

Comments and Suggestions for Reports

Prepared by Engineers Appointed

Under

The *Drainage Act*

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Preface

A number of individuals have influenced the contents of this paper. The critics who are pro or anti drainage have expressed their feelings and have demonstrated where we fail to provide understandable detail in the reports. The engineers who often ask why they should change have encouraged the development of hopefully, acceptable arguments.

Ralph Clayton and Steve Jacobs have read many reports and have contributed ideas to the text and the suggested table of contents found in the appendix.

A special thanks goes to Herb Todgham whose interest and dedication to the well being of his fellow engineers has encouraged the inclusion of much of the background and comments contained in the paper.

And of course, I cannot forget my fellow staff of the Drainage and Water Management Section in the Soil and Water Management Branch, particularly John Johnston and Vernon Spencer for their encouragement and Ann Phillips for the typing and editing.

I hope that this paper will encourage the engineers, as defined by the *Drainage Act* to demonstrate that we are all involved in a credible and honourable profession and are a necessary component of the drainage industry.

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Present Day Controversy

An Act governing the construction of municipal drains has existed in Ontario for well over 100 years. A fundamental requirement has always been the involvement of an engineer to design the drain and make the initial recommendation for the assessment of costs.

Often it is stated that in the past the engineer's opinion was respected by his client. But those of us in the Soil and Water Management Branch of the Ministry of Agriculture and Food with the responsibility of administering the drainage acts, are exposed to a broad range of the criticisms for, but predominantly against certain aspects of the *Drainage Act*. Today, it appears the engineer experiences greater difficulty in convincing the client and the critics that he has made his recommendation based on careful analysis, sound judgement, and without bias or prejudice.

The critics include a number of landowners directly affected by projects, groups of environmentalists, naturalists, and personnel from government agencies. Some individuals in the latter group claim to speak for farmers who do not have faith in their ability to win arguments before the courts established by the *Drainage Act*. Right or wrong, these individuals could potentially be successful in having the legislation revised. Whether this would be for better or worse, we wouldn't know until we experienced the change.

The assembly of the following material was instigated because of statements such as the following:

“The *Drainage Act* is a licence for engineers to print money.”

“Once a project is started, there is no way to stop it.”

“I don't know why they designed a municipal drain to empty a little duck pond, I could have filled it in two hours with my bulldozer.”

This last statement was made by the contractor who was doing the construction of the drain. Just the way the statement was presented, it sounds like the engineer decided it was more practical to design a drain than to tell the farmer to fill the pond.

Assumed Role of the Engineer

Under the *Drainage Act* the ethics of the engineering profession are assumed to be transferred, and applied to drainage projects in the same manner as they would be applied to any other type of project. This is demonstrated through the description of the duties of the engineer as described by Section 11 of the *Act*.

“The engineer shall, to the best of his skill, knowledge, judgement and ability, honestly and faithfully, and without fear of favour to or prejudice against any person, perform the duty assigned to him in connection with any drainage works and make a true report thereon.”

The “practice of engineering” as defined by the *Professional Engineer’s Act* further enforces the attitude that the engineer should be the individual most capable of making the appropriate recommendations for drainage projects. Attitudes such as those which were previously expressed earlier have the potential to affect the reputation and the livelihood of the engineer.

Why Change?

In order for the engineer to recognize the potential need to alter his present practice he can accept the fact that his work under the *Drainage Act* is assured only by the legislation. Legislation however, can be changed when the critics successfully convince the members of parliament that the present system, or a component of the system, is not performing up to the anticipated expectations and a viable alternative exists.

The Ministry receives copies of all reports for projects that are to be eligible for grants under the *Act*. Subsequently, we are in a position which allows us to read the reports, evaluate contents, and at times, respond to the critics. It is sometimes necessary to convey what we expect to be the assumptions of the engineer. As there is often insufficient information contained within the report, the caller is encouraged to verify the true assumptions with the engineer. We would be more comfortable if we could extract fundamental assumptions directly from the report. These assumptions, when clearly expressed with their limitations, should create some road blocks for the critics. They would have to first respond to the limitations and then the assumption. Its like winning a debate. If you express your opinion along with the factors that could make the opinion weak, you have potentially destroyed the opponents argument.

Who Reads Reports

There are a range of readers who use the report for different purposes. Some of these groups are landowners within the watershed, municipal councillors, drainage commissioners and superintendents, contractors, government agencies and non-government agencies. We do not want the landowners and councillors to feel that the engineer’s report exists only because it is a requirement of the *Drainage Act*. The engineer has to show that he is protecting their interests without favour or prejudice, also, that the report is worth the cost. Municipal councillors will look at the report to determine the effect of the project on the community and maybe to evaluate the engineer. They need to know if the engineer is looking after the council and the commissioner or superintendent.

Drainage commissioners and superintendents should want to know about the structural detail and the future maintenance. Do they have a maintenance assessment schedule for each branch drain?

The contractor will be looking for details which will affect the cost of construction.

Government agencies want to know if the project meets the legislative requirements. They also want to confirm that the legislation is not being manipulated for the benefit of a few at the expense of the taxpayer.

Non-government agencies have a commitment to exercise their mandate for the purpose of protecting the interests of their members. These agencies may believe that they are pro or anti drainage. When the information is in the reports, the “anti” groups will be able to look at their mandate on a project basis as opposed to condemning all projects.

A Different Style

In an attempt to overcome any apparent lack of confidence in the engineer as expressed by the farmers and the critics it is suggested that the engineers adopt a style of report which is not currently being used by many practitioners.

The idea is to communicate the engineer’s understanding of the project through the report. What we wish to provide are not tables of numbers and mounds of technical detail, but the numerous factors which were considered, the relative importance of each and how they influence to the final recommendation.

A suggested table of contents was prepared after reviewing a number of reports, Design and Construction Guidelines, Guidelines for Engineers Preparing Reports Under the *Drainage Act* and discussions regarding perceived problems. This table is directed toward reports for new construction or projects requiring major reconstruction. However, the style should be suitable for any project.

If you find there is difficulty in putting different parts of the subject together with relative certainty, it might be an indication of (a) present scientific principles and methods cannot be applied with a reasonable degree of accuracy to a field situation, or (b) there is not sufficient site data to evaluate the importance of the factor. We can say that engineers can never be 100 percent certain of all the facts. However, we have to develop a reasonable approach which reduces the probability of failure to a level that is economically, politically and legally acceptable. With this in mind, you may ask yourself the following questions when you decide not to include any of the material on the subject for discussion:

1. Do I leave it out because it is not applicable to the project?
2. Do I leave it out because I do not have sufficient information or a method of evaluation?

When the answer to the second one is “yes”, then we should be getting together at conferences or educational sessions with the particular subjects on the agenda.

Communicating the Right Information for the Right Impression

If the engineers are to preserve their role under the *Drainage Act*, they have to communicate, not only verbally but also within the reports, that they have analyzed the problem and have made recommendations

which are the best for the situation at hand. In making these recommendations they have amongst other things, considered guidelines, but at the same time, shown a depth of understanding and demonstrated the ability to determine the suitability of the guideline to the site.

The remainder of this paper emphasizes the importance of maintaining a concise meaning in the body of the report and in the specifications. While reviewing some of the reports which have been filed with the Ministry it was noticed that some statements present a vague and incomplete description.

Some examples will help to demonstrate the point. The following quotes were selected:

“The area requiring drainage included Lot 7, Concession 4.”

As long as the statement contains the word “included”, then the statement does not describe the area requiring drainage. Section 8 of the *Act* requires a description of the area requiring drainage. In this particular report there was no further discussion of the area. Does the quote provide a description?

“There appears to be no conflict between the requirements for drainage and for environmental concerns.”

The statement is broad. The Design and Construction Guidelines make reference to water temperature, water turbidity, wetlands, and fish and wildlife. If the engineer were to state why it was decided all or some of these factors were not applicable to the project area, a reader would be more comfortable knowing that these subjects received some consideration.

“I would like to point out that no topographic survey has been made of the lands within the affected area and our report does not intend to show how any of these lands might be underdrained.”

Initially this statement generated the following question “Will the drain provide outlet for tile drainage within the watershed?”

A suggested alternative, providing it is true, is “Although a detail topographic survey of the watershed has not been prepared for the design of tile drainage systems, the drain is designed to sufficient depth and capacity to provide outlet for tile drains if installed in accordance to the recommendations of the *Drainage Guide for Ontario*.”

“Should any landowners wish to verify that any low areas can be drained to the existing (?) drain, he should contact the engineer prior to adoption of the report.”

The word “existing” possibly should be replaced by “proposed”.

The overall statement might be considered to place the responsibility back upon the landowner to tell the engineer how to do the job council had hired the engineer to do. It is likely that if a landowner did not heed the statement and then found that the drain was not of sufficient depth to drain his lands, the

municipality might find themselves doing further construction financed from the general funds with the engineer providing free service.

“Should the construction of this drainage scheme lower the groundwater levels in ponds, wells, vegetation areas or woodlots, the owners of the property on which such woodlots, well or pond is located will be responsible for any damage sustained and for taking any necessary corrective measures.”

This statement is contradictory to the provisions of the *Water Resources Act*. It is now suggested by the Design and Construction Guidelines that if the engineer anticipates some problems with water supplies, data, such as well water levels, well depth, etc. should be collected prior to construction.

Further, it is by no means evident that the engineer has the authority to dismiss his clients of liability that may be incurred as the result of the construction of a project.

“The contractor is to clean up in a workmanlike manner.”

Like beauty, a workmanlike manner is subject to the definition of the beholder. If for example, it means the piling of rock at intervals of no less than 200 meters along the length of the drain and at a distance of 10 meters from the centre line of the drain, then that is what should be stated.

Comments on Report Specifications

Statements such as the preceding are not necessarily confined to the body of the report. They can also be found in the specifications. If specifications are not precise, the control of the project can be lost.

Let us say the purpose of the specifications is to provide a detail description of the work to be done and subsequently, provide a standard to maintain the integrity and control of the cost of the project.

Before the specifications can have strength there has to be a distinct line of authority established between the owner of the contract (in this case the municipality) the engineer, the individual inspecting the work, the contractor, and the landowners. This authority establishes who can make changes and how. Ideally, before grants can be paid under the *Drainage Act*, changes in the specifications, at any time before the costs are levied, have to be documented by an amendment to the report.

It is expected that specifications would clearly describe the structural detail of the end product, i.e. drain width or diameter, rip-rap locations, side-slopes, culvert sizes, etc. These are specific to the project.

Materials can be required to meet standard criteria to ensure strength and durability, i.e. concrete strength, pipe specifications, rock size and type, etc. Reference to a standard criteria is generally suitable.

Other factors which affect the construction process such as the width of right-of-way or easement, access routes, maximum clearing required can be defined within definite limits to assure that these limits are adequate the engineer has to visualize the construction process.

The other factor which is often included but theoretically could be eliminated, is the methods and equipment used for the construction. The purposes of establishing the method of construction and allowable equipment may be to minimize damages, to minimize the amount of construction supervision, or to conform with requirements for the protection of a road, utility, or the environment.

General specifications are often incorporated to prevent repetitive work by the engineer. These describe general structural detail and methods that are common to many projects. If any aspect of the general conditions are altered by a site specific requirement, the engineer has to clearly indicate that the site specific specifications take precedent over the general specifications.

With respect to the actual materials required for construction, the structural detail specifications are generally well done. Standard drawings generally present a more explicit description of the final assembly of the materials and could be used more often.

It is important that the list of materials be complete. There was a situation where the engineer's report did not provide any detail on the materials to be used. An example was the culvert crossing. The engineer, said he would give the specifications at the time of construction. Other descriptions were equally as vague. With that in mind, how does the engineer prepare a representative cost estimate? How does the owner know what he is going to pay for?

The specifications have a tendency to leave decisions on significant aspects of the construction to the "discretion of the contractor". This might be acceptable when it applies to factors which might minimize damages. However, the engineer has to be careful that the contractor's discretion will not lead to substantial changes to the end product or the cost.

Working area and access routes are not always clearly established for construction or future maintenance. If the damages for construction are calculated on an area basis, the lines to establish the area are necessary. If established, there should be less probability of conflict during construction, but you can expect more pre-construction negotiation.

A element which appears to becoming more common in reports and specifications are disclaimers to the effect that the engineer is not responsible for much of anything after the report is accepted. These engineers might be seen as attempting to transfer responsibility from anything that might be realistically interpreted to be poor design to requirements for permits. Fortunately or unfortunately, depending on your point of view, there are no court actions involving drainage engineers which address this particular matter. However, the Drainage Tribunal has suggested in a recent decision that an engineer cannot relieve himself of responsibility. After all, the practice of engineering involves the evaluation and interpretation of the facts, the technical facts.

Plans and Profiles

Plans and profiles are an essential part of the report for two reasons. The plan provides a bird's-eye view of the watershed with the relative configuration of the physical detail, property lines, drain location, etc. The profile provides the detail on slopes, depths and structure locations along the length of the drain. Secondly, the inclusion of the plan and profile are a requirement of the *Drainage Act*.

Different practitioners have different styles for this aspect of the report. Although some engineers provide more detail than others on the plan, the quality of the reproduction method is not of sufficient quality to make the information available. The information has to be neat and legible.

Reports which include roll numbers and/or lot and concession numbers for individual parcels both on the plan and in the schedules allow easy interpretation from schedules to the plans. Those which include numerous station locations at roads, property lines, etc. on the plan while also including the stations with the detail description of the work to be done are also easily understood. When such detail is not included, studying the report can be a frustrating exercise.

Many plans do not include a key to the plan. When this is not included, a reader has to start guessing or doing calculations to determine the meaning of the different symbols and numbers. We cannot assume that readers know of any standard convention.

The majority of reports do not provide any cross section diagrams, especially for channels. To prevent surprises for the property owners who might not be able to perceive the width and depth of a drain simply by looking at a profile, some typical cross-sections from a few distinctly different locations along the profile might be effective. You might also show where the spoil is spread relative to these sections.

It is likely fair to assume that many people who read the reports pull out the plan to get a basic understanding of the project area prior to reading the report. Even if they don't, the plan should be informative.

Methods for Checking Reports and Specifications for Clarity

As with other writing, the most reasonable method of determining the clarity is to have them reviewed by another individual who is not familiar with your work. Each time you bring a new colleague on staff, summer or permanent, it might be a good idea to have them read the specs and where applicable, make sketches to provide their interpretation of what you wrote. The exercise would serve a few purposes. It would educate new staff, test the clarity of the specs, and give you an idea of the strength or weakness of the new staff member.

Another sign of the quality of your overall work, specifications and your ability to develop a strong contract is a review of your own projects. If you find that extras and contract changes are common you

don't have to tell anyone else, but ask yourself this question, "What reasonable action could I have taken in preparing my report to have avoided that change during construction?" Don't be too quick with the response of "no reasonable action".

Summary

Business as a drainage engineer for projects under the *Drainage Act* is expected to become even more difficult to obtain and will be more closely scrutinized by the critics. The theory is, the more informative the report, the less controversy the engineer will confront and the more prepared he will be to deal with controversy.

The engineers who can convince the public that their recommendations are unbiased and are the best for the situation and the public interest, will hopefully continue to be responsible for drainage projects even if the legislation should change. If quality information is presented in a convincing form at the right price, the service would be sought even if not required by legislation.

There will always be opposition to drainage. We must show that we can distinguish between those who are not willing to accept a reasonable interpretation of the facts and those who are.

Initially, a new style of report will take extra time to prepare. Recommendations which have been correct in the past cannot be assumed to be acceptable today. The understanding of real physical concepts of drainage and how they result in benefits and the most economic method of achieving those benefits, must be displayed through the report.

Whether or not you have thought of it before, you might think of each report as an investment in your future. Don't you want to make each investment profitable?

Appendix

TABLE OF CONTENTS FOR DRAINAGE REPORTS

FOREWORD

- Authorization
- Objective
- Recommendation Summary
- Acknowledgements

DESCRIPTION OF WATERSHED

- Watershed Area
- Topography
- Soils - Textural Classification
- Soils - Drainage Rating
- Land Use
- Hydrologic Information
- Development Potential

AREA REQUIRING DRAINAGE

- What is it and how is it defined?

DESIGN CONSTRAINTS

- Costs
- Flows
- Soil Conditions
- Outlet of Project
- Construction Equipment
- Effect on Water Quality
- Effect on Water Supply
- Wildlife
- Potential Permit Requirements
- Right-of-Way
- Potential Crop Damages

RECOMMENDATION AND ALTERNATIVES

- Recommended Solution
- Alternatives
- Construction Scheduling
- Other Potential Expansion of the Municipal Drain
- Expected Performance
- Future Maintenance
- Cost Estimate
- Schedules

PLAN

PROFILE

TECHNICAL SPECIFICATIONS

CONTRACT DOCUMENTS (if requested)

EXPLANATION OF CONTENTS

FOREWORD

- Authorization
 - Legislative Authority
 - Initiating Municipality
- Objective
 - Terms of Reference
 - i.e. preliminary report
 - cost/benefit
 - environmental appraisal
 - What has been requested in the final report
 - a ditch
 - a tile
 - a combination system
 - whatever the engineer thinks is most appropriate

- Recommendation Summary
 - Type of drain
 - Cost
 - Whether or not there will be need of more outlet construction in future

Acknowledgements of individuals or groups whose participation or cooperation has made the preparation of the report less difficult.

DESCRIPTION OF WATERSHED

- Watershed Area
 - Size
- Topography
 - Types of terrain
 - Slope ranges
- Soils
 - Textural classification (from soils reports if available)
 - Comments as per apparent accuracy of the report
- Soils
 - Drainage rating (from *Drainage Guide for Ontario*)
- Land Use
 - Area of agricultural land and the cropping system (see Agricultural Resource Inventory, OMAF)
 - Area of non-agricultural land description of alternate uses
- Hydrologic Pattern
 - Flows channelize or intensify in what areas
 - Existing channels and their history
 - Types of flow
 - intermittent
 - continuous
 - Development Potential
 - What changes can result if drained? (i.e. changes in crops grown, changes in type of agriculture)

DRAINAGE PROBLEM

- Surface or Subsurface
- Approximate duration of flows and flooding from short duration summer storms, high water table
- Exact problem(s) to be addressed
 - Inundation of land and crops

- Requirement for tile drainage outlet while considering what areas could be physically tile drained without a pump or the construction of the outlet
- Requirement for a legal outlet
- Requirement for new crossings
- Drain to be closed or relocated and how that is expected to improve farming efficiency and productivity
- Lands affected by above

AREA REQUIRING DRAINAGE

- Definition and size of “area requiring drainage”, legal, physical, or both

DESIGN CONSTRAINTS

- Costs
 - Brief discussion of factors that affect the initial investment materials, allowances, excavation, erosion control, etc. It may be applicable to mention how a small initial cost could lead to a larger long term cost
 - Direct
 - Benefits to be obtained from the drain
 - Flows
 - Qualitative description of flows that are expected throughout the year, how they affect the design of the channel and the structures
 - Soil Conditions
 - Amount of investigation and limitation
 - Findings
 - Potential effect on construction and future maintenance
 - Erodability
 - Protective measures necessary to preserve drain stability ie. grade control, interceptor drains, etc.
 - Outlet of the Project
 - Location
 - Description
 - Sensitivity of drain to outlet changes (beaver dam)
 - Sufficiency
 - possible effects of drainage improvements on peak flows into the outlet of the project

- Construction Equipment
 - Conditions allow use of conventional equipment without extreme difficulty
 - May require work after freeze-up
 - Might require pads for hoe, tow-dozers, etc.
 - Seedbed preparation
- Effect on Water Quality
 - Water serves as a supply for livestock, fish habitat, empties into a lake or pond which is a recreational area
 - If not a significant issue - why not?
- Effect on Ground Water Supply
 - Excavation could cut a main vein that is a supply to another area
- Effect on Wildlife
 - Fish or water fowl habitat
 - Nonexistent
- Potential Permit Requirements
- Right-of-Way
- Potential Crop Damages Due to Construction
- RECOMMENDATION AND ALTERNATIVES
 - Recommended Solution
 - Type of drain, length, location provisions to reduce maintenance costs
 - Sediment basins
 - Grade control structures
 - Rip rap at outlets of tributary drains surface or subsurface
 - Seeding
 - Fencing
 - Alternate water supply - livestock or domestic
 - Landowner actions or practices that could preserve the drain
 - Reference to Design and Construction Guidelines
 - Alternatives
 - Construction Scheduling
 - anticipated pattern
 - overall time requirement
 - Other Potential Work
 - future extensions to provide outlet for other parcels
 - deepen to provide tile drainage outlet

- Expected Performance (not numbers but a qualitative description of what is expected in future)
 - low flow levels
 - level of flow for 2-year or 5-year event
 - levels for spring runoff conditions and potential alternate flow pattern or ponding due to ice and snow
- Future Maintenance
 - type of work anticipated
 - methods to reduce frequency
 - responsibility for the work
 - how the costs are to be assessed
- Cost Estimate
 - construction and material
 - total allowances
 - with reasons and reference to legislative authority
 - special assessments
 - contingency
 - engineering
 - financing
- Schedule of Allowances
- Schedule of Special Assessments
- Schedule of Assessments
 - individual parcel
 - owner summary

PLAN

PROFILE

TECHNICAL SPECIFICATIONS

- General, brief outline of the line of authority to be followed by all individuals to be altered after the by-law is passed while at the same time expressing the difficulty imposed by the *Act* in making a change.
- Description of work from the point closest to the outlet where construction begins, to the top end of the drain.
- General Specifications
 - describe structural detail and, if appropriate, method of construction

CONTRACT DOCUMENTS (not necessarily include in the report)