of soils erosion • Increased amount of soil transported to watercourses, increased risk of flooding and damaging aquatic habitat
Hydraulic impacts	• Increased flood levels, increased risk of flooding • Change in flow velocities and change in bank erosion
Geomorphologic impacts	• Change in flow depth, and channel dimensions • Change in sediment loads • Change in channel formations
Water quality impacts	• Change in water quality • Change in sediment quality

Type of impact	Effects
Terrestrial and aquatic biota impacts	• Loss of fish habitats • Loss of riparian vegetation • Losses or reduction in native plants • Losses of animal species and linkages • Disruption between components of the terrestrial ecosystem
Socio-economic impacts	• Loss of life and property • Loss of agricultural resources • Loss of archeological and historic importance of native cultures • Increased cost of erosion control, flood control, water supply and treatment • Loss of recreational facilities • Loss of aesthetics • Loss of biodiversity

In summary, uncontrolled development in Ingersoll could result in potential degradation of the environment in the Town's watersheds as a result of stormwater impacts.

3.2 EXISTING LEGAL PRINCIPLES AND LEGISLATION

3.2.1 Common Law Principle

Common law is based on long standing usage and customs and historic court decisions. Consequently, it is largely a matter of precedent. Generally, actions can be brought against the designer or the agency in charge of setting municipal standards, design approval, operation and maintenance in three ways:

1. Violation of riparian rights

Stormwater management facilities frequently require changes to the existing drainage systems. Examples where riparian rights and obligations are considered include: use of water, interference with natural watercourses, diversions, crossings, obstruction, and increase in surface flows. Any change in flow characteristics caused by upstream owners means they can be liable for the damages that result. The key criteria the courts would consider are: reasonableness and the changes were caused by artificial means.

2. Nuisance

Nuisance is an unreasonable interference with another person's use or enjoyment of property and is not predicated upon a fault.

Generally, Courts have found that if a plaintiff can show actual physical damage to property, then the plaintiff is entitled to recover damages, even if the defendant can prove that its

activities are reasonably necessary, or even if it can be proven to benefit the community as a whole.

For example, in the Scarboro Golf and Country Club v. City of Scarborough Case the courts found that a continuous upstream development over a 40-year period increased the runoff in the creek and widened the stream banks which had a detrimental effect on the golf course. The Court found that the City's use of the watercourse for urban runoff conveyance was not reasonable. Consequently, the City was found liable to the golf club by creating nuisance. The City was also found negligent in breaching the common law duty of care in planning and constructing an adequate stormwater drainage system.

This case illustrates that a municipality can be liable for damages caused by storm sewer systems despite the fact that such a system may be necessary, reasonable and was constructed in a proper manner.

3. Negligence

Negligence is the lack of reasonable care taken resulting in damages or injury. The Court investigates procedures and prevailing practices to determine whether the defendant owes the plaintiff a duty of care, and if that care was broken whether the plaintiff's injury was foreseeable.

A review of cases relevant to stormwater and watercourse management revealed a number of important general principles of the common law:

- Municipalities can be liable for damages caused by municipal works like stormwater facilities, or where their works cause additional flooding or erosion.

- An owner of riparian lands has the right to the flow of water through his land in its natural and unpolluted state.

- Municipalities are not immune to common law actions just because they are considering works that are for the benefit of the community, nor because they have the mandate to construct such works.

- An agency may be found negligent in breaching its statutory duty of care where it issues a permit without enquiring into whether the approval works would have adverse effects in terms of flooding, pollution or conservation.

3.2.2 Statute Laws and Government Roles and Responsibilities

There are a number of Federal and Provincial statues addressing the administration and requirements of legislation through government agencies, such as federal departments, provincial ministries, conservation authorities, crown corporations boards and municipal and regional departments. The agencies with which the authority rests are the mandated agencies.

In addition to the role of the mandated agencies in granting approvals, other agencies may be assigned the role of a commenting agency in the approval review process. The following Ministries may have interests and responsibilities relating to surface waters:

- Department of Environment
- Department of Fisheries and Oceans
- Ontario Ministry of Natural Resources
- Ontario Ministry of Municipal Affairs and Housing
- Ontario Ministry of Environment
- Ontario Ministry of transportation
- Ontario Ministry of Agriculture Food and Rural Affairs

A list of statutes relating to various aspects of stormwater management includes:

- Canadian Environmental Assessment Act
- Fisheries Act
- Navigable Waters Protection Act
- Environmental Assessment Act
- Environmental Protection Act
- Ontario Water Resources Act
- Beds of Navigable Waters Act
- Conservation Authorities Act
- Drainage Act
- Lakes and Rivers Improvement Act
- Municipal Act
- Planning Act
- Public Lands Act
- Tile Drainage Act
- Safe Drinking Water Act
- Bridges Act
- Local Improvement Act
- Endangered Species Act

All levels of government have roles and responsibilities in stormwater management.

Federal Government

The Department of Fisheries and Oceans is responsible for fisheries and the habitats supporting them. Charges under the Fisheries Act could be laid if urban runoff entering a watercourse is deemed deleterious to fish. Any storm water works that would harmfully alter fish habitats require approval under the *Fisheries Act*.

Provincial Government

- Under the *Environmental Protection Act* the Ministry of the Environment has the powers to regulate or prohibit storm sewer discharge provided that it can be proven that the discharge causes harm.

- The cabinet also has the power to make regulations exempting a class or source of contaminants and/or setting permissible levels.

- Most urban runoff related projects must fulfill the requirements of the Class Environmental Assessment for Municipal Water and Wastewater Projects.

- Municipalities must obtain a Certificate of Approval for Sewage Works which could include drainage and stormwater projects under the Ontario Water Resources Act

- The Ministry of Natural Resources has some jurisdiction over water quantity/quality (e.g., construction of buildings, placement of fill, alteration of watercourses).

- The Ministry of Municipal Affairs is responsible for approval of Municipal Official Plans.

- The Provincial Government is developing legislation to protect drinking water sources by requiring watershed-based source water protection, and to enhance the ecological, recreational and commercial values of our resources.

Conservation Authorities

Under the *Conservation Authorities Act*, Conservation Authorities have jurisdiction for all the watercourses within their area watersheds. They provide approval for development that may discharge into the watercourses within their jurisdiction, regulate activities in areas susceptible to flooding during a Regulatory Flood and ensure inclusion of policies for stormwater management in municipal planning documents and assist in the preparation of drainage plans.

Conservation Authorities study and investigate watersheds, determine programs whereby the natural resources of the watersheds may be conserved, restored, developed and managed. They conduct monitoring of stream flow and water quality, sediment quality and aquatic life. Conservation Authorities establish flood flow management criteria on the control of surface waters, to prevent floods or pollution or to reduce the adverse effects of development. Conservation Authorities maintain hydrologic and hydraulic databases and mapping for their area of jurisdiction, flood warning service and undertake maintenance and operation of flood control structures.

3.3 RELEVANT PROVINCIAL, MUNICIPAL AND CONSERVATION AUTHORITY STORMWATER MANAGEMENT GOAL, OBJECTIVES AND POLICIES

A review of existing provincial, regional and local conservation authority documents identified the following stormwater management related goal, objectives and policies, relevant to the Ingersoll area.

3.3.1 Provincial Surface Water Quality Management

Under the *Ontario Water Resources Act* stormwater collected in sewage works, which contribute to direct discharges to lakes and rivers, require a Certificate of Approval from MOE. The current provincial policy framework related to stormwater management includes both mandatory requirements and guideline documents.

Industrial facilities regulated through the Municipal and Industrial Strategy for Abatement (MISA) Clean Water regulations are required to prepare stormwater management plans and submit them to the MOE. Provincial approvals for municipal drainage as defined under the Drainage Act are not required, however plans can be appealed. Drainage systems serving highways and agricultural lands are exempt from the MOE's approval process.

The recently updated Provincial Policy Statement issued under the *Planning Act* (March 2005) require that planning authorities shall:

- protect, improve and restore the quality and quantity of water by using the watershed as the ecologically meaningful scale for planning;
- minimize potential negative impacts;
- implement necessary restrictions on development and site alternation to protect all municipal drinking water supplies and designated vulnerable areas and protect, improve or restore vulnerable or sensitive surface and groundwater features and their hydrologic functions;
- ensure that stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and precious surfaces.

Provincial water quality Goals, Objectives and Policies state:

<u>Goal:</u>

- To ensure that the surface waters of the Province are of quality this is satisfactory for aquatic life and recreation.

<u>Objectives:</u>

- To meet the water quality requirements for the protection of aquatic life and recreation;
- Prevent the release, in any concentration, of hazardous substances that have been banned;
- Ensure that special measures are taken on a case-by-case basis to minimize the release of hazardous substances that have not been banned.

Policies:

- In areas which have water quality better than the Provincial Water quality objectives, water quality shall be maintained at or above the objectives.
- Water quality, which presently does not meet the Provincial Water Quality Objectives, shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Provincial Water Quality Objectives.

The province relies on municipalities to manage storm water within their respective jurisdictions.

3.3.2 County of Oxford Official Plan

The County of Oxford Official Plan addressed a number of water quantity and quality issues driven by the concern that the County is totally dependent upon groundwater for its water supplies.

The Plan lists the following watershed management and water conservation related statements:

Objectives:

- To ensure that land use planning contributes to the protection, maintenance and enhancement of water and related resources and aquatic ecosystems on an integrated watershed management basis.
- To maintain, and where practical, enhance surface and groundwater resources, in sufficient quality and quantity to meet the needs of existing and future users.
- To the extent practical, ensure all land use decisions promote water conservation and support the efficient use of water resources.

Development Approval:
Since the County of Oxford is located within four separate watersheds and, the development of watershed and sub-watershed plans will be a lengthy process, the County has adopted the following interim measures for stormwater control.

- Until such time as sub-watershed studies are approved, an application for approval for development may be required to submit for approval a stormwater management report to the County, the Ministry of the Environment, the Ministry of Natural resources, and/or the Conservation Authority with jurisdiction providing the following information:

    i) a plan for the provision of stormwater drainage facilities to accommodate the proposed development, including consideration of the feasibility of using at-source infiltration to achieve stormwater management objectives;
    ii) a grading plan for the proposed development;
    iii) an assessment of the pre-development and post-development discharge of water during all runoff conditions including flood conditions on any stream. Post development flows should not exceed pre-developo0ment conditions;

iv) an assessment of the proposed development on the water quality of any stream or watercourse and the means of mitigating any potential reductions in water quality;

v) an assessment of the stormwater capacity on any proposed receiving watercourse;

vi) the means for controlling erosion, sedimentation and in-stream bank stability using the best available construction and management practices both during and after the construction of the development;

vii) an assessment of how development will maintain or enhance the minimum baseflow of an affected watercourse and maintain storage levels during periods of minimum baseflow for flow augmentation.

- Stormwater management plans will be consistent with the concepts and technological requirements established by the Province through its Stormwater Management Quality Guidelines and Planning and Design Manual.

Stormwater Retention and Detention Facilities:

Where new development will require facilities for the temporary storage of stormwater during storm events, such facilities shall be designed in accordance with the technical standards established by the Area Municipality, the Conservation Authority with jurisdiction and/or the Ministry of the Environment and will also meet the following requirements.

- stormwater management areas will be on lands dedicated to the Area Municipality and will be over and above any land required to be dedicated for park purposes under the Planning Act, subject to a portion of the lands required for the stormwater management facility being accepted as parkland dedication, at the sole discretion of the Area council based on the location, design and usability of the stormwater management facility as a functional park space;
- facilities will generally be designed in a manner which will result in gentle sloping, shallow retention ponds that will not typically require fencing for security purposes and which can be utilized for park purposes during dry periods;
- a landscaping plan approved by the Area Council will be required for all stormwater retention and detention facilities. All required landscaping, in accordance with the approved plan, shall be installed at the proponent's cost within two years of registration of the subdivision plan;
- stormwater management facilities located in parking areas shall be designed such that the maximum depth of water, at any time, shall not exceed 300 mm; and
- stormwater management facilities for new development will not be permitted in a Regulatory Flood Plain.

Water Quality:

In recognition that the County is totally dependent on groundwater supplies as well as interrelationships between surface water quality and groundwater quality and in order to

maintain and, where possible, enhance the quality of both surface and groundwater supplies, the County and Area municipalities will require the following:

- Natural drainage systems will be promoted in the design of new subdivisions and major watercourses will be left as much as possible in their natural state incorporating existing and newly naturalized vegetative buffers. County and Area Councils will be satisfied that any proposed modifications to a natural watercourse are necessary and are acceptable to the Conservation Authority with jurisdiction and/or the appropriate Provincial Ministries.

The following measurers for water quality maintenance and enhancement purposes may be applied as conditions of approval in situations where proposed development abuts a watercourse:

- the use of a setback from the top of the bank of the watercourse to the nearest property line;
- the acceptance of riparian lands and of lands immediately adjacent as part of the required parkland dedication;
- the use of site planning to situate building and parking area locations away from the riparian lands and to address stormwater flows;
- the requirements to incorporate erosion and sedimentation control measurers during construction;
- for industrial, commercial, institutional and residential development a requirement for the establishment of permanent filter strip and other measures to improve stormwater quality as part of the landscaping requirements;
- the requirement to retain existing vegetation and to add new indigenous plantings to achieve a natural buffering corridor adjacent to the watercourse. County Council and/or Area Council may consult with the Ministry of Natural resources and/or Conservation Authority with jurisdiction to determine the appropriate buffer width; and
- requiring measures such as the fencing of riparian lands and restricting individual access from properties abutting such lands as a means of discouraging alterations to natural vegetation.

<u>Rural policies:</u>
In the interest of protecting the quality of ground and surface waters in Oxford County, new intensive livestock farms and existing livestock farms expanding to the scale of an intensive livestock farm will be required to:

- prepare a nutrient management plan;
- demonstrate that the intensive livestock farm has adequate manure storage capacity; and
- satisfy the requirements of the Minimum Distance Separation Formula II, to the satisfaction of the Area Council prior to the issuance of a building permit.

In order to reduce the probability of groundwater contamination, Groundwater Recharge Areas are identified on Schedule C-2, Environmental Constraints. It is intended that these areas will

be protected from contamination by uses and activities that would affect the recovery and use of groundwater supplies for both domestic and agricultural purposes.

3.3.3 Conservation Authority Stormwater Management Goal, Objectives and Policies

Flood Control:
One of the main responsibilities of the Upper Thames River Conservation Authority is flood control. In the past the Authority's policy on flood control followed the 1980 MacLarens report recommendations, encouraging flow control where the post-development imperviousness exceeded 45%.

For the Regulatory Flood used for flood plain mapping, the Authority designated the 1937 historic flood, or in absence of local flood records, an equivalent flood represented by the 1 in a 250-year event.

The Authority is planning to prepare an update to the currently used flood lines in Ingersoll, based on a new hydrology model presently under preparation.

Water Quality Control:
For water quality control, the Conservation Authority adopted the latest approach of receiving system classification (Basic, Normal and Enhanced), presented in the Provincial Stormwater Management Planning and Design Manual (2003).

Erosion Control:
The Conservation Authority for future use is considering volumetric control of stormwater, an approach described in the same 2003 Manual.

The Authority is also planning to identify slope hazard areas and meander belts along the Ingersoll watersheds.

Water Balance:
Where local soils are porous infiltration measures are encouraged to compensate any volumetric loss to groundwater caused by impervious development areas.

3.4. DEVELOPMENT OF INTERIM STORMWATER MANAGEMENT POLICIES FOR INGERSOLL

Until the Town of Ingersoll completes its Stormwater Management Strategy and undertakes a series of follow-up studies the Interim Stormwater Management policies and criteria will require periodic updating as new information is collected.

The Interim Stormwater Management Vision, Goal, Objectives and Policies presented below are based on general stormwater and environmental information available for the area and on

similar studies undertaken in Southern Ontario. The Goal in stormwater management should represent a qualitative statement of a desired future condition, while the Objective should describe a measurable accomplishment toward the achievement of the goal, to be completed within a specified, realistic schedule.

The final policy document should reflect the results of the ongoing analysis of the Ingersoll watersheds.

Through the review of background data and discussions with local stakeholders, several management components were identified that may contribute to the potential environmental impacts of stormwater. These management components were grouped into the following three groups:

Technical Management Component

- Protect natural environment
- Control stormwater quantity
- Control Stormwater quality
- Control erosion
- Protect local groundwater
- Infrastructure component

Institutional Management Components

- Need for public awareness
- Need to update standards

Funding Management Components

- Budget limitations
- Resource allocation and need for cost recovery mechanism

3.4.1 Goal

It is recommended first that the Town adopt the following Vision Statement to assist in the identification of the Goals of Stormwater Management:

Stormwater will be managed in a manner that recognizes rainwater as a potential resource to maintain or where necessary to improve the health of the local watercourses.

The basic difference in the old and proposed approach to stormwater management is the realization that the "out of sight, out of mind" philosophy conveying urban runoff in underground pipes to the nearest receiving system is environmentally unacceptable and not cost effective in the long term. Based on the above Vision statement, the Town should adopt a clear, compelling and comprehensive Goal statement; one that embraces the magnitude of the Stormwater Management mandate but also allows flexibility.

The following stormwater management Goal statement is recommended:

To reduce and ultimately eliminate, where feasible, the adverse impacts of urban runoff on the built and natural environment, to restore the beneficial aspects of rainwater and to achieve a measurable improvement in water quality in the Town's surface and ground water resources and in the overall environment, in a timely and sustainable manner that balances environmental, social and economic considerations.

3.4.2 Objectives

To support the above Goal and provide further direction to it, Stormwater Management objectives were developed and organized under three separate management components:

1. ***Technical Objective:***

Generally, stormwater control can be achieved at the source, in the conveyance system or at the end-of-pipe. Source Control includes those measures designed to reduce both the volume of water and pollutant loads entering the stormwater management system at the lot level. The types of measures that can be implemented vary according to retrofit or new development proposals. Conveyance control includes those measures that transport the flows from source to an outlet/treatment point. However, conveyance control can also provide treatment to stormwater runoff. End-of-the-pipe measures include structural facilities (e.g., ponds) to either store and/or treat runoff.

A "source control first" (i.e., nonstructural means) approach is recommended to manage stormwater. This would involve the consideration of source control measures first when reviewing and selecting control alternatives. However, these source control measures should only be implemented after the benefits and environmental/social impacts and costs are considered and compared to those associated with conveyance and "end-of -pipe" measures.
A "source control first" plan is a fundamental shift from previous Canadian practices. This is an approach that has been advocated by concerned citizen groups in Ontario for some time. Key to the success of this approach is being able to fully understand the effectiveness of source control programs. This approach should not be construed to mean that source control programs and structural projects couldn't be implemented concurrently. Ultimately the selection process has to determine the best balance of source control and end-of-pipe measures.

The following Technical Objective is recommended for Ingersoll:

Rainwater is to be treated as a resource. A hierarchy of source, conveyance and "end-of-the-pipe" control measures should be developed to manage stormwater. Source control measures should be considered first in this hierarchy in a manner that is balanced with the other two measures in terms of environmental, social and economic impacts, costs and benefits.

2. *Institutional Objective:*

Coordination among the various agencies is important to eliminate any barriers in addressing the stormwater management problems.

Stormwater management activities should be undertaken in a co-ordinated manner between the Town of Ingersoll and the Upper Thames River Conservation Authority, other government agencies, community groups and upstream municipalities.

3. *Funding Objective:*

To date, stormwater management initiatives in Ingersoll have not been funded through a dedicated revenue fund. The true costs of managing stormwater are hidden through this approach. If stormwater management efforts are to be funded on a cost recovery basis, the issue of who pays is an important one. It is proposed that both the generators of pollution (i.e., land owners) and the beneficiaries of management efforts (i.e., local citizens) be financially responsible.

For new development or re-development, the costs associated with avoiding/preventing negative impacts of stormwater on the environment should be borne equitably among the beneficiaries, i.e. the developers.

Where SWM facilities will be retrofitted within existing development areas, both the generators of the stormwater and the beneficiaries (i.e., landowners and the general public) of a clean environment should contribute equitably to the financing of these management initiatives.

Based on the Goals and Objectives described above, a set of Interim Stormwater Management Policies has been developed. These policies can be organized on the basis of the same three management components: technical, institutional and funding policies.

3.4.3 Recommended Interim SWM Policies

The long-term plan for Ingersoll is to complete a comprehensive Stormwater Management Strategy for the Town to address future development and long-term Stormwater and Watercourse Management issues. The basis of the Strategy is to ensure that:

- Adequate flood protection is provided to area residents;
- Water quality will be protected and enhanced where feasible;
- Groundwater and base flow characteristics will be preserved;
- Local watercourses will not undergo undesirable and costly geomorphic changes; and
- Appropriate diversity of aquatic life and opportunities for human uses will be maintained.

A set of Interim SWM policies have been developed recognizing i) the previously described three groups of management components; ii) the selected goals and objectives; iii) the requirements of the proposed Stormwater Management Strategy Plan; and iv) the mandates of various responsible agencies.

The recommended policies are organized on the basis of the identified three SWM management categories (Technical, Institutional and Funding) and are summarized in ***Table* 2**. A more detailed description of the brief summary statements listed in the table is presented in ***Appendix B.***

The policies represent broad statements of intent with respect to the direction for SWM in the Town and should not be regarded as guidelines or targets, nor can they be quantified. The policies are intended to be applicable to the entire Town and potentially the lands of the entire subwatersheds draining through the Town. Although the Town cannot adopt policies to apply beyond its jurisdiction, it can encourage and support the adoption of similar policies in an adjacent municipality.

3.4.4 Next Steps

The purpose of this Stormwater Management Strategy Study document is to provide a base for discussions with Town and Conservation Authority staff and allow for refinement and detailing of stormwater management policy and design criteria.
To advance these Interim SWM policies, the following should occur:

1. The Interim policies and stormwater management design criteria should be utilized and if necessary modified/updated at the time of future updates of the Stormwater Management Strategy Plan;

2. The Final policies and stormwater management design criteria adopted under the Stormwater Management Strategy Plan should be reflected in future Official Plan and/or Strategic Plan documents; and

3. The Final policies and stormwater management design criteria should be circulated to Town and Conservation Authority staff and outside stakeholders for their awareness and information.

Table 2 - Summary of recommended Interim Stormwater Management Policies

Management Component	Policies
TECHNICAL MANAGEMENT	
1.Protect Natural Environment	Preservation, maintenance and restoration of natural systems
	Stormwater shall be regarded as a resource
	Use of naturalized/bio-engineered design
	SWM to be managed on a watershed basis
	Stormwater runoff to simulate natural hydrology
	Set watercourse targets
	SWM not to impact aquatic habitat
	Source water protection
2. Control Stormwater Quantity	Reduction in peak flows to reduce flooding and erosion
	Post to pre development peak flow and volume control
	Use of the major-minor system
3. Control Stormwater Quality	Discharges free from debris, oil, scum
	Reduce volume of sediment and pollutants entering the receiving water system
	Contaminants to be controlled through by-laws and public awareness
	Water quality targets for outfalls to be set
	Surface and sub-surface water quality not to be degraded
	Development review to require hydro-geological analysis for high risk areas
4. Control Erosion	Erosion and sediment control to be applied
5. Control Groundwater	Infiltration/groundwater problems to be identified and mitigated, where feasible.
6. Infrastructure	Discharges from existing development to be prioritized
	Drainage system capacities developed in an integrated manner
	Develop source control program
	When replacing infrastructure use best technology
	Consider emerging and state of art technologies
	Pilot projects to be pursued
	Existing infrastructure to be utilized fully
	Identify infrastructure contributing to infiltration and groundwater problem
	All new foundation drains discharge to rear-yard swale or surface management system, connection to storm/sanitary sewer prohibited
	Priority of stormwater management problems originating within the Town
INSTITUTIONAL MANAGEMENT	
1. Need for Public Awareness	Promote public awareness
	Use community based approach
	Solicit stakeholder input in planning and management
	Stormwater to be managed on a watershed base and coordinated with appropriate regulating agency
	Town to be responsible for the resolution of problems within its boundaries
	Ponds and wetlands in public ownership
2. Update Standards	All agencies to adhere to the guidelines and strategies
FUNDING MANAGEMENT	
1. Budget Limitations	Dedicated funding to finance SWM initiatives
	Establish capital and operating budgets
	SWM solution to be cost effective and affordable
2. Resource Allocation and Cost Recovery	Owners/proponents to be responsible for the cost of SWM including 30-year maintenance program
	Review all projects for consistency with policies
	Pursue pricing techniques to encourage innovation

3.5 INTERIM STORMWATER MANAGEMENT DESIGN CRITERIA

3.5.1 Introduction

Ideally all Stormwater Management design criteria should be based on recommendations developed as part of a comprehensive Stormwater Management Strategy Plan or a set of Subwatershed plans prepared for the watershed. The Plan when completed would incorporate the results of the hydrologic information and flood plain mapping generated to date and the results of future environmental and land use studies of the Ingersoll watersheds. The purpose is to identify those areas that should be protected and preserved, so that the impact of future land use changes can be evaluated.

Until the completion of the Stormwater Management Strategy Plan for the Town, it is recommended that a set of interim design criteria based on information collected to date and on criteria selected by other Southern Ontario municipalities be used. The adoption of this unified approach, applicable within the Town's watersheds, (preferably should apply to areas outside the Town's municipal boundaries) would ensure that the design of stormwater management practices would meet the flooding, water quality, erosion control and groundwater recharge policies.

Table 3. Summary of Design Criteria

Control	Criteria	Comments
Flood and water quantity control	Control peak discharges from the 2, 5, 25, 50, 100 and 250-year storms to pre-development rates	• Should consider the cumulative effects of development and controls. • 24 hour storm effect to be evaluated when sizing facility volume Duration of storms used for pre-development calculations may be less than 24 hours, depending on the watershed characteristics
Water quality	Volume control for storage facilities, or control of a volume of water for a minimum 24 hours from a 25 mm rainfall	• Compute storage from MOE Manual or generate hydrographs for the single event design storm
Stream channel erosion	Control of peak flows and runoff volume	• Detailed, simplified or distributed runoff control method • 24 hour-48 hour extended detention of post-development 25 mm storm event. • Bank protection for a 25 mm runoff peak flow
Baseflow	Infiltrating the first 5 mm rainfall	• Where feasible, the pre-development hydrologic cycle components should be maintained.

3.5.2 Design Criteria for Water Quantity Control

The intent of quantity control is to prevent the increased damages from large storm events, to maintain the flood plain limits in existing development areas, and to protect the physical integrity of stormwater management facilities.

Ideally, watershed or subwatershed studies should evaluate requirements for post-development water quantity controls based on the potential cumulative impacts of development and potential flood hazards. Where such studies do not exist, requirements for water quantity control should be based on potential downstream flooding hazard. Generally, the criteria are to control post-development peak flows for the 2, 5, 25, 50, 100 and 250–year storms to pre-development levels. The selection of the design criteria should be based on the receiving system characteristics, such as:

- Capacities of downstream hydraulic structures. (Consideration should be given also to MTO Directive B-100 which describes culvert and bridge design criteria for different types of road crossings);
- Storm sewer capacities, based on the Town's design criteria;
- Municipal drain capacities determined from Drain Assessments; and
- Control of the 2 to 100-year or 250-year post-development flows to pre-development level. Depending on the downstream conditions over-control may be required

The selection of the storm duration to be used for the design event should be based on the drainage characteristics of the watershed, such as the physical characteristics: size, shape, length and slope, land use, and soil type and percent impervious area.

For sizing wet ponds and constructed wetlands, a 24-hour duration event should be selected, as shorter rainfall durations may under-estimate design runoff volumes and associated storage volume requirements. For pre-development target flows used in the sizing, shorter duration events, such as 6 and 12 hour durations should be tested.

Hydrographs for the individual return period events should be generated by hydrologic models using the London Airport gauge Intensity-Duration-Frequency data.

3.5.3 Design Criteria for Water Quality Control

Maintenance of healthy aquatic ecosystems requires that pre-development water quality be maintained and where feasible enhanced. The goal is to restore, protect and enhance water quality and associated aquatic resources and water supplies of the receiving watercourse. This goal mandates the prevention of contamination of streams and lakes from urban runoff containing nutrients, pathogenic organisms, organic substances, heavy metals and toxic substances.

Similar to the quantity criteria, water quality criteria should be based on the premise that where feasible the post-development water quality should be similar to the pre-development water quality.

The selection of water quality criteria is influenced to a great extent by the receiving system environment. Protection of receiving waters from impacts of sediments generated by urban development construction and post construction periods have been recommended by most provincial and municipal agencies across the North American continent. In Canada the Federal Government prepared guidelines on the potential impacts of sediment on aquatic organisms and their habitat.

In controlling the pollutant efficiency of a stormwater management facility, it is recommended that TSS (total suspended solids) be adopted as a primary indicator. As a rule of thumb, when rural land use becomes urbanized, the resulting runoff could double. At the same time the TSS loads from urban land uses are twice as high as from rural land uses. Therefore, the combined effect could be a fourfold increase in the TSS loads caused by urbanization. To match the pre-urbanized TSS loading, the selected BMP should reduce the post-development load by approximately 75%. Wet ponds and constructed wetlands are capable of removing 80% of TSS or higher.

The water quality design criteria selection should start by assessing the state of the environment in the downstream receiving water bodies. There are two alternative indicators of the downstream water quality that could be considered in the selection of design criteria: 1) aquatic habitat, and/or 2) the nutrient concentration in the receiving system.

For the first alternative indicator, consideration should be given in the selection of design criteria to the potential effects of urban runoff on the aquatic habitats of the receiving system streams and lakes. A simple classification based on Provincial and Federal documentations is presented in ***Table 4*** to describe the downstream habitat. It is recommended that for the interim the Enhanced category should be used as a water quality criterion for all Ingersoll watercourses.

Table 4 Classification of Downstream Habitat

Category	Aquatic habitat	Type of species	Suggested TSS control
Enhanced	***Cold water fishery***	***Salmonids, aquaculture***	***80%***
Normal	Warm water fishery	Perch, minnows, suckers and urbanized lakes	70%
Basic	No existing or prospect of future habitat	Habitat in ditches, intermittent streams, stream with blockage	60%

Where body contact recreation, aesthetic or other uses require the control of nutrients entering the receiving system, it is recommended to adopt TP removal as an alternative or as an additional primary design criterion indicator. The following general relationship exists between TSS and TP removal rates:

TSS %	TP %
80	50
70	45
60	35

Just as comprehensive watershed studies may address flood control requirements based on cumulative effects of multiple developments, nutrients loading and trophic status modelling may be required to determine TP removal requirements. Such studies may even identify linkages between nutrient levels and fish habitat as excessive algae and plant growth can result in depletion of dissolved oxygen as plant material decomposes.

The second alternative indicator to assess receiving system impacts is the health on existing or potential future aquatic habitat. Impacts on this health can be measured by the relative changes in in-stream concentration or by the severity of impacts due to sediment concentration and duration of exposure.

Researchers on fish and exposure to increase in sediment concentration identified the phenomenon that most species of fish can withstand higher exposure of elevated levels of TSS, but impairment will occur when sediment exposure increases beyond threshold values which are a function of both the sediment concentration and its duration. According to Ward (1992) sediment concentration in the receiving stream below 25 mg/L would result in few ill effects regardless of the duration. For typical runoff events lasting less than 4 hours, moderate impacts would occur at about 200 mg/L. For duration of more than 10 hours, a concentration of 1,000 mg/L could result in major impacts.

When managing runoff for water quality impacts, the control of more frequent and smaller rainfall events are selected. This approach is based on the fact that the percentage of annual precipitation for very large events is relatively small, and the construction cost of storage facilities based on extreme rainfall events would be prohibitive. This approach provides partial benefit for larger storms as it can continue to control pollutants from the first portion of the larger storm's runoff.

The water quality criterion has two components. For large-scale greenfield developments where storage facilities are used to control the post-development water quality, a volume criterion is recommended based on the Ministry of Environment Stormwater Management Design Manual recommendations. For stormwater Best Management Practices other than storage facilities, runoff from a 25 mm rain is used to control the peak flow.

Water quality control facilities use primarily sedimentation processes to remove pollutants, through settling and/or filtering. Particulate pollutants such as sediment and metals are relatively easy to remove, while soluble pollutants such as nitrates and phosphates are more difficult to remove. A volume generated by a relatively low rainfall and runoff water quality design event

generally defines the detention volume requirement for a BMP with a storage facility. Design criteria for stormwater management facilities that permit runoff to flow-through a filtration or settling system, such as infiltration basins is related to flow rates and velocities.

The two alternative water quality design criteria suggested for the interim period:

- The water quality **volume for sizing storage facilities** should be determined from the tables provided in the MOE Stormwater Management Practices Planning and Design Manual (2003).
- For **flow-through facilities a peak flow** criterion should be adopted based on a statistical analysis of local precipitation data. It is recommended that a 25 mm rain event should be used to estimate the design peak flow generated by the proposed land use.

3.5.4 Design Criteria for Erosion Control

The preferred approach for addressing erosion concerns is at the watershed/subwatershed planning level. At that time pre and post-development exceedance erosive index values are computed for a watercourse to determine the need for and the magnitude of erosion control measures.

To select the erosion criterion when no such information is available, it is recommended to review the results of the UTRCA erosion/geomorphology study of channel conditions downstream of the proposed development to assess the potential effects of post-development flows, water levels, and velocities on erosion.

The selection of the proper approach for bank protection measures requires the establishment of a geomorphology strategy, including the definition of specific project needs and priority locations. The selection should also include a review of the flow control or in lieu contribution alternatives, before making the final recommendation.

The traditional approach to control erosion is based on the control of peak flow rates, by reducing the post-development peak flow for specified storm to the pre-development flow rate for the same storm. Frequently, in Ontario the two-year storm or a 25 mm, 4-6 hour event based on the Chicago distribution is adopted as the design criterion.

In the 2003 edition of the Ontario Stormwater Management Planning and Design Manual the following three design approaches are presented, each aimed to overcome the limitation of the simple traditional approach:

1. Detailed approach used for sensitive morphology and habitat conditions in a receiving system;
2. Simplified approach generally used for development areas under 20 ha, and for receiving streams with shallow bankfull depth, and
3. Distributed runoff control approach used to design outlet control for storage facilities.

Depending on the size of development, receiving system sensitivity, and geomorphology conditions, the detailed approach would be recommended for the Ingersoll watercourses.

For stormwater management facilities other than wetpond/wetland, the analysis of downstream channel conditions should determine the need for flow control or erosion protection requirements based on velocities and erosive forces.

3.5.5 Recharge and Base Flow Maintenance

The importance of recharge is dictated by the fact that water supply for the area is drawn from groundwater sources. The need for providing groundwater recharge at a particular site will depend on the use of local aquifers. Where there is a potential risk of adversely affecting groundwater supply (quantity or quality) in the area, or the risk of reduction in base flow, the recharge from a proposed development should attempt to match the pre-development recharge. The pre- and post-development recharge can be estimated by a simple computation of the hydrologic cycle components.

Infiltration through stormwater management facilities can provide groundwater recharge by diverting runoff from small and moderate storms into an infiltration facility. An additional benefit is derived by providing opportunities for a number of physical, chemical and biological processes that remove pollutants from the recharge water. A general guideline for recharge and base flow maintenance is to capture where feasible the first 5 mm of rainfall. However, this 5 mm rainfall could not be used as a storage requirement credit.

3.5.6 Infill Areas and Retrofits

Stormwater management in infill areas requires a special consideration when selecting design criteria and suitable alternative stormwater Best Management Practices (BMPs). Generally, small infill areas provide limited opportunity to introduce many of the alternative BMPs. For infill areas in excess of 5 ha normally there should be more opportunity to introduce other alternative BMPs. Although the development of a relatively small infill area may not have a significant impact, the development of several individual sites can have a significant cumulative effect on the watershed.

Infill developments with no stormwater management facility should be discouraged. As a minimum criterion, a 5 mm rainfall event should be retained at the site. Only where on-site control may be ineffective or impractical because of physical constraints, off-site control should be considered. In some circumstances the Town could request financial contribution toward the development of a stormwater management facility at another location, preferably in the same watershed.

Only infill developments consisting of one residential lot discharging into an existing storm sewer (not combined) should be permitted to proceed without any BMPs, other than basic good housekeeping measures.

When considering the need for stormwater management for infill areas, a number of factors have to be assessed:

- Proposed land use;
- Infrastructure capacity;
- Opportunities of retrofitting existing stormwater management systems; and
- Site conditions, such as soil percolation level, slopes, vegetation, aquifer and bedrock location.

Retrofitting is the process by which older runoff control structures constructed prior to the introduction of BMPs designed to control flooding only are modified to serve a water quality improvement function as well. Retrofitting can improve the multi-use function (flood peaks, velocities, pollutant loadings) and appearance of existing facilities, enhance the useful life of the BMP, and reduce the operation and maintenance costs. In some instances retrofitting could also be considered to improve an existing water quality BMP.

Opportunities to retrofit can exist at the source, for example roof top storage on flat roofs, with or without vegetated cover, dry wells or below ground detention facilities.

Detention basins provide another opportunity for retrofitting. Basins designed primarily for flood protection can be retrofitted to provide additional benefits by providing extended detention with permanent pool in place to control the outflow and to incorporate forebays at the inlet and outlet for enhanced settlement of suspended solids.

Infiltration measures can be introduced where soil permeability and groundwater depth are sufficient at locations such as medians, parking area and roadside swales.

4. HYDROLOGIC MODELING OF LOCAL WATERCOURSES

The following is a summary of the model selection and the various input data used in the hydrologic modeling to estimate flows.

Selection of Model

At present time, hydrologic modeling techniques fall short of a universal model that can be recommended for all applications. Prior to undertaking a hydrologic modeling task, it is standard practice to consider alternative models before adopting a particular model for a given application. The following procedure was adopted for the model selection:

- Define the problem to be analyzed and identify the information required;
- Identify available models and assess whether the watershed characteristics represented by the model parameters govern watershed response for the intended application;

- Determine the watershed and hydrometeorology data required by the model is available;
- Specify the required performance of the model, such as accuracy of flows;
- Estimate data preparation requirements and costs;
- Review acceptance of model by agencies and familiarity of client's staff with the model; and
- Rate candidate models and select the most appropriate.

Based on our past experience, a short list of models was prepared consisting of OTTHYMO, OTTSWM, GAWSER and MIDUSS. Following a review of the list of models the Visual OTTHYMO model was selected in consultation with the Town and the Conservation Authority staff.

Surface Water Drainage

Input data for the modeling was based on topographic mapping based on 5 m contour intervals for areas outside the Town, and 0.5 m contours within the Town, to delineate the watershed and subwatersheds.

There are five main subwatersheds draining the study area (see ***Figure 2***), three from the north of the Thames River: Baxter, Murphy and Sutherland Creeks. From the south, two named subwatersheds drain to the Thames River: Hall's and Whiting Creeks as well as four additionally evaluated small tributaries marked A, B, C, and D. The origins of the five named watersheds are located outside the boundaries of Ingersoll. ***Table 5*** lists drainage areas of the five major subwatersheds

Table 5. Subwatershed Drainage Areas

Watercourse	Location	Drainage area – km²	Drainage area within the Town
Baxter Creek	Town limit	10.94	8%
	Thames River	11.90	
Murphy Drain	Town limit	1.51	24%
	Thames River	2.00	
Sutherland Creek	Town limit	3.99	20%
	Thames River	5.00	
Hall's Creek	Town limit	19.24	14%
	Thames River	22.45	
Whiting Creek	Town limit	7.15	30%
	Thames River	10.25	

Land use and Natural Heritage

Land use in the three northern and two southern subwatersheds are identified on ***Figures 3a and b.*** The enlarged portion of the watersheds located within the Town is shown separately on ***Figures 4a and b.*** The maps also identify the numerous small catchments used in setting up the

Ingersoll Hydrologic Model Key Plan

Legend

- Creek
- Roads
- Watershed
- Sub-Watershed
- Wooded Area
- Wetlands
- 300 Storm Sewer
- H63 Individual Minor System Basin
- Hall's Creek Tributary Area
- Whiting Creek Tributary Area
- Baxter Creek Tributary Area
- Murphy Creek Tributary Area
- Sutherland Creek Tributary Area

Baxter Creek
Murphy Creek
Sutherland Creek
Tributary A
Tributary B
Whiting Creek
Hall's Creek
Highway 401
Dundas Street
Victoria Street
King Street West
King Street East
Bell Street
Clark Road
Road 66
Road 64
North Town Line
Curry Road
Sweaburg Road
Jordan Line
Foldens Line
Plank Line
Union Road
Salford Road
Duffy Line
Dereham Line
Thames Street South
Pemberton Street
25th Line
27th Line
31st Line
33rd Line
35th Line

0 125 250 500 Meters

0 375 750 1,500 2,250 3,000 Meters

0 125 250 500 750 1,000 Meters

Project No: 04-4019	Designed By: C.S.
Figure No.: 2	Drawn By: C.S.

DILLON CONSULTING

TOWN OF INGERSOLL

N
W E
S

Baxter Creek

Murphy Creek

Sutherland Creek

B01
B02
B03
B04
B05
B06
B07
B08
B09
B10
B11
B12
M01
M02
M03
S01
S02
S03
S04
S05

23rd Line
25th Line
27th Line
31st Line
33rd Line
35th Line
Dundas Street
Road 66
Road 64
North Town Line
Hwy 401

Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sub-Watershed

Land Use

- Agricultural
- Commercial
- Development Area
- Institutional
- Industrial
- Medium Density Residential
- Rural Residential
- Open Space

Source: County of Oxford

Figure 3A: Existing Land Use - Major System - North

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 2,000 Meters

N
W E
S

TD
H13
H09
H12
W08
H10
H11
H07
H08
TA
W07
W06
TB
W05
H05
Curry Road
Hwy 401
Foldens Line
Sweaburg Road
H03
Jordan Line
TC
W04
H06
Hall's Creek
W03
Plank Line
Union Road
H02
Whiting Creek
Hwy 401
Duffy Line
H04
W01
Salford Road
W02
H01
Culloden Line
Dereham Line
Plank Line

Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sub-Watershed

Land Use

- Agricultural
- Commercial
- Development Area
- Institutional
- Industrial
- Medium Density Residential
- Rural Residential
- Open Space

Source: County of Oxford

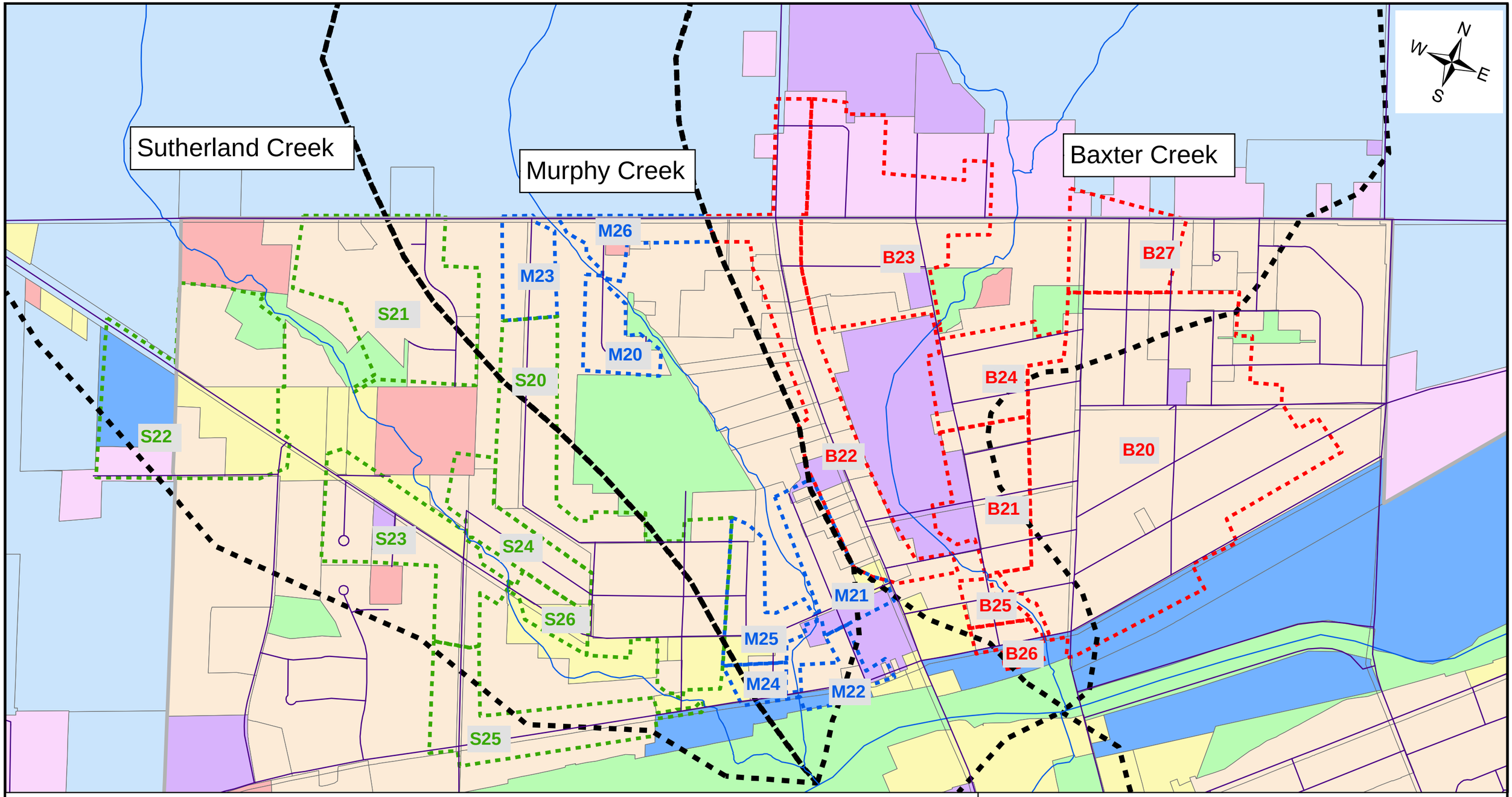
Figure 3B: Existing Land Use - Major System - South

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 2,000
Meters



Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sutherland Subwatershed
- Murphy Subwatershed
- Baxter Subwatershed

Land Use

- Agricultural
- Commercial
- Development Area
- Institutional
- Industrial
- Medium Density Residential
- Rural Residential
- Open Space

Source: County of Oxford

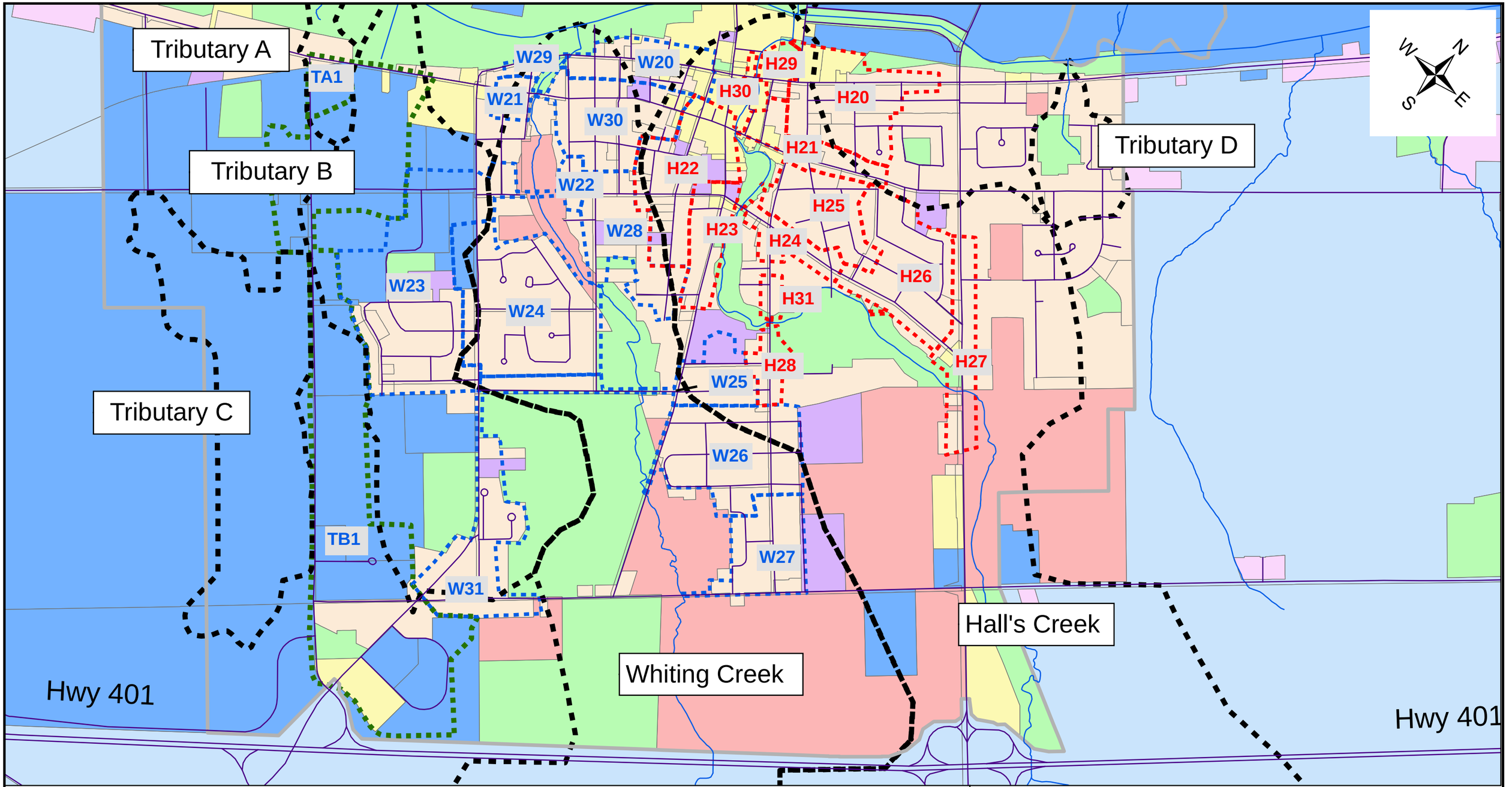
Figure 4A: Watersheds - Minor System - North

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 125 250 500 750 Meters



Legend

- Roads
- Creek
- Town Limits
- Watershed
- Whiting Subwatershed
- Hall Subwatershed
- Tributary A & B

Land Use

- Agricultural
- Commercial
- Development Area
- Institutional
- Industrial
- Medium Density Residential
- Rural Residential
- Open Space

Source: County of Oxford

Figure 4B: Watersheds - Minor System - South

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1 , 2007

DILLON CONSULTING

0 250 500 1,000 1,500 Meters

model. Generally, the entire area beyond the Town limits is made up of agricultural lands. The areas within the Town's boundary include commercial, institutional, industrial, residential and rural residential land uses.

The model also reflects the impact of small wooded areas and wetlands on flows located within subwatersheds. These natural heritage features within the three northern and two southern subwatersheds are identified on ***Figures 5 a and b.*** The enlarged portion of the subwatersheds located within the Town is shown separately on ***Figures 6a and b.*** The maps also identify the numerous small catchments used in setting up the model.

For the major and minor system delineation aerial photos and storm sewer plans were used. Slopes and channel lengths were calculated using topographic maps. Cross sections for areas outside the Town boundaries were provided by the UTRCA, for areas inside the Town, topographic maps were used.

Imperviousness and directly connected imperviousness were estimated from land use maps and aerial photos. The parameters used in the model are presented in ***Table 6.***

Table 6. Percent of Imperviousness Assumed in the Hydrological Model

Land Use	Imperviousness	Directly connected Imperviousness
Agricultural/Open Space	0	0
Rural/Estate Residential	15	10
Medium Density Residential	45	30
Commercial	95	90
Industrial/Institutional	30	20

Climate

There is no long–term weather station located in the Ingersoll area. For characterizing the Ingersoll climate data collected at the London Airport long-term weather station was used. In addition the Reference Manual for the Precipitation Design Events in the Upper Thames River Watershed, prepared by Wood and Goldt and released in December 2004, provided valuable input to the model.

The long-term average temperature and precipitation data for the London Airport station compiled by Environment Canada is shown in the ***Appendix C***.

For the hydrologic modeling the London Airport 24 hour rainfall intensity-duration-frequency data was adopted, based on the Chicago design storm distribution. A second hydrological model was developed based on the 1-hour AES design storm concept, which gave smaller flows and were not used in any further analyses.

N
W E
S

Baxter Creek

Murphy Creek

Sutherland Creek

B01
B02
B03
B04
B05
B06
B07
B08
B09
B10
B11
B12
M01
M02
M03
S01
S02
S03
S04
S05

23rd Line
25th Line
27th Line
31st Line
33rd Line
35th Line
Dundas Street
Road 66
Road 64
North Town Line
Hwy 401

Legend

- Roads
- Creek
- Town Limits
- Wooded Area
- Wetlands
- Watershed
- Sub-Watershed

Source: County of Oxford

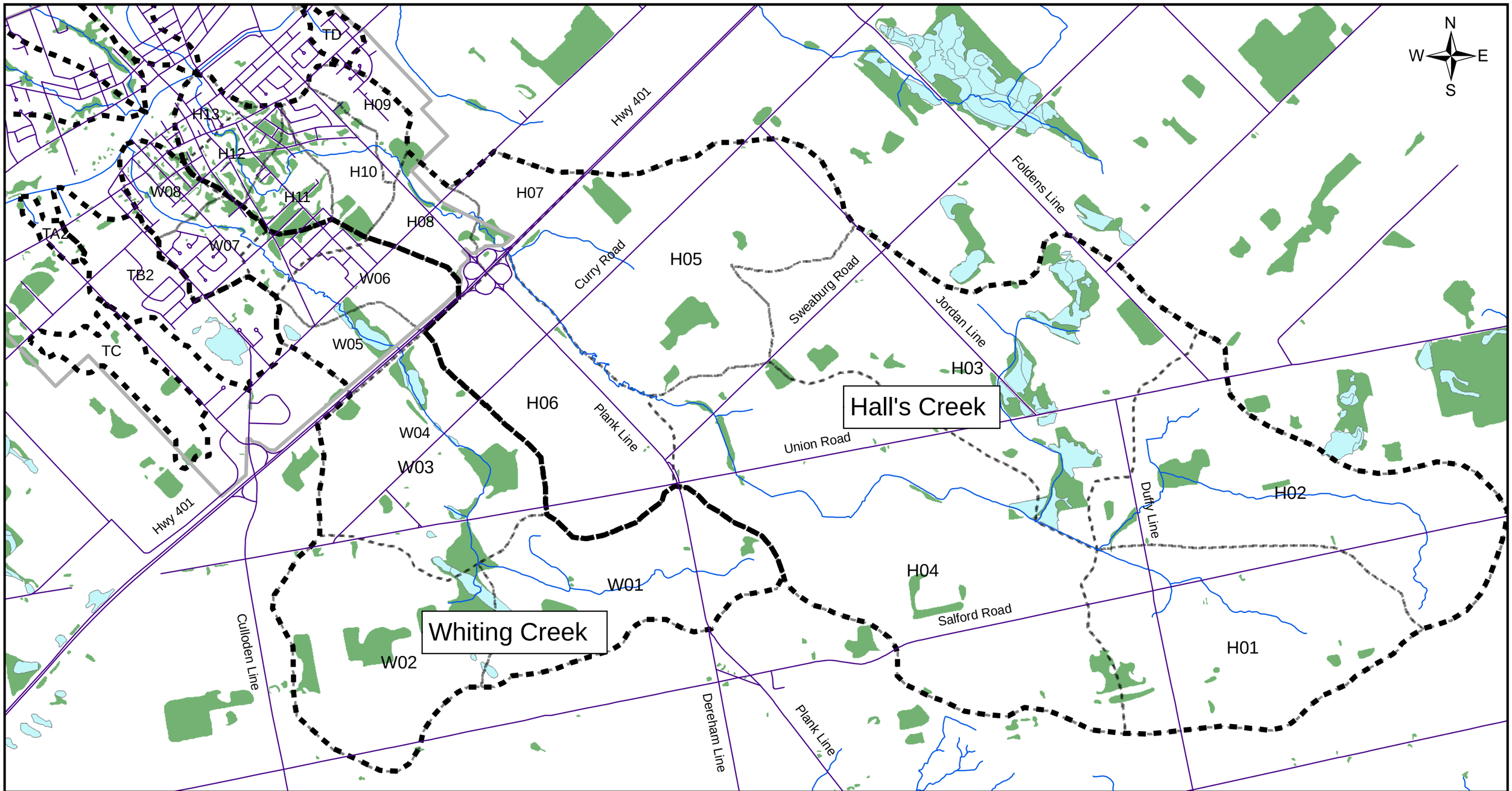
Figure 5A: Natural Heritage - Major System - North

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 2,000
Meters



Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sub-Watershed
- Wetlands
- Wooded Area

Source: County of Oxford

Figure 5B: Natural Heritage - Major System - South

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 2,000 Meters

Sutherland Creek

Murphy Creek

Baxter Creek

N

W

E

S

M26

M23

M20

M25

M24

M22

M21

S21

S20

S22

S23

S24

S26

S25

B23

B27

B24

B22

B20

B21

B25

B26

Legend

- Creek
- Roads
- Town Limits
- Wetlands
- Wooded Area
- Sutherland Subwatershed
- Murphy Subwatershed
- Baxter Subwatershed

Source: County of Oxford

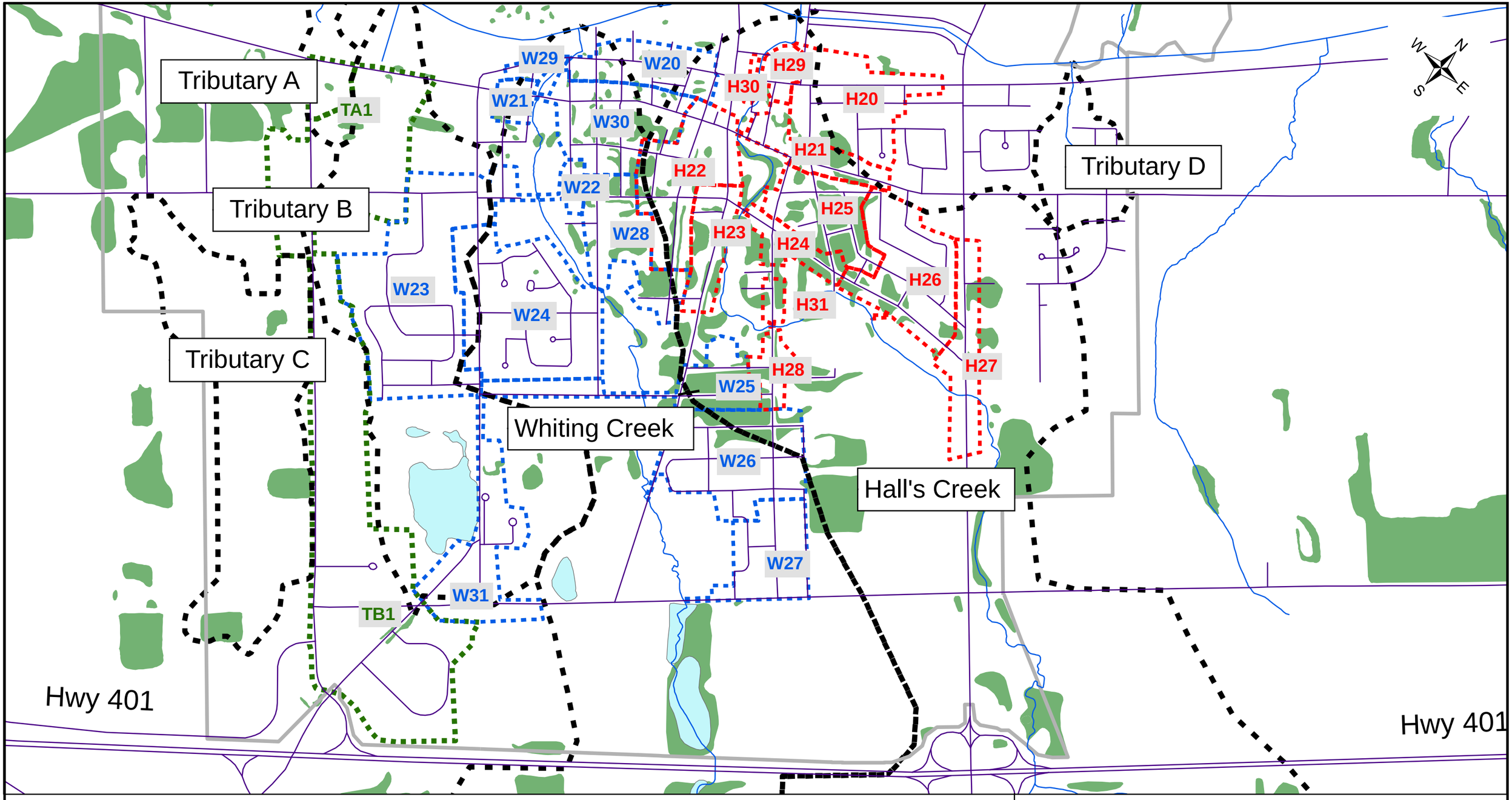
Figure 6A: Natural Heritage - Minor System - North

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 125 250 500 750 Meters



Legend

- Creek
- Roads
- Town Limits
- Wetlands
- Wooded Area
- Watershed
- Whiting Subwatershed
- Hall Subwatershed
- Tributary A & B

Source: County of Oxford

Figure 6B: Natural Heritage - Minor System - South

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 Meters

The 24-hour total rainfall values for the 2, 5, 10, 25, 50, 100 and 250-year storms required by the model were generated from the Intensity-Duration-Frequency curve parameters published in the Reference Manual. The resulting 24-hour values are listed in ***Table 7*** below including the July 9th 2000, 24-hour total rainfall is also shown for comparison.

Table 7. Rainfall Data used in the Modeling

Frequency-year	Total rain - mm	Frequency-year	Total rain - mm
2	51.56	50	99.98
5	63.34	100	111.59
10	73.97	250	114.02
25	89.53	July 9th, 2000	171.00

Surficial Soils

The Town is located in a glacial spillway valley. On the north the three watercourses drain part of the Oxford Till plain. From the south, the two watercourses drain part of the Ingersoll Moraine. ***Figures 7 a to b*** describe the surficial soil classifications of the five subwatersheds used in the hydrologic modelling. Surficial soil mapping was only available for areas outside the Town, for the Town portion of the subwatersheds surficial geology data shown on ***Figure 8 a and b*** was used. The majority of the subwatersheds are classified as type B, with small pockets of type C soils, located mainly in the headwaters of Hall's and Whiting Creek. CN* numbers used for the different soil and land use groups are summarized in ***Table 8.***

Table 8. Summary of CN Numbers Used in the Modeling*

Land Use	CN* for Hydrologic Soil Group			
	A	B	C	D
Lawns. Open Spaces	39	61	74	80
Urban Wooded Area	25	55	70	77
Farmland (Poor hydrologic conditions)	72	81	88	91
Farmland (Good hydrologic conditions)	67	78	85	89
Rural Wooded Area with:				
Poor hydrologic conditions	45	66	77	83
Fair hydrologic conditions	36	60	73	79
Good hydrologic conditions	25	55	70	77

A more detailed list of input parameters used in the model together with the computer output data is provided in digital format in ***Appendix D*** (pocket at the back of the report).

N
W E
S

Baxter Creek

Murphy Creek

Sutherland Creek

B01
B02
B03
B04
B05
B06
B07
B08
B09
B10
B11
B12
M01
M02
M03
S01
S02
S03
S04
S05

23rd Line
25th Line
27th Line
31st Line
33rd Line
35th Line
Dundas Street
Road 66
Road 64
North Town Line
Hwy 401

Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sub-Watershed

Hydrologic Soil Group

- No Information
- A
- B
- C
- D

Source: County of Oxford

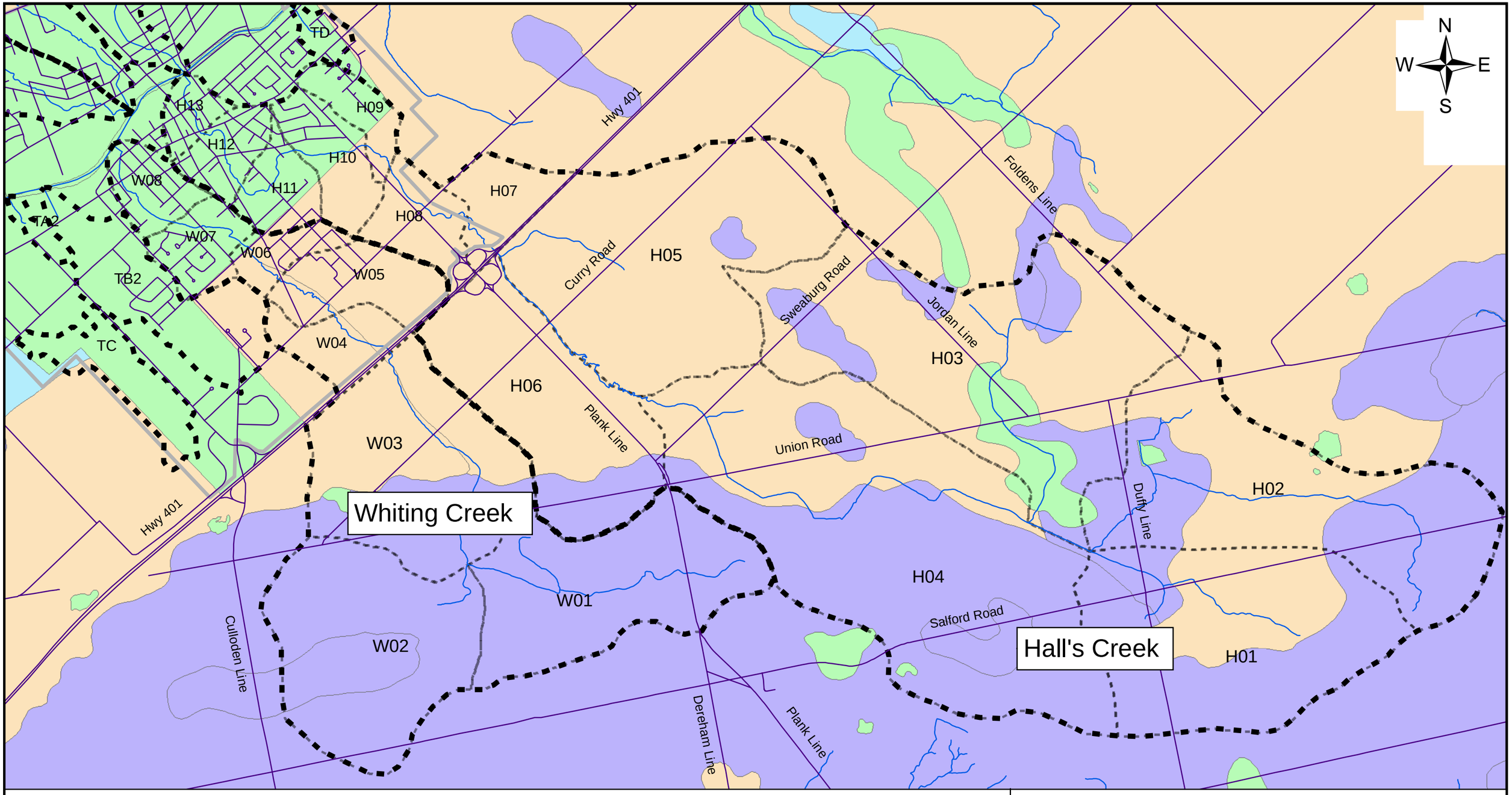
Figure 7A: Surficial Soils - Major System - North

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 2,000
Meters



Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sub-Watershed

Hydrologic Soil Group

- No Information
- A
- B
- C
- D

Source: County of Oxford

Figure 7B: Surficial Soils - Major System - South

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 250 500 1,000 1,500 2,000 Meters

Sutherland Creek

Murphy Creek

Baxter Creek

N

W

E

S

M26

M23

M20

S21

S20

S22

B23

B27

B24

B22

B20

B21

S23

S24

M21

B25

S26

M25

B26

M24

M22

S25

Legend

- Roads
- Creek
- Town Limits
- Watershed
- Sutherland Subwatershed
- Murphy Subwatershed
- Baxter Subwatershed

Surficial Geology Classification

- A
- B
- C
- D

Source: County of Oxford

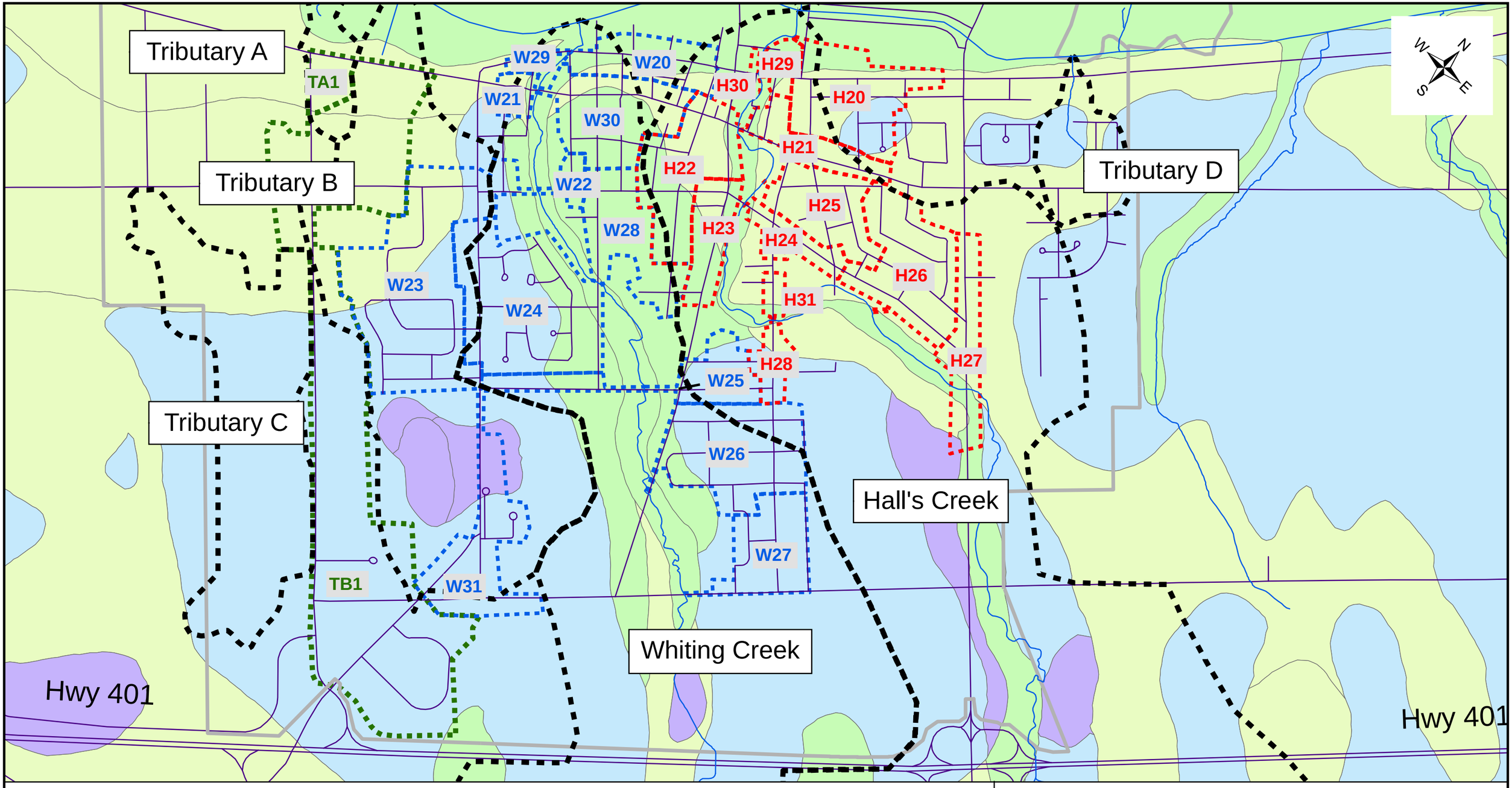
Figure 8A: Surficial Geology - Minor System - North

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

0 125 250 500 750 Meters



Legend

- Roads
- Creek
- Town Limits
- Watershed
- Whiting Subwatershed
- Hall Subwatershed
- Tributary A & B

Surficial Geology Classification

- A
- B
- C
- D

Source: County of Oxford

Figure 8B: Surficial Geology - Minor System - South

TOWN OF INGERSOLL

Drawn By: C.S.
Date: February 1, 2007

DILLON CONSULTING

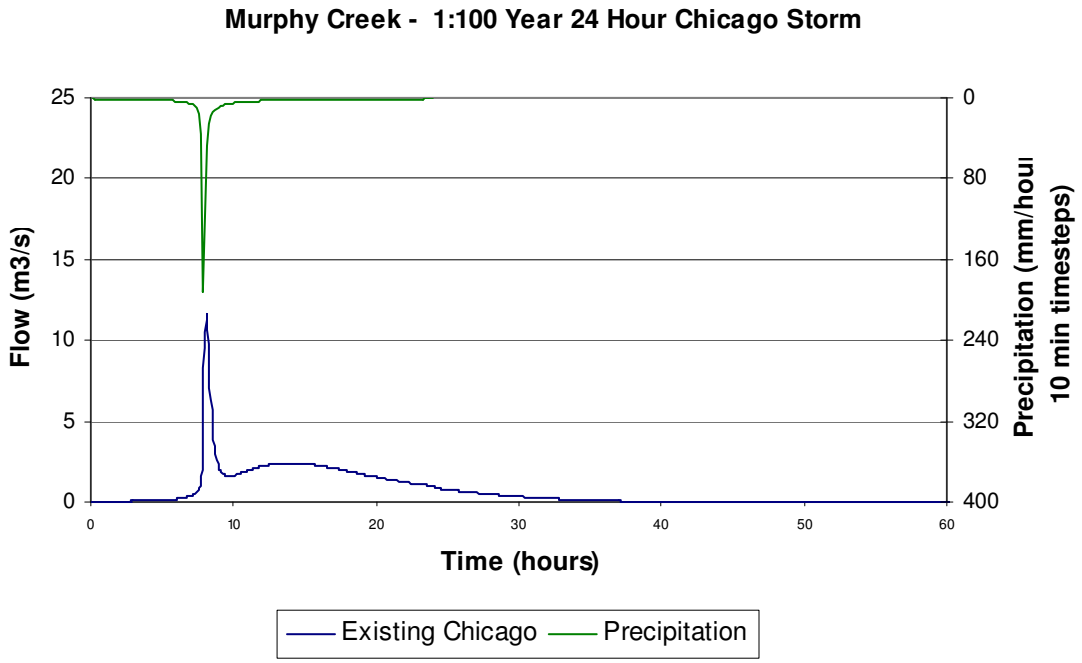
0 250 500 1,000 1,500 Meters

Modeling Results

The Visual OTTHYMO Version 2 model was used to generate flows. A schematic for the model setup is shown in the back pocket ***Attachment 1.*** Modeling was done for existing and future conditions. Results show that generally, the flows for the two land use scenarios were very similar, except for the Whiting Creek, but even there the increase in the future land use flows downstream of the Town boundary was only 15% over the existing land use flows. Printouts of the model output for existing and future conditions, for the 2, 5, 10, 25, 50, 100, and 250-year flows, based on the Chicago storm distribution, are presented in ***Appendix D***. An additional computer run carried out for the July 2000 storm for future development scenario is also attached in the same ***Appendix D***.

The unit flows (m^3/s per ha) are very similar for all watercourses, except for the smallest watershed Murphy Drain, which showed a peakier hydrograph than the other four watercourses. For example the 2-year unit area flows ranged from 0.4 m^3/s per ha. to 0.74 m^3/s per ha. for Hall, Sutherland, Whiting and Baxter Creeks. The 2-year unit flow for Murphy Drain is 1.45 m^3/s per ha. Similarly the 100-year unit area flows ranged from 1.8 m^3/s per ha. to 2.76 m^3/s per ha. for the four creeks, while the Murphy Drain 100-year unit area flow is 5.85 m^3/s per ha.

Plate 1 reproduces two examples of the computed hydrographs: for Hall's Creek with the largest drainage area and for Murphy Drain with the smallest drainage area. The hydrographs were generated by a 24-hour duration storm using the Chicago rainfall distribution based on 10-minute time steps. For small drainage areas like Murphy Drain the timing of the peak flow coincides with the peak rainfall. For larger drainage areas like Hall's Creek there is a 3-4 hour time lag between rainfall and hydrograph peaks. ***Appendix E*** includes the computed-hydrographs for the five main drainage areas in the study area for the entire range of design events.



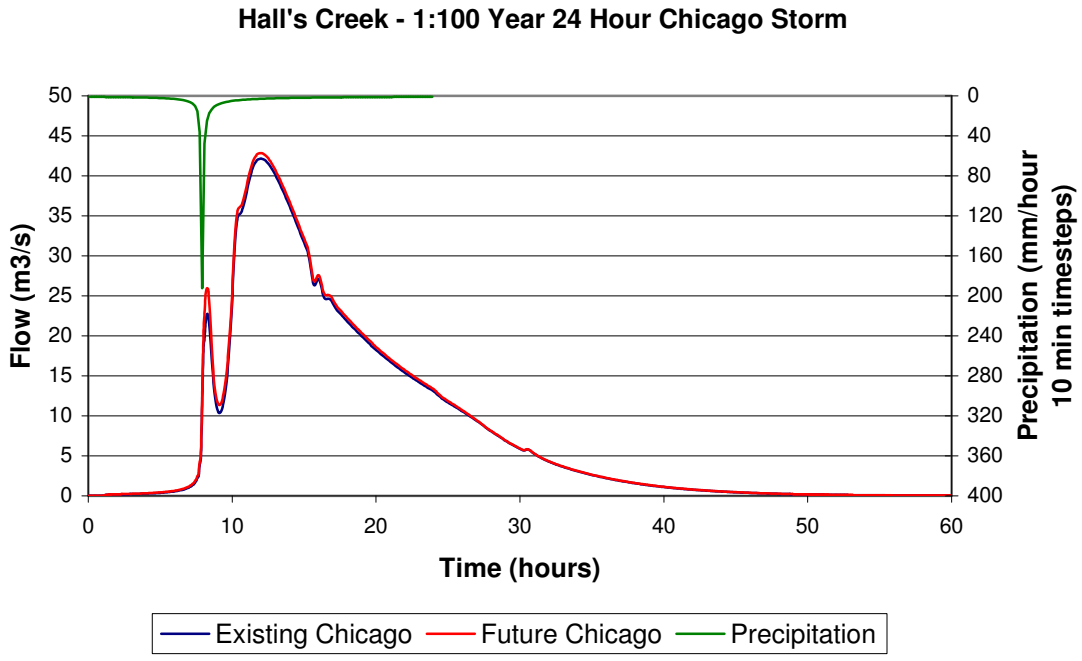


Plate 1. Murphy Drain and Hall's Creek 100-year hydrographs

Table 9 summarizes the peak flows for the 2, 5, 10, 25, 50, 100 and 250-year events predicted by the model at the outlet into the Thames River. As shown the difference between existing and future condition flows is small.

Table 9. Summary of Existing and Future Condition Flows at Thames River – m³/s

Watershed	Scenario	Storm Event						
		1:2 (m³/s)	1:5 (m³/s)	1:10 (m³/s)	1:25 (m³/s)	1:50 (m³/s)	1:100 (m³/s)	1:250 (m³/s)
Hall Creek	Existing	10.9	17.4	23.1	30.8	36.4	42.2	50.1
	Future	11.2	17.8	23.5	31.3	37.0	42.9	50.8
Whiting Creek	Existing	6.8	11.0	14.4	17.5	19.8	22.2	26.7
	Future	7.4	12.0	15.7	19.3	22.2	25.0	30.7
Sutherland Drain	Existing	3.9	6.7	8.7	10.8	12.6	14.5	17.9
	Future	3.7	6.3	8.3	10.4	12.0	13.8	17.0
Murphy Drain	Existing	2.9	5.0	6.6	8.6	10.1	11.7	15.1
	Future	2.9	5.0	6.6	8.6	10.1	11.7	15.1
Baxter Creek	Existing	5.8	9.6	12.4	16.0	18.8	21.8	27.0
	Future	5.8	9.6	12.4	16.0	18.8	21.8	27.0
Tributary A	Existing	0.3	0.5	0.6	0.7	0.9	1.0	1.1
	Future	0.3	0.5	0.6	0.7	0.9	1.0	1.1
Tributary B	Existing	6.1	9.2	12.2	15.1	17.3	19.5	22.5
	Future	6.1	9.2	12.2	15.1	17.3	19.5	22.5
Tributary C	Existing	4.5	7.3	9.1	11.2	12.9	14.5	16.7
	Future	4.5	7.3	9.1	11.2	12.9	14.5	16.7
Tributary D	Existing	0.8	1.2	1.6	2.0	2.3	2.6	3.0
	Future	0.8	1.2	1.6	2.0	2.3	2.6	3.0

July 2000 Storm

A comparison of the July 2000 storm event as recorded in Ingersoll with long-term rainfall data (63 years) recorded at St. Thomas is shown on ***Figure 9***. The London rainfall data set is based only on 43 years of records. It appears that the July storm was most severe over a 6 to 12 hour period, when it exceeded the 100-year St. Thomas rainfall data.

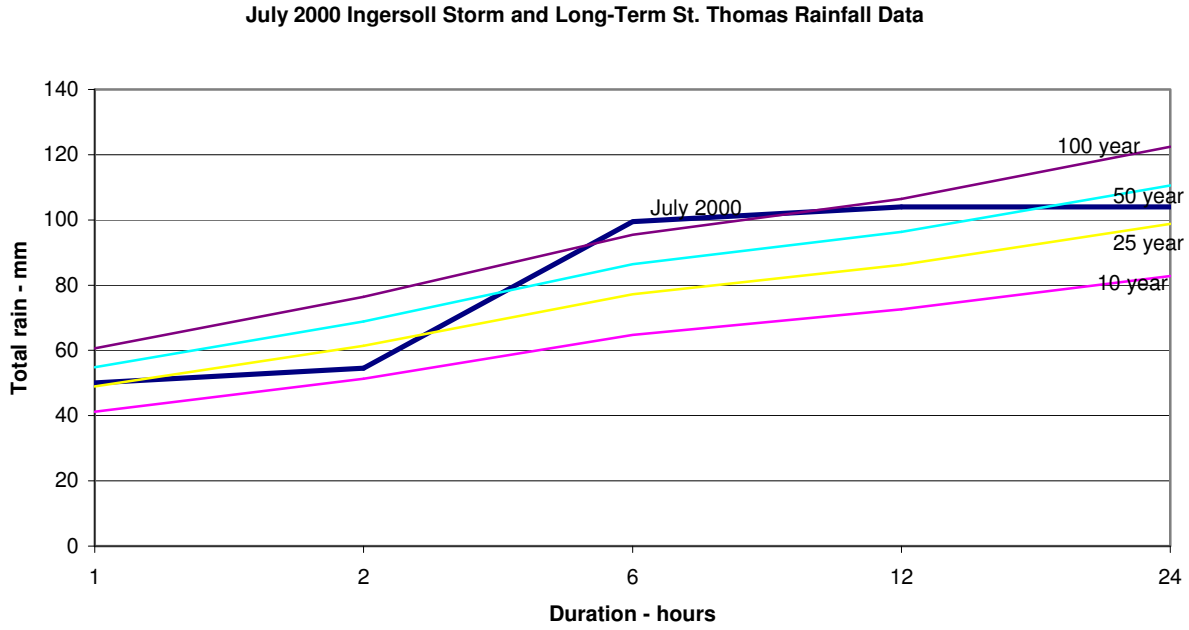


Figure 9. Comparison of Ingersoll July 2000 Rainfall and St. Thomas Historic Rainfall Data

The Conservation Authority extensively studied the July 9th 2000 storm that produced up to 175 mm rain within a 12-hour period, between St. Mary's and Woodstock. To model the flows generated by this severe storm, hourly rainfall data presented in the Conservation Authority Reference Manual was used the estimate the rainfall distribution for the Ingersoll area and was input to the Visual OTTHYMO model. ***Figures 10 a*** and ***b*** compare the severity of the July 2000 storm with computed return period events.

Figure 10a shows the drainage area-peak flow relationship for the five Ingersoll watercourses at the Town limit and at the Thames River outfalls for the July 2000 and for the 100-year events. As shown the July 2000 storm over the Ingersoll area generated smaller flows as the estimated 100-year flows. However, it is important to note that the return period of peak flow event does not necessarily equal the return period of the storm, which produced the runoff. Antecedent conditions prevailing at the time of the event can strongly influence the relationship between rainfall and runoff. To illustrate the severity of the July 2000 storm event, Hall's Creek flows for the 2 to 250-year events are compared on ***Figure 10b*** to the simulated the July 2000 peak flow.

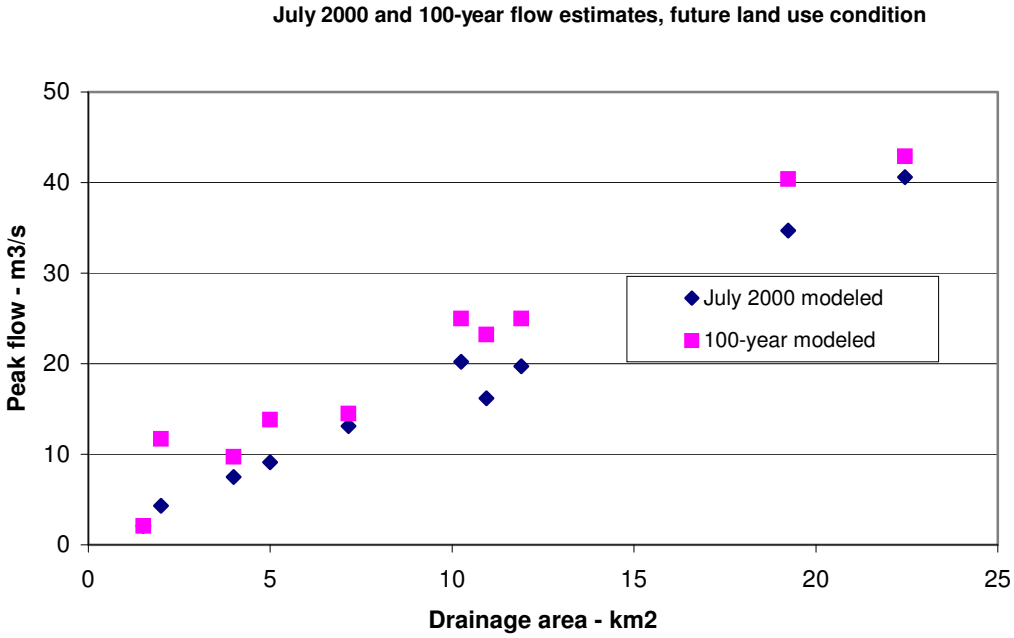


Figure 10a. Drainage Area – 250-year and July 2000 Simulated Flows in Ingersoll

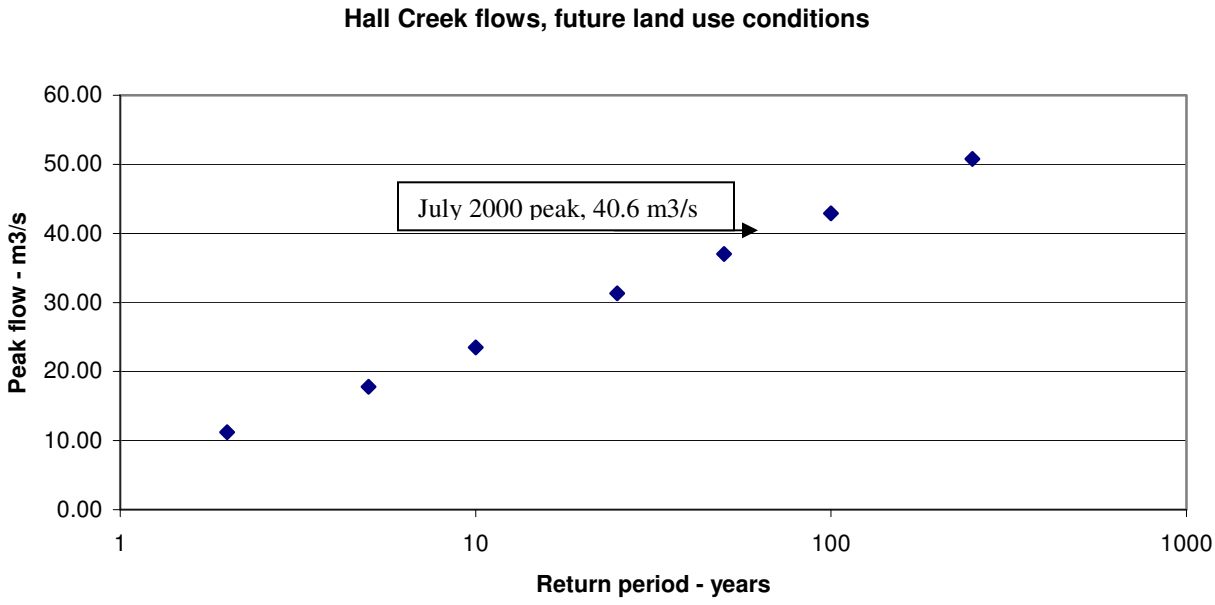


Figure 10b. Hall's Creek Flows for the 2 to 250-Year and July 2000 events

Modeling Conclusions

Five hydrologic models were set up for the five subwatersheds. Both existing and future land use scenarios were analyzed with the models, for the 2, 5, 10, 25, 50, 100 and 250 year events but the pre and post-development flows were very similar, except for the Whiting Creek watershed. The implication of these results is that future developments, with adequate runoff control would not increase the peak flows for the 2 to 250 - year flows. The 2 and 100-year event hydrographs for the five watercourses are reproduced in ***Appendix E.*** The proposed Ingersoll Stormwater Strategy Report will have to assess in more detail the water quality and other environmental impacts of future developments, to determine the required urban runoff controls.

Comparison of Modeled Flows with Flows Reported in the Past

Generally, the flows predicted by the Visual OTTHYMO model were similar to the flows computed in the past. ***Figure 11*** compares the 2 to 250-year future condition peak flows for Halls Creek estimated in four different reports. The Halls Creek flows reported by Stantec assumed existing land use conditions.

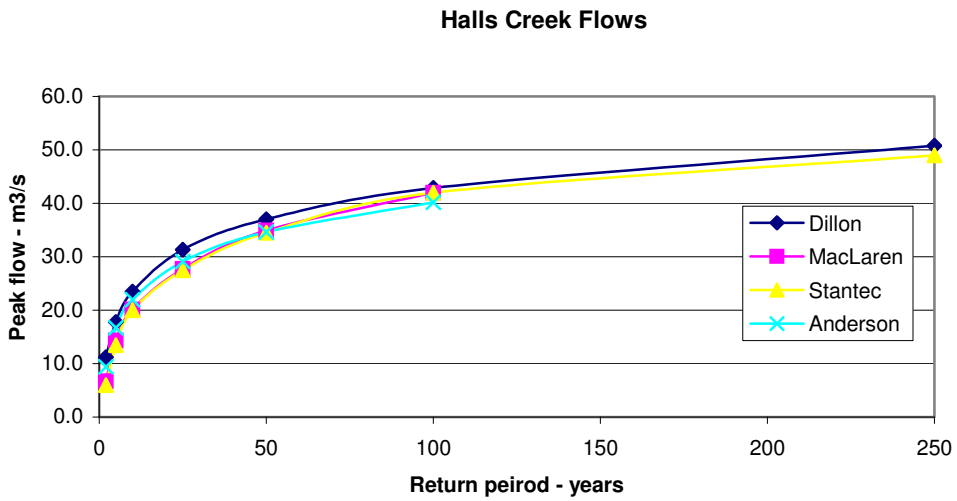


Figure 11. Comparison of Hall Creek Flows with Flows Reported in the Past

5. PUBLIC CONSULTATION

5.1 PUBLIC INFORMATION CENTRE

A public meeting was held on January 19, 2006 at the Ingersoll council chambers. The PIC was a drop-in centre format with handouts, display boards, and a video presentation of the study details. Dillon, UTRCA, and Town of Ingersoll staff were on hand to answer questions. As well, comment forms were provided to attendees.

Appendix F includes copies of:

- the PIC display boards and the power point presentation
- the attendance sheet (24 attendees)
- comment sheets provided
- PIC meeting notice and the contact list.

Several comments related to flooding and debris issues on the Sutherland Drain in the area of Wonham Street. Another comment related to the North Meadows SWMP's, noting that they do not appear to be functioning properly.

5.2 INGERSOLL TOWN COUNCIL PRESENTATION

On May 8, 2006, Dillon and UTRCA presented the findings of the Stormwater Management Strategy Study to Ingersoll Town Council. A copy of the presentation is included in ***Appendix G***.

6. STORMWATER MANAGEMENT STRATEGY IMPLEMENTATION

6.1 DEVELOPMENTS AND RE-DEVELOPMENTS

The following suggested implementation measures, applicable to both "Greenfield" and "Brownfield" developments and redevelopments, will confirm the Interim Stormwater Management Policies, and will permit future development to proceed in a manner, which harmonizes the community's need for housing, industry and services with the need for sustaining the long-term health of the environment.

The proposed implementation tasks for developments or re-developments should incorporate the data and findings of this Stormwater Management Strategy Study and be conducted in two phases. The main activities of the proposed study are outlined below. A more detailed list of tasks is presented in ***Chapter 5.3***.

Main Activities **Description of Main Activities**

Phase 1

1. Data collection	Purpose of data collection is to supplement the data collected during the previous Stormwater Management Strategy Study and the recently completed detailed groundwater studies. The collection and review of background information should include water quality, aquatic and terrestrial habitat conditions pertinent to stormwater management and not covered in the previous studies.
2. Field studies	Conduct field studies, reconnaissance and monitoring.
3. Data Assessment	Identify natural heritage features and ecological functions such as the hydraulic and hydrogeological functions to supplement the hydrologic process presented in the Stormwater Management Strategy Study.
4. Opportunities/constraints	Identify opportunities for protection and enhancement of the natural heritage features and ecological processes, and identify constraints to development.
5. Review Goals/Objectives	Review and update Interim Stormwater Management Goals, Objectives and Policies presented in the Stormwater Management Strategy Study.

Phase II

6. Technical assessments	Conduct technical assessments to establish how the natural system and the hydrologic processes based on the findings of the Stormwater Management Strategy Study would respond to land use changes.
7. Targets/constraints	Establish targets and constraints using information from the technical assessments.
8. Management strategy	Develop and evaluate management alternatives for the protection and enhancement of the natural features and ecological functions.
9. Implementation strategy	Develop an Implementation strategy to guide development that identifies recommended management works, responsibilities and commitments.

10. Documentation	Prepare and submit Draft report for review. Subject to comments by client, agencies and stakeholder, prepare and submit Final report.

Throughout the study period consult with stakeholders and the public.

6.2 ADDITIONAL FOLLOW-UP STUDIES

In addition to the above development related main activities, a number of general follow-up studies should be undertaken. Refinements to the Interim Policies could be achieved by undertaking follow-up studies listed below:

1. Establish the location, extent, significance and sensitivities of the existing streams, valleys and woodlands and ecological functions of groundwater recharge, water use, habitats, and stream corridors potentially affected by stormwater.

2. Identify specific opportunities for protection, enhancement and rehabilitation of the environment, and identify constraints to development by setting specific resource management objectives.

3. Determine the potential impacts on natural systems and hydrologic processes resulting from proposed changes in land use, such as increased flooding and erosion, water quality impairment, base flow reduction and habitat loss or disruption.

4. Identify stormwater management alternatives to mitigate the potentially adverse impacts of future development and develop a management plan that includes land use controls, areas to be protected or enhanced, the size, type and location of stormwater management facilities. To assist developers, designers and approval agency staff in the selection and design of stormwater management facilities, a Best Management Practices Design Guideline document should be prepared.

5. Develop an implementation strategy to guide development by identifying recommended management works, responsibilities and commitments required at subsequent stages of the planning and development process, necessary future studies and required monitoring and maintenance.

6. The existing inventory of stormwater management facilities should be completed and an asset management program should be developed for urban drainage infrastructures.

7. Based on the policy of applying erosion and sediment control to all developments, recommended in the Stormwater Management Strategy, erosion and sediment control Guidelines should be prepared, including effective QA/QC measures.

8. Based on the Institutional and Funding Management policies recommended in the Stormwater Management Strategy, an institutional and financial implementation plan should be prepared for the Town.

Future investigations into developing stormwater management policies for infill, retrofit, and redevelopment areas may also be required. As part of the investigation a long-term Growth Plan should be prepared for the Town and adjacent areas located outside the Town's present boundaries. Also, these future investigations will identify additional watercourses to be studied.

High priority should be given to the environmental investigations outlined in items 1, 2 and 3 above. Similar high priority is attached to item 4, dealing with stormwater management alternatives and the preparation of a BMP Guideline document. Although the rest of the eight items carry lower priority, all studies should be completed in the longer term to ensure orderly future development and the protection of the local and adjacent environment.

6.3 LIST OF MAIN ACTIVITY STUDY TASKS

Activity 1. Data collection

Task 1.1 Collect and review background information on aquatic resources: benthic-invertebrates, fish communities and fish habitat classification.

Task 1.2 Develop a field program to obtain additional information on aquatic resources.

Task 1.3 Collect data on woodlots, vegetation, animals, and linkages.

Task 1.4 Review background information with respect to geomorphology at a broad spatial and temporal scale to enable an understanding and synthesis of the recently completed studies and relevant supporting information.

Task 1.5 Identify gaps in the background review and develop a program to obtain the additional information on geomorphology to fill the gaps on basin morphometric assessment, identification or refinement of existing channel reaches, and historic assessment at a reach-level to determine the degree of channel alteration, planform adjustment or land use change that may have occurred over the available historic record.

Activity 2. Field studies

Task 2.1 Carry out on-site observations to confirm the drainage boundaries, storm outlet locations and directions of overland flows.

Task 2.2 Confirm land use and vegetative cover from on-site observations.

Task 2.3 Confirm and update inventory of hydraulic structures (bridges, culverts and storm sewer outfalls) and measurements of dimensions from on-site observations.

Task 2.4 Collect information on historical high water marks.

Task 2.5 Review hydraulic backwater models and obtain missing information on stream channel measurements.

Task 2.6 Confirm stream channel and flood plain hydraulic characteristics from on-site observations.

Task 2.7 Develop a limited water quality sampling program and collect samples at the Town boundary and at the outlets to Thames River. Conduct laboratory analyses of water samples. Suggested list of field measurements and laboratory analyses:

Field measurements

- Temperature
- Ph
- Conductivity and
- DO.

The lab analyses should include:

- TSS, and TDS
- BOD, COD
- Chloride
- Nutrients: TN TP, Ammonia, TKN, and
- Biological indicators: E. coli, Total and Fecal Coliform.

Task 2.8 Collect and supplement existing information on fish habitats in local watercourses.

Task 2.9 Carry out field reconnaissance of terrestrial features, vegetation, and animals from on-site observations, concentrating on stream valleys.

Task 2.10 Carry out preliminary fluvial geomorphology assessment to confirm the erosion sites and the stability of the watercourses through a site inventory. The site inventory would include the application of the Rapid Stream Assessment Technique (RSAT) and Rapid Geomorphic Assessment (RGA) to each identified reach to provide a qualitative estimate of channel stability, health and function.

Task 2.11 Based on the preliminary fluvial geomorphology assessment, carry out detailed fluvial geomorphology field assessments of the five watercourses to determine existing stream bank erosion sites, bank-full widths, gradients, bed material D_{50} values, Manning's n and average bank-full velocities.

Task 2.12 Establish one monitoring cross-section at each of the detail geomorphic field sites to monitor change in cross-sectional form. In addition, erosion pins should be installed at several locations along the site at varying heights on the bank to measure the rate of erosion. Bed chains should also be installed where possible to monitor bed down cutting or aggradation.

Task 2.13 Carry out field observations to establish base flows in the five streams.

Task 2.14 Carry out summer temperature readings in watercourse with fish habitat.

Activity 3. Data Assessment

Task 3.1 Assess existing erosion conditions based on field observations and surveys.

Task 3.2 Assess surface water quality conditions. Determine impacts of human activities. Characterize the surface water quality and compare to MOE Provincial Water Quality Objectives.

Task 3.3 Based on previous groundwater studies prepare groundwater recharge estimates.

Task 3.4 Determine the infiltration capacity of local soils using a Guelph Permeameter. Describe suitability of local soils for infiltration based BMPs.

Task 3.5 Calculate index biotic integrity (IBI) for the fisheries sampling locations. Determine fish habitat classification for watercourses with fish habitat.

Task 3.6 Calculate using spreadsheet analysis the annual water balances for existing and future land use conditions.

Task 3.7 Review existing conditions and assess the health of the general ecosystem.

Task 3.8 Review HEC-RAS backwater computation results and assesses the effect of channel velocities on stream erosion potential.

Task 3.9 Analyze the results of the geomorphological assessment to determine the appropriate erosion thresholds of the area. Determine the magnitude of flows required to potentially erode and transport sediment.

Activity 4. Opportunities/constraints

Task 4.1 Review recently prepared flood plain mapping and determine the need for the protection of existing developments located on the flood plain.

Task 4.2 Describe fish species, habitat classification, and rationale and management recommendations.

Task 4.3 Identify areas under stress from past or present land use practices, and where remedial action and rehabilitation is required.

Task 4.4 Identify stream corridors by determining the meander belt width using topographic mapping.

Activity 5. Review Interim Stormwater Management Goals, Objectives and Policies

Task 5.1 Based on findings update the Interim Goals, Objectives and Policies prepared for the previous Stormwater Strategy Study.

Activity 6. Technical assessments

Task 6.1 Assess water balance modelling and the potential long-term quantity and quality effects on groundwater recharge.

Task 6.2 Assess changes in flows, depth and velocities in streams caused by future urbanization.

Task 6.3 Revisit design criteria currently adopted for flood protection by reviewing the intensity and estimated return period of the July 2000 storm.

Task 6.4 Assess potential disruption of valley lands caused by future road crossings and utility easements.

Task 6.5 Assess the effect of future increased peak flows on stream bank erosion.

Task 6.6 Assess the water quality conditions in the local watercourses. Streams impacted by past and future land use practices should be identified.

Task 6.7 Assess the ecological functions of the stream shorelines and ravine tributaries to determine the risk of further negative impacts.

Task 6.8 Assess the productive capacity of local fish habitats and the potential effect of urban stormwater discharges.

Activity 7. Targets and Constraints

Task 7.1 Establish natural heritage targets for fish and aquatic habitats, and valley lands.

Task 7.2 Establish water quality targets for infiltration, instreams, and wet pond release rates.

Task 7.3 Establish water quantity targets to minimize flooding, maintain base flows, and wet pond release rates.

Task 7.4 Establish stream erosion targets.

Activity 8. Management Strategy

Task 8.1 Develop urban stormwater management strategies: select recommended structural and non-structural BMPs, retrofits for existing urban areas, erosion and sediment controls, design guidelines for lot level, conveyance and end-of-pipe controls.

Task 8.2 Develop Hazard Land Management strategies for flooding: review need for additional flood plain mapping, or updating of flood plain mapping, reduce flooding impacts associated with new development, recommend improvement of hydraulic structures, and identify flood susceptible areas.

Task 8.3 Develop Erosion Hazard Management strategies: identify the need for and type of geotechnical studies.

Task 8.4 Develop Surface Water Quality Hazard Management strategies: protect existing and future sensitive water quality areas, reduce and eliminate waste water inflows into local watercourses, stabilization of existing stream banks showing excessive erosion, construction of BMPs for existing urban areas, reduction of agricultural and rural area runoff impacts, and reduction of impacts of runoff from new development.

Task 8.5 Develop Surface Water Quantity Hazard strategies: construction of BMPs for new development, maintain existing hydrologic cycle, maintain existing surface water drainage patterns, and restrict surface water withdrawals.

Task 8.6 Develop Groundwater Quality and Quantity Hazard strategies based on the recommendations presented in the Oxford County Hydrogeology study.

Task 8.7 Develop Aquatic Habitat Restoration and Enhancement strategies.

Task 8.8 Identify and prioritize any potential stream or bank rehabilitation sites.

Task 8.9 Develop initial restoration plans for potential stream rehabilitation sites.

Activity 9. Implementation Strategy

Task 9.1 Identify lists of implementation agencies and their respective roles.

Task 9.2 Identify implementation mechanisms: planning controls, land use designations, by-laws, OP Amendments, servicing options, subdivision and site plan reviews, municipal design guidelines, policies, initiatives and BMPs.

Task 9.3 Review and identify appropriate funding sources.

Task 9.4 Prepare implementation schedule, and phasing.

Task 9.5 Prepare monitoring plan for the water quantity and quality components.

Task 9.6 Prepare routine maintenance plan.

Task 9.7 Recommend pilot projects.

Activity 10. Documentation

Task.10.1 Prepare monthly progress reports.

Task 10.2 Prepare Draft Report and submit for comments.

Public Consultation

Tasks to be included:

- Preparation of Master List of agencies, groups and individuals interested in the development of a Stormwater Management Strategy for Ingersoll.
- Organization of Public Forum(s) to discuss the project.
- Liaise with Steering Committee during the study.
- Attend staff meetings with agency representatives.

APPENDIX A
ANNOTATED BIBLIOGRAPHY AND REFERENCES

APPENDIX A - ANNOTATED BIBLIOGRAPHY AND REFERENCES

R.V. Anderson Associates Limited "Stormwater Management Strategy for Secondary Plan – Appendix J", April 2002.

The report undertook to explore and determine servicing options for two areas of land within the Town of Ingersoll. The preferred alternative for stormwater management was a combination of lot level and conveyance controls and end-of-pipe facilities. Four stormwater management ponds were recommended to be constructed as build-out of the area occurs. The Visual OTTHYMO program was used to compute flows for the Whiting and Hall's Creek watersheds. The results were slightly less than the peak flows published in the MacLaren Report.

J.B. Chambers Consulting Engineers Ltd. "Town of Ingersoll Stormwater Management Report – Sutherland Creek, August 2000.

The report describes the stormwater management proposed for an 8.2 ha development site. A storage facility was selected to control post development peak flows for the 2 to 50–year events. The extended detention pond provides water quality control to meet the MOE Basic protection level.

The report also recommended erosion control by restricting the runoff from a 25 mm storm over a 24-hour period.

Delcan "Stormwater Management Report – Conceptual, Bell Street Subdivision, Ingersoll, Ontario", June 1997.

The hydrologic modeling was done with the Interhymo/Otthymo 89 computer model. The recommended stormwater management plan included quantity and quality control facilities:
Lot level controls

- Minimum grades of 2%
- Discharge of roof leaders to grassed surfaces
- Discharge of sump pumps to ground

Conveyance control:

- Rear yard grassed swales with a minimum slope of 2%

- End of pipe control:

An extended detention wet pond with a sediment forebay

MacLaren, "Town of Ingersoll Storm Water Management Study for the UTRCA", January 1982

The first and only comprehensive stormwater management study undertaken in the past for

Ingersoll was by MacLaren Engineers, Planners and Scientist. A brief report summarizing the results of the study was released in January 1982 and it described the flows and water levels for the five watercourses: Hall, Whiting, Sutherland, and Murphy Creeks and Baxter Drain. The hydrology analysis was based on an early version of the HYMO program, developed in the US in the 1970s for mainly rural areas. In absence of local rain gauge data, the St. Thomas data was used as a rainfall input. Generally, the St. Thomas data showed lower rainfall intensity duration values than the London Airport data used in the current study. The MacLaren report concluded that if the total imperviousness in any proposed development area were kept below 45%, no stormwater management technique would be required to control the peak flows. The report did not address water quality, erosion or environmental constraints.

Planning & Engineering Initiatives Ltd. "Stormwater Management Report Cami Cross Dock Site", April 2003

The report recommended two wetlands to control the post development peak flows for the 2 to 100-year Events. The wetland would also provide water quality control to meet the MOE criteria for Basic level of protection. The hydrologic modeling was done with the MIDUSS program.

K. Smart Associates Limited "Drainage Study to Determine Outlet Works Necessary for Proposed Subdivision Pemberton Street North – Town of Ingersoll", October 1986.

The vacant land of 36 acres drains mainly to a ditch and along either side of the CPR railway land. Due to the porous nature of the local soils the existing drainage soaks into the ground with little downstream runoff. The preliminary hydrology calculations were done by the SCS method, but further refinements were recommended at a subsequent design stage. The preferred stormwater management alternative was the use of detention facility and exfiltration.

Stantec Consulting Ltd. "Oxford Village (Formerly Mapleridge Meadows) Interim Stormwater Management Strategy", May 3, 2000.

The report originally prepared in May 1998 developed a stormwater management concept for the proposed 94 single-family residential area included:

- one storage basin for each of the two stages of the development to control the post to pre-development flows up to the 5 –year event;
- provide permanent pools for infiltration, to simulate existing water balance conditions; and
- provide level spreader weirs at the basin outlets

The MIDUSS hydrologic model was used to estimate flows.

Stantec Consulting Ltd. "Hall's Creek Hydrologic Models – Town of Ingersoll" (Model Data), March 2004.

The 2004 letter report by Stantec addresses the differences between the MacLaren and Stantec Hall Creek flows. According to Stantec the MacLaren flows based on an early version of HYMO

model should not be used, as it does not accurately represent the hydrologic flow regime of Halls Creek. Similarly, the flow hydrographs generated by R.V.Anderson as part of the Secondary Plan study are not representing the current drainage area contributing to Halls Creek flow. As a result, Stantec recommended quantity control to be applied for the Oxford Village area based on their revised flows.

Wood, M. and Goldt, R. Reference Manual for the use of Precipitation Design events in Upper Thames River Watersheds, December 2004

The reference manual describes the rainfall and rainfall on snowmelt data compiled in both synthetic design storms and historical storm events for the Upper Thames River Watersheds. The data from four meteorological stations relative to the Upper Thames Watershed is presented followed by various synthetic rainfall design events. The report presents three major historical rainfall events as well as their application as potential design storms. The report contains six appendices with detailed information on rainfall data, synthetic storms, historical storms, long duration rainfall, rainfall on snowmelt and recommendations.

ADDITIONAL REFERENCES

- R.V. Anderson Associates Limited, Green Scheels Pidgeon, Natural Resource Solutions Inc. "County of Oxford - Ingersoll Servicing Strategy Class Environmental Assessment", April 2002.

- Dams Inventory and Potential Barrier Removal Rankings

- Design Storms, Upper Thames River Watershed

- Digital Files on mapping contours, land use and soils

- Floodplain mapping and aerial photography

- Law Engineering, "Bridges & Culvert Structural Review & Recommendations", 2002, 2004

- Storm Sewerage Mapping (hardcopy and digital, associated DB)

- Upper Thames River Conservation Authority "Ingersoll Stormwater Studies" (Digital Files), 2004.

- Upper Thames River Watershed - Report Cards, 2001

APPENDIX B
INTERIM STORMWATER MANAGEMENT POLICIES

APPENDX B

Technical Management Policies

The following policies describe in some detail the items summarized in ***Table 2*** of the report.

1. ***Protect Natural Environment***

- The preservation, maintenance and where practical and required, restoration of natural systems shall be encouraged recognizing their benefits in the management of SWM.

- Stormwater shall be considered as a resource.

- Natural systems shall be incorporated (to the extent practical) into the storage, flow and quality improvement of storm runoff, while, ensuring the protection of stream banks from erosion.

- SWM shall be managed on a watershed basis within the Town. These efforts should also be co-ordinated with the SWM management efforts of an upstream

- Stormwater runoff from new developments should simulate the natural hydrology of the area with a goal of preserving the hydrological cycle. As a condition of new "greenfield" development approval, peak flows for a range of return period events shall not exceed pre-development levels. Flow volumes shall be reduced as much as is practically possible (i.e., given soil conditions).

- As more detailed watershed information becomes available, specific watercourse targets are to be developed.

- Stormwater management measures shall be designed in a manner not to impact aquatic habitat, and where feasible, to regenerate aquatic habitat.

- Source water protection shall be incorporated in the design and implementation of storm water management processes and facilities

2. ***Control Stormwater Quantity***

- Reductions in peak storm discharges from urban areas through a hierarchy of source, conveyance, and end-of-pipe control measures shall be implemented to reduce the risk of flooding and stream bank erosion.

- As a condition of development approval, peak flows shall not exceed existing levels and where feasible, shall be reduced. Similarly, post-development runoff volumes shall be controlled where feasible.

- Drainage systems shall be designed using the major-minor system.

3. Control Stormwater Quality

- Discharges to the storm sewer system shall be free of debris, oil, scum and other substances that would produce an objectionable deposit, colour, odour or turbidity in the receiving watercourses.

- The volume of sediments and contaminants being deposited into the storm sewer system shall be reduced to levels that are not harmful to the intended use of the receiving waters and shall not exceed current limits under a sewer use bylaw.

- Contaminants including sediments shall be controlled through the use of means such as municipal bylaw, or sewer use bylaw and public awareness initiatives.

- Water quality targets for storm sewer outfalls shall be set based on defined criteria, recognizing the envisioned reasonable uses of the water bodies into which stormwater is being discharged. It is recognized that this is a long- term process. In the interim;

  - new stormwater management facilities should be designed on the basis of the MOE Stormwater Management Practices Planning and Design Manual;

  - retrofitting of existing SWM facilities shall consider onsite stormwater quality control measures where possible.

  - water quality in Ingersoll's surface and sub-surface waters shall not be degraded further from stormwater and all reasonable effort should be made to improve water quality.

  - development review process shall require a detailed hydrogeological analysis for areas identified as high vulnerability aquifer areas to ensure that development will not compromise groundwater recharge and impair groundwater quality.

4. Control of erosion

- Erosion and sediment control shall be applied to all development and construction activity.

5. Control groundwater quantity and quality

- Infrastructure contributing to infiltration and groundwater problems shall be identified and replaced, where practical.

6. Infrastructure

- Discharges from existing development areas shall be prioritized and peak flows and volumes shall be reduced where practical in high priority areas.

- Drainage system capacities (hydraulic) shall be developed in an integrated manner for sewer systems, waterways, roadways and other overland flows, and where this integrated system already exists, it shall be maintained and enhanced.

- The development of an initial source control program shall be pursued through the development of education programs, financial incentives, land use policies and municipal bylaws recognizing the constraints/opportunities in existing and new "greenfield" development and infill situations. Source control measures and other Stormwater Management Practices shall be considered to control the quality and quantity of stormwater and sediments from all existing and new developments.

- When there is a need to replace an existing infrastructure, the best available means/technology to address stormwater quantity and quality concerns shall be considered.

- Pilot projects shall be pursued when practical to demonstrate the effectiveness and suitability of innovative SWM management practices.

- Emerging and "state-of-the-art" technologies shall be considered for SWM management in Ingersoll with emphasis on the importance of natural (non-structural) systems.

- The existing infrastructure shall be utilized to its fullest extent to meet the goals and objectives.

- Existing foundation drains connected to sanitary sewers shall be reconnected to sump pumps discharging to the surface or to storm sewers and no new foundation drain shall be connected to sanitary/combined systems, where feasible. Connection to storm sewer system shall be discouraged where feasible.

- SWM problems that originate within the Town's boundaries shall be the first priority. Problems originating in the headwater areas are to be recognized but ultimately, are the

responsibilities of adjacent municipalities. Liaison with the headwater municipalities in managing SWM shall be encouraged.

- Infrastructure contributing to infiltration and groundwater problems shall be identified.

INSTITUTIONAL MANAGEMENT

1. Need for public awareness

- The Town and the Conservation Authority shall promote public awareness of SWM issues and related programs to increase local knowledge and community participation.

- Community-based approaches to SWM management (i.e. bottom-up planning) shall be encouraged and supported by the Town.

- Stakeholder inputs shall be solicited in the planning and implementation of SWM initiatives.

- SWM shall be managed on a watershed basis within the Town. These efforts should also be coordinated with the SWM management efforts of an upstream municipality, the appropriate government agencies and interested public stakeholders.

- The Town and its citizens shall be financially responsible only for the resolution of SWM problems that have been generated within its own boundaries (i.e. not responsible for solving problems generated outside the Town's boundaries).

- For Subdivision developments ponds and artificial wetlands will be on lands dedicated to the Town.

2. ***Update standards***

- All government agencies should adhere to a consistent set of guidelines and strategies for improving receiving water and storm water quality in the Ingersoll area. There should be a regular co-ordinated review of policy, guidelines and standards by all stakeholders.

FUNDING MANAGEMENT

1. ***Budget limitation***

- A dedicated funding source shall be established to finance SWM initiatives including future maintenance of facilities.

- Capital and operating budgets shall be established for the institution ultimately responsible for SWM management in the Town.

- SWM solutions need to be cost effective and affordable and shall be funded through a combination of public and private sector funds.

2. ***Resource allocation***

- The owners/proponents of new development initiatives shall be responsible for the costs of managing SWM generated from their properties, with cash in lieu as an option.

- All capital projects and expenditures shall be reviewed for consistency with the above policies and to identify opportunities for SWM management.

- Pricing techniques shall be pursued as a possible incentive to encourage innovative stormwater management initiatives at the lot level.

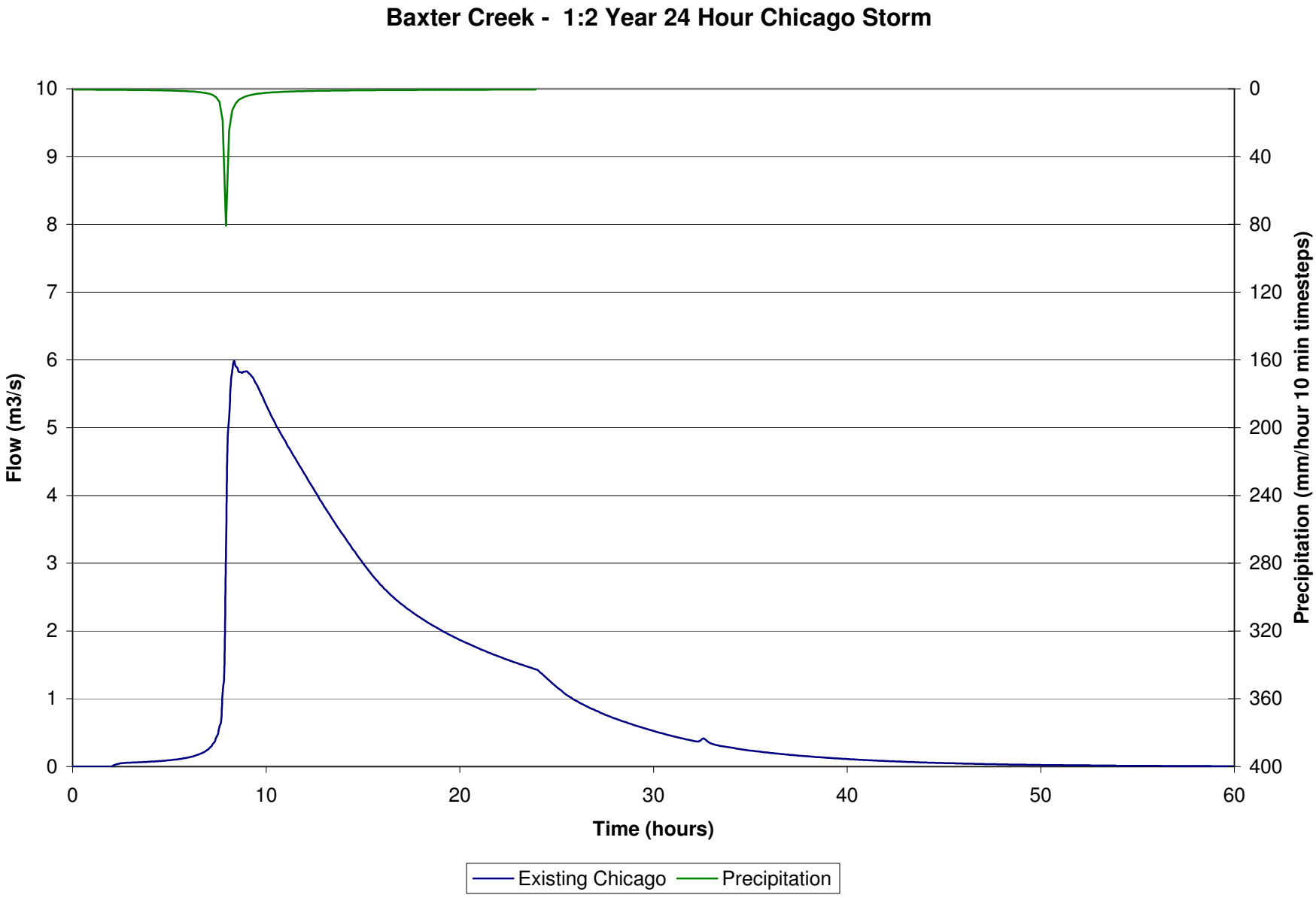
APPENDIX C
LONDON AIRPORT CLIMATE DATA BASED ON ENVIRONMENT CANADA 30 YEAR NORMALS

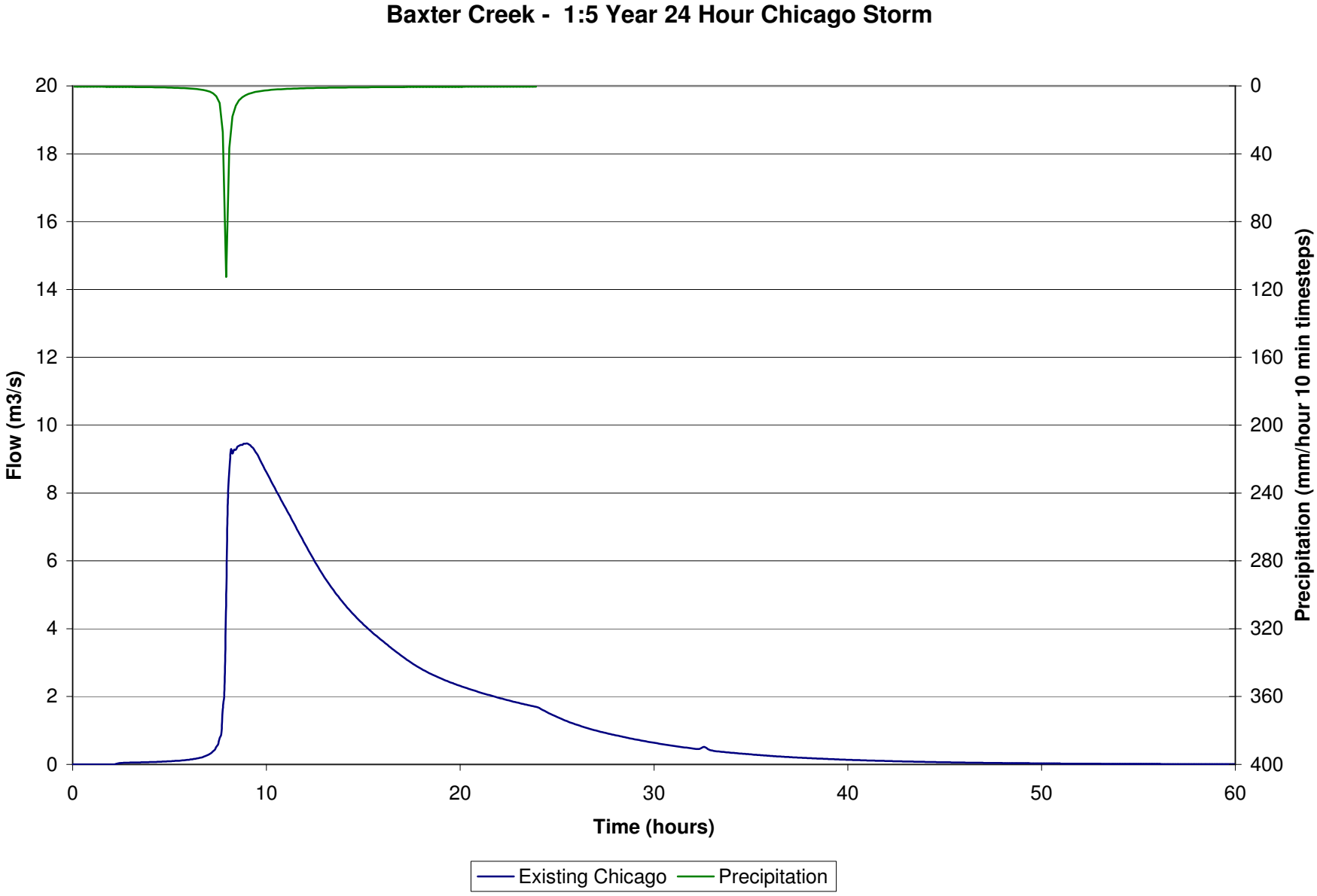
APPENDIX C
Summary of London Airport Climate Data

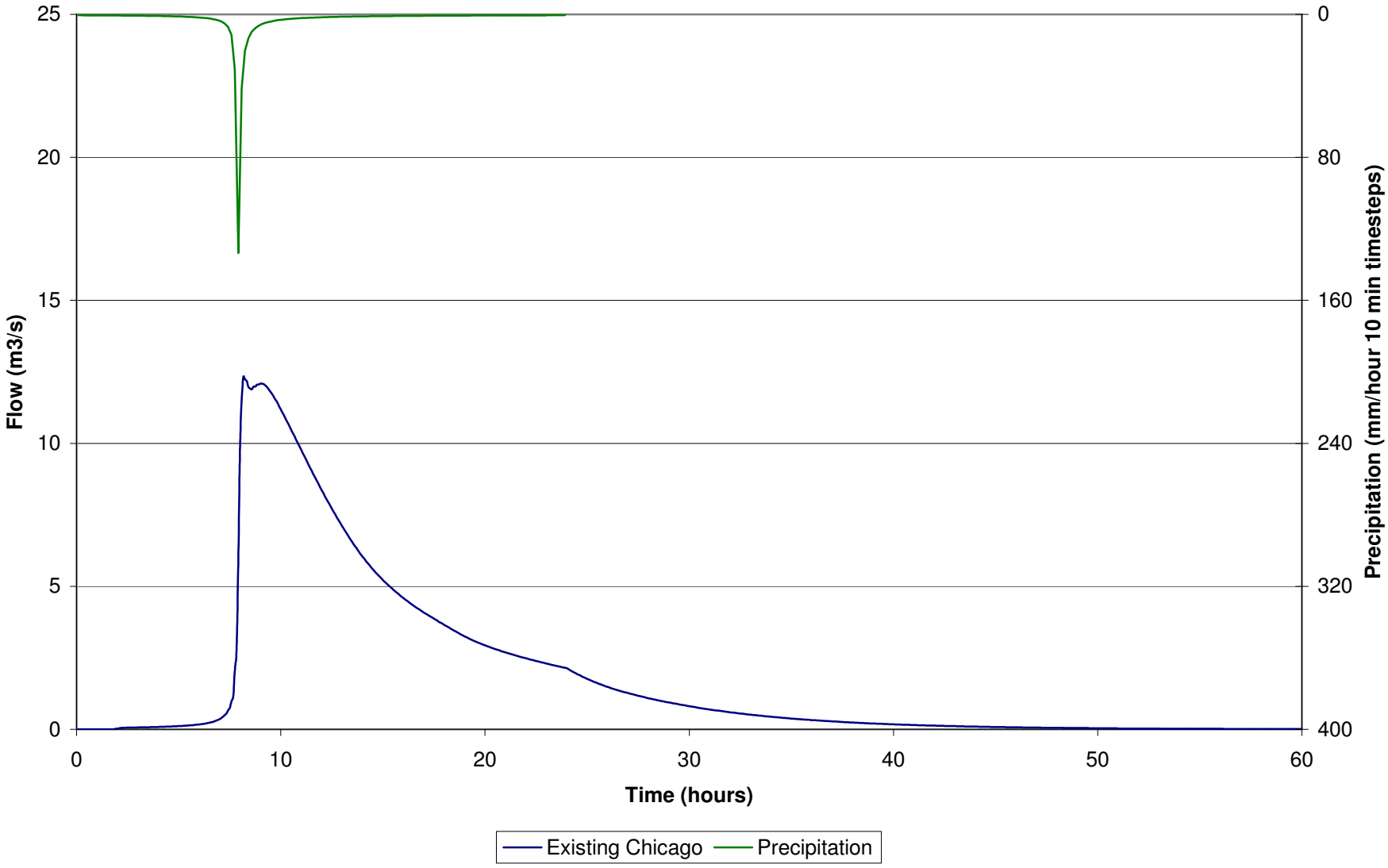
Data	Amount
Temperature - C	
30 year annual average	7.5
30 year daily maximum	26.3
Extreme maximum	38.2
Extreme minimum	-31.7
Precipitation - mm	
Rain, 30 year annual average	817.9
Extreme daily rainfall	89.1
Snowfall, 30 year annual average	202.4
Extreme daily snowfall	300
Extreme snow depth	690
Precipitation, 30 year annual average	987.1
Days of rainfall in an average year	
>0.2 mm	120.3
>5 mm	49.1
>10 mm	27.5
>25 mm	5.6

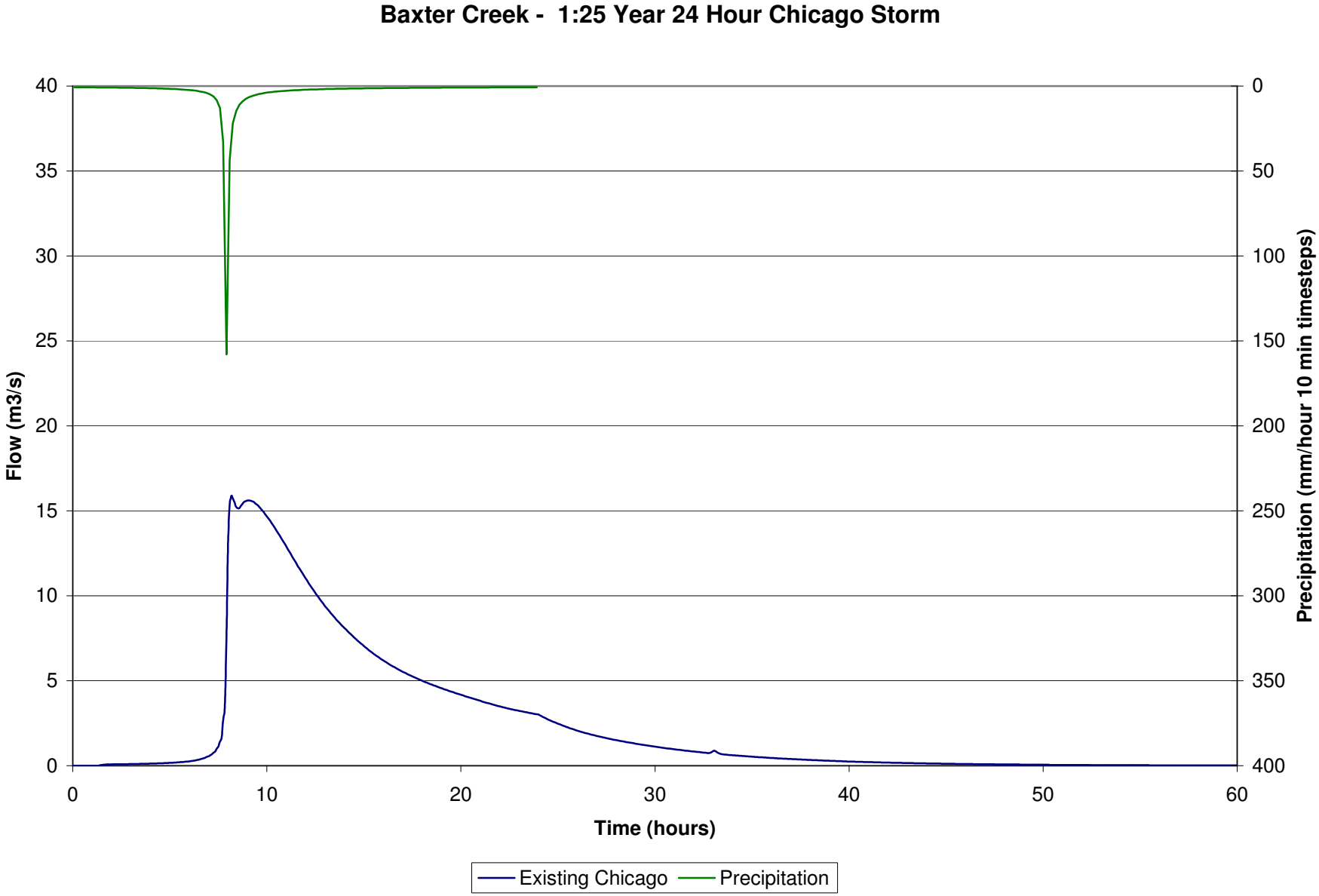
APPENDIX D
COMPUTER INPUT AND OUTPUT DATA
(CD BACK POCKET)

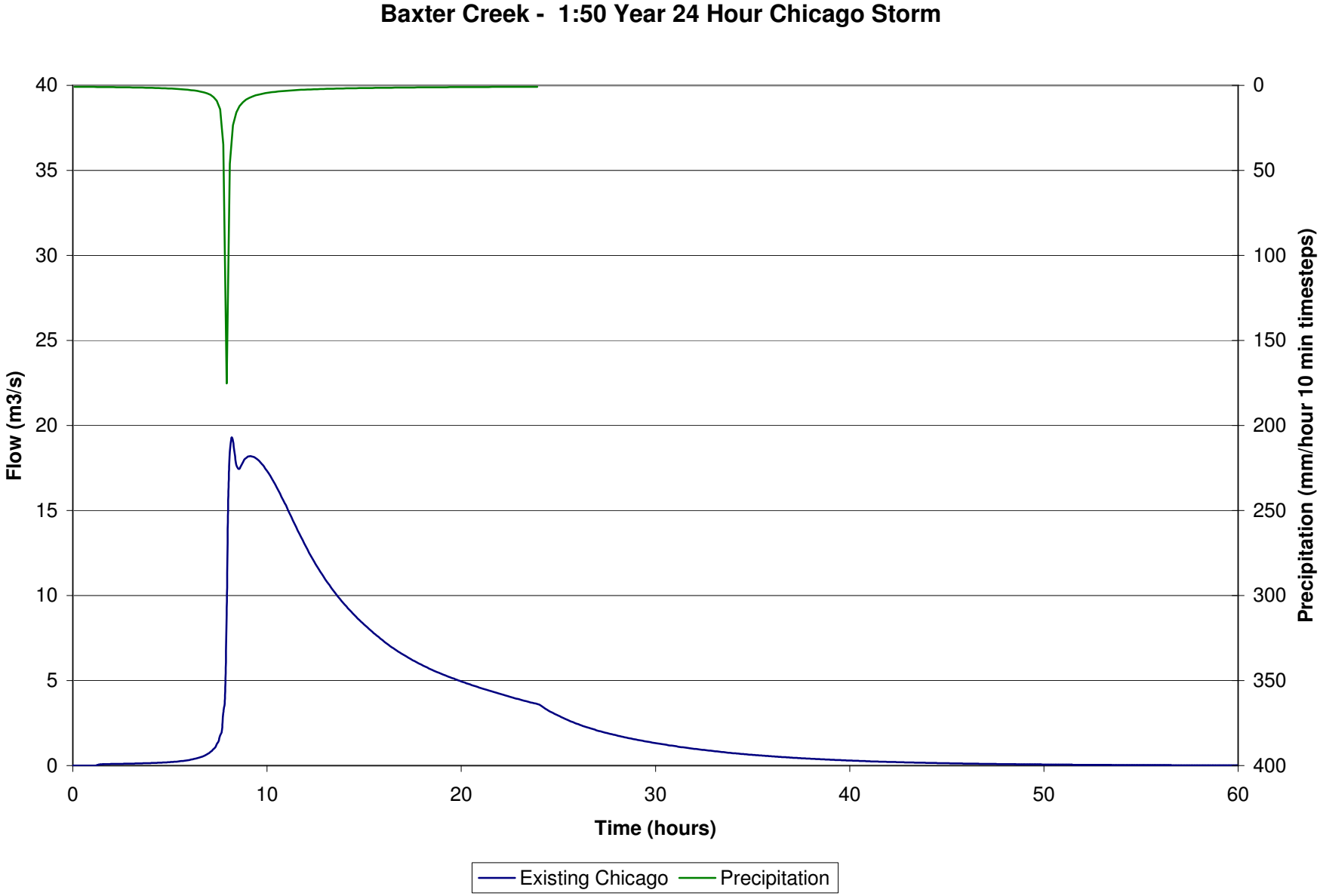
APPENDIX E
RUNOFF HYDROGRAPHS

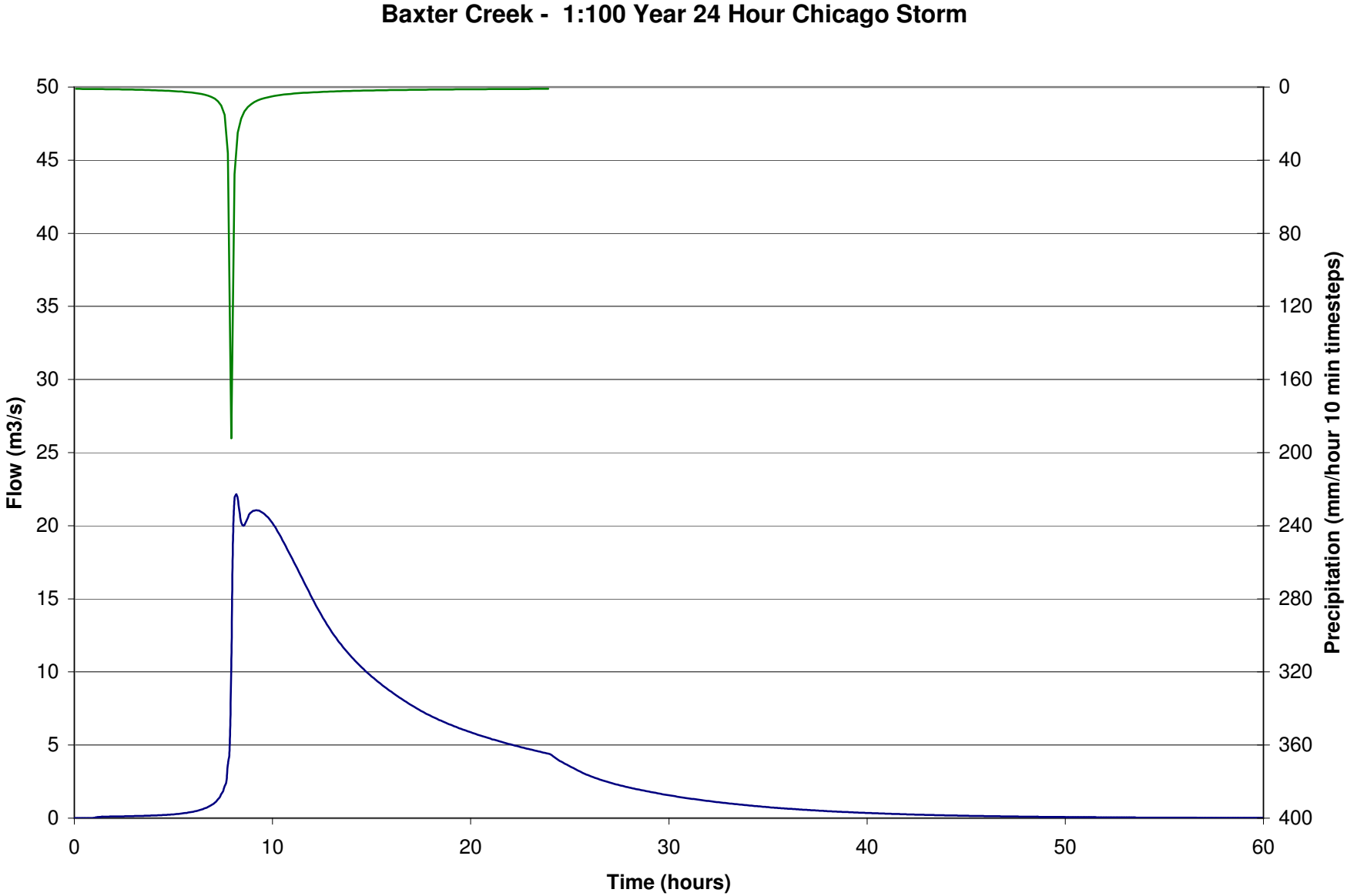

Baxter Creek - 1:2 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

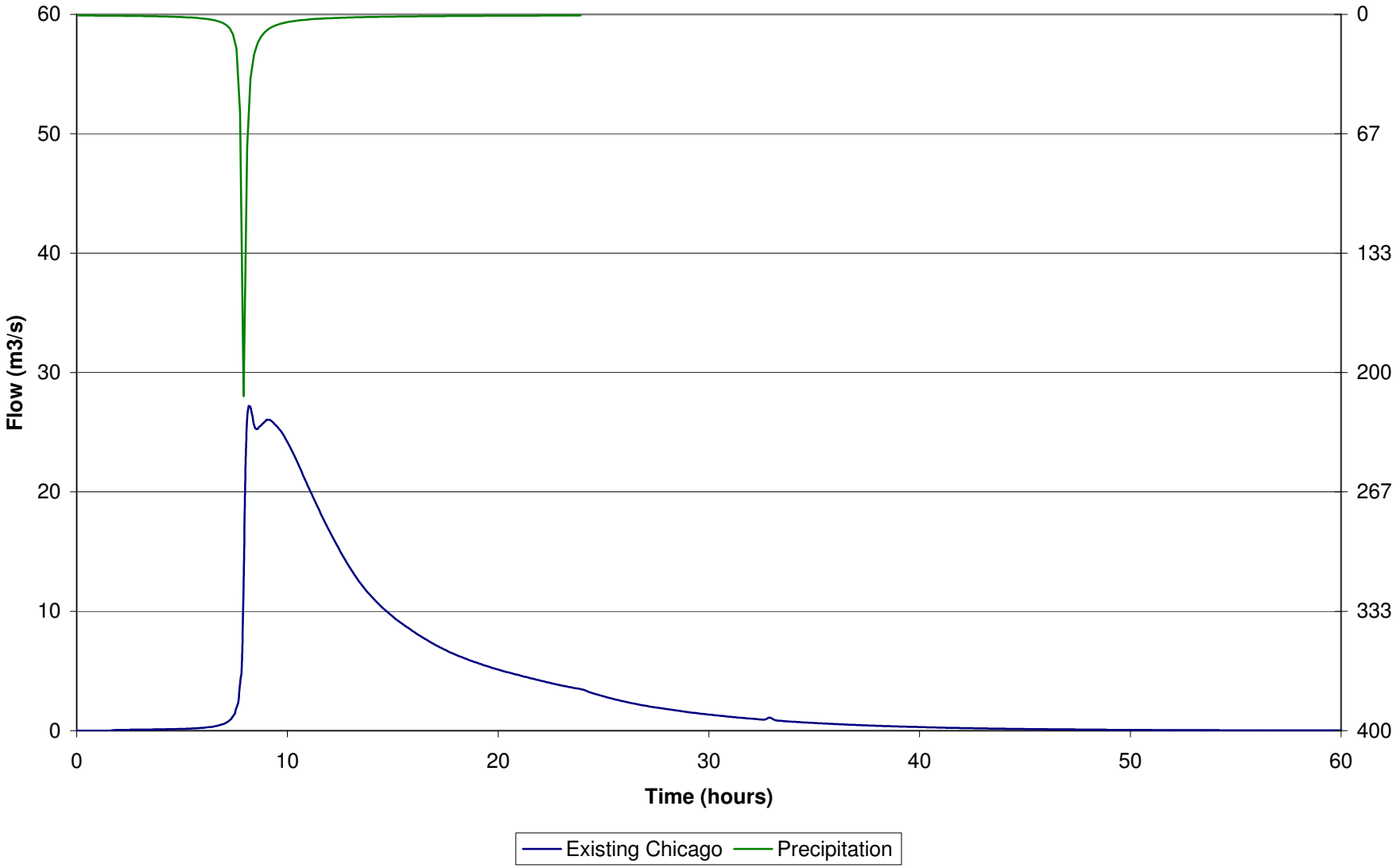

Baxter Creek - 1:5 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

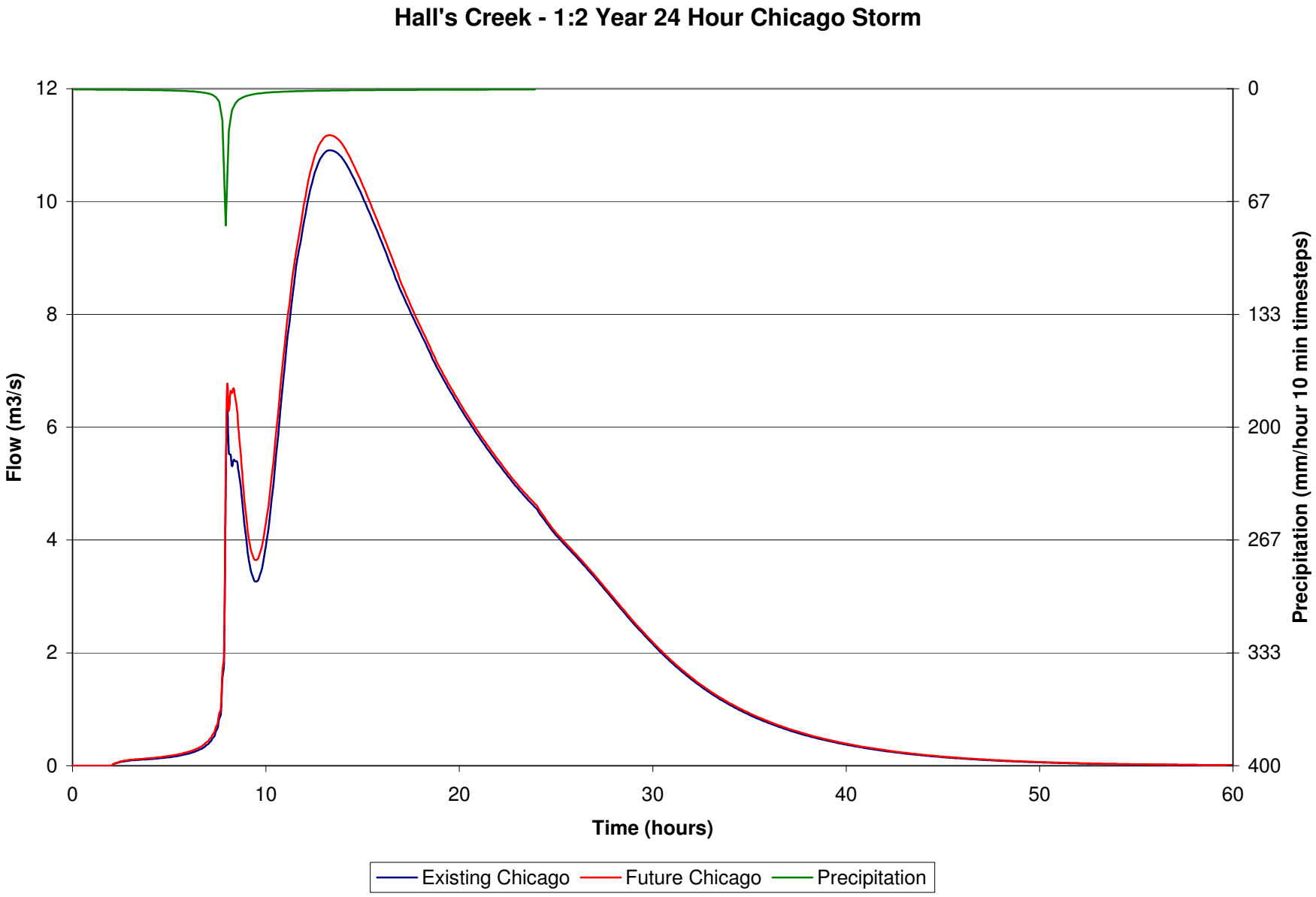

Baxter Creek - 1:10 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
0
80
160
240
320
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

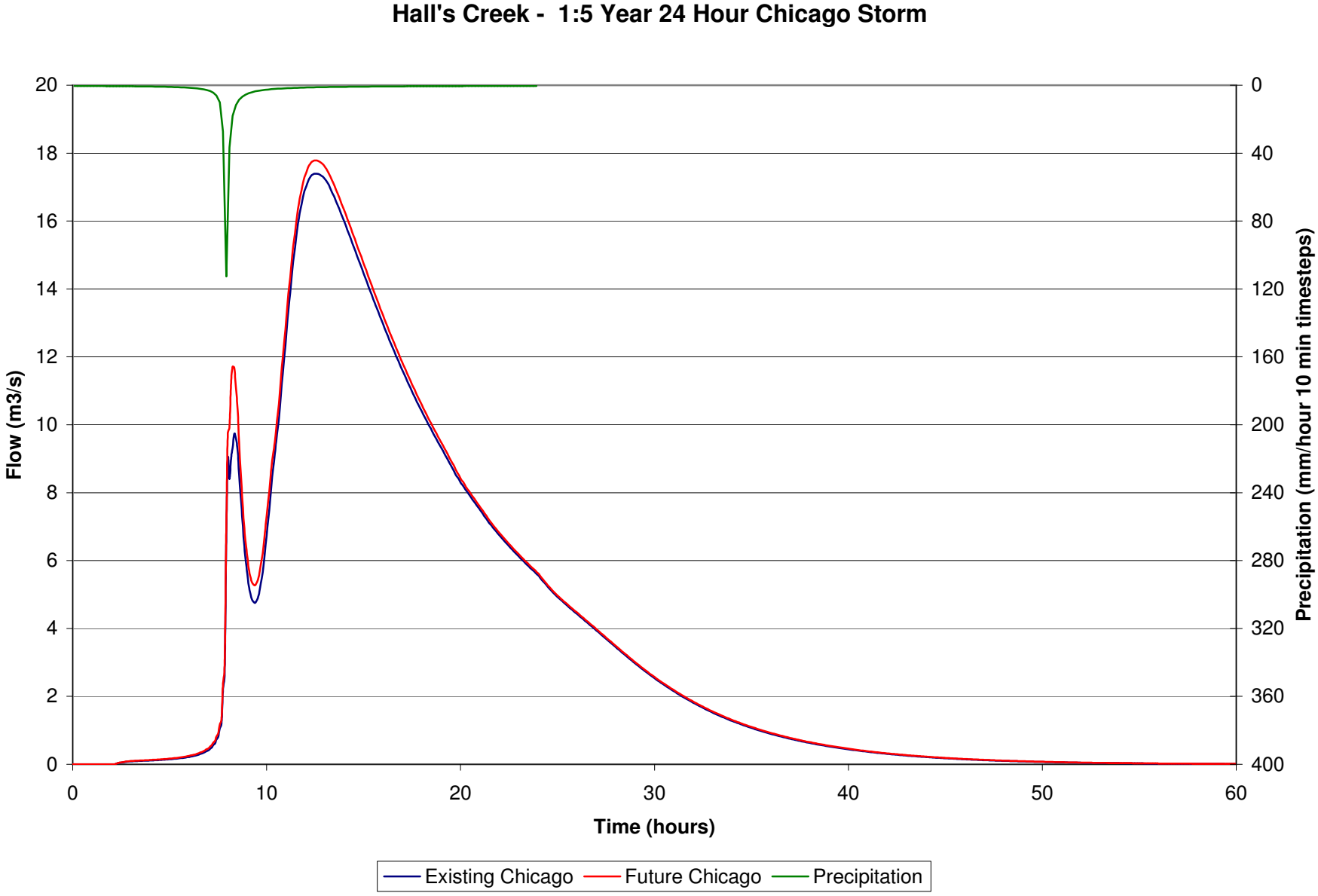

Baxter Creek - 1:25 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

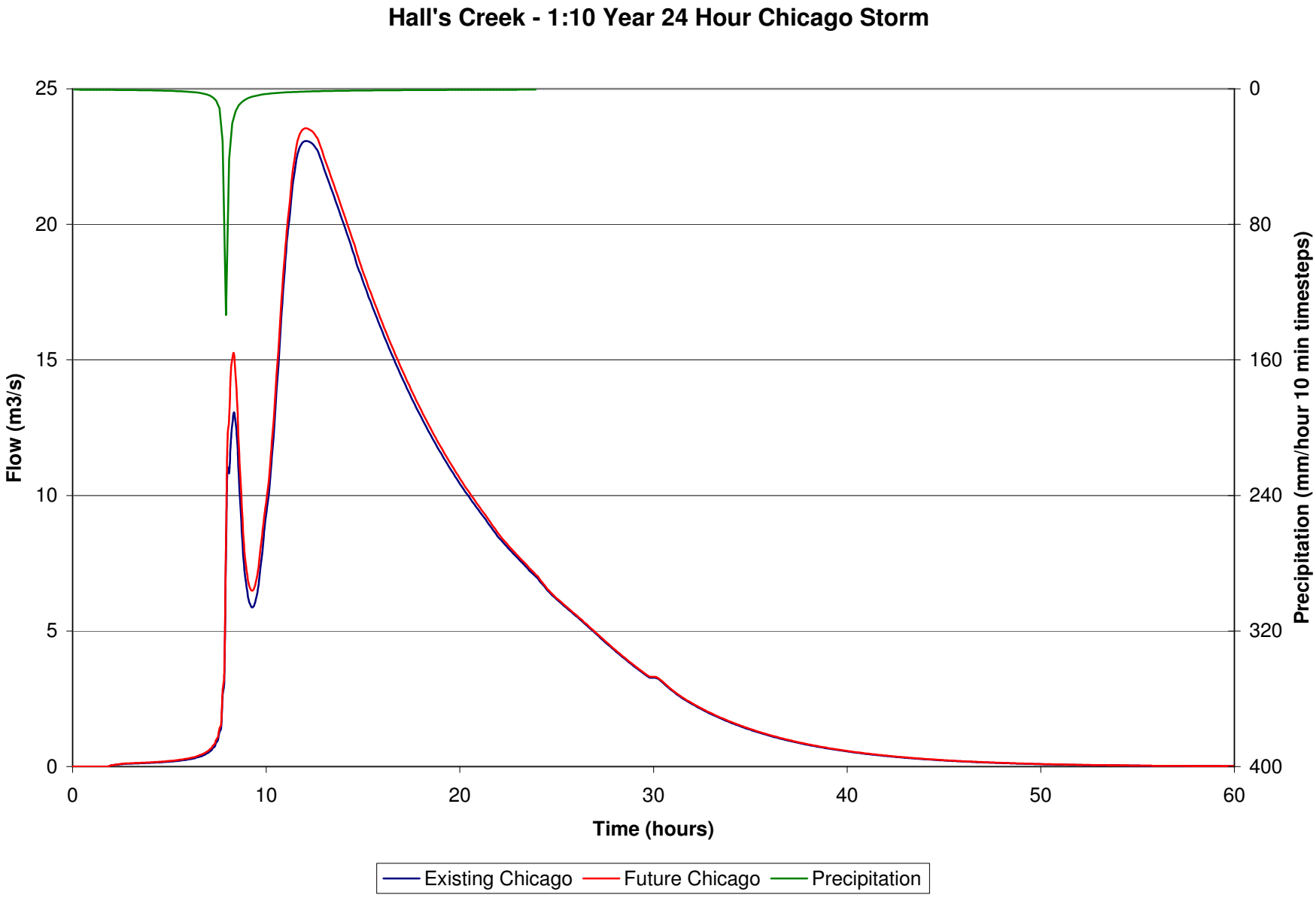

Baxter Creek - 1:50 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

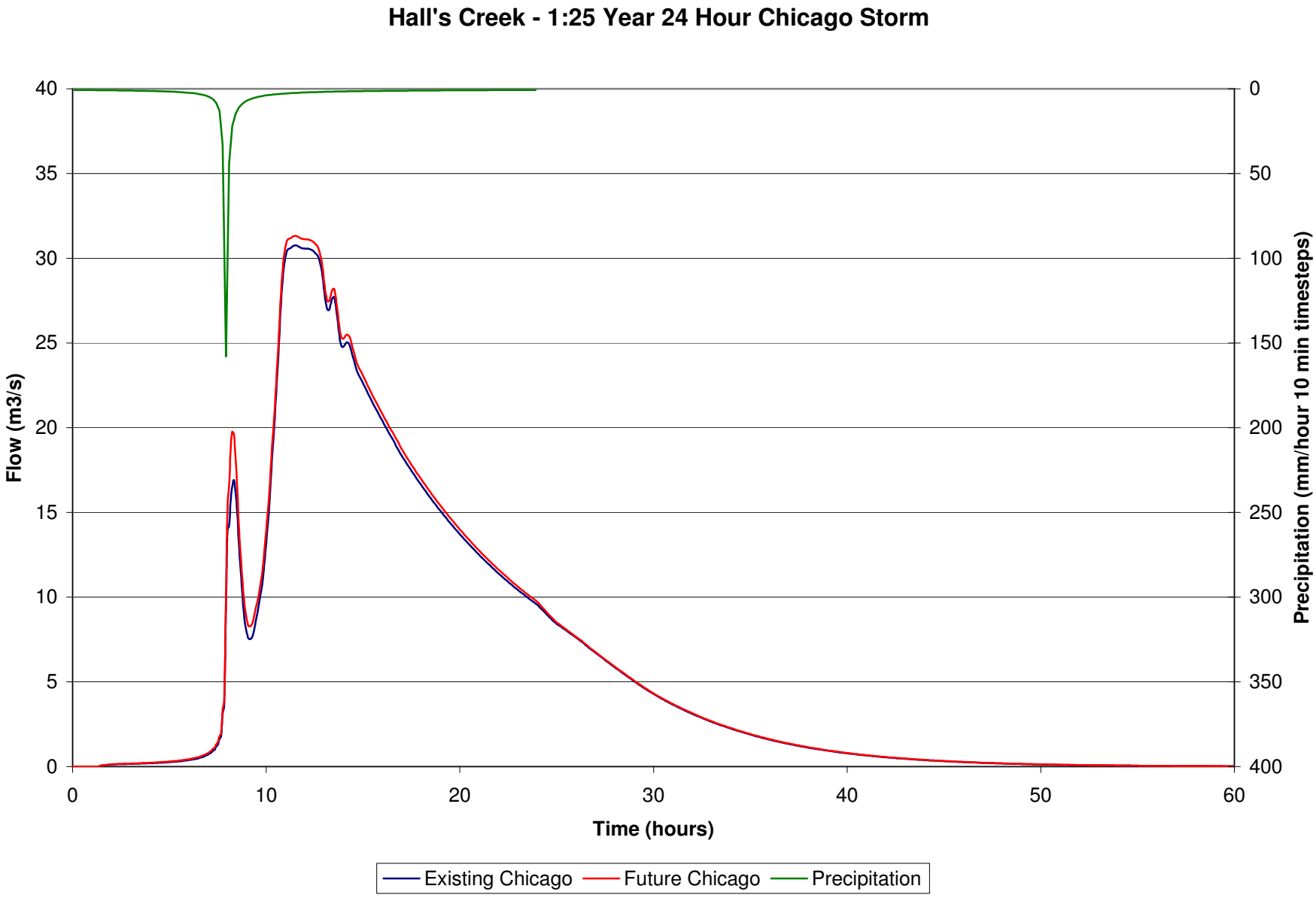

Baxter Creek - 1:100 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
45
50
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60

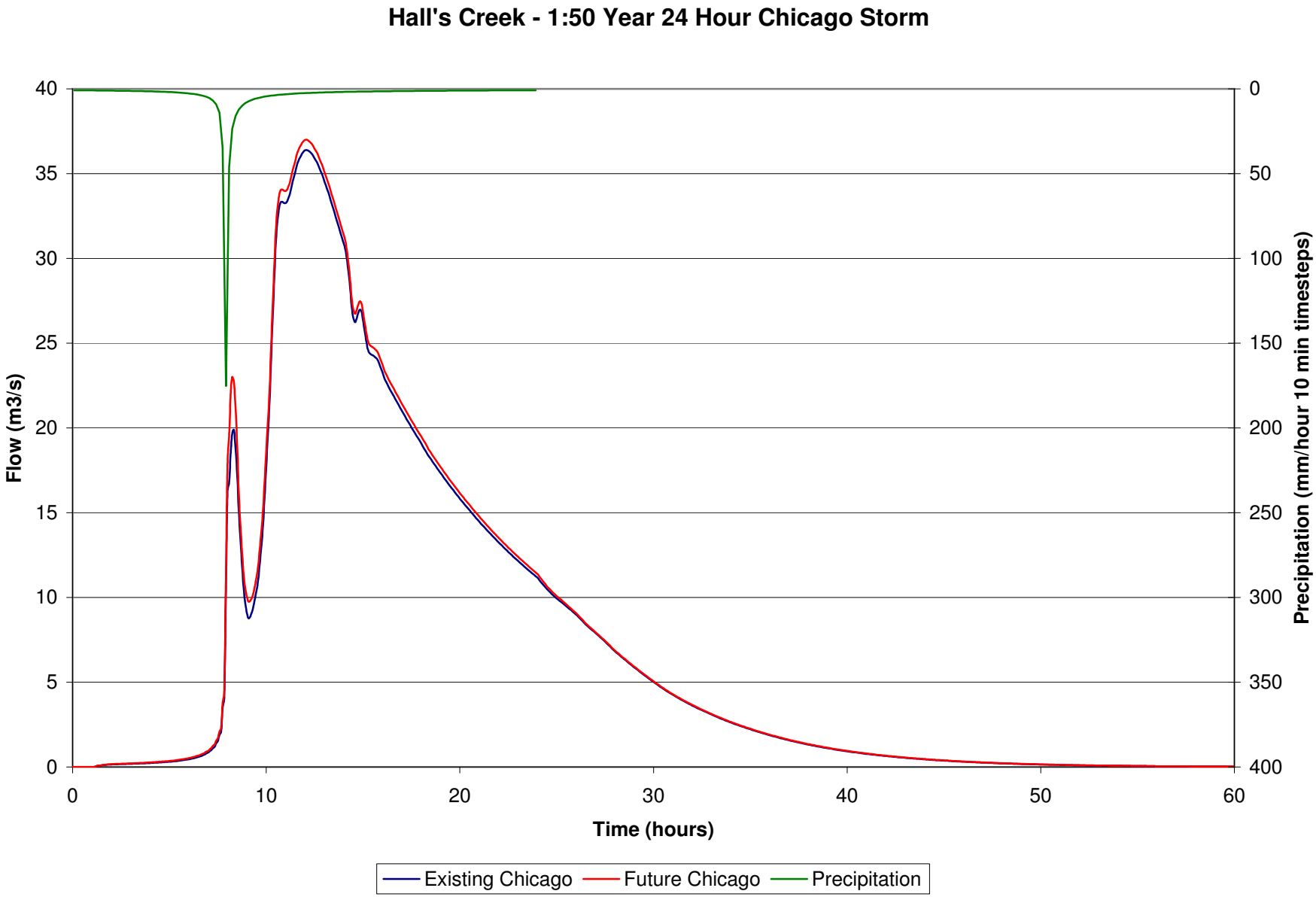

Baxter Creek - 1:250 Year 24 Hour Chicago Storm
Flow (m3/s)
60
50
40
30
20
10
0
0
67
133
200
267
333
400
0
10
20
30
40
50
60
Time (hours)
Existing Chicago
Precipitation

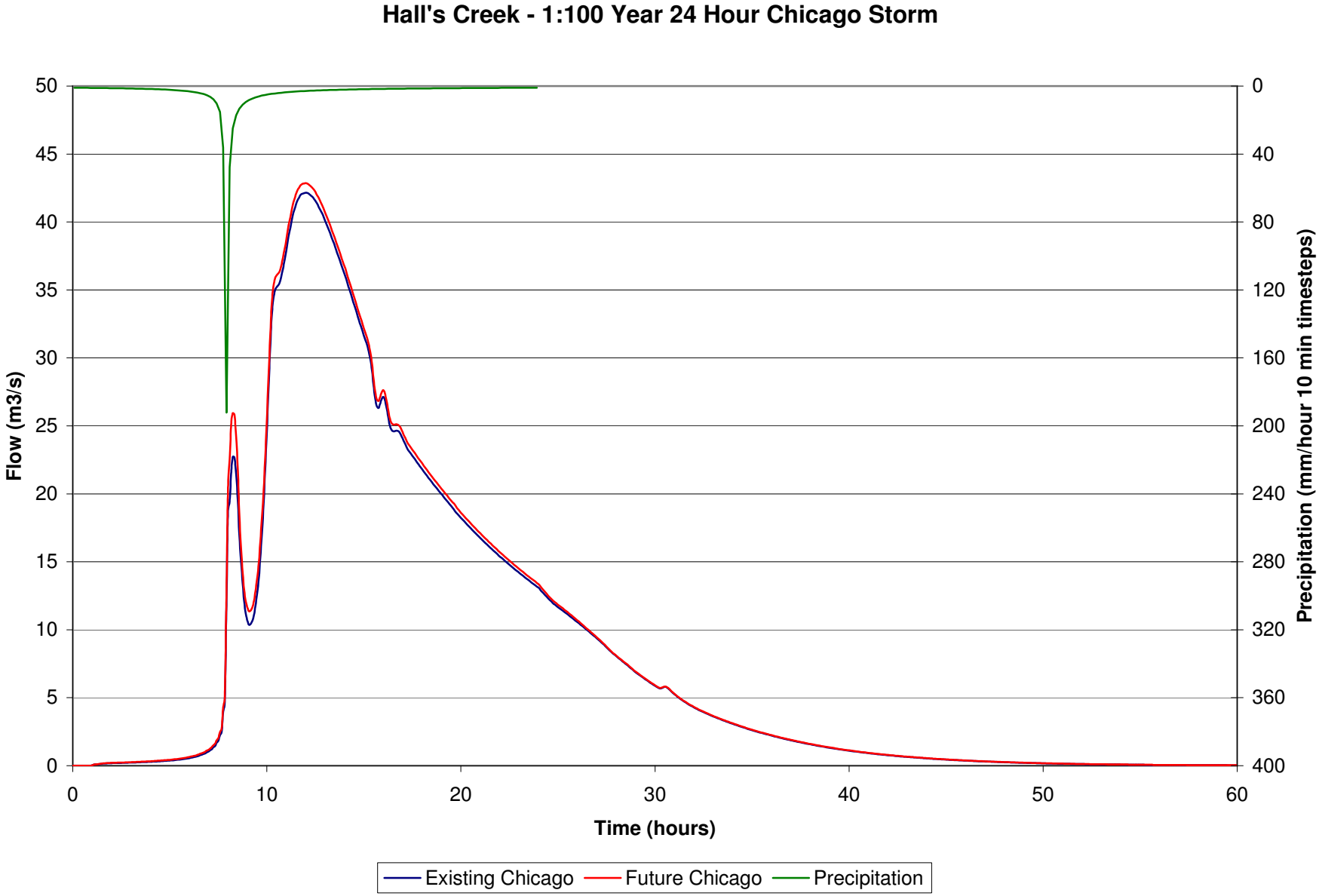

Hall's Creek - 1:2 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
0
67
133
200
267
333
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

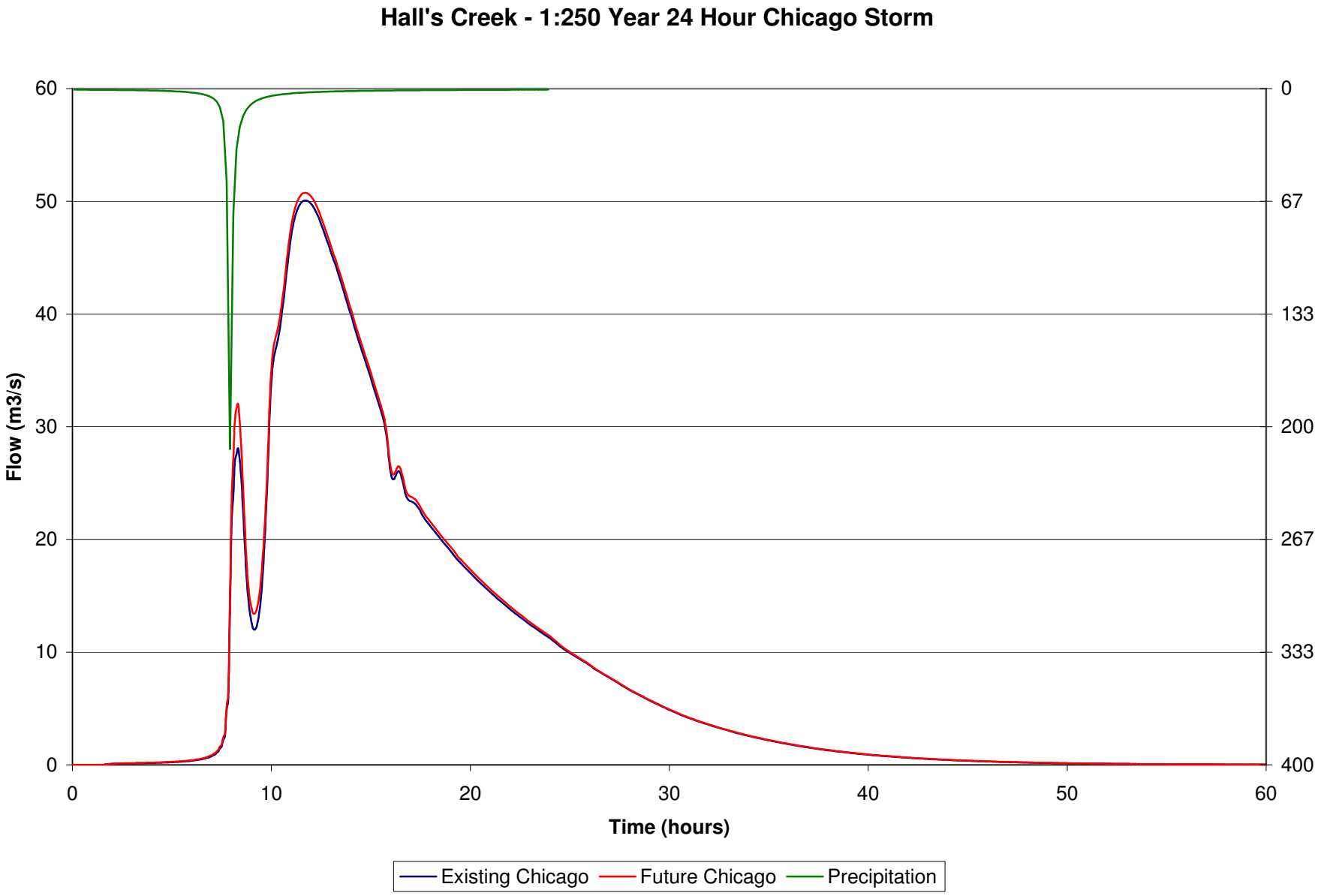

Hall's Creek - 1:5 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

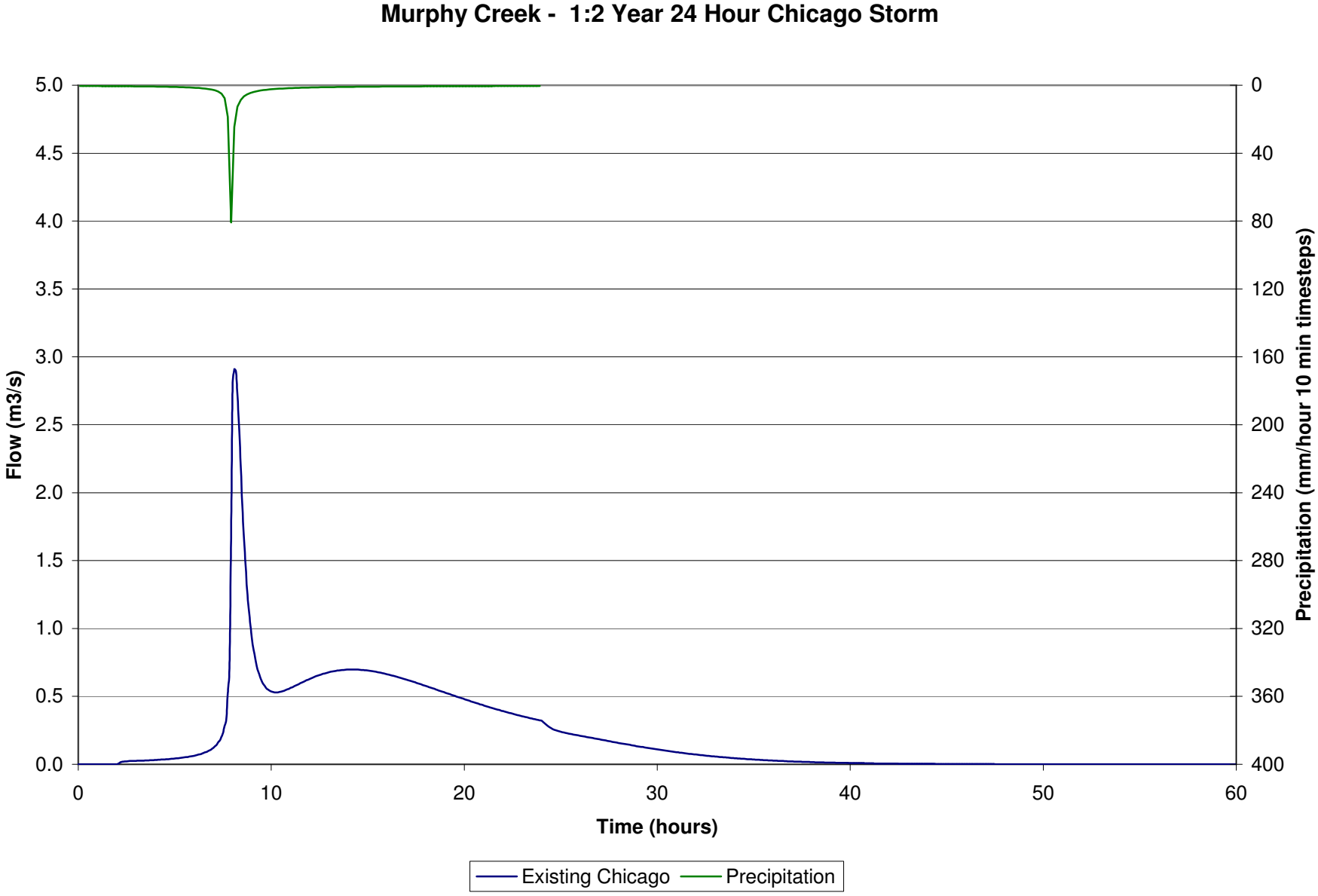

Hall's Creek - 1:10 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
0
80
160
240
320
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

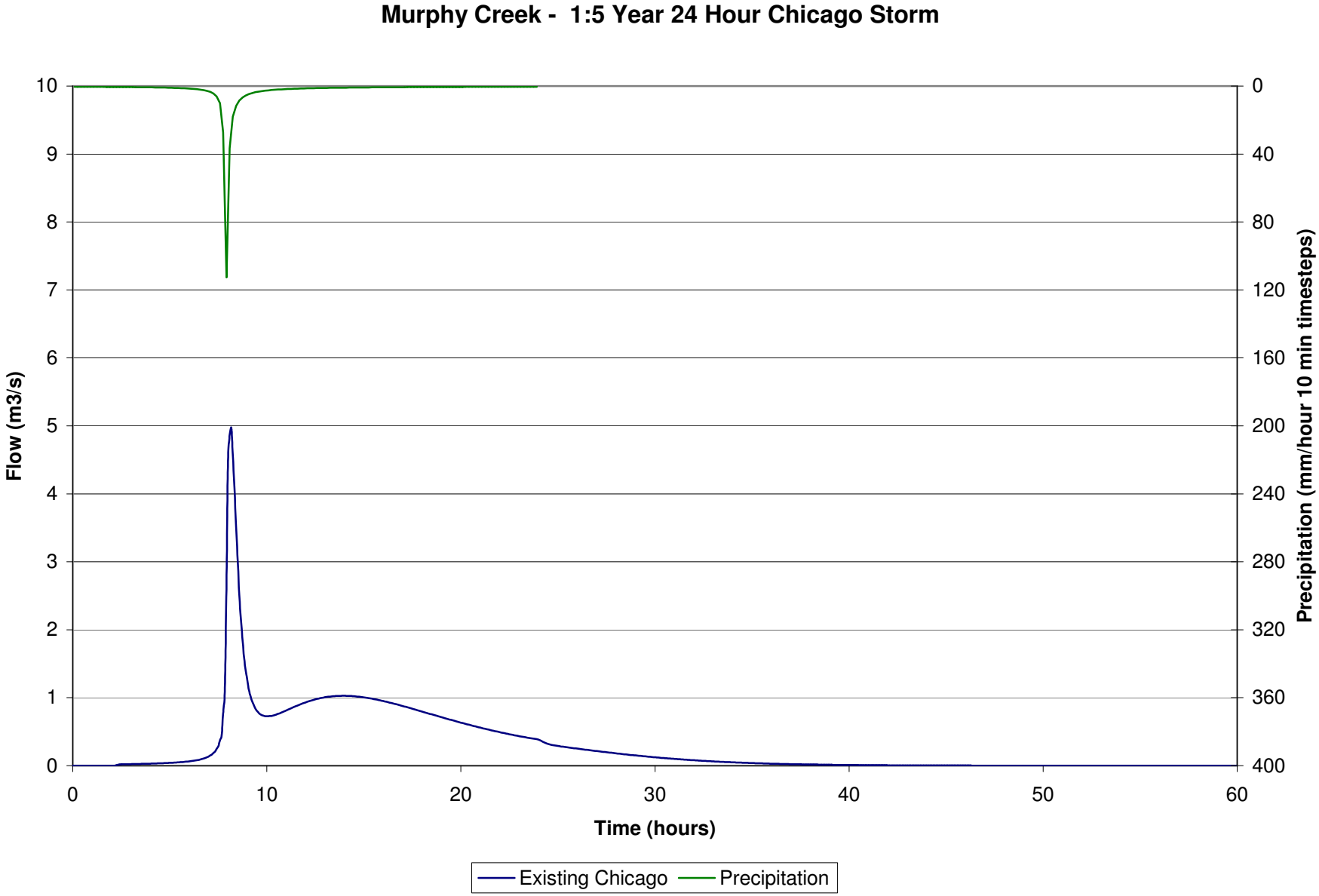

Hall's Creek - 1:25 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

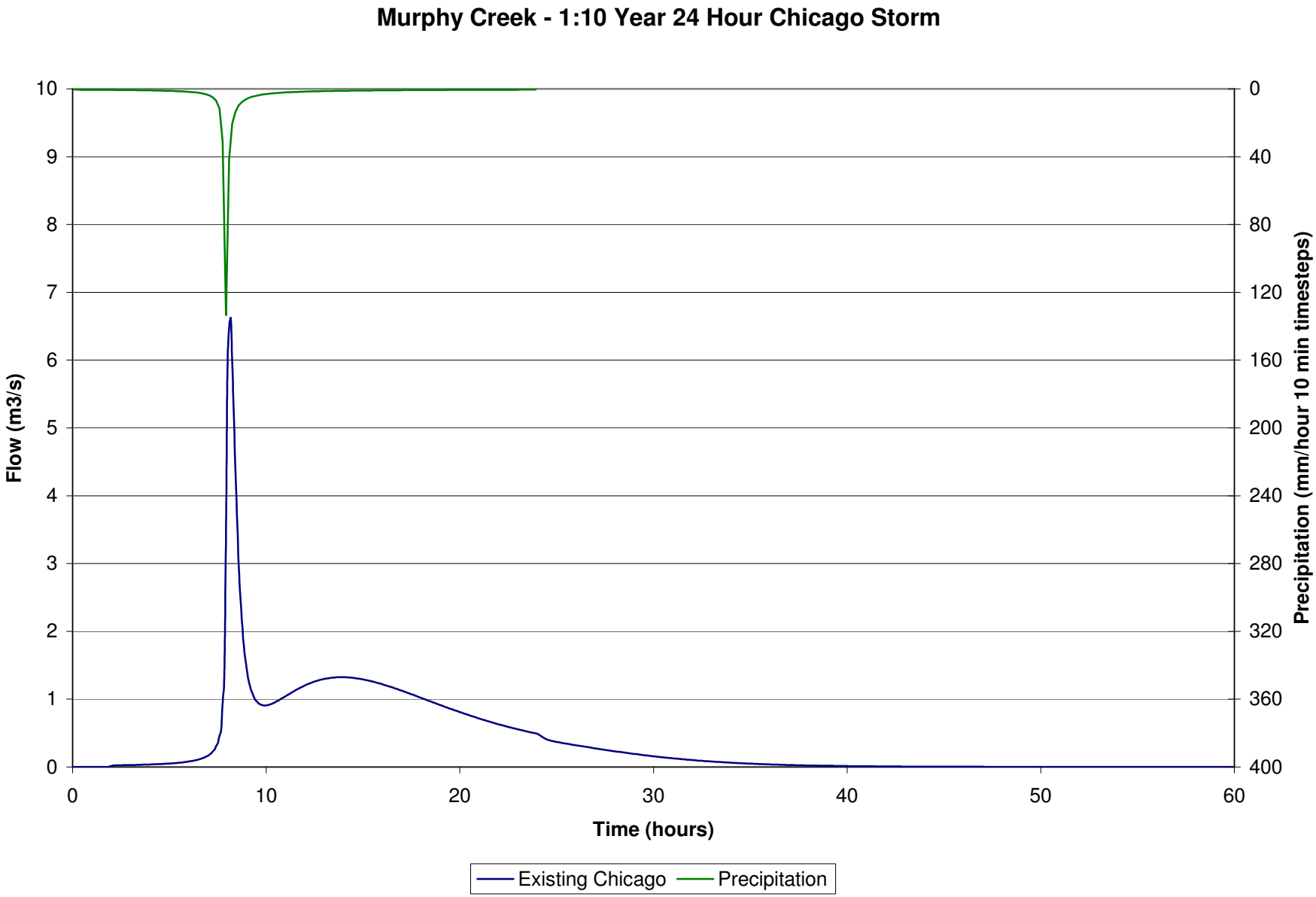

Hall's Creek - 1:50 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

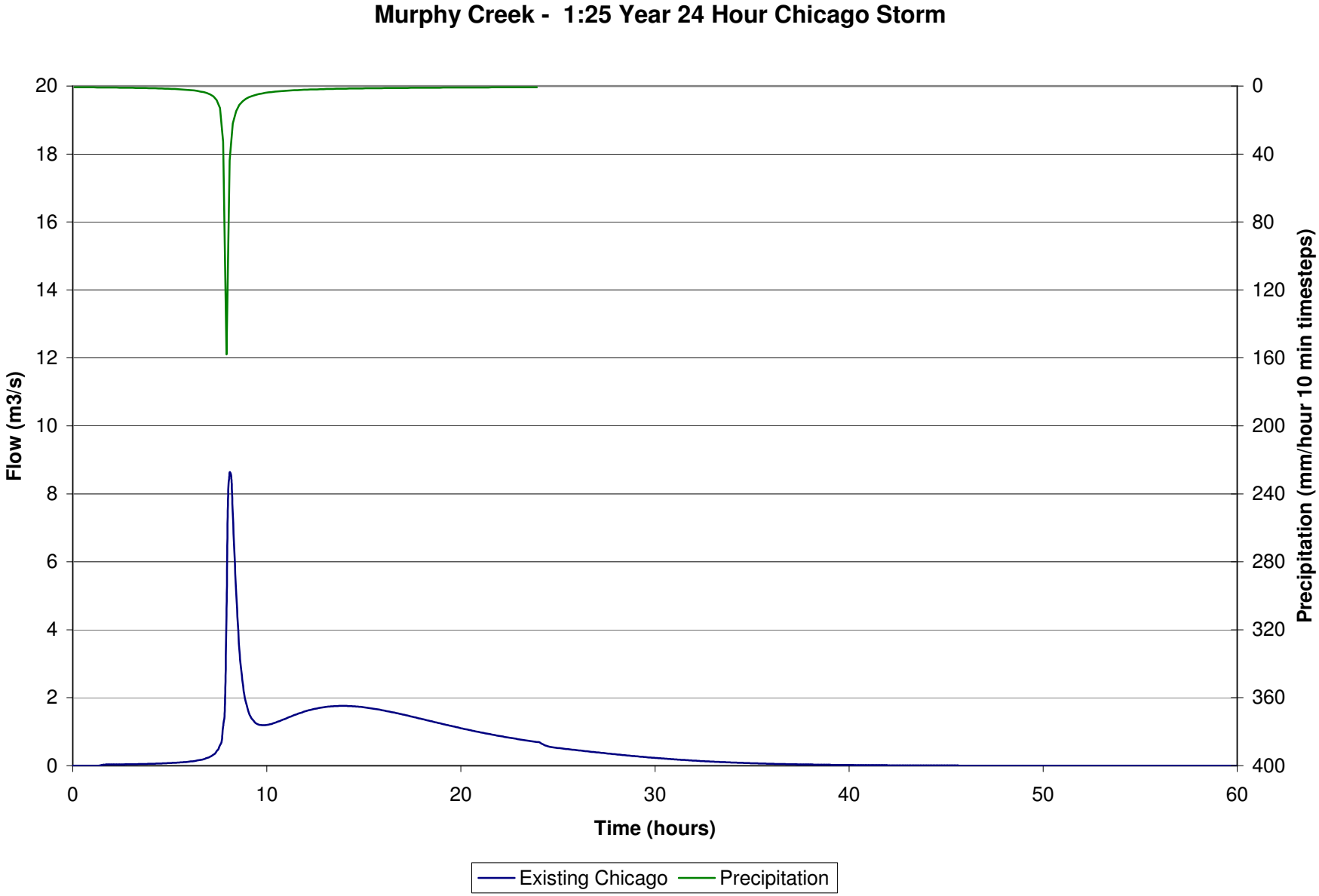

Hall's Creek - 1:100 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
45
50
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

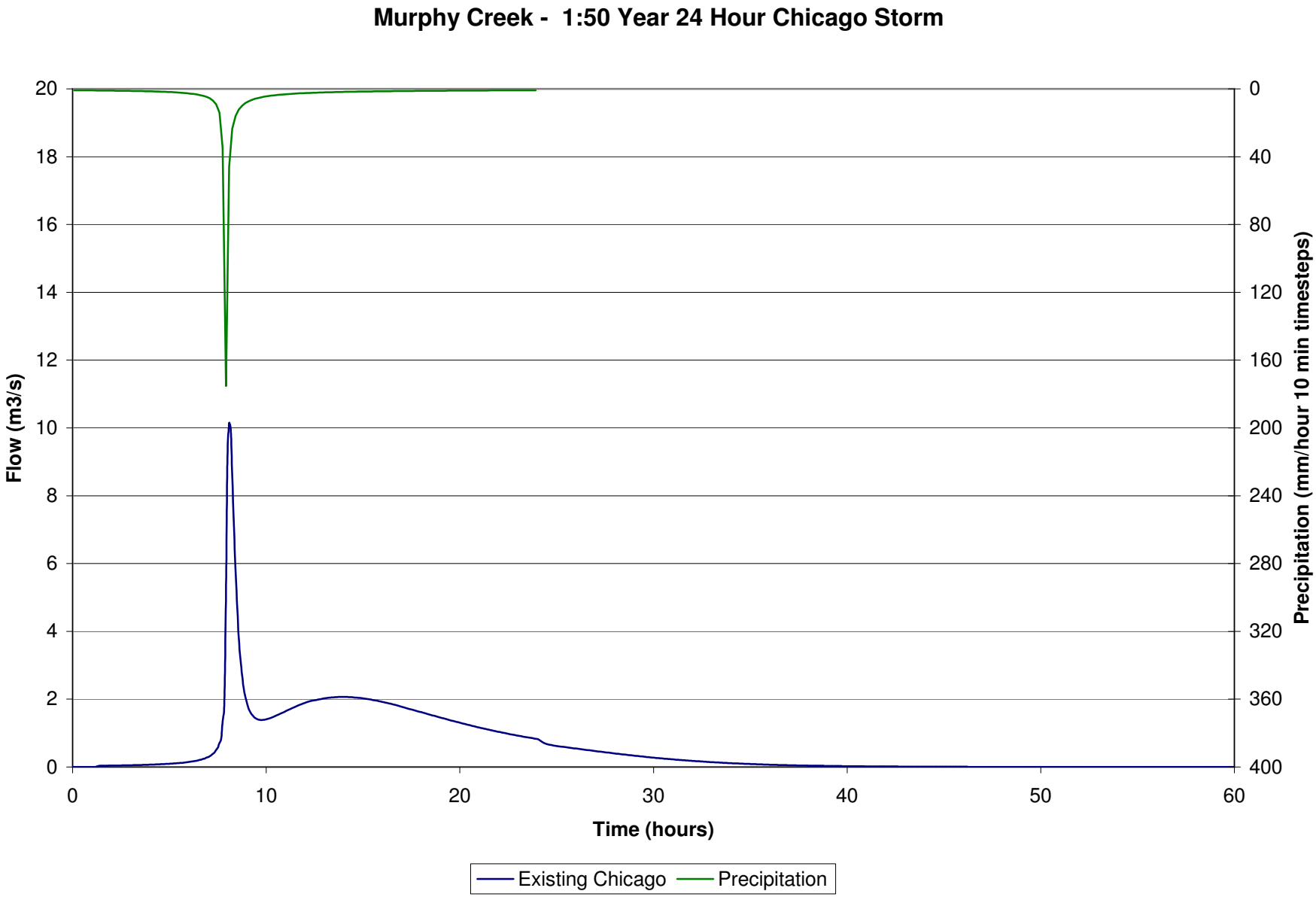

Hall's Creek - 1:250 Year 24 Hour Chicago Storm
Flow (m3/s)
60
50
40
30
20
10
0
0
67
133
200
267
333
400
0
10
20
30
40
50
60
Time (hours)
Existing Chicago
Future Chicago
Precipitation

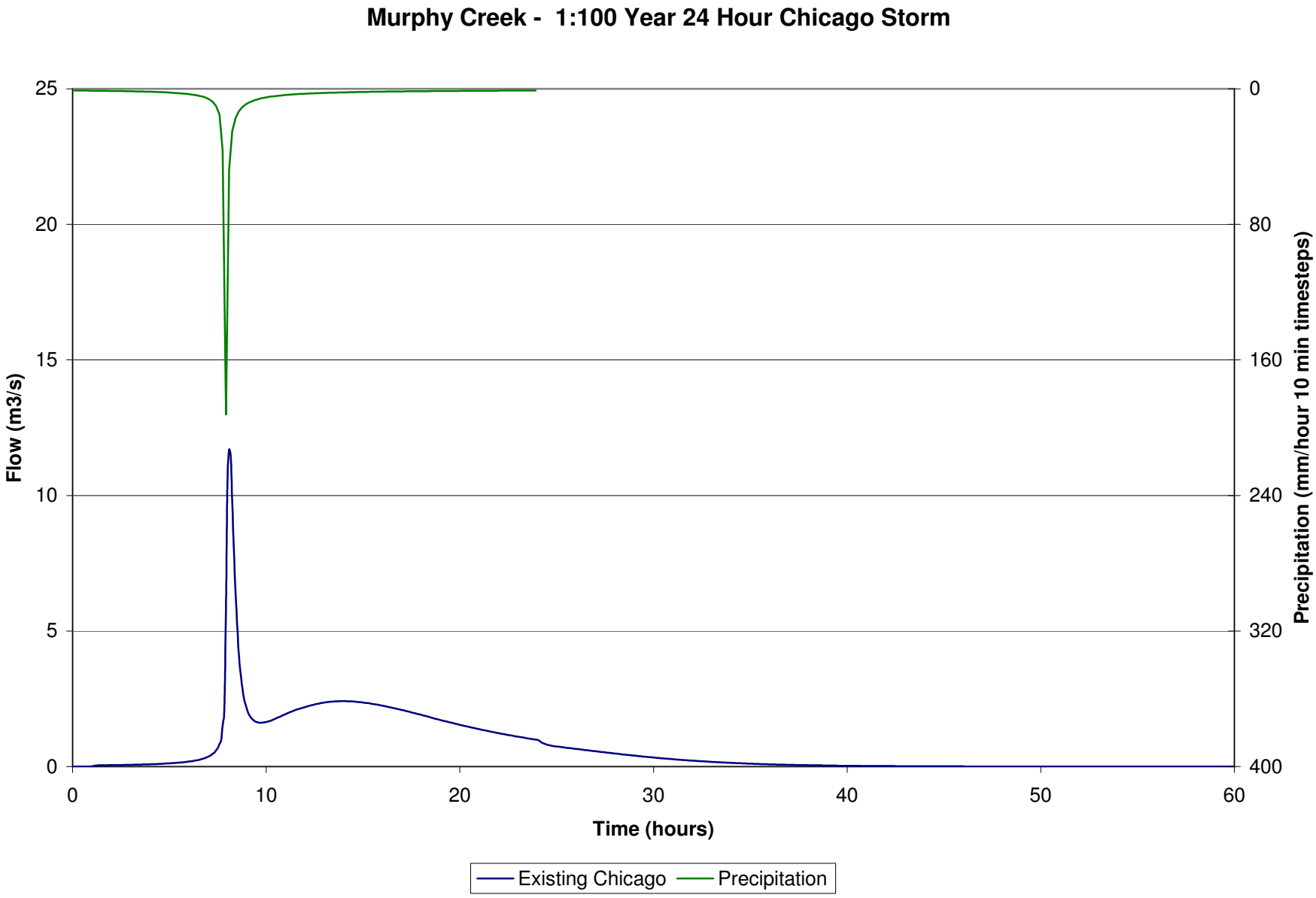

Murphy Creek - 1:2 Year 24 Hour Chicago Storm
Flow (m3/s)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Precipitation (mm/hour 10 min timesteps)
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Time (hours)
Existing Chicago
Precipitation

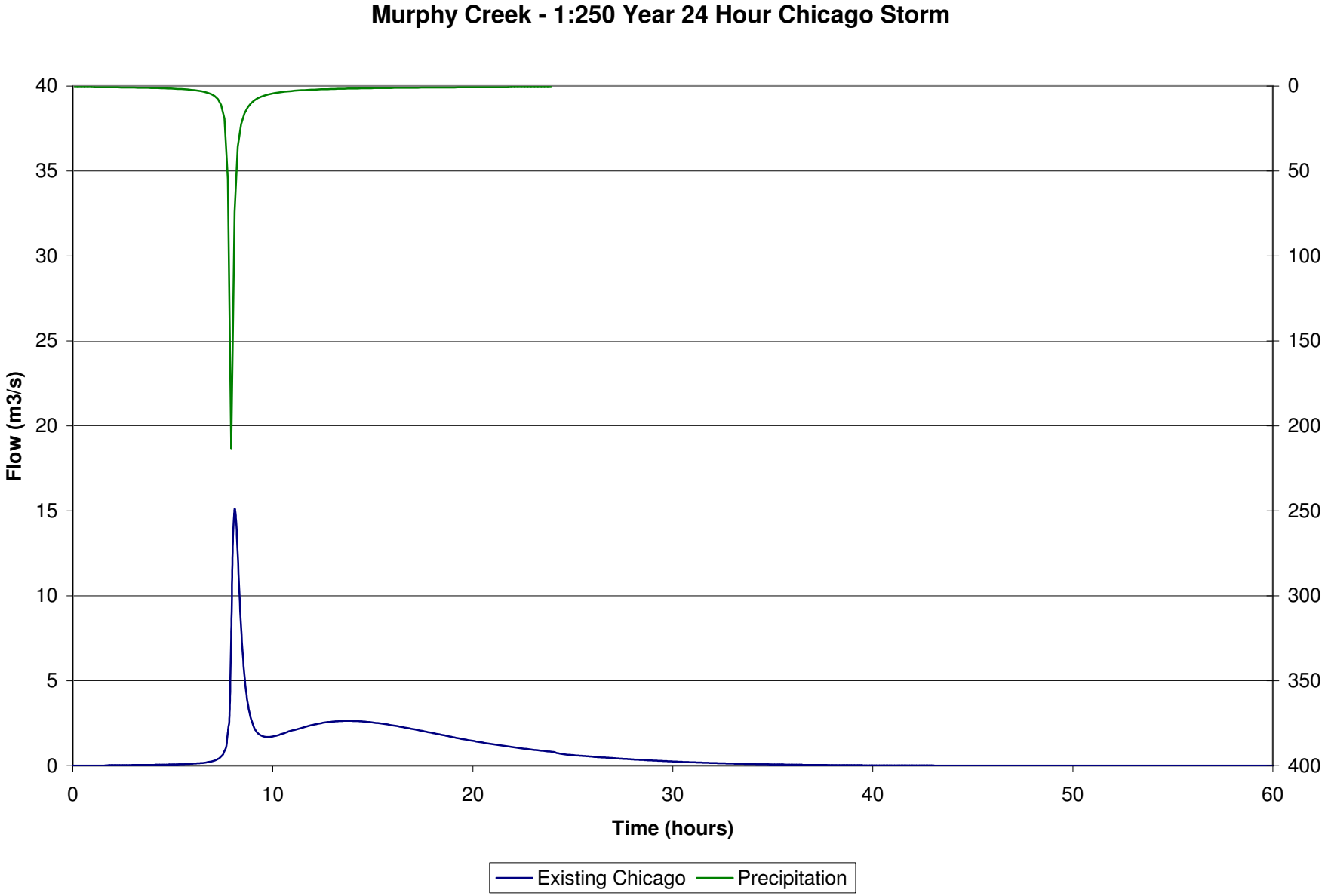

Murphy Creek - 1:5 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

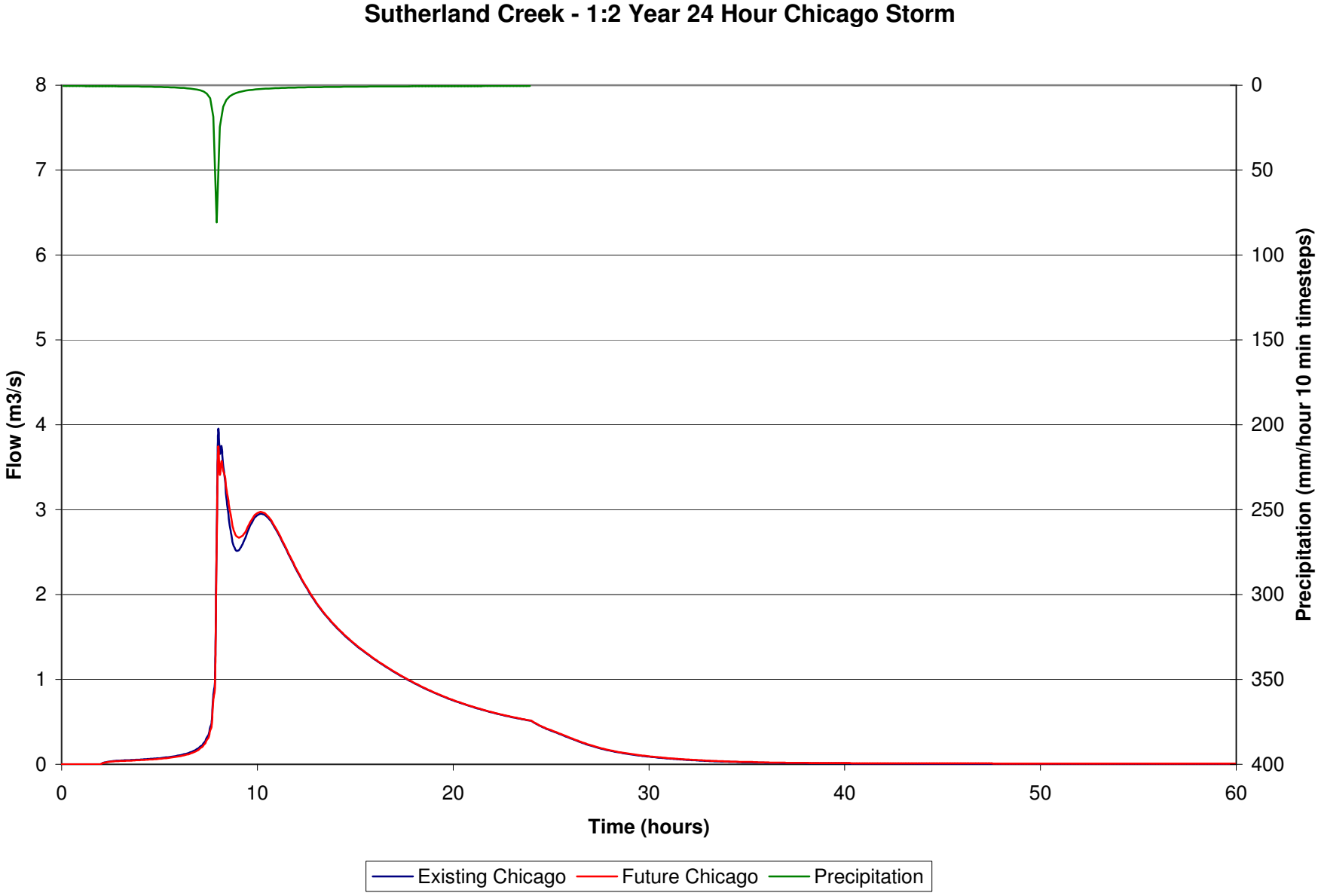

Murphy Creek - 1:10 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation


Murphy Creek - 1:25 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

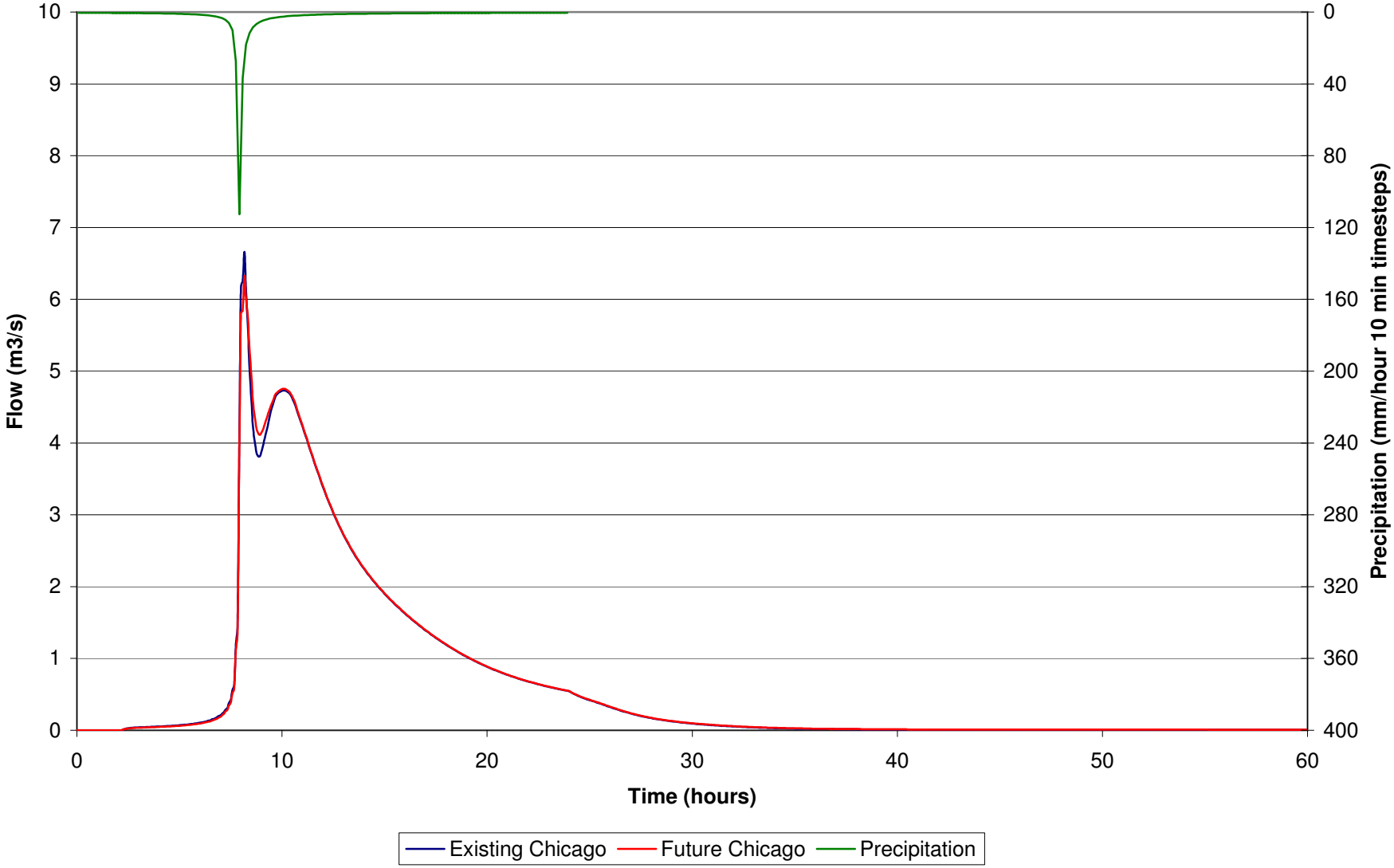

Murphy Creek - 1:50 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

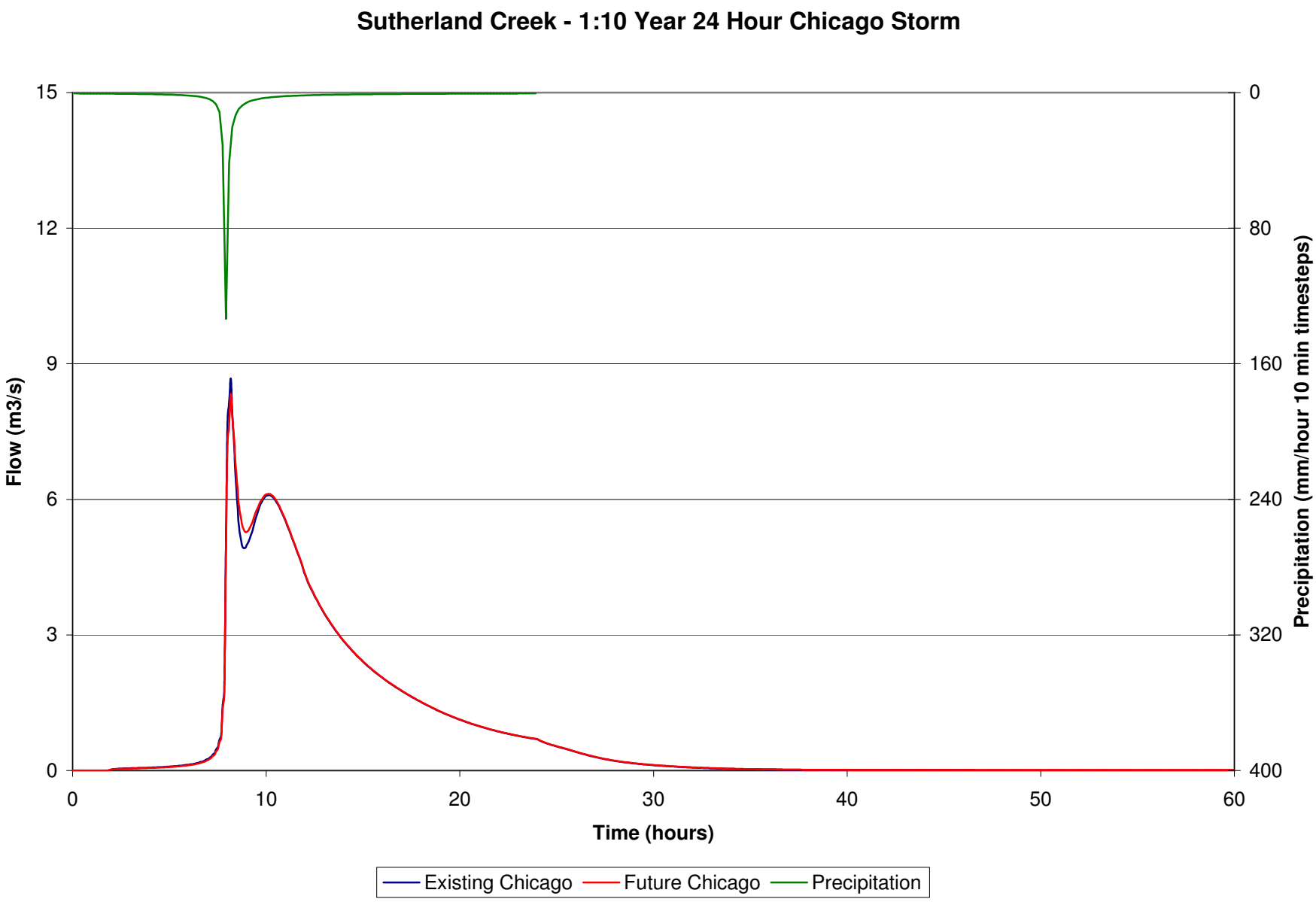

Murphy Creek - 1:100 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
0
80
160
240
320
400
0
10
20
30
40
50
60
Existing Chicago
Precipitation

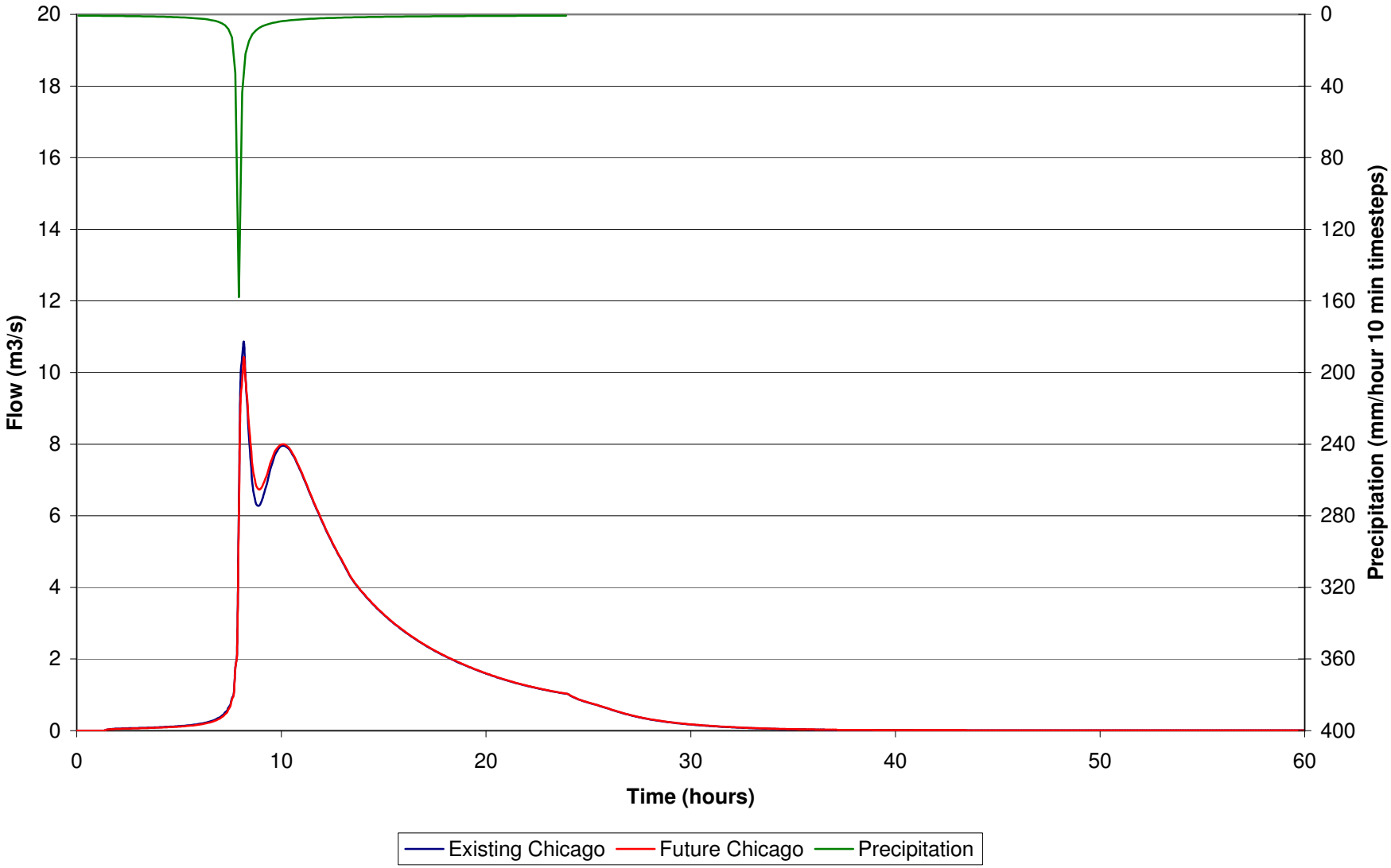

Murphy Creek - 1:250 Year 24 Hour Chicago Storm
Flow (m3/s)
40
35
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Time (hours)
Existing Chicago
Precipitation

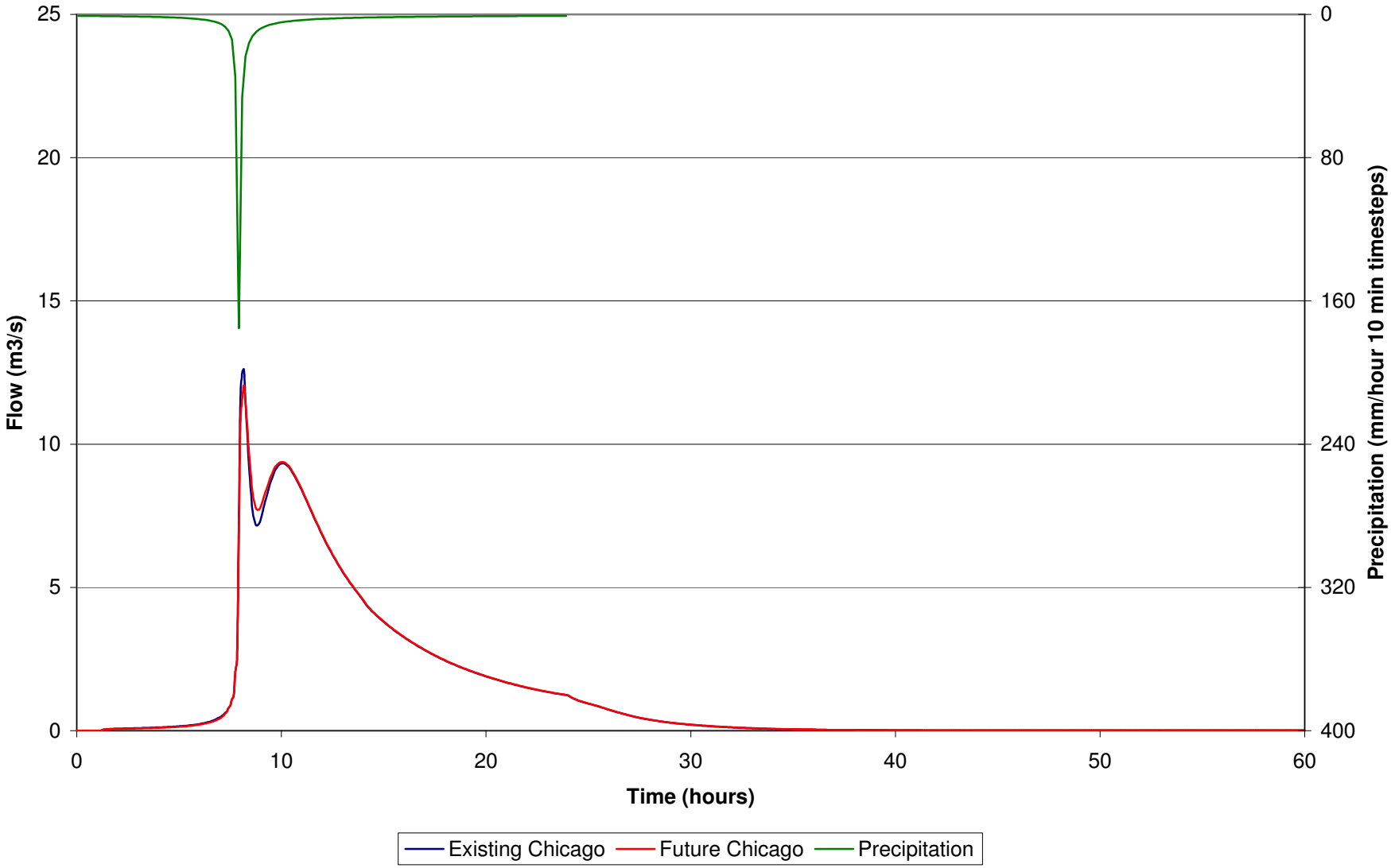

Sutherland Creek - 1:2 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

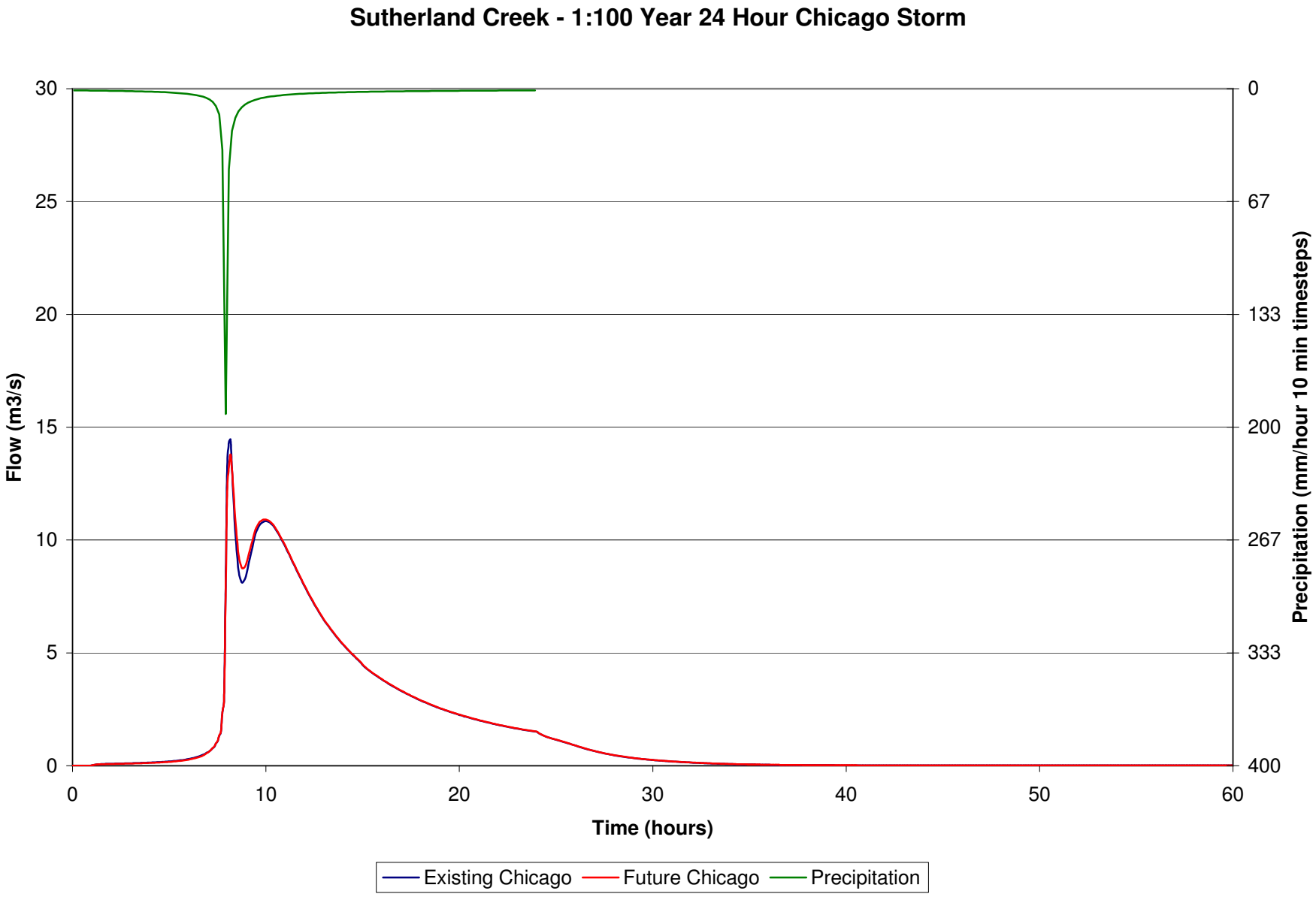
Sutherland Creek - 1:5 Year 24 Hour Chicago Storm

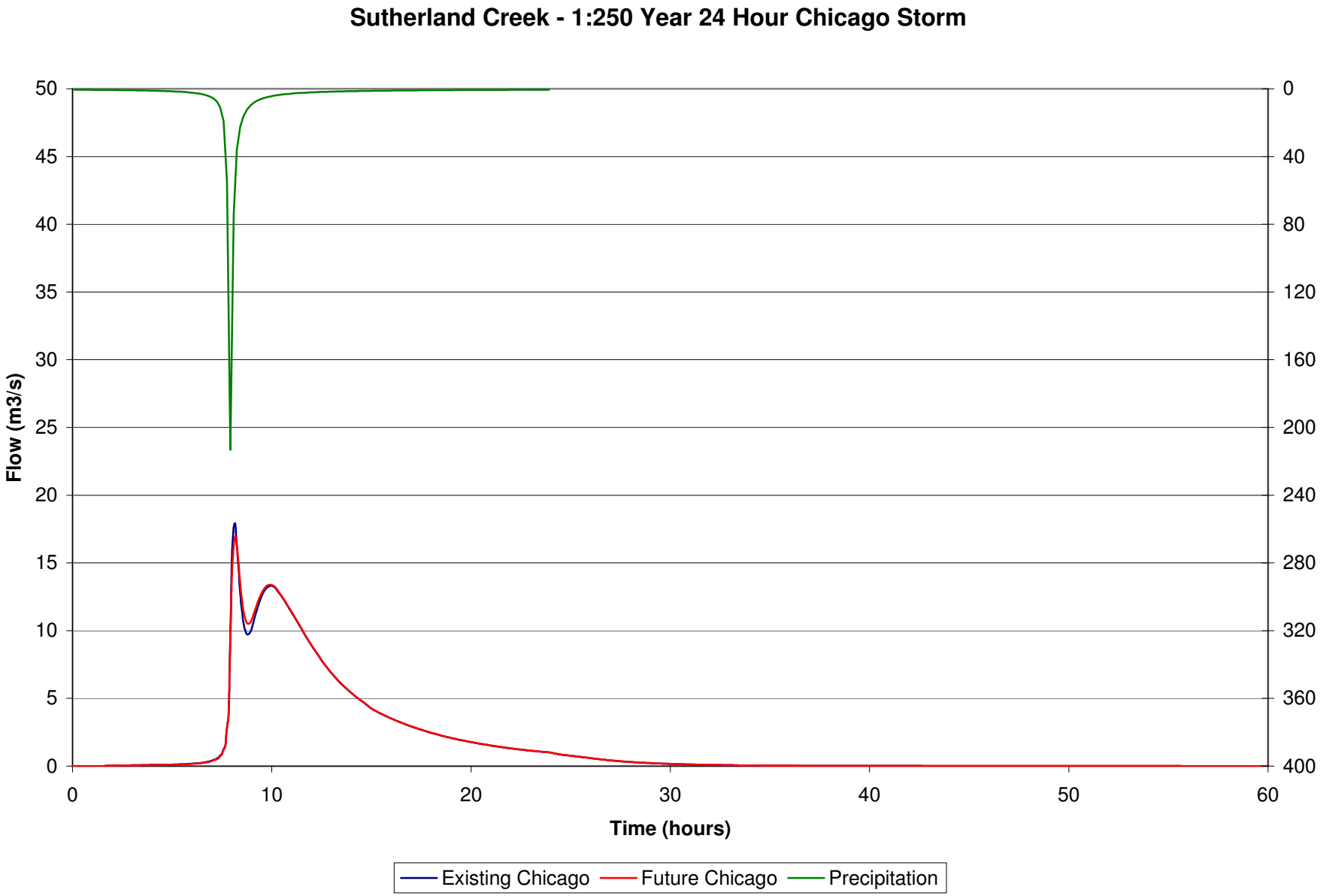


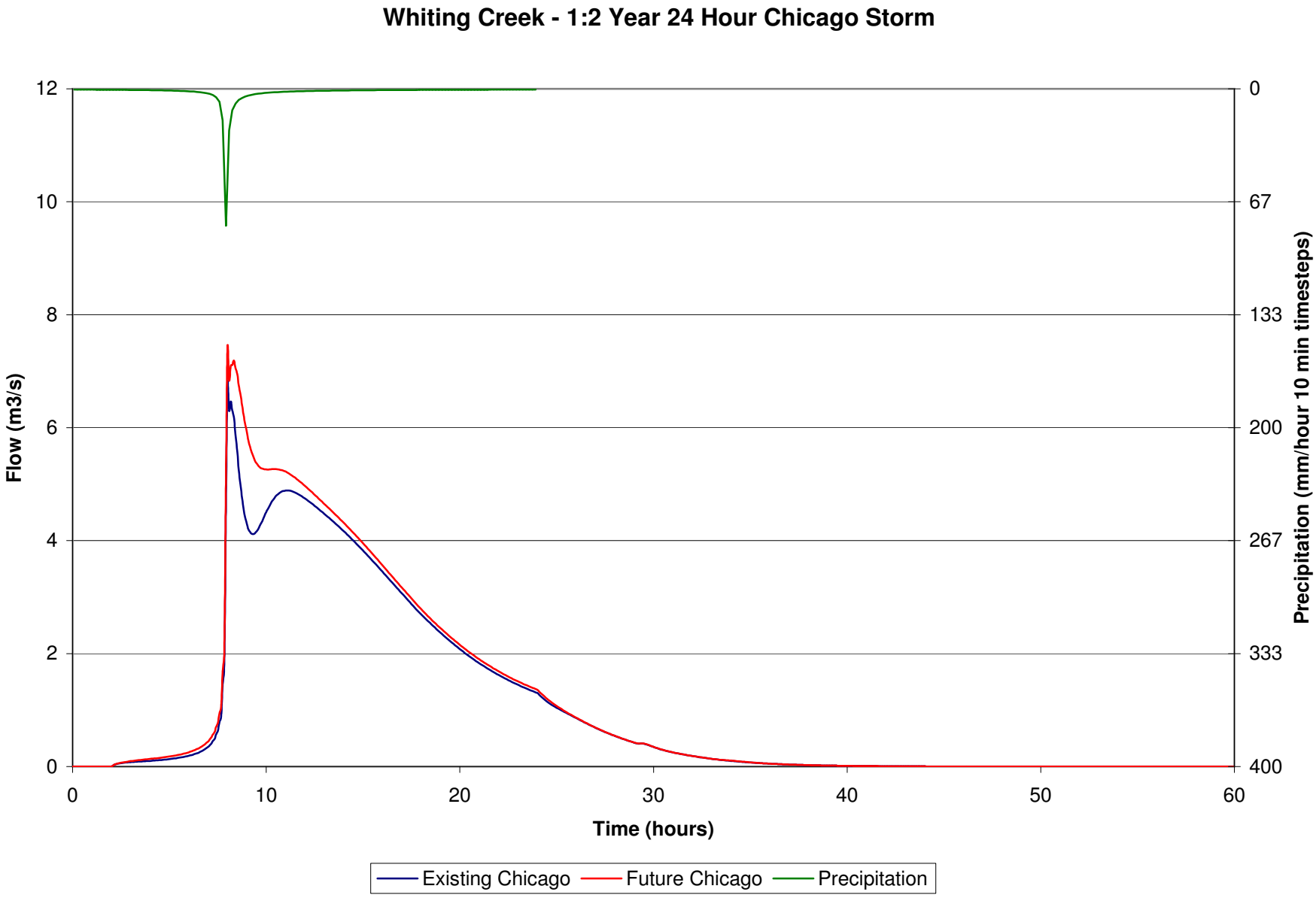

Sutherland Creek - 1:10 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
3
6
9
12
15
0
80
160
240
320
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

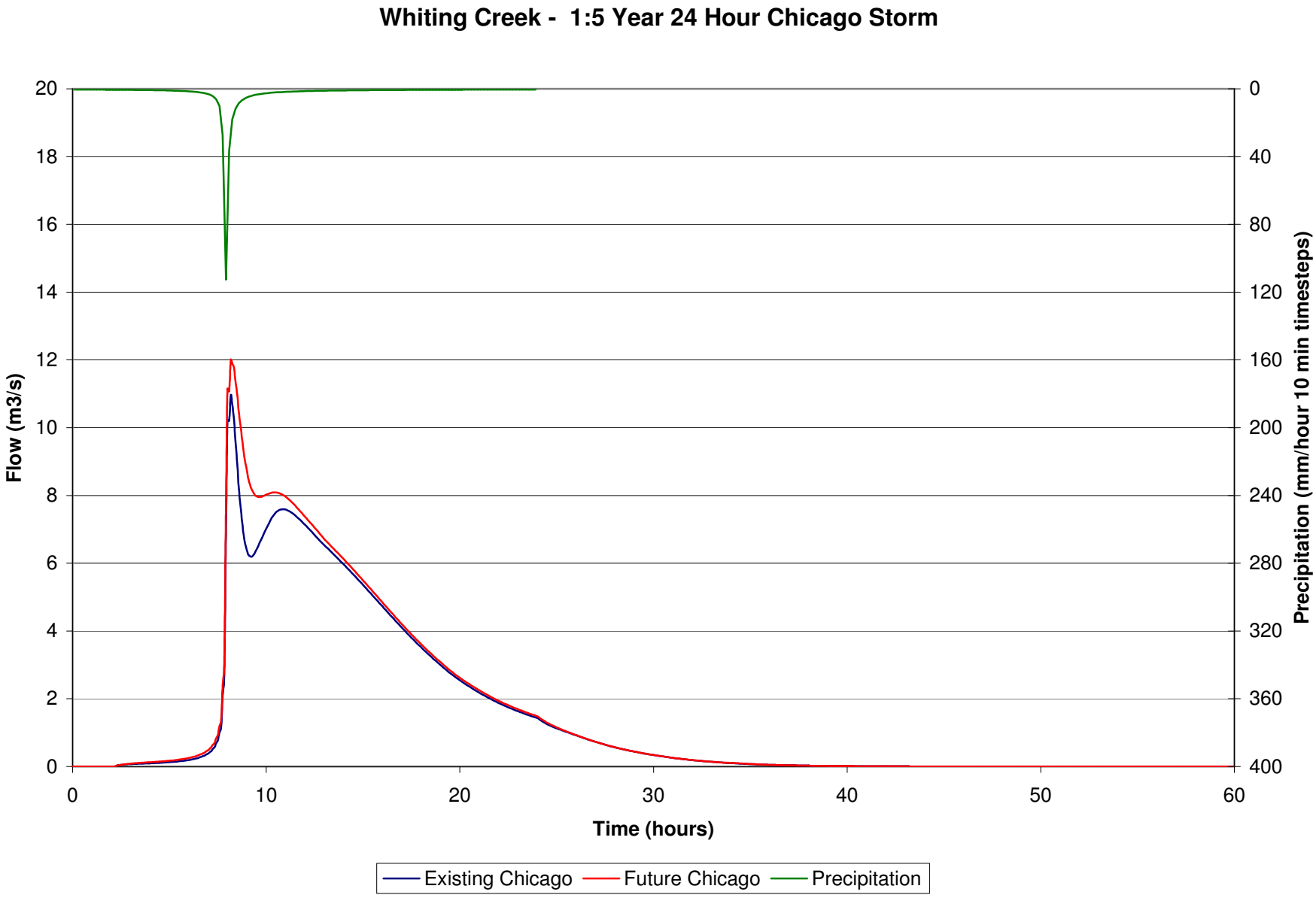

Sutherland Creek - 1:25 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

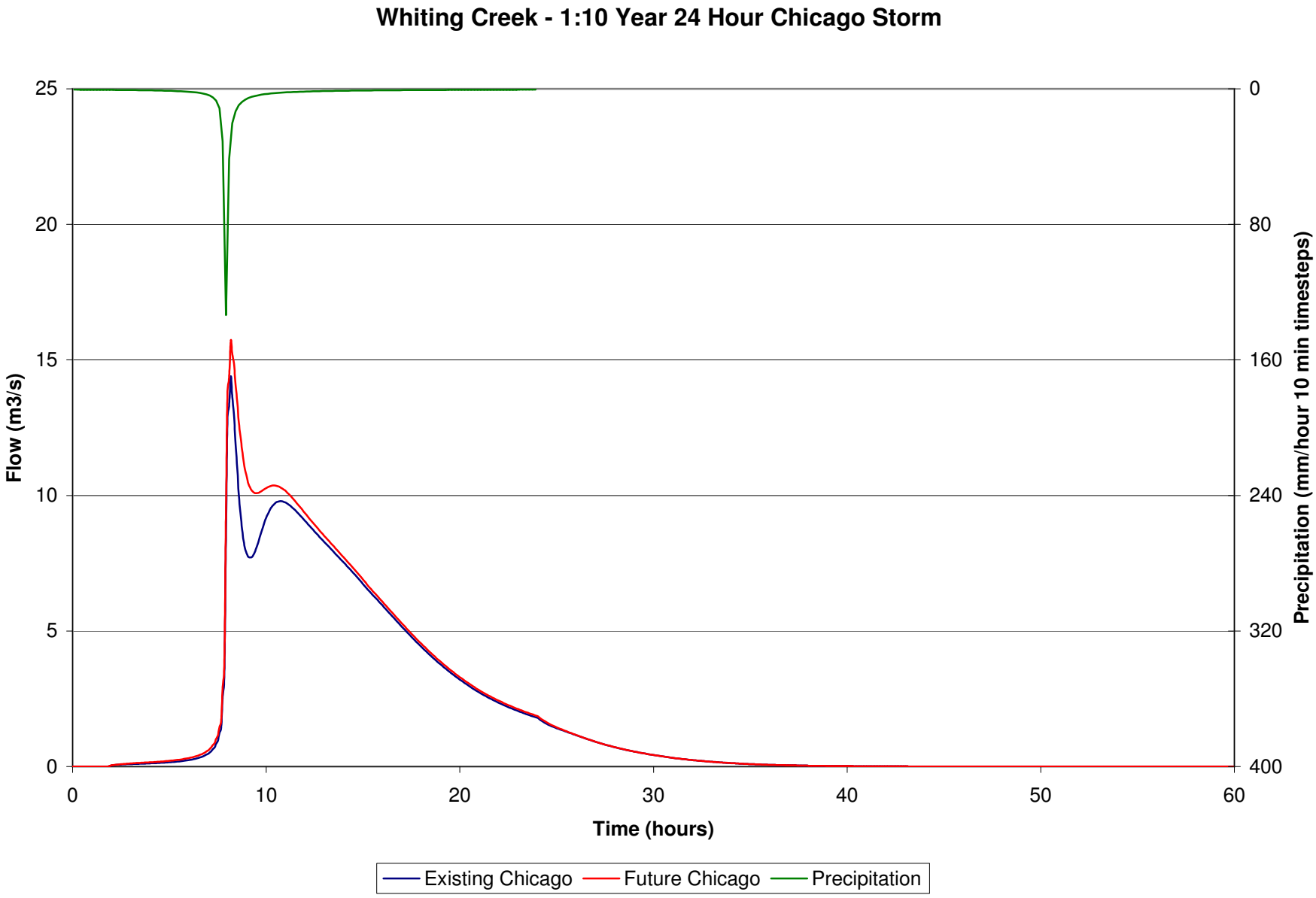

Sutherland Creek - 1:50 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
0
10
20
30
40
50
60
80
160
240
320
400
Existing Chicago
Future Chicago
Precipitation

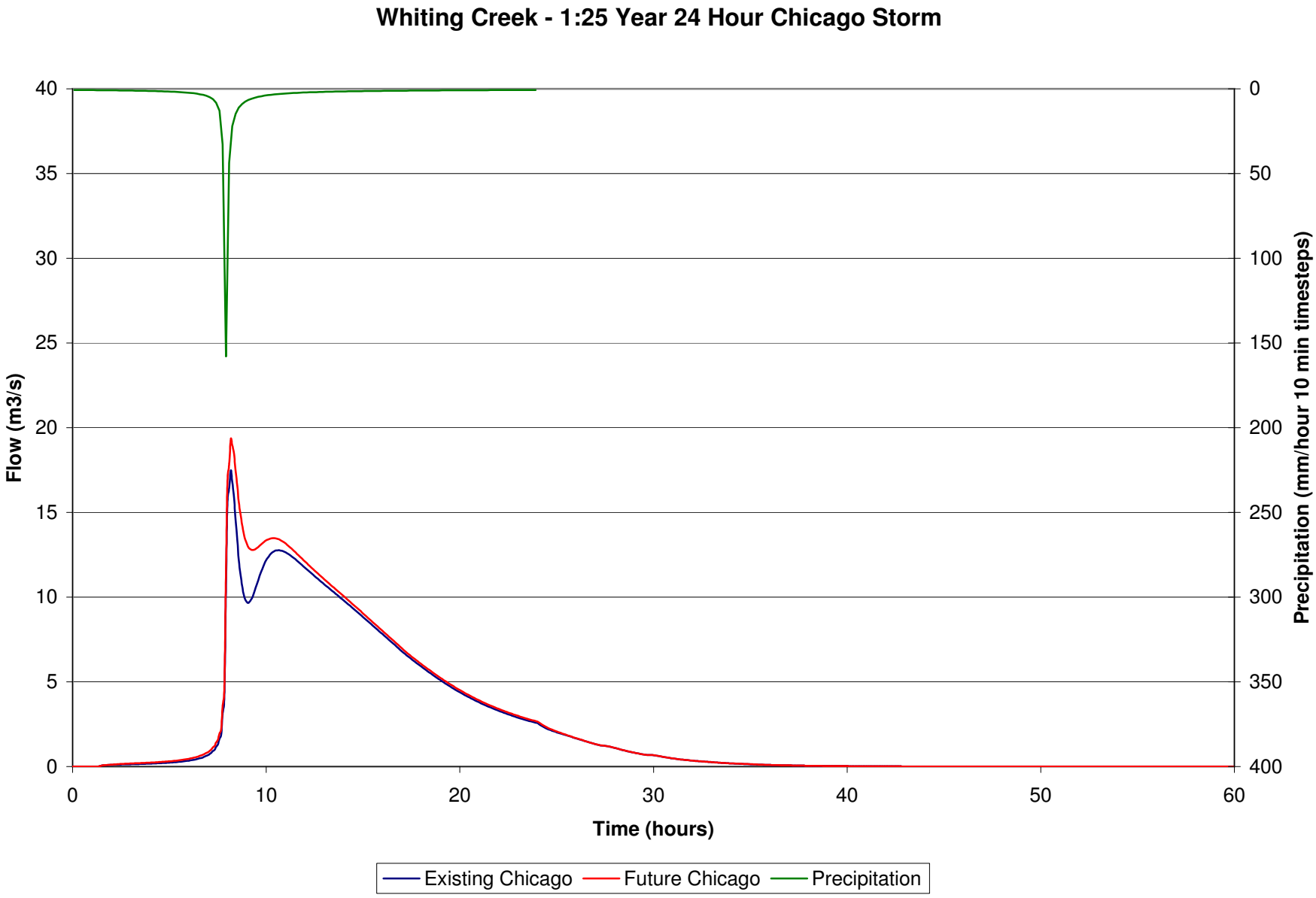

Sutherland Creek - 1:100 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
0
10
20
30
40
50
60
0
67
133
200
267
333
400
Existing Chicago
Future Chicago
Precipitation

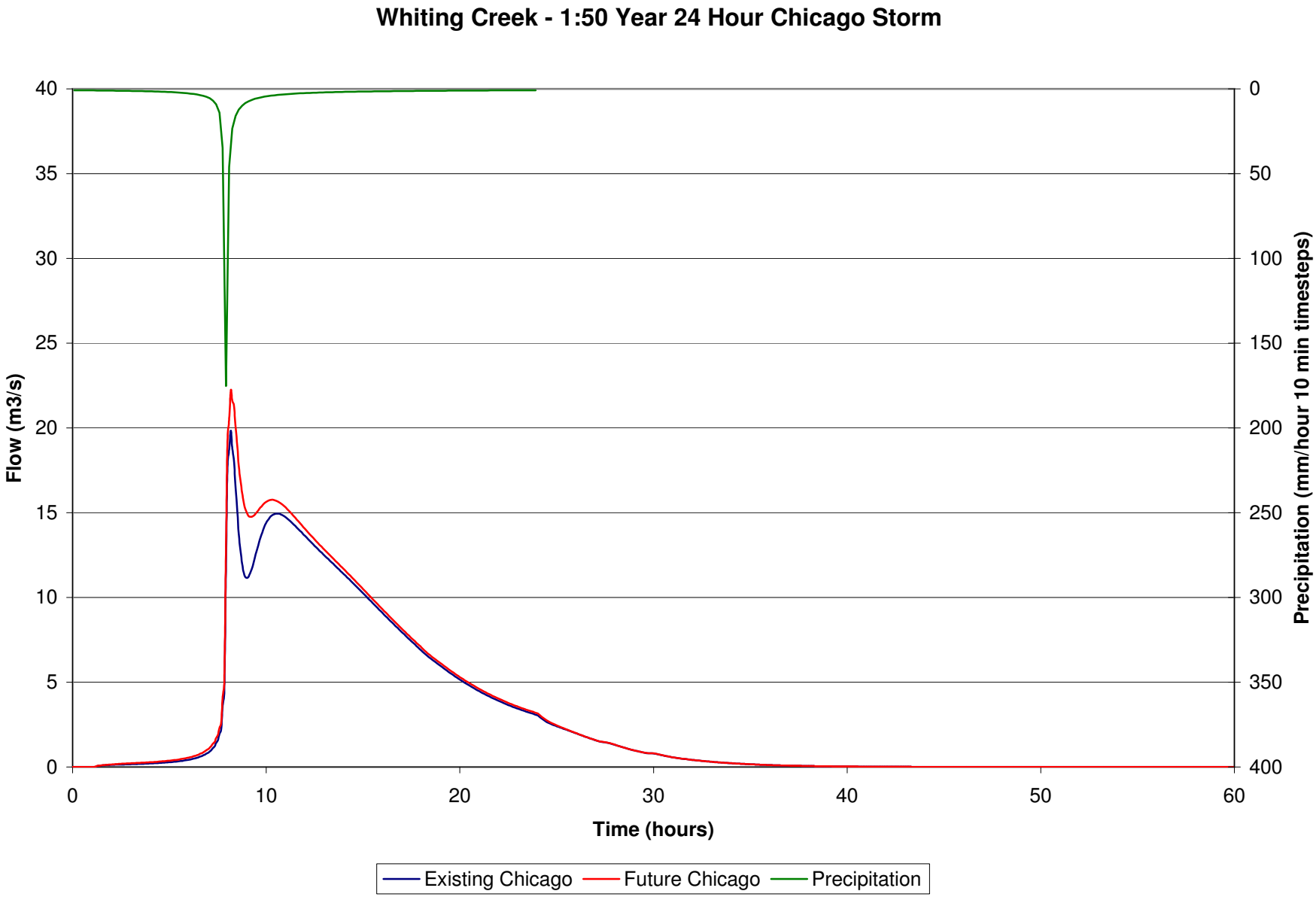

Sutherland Creek - 1:250 Year 24 Hour Chicago Storm
Flow (m3/s)
50
45
40
35
30
25
20
15
10
5
0
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Time (hours)
Existing Chicago
Future Chicago
Precipitation

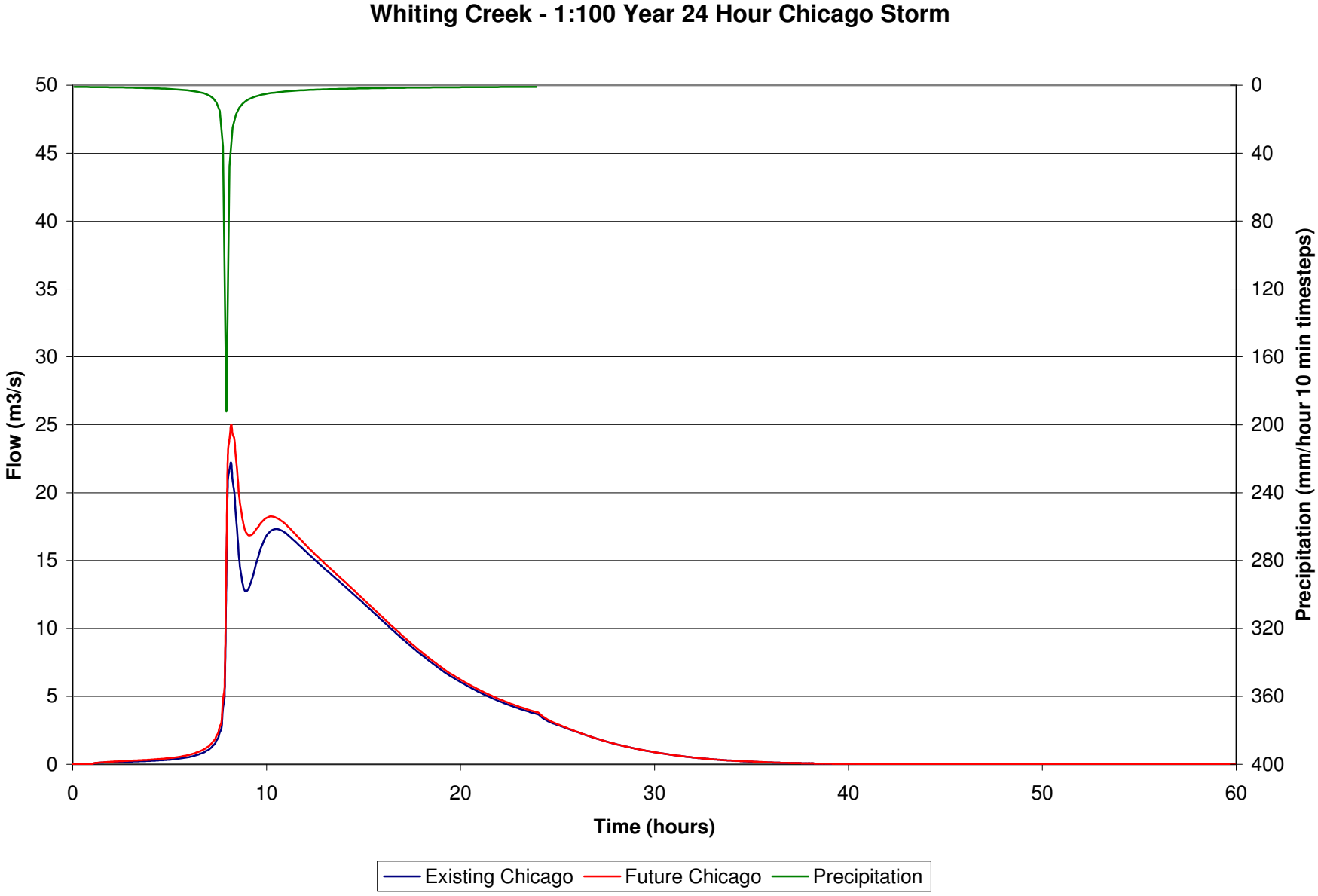

Whiting Creek - 1:2 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
0
67
133
200
267
333
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation

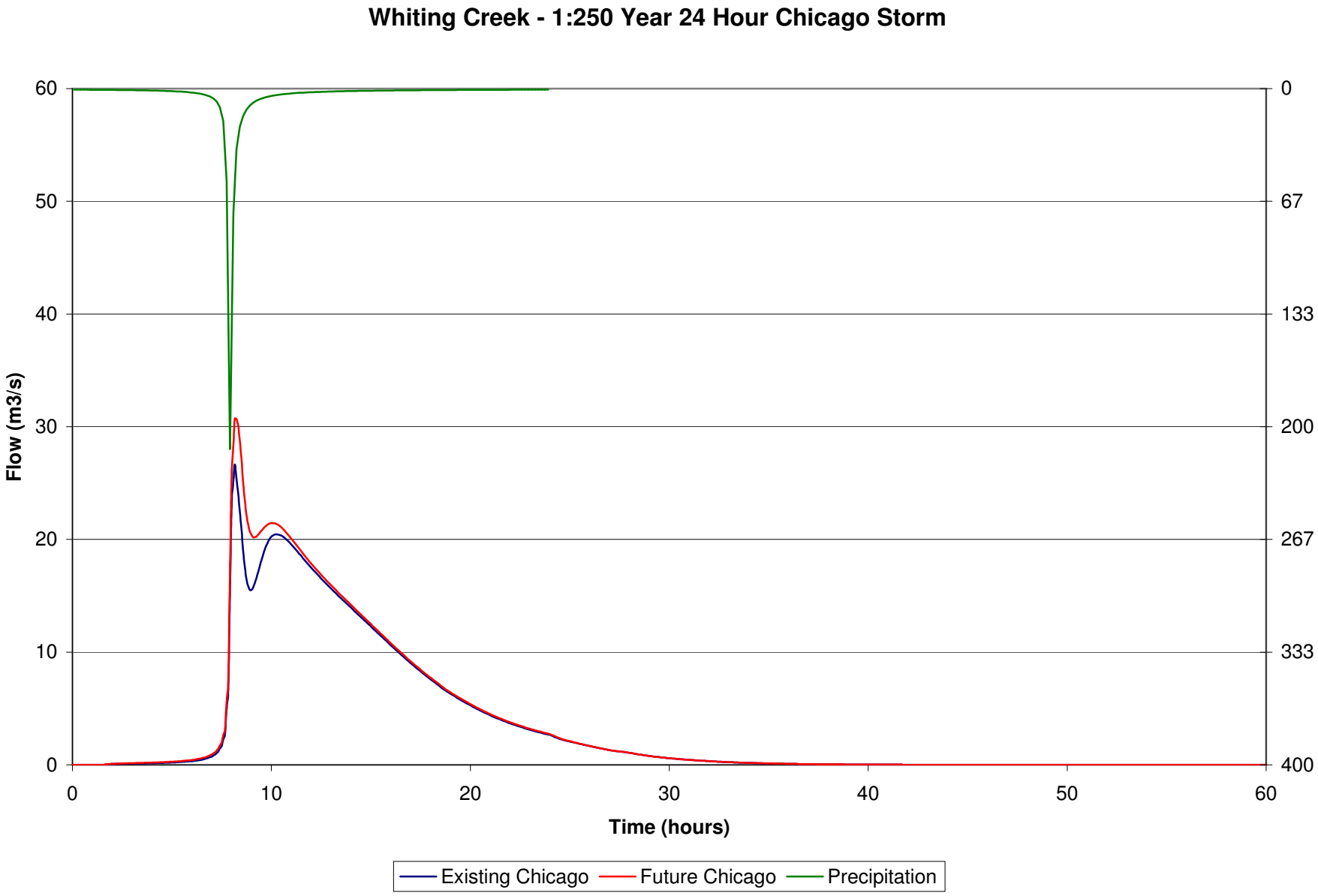

Whiting Creek - 1:5 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation


Whiting Creek - 1:10 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
0
80
160
240
320
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation


Whiting Creek - 1:25 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation


Whiting Creek - 1:50 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation


Whiting Creek - 1:100 Year 24 Hour Chicago Storm
Flow (m3/s)
Precipitation (mm/hour 10 min timesteps)
Time (hours)
0
5
10
15
20
25
30
35
40
45
50
0
40
80
120
160
200
240
280
320
360
400
0
10
20
30
40
50
60
Existing Chicago
Future Chicago
Precipitation


Whiting Creek - 1:250 Year 24 Hour Chicago Storm
Flow (m3/s)
60
50
40
30
20
10
0
0
67
133
200
267
333
400
0
10
20
30
40
50
60
Time (hours)
Existing Chicago
Future Chicago
Precipitation

APPENDIX F
REPORT FROM JANUARY 19, 2006
PUBLIC INFORMATION CENTRE

January 23, 2005

DILLON
CONSULTING

Town of Ingersoll
130 Oxford Street, 2nd Floor
Ingersoll, Ontario
N5C 2V5

Attention: Mr. G. McLaren, CET
Engineering Services Coordinator

Town of Ingersoll
Stormwater Management Study

Dear Mr. McLaren:

Enclosed is a copy of the Public Information Centre handouts, boards, sign-in sheets and comments turned in at the PIC.

If you receive any more comment forms, please forward a copy to our office.

Yours sincerely,

DILLON CONSULTING LIMITED

Brian Huston, P.Eng.
Project Manager

BGH:c;r
Encls.

cc : Rick Goldt, UTRCA (encls.)
Ivan Lorant, Dillon (encls.)

Our File: 04-4019

495
Richmond Street
London, Ontario
Canada
N6A 5A9
Mail: Box 426
London, Ontario
Canada
N6A 4W7
Telephone
(519) 438-6192
Fax
(519) 672-8209

Town of Ingersoll Stormwater Management Study

UPPER THAMES RIVER
CONSERVATION AUTHORITY

Town of Ingersoll Stormwater Management Strategy Study

Drop-in Centre Format

- Handouts and video presentation of study details
- Display boards of key study issues and maps
- Dillon, UTRCA and Town staff on hand to answer questions
- Comment forms to allow input to be provided to study team.

Town of Ingersoll Stormwater Management Strategy Study

Phase 1 (Work to date)

- Prepare inventory (flooding, erosion, and stormwater management facilities)
- Information gaps and issues
- Computer modeling of flows
- Preliminary set of goals and objectives
- Interim Stormwater Management Policies
- Comprehensive set of Terms of Reference for a Stormwater Management Strategy study

Interim Policies Developed

- Protect natural environment
- Control stormwater quality
- Control stormwater quantity
- Control erosion
- Control groundwater
- Infrastructure
- Public awareness

What's Next

- Input from public agencies and stakeholders
- Finalize Phase work and prepare SWM Strategy
- Town to proceed with future (Phase 2) work:
  - Additional background data and information
  - Constructs and concerns
  - Targets for water quality and quantity, fish, aquatic habitats
  - Management strategy
  - Recommended Best Management Practices
  - Implementation Strategy

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2005, 3:00 to 7:00 p.m.
Ingersoll Town Centre

2 - a Herdues didn't wish to sign in (Comm. from Cam.)

RECORD OF ATTENDANCE

NAME (please print)	ADDRESS (please print)	POSTAL CODE
PETER RIGBY	308 THAMES ST. S. INGERSOLL	N5C 2J1
WAYNE CAMPBELL	14 FERGUSON AVE INGERSOLL	N5C 1E4
Oswald & Carol Dong	9. N. Town Line E, Ing.	N5C 1R3
LAWRENCE BECKETT	100 CANDLEFEE ST. INC	N5C 4A8
JOE HEYNINCK	IBI GROUP 350 OXFORD ST W. LONDON	N6N 3Y6
Brenda Harris	234 Charles St E. Ingersoll	N5C 1K5
KATHY BOOT	190 McKEAND ST. INGERSOLL	N5C 3V1
Don Myer	190 McKeand St Ingersoll	N5C-3V1
PAT NAPTHEN	59 CARNEGIE ST INGERSOLL	N5C-1K8
[illegible]	171 [illegible]	485-2663
ELAINE CLARK	7 RIDGE	N5C 4B8

Project No. 04-4019

UPPER THAMES RIVER CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2005, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF ATTENDANCE

NAME (please print)	ADDRESS (please print)	POSTAL CODE
SCOTT GARTON	18 MCCREERY RD	N5C-4E9
DAOEAN ASSAM	OXFORD COUNTY	N4S 7Y3
Lanie Hunt	242 CHARLES ST	N5C-1K5
MIKE MCLEHAN	8C MARKET ST - BOARTKAS	N3S-2Z8
Tony Bowden	16 cedar ct E	N5C-1A7
Lilyanne Bruce	121 Wonham St North	N5C 3G8
Morris Bruce	121 Wonham St N.	N5C 3G8
Fred Freeman	226 Wellington St.	N5C 1S8
JAMES BUDDEN	(19 DAVEY) RR2 INGERSOLL	N5C 3J5
Denise Vyse	119 Wonham St N	N5C 3G8
Steve Sutherland	113 Wonham St N	N5C 3G8

Project No. 04-4019

UPPER THAMES RIVER CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2005, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF ATTENDANCE

NAME (please print)	ADDRESS (please print)	POSTAL CODE
RALPH BENEDICT	148 CARROLL ST	N5C 1W2
Vicki Edwards	207 Wonham	N5C 2Z5

Project No. 04-4019

UPPER THAMES RIVER CONSERVATION AUTHORITY

RECEIVED JAN 20 2006

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: Morris Bruce

Address and Postal Code: 121 Wonham St North N5C 3G8

Telephone: (519) 485-2743

Comments: Culvert Under Wonham St North too Small Water way Sutherland Creek to Shallow and full of debris Weeds Grass Etc) Old Trees have fallen Down Across Water Way It is not Wide or deep enough for large Volumed Water Old Shids for fire wood at West End The Holding pond West of Shelton Drive What will happen when it fills with Water and a heavy rain Comes it will overflow into Sutherland Creek ?

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: Lilyanne Staples Bruce

Address and Postal Code: 121 Wonham St North Ingersoll N5C 3G8

Telephone:

Comments: Sutherlands Drain has no capacity It is filled in with silt, debris, grasses, limbs, rocks, The Drain is not deep enough & should be bulldozed deeper, the Culvert is not large enough to drain the water through, It is very very dangerous for the people living on Wonham Street North

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

TOWN OF INGERSOLL
PROSPERITY THROUGH PROGRESS

UPPER THAMES RIVER
CONSERVATION AUTHORITY

RECEIVED JAN 20 2006

Ingersoll, Ontario,
January 20, 2006

Re:- Flooding on Wonham Street North 2001
in the Town of Ingersoll.

Attention: Mayor Paul Holbrough,
130 Oxford Street
Ingersoll, Ontario

Dear Sir:

I attended a meeting in the Council Chambers Ingersoll Town Centre on January 19, 2006.

Since the flooding in July 2001, with serious damage to the homes on Wonham St North, the homeowners have repeatly asked for help to have the Sutherland Creek cleared of all the debris, silt, decayed wood, grasses etc to no avail.

Almost 5 years later nothing has been done to protect the homeowners against another flood.

I find in the Literature which was handed to me at the meeting under the heading "Some Watercourses in Ingersoll" the drainage from Sutherland Creek for the Town Limit is "3.99 Km".

On the last page Item # 6 I read
"Town to be responsible for the resolution of problems within its Boundaries"
Whenever the Town was approached for help with this serious and dangerous problem the "Town" could do nothing because the "Town" was not responsible

The Culvert on Wonham St North is often plugged with debris and half filled with silt. This Culvert is not large enough to carry all of the water from Sutherland Creek! thus the water backs up and our homes are flooded!

This is a very dangerous problem just waiting to happen again, it can easily be avoided if the Town would take the homeowners requests more seriously.

Please help us to avoid another flood!

Yours truly
Lilyanne Staples

c.c. Gene McLaren
Engineering Dept.

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: Vicki Edwards - Ingersoll Recreational TRAILS

Address and Postal Code: 207 Wonham S.
Ingersoll N5C 2Z5

Telephone: 485. 5483

Comments: - Would like to be kept informed about future development plans & how trail system can be incorporated.
- would like information on anything that might affect current / future trail use

- wonham@hotmail.com.

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: _____

Address and Postal Code: _____

_____

Telephone: _____

Comments: _____

_____

_____

_____

_____

_____

_____

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER
CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: Steve Sutherland

Address and Postal Code: 113 Wonham St N

Telephone: 485-4311

Comments: Since the flood of July 2000 nothing has been done to change the situation on the Sutherland Drain which is inadequate also the culvert is too small, it is continually plugged with debris, silt, branches & grasses, causing floods to residents on Wonham St. This is a very dangerous situation.

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

A bulldozer would be very effective to make the Drain deeper.

TOWN OF INGERSOLL — PROSPERITY THROUGH PROGRESS

UPPER THAMES RIVER CONSERVATION AUTHORITY

RECEIVED JAN 20 2006

PT
04-4019

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: Morris Bruce

Address and Postal Code: 121 Workam St North N5C 3G8

Telephone: (519) 485-2743

Comments: Culvert Under Workam St North too Small Water way Sutherland Creek to Shallow and full of debris Weeds Grass Etc. Old Trees have fallen down across Water way. It is not Wide or deep enough for large Volumed Water Old Skids for firewood at West End of the Holding pond West of Shelton Drive What will happen when it fills with Water and a heavy rain Comes it will overflow into Sutherland Creek ?

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER

04-4019
Corr File

RECEIVED
FEB 07 2006
TOWN OF INGERSOLL

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2006, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: JOHN & BRENDA HARRIS

Address and Postal Code: 234 CHARLES ST. E.
INGERSOLL, ON N5C 1K5

Telephone: (519) 485-3875

Comments: NORTH MEADOWS SWMP'S NOT INCLUDED IN THIS STUDY. PLEASE INCLUDE AS THE PONDS DO NOT FUNCTIO PROPERLY. TORRENTS OF WATER FLOW THROUGH RAVINE EVEN AFTER A SMALL RAIN STORM, CAUSING EROSION ETC. THE JULY 2000 STORM CAUSED MAJOR DAMAGE ON MY PROPERTY AND RAVINE. PROJECT ENGINEER L. GIRARD STATED THE SWMP'S WOULD PREVENT THE MASSIVE FLOWS OF WATER. ALSO ALL MAN MADE STRUCTURES SHOULD BE REMOVED FROM RAVINE TO PREVENT PLUGGING THE CHARLES ST. E. CULVERT.

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER

Pf 044019

TOWN OF INGERSOLL
STORMWATER MANAGEMENT STRATEGY STUDY

PUBLIC INFORMATION CENTRE

The Town of Ingersoll, in partnership with the Upper Thames Conservation Authority, is conducting a Stormwater Management Strategy Study. The purpose of the study is to develop a comprehensive strategy to ensure orderly development and to provide protection to the human and natural environment. This will include developing a stormwater model of the storm drainage system, preparing Interim Stormwater Policies, as well as the prioritization and Terms of Reference for future more detailed studies that may be required.

A **Public Information Centre** to present work completed to date and obtain public input on the Study process, will be held on:

Date: **January 19, 2006**

Location: **Council Chambers,**
Ingersoll Town Centre
130 Oxford Street
Town of Ingersoll

Time: **3:00 p.m. to 7:00 p.m. Open House (Drop in Centre)**

From 3:00 p.m. to 7:00 p.m., the Information Centre will consist of an informal walk-in session with displays summarizing the work completed to date. Staff from the Town, UTRCA and Dillon Consulting Limited will be available to explain the displays and answer any questions. Comment sheets will be available to record your concerns and issues of interest. If you have any questions or concerns about the Stormwater Management Strategy Study, or wish to be added to a contact list, please call our information line at 519-485-0120, Ext. 403, or contact:

Gene McLaren, C.E.T.
Engineering Services Coordinator
Engineering Department
130 Oxford Street
Ingersoll, Ontario
N5C 2V5
Tel: 519-485-0120, ext. 232
Fax: 519-485-6572
e-mail: gmclaren@ingersoll.ca

Rick Goldt, C.E.T
Project Manager
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario
N5V 5B9
Tel: 519-451-2800, ext. 244
Fax: 519-451-1188
e-mail: goldtr@thamesriver.on.ca

UPPER THAMES RIVER
CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2005, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: _____

Address and Postal Code: _____

_____

Telephone: _____

Comments: _____

_____

_____

_____

_____

_____

_____

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER
CONSERVATION AUTHORITY

pf

C4.4019

Brian Huston - PIC Ingersoll Study

From: Brian Huston
To: gmclaren@ingersoll.ca; Goldt, Rick; Lorant, Ivan; Rebry, Catherine
Date: 23/12/2005 9:37 AM
Subject: PIC Ingersoll Study

Gene, Rick.....attached are final contact list (based on input received), final PIC Notice and Comment sheet.

I will have the notice and comment sheets mailed out during the week of Jan 2 (early in the week), so the hotline will need to be in place then. Below is my suggested message (I assume someone will monitor and document messages left).

Catherine, please arrange for the PIC notice go in the Ingersol paper during the week of Jan 9 and the Oxford review during the weel of Jan 15.

Any comments or concerns with this, please email back.

Thanks and I wish each of you a good Holiday.

Brian.

Thank you for calling the Ingersoll Storm Water Study information line. The study is being undertaken to develop a comprehensive strategy for development and protection of human and natural environment in Ingersoll.

If you would like to be added to the contact list for the study, please leave your name and contact information after the tone.

If you have specific concerns or questions about the study, or have information on past flooding or erosion problems that you would like to provide, please leave your name and number at the tone.

Thankyou.

Brian Huston P.Eng.
Partner
Dillon Consulting Ltd
495 Richmond Street
London, Ontario
N6A 5A9

bhuston@dillon.ca
www.dillon.ca
phone office 519.438.6192 (227)
phone cell 519.521.5547
fax 519.672.8209

TOWN OF INGERSOLL
STORMWATER MANAGEMENT PROJECT

04-4019
DILLON CONSULTING LIMITED
CONTACT LIST
December 22, 2005

UPPER THAMES RIVER CONSERVATION AUTHORITY

DILLON CONSULTING

1. FEDERAL AGENCIES

Canadian Coast Guard
201 North Front Street
Suite 703
Sarnia, Ontario
N7T 8B1

Tel: 519-383-1863

Attention: Barry Putt
A/Inspections Supervisor
Navigable Waters Protections

2. PROVINCIAL MINISTRIES

Ministry of Culture
Heritage and Libraries Branch
Southwest Archaeological Field Office
900 Highbury Avenue
London, Ontario
N6J 1T4

Tel: 519-675-7742
Fax: 519-675-7777

Attention: John MacDonald
Heritage Planner

Ministry of Environment
London Regional Office
733 Exeter Road
London, Ontario
N6E 1L3

Tel: 519-873-5015

Attention: Ron Griffiths
Environmental Assessment
Co-ordinator

Ministry of Environment
London Regional Office
733 Exeter Road
London, Ontario
N6E 1L3

Tel: 519-873-5015

Attention: Micheline Riopelle
Regional Director

Ministry of Environment
London Regional Office
733 Exeter Road
London, Ontario
N6E 1L3

Tel: 519-873-5000

Attention: Hugh Geurts
Surface Water Specialist

Ministry of Natural Resources
Aylmer District Office
353 Talbot St. W
Aylmer ON
N5H 2S8

Tel: 519-733-4710

Attention: Alec Denys
District Manager

MPP – Oxford
Ernie Hardeman
12 Perry Street
Woodstock, Ontario
N4S 3C2

Tel: 519-537-5222
Fax: 519-537-3577

3. TOWN OF INGERSOLL AND OTHER MUNICIPALITIES

Town of Ingersoll
130 Oxford Street
Ingersoll, Ontario
N5C 2V5

Tel: 519-485-0120
Fax: 519-485-3543

Attention: Paul Holbrough, Mayor

County of Oxford
21 Market Square East
Woodstock, ON
N4S 1H6

Tel: 519-539-9800 ext 3100
rwalton@county.oxford.on.ca

Attention: Robert Walton, Director of Public Works

Southwest Oxford Township
Municipal Office
312915 Dereham Line, R. R. #1
Mt. Elgin, Ontario
N0J 1N0

Tel: 519-877-2702 or 485-0477
Fax: 519-485-2932

Municipality of Thames Centre
4305 Hamilton Road
Dorchester, Ontario
N0L 1G3

Tel: 519-268-7334

Township of Zorra
Municipal Office
274620 27th Line
P.O. Box 306
Ingersoll, Ontario
N5C 3K5

Tel: 519-485-2490
Fax: 519-485-2520
zorra@zorra.on.ca

4. UTILITIES

Union Gas
109 Commissioners Rd
London, Ontario
N6A 4P1

Tel: 1-519-667-4140

Attention: Katie Hooper

Rogers Cable Systems
500 York St.
London, Ontario
N6A 5B1

Tel: 516-660-7557

Attention: Garth Pickering

Bell Canada Access Network
86 Market St., Floor 2
P.O. Box 938
Brantford, Ontario
N3T 2Z8

Tel: 519-744-0593
Fax: 519-744-3082

Attention: Mike McLuhan

Erie Thames Power
PO Box 157
Ingersoll, Ontario
N5C 3K5

Tel: 519-485-1820

Attention: Scott Garton

Add CN and CP

5. OTHERS

Ingersoll BIA c/o Peter Rigby 130 Oxford Street Ingersoll, Ontario N5C 2V5	Carolinian Canada c/o Michelle Kanter, Exec. Director 1017 Western Road London, Ontario N6G 1G5	Christian Farmers Association Oxford District c/o Nico Vandenakker 340 McBeth, # 364 Salford, Ontario N0J 1W0
Creative Arts Centre c/o Heather McIntosh P.O. Box 384 345 Hall St. Ingersoll, Ontario N5C 3V3	Ducks Unlimited Canada 566 Welham Road Barrie, Ontario L4N 8Z7	Greenpeace Canada 250 Dundas Street West Suite 605 Toronto, Ontario M5T 2Z5
National Farmers Union c/o Don Mills 34200 Granton Line R. R. # 3 Granton, Ontario N0M 1V0	Ontario Federation of Anglers and Hunters c/o Doug Ross 173 Park Row Woodstock, Ontario N4S 1V9	Ingersoll Horticultural Society c/o Vicki Edwards 207 Wonham Street Ingersoll, Ontario N5C 2Z5

Ingersoll Nature Club c/o Sheila Fleming 205 George St Ingersoll, Ontario N5C 1Z5	Ingersoll Trails Committee c/o Marie DeGaust 17 Dean Crescent Ingersoll, Ontario N5C 3C4	Oxford County Federation of Agriculture c/o June Nussey 276 Whiting Street Ingersoll, Ontario N5C 3B8
Royal Canadian Legion c/o Chris McLelland 211 Thames Street North Ingersoll, Ontario N5C 3E3	Township of Southwest Oxford 312915 Dereham Line R. R. # 1 Mount Elgin, Ontario N0J 1N0	Stewardship Oxford c/o Cher Sprague RR 3 Embro, Ontario N0J 1J0
Thames Region Anglers Association c/o Grosvenor Lodge 1017 Western Road London, Ontario N6G 1G5	Thames River Anglers Association c/o Grosvenor Lodge 1017 Western Road London, Ontario N6G 1G5	Thames Valley District School Board 1250 Dundas Street, (P.O. Box 5888) N6A 5L1 London, Ontario N5W 5P2
Thames Valley Trail Association c/o Grosvenor Lodge 1017 Western Road London, Ontario N6G 1G5	Tourism Oxford 419 Hunter Street P. O. Box 397 Woodstock, Ontario N4S 7Y3	Trout Unlimited Canada 3455 Harvester Road, Unit 24 Burlington, Ontario L7N 3P2
Urban Development Institute 2025 Sheppard Avenue East, North York, Ontario M2J 1V6	Western Ontario Fish & Game Protective Association 790 Southdale Road London, Ontario N6E 1A8	Township of Zorra P. O. Box 306 Ingersoll, Ontario N5C 3K5
County Contracting of Wheatley 160 Carnegie St. Ingersoll, Ont. N5C 4A8	Oak Country Homes Limited R.R. 4 Embro, Ontario N0J 1J0	Reeves Land Corporation 95 Young St. Woodstock, Ontario N4S 3L6
Pyne Hall Developments 95 Barber Greene Rd. St.210 North York , Ont. M3C 3E9	Reliance Developments 6176 Kestrel Road Unit 101 Mississauga, Ont. L5T 1Z2	Klondike Homes 827 Birtchmount Rd. Waterloo, Ont. N2V 2R3
Extra Realty P.O. Box 143 Arva, Ont. N0M 1Co	CTX Homes P.O. Box 8118 London, Ont. N6G 2B0	B. W. Conn Homes 6 Moulton Crt. Ingersoll, Ontario N5C 4C4

Vic Carter Limited P.O. Box 125 Ingersoll, Ont. N5C 3K1	Cam Don Developments P.O. Box 308 Ingersoll, Ont. N5C 3K5	Frohlinger & Takac 54 Verwood Ave North York, Ont. M3H 2K7
Southside Construction 358 Horton St. London, Ontario N6B 1L7	Ingersoll Golf & Country Club P.O. Box 2 51 Holcroft St. W. Ingersoll, Ont. N5C 3K1	Eugene Mabee 271 Harris St. Ingersoll, Ontario N5C 1Y5
Tacham Developments 259 Harris St. Ingersoll, Ont. N5C 1Y5	CAMI 300 Ingersoll St. P.O. Box 1005 Ingersoll, Ont. N5C 4A6	Ingrox Limited 11 St. Andrew St. Ingersoll, Ontario N5C 1K6
London District Catholic School Board 5200 Wellington St. S. London, Ont. N6E 3X8	J. B. Chambers Consulting Engineers 895 Dundas St. Woodstock, Ont. N4S 1G9	Springbank Consulting Engineers 871 Dundas St. Woodstock, Ont. N4S 1G8
Ingersoll Machine & Tool Limited (IMT) 347 King St. W. Ingersoll, Ont. N5C 2K9	Sivaco 330 Thomas St. Ingersoll, Ont. N5C 2G7	Ingersoll Fasteners 390 Thomas St. Ingersoll, Ont. N5C 2G7
Ingersoll Chamber of Commerce 132 Thames St. S. Carr's Walkway Ingersoll, Ontario N5C 2T4	R.J. Burnside & Associates Limited 332 Lorne Avenue East Stratford Ontario N5A 6S4 Att. Ed Talsma	Law Engineering 69 Bessemer Rd. London, Ontario N6E 2V6
MRC 2655 North Sheridan Way Suite 300 Mississauga, Ontario L5K 2P8	CCL 350 Oxford Street West Suite 203 London, Ontario N6H 1T3	AGM London 553 Southdale Road East London, Ontario N6E 1A2
POW Engineering 50 Samnah Cres. Ingersoll, Ont. N5C 3J7	Stantec 171 Queens Avenue, 8th Floor London, Ontario N6A 5J7	Stantec 49 Frederick Street Kitchener, Ontario N2H 6M7
Thames Trail Task Force Att. Tammy Fehr County of Oxford P.O. Box 397 Court House Woodstock, Ont. N4S 7Y3		

Donald Myer / Kathy Boot 190 McKeand St. Ingersoll, Ontario N5C 3H9	Theresa Sonder 287 Skye St. Ingersoll, Ontario N5C 2R3	Jean Collins 285 Skye St. Ingersoll, Ontario N5C 2R3
Brian Ellis 289 Skye St. Ingersoll, Ontario N5C 2R3	Tim Kirwin 291 Skye St. Ingersoll, Otario N5C 2R3	John Paget 283 Skye St. Ingersoll, Ontario N5C 2R3
Terrence Vander Hoek 42 Bell St. Ingersoll, Ontario N5C 2N6	Steve Sutherland 113 Wonham St. North Ingersoll, Ontario N5C 3G8	Paul Dona 119 Wonham St. North Ingersoll, Ontario N5C 3G8
Morris Bruce 121 Wonham St. North Ingersoll, Ontario N5C 3G8	Norman Cooper 46 Bell St. Ingersoll, Ontario N5C 2N6	Darlene Devost 153 John St. Ingersoll, Ontario N5C 3G1
C. McDonald 159 John St. Ingersoll, Ontario N5C 3G1	Chris Riley 55 Bell St. Ingersoll, Ontario N5C 2N7	Laura Dale 61 Bell St. Ingersoll, Ontario N5C 2N7
R. Williams 64 Victoria St. Ingersoll, Ontario N5C 2M7	R. Pinter 66 Victoria St. Ingersoll, Ontario N5C 2M7	R. Pinter 72 Victoria St. Ingersoll, Ontario N5C 2M7
Chris Phillips 62B Victoria St. Ingersoll, Ontario N5C 2M7	Lenore Plester 423 Thames St. S. Ingersoll	Ms. Pat Napthen 59 Carnegie St. Ingersoll, ON M5C 1K8

McIlwraith Field Naturalists
c/o Dorothy McCallum
878 Clearview Avenue
London, Ontario
N6H 2N4

Tel: 519-472-0526

Thames Region Ecological Association
c/o Grosvenor Lodge
1017 Western Road
London, Ontario
N6G 1G5

Tel: 519-645-2845
Fax: 519-645-0981
trea@wwdc.com

Woodstock Field Naturalists
c/o Roger Boyd
P.O. Box 20037
RPO Woodstock Centre
Woodstock, Ontario
N4S 8X8

TOWN OF INGERSOLL
STORMWATER MANAGEMENT STRATEGY STUDY

PUBLIC INFORMATION CENTRE

The Town of Ingersoll, in partnership with the Upper Thames Conservation Authority, is conducting a Stormwater Management Strategy Study. The purpose of the study is to develop a comprehensive strategy to ensure orderly development and to provide protection to the human and natural environment. This will include developing a stormwater model of the storm drainage system, preparing Interim Stormwater Policies, as well as the prioritization and Terms of Reference for future more detailed studies that may be required.

A **Public Information Centre** to present work completed to date and obtain public input on the Study process, will be held on:

Date: **January 19, 2006**

Location: **Council Chambers,**
Ingersoll Town Centre
130 Oxford Street
Town of Ingersoll

Time: **3:00 p.m. to 7:00 p.m. Open House (Drop in Centre)**

From 3:00 p.m. to 7:00 p.m., the Information Centre will consist of an informal walk-in session with displays summarizing the work completed to date. Staff from the Town, UTRCA and Dillon Consulting Limited will be available to explain the displays and answer any questions. Comment sheets will be available to record your concerns and issues of interest. If you have any questions or concerns about the Stormwater Management Strategy Study, or wish to be added to a contact list, please call our information line at 519-485-0120, Ext. 403, or contact:

Gene McLaren, C.E.T.
Engineering Services Coordinator
Engineering Department
130 Oxford Street
Ingersoll, Ontario
N5C 2V5
Tel: 519-485-0120, ext. 232
Fax: 519-485-6572
e-mail: gmclaren@ingersoll.ca

Rick Goldt, C.E.T
Project Manager
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario
N5V 5B9
Tel: 519-451-2800, ext. 244
Fax: 519-451-1188
e-mail: goldtr@thamesriver.on.ca

UPPER THAMES RIVER
CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2005, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF COMMENTS

Name: _____

Address and Postal Code: _____

_____

Telephone: _____

Comments: _____

_____

_____

_____

_____

_____

_____

Please hand in at Information Centre, fax or mail by **February 6, 2006** to:

Gene McLaren, CET, Engineering Services Coordinator
Town of Ingersoll
130 Oxford Street, Ingersoll, Ontario, N5C 2V5
Fax: 519-485-6572
E-mail: gmclaren@ingersoll.ca

With the exception of personal information, all comments will become part of the public record.

Project No. 04-4019

UPPER THAMES RIVER
CONSERVATION AUTHORITY

TOWN OF INGERSOLL
Stormwater Management Strategy Study

PUBLIC INFORMATION CENTRE
Thursday, January 19, 2005, 3:00 to 7:00 p.m.
Ingersoll Town Centre

RECORD OF ATTENDANCE

NAME (please print)	ADDRESS (please print)	POSTAL CODE

Project No. 04-4019

UPPER THAMES RIVER
CONSERVATION AUTHORITY

UPPER THAMES RIVER CONSERVATION AUTHORITY

TOWN OF INGERSOLL
STORMWATER MANAGEMENT PROJECT

04-4019
DILLON CONSULTING LIMITED
CONTACT LIST
December 22, 2005

DILLON CONSULTING

1. FEDERAL AGENCIES

Canadian Coast Guard
201 North Front Street
Suite 703
Sarnia, Ontario
N7T 8B1

Tel: 519-383-1863

Attention: Barry Putt
A/Inspections Supervisor
Navigable Waters Protections

2. PROVINCIAL MINISTRIES

Ministry of Culture
Heritage and Libraries Branch
Southwest Archaeological Field Office
900 Highbury Avenue
London, Ontario
N6J 1T4

Tel: 519-675-7742
Fax: 519-675-7777

Attention: John MacDonald
Heritage Planner

Ministry of Environment
London Regional Office
733 Exeter Road
London, Ontario
N6E 1L3

Tel: 519-873-5015

Attention: Ron Griffiths
Environmental Assessment
Co-ordinator

Ministry of Environment
London Regional Office
733 Exeter Road
London, Ontario
N6E 1L3

Tel: 519-873-5015

Attention: Micheline Riopelle
Regional Director

Ministry of Environment
London Regional Office
733 Exeter Road
London, Ontario
N6E 1L3

Tel: 519-873-5000

Attention: Hugh Geurts
Surface Water Specialist

Ministry of Natural Resources
Aylmer District Office
353 Talbot St. W
Aylmer ON
N5H 2S8

Tel: 519-733-4710

Attention: Alec Denys
District Manager

MPP – Oxford
Ernie Hardeman
12 Perry Street
Woodstock, Ontario
N4S 3C2

Tel: 519-537-5222
Fax: 519-537-3577

3. TOWN OF INGERSOLL AND OTHER MUNICIPALITIES

Town of Ingersoll
130 Oxford Street
Ingersoll, Ontario
N5C 2V5

Tel: 519-485-0120
Fax: 519-485-3543

Attention: Paul Holbrough, Mayor

County of Oxford
21 Market Square East
Woodstock, ON
N4S 1H6

Tel: 519-539-9800 ext 3100
rwalton@county.oxford.on.ca

Attention: Robert Walton, Director of Public Works

Southwest Oxford Township
Municipal Office
312915 Dereham Line, R. R. #1
Mt. Elgin, Ontario
N0J 1N0

Tel: 519-877-2702 or 485-0477
Fax: 519-485-2932

Municipality of Thames Centre
4305 Hamilton Road
Dorchester, Ontario
N0L 1G3

Tel: 519-268-7334

Township of Zorra
Municipal Office
274620 27th Line
P.O. Box 306
Ingersoll, Ontario
N5C 3K5

Tel: 519-485-2490
Fax: 519-485-2520
zorra@zorra.on.ca

4. UTILITIES

Union Gas
109 Commissioners Rd
London, Ontario
N6A 4P1

Tel: 1-519-667-4140

Attention: Katie Hooper

Rogers Cable Systems
500 York St.
London, Ontario
N6A 5B1

Tel: 516-660-7557

Attention: Garth Pickering

Bell Canada Access Network
86 Market St., Floor 2
P.O. Box 938
Brantford, Ontario
N3T 2Z8

Tel: 519-744-0593
Fax: 519-744-3082

Attention: Mike McLuhan

Erie Thames Power
PO Box 157
Ingersoll, Ontario
N5C 3K5

Tel: 519-485-1820

Attention: Scott Garton

Add CN and CP

5. OTHERS

Ingersoll BIA c/o Peter Rigby 130 Oxford Street Ingersoll, Ontario N5C 2V5	Carolinian Canada c/o Michelle Kanter, Exec. Director 1017 Western Road London, Ontario N6G 1G5	Christian Farmers Association Oxford District c/o Nico Vandenakker 340 McBeth, # 364 Salford, Ontario N0J 1W0
Creative Arts Centre c/o Heather McIntosh P.O. Box 384 345 Hall St. Ingersoll, Ontario N5C 3V3	Ducks Unlimited Canada 566 Welham Road Barrie, Ontario L4N 8Z7	Greenpeace Canada 250 Dundas Street West Suite 605 Toronto, Ontario M5T 2Z5
National Farmers Union c/o Don Mills 34200 Granton Line R. R. # 3 Granton, Ontario N0M 1V0	Ontario Federation of Anglers and Hunters c/o Doug Ross 173 Park Row Woodstock, Ontario N4S 1V9	Ingersoll Horticultural Society c/o Vicki Edwards 207 Wonham Street Ingersoll, Ontario N5C 2Z5

Ingersoll Nature Club c/o Sheila Fleming 205 George St Ingersoll, Ontario N5C 1Z5	Ingersoll Trails Committee c/o Marie DeGaust 17 Dean Crescent Ingersoll, Ontario N5C 3C4	Oxford County Federation of Agriculture c/o June Nussey 276 Whiting Street Ingersoll, Ontario N5C 3B8
Royal Canadian Legion c/o Chris McLelland 211 Thames Street North Ingersoll, Ontario N5C 3E3	Township of Southwest Oxford 312915 Dereham Line R. R. # 1 Mount Elgin, Ontario N0J 1N0	Stewardship Oxford c/o Cher Sprague RR 3 Embro, Ontario N0J 1J0
Thames Region Anglers Association c/o Grosvenor Lodge 1017 Western Road London, Ontario N6G 1G5	Thames River Anglers Association c/o Grosvenor Lodge 1017 Western Road London, Ontario N6G 1G5	Thames Valley District School Board 1250 Dundas Street, (P.O. Box 5888) N6A 5L1 London, Ontario N5W 5P2
Thames Valley Trail Association c/o Grosvenor Lodge 1017 Western Road London, Ontario N6G 1G5	Tourism Oxford 419 Hunter Street P. O. Box 397 Woodstock, Ontario N4S 7Y3	Trout Unlimited Canada 3455 Harvester Road, Unit 24 Burlington, Ontario L7N 3P2
Urban Development Institute 2025 Sheppard Avenue East, North York, Ontario M2J 1V6	Western Ontario Fish & Game Protective Association 790 Southdale Road London, Ontario N6E 1A8	Township of Zorra P. O. Box 306 Ingersoll, Ontario N5C 3K5
County Contracting of Wheatley 160 Carnegie St. Ingersoll, Ont. N5C 4A8	Oak Country Homes Limited R.R. 4 Embro, Ontario N0J 1J0	Reeves Land Corporation 95 Young St. Woodstock, Ontario N4S 3L6
Pyne Hall Developments 95 Barber Greene Rd. St.210 North York , Ont. M3C 3E9	Reliance Developments 6176 Kestrel Road Unit 101 Mississauga, Ont. L5T 1Z2	Klondike Homes 827 Birtchmount Rd. Waterloo, Ont. N2V 2R3
Extra Realty P.O. Box 143 Arva, Ont. N0M 1Co	CTX Homes P.O. Box 8118 London, Ont. N6G 2B0	B. W. Conn Homes 6 Moulton Crt. Ingersoll, Ontario N5C 4C4

Vic Carter Limited P.O. Box 125 Ingersoll, Ont. N5C 3K1	Cam Don Developments P.O. Box 308 Ingersoll, Ont. N5C 3K5	Frohlinger & Takac 54 Verwood Ave North York, Ont. M3H 2K7
Southside Construction 358 Horton St. London, Ontario N6B 1L7	Ingersoll Golf & Country Club P.O. Box 2 51 Holcroft St. W. Ingersoll, Ont. N5C 3K1	Eugene Mabee 271 Harris St. Ingersoll, Ontario N5C 1Y5
Tacham Developments 259 Harris St. Ingersoll, Ont. N5C 1Y5	CAMI 300 Ingersoll St. P.O. Box 1005 Ingersoll, Ont. N5C 4A6	Ingrox Limited 11 St. Andrew St. Ingersoll, Ontario N5C 1K6
London District Catholic School Board 5200 Wellington St. S. London, Ont. N6E 3X8	J. B. Chambers Consulting Engineers 895 Dundas St. Woodstock, Ont. N4S 1G9	Springbank Consulting Engineers 871 Dundas St. Woodstock, Ont. N4S 1G8
Ingersoll Machine & Tool Limited (IMT) 347 King St. W. Ingersoll, Ont. N5C 2K9	Sivaco 330 Thomas St. Ingersoll, Ont. N5C 2G7	Ingersoll Fasteners 390 Thomas St. Ingersoll, Ont. N5C 2G7
Ingersoll Chamber of Commerce 132 Thames St. S. Carr's Walkway Ingersoll, Ontario N5C 2T4	R.J. Burnside & Associates Limited 332 Lorne Avenue East Stratford Ontario N5A 6S4 Att. Ed Talsma	Law Engineering 69 Bessemer Rd. London, Ontario N6E 2V6
MRC 2655 North Sheridan Way Suite 300 Mississauga, Ontario L5K 2P8	CCL 350 Oxford Street West Suite 203 London, Ontario N6H 1T3	AGM London 553 Southdale Road East London, Ontario N6E 1A2
POW Engineering 50 Samnah Cres. Ingersoll, Ont. N5C 3J7	Stantec 171 Queens Avenue, 8th Floor London, Ontario N6A 5J7	Stantec 49 Frederick Street Kitchener, Ontario N2H 6M7
Thames Trail Task Force Att. Tammy Fehr County of Oxford P.O. Box 397 Court House Woodstock, Ont. N4S 7Y3		

Donald Myer / Kathy Boot 190 McKeand St. Ingersoll, Ontario N5C 3H9	Theresa Sonder 287 Skye St. Ingersoll, Ontario N5C 2R3	Jean Collins 285 Skye St. Ingersoll, Ontario N5C 2R3
Brian Ellis 289 Skye St. Ingersoll, Ontario N5C 2R3	Tim Kirwin 291 Skye St. Ingersoll, Otario N5C 2R3	John Paget 283 Skye St. Ingersoll, Ontario N5C 2R3
Terrence Vander Hoek 42 Bell St. Ingersoll, Ontario N5C 2N6	Steve Sutherland 113 Wonham St. North Ingersoll, Ontario N5C 3G8	Paul Dona 119 Wonham St. North Ingersoll, Ontario N5C 3G8
Morris Bruce 121 Wonham St. North Ingersoll, Ontario N5C 3G8	Norman Cooper 46 Bell St. Ingersoll, Ontario N5C 2N6	Darlene Devost 153 John St. Ingersoll, Ontario N5C 3G1
C. McDonald 159 John St. Ingersoll, Ontario N5C 3G1	Chris Riley 55 Bell St. Ingersoll, Ontario N5C 2N7	Laura Dale 61 Bell St. Ingersoll, Ontario N5C 2N7
R. Williams 64 Victoria St. Ingersoll, Ontario N5C 2M7	R. Pinter 66 Victoria St. Ingersoll, Ontario N5C 2M7	R. Pinter 72 Victoria St. Ingersoll, Ontario N5C 2M7
Chris Phillips 62B Victoria St. Ingersoll, Ontario N5C 2M7	Lenore Plester 423 Thames St. S. Ingersoll	Ms. Pat Napthen 59 Carnegie St. Ingersoll, ON M5C 1K8

McIlwraith Field Naturalists
c/o Dorothy McCallum
878 Clearview Avenue
London, Ontario
N6H 2N4

Tel: 519-472-0526

Thames Region Ecological Association
c/o Grosvenor Lodge
1017 Western Road
London, Ontario
N6G 1G5

Tel: 519-645-2845
Fax: 519-645-0981
trea@wwdc.com

Woodstock Field Naturalists
c/o Roger Boyd
P.O. Box 20037
RPO Woodstock Centre
Woodstock, Ontario
N4S 8X8

APPENDIX G
COUNCIL PRESENTATION, MAY 8, 2006

Town of Ingersoll Stormwater Management Study

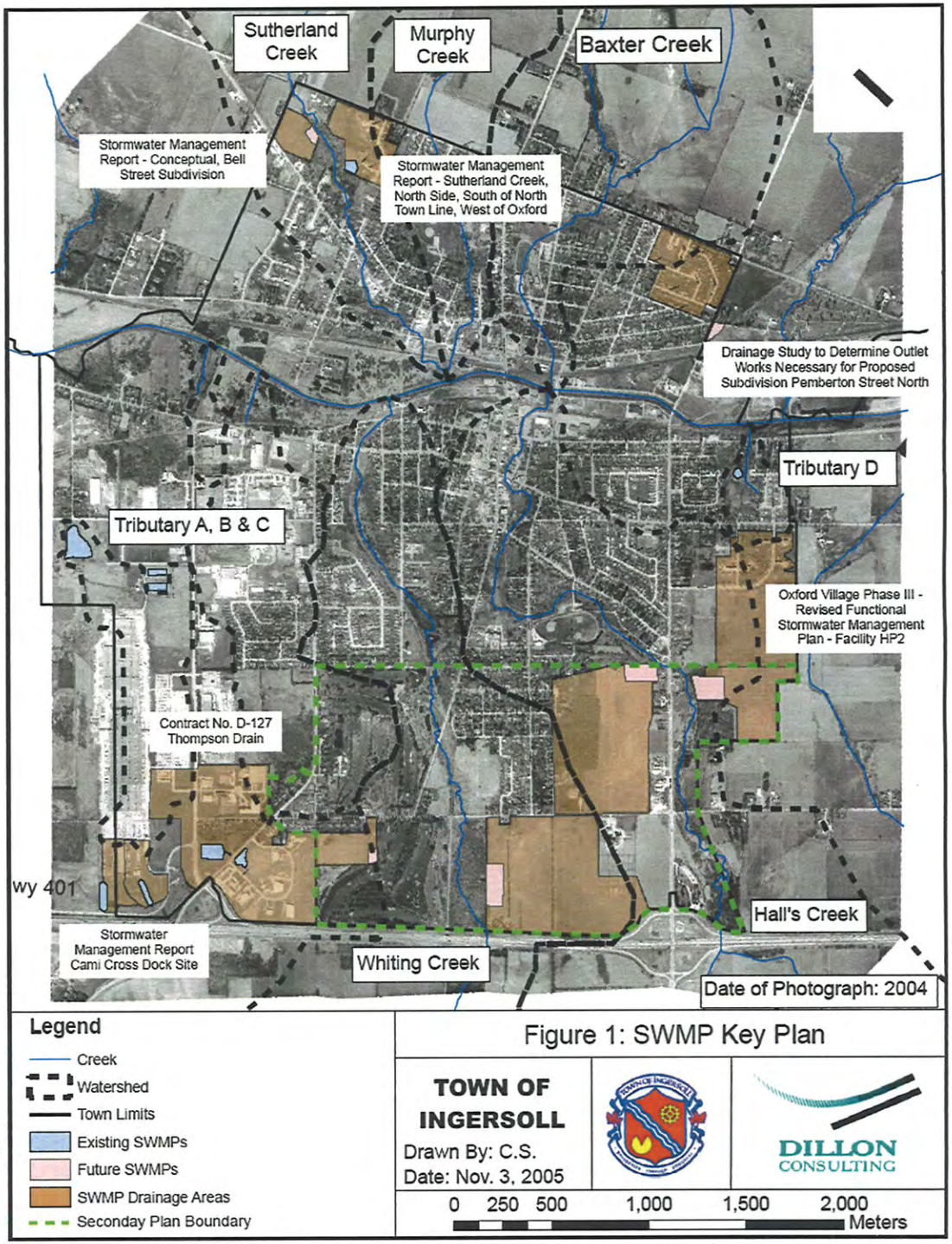
Dillon Consulting Limited

Why undertake the study?

- Town facing continuing development pressures
- In past criteria for new development based on 1982 report focusing on water quantity
- Increased evidence and awareness of negative impacts of uncontrolled runoff (erosion, quality, baseflow, stream morphology)
- Need to update and expand policies and criteria to meet Provincial Standards
- Need to gather together information previous studies, reports and data collection
- No current criteria or policies to guide development

Ingersoll Drainage Areas

Watercourses	Area km²	Area Within Town
Baxter Creek	11.90	8%
Murphy Drain	2.00	24%
Sutherland Creek	5.00	20%
Hall's Creek	22.45	14%
Whiting Creek	10.25	30%



Study Purposes

#1) Prepare Interim Policies for Stormwater Management

#2) Develop Stormwater Computer Model of the existing and future flows (hydrology), existing drainage system (hydraulics)

#3) Prepare a set of Interim Criteria and a Stormwater Management Strategy for Future Work

Background – Past Studies

- Several previous studies reviewed, as well as aerial photos, mapping, landuse, planning and infrastructure plans (Detailed in Appendix A of Report)
- 1982 MacLaren Report first and only comprehensive study
- A number of site specific SWM Studies over the years, using various models and all recommending some sort of control
- Other studies include erosion assessments, use of rainfall design storms, prepared by UTRCA

Background –
The Need for Stormwater Management

- Incorporates the planning, design and implementation of urban runoff systems
- Provides tools for planning and development
- Generally accepted practices by all levels of Government
- Existing Legal Common Law Principals and Legislation
- Impacts on the Environment and other adverse impacts as follows…….

Background - Peak Flows and Flooding

- In the 1970's we became aware of the effect of urban drainage on the peak floods as a result of effect of development
- Developed computer modeling of the complex relationship between precipitation and runoff
- Recent models enabled us to analyze and predict flows generated by future development

Background - Surface Runoff Effects

Uncontrolled runoff from development can:

- Increase surface runoff volume
- Can cause more frequent and higher flows
- Decrease infiltration to aquifer
- Decrease base flow

Background - Water Quality

- Urban runoff contains numerous pollutants generated in an urban area
- The first effects were noticed in streams, rivers and lakes used for drinking water, or swimming
- The most well known and publicized case was the closing of the Toronto beaches during the summer bathing season

Background - Erosion

- Increased peak flows produced more frequent and higher velocity flows which resulted in an increase in downstream bank erosion
- In some cases the eroded material produced sedimentation further downstream, killing fish and causing flooding problems
- Any increase in paved area results in an increased peak flow if left uncontrolled

Background - Aquatic Environmental Effects

- Pollutants and sediment carried from urban areas into our watercourses affected the aquatic environment

- Similar detrimental effects of urbanization are seen on wetlands

Background - River Geomorphology

- Morphology is a relatively new science, it investigates the changes in a river regime caused by either natural or human interferences
- We must look at our rivers and stream as living and dynamic entities
- There are a number of factors controlling the river morphology,such as meandering, cross-section shape and size

Background - Low Flows and Base Flows

- Paving produces quick response to rainfall
- Pre-development during dry periods produce some subsurface or groundwater flows
- Post-development conditions with no precipitation events resulted in long periods of no flows
- This can have serious consequences on the aquatic habitat

Study Purpose #1

Prepare Interim Policies for Stormwater Management

- Developed SWM Vision, Goals and Objectives
- Policies influenced by:

i) potential impacts on the environment (Table 1 Report),

ii) legal principles and legislation,

iii) Relevant Provincial, Municipal, and Conservation Authourity Goals, Objectives and Policies,

iv) budget constraints

Interim Stormwater Management Policies

- The policies represent broad statements of intent with respect to the direction for storm water in the Town and should not be regarded as targets, nor can they be quantified

- The policies are intended to be applicable to the entire Town and potentially the entire watershed draining through the Town

Policies detailed in SWM Report and Appendix B.

Interim Stormwater Management Policies - Technical

1. Protect Natural Environment
2. Control Stormwater Quantity
3. Control Stormwater Quality
4. Control Erosion
5. Control Impact on Groundwater
6. Infrastructure

Interim Stormwater Management Policies - Institutional

1. Need for Public Awareness
2. Update Standards

Interim Stormwater Management Policies-Funding

1. Budget Limitations
2. Resource Allocation and Cost Recovery

Study Purpose #2

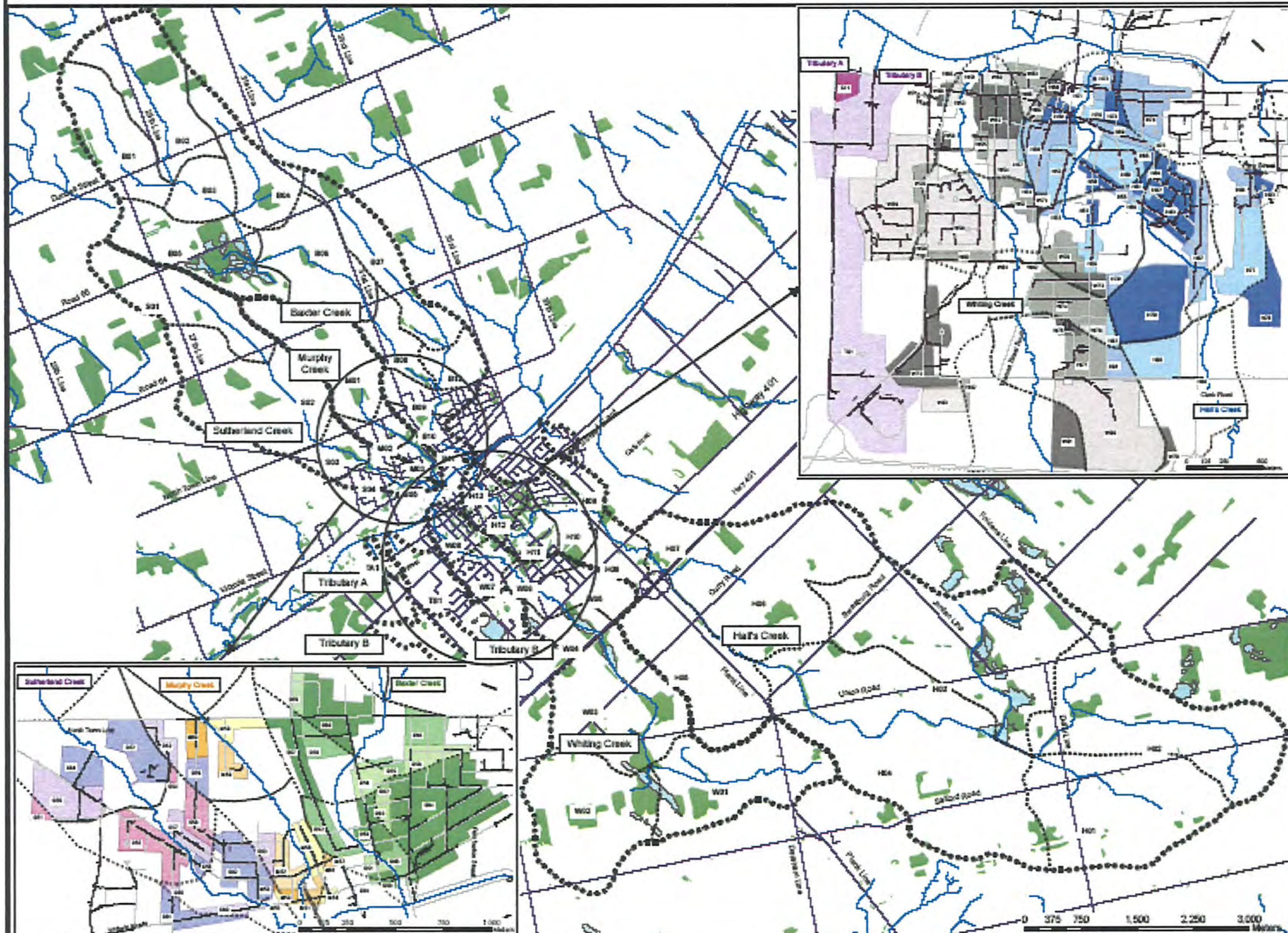
Develop Stormwater Computer Model of the existing drainage system, with existing and future flows

- Analysis of watercourses
- Setting up of computer model and computing flows (both existing and future)
- Conservation Authority to adopt flows and compute flood lines
- Computer model to model existing drainage system

Analysis of Watercourses

Results provide the Town with:

- GIS composite of landuse, surficial soils, existing / future conditions,
- Hydrologic and Hydraulic Modelling results for 2,5,10,25,50,100 and 250 year events and for existing and future scenerios
- Comparison with results from previous studies and with July 2000 event
- Develop computer models for existing drainage system



Ingersoll Hydrologic Model Key Plan

Project No. [illegible] | Designed By: C.S.

Figure No. 2 | Drawn By: C.S.

DILLON CONSULTING

TOWN OF INGERSOLL

Study Purpose #3

Prepare a set of Interim Criteria and a Stormwater Management Strategy for Future Work

- Based on Interim Policies and Technical Information available, prepare **Interim Criteria** to allow consistent requirements for development
- Prepare **Terms of Reference** for future work to allow further refinement of Interim Policies and Critieria

Interim SWM Criteria

Control	Criteria	Comments
Flood and water quantity control	Control peak discharges from the 2, 5, 25, 50, 100 and 250-year storms to pre-development rates	• Should consider the cumulative effects of development and controls.
Water quality	Volume control for storage facilities, or control of a volume of water for a minimum 24 hours from a 25 mm rainfall	• Compute storage from MOE Manual or generate hydrographs for the single event design storm
Stream channel erosion	Control of peak flows and runoff volume, or provide bank protection to mitigate aggravation of existing erosion issues	• Detailed, simplified or distributed runoff control method, or • 24 hour-48 hour extended detention of post-development 25 mm storm event. • Bank protection for a 25 mm runoff peak flow
Baseflow	Infiltrating the first 5 mm rainfall	• Where feasible, the pre-development hydrologic cycle components should be maintained.

Terms of Reference

Prepare Terms of Reference for future work to allow further refinement of Interim Policies and Critieria. Work includes:

- Data collection, field studies and analysis to fill in gaps from previous work
- Focus analysis and technical work on priority areas
- Establish targets and constraints to update and refine the Interim Policies and Criteria

Public Information Centre

- Held January 19, 2006 in Council Chambers
- approximately 18 attendees
- displays of Stormwater Study and UTRCA had information on floodline mapping and Generic Regulations
- Town, UTRCA and Dillon staff on hand to provide information and answer questions

Public Information Centre

Comments received were:

- Undersized culverts and debris on Sutherland Creek
- Sutherland Creek too small in Wonham Street area
- Culvert on Wonham Street regularly plugged with debris and silt
- Questions about potential impact on recreational trails
- Resident indicated North Meadows SWMP's not effective and erosion is occurring in ravines downstream

Public Information Centre

Follow-up on PIC Comments:

-PIC underscores the need to undertake a Geomorpholgy orientated study of significant tributaries in Ingersoll
-Incorporate PIC information into the followup work

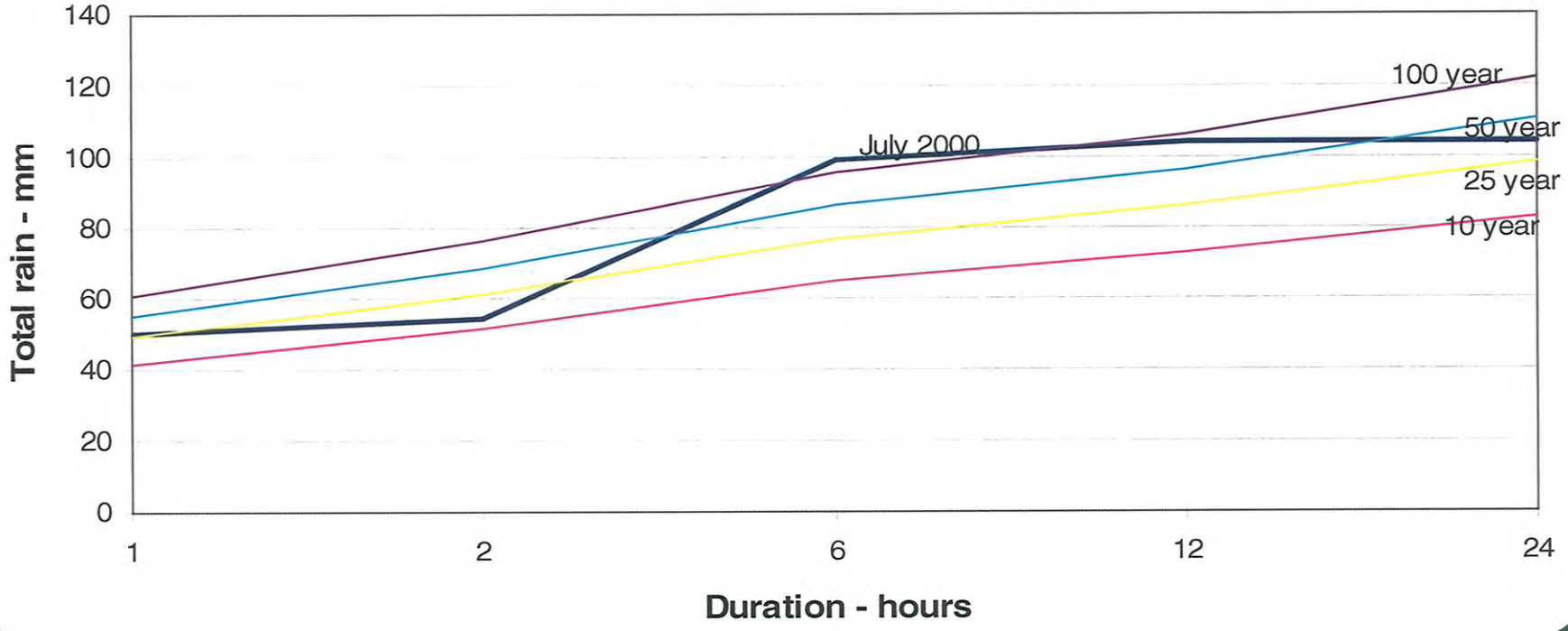
Town of Ingersoll Stormwater Management Strategy Study

What's next - Follow-up Work

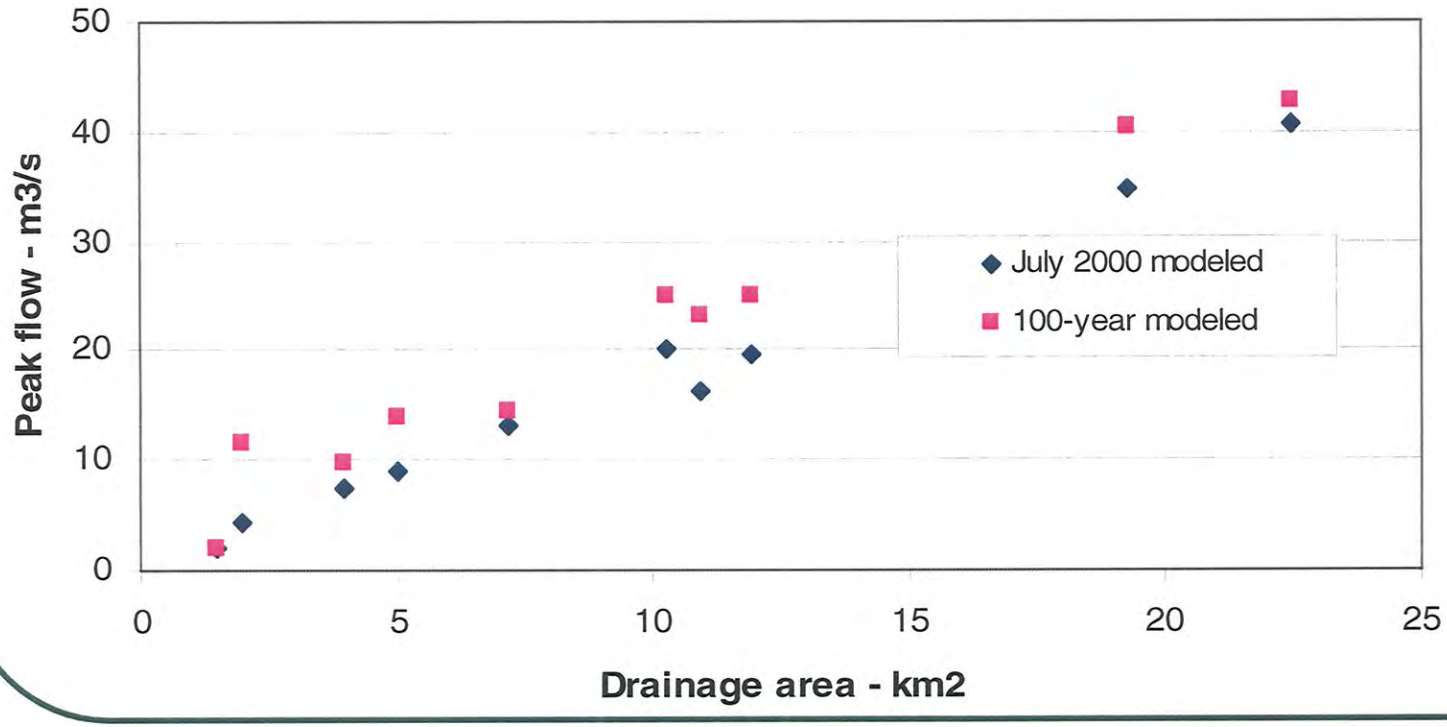
- Strategy is to undertake focused activities over several years, with the Policies and Criteria revised as appropriate, rather than a single large Master Plan approach
- Needed to fill in data gaps and gather additional or more detailed information
- Gather data specific to the issues in Ingersoll and the specific stream sensitivities and significance for further refinement of Policies and Criteria
- Will result in updates to the Interim Policies and Criteria over time

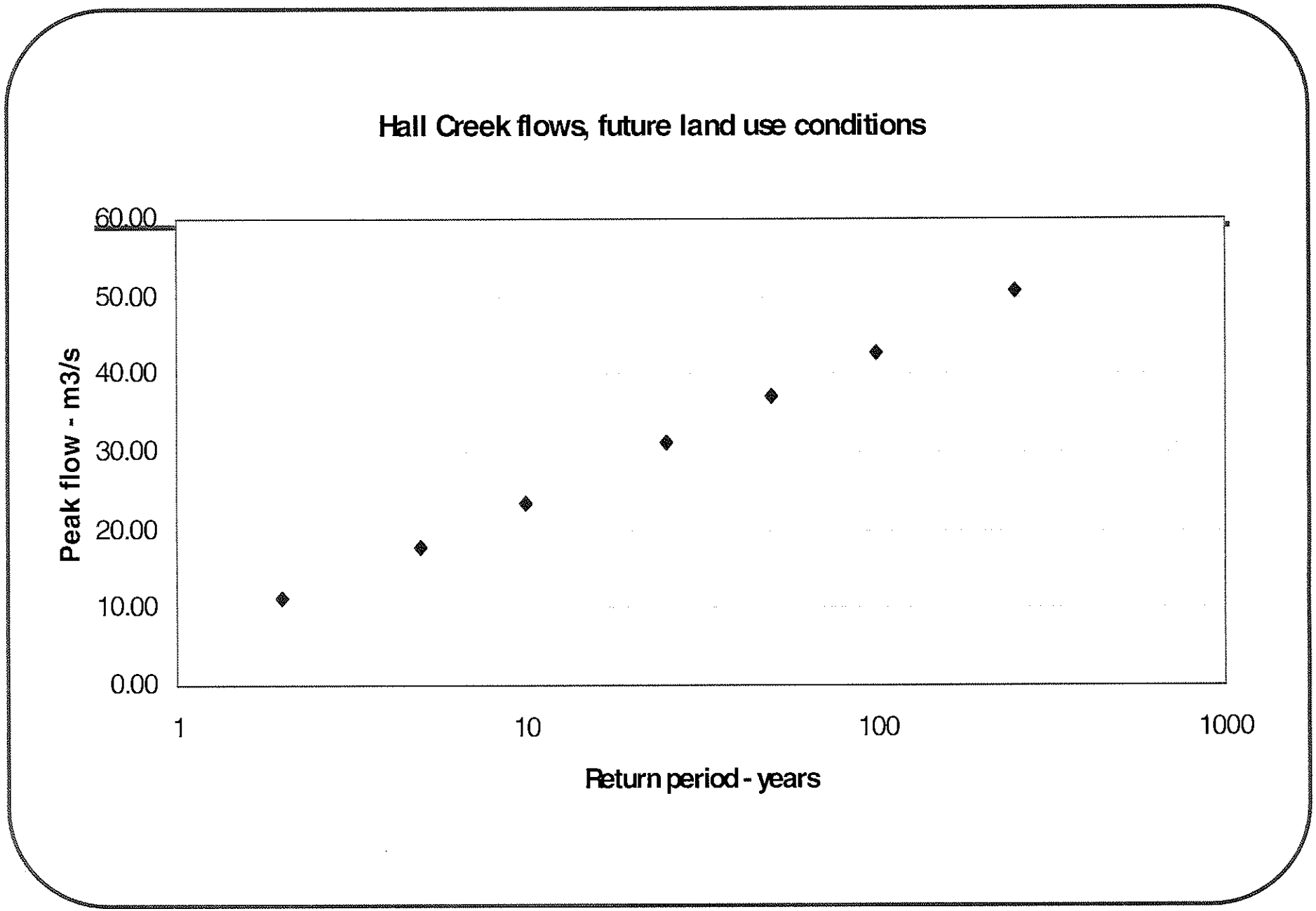
Generic Regulations

July 2000 Ingersoll Storm and Long-Term St. Thomas Rainfall Data



July 2000 and 100-year flow estimates, future land use condition




Hall Creek flows, future land use conditions
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Peak flow - m3/s
1
10
100
1000
Return period - years