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MANUAL ON THE APPLICATION OF THE ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS WITHIN PARKS CANADA

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NATURAL RESOURCES DIVISION

NATIONAL PARKS BRANCH

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CHAPTER 1: Background Information

Cabinet Directive

The Environmental Assessment and Review Process (EARP) was established by Cabinet directive in December, 1973 and applies to all federal government activities, including those which take place under the sponsorship or jurisdiction of the federal government, take place on federal land or use federal money. All federal departments and agencies are bound by EARP with the exception of proprietary Crown Corporations and federal regulatory agencies which are invited, rather than directed, to participate. The purpose of EARP is to determine in advance the environmental acceptability of federal projects and to ensure that damage to the natural environment is reduced to a minimum.

Parks Canada Policy

We in Parks Canada responded to the Cabinet directive by stating in our policy document[1] that we will take into account the full range of adverse impacts of proposed actions under our management on public lands under our jurisdiction, including biophysical, socio-economic, cultural, archaeological, historical and aesthetic impacts. The consequences of each project must be considered as early as possible in planning and this assessment incorporated in the decision to proceed with, reject or modify the activity. All actions' including ongoing operational activities are to be subject to impact identification and evaluation procedures to the degree necessary to determine the anticipated level of impact.

Three Stage Assessment And FEARO's Role

EARP is administered by the Federal Environmental Assessment and Review Office (FEARO). FEARO is responsible for assisting other government agencies in applying EARP, and has prepared a general framework for assessment which includes three phases: 1. screening, 2. initial environmental evaluation (IEE) and 3. environmental impact statement (EIS) with panel review and public hearings. Screening is intended to identify and describe possible adverse environmental effects using available information, early in project planning. An IEE is done only when questions remain following the screening and new information must be collected in order to provide answers. It provides a description of the existing environment and resource use, and the potential environmental effects and proposed mitigative measures for each possible alternative plan for the project. An EIS is the most thorough level of assessment. It is used only for the very few projects which threaten to have especially severe

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1 Parks Canada Policy, Ottawa, 1979

environmental consequences, for example the twinning of the Trans-Canada Highway through Banff National Park, and each EIS is subject to review by the public and by a panel of experts. The philosophy of EARP is that each government department or agency should be responsible for environmental protection within its own jurisdiction and should therefore perform its own impact assessments with FEARO providing assistance upon request. FEARO is responsible for appointing a panel of experts should a project require an environmental impact statement, public hearings and panel review. The panel provides terms of reference for the EIS for the project in question. FEARO has issued general guidelines for the screening[2] and initial environmental evaluation[3] stages of assessment. While these are useful references, their applicability to specific projects is limited because they must encompass such a broad range of project types. This manual is designed to provide guidance more specifically suited to Parks Canada activities.

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2 FEARO & E.P.S. Guide For Environmental Screening 1978.

3 FEARO. Guidelines For Preparing Initial Environmental Evaluations, October 1976.

CHAPTER 2: An Overview Of The Manual's Purpose And Content

Parks Canada's Need For EARP

Parks Canada has a mandate "to protect outstanding naturaland historic places of Canadian significance"[4]. In our efforts to fulfill this mandate we in Parks Canada are not likely to propose activities which would seriously endanger the natural areas we are trying to protect. However, lesser degrees of damage can be inflicted upon the environment by many of the projects with which we are involved if they are poorly planned or executed. There is enough evidence of past mistakes that it is obvious that we must accept our responsibility for impact assessment and not assume that the nature of our business precludes adverse environmental impact. We should assume, however, that projects initiated by Parks Canada can be assessed at the screening and IEE levels of EARP without requiring an EIS. If we were to propose a project which required an EIS and panel review it would surely be in direct conflict with our stated objectives.

Objectives Of EARP For Parks Canada

The main goals which must be satisfied by a Parks Canada environmental impact assessment procedure are: a) the thorough identification and description of the adverse impacts which could occur, and b) the monitoring of changes which actually do occur to the natural environment as a result of any project within a National Park, National Historic Park or Site, or area covered by an Agreement for Recreation and Conservation. It is essential that impact identification and description take place relatively early in the planning process to allow time for the project planners and the engineering/ architectural support group to analyze their options from an environmental perspective before making irrevocable commitments. The impact assessment of a project at an early stage serves several purposes which help to ensure its ultimate success. Firstly, it improves program credibility by demonstrating publicly that a project will cause minimal damage to the environment. This is a valuable exercise even for those projects which seem very straight forward and innocuous to Parks Canada staff. Secondly, it helps to identify the projects with harmful effects which were overlooked in the initial planning process, highlighting the potential problems and information gaps which would require extra time and expense to solve. An impact assessment at the conceptual stage may also suggest some of the mitigative measures which could reduce or eliminate the project's environmental costs. This allows for the re-evaluation of planning priorities if necessary and for a more

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4 J. Hugh Faulkner, Minister responsible for Parks Canada, 1979.

rational discussion of impact significance and the cost of impact reduction at the managerial level. A third benefit to management is the improved efficiency in allocating person years and funds which is to be gained from the early assessment of project viability and cost.

Format Of The Manual

The manual introduces the advantages and disadvantages of several environmental impact assessment methods and tools which have been developed largely over the past decade. It then proceeds to describe how these techniques could be usefully applied to Parks Canada project development situations.

Because of our heritage protection mandate, the emphasis in this manual is on the initial (screening) stage of environmental impact assessment. The procedure described continues from screening through the IEE and EIS stages, although these latter stages will not often be required for Parks Canada projects.

The manual follows with a discussion of objectives and planning procedures for project monitoring and post-construction impact assessment evaluation. The last section outlines the relationship between environmental impact assessment, project funding, and project planning procedures for the three Parks Canada programs; National Parks, National Historic Parks and Sites, and Agreements for Recreation and Conservation.

The appendices contain a glossary, a detailed checklist of environmental parameters subject to impact, a sample format for a screening report with an explanation of the appropriate information to include in each section, and guidelines for the assessment of impacts on archaeological and historical resources.

The major bulk of the appendices is devoted to a series of excerpts from documents produced mainly by Environment Canada containing "codes of good practice" or information on environmentally sound techniques for various types of development. Each of the relevant publications was reviewed and any information which seemed particularly useful, such as specific guidelines, was excerpted. The title page and table of contents from each document has been included so that readers can determine whether there are items of interest not included here and obtain the complete report if they wish. Some subjects such as road construction and erosion control are dealt with in more than one code and a list of reference locations has been prepared for major subject categories to assist readers in finding all of the information on each topic.

The information in the codes may be useful to project designers when they are choosing amongst their options, and helpful to those who must provide terms of reference on project design and construction to contractors. The codes may also be useful to anyone assessing environmental impact, enabling him or her to compare the project being assessed with the desirable practices described.

A list of the references consulted during the preparation of the manual appears at the end, along with information on obtaining the publications.

CHAPTER 3: Environmental Impact Assessment Methodologies

Development Of The State Of The Art

An extensive literature review has indicated that numerous methods have been developed over the past ten years for assessing the environmental impacts of a wide range of types and sizes of projects. Many of the techniques were developed in response to the United States National Environmental Protection Act (NEPA) of 1969 and aim at a greater degree of complexity than seems necessary for meeting Parks Canada's needs, often requiring advancedmathematical skills and computer resources. Those who have worked with environmental impact assessment have been frustrated in their attempts to measure, rank, weight, standardize and otherwise quantify impacts (many of which are unquantifiable by nature) to achieve objectivity and to facilitate the comparison of alternative options. The critical literature indicates that all of these attempts are suspect and that these techniques should be used with a great deal of caution. Other methods involving overlay and computer mapping have been developed as planning tools but may also have some useful applications in impact assessment. They are designed to provide land use capability information by describing biophysical characteristics, sensitive environments and existing resource uses, enabling planners to identify and avoid potential land use conflicts.

Methods Most Appropriate For Parks Canada

The methods described in the literature which are most adaptable for Parks Canada's impact assessment purposes are the mutli-disciplinary team "common sense" approach, checklist, network and matrix methods. These will be most effective when used in combination as each one contributes a different emphasis to the process. Following is a description of these approaches to impact assessment.

Common Sense Team Approach

The common sense team approach is the least structured of the impact assessment "methods". It relies upon the combined expertise of professionals in each of the areas of possible impact who are familiar with the project and its receiving environment. Initially, each expert individually evaluates the project for any potential problems. This is often followed by group discussions in which the experts attempt to reach a consensus on the nature and extent of the impact. The value of the common sense team approach depends entirely upon the degree of expertise of each of the individuals involved. If he or she is perceptive, knowledgeable and thorough, then this approach will be as effective as any other. However, if he or she has a poor understanding of the natural resources affected by the project, of the project itself, or fails to spend sufficient time on the review, then the results will be inaccurate or incomplete. The team approach to impact assessment is widespread because it is relatively straightforward and quick. It inevitably plays an important part in the process even when other methodologies are used as well.

Checklist Method

The checklist technique for environmental impact assessment is one stage more advanced than common sense. Checklists organized by a) environmental parameters (see example in appendices), b) impact types, c) phases of development and associated activities or by d) spatial categories such as land use types, provide a structure for the assessment. Unlike the common sense team approach, checklists serve to remind the reviewers of the factors involved and ensure that environmental reviews are consistent and thorough in the factors considered regardless of whether different personnel are doing the reviews from one project to the next. Checklists can be easily adapted to suit any type of environment or project and can be made as detailed as is necessary. They may or may not be accompanied by guidelines for measuring and interpreting environmental data. The main advantages of the checklist are that it is adaptable, systematic, and easy to understand and use.

Its main disadvantage is that it is a reminder of only one component of the interaction between an activity and part of the environment and does not guide the user to any cause-effect link between the two. One must depend upon personnel experience, advice from others, or other techniques in order to establish the relationships. Examples of checklists devised as the basis for impact assessment include a simple one page list in the Province of Alberta (Figure 1), an eight page checklist in the State of Washington (Bendix and Graham p. 116), a computerized version used by the United States Army (Canter p. 203) and a relatively complex "scaling-weighting" checklist developed by Battelle Laboratories for the United States Bureau of Reclamation (Canter p. 207). The Battelle system reduces different types of impacts on different environmental parameters to comparable units by rating impact values on a scale from 1 to 10 and weighting parameters by having an interdisciplinary group of experts assign importance values. While the Battelle "environmental evaluation system" seems to be one of the least criticized of the quantification techniques it is unnecessarily complex for most in-house Parks Canada impact assessments.

ENVIRONMENTAL CHECKLIST CATEGORIES AND SUB-CATEGORIES

CATEGORIES	SUB-CATEGORIES	DESCRIPTION
Settlement Land Uses	Residential Commercial Industrial Transportation Utilities and Communications Institutional Facility Based Recreation Archaeological	Settlement uses includes parameters which describe existing settlement oriented land uses.
Resource Land Uses	Argricultural Forestry Mineral Resource Extraction Non-mineral Resource Extraction Water Wildlife Resource Based Recreation	Resource uses include parameters which describe existing natural resource oriented land uses.
Geology	Surficial Bedrock	Geology includes all parameters which describe landforms and surface materials, and bedrock geology.
Soils	Soil Types and Capability Rating Soil Productivity	Soils includes parameters which pertain to soil types and soil capability ratings and soil productivity.
Vegetation	Terrestrial Aquatic	Vegetation lists all those parameters pertinent to the productivity, structure, and composition of terrestrial and aquatic communities.
Fauna	Terrestrial Aquatic	Fauna includes all parameters relevant to health, distribution, abundance and productivity of terrestrial and aquatic animal populations.
Water	Ground Water Surface Water Flowing Surface Water Standing	Water includes all parameters which pertain in water quantity, quality and flow.
Air	Temperature and Heat Transfer Wind Precipitation Isolation and Radiation Fog and Ice Fog Humidity Air Pressure Air Quality Noise and Vibration	Air includes all those parameters which describe weather conditions, quality of the air (primarily pollution levels), noise levels and vibration.
Community	Community Structure and Stability Community Health Commercial Vitality	Community includes parameters which describe the human environment.

Alberta Environment, Environmental Impact Assessment Guidelines p.5.

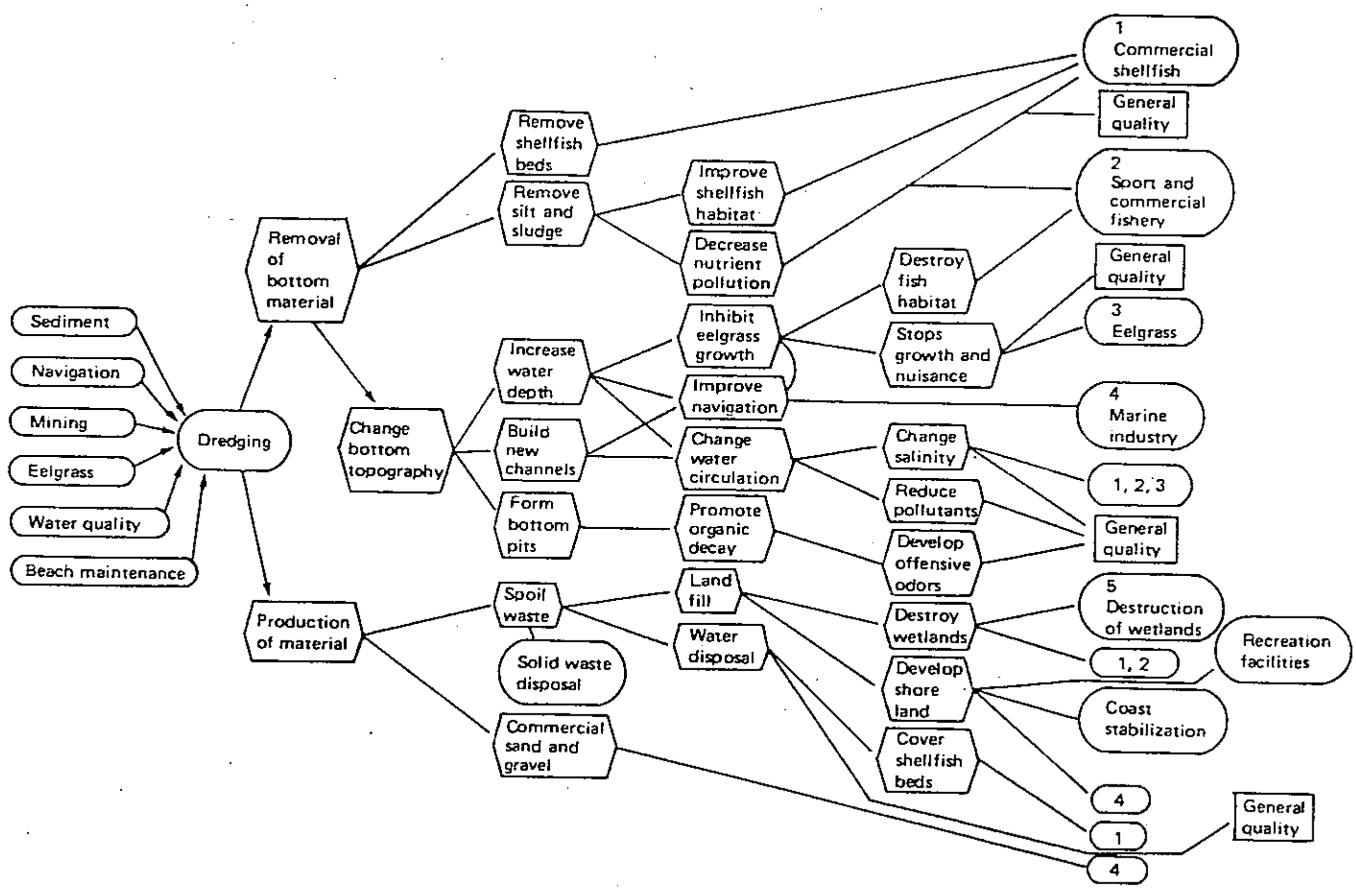
Figure 1

Network Method

Network systems were designed to identify and document the relationships between environmental parameters, project activities which cause impacts, and the nature of the impacts caused. Networks are particularly useful for identifying secondary and tertiary impacts as well as primary impacts because the network develops as each impact level leads to the next. Any given primary impact such as soil erosion will often lead to more than one secondary impact such as 1) stream siltation and 2) loss of vegetation and these will in turn lead to further impacts, thus expanding the network. Figure 2 shows how dredging could have an impact upon certain environmental parameters, and how those primary impacts (removal of bottom material and deposit of material elsewhere) will lead to secondary impacts (removal of shellfish beds and spoil waste) which will, in turn, cause tertiary and higher order impacts. While it is highly desirable that the identification of secondary and tertiary impacts be included in any impact assessment system, networks such as the one in Figure 2 become difficult to portray and to interpret if they attempt to deal with more than a few environmental parameters. Fairly simple networks could, however, be established by using a detailed checklist of environmental parameters several times over, once for each primary impact identified, then once for each secondary impact etc. This would allow reviewers to trace a path from each primary impact through the possible subsequent impacts. A more detailed description of this procedure along with an example of its use can be found in the following section "An Approach to Environmental Impact Assessment For Parks Canada".

Matrix Method

Matrix designs range in complexity and size to serve many purposes. The best known and probably most widely used version is the Leopold-type matrix which was developed for the United States Geological Survey in 1971. It is essentially a checklist of environmental parameters along one axis and a checklist of project activities which could cause environmental impact along the other. As with the network method, its advantage over a simple checklist is that it directs the reviewer to identify cause-effect interactions. Leopold's matrix system also allows for the designation of magnitude and importance values (magnitude meaning the size of the area affected and importance referring to the relative importance of the affected resource) for each impact, on a scale of one to ten. However it is difficult if not impossible to assign these numbers objectively to provide a valid comparison of the impacts caused by different project proposals. Leopold suggested that a text would accompany the matrix form to describe each of the more extensive and important impacts. The checklists which Leopold designed to form



Canter, Environmental Impact Assessment, 1977
"A Network Analysis of Dredging" p. 197
Figure 2

the matrix are very comprehensive ... 100 activities and 88 environmental parameters ... however the system can be used equally well with less comprehensive axes.

Matrices are useful at the beginning of an impact assessment for identifying primary impacts, and do not have to include the magnitude and importance values. They are also useful as an illustrative summary of an impact assessment. Their main disadvantage is that they do not lead the user to identify secondary and tertiary impacts. An impact assessment procedure does not, however, have to be based entirely upon one technique, and the Leopold-type matrix is an effective tool when used as one component of an assessment. It can be easily adapted to suit specific project types and environments and can be used in the field. An example of a Leopold-type matrix can be found in the Project Register and Screening Form in Parks Canada Management Directive 2.4.2 on EARP, included at the end of this manual.

Another approach to matrix design which involves some mathematical complexity was developed by Ross (1974) to determine second, third and higher orders of interdependence among environmental factors. This is an attempt to incorporate the network concept into a matrix design by showing, for example, that, if crabs are dependent upon bottom fish, and bottom fish are dependent upon insects, then crabs are dependent upon insects. Interdependence chains can become very long and determining the degree of interdependence between factors becomes increasingly difficult.

Several authors[5] have analyzed various matrix techniques and have concluded that their principal weaknesses show up whenever there is any attempt to use matrices as other than an interaction checklist. No one has as yet developed a quantification scheme which has general applicability.

Environmental Assessment Tools

The following techniques may be useful tools in the organization of information for assessing environmental impacts.

Overlay Mapping

Environmental impacts can be identified on a very general scale through the use of overlay maps of the critical characteristics of the project environment. The method came into

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5 (Bennington et al 1974, Armour 1979, Canter 1977, Dickert and Domeny (eds) 1974, Grafetal 1974, Holling 1978, Jain, Urban and Stacey 1977, Schlesinger and Daltz 1973, Sorenson 1072, Smith 1974, Viohl and Mason 1974, Warner and Bromley 1973, Warner and Preston 1974)

prominence with its use by McHarg (1970), who used a number of transparent overlays to indicate the aerial extent of different landscape features. Thosefeatures which were unfavourable for road-building, for example, were shaded, and when several overlays were viewed together the least favourable areas would appear very dark. Secondly, overlays showing the area to be affected by a proposed activity could be placed over base maps or overlays showing environmental features in order to study the compatability of the activity and environment or lack thereof.

One disadvantage of the overlays is the difficulty in indicating degrees of incompatability between environmental characteristics and an activity. For example, areas with steep slopes are unfavourable for road building, but one overlay cannot effectively portray varying degrees of steepness with reasonable accuracy. Also, if certain acceptable criteria are chosen to indicate the landscape features appropriate to a particular development, eg. any slope less than 20 degrees, and overlays are prepared to represent areas within those criteria, it would be very time consuming and expensive to revise the criteria. Computers can make either of these tasks much simpler.

Manually produced maps and overlays could, however, be used for regions where data has not been systematically collected and stored in a computer system.

Computer Data Storage And Analysis

Computer systems such as CGIS (Canadian Geographic Information System) are proving extremely useful tools for storing and analyzing environmental information for some National Parks. Data is stored in polygonal geographic units and can be presented in tabular or map format when required. The Canadian Soils Inventory System (CANSIS), which is also being used to store biophysical inventory data for some Parks, has limited analytical powers compared to CGIS. Both systems can produce black and white or coloured maps, either on paper or mylar, at any scale. CGIS can, however, produce maps describing a single environmental feature or any combination of features and makes them available on video display prior to printing.

For planning purposes CGIS can sort through all the available stored data for a given area to choose sites or corridors which meet criteria established for a certain project such as a road or campground. For impact assessment purposes the system could be used to indicate, for example, the proportion of a particular resource within a park which would be affected by an activity, or the uniqueness within a park of a particular feature or species. If, for example, the disturbance of prime sheep habitat was a concern associated with a project, then a map could be printed to show all the available data on sheep habitat in that locale and the relative importance of the habitat affected by the project would become apparent.

Summary

Much of the research effort which has been devoted over the past decade to environmental impact assessment has focussed on the large projects which are likely to produce the most extensive and damaging impacts. Because of the massive amounts of data which are often generated by these projects the complex techniques are perhaps justified, however one senses that the experts remain frustrated as the increasing complexity, involving extra time, effort and expense, has failed to produce increasing validity. Even when the impacts can be predicted relatively objectively using a complete data bank we remain dependent upon subjective analysis for the determination of impact "significance". The most we can hope to achieve is a method for systematically identifying, describing, and quantifying where possible, the ecological impacts and available mitigative measures so that managers have a sound factual basis for assessing the importance of those impacts in relation to the other factors which affect project approval.

The environmental impact assessment procedure must be integrated with the existing project planning and budgeting structures in order to contribute constructively to the definition of project constraints. If these different aspects of project development are successfully integrated then decision makers can be presented with several options for any project or plan, each accompanied by a clear definition of the associated costs in terms of dollars, social welfare and the natural environment.

CHAPTER 4: An Approach To Environmental Impact Assessment For Parks Canada

Introduction

The main goal of a Parks Canada environmental impact assessment procedure must be to identify and describe the potential impacts of projects on the natural environment. This is done to facilitate the comparison of alternatives to the project, to provide direction for the design of mitigative measures, and to evaluate the actual response of the environment to the project to ensure that impacts are being mitigated as intended. Different ways of meeting this goal have been introduced in the previous section and some of those methods and tools will be adapted and combined in this section to produce a system which will work efficiently for Parks Canada.

When To Begin Environmental Impact Assessment

One of the most difficult aspects of impact assessment is the decision as to when in the planning process to begin. If impact assessment is attempted too early it is pure speculation with little focus. It should wait until planners have reviewed the available biophysical inventory data and, based on that review and other factors, tentatively chosen one or several possible sites. An impact assessment at this stage will help planners to choose amongst alternative sites or to look for new sites. If, on the other hand, the impact assessment is not initiated until after a site is finally chosen, it will be more difficult to change the decision in favour of an alternate site. There may have already been a substantial investment of effort which people will hesitate to "waste". Impact assessment undertaken at the conceptual stage of planning must be appropriately general, the purpose being not to identify every detail of potential impact but to ensure that detailed planning proceeds in an environmentally acceptable direction.

Screening

The procedure outlined in the Parks Canada Management Directive on EARP begins with screening. It is the only stage of the process which every project must be subject to. Screening is flexible to allow for the assessment of a wide variety of project types and sizes. The screening "report" can be very brief (a page or less) allowing us to quickly eliminate from more complex and time consuming assessments those projects which clearly pose minimal danger or no danger to the environment. It also allows an undetailed form of assessment for those projects which are in the early, conceptual stage of development. The screening can be a more substantial, detailed document as is appropriate for projects which present problems. It will provide a record for the benefit of Parks Canada managers, as well as the public, of the fact that the environmental impacts of each project resulting from the construction, operation and maintenance phases, have been considered during planning.

The two main purposes of screening are to identify impacts and to describe their nature and extent in the context of the locale affected. The impact description should include factors such as:

(a) the area of the resource(s) affected

(b) the number of individuals of a species affected and proportion of the park population(s) or other resource affected

(c) the duration of the impact

(d) the timing of the impact with respect to the life cycle(s) of the specie(s) affected

(e) the rarity of the resource(s) affected within the park, region or country

(f) existing land use and zoning of the area affected.

For further discussion of the contents of a screening report refer to "Sample Format For A Screening Report" in the appendices.

The degree of severity of effects or lack of information concerning effects should be evident from the screening impact description. A decision can then be made by management to either proceed with the project as planned or with mitigative measures, to modify the project extensively and do another screening, or to undertake further impact assessment.

Who Should Do It And How?

The screening should be carried out by those who are most familiar with the project locale. Assistance from others with a particular type of expertise such as archaeology, geomorphology or wildlife ecology should be sought when specialized information is required. Archaeological inventories of prehistoric and historic sites should be undertaken by qualified archaeological researchers. The Regional or National EARP Coordinator should be called upon for assistance in obtaining such outside expertise.

While the impact assessment will be based mainly on the experience and knowledge of the people involved, it should include a field reconnaissance of the site(s) and a review of available literature to validate the results.

Checklists and matrices have been described in the previous section as effective tools for the identification of primary impacts. They allow the screening team to document the potential impacts of each of the activities associated with a project on the relevant environmental parameters, and to display this information to others relatively quickly and easily.

In the case of a project for which adverse effects are identified, the screening team should take each of the primary impacts in turn and check the entire list of environmental parameters (appended) to determine whether any of them could be affected. For example, could a primary impact such as reduced vegetation cover due to clearing cause secondary impacts? The answer is yes; it could lead to reduced terrestrial fauna populations, susceptibility to erosion and perhaps other secondary impacts. The team should then repeat the procedure with any secondary impacts in order to identify tertiary impacts. For example, erosion could lead to stream siltation and reduction of fish spawning habitat. The screening team would at this stage need to be familiar with all available literature on the resources in the area of concern. They should also consult outside expertise to ensure that all the available information is considered. Repeated field reconnaissance may be required to check the validity of information and to give the screening team first hand knowledge of the proposed site(s).

All of the impacts identified should be described in as much detail as possible, preferably in specific quantitative terms, avoiding generalities such as "large". The other environmental features in the vicinity of the project should be described quite briefly or reference made to sources of detailed information. This information is not critical to a decision on the project and can consume a lot of time and space unnecessarily. Photos and maps of the site(s) are useful for providing quick orientation to the area.

Mitigative Measures

The planning, engineering and architecture team should contribute to the development of mitigative measures as these could involve revision of the plan or project design. The appended information on codes of good practice may be helpful at this stage. While it may be possible to modify a project to avoid environmental damage in almost every circumstance, the cost of such modification may be prohibitive. Where the effectiveness of the mitigative measures increases with their cost, a decision must be made as to the amount of money worth spending to achieve an acceptable level of mitigation. The degree to which an impact is mitigated will depend upon the project's priority, the sensitivity of the receiving environment, and the funds available. Those responsible for proposing mitigative measures should evaluate their cost-effectiveness, if possible.

Any mitigative measures which could result in further environmental impacts (for example plan or project design changes) should be reviewed by the screening team before the completed report is submitted to management.

The Next Step...Is An IEE Required?

An IEE is required for those projects for which the screening report indicated either worrisome environmental impacts or uncertainty about environmental impacts. To use the word "worrisome" is no more helpful to those who must do the impact assessment than to use any of the other words which usually describe this critical, yet elusive factor in environmental impact assessment, i.e. "significant", "serious", "important" etc. There is no valid way of standardizing or of measuring the amount of impact which would necessitate an I.E.E. rather than just a screening. It is a "judgement call" based on the results of the screening process, made by a manager who must decide whether he is satisfied with the level of information provided by the screening report.

The seriousness of the impact will depend upon the degree to which the area has already been altered from its natural state, the sizes and variety of populations dependent upon the potentially impacted resource, the rarity of the resource, and undoubtedly other "importance" factors such as those listed on page 25 and in Appendix I of Management Directive 2.4.2 Environmental Assessment And Review In Parks Canada. The evaluation of the seriousness of environmental impact is a very site-specific problem. It can only be resolved in the context of the particular combination of environmental features and other circumstances which is unique to each location. "Significance" criteria developed for one location would likely be invalid for other areas. In the absence of evaluation standards for each specific location those doing the assessment must decide whether they have enough information about the project and the resources affected to be able to describe the anticipated impacts with confidence. They should provide as complete a report as they consider to be necessary to allow the manager responsible to make an informed decision.

If members of the screening team are left with questions in their minds after the screening exercise concerning either impacts or mitigative measures then these questions should be stated in the report. If the manager is not confident that the information is complete enough to allow him to make a decision, then he should request that an I.E.E. be done. The transition from one level of assessment to the next, simply put, is a matter of professional opinion.

Initial Environmental Evaluations

An IEE is undertaken only when there are major questions remaining after the screening exercise concerning adverse environmental effects. Its main purpose is to report the results of studies done to answer these questions.

An IEE should contain a detailed discussion of project options with a listing of the main advantages and disadvantages of each. The techniques used for impact assessment will vary from project to project but some quantitative analysis or ranking of alternative options may be appropriate (eg. The Battelle Environmental Evaluation System described in Chapter 3).

An IEE should focus on the information gaps identified during screening. It would require additional field work and possibly further literature review. Completed IEE's should be referred to the appropriate DOE Regional Screening and Coordinating Committee (RSCC) and Parks Canada Headquarters for review. RSCC's are made up of representatives from each component of DOE. For projects initiated by Parks Canada, an assessment at the IEE level should be sufficient to provide answers to any questions raised by the screening.

Environmental Impact Statements

An Environmental Impact Statement (EIS) is required only for those major projects which are potentially very environmentally damaging. It is highly unlikely that Parks Canada would ever be in the position of proposing such a project and having to produce an EIS. Parks Canada will, however, occasionally be involved in the EIS "panel" review process as an intervenor at public hearings if our lands are to be adversely affected, or as the "initiator" (referrer of a project to FEARO) where an externally proposed project is to be located on our lands. In the latter case we would contribute to the development of terms and conditions for the EIS which would be prepared by the proponent.

Summary of Environmental Assessment Phases, Contributors and Information Requirements

Contributors	Information Required	Assessment Phase
Planners Engineers & Architects Resource Conservation	Biophysical Inventory	Plan/Project Development
Park/Site/Regional Office Resource Conservation Staff EARP Co-ordinator	Experience Field Reconnaissance. Literature Review	Screening
Screening Team Planning Team (including Engineers & Architects)	Experience Literature Review	Mitigative Measures Development
Park/Site Superintendent or Regional Director	Screening Report	Decision
Screening Team Outside Experts (if necessary) EARP Co-ordinator	Screening Report Experience Literature Review Field Reconnaissance. Field Research	IEE (if necessary)
IEE Team Planning Team	Experience Literature Review	Mitigative Measures Development
Park/Site Superintendent or Regional Director	IEE Report	Decision
FEARO Panel Proponent	IEE Report Field Research Literature Review	EIS (if necessary)
FEARO Panel Minister	Public Hearings Transcripts. EIS	Decision
Park/Site/Regional Office Staff	Field Research	Impact Monitoring Modification of Project (if necessary)

Figure 3

Chapter 5: Project Monitoring

Definition Of A Monitoring Program

Monitoring may be defined as a scientifically designed system of continuing standardized measurements and observations intended to indicate changes in trends and levels of one or more elements of an environment. The results are recorded and reported according to a pre-arranged schedule and method, and evaluated for the purpose of determining magnitudes and characteristics of environmental change resulting from man's activities.

Objectives

Each monitoring program will differ according to the scope and complexity of the project, the nature of its receiving environment, and the extent of the manpower and financial resources available. Generally the following objectives should be considered for the monitoring of environmental impact:

1. Determination of the accuracy of the impact assessment, ie. whether the nature and extent of impacts is as predicted.

2. Assurance of compliance by contractors with procedures established for the project by the impact assessment report. An evaluation must also be made of these procedures to establish their effectiveness and adequacy.

3. Assurance that mitigative measures are having the desired effect, or modification of the mitigative measures if they prove to be ineffective.

4. Use of the monitoring program results to aid in the development and implementation of increasingly efficient environmental impact assessment and monitoring techniques and procedures in the future, specifically, the appraisal of the results of present techniques to determine whether they are providing adequate impact identification.

5. Use of the monitoring results to aid in the refinement of park/site operational procedures.

Planning A Monitoring Program

To successfully design and implement a monitoring program, consider: 1) what is to be monitored, 2) why it is being monitored, 3) how changes will be measured, 4) where the project will be monitored, 5) how frequently each site will be monitored, 6) how the data will be reported and evaluated, 7) whether there is a pre-project development data base, and 8) the cost of the monitoring program.

The document produced as a result of these considerations will specify the purpose, duration and methodology for the proposed monitoring program.

In order to determine what, if anything, needs to be monitored following project completion, and why, it will be necessary to review the project impact assessment. Any environmental feature that was identified as being potentially impacted, and for which mitigative measures have been designed, is the potential object of a monitoring program. There is always a chance that an impact assessment is inaccurate, the worst dangers being that an impact has been underestimated or overlooked. The impact assessment team members for each project should recommend which aspects of the project need to be monitored, as they are in the best position to judge which impact predictions and/or mitigative measures they are least confident about.

How the changes will be measured, how frequently and where the measurements will be taken are all questions for which it is difficult to provide general guidance. Standard measurement techniques for some environmental parameters such as water and air quality are described in various technical manuals. Many situations may require an innovative approach and common sense more than knowledge of complex technology. Others may require the use of equipment and/or personnel from outside Parks Canada in order to achieve the quality or quantity of data desired. Reporting and evaluation procedures for the data collecteddduring the program are a very important consideration. Results must be recorded using a pre-designed format so that they can be compared to past and future results to indicate changing trends or levels of the parameter being monitored. Those responsible for each monitoring program should establish standards of "acceptability" and "unacceptability" of change before starting the program. Such standards will help to keep the purpose of the monitoring clearly in focus, and will ensure that those involved have agreed ahead of time how to respond to any changes which occur.

Using The Results Of A Monitoring Program

If adverse changes are noted then action must be taken to stop them and such actions must be recorded in project documentation. Related projects should be reviewed to determine whether the monitoring results have implications for their success. Appropriate action should be taken to modify such projects and their documentation should be updated.

At a more general level, established operational procedures within parks and sites should be reviewed in light of monitoring results and modified where necessary. The principle involved is very basic ... learning from pastmistakes.

Methodical monitoring programs help us to determine the cause(s) of a mistake, enabling us to correct it and avoid similar problems in the future.

CHAPTER 6: Planning And Funding Procedures In Relation To EARP

Three Parallel Procedures

If Parks Canada's EAR procedure is to provide an effective contribution to project development then it must be structured to be compatible with existing planning and funding procedures since all three activities are necessary elements of successful project implementation. Planning, funding and environmental impact assessment processes are all iterative by nature, starting out general and becoming increasingly specific towards project implementation. A park plan, for example, begins as a collection of ideas. Subsequent revised versions each gain more detail until enough research has been done to allow implementation.

While funding procedures are common to the National Parks Branch, National Historic Parks and Sites Branch and Agreements for Recreation and Conservation (ARC) projects which use Parks Canada money, planning objectives and procedures differ. The EAR procedure must be flexible enough to accommodate these differences.

Project Planning And EARP

The conceptual planning of developments within National and Historic Parks and Sites is initiated in the regional offices well before the completion of a Management Plan. Subsequent detailed planning and project implementation is also a lengthy process allowing ample time for environmental impact assessment and project modification along the way. Occasionally an emergency situation arises and action must be taken as soon as possible, for example, in the cases of an historic site where a situation develops which poses a severe threat to life, or an important property which is deteriorating rapidly beyond the point of being worth saving. In these events the Parks Canada EAR policy states that impact assessment is not required but that an explanation of the circumstances and a description of the activity and its impact should be provided subsequently. The main themes in the planning of National Parks are those of conservation of the natural environment and provision of opportunities for visitors to appreciate the natural environment. Therefore environmental impact assessment for the purpose of protecting the natural environment is entirely compatible with the established planning goals, and in fact helps to ensure that the goals are met successfully. The "development" of National Historic Parks and Sites, however, is planned with historic authenticity as the main objective along with the provision of access and interpretive opportunities for the public. The preservation of historic values is not, however, likely to result in large scale disturbance of the natural environment, especially considering the relatively small areas of land involved. While environmental impact assessment will ensure that environmental values are protected to an acceptable level it must be recognized that National Historic Parks and Sites are not created primarily to protect the natural environment. Occasionally it may be necessary to compromise the natural environmental values for the sake of preserving or portraying historical values.

Agreements for Recreation and Conservation are created for the purpose of providing a framework for the cooperative enhancement of Heritage Areas, Heritage Canals, and Heritage Rivers by establishing common objectives and planning strategies amongst the government agencies with jurisdiction. These may be federal, provincial, regional or municipal, and planning, funding, and administrative circumstances will vary from one project to the next, depending upon the agencies involved. In spite of this variability and the fact that the ARC program is relatively new and has not had time to develop and test standard planning procedures, there are two planning processes in general use. The process used for Heritage Canals "is almost identical to that used for National Historic Parks"[6]. The process used for cooperative Heritage Areas "is unique to the ARC Branch and has evolved over several years to meet the special needs of the branch in undertaking planning studies jointly with other levels of government."[7] The EAR process applies to those ARC projects which involve the use of either federal funds or lands.

An outline of the basic planning procedures for National Parks, National Historic Parks and Sites, and cooperative Heritage Areas is provided in chart form in Figure 4. This chart also shows the parallel relationships between planning, budgeting and EARP, approximating the stages at which the various levels of impact assessment would be appropriate. Stages of planning which produce only conceptual outlines should not be the subject of detailed impact assessment, but must be assessed at least at the screening level. As the planning becomes more detailed and site-specific, so does the impact assessment.

The management planning process requires several successive environmental impact assessments from conception through to implementation. The alternative management plan concepts must be assessed for the comparative impacts they may have. This information must be considered in the choice and approval of one of the alternatives for further development.

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6 Parks Canada, ARC Branch 1980.

7 Parks Canada, ARC Branch 1980.

As the approved concept is planned in detail the environmental impact assessment must be repeated or updated in order to evaluate the detailed information which was previously unavailable. The impact assessment might need to be repeated or updated again when a specific component of the plan such as a campground is to be built. At this stage there will likely be some additional information on facility design and location which was not evaluated earler. The "EARP" column of the chart in Figure 4 should not be misinterpreted as an indication of assessment levels which must be carried out for the given stages of planning. With the exception of mandatory screening for each project, it is only a guide as to the levels of impact assessment which could usefully be applied if necessary.

Project Funding And EARP

A project becomes considered for funding after it is identified from the management plan for inclusion in program forecasts. Alternatively, a capital project may receive consideration because of program priorities or public safety concerns. Detailed information is required to define the objective(s) for the project and to provide justification for the expenditure. This information is gathered during project planning and documented for the purpose of requesting funds through the Project Initiation and Planning System (PIPS), which is common to all Parks Canada programs. The PIP system provides management with the documentation generated from the project proposal and planning stages through to project implementation. It is through this process that EARP and other project requirements are kept track of for specific capital projects. The fulfillment of the EARP requirement for each project can be checked as the documentation passes through the Management Review Process at each regional office. The various PIPS forms require the estimation of environmental impact assessment costs, including mitigative measures and monitoring, in addition to all other project costs. The chart in Figure 4 shows the four stages of funding justification and approval from the initial conceptual project proposal through to final detailed design. The funding process evolves, parallel to the planning process, from the general estimation of project costs (based on general plans) to the generation of specific estimates (based on final design drawings). The length of time it takes to complete the whole process varies from several months to six years, or longer, depending upon project priority and planning lead time available. EARP follows the same path at the same time, ensuring that the planning procedures are "on track" in terms of protecting natural resource values and that the funding procedures accurately reflect any costs involved in protecting those values.

Summary

Project planning and funding procedures and EARP all aim to provide decision makers with a thorough description of project costs and benefits, environmental and otherwise. If managers are presented with inadequate information they are being asked to make blind decisions and cannot have much confidence in successful project completion. When used properly these three systems are complementary and will provide an effective means of developing and substantiating a system of resource management which will be a credit to those involved and a good example to others.

Relationship Between Project Funding, Planning, And Environmental Impact Assessment Processes

FUNDING	PROGRAM PLANNING			E A R P *
	NATIONAL PARKS	NAT'L HISTORIC PARKS/SITES	CO-OP HERITAGE AREAS-ARC	
Concept Proposal - "D" cost estimate based on layman's opinion	Alternative Park Management Plan Concepts	Themes and Objectives and Management Guidelines and Development Concept	Joint Concept Plan	Screening
Project Definition - "C" cost estimate based on professional opinion	Park Management Plan	Development Plan or Comprehensive Management Plan or Interim Management Plan	Joint Master Development Plan	Update or re-do Screening
Pre-Design - "B" cost estimate based on rough drawings	Area Plan Concepts (for portion of total area covered by P.M.P.) or Sub-Activity Plans (for one aspect of management eg. Resource Conservation Visitor Services)			Update or re-do Screening IEE
Design (Treasury Board Approval) - "A" cost estimate based on final detailed design drawings	Development, Site, Facility Plans	Action Plan	Joint Site/Project Plan	Update or re-do Screening IEE
	Monitoring Program	Monitoring Program	Monitoring Program	Update original documentation

* These stages of assessment may be appropriate at the corresponding stage of project planning. Beyond the initial screening for each project none of them is necessarily required.

Figure 4

DEFINITIONS

The following definitions are included to provide a common understanding of some of the terms used in the manual. While some terms (such as monitoring) are widely used, they are not always given the same meaning and misunderstandings quickly develop. The definitions given here for the terms which apply to EARP (Proponent, Initiator etc.) are the same as those which appear in the Parks Canada Management Directive on EARP.

ACUTE TOXICITY - Any poisonous effect produced within a short period of time, 24-96 hours, resulting in severe biological harm and often death.

AMBIENT - Surrounding on all sides

BACKFILL - Material used to refill a ditch or other excavation, or the process of doing so.

BIOCHEMICAL OXYGEN DEMAND (B.O.D.) - Amount of O_2 required to decompose (oxidize) a given amount of organic compounds to simple stable substances.

DISSOLVED OXYGEN (D.O.) - The O_2 dissolved in water or sewage effluent. Adequately dissolved oxygen is necessary for the life of fish and other aquatic organisms and for the prevention of odours. Low dissolved O_2 concentrations are generally due to the discharge of excessive organic solids having high BOD.

E.A.P. - Environmental Assessment Panel. A "Panel" is a multi-disciplinary group of persons (4-6 individuals) appointed on the basis of expertise and objectivity to evaluate the potential environmental impact of proposals referred to FEARO for review. Panels are chaired by the Executive Chairman, FEARO, or his delegate, hold public hearings and subsequently report their views directly to the Minister of the Environment.

E.A.R.P. - Environmental Assessment and Review Process. The process applies to all programs, projects and activities that are proposed or sponsored by federal departments and agencies or involve federal funds or federal properties. All federal departments and agencies are obliged to apply the process, except proprietary Crown Corporations and regulatory agencies, who are invited to participate.

EFFLUENT - A discharge of pollutants in the environment, partially or completely treated or in its natural state. Generally used with regard to discharges into water.

E.I.A. - Environmental Impact Assessment. A written analysis of the environmental impacts of proposed actions. A general term not referring to a specific stage in the EARP process.

E.I.S. - Environmental Impact Statement. A more detailed (than the IEE) documented assessment of the environmental effects of any proposed action expected to have significant adverse environmental consequences. The EIS is completed as early as possible by the proponent of any proposed action in accordance with guidelines established by an Environmental Assessment Panel.

ENVIRONMENTAL PARAMETERS - Physical, chemical or biological components of the environment which can be described in quantitative terms.

FEARO - The Federal Environmental Assessment and Review Office (within DOE) which administers the Environmental Assessment and Review Process (EARP).

FILTRATION - In waste water treatment, the mechanical process that removes particulate matter by separating water from solid matter usually by passing it through sand.

HAZARDOUS AND TOXIC SUBSTANCE - A poisonous, inflammable, explosive, or corrosive product or substance which, upon release or escape to the environment, may cause or contribute to a harmful effect to the environment and/or human health. It includes gaseous, liquid and solid wastes with the exception of radioactive or pathological wastes.

IEE - Initial Environmental Evaluation. A documented assessment of the nature and extent of environmental effects of any proposed project or activity identified in the screening report as having the potential for adverse environmental effects. The IEE is prepared or procured as early as possible in planning following screening.

An IEE will normally require that studies be initiated to fill information gaps identified during the screening stage. Guidelines covering various project categories (eg. linear transmission) issued by FEARO are available to assist organizations in this task.

IMPACTS - Changes in the environment which may result from man's actions. The direct results of actions are primary impacts. Primary impacts may cause secondary impacts which may, in turn, cause tertiary impacts. For example:

Construction	(Action)
Erosion	(Primary impact)
Siltation of stream	(Secondary impact)
Reduction of fish spawning success	(Tertiary impact)

INITIATOR - A federal agency which refers a project or activity having potential environmental effects to FEARO because that agency is contributing to project funding or because the project or activity would take place on lands within its jurisdiction. The initiator may or may not be in support of the project or activity.

INTERVENORS - Individuals, citizen groups, corporations or other government agencies that may be interested in, affected by, or technically competent to comment on the environmental impacts of the proposed action.

LEACHATE - Liquid that has percolated through solid waste or other mediums and has extracted dissolved or suspended materials from it. Can be toxic.

MITIGATIVE MEASURES - Measures to prevent or reduce the severity of effects likely to be caused by a particular activity.

MONITORING - A process that utitlizes baseline data to evaluate magnitudes and characteristics of change over pre-determined time frames.

Repeated measurement and observation to quantify changes in one or more variables are recorded according to a standardized schedule and method.

In the content of E.A.R.P., monitoring allows one (i) to test the original impact analysis (predictions) and (ii) to test the effectiveness of miligative measures and to determine if additional or different mitigative measures are necessary.

PERMAFROST - Ground which has a temperature colder than 0°C continuously for two or more years. It is designated exclusively on the basis of temperature though part or all of its moisture may be unfrozen due to the chemical composition of the water or depression of the freezing point by capillary forces. An area that freezes in winter and thaws in summer is called the active layer.

PESTICIDE - Toxic chemical used for killing organisms.

POLLUTION - An undesirable change in atmospheric, land or water conditions affecting the material or aesthetic attributes of the environment.

POL WASTE - Petroleum, oil or lubricant wastes which may or may not be contaminated.

PRIMARY IMPACT - See "IMPACTS"

PROPONENT - A federal agency, provincial government agency, or a private individual or organization which intends to undertake a project or activity on lands or waters administered by Parks Canada. In addition, federal agencies are considered to be proponents of projects or activities to which they contribute funding.

SCREENING - A review carried out at the earliest stages of planning providing the initial documented identification and evaluation of environmental effects associated with a proposed plan or existing activity. Screening is based on existing published and unpublished information along with site reconnaissance as necessary.

SECONDARY IMPACT - See "IMPACTS"

SEWAGE LAGOON - In wastewater treatment, a shallow pond, usually manmade, where O_2, sunlight and bacterial action interact to restore wastewater to a reasonably pure state.

SILTATION - The deposition of silt-sized (smalier than sand) particles in waterbodies.

SLUDGE - The solids removed from sewage during waste water treatment, subsequently disposed of by incineration, dumping or burial.

TERTIARY IMPACTS - See "IMPACTS"

THERMAL POLLUTION - The excessive raising or lowering of water temperatures above/below normal seasonal ranges in streams, lakes, estuaries or oceans as a result of discharge of hot or cold effluents into the water.

TOXIC POLLUTANTS - Substances which, upon exposure to, ingestion, inhalation or assimilation by any organism, can cause death, disease, mutations, deformities or malfunctions in such organisms and/or their offspring.

TURBIDITY - Condition of the water resulting from suspended matter; water is turbid when its load of suspended material is conspicuous.

CHECKLIST OF ENVIRONMENTAL PARAMETERS SUBJECT TO IMPACT

A. ATMOSPHERE

1. Microclimate

1.1 Temperature
- (a) Daily ranges - maximum and minimum

1.2 Humidity
- (a) Dewpoint temperature
- (b) Specific humidity

1.3 Winds
- (a) Velocity (average)
- (b) Average direction of flow
- (c) Range of velocities
- (d) Airflow and turbulence

1.4 Insolation and Radiation
- (a) Intensity of solar radiation received at ground level

1.5 Feature of Special Interest

2. Air Quality

2.1 Chemical Composition
- (a) Hazardous toxicants
- (b) Odours

2.2 Particulate Loading
- (a) Dust
- (b) Other particulates

2.3 Feature of Special Interest

B. LAND

1. Soils

1.1 Susceptibility to Erosion

1.2 Drainage Properties
- (a) Permeability
- (b) Porosity

1.3 Compaction

1.4 Organic Content

1.5 Chemical Composition
(a) P.H.
(b) Nutrients
(c) Salinity
(d) Hazardous toxicants

1.6 Feature of Special Interest

2. Permafrost

2.1 Distribution Profile

2.2 Depth Profile
(a) Thickness
(b) Active layer
(c) Duration

2.3 Surface Conditions
(a) Vegetation
(b) Drainage

2.4 Feature of Special Interest

C. WATER

1. Ground

1.1 Quantity

(a) Volume of ground water available
(b) Depth to water table

1.2 Quality
(a) Chemical composition
(b) PH
(c) Dissolved solids
(d) Toxic compounds
(e) Fecal coliforms
(f) Salinity

1.3 Feature of Special Interest

2. Surface Water

2.1 Quantity
(a) Drainage pattern
- spatial distribution
- lag time
(b) Flow velocity
(c) Depth
(d) Area of surface
(e) Circulation

2.2 Quality
(a) Chemical Composition
- BOD (Biochemical Oxygen Demand)
- PH
- DO (Dissolved Oxygen)
- Dissolved solids
- nutrients
- toxic compounds
- fecal coliforms
- salinity

(b) Temperature
(c) Suspended solids

2.3 Drainage Pattern

2.4 Feature of Special Interest

D. SPECIES AND POPULATIONS

1. Flora

1.1 Terrestrial
(a) Community structure and composition
- number and type of strata
- composition of each strata
- extent of community
- rare and endangered species
- utilization by wildlife

(b) Natural revegetation
- species availability
- seed dispersal distances
- growth rates of species (soil nutrients, moisture)

1.2 Aquatic
(a) Community structure and composition
- plant composition of benthic and littoral zones
- abundance of each plant species in each zone
- extent of community
- rare and endangered species
- utilization by fauna
- plant structure and composition of limnetic zone

(b) Natural revegetation
- species availability
- dispersal opportunities
- growth rates and requirements (water temperature, nutrients)

1.3 Species of Special Interest

2. Fauna

2.1 Terrestrial

(a) Composition, distribution, abundance, productivity
- population distribution, regional and provincial
- population density
- habitat distribution, regional and provincial
- reproductive rate and success
- sex and age structure
- mobility of species
- carrying capacity of area

(b) Ecological role
- as predator including browsing
- as prey
- as competitor for food
- as competitor for space

(c) Special use areas, seasonal or continuous
- for reproduction
- for feeding
- for resting
- for migration routes

(d) Population health
- disease and parasite load
- environmental pollutant uptake and load (pesticides and herbicides)

(e) Access to species
- control of access
- location of roads and other transportation routes near populations
- condition of transportation routes
- tolerance of species to disturbance
- presence of people and their wastes
- duration, frequency and intensity of noise
- timing and extent of disturbances

2.2 Aquatic

(a) Composition, distribution, abundance, productivity
- population size, local and regional
- population distribution, regional, provincial
- reproductive rate and success
- habitat type distribution, regional and provincial

- mobility of species
- sex and age structure
- individual growth rates

(b) Ecological role
- as predator
- as prey
- as competitor for food
- as competitor for space

(c) Special requirements
- for reproduction
- for feeding
- for resting
- for migration

(d) Population health
- disease and parasite load
- environmental pollutant uptake and load (pesticides and herbicides)

(e) Access to species
- control of access
- location of transportation routes near populations
- publicity regarding region and species

(f) Tolerance of species to disturbance
- turbidity
- flow rates
- turbulence, falls
- chemical contaminants
- temperature
- water depth
- siltation

2.3 Species of special interest

E. CULTURAL FEATURES

1. Social

1.1 Visitor Experience

(a) Natural or historical appearance of landscape

(b) Sounds
- removal of natural sounds
- addition of unnatural sounds

(c) Odours

(d) Number of other visitors present
- adequacy of facilities
- loss of sense of solitude

1.2 Public Safety
(a) Road design and location
(b) Trail design and location
(c) Presence of natural hazards
(d) Presence of incompatible wildlife or potential habitat

1.3 Lifestyle Of Residents Of Park/Site Vicinity
(a) Conflict with traditional occupation
- hunting
- logging
- fishing
- trapping

(b) Access to home
- traffic routing
- road maintenance

(c) Number of visitors present

(d) Business opportunities
- existing
- potential

2. <u>Historical</u>

2.1 Known Value
(a) Research value
(b) Interpretive/educational/value

2.2 Potential Value
(a) Research value
(b) Interpretive/educational value

2.3 Feature Of Special Interest
(a) Internationally acclaimed
(b) Nationally unique

3. <u>Archaeological</u>

3.1 Known Value
(a) Research value
(b) Interpretive/educational value

3.2 Potential Value
(a) Research value
(b) Interpretive/educational value

3.3 Feature Of Special Interest
(a) Internationally acclaimed
(b) Nationally unique

GENERAL FORMAT FOR A SCREENING REPORT

The following format provides a general outline of the information to be covered in a screening report.

1. **Title of Park/Site and Project**

2. **Introduction**

3. **Project description**

    a) Purpose of project
    b) Nature of work
    c) Agencies involved and their responsibilities
    d) Contractual arrangements
    e) Work plan
    f) Work schedule
    g) Project components
    h) Cost of project
    i) Future and related activities
    j) Alternatives
    k) Information deficiencies

4. **Site description**

    a) Area affected
    b) Zoning and present uses
    c) Resource values
    d) Information deficiencies

5. **Screening procedure**

    a) Date of screening
    b) Method(s) used

6. **Screening results**

    a) Space/time boundaries
    b) Water
    c) Land
    d) Atmosphere
    e) Species and populations
    f) Cultural features
    g) Aesthetic values
    h) Socio-economic conditions

7. **Mitigative measures**

    a) Description
    b) Cost
    c) Alternatives

8. **Residual impact**

   a) Description

9. **Monitoring requirements**

   a) Project components
   b) Procedure
   c) Responsibility
   d) Follow-up study

10. **Appendices**

   a) Maps
   b) Photos
   c) Plans and design drawings

11. **References**

12. **Names, titles and affiliations**

EXPANDED FORMAT

The "Expanded Format" is an expanded version of the previous one, explaining in greater detail the type of information which should be included in the report.

1. **Title of park/site and project**

2. **Introduction**

3. **Project description**

   a) Purpose of project - a statement explaining why the project is being proposed and what social, economic or other need it is designed to meet. Include a description of the advantages and disadvantages of the project.

   b) Nature of work - a statement describing the project and work involved in its implementation.

   c) Agencies involved and their responsibilities - a statement explaining which agency or agencies are proposing the project and/or participating in the development, and what role each will play.

   d) Contractual arrangements - a statement explaining any contracting or sub-contracting involved in the project development including any existing performance control mechanisms such as bonds, inspection etc.

   e) Work plan - a statement explaining the specific activities and methods involved during each stage of project development including construction, operation, maintenance, and abandonment if applicable.

   f) Work schedule - a statement explaining the intended timing of each phase of project development.

   g) Project components - statement explaining whether there are several components to the project and specifying whether any of them are to be screened separately from this screening.

   h) Cost of project - statement explaining the cost breakdown of the proposed project, including which agencies are responsible for paying for each aspect.

i) Future and related activities - statement describing any later activities that are considered subsequent to project development.

j) Alternatives - statement explaining any alternatives to the project as a whole, and their related advantages and disadvantages.

k) Information deficiencies -statement specifying any information concerning the proposed project (design, location etc.) which was unavailable.

4. Site description

a) Area affected - statement explaining the location of the area in which the project is proposed to take place as well as the extent of that area in quantitative terms. Maps are useful.

b) Zoning and present uses - statement describing the zoning, if any, of the area affected and the present land use within the area.

c) Resource values - statement describing the most noteworthy features of the area for which the project is proposed, that is, waterbodies, landforms, flora and fauna populations, archaeology etc. (refer to Project Register and Screening Form and to Checklist section in this manual for further details).

d) Information deficiencies - statement specifying what resource inventory information is deficient for environmental impact assessment purposes.

5. **Screening procedures**

a) Date of screening - statement explaining when the screening was carried out, and at what level of project development.

b) Method(s) used - statement explaining the method(s) or tool(s) used to assess the environmental effects of the project and to report them. These might include the use of site reconnaissance, checklists, matrices, network analysis, computer analysis of biophysical inventory data etc.

6. **Screening results**

a) Space/time boundaries - statement defining the spatial limits of the natural system, and the time span over which the impacts will be predicted and/or evaluated. Recovery time (time needed for ecosystems or populations to return to their original states) is important when establishing the boundaries.

b) Water - statement of the predicted primary, secondary, and tertiary effects of all phases of the project (construction, operation and maintenance) upon surface and ground water.

c) Land - statement (as above) of the predicted effects on landforms, soils and permafrost.

d) Atmosphere - statement (as above) of the predicted effects on microclimate and air quality.

e) Species and populations - statement (as above) of the predicted effects on flora and fauna.

f) Cultural features - statement (as above) of the predicted effects on archaeological or historical features or social conditions.

g) Aesthetic values - statement (as above) of the predicted effects on the landscape and aesthetics of the area.

h) Socio-economic conditions - statement (as above) of the predicted effects on the socio-economic status of the area and people concerned.

7. **Mitigative measures**

a) Description - statement describing the nature of proposed mitigative measures and the experience, if any, with their use on past projects. Include an estimation of the degree of effectiveness and time involved if possible.

b) Cost - statement of the estimated cost of proposed mitigative measures, if known, and the agency(ies) responsible for paying.

c) Alternatives - statement of any possible alternative mitigative measures along with a comparison of the effectiveness and/or cost of the alternative with the primary proposal.

8. **Residual impact**

a) Description - statement of any predicted effects itemized in the "screening results" which cannot be mitigated. Explain whether the inability to prevent or greatly reduce these effects is due to a lack of techniques or to the high cost of available techniques.

9. **Monitoring requirements**

a) Project components - statement describing which components of the project need to be monitored taking into consideration all phases of development and proposed mitigative measures.

b) Procedure - statement specifying what techniques are to be used and what the schedule for the various parts of the monitoring program would be. Monitoring should be continued for at least 5 years to detect serious side effects and for 10 years or longer when highly sensitive systems are involved.

c) Responsibility - statement specifying who would carry out each part of the monitoring program, and who would be responsible for surveillance during construction.

d) Follow-up study - statement specifying when a complete review of the project will be carried out, and the agency responsible for its implementation.

10. **Appendices**

a) Maps
b) Photos
c) Plans and design drawings

Include copies of any of the above which are available.

11. **References** - list any literature, unpublished information or individuals consulted during the preparation and write-up of the screening report.

12. **Names, titles and affiliations** - list the people who prepared the screening report including expertise from other agencies, and the people responsible for accepting and registering the report. The report should be prepared by those most

familiar with the project locale (eg. park staff, regional office staff). The reports are endorsed and registered by the Regional EARP Co-ordinator, and accepted for consideration by the Superintendent or Regional Director as appropriate.

AN OVERVIEW OF SOME COMMONLY USED MEASUREMENT TECHNIQUES WITH POSSIBLE APPLICATION TO MONITORING PROGRAMS

Stream velocity can be measured by using a current meter. The current meter uses either a metal propeller or a set of revolving cups. When lowered into the stream, the revolution rate indicates the velocity of streamflow. The current meter successfully measures velocities from 0,6 - 6m/sec (C2-20 ft/sec).

Alternatively, floats can be used to estimate magnitude and direction of flow.

Mean velocity can be determined by lowering the current meter into the stream at closely spaced intervals so that velocity can be read at a large number of points evenly distributed through the stream's cross-section. The velocities are then summed and divided by the total number of readings.

Stream discharge is calculated by using the formula; Q = AV where Q = discharge, A = area of the cross-section and V = mean velocity.

- for accuracy of current metering, the stream section being measured should be straight, uniform in cross-section, free from excessive turbulence and at least 15 cm (6 in.) deep;

- the average velocity in a stream is usually located at approximately $6/10^e$ of the total depth of the stream. In larger, deeper streams, this of course may vary. In such cases, measurements must be taken from $2\text{-}8/10^e$ depths and averaged.

Dissolved solid content is determined by evaporating a water sample and subsequently oven-drying the contents remaining. Measurement is taken as mg./L. of total dissolved solid.

- limit for potable water - 500 mg/LTDS
- upper limit for salts for fresh water fish - 5000 mg/L.TDS

Fecal coliform counts may be determined by two methods. The more common measurement, the membrane filter technique, is obtained by tests which actually count the number of coliform colonies developed over a membrane filter. Estimated coliform density is reported in terms of coliform/100 ml.

Equipment used is common to routine microbiological studies.

Desirable criteria for surface water supply is fecal coliforms less than 20/100 ml.

The recommended value for recreational uses is 200/100 ml.

Water Level

- Staff gauge - simple graduated stick permanently attached to a bridge, post or pier. The staff is read directly by the observor according to a predetermined schedule.

- Automatic recording gauge - gauge is mounted in a stilling tower beside river/stream bank. The tower is simply a hollow masonry shaft filled by water which enters through a pipe at its base. By means of a float connected by cable to a recording mechanism above, a continuous inkline record of stream stage is made on graph paper attached to a slowly rotating drum.

BOD is measured by incubating a water sample at 20°C for 5 days in darkness. BOD may be calculated from the reduction in dissolved oxygen concentration.

Dissolved Oxygen (DO), using the probe method, DO is measured by an electrical meter. The current produced by cathodic reduction of oxygen diffusing across the oxygen permeable membrane of the probe depends on the dissovled oxygen content of the water.

Analytical range - 0-20 mg/1DO

Sensitivity range - .05 mg/L.

- note that inorganic salts and reactive gases, ie., Cl_2, H_2S may interfere.

Sedimentation can be estimated in streams by the construction and regular check of sediment traps (or gabions) downstream from construction activity.

Flora Changes in acreage of vegetation types can be calculated from "before and after" aerial photos. A planimeter can be used to measure the areas of each vegetation types on each photo or mosaic, allowing quantitative comparisons to be made fairly accurately.

For smaller areas, surveys of ages of trees and growth rates can be carried out by using an increment bore. Increment boring is also useful to determine disease or fungal growth in trees.

Onsite photography may be vary useful in monitoring vegetation conditions to determine the extent of deterioration and the rate at which it occurs.

Soil profiles may be a useful indicator of compaction and erosion. They can be recorded directly by diagram, photograph or written record on a periodic basis.

Compaction is usually measured at various points across a site with a penitrometer (a graduated stake with standard weight attached). By driving the penitrometer into the soil at the specified point and time, a measure of compaction may be calculated.

Percolation may be measured by digging a hole to a predetermined desired depth (the depth of the hole depends upon the intended use and drainage needs of the site), saturating it for 24 hours, then measuring the rate at which the water level drops.

GUIDELINES FOR THE ASSESSMENT
OF IMPACT ON
ARCHAEOLOGICAL AND HISTORIC RESOURCES

Prepared by: Archaeological
Research Section
National Historic Parks and Sites Branch

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PURPOSE

The purpose of these guidelines is to provide standards and criteria for assessing the impact of Federal actions on historical resources and for assessing the adequacy of information on these resources included in environmental impact assessments.

The intent of these guidelines is to ensure that information on these resources is factually adequate for an unbiased decision regarding the advisability or feasibility of Federal actions which affect the environment. Hence these guidelines will allow planners to:

(a) consider and evaluate alternatives in project design, such as excluding specific areas from the project, or relocating or redesigning the project to avoid archaeological resources. It is important that such resources be identified at early planning stages to permit preservation;

(b) consider the cost of adequate studies to mitigate adverse impacts along with other project costs;

(c) have adequate research designs prepared for requisite additional studies if the decision is to proceed with a project;

(d) to program and budget for these studies well ahead of construction schedules.

THE NATURE OF HISTORICAL RESOURCES

Historical resources are a limited, fragile, non-renewable part of the environment, and disturbance of them results in irreversible and cumulative impacts. The resource base includes any source of information about the lives of past peoples including, but not limited to, artifacts, architecture, plant and animal remains, local geology, soil composition, topography and the modern environment. Much of this evidence is extremely fragile, and can be obliterated by relatively minor modifications of the ground surface. Analysis and interpretation of the data contained in archaeological resources requires examination of their total physical and ecological context. Any disruption of this context reduces the amount of, and often competely destroys, recoverable information about past human existence and constitutes an irretrievable loss for historic and scientific study. Identification and assessment of archaeological remains in a project must be based on examination by a competent, trained archaeologist. Archaeological resources are frequently subtle and inconspicuous, and can only be recognized by a qualified professional. In addition, existing knowledge of archaeological resources is often insufficient for a detailed environmental statement. Most areas of the archaeological resource base are very incomplete. In those areas which have been studied, existing records vary greatly in quality. A large proportion of them are over 30 years old, the data contained in the records are out-of-date and frequently incomplete, and locations are often so vaguely described that they cannot be easily relocated.

CONTENT OF ENVIRONMENTAL IMPACT ASSESSMENT

A statement of the effects of a Federal action on historic and archaeological resources should include:

1. An inventory of the cultural resources affected by the action;

2. A map showing the location of these resources;

3. The predicted effect of the action on the resources;

4. A recommended program for mitigating adverse effects on the resources;

5. Description and evaluation of unavoidable adverse effects;

6. A statement of irreversible and irretrievable commitments of archaeological resources.

In an environmental statement, this information and any assessments based on it may be presented in summary form. They must, however, be based on a detailed study of substantive data by a professionally competent archaeologist and his report should be specifically cited in the statement.

1. Inventory of Resources

Each study of impact should include an inventory of cultural resources affected directly or indirectly by the action. The sources of information used in preparing the inventory should be clearly identified, and must conform to current standards of professional knowledge and method. It should be prepared by a competent professional archaeologist acceptable to the National Historic Parks and Sites Branch. Any reconnaissance or survey required for this inventory must also be carried out by a competent professional archaeologist and the resulting inventory should give the name of the archaeologist, his institutional affiliation, the length of time spent in survey, and the extent of coverage provided by the survey.

The degree of specific detail required in the inventory will depend on the stage of planning of the action. A preliminary reconnaissance can provide the information necessary for general program studies, or for a project in the initial planning stage. An intensive field testing survey will be necessary to obtain the data for projects at the feasibility or pre-authorization stage of planning.

(1) Preliminary reconnaissance

At the initial planning stage of an action, or in general program studies, an inventory should define the categories of cultural resources in the area and the nature of the predicted effects of the action on them. The exact number of resources, and their precise relationship to the project area, is necessary. The inventory should be a realistic and reliable basis for evaluating the known and potential cultural resources which may be affected by the action. The inventory may, in some cases, be made from existing primary scientific or historic records; information may also be obtained through consultation with a competent professional archaeologist with personal knowledge of the area. The degree to which this information represents comprehensive coverage of the area should be stated. Significant deficiencies in knowledge should be indicated as background for required studies.

The inventory should identify the indigenous cultures, historic and prehistoric, in the project or program area, and state their significance in local, regional and national contexts. Cultural resources that have been declared as nationally significant by the Historic Sites & Monuments Board of Canada should be identified. The expected density of cultural resources should be estimated, and the settlement patterns should be identified as far as possible for assessing the effects of an action on these resources. For example, if a particular part of the topography of the project area is known to have been favored by past peoples, the extent to which the action will affect these locations can be used for predicting impact. The preliminary reconnaissance should provide an estimate of the cost and time required for an intensive testing survey which will be required for a detailed environmental statement necessary in later planning stages. **If existing knowledge of the cultural resources of an area is insufficient for an adequate inventory, a preliminary field reconnaissance of the project area should be carried out.** This should be an examination of the area by a competent archaeologist to obtain representative data of the cultural resources, permitting determination of the scope and significance of resources which will be affected by the project, as described above.

(2) Intensive field testing survey

In conjunction with projects in feasibility stage, or those to be proposed for authorization, a detailed statement of impact should be prepared, based on an inventory from an intensive field testing survey. This survey should involve a comprehensive examination of the project area, supplemented by test excavations as necessary to accomplish adequately the following:

(a) Identify and describe the historical and archaeological resources which will be affected by the action;

(b) Sample all categories of archaeological resources in all environmental contexts which will be affected directly or indirectly by the action;

(c) Develop a reliable statement of the value of archaeological resources to be affected in terms of their rarity in the park/site or country, etc.;

(d) Develop an estimate of the cost of recovering all data from resources to be affected;

(e) Develop an estimate of the cost of mitigating the adverse effects of an action on archaeological resources;

(f) Identify locations that have been declared as nationally significant or appear to qualify for this by the Historic Sites and Monuments Board of Canada;

(g) Develop a factual basis upon which the responsible manager can decide amongst alternative dispositions of the archaeological resources affected by the action. These alternatives can include: (1) mitigation studies; (2) relocation of part or all of a project to preserve archaeological remains; (3) other protective or management measures to preserve these remains; (4) no action required concerning archaeological resources;

(h) Outline the research needs in the project area, and provide a research design sufficient to meet these needs.

2. Map of Archaeological Resources

The map of archaeological resources should show clearly and accurately the distribution of these resources throughout the area of the proposed action as well as areas where indirect effects can be expected. The location of resources relative to the project boundaries should be accurately shown. In order to prevent misuse by treasure-hunters or unqualified persons, these maps should be included only in a limited number of "key copies" of the survey report which are available only on a restricted basis to archaeologists and planners concerned with project study and planning.

3. The Predicted Effect of the Action on Archaeological Resources

The effect of the action on archaeological resources and their related context should be clearly stated. All categories of effects, direct, indirect, continuous, permanent or periodic, should be calculated from the archaeological resource locations identified in the inventory. Adverse effects occur if the action will destroy or disturb part or all of the resources, alter their context, affect the preservation of data, or significantly obstruct access by activities such as landfilling or inundation. If historical resources are known, a statement that they will not be adversely affected must be based on scientific study of the project area, or on known and applicable precedent.

4. Evaluation of Effects

The extent of effects should be assessed in terms of historical, scientific, social and economic values. Historical significance of cultural resources depends on the potential for identification and reconstruction of specific cultures, periods, lifeways, and events. Cultural resources are historically significant if they provide a typical or well-preserved example of a prehistoric culture, historic tribe, period of time, or category of human activity. Archaeological remains are also historically significant if they can be associated with a specific individual event or aspect of history. Scientific significance is the potential for using cultural resources to establish reliable generalizations concerning societies and cultures and deriving explanations for the differences and similarities between them. Much of the same data is used for scientific purposes as in historic studies, but the treatment and scope of information differ. Generalizations and explanations require controlled comparison of statistically representative samples of all types of data relevant to past human life. This includes such things as artifacts, settlements, dietary remains and evidence for past environments. Scientific significance depends on the degree to which archaeological resources in the project or program area constitute a representative sample of data which can be used in comparative studies. The value of this data should be determined in the regional context of the project or program and in relation to general historical and anthropological problems. The importance of the cultural remains involved by an action should be assessed by consideration of: (1) the relative abundance of the resources to be affected; (2) the degree to which specific resources and situations are confined to the project area; (3) the cultural and environmental relationship of the archaeology of the project or program area to the surrounding culture province or provinces; (4) the variety of evidence for human activities and their environmental surroundings that is contained in the project or program area; (5) the range of research topics to which the resources may contribute; and (6) specific deficiencies in current knowledge that study of these resources may correct. Proper evaluation of these factors will require a reliable and accurate identification of the content of archaeological and historical resources, extensive knowledge of cultural development in the project area and in surrounding regions, and competence in current archaeological method and theory. Social Values consist of direct and indirect ways by which society at large benefits from study and preservation of archaeological resources. Benefits which should be described and included are: (1) the acquisition of knowledge concerning man's past; (2) indirect benefits received by educational and research institutions and their communities, from salaries and funds supporting archaeological studies and in increased opportunities for professional training; (3) the acquisiton and preservation of objects and structures for public exhibit and enjoyment; (4) educational and economic benefits from tourism attracted by archaeological exhibits; and (5) practical applications of scientific findings acquired in archaeological research. Economic Values can best be calculated as the cost of total data recovery from the resources to be affected by the action. This figure can be cited as a cost in cost-benefit ratios. It should be calculated by a competent professional archaeologist as the amount of funds required to recover all significant archaeological data (cultural and environmental) using the most current methodology, technology and theory available. The cultural inventory should provide the factual basis for this estimate.

5. A Recommended Program for Mitigation of Adverse Effects on the Resources

If historical resources are to be adversely affected by an action, the effects can be mitigated by scientific recovery of information contained in these resources. An acceptable mitigation program should recover and describe representative categories of data, and should make optimum use of the threatened resources to contribute to the understanding of past human occupation of the region. This program should be prepared by a professional archaeologist as part of the cultural inventory derived from an intensive survey. It should be designed to recover a reliable sample of all significant cultural and related ecological resources which will be affected if the project is to be implemented. Proposed studies should use the most current methodology, technology and theory available.

The basis of sampling resources to be studied should be stated and should be the result of a systematically prepared and explicitly stated research design. This design should be adequate to contribute to the solution of significant archaeological and historical problems for which the resources are suited. The level of sampling required for an adequate mitigation program will vary depending on the number and value of archaeological resources affected by an action. In some cases where only one or a few archaeological localities are affected, study of all resources may be required; in most cases, only a portion of the resources will need study. An estimate of cost should be included in the recommended mitigation program.

6. Adverse Unavoidable Effects

The effect of land-modification developments on archaeological resources is an adverse effect which can be avoided if the development is planned so that the resources and their context are left in their present condition. Provision for archaeological studies lessens some of this impact, but it does not eliminate it. Limitations in time and funding impose constraints on the degree to which these studies mitigate effects. In addition, enforced study precludes research in the future using advanced techniques and more developed theories. Therefore, a statement that archaeological studies are planned or scheduled does not constitute a statement of negative impact. Archaeological resources which are lost to study as a consequence of these limitations in recovery techniques represent unavoidable effects. The loss of archaeological structures or features which have potential value as public exhibits also represents unavoidable adverse impact and should be documented. Unavoidable effects on archaeological resources can be quantitatively expressed in two ways: (1) the cost of unavoidable adverse effects can be calculated as the difference between the cost of mitigation and the cost of total recovery; (2) an index of unavoidable effects can be calculated by dividing the cost of unavoidable effects by the cost of total recovery. Both figures should be included in an environmental statement.

7. Alternatives to Proposed Action

Each alternative to proposed actions should be evaluated in terms of the impact on archaeological resources. The primary criterion for judging these alternatives should be the extent to which they permit preservation of resources and their context for future study and enjoyment. If historical resources of major scientific importance will be adversely affected by the action; if the cost of adequate mitigation will add markedly to the cost of the action; or if cost of total recovery increases markedly the ratio of costs to benefits, the action should be re-evaluated to consider relocating part or all of the development so that these resources can be preserved.

For each alternative action, the alternative treatments for archaeological resources affected should also be described and their impact and cost evaluated. Alternatives include:

(1) Protective management measures to preserve sites;

(2) Mitigation measures using scientific study;

(3) No action concerning archaeological resources.

Impact on resources, value of resources, cost of total recovery, and mitigation cost should be clearly defined for each alternative, and comparative effects for all alternatives should be evaluated. The archaeological inventory report should provide the substantive basis for recommendations for preservation. If the recommended alternative action involves major archaeological loss, the basis for choosing that alternative should be explicitly stated.

8. The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The long-term and cumulative effects of actions on our lands must be assessed from the perspective of preserving resources for future generations. Historical resources are especially subject to cumulative adverse effects because they are non-renewable and the continuing growth of archaeological knowledge depends on the availability of a representative resource base for future generations. Long-term productivity is maintained only if a representative sample of the cultural resource base in a culture province is preserved for future study. Any adverse effect on archaeological remains and their context reduces this sample and these effects are cumulative.

Cumulative effect should be assessed in terms of: (1) individual actions and the number of archaeological resources that they affect; (2) regional programs in which a series of actions are included which have the potential for major cumulative effects; and (3) the degree to which individual actions or programs compound the loss of archaeological resources from other Federal or non-Federal actions.

DEFINITIONS

A. Historical Resources

Historical resources are all evidences of past human occupations which can be used to reconstruct the lifeways of past peoples. These include historic and prehistoric archaeological sites and standing buildings, artifacts, environmental data and all other relevant information.

B. Culture

Shared learned patterns of human activity, evident in behavior and the results of behavior.

C. Culture History

The chronological and spatial framework for the development of human societies and cultures, and the documented processes of change involved in this development. Studies in culture history are primarily concerned with defining the relative age of cultures, and influences transmitted from one cultural province or period to another.

D. Culture Province

A culture province or area is a region characterized by common customs and patterned behavior, which can be distinguished by these characteristics from other culture provinces.

E. Direct Impact

The effects an action will have on environmental resources as a direct and immediate result of construction or development. This includes such effects as destruction of archaeological sites and standing structures and their environment by earth-moving, plowing, flooding, or building construction.

F. Indirect Impact

Effects on the environment which are not an immediate or direct result of an action, but which would probably not occur without it. Indirect impact is the extent to which a project or action exposes resources, either within or adjacent to the development, to such adverse effects as accelerated erosion, construction of private homes or commercial buildings, road-building, increased vandalism, or other disturbances attendant on the action.

G. Intensive Survey

A comprehensive and extended physical examination of an area, for the purpose of obtaining an accurate sample of data on all historical resources, situations, and associated environmental variables. This should provide a quantitative measure of the resources affected by the action. All periods of occupation should be identified. Test excavation will usually be necessary for this type of survey to identify the character, age, and extent of archaeological resources. The intensive survey should provide, and result in definition of research problems and strategy for further study.

H. Mitigation of Impact

Detailed study of, and information recovery from, representative examples of archaeological resources, in order to ameliorate the information loss which will result from an action or project. The primary strategy involved in mitigation is extensive excavation of selected archaeological sites, coupled with interdisciplinary studies necessary to reconstruct past human activities and environmental relationships.

I. Preliminary Field Reconnaissance

A relatively brief examination of representative portions of a program or project area, conducted for the purpose of defining the general categories of cultural and related environmental resources contained in the area. Test excavation is usually not required in a preliminary reconnaissance, and collection of artifacts is not necessary if they can be satisfactorily classified and recorded in the field. A preliminary field reconnaissance should be adequate to estimate the time and cost of an adequate intensive survey.

J. Substantive Data

Factual information acquired by systematic examination of a project or program area, by a professionally qualified observer. In order to prepare a detailed and accurate statement of impact, archaeological resources affected by an action must be identified by such examination. An accurate and detailed assessment of impact cannot be obtained from general textbooks or generalized treatments of the region in which an action is located.

EXPLANATORY NOTE RE EXCERPTS FROM CODES OF GOOD PRACTICE

The following excerpts were taken from documents which represent syntheses of environmentally accepted practice for a variety of activities. The sections which seemed particularly useful to Parks Canada operations were extracted and included here with the same numbering system as the source documents. This should facilitate users referring back to the source for further information. The table of contents for each report is included with each excerpt to provide an overview of all of the topics covered in the document for users who wish to refer to sections not contained in this report. Most of the publications can be obtained from:

Publications
The Environmental Protection Service
Department of the Environment
Ottawa, Ontario
K1A 1C8
or
Telephone (819) 994-4511

Any which are out of print are available on loan from the departmental library.

In addition, titles and table of contents are provided for publications which have not been excerpted but may be useful.

Following are page references for major topics included in the codes of good practice.

1. Erosion control and rehabilitation: 10-4 to 10-7, 10-8, 10-9, 12-4 to 12-10, 13-5 to 13-9, 13-11, 21-1 to 21-5.

2. Waste disposal: 6-1 to 6-12, 13-12 to 13-14.

3. Wildlife habitat protection: 7-5 to 7-6, 8-7 to 8-8, 10-4, 10-5, 10-8 to 10-10, 12-4 to 12-5.

4. Handling hazardous materials 10-9 to 10-10, 11-1 to 11-16.

5. Buffer strips for aesthetic and habitat protection purpose: 8-4, 10-4, 10-09 to 10-10, 12-4 to 12-09, 13-12.

6. Water quality standards and aquatic habitat protection procedures: 7-5 to 7-6, 8-5 to 8-6, 8-8 to 8-11, 10-4, 10-6, 10-7 to 10-10, 12-4 to 12-6, 12-8 to 12-10, 13-10 to 13-11.

7. Air quality standards: 9-3 to 9-4, 13-14.

8. Culvert installation: 10-6 to 10-8, 12-8, 13-10 to 13-11.

9. Blasting: 7-5, 10-9, 12-5.

EXCERPTS FROM:

CODE OF GOOD PRACTICE
ON DUMP CLOSING OR CONVERSION TO SANITARY
LANDFILL AT FEDERAL ESTABLISHMENTS

Regulations, Codes and Protocols

Report EPS 1-EC-77-4.

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LIST OF FIGURES

2.2 Objectives of Closing Open Dumps are:

1. Prevention of vector breeding or sustenance and removal of a wildlife attractant.

2. The control of air pollution by dust, smoke, and odour.

3. The control of fire hazards.

4. The prevention of surface and ground water pollution.

5. The effective control of all other nuisance factors so that the site is aesthetically acceptable.

6. The recovery, when feasible and practical, of the land for a variety of purposes.

2.3 General Requirements

In order to be environmentally acceptable, a closed dump should meet the following requirements.

1. Proper fencing should be installed and access to the site should be prohibited at least until conversion or renovation is completed.

2. A uniform layer of suitable cover material compacted to a minimum depth of 0.6 metres (2 feet) should be placed over the entire surface of the refuse.

3. Refuse should not be allowed to be deposited in locations where contact occurs between refuse and the ground water table.

4. The entire site, including the fill surface, should be graded and/or provided with proper drainage facilities to minimize run-off onto and into the fill, and prevent collection of standing water. The final surface of the fill should be graded to a slope in the range of one percent to three percent, but no surface slope should be so steep as to cause erosion of the cover.

5. If decomposition gases are likely to present a problem, their movement should be controlled with proper venting facilities to prevent accumulation in structures or soil which could cause explosions and damage to vegetation. In small operations natural venting will likely be quite adequate.

6. The completed fill should be graded to serve the purpose for which the fill is ultimately planned, within the restriction of (4) above. The surface drainage should be consistent with the surrounding area. The finished construction should not in any way cause interference with proper drainage on adjacent lands nor should the finished fill concentrate run-off waters into adjacent areas. Finished portions should be seeded with appropriate grasses to promote stabilization of the cover.

7. Necessary information signs should be posted near the site describing the dump closing program and the location of alternate operating sites.

2.4 A Guide to Evaluating Waste Disposal Sites

2.4.3 Sanitary Landfill Requirements

The requirements that a disposal site should meet in order to qualify as a sanitary landfill are presented below.

Requirement 1: Open Burning Prohibited. No solid waste should be burned at the sanitary landfill.

Basis: Open burning of solid waste creates odours, air pollution, fire and safety hazards. It also adversely affects public acceptance of the operation and proper location of future sanitary landfill sites. Local laws that allow or require the open burning of such materials as diseased elm trees and condemned dry foods are outmoded. Such materials can either be incorporated within the sanitary landfill or disposed of in such a manner as to prevent health hazards or nuisances. Open burning for any reason converts the operation to that of an open dump.

Requirement 2: Access Limited. Access to a sanitary landfill should be limited to those times when an attendant is on duty and/or only to those authorized to dispose of solid waste.

Basis: If public access is permitted when no attendant is on duty, scavenging, burning, and indiscriminate dumping commonly occur. Men and equipment must then be diverted from other operations to restore sanitary conditions at the disposal site. Furthermore by selectively authorizing use of the disposal site traffic is reduced and operational hazards are minimized.

Requirement 3: Spreading and Compacting. Solid waste should be spread in uniform layers.

Basis: Successful operation and maximum utilization of a sanitary landfill depend on adequate compaction of the solid waste. In addition, settlement will be excessive and uneven if this not done. Settlement permits invasion by insects and rodents and severely limits the usefulness of the finished area.

Compaction is best initiated by spreading the solid waste evenly in shallow layers, the thickness of the layers depending on the equipment available for compacting. A 0.6 metre (2 foot) layer will usually provide the most economical compaction operation. Better compaction is achieved if the working face is operated on a slope. Further compaction is provided by the repeated travel of heavy equipment (tractors, trucks) over the layers and, if necessary, by the use of equipment designed specifically for compaction.

Requirement 4: Daily or Periodic Cover. A uniform compacted layer of at least 0.15 metres (6 inches) of suitable earth cover (see Table 3-1) should be placed on all exposed solid waste by the end of each working day or at other practical frequency.

Basis: Daily or periodic covering is necessary to prevent insect and rodent infestation, blowing litter, fire hazards, unsightly appearance, and to help control gas and water movement. Fly emergence generally is prevented by 21.24 cm (6 inches) of compacted soil. Covering also divides the fill into "cells" that may help to limit any underground fires that might occur. The cover material should be easily workable and compactible and should be free of large objects. It should not contain organic matter in quantities or distribution likely to encourage harborage and breeding of vectors.

Requirement 5: Final Cover. A uniform layer of earth cover compacted to a minimum depth of 0.6 metres (2 feet) should be placed over the entire covered surface of each portion of the final lift. This should be done not later than one week following the completion of a section of the fill area.

Basis: A minimum final cover of 0.6 metre (2 feet) of compacted suitable earth cover will prevent emergence of insects from the compacted solid waste, minimize the escape of odours, prevent rodents from burrowing, assist in the control of gas and water movement, support plant growth, and provide an aesthetically acceptable finished site. This cover also provides an adequate bearing surface for vehicles and is of sufficient thickness for cover integrity in the event of settlement or erosion. Workability and compaction characteristics should at least equal those provided for daily cover (see Table 3-1).

Requirement 6: Environmental Protection. The location and the operation must have the approval of the appropriate government agency.

Basis: Location, nature of the waste deposited, and sub-standard operational procedures may lead to pollution of surface waters or underground aquifers. Unless proper standards of location and operation are followed, offensive and dangerous concentrations of gases may adversely affect the surroundings. A routine site evaluation will not normally reveal this sort of information. The exception may occur when obvious signs of leachate contamination of surface waters is apparent. The evaluator should generally examine the site looking for potential problem areas such as nearby surface watercourses, signs of high water tables, vegetation condition in streams and around the periphery of the fill area (abnormalities in growth, colour, etc.).

This may result in a need for further detailed evaluation (hydrogeological study) depending on the size of the site and extent of the problem. Alternatively it may be necessary to provide site modifications or to change operating procedures to control adverse environmental effects.

Requirement 7: Blowing Litter Controlled. Blowing litter should be controlled by fencing placed near the working area or by the use of earth banks or natural barriers. The entire site should be policed at least daily and litter clean-up operations performed as required to prevent unsightly conditions. Unloading shall be performed so as to minimize the scattering of the solid waste.

Basis: the purpose of the sanitary landfill is to dispose of solid waste in a nuisance-free manner. If papers and other light materials are scattered and the area is not policed, fire hazards, nuisances, and unsightliness results.

Requirement 8: Salvage Prohibited. Salvaging should not be permitted at the working face of the sanitary landfill.

Basis: Nothing can be tolerated that interferes with the prompt sanitary disposal of solid waste. Salvaging at the working face delays the filling operation and creates unsanitary conditions. The accumulation of salvaged materials also provides harborage for vectors and promotes an unsightliness that can be detrimental to public acceptance of the operation.

Requirement 9: Operational Considerations

Roads: Provisions should be made for all-weather access roads leading to the disposal site.

Equipment: Written provisions and guarantees should be made for the replacement of operating equipment when it is down for more then 24 hours.

Basis: Access roads that are not negotiable by collection vehicles cause unnecessary delays in the disposal operation.

The purpose of a sanitary landfill is the immediate disposal of solid waste. This results in the elimination of nuisances and produces an aesthetically acceptable operation. A major breakdown (operating equipment out of service for more than 24 hours) reverts the sanitary land fill operation to an open dump.

Requirement 10: Special Waste Handling. Toxic, pathogenic, corrosive, flammable, explosive, and other hazardous wastes should be handled in accordance with the requirements of the Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments.

Basis: Materials such as oil sludges, chemical wastes, magnesium shavings, empty pesticide containers, and contaminated medical wastes can be a special hazard to employees and to the environment if their presence in the waste mixture is not known or if they are improperly handled.

3.2 Sequence of Operations in Dump Closing:

1) Fence/restrict unauthorized access.

2) Place necessary dump signs and assign dump manager to the site during normal operating hours till dump closure is completed.

3) If an alternate site is available, close dump to incoming refuse. If a new site is not yet available, establish specific spot at the dump for sanitary landfill operation during closing.

4) Extinguish fires.

5) Eliminate vectors.

6) Provide necessary drainage.

7) Establish grades.

8) Provide surface and ground water protection systems and gas movement control when necessary.

9) Clean up miscellaneous debris, compact and cover.

10) Seed or otherwise prepare area for final use.

11) Maintain the cleanliness of the site and monitor for settlement and cover material integrity.

3.5 Rodent Control

3.5.1 Time Schedule

1) Site should be closed for minimum of 3 days under all circumstances.

- Day 1 - site remains free of activity to allow rodents to feed on previously deposited refuse and use existing food supply.
- Day 2 - bait is distributed in burrows and in sheltered areas.
- Day 3 - the rodents are allowed to feed on bait. If anticoagulant type rodent baits ie., warfarin are used, this time should be extended to at least 4 days.

3.5.3 Control

1. Only trained personnel should be allowed to conduct control operation.

2. Baiting should not be done on days when rain/snow is predicted within the next 24 hours.

Further detailed information on specific poisons and their application is contained in the Code.

3.6 Control of Surface and Ground Water Pollution

- Leachate collection and treatment systems should be used when necessary to protect ground and surface water. Collected leachate should receive adequate treatment before discharge to a receiving body.
- In no case should solid wastes be allowed to contact ground water. Groundwater (ie., high water mark of 50-year design flood) and deposited solid waste should be at least 1.52 m (5 feet) apart.

3.7 Control of Gas Movement

- When decomposition gases may present hazard, they should be controlled on site. Techniques for gas movement control:

1) Gravel vents or gravel filled trenches
2) Compacted clay barriers
3) Vent pipes

3.8 Covering the Dump

3.8.1 Trench Method

- Used where high water table is not a problem.

- Loose refuse is brought together and then spread and compacted.

- Deposit refuse in trench. The bottom of the trench should be kept above groundwater level.

- Refuse covered with soil and graded to prevent ponding.

3.8.2 Area Method

- Used when high water table prohibits trenching.

- Loose refuse is stockpiled and compacted against earth berm.

- Covering of refuse made with soil.

- Grading of site desirable periodically to avoid ponding of surface runoff.

3.8.3 Bank Method

1. The bank method is a modification of the area method and merely takes advantages of the original sloping nature of the refuse (Figure 3-6).

2. When the refuse has been set to a 3.1 slope, it is compacted and covered, thus forming the berms for the adjacent cell.

3.8.4 Wetland Method

1. This method is used where the dump is in a marshland or in an area where the groundwater or surface waters have been contaminated. The solid waste is first removed and then separated from the water by placement of a mat of inert material that reaches above high water level (Figure 3-7). Materials such as rocks, soil, broken concrete or demolition debris may be used for this purpose.

2. Another means of separation between the solid waste and the water can be achieved by diverting the flow of water or if necessary by lowering the ground water level.

3. When the refuse has been separated from the water by either one of the methods described above, it is compacted and covered with suitable cover method.

3.9 Cover Material

In all covering methods the surface of the refuse should be covered with at least 0.6 metres (2 feet) of compacted soil. The cover material should be selected according to its ability to perform the following functions.

1. Minimize vector breeding grounds
2. Minimize surface and ground water pollution
3. Minimize air pollution by smoke and odours
4. Minimize fire hazard potential
5. Minimize blowing paper and unsightly appearance of operations

Not all soils perform these functions equally well (Table 3-1). While the soil is usually selected from the types available nearby, consideration needs to be given to its suitability before using it as cover material.

TABLE 3 - 1

COVER MATERIAL SUITABILITY OF GENERAL SOIL TYPES

Function	General Soil Type					
	Clean gravel	Clayey-silty gravel	Clean sand	Clayey-silty sand	Silt	Clay
Prevent rodents from burrowing or tunneling	G	F-G	G	P	P	P
Keep flies from emerging	P	F	P	P	P	E*
Minimize moisture entering fill	P	F-G	P	G-E	G-E	E*
Minimize landfill gas venting through cover	P	F-G	P	G-E	G-E	E*
Provide pleasing appearing and control blowing paper	E	E	E	E	E	E
Support vegetation	P	G	P-F	G-E	F-G	+
Be permeable for venting decomposition gas+	E	P	G	P	P	P

E - excellent; G - good; F - fair; P - poor

* Except when cracks extend through the entire cover

\+ Only if well drained

Excerpts From:

RECOMMENDED ENVIRONMENTAL STANDARDS FOR THE DESIGN AND CONSTRUCTION OF A MACKENZIE VALLEY GAS PIPELINE

Prepared by the

Environmental Protection Service

Northwest Region

Environment Canada

November 1976

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TABLES

NOTE

The following information refers specifically to the Mackenzie Valley but also represents concerns widespread throughout northern areas. The dates quoted here should be interpreted as general guidelines because they will undoubtedly vary from one place to another. Reference should also be made to the excerpts from the Yukon Environmental Terms, Conditions and Related Guidelines: Alaska Highway Gas Pipeline Draft II. The Yukon guidelines provide a more recent information synthesis and apply to a different geographical area but largely share the same concerns.

2.1 Scheduling of Construction Activities

Pipeline construction and related activities shall be prohibited:

a) during the period October 15 to April 30 within 3 km of Dall's sheep winter range; May 1 to June 15 within 3 km of Dall's sheep lambing areas; and May 1 to August 31 within 3 km of Dall's sheep mineral licks;

b) within 3 km of nesting sites of ospreys and golden eagles during the period March 1 to August 31; gyrfalcons during the period February 1 to August 31; peregrine falcons during the period April 15 to August 31;

c) during the periods May 15 to August 31 in waterfowl nesting areas, and August 15 to October 15 in waterfowl staging and feeding areas;

d) during the period November 1 to May 15 in known grizzly bear denning areas;

e) during the periods May 1 to July 31 in calving grounds of caribou if caribou are in or approaching the areas, and March 15 to May 31 and September 15 to November 30 in caribou migration routes if caribou are in or approaching the area;

f) during the period June 15 to July 31 in whale calving areas;

g) during the period January 1 to March 31 in critical moose winter range.

2.2 The Permittee shall not undertake blasting operations:

a) within 16 km of any caribou calving ground during the month of June;

b) within 16 km of any caribou herd during the month of July;

c) within 8 km of any Dall's sheep winter range during the month of May, and any mineral licks during snow free periods;

d) within 8 km of any nest site of bald eagles, golden eagles, gyrfalcons, ospreys or peregrine falcons during the period March 1 through August 31;

2.3 Crossings of streams or lakes frequented by spring spawning or migrating fish shall not be constructed between May 1 and July 15.

2.4 Crossings of streams or lakes frequented by fall spawning fish shall not be constructed during the period September 1 to November 15, unless the stream is frozen to the bottom.

2.5 Crossings of streams or lakes frequented by over-wintering fish or fish eggs shall not be constructed between December 1 and April 30 unless it is shown that fish and/or their eggs do not overwinter either at the crossing site or in a downstream portion of the stream which may be affected by sediment or by interruption of surface or subsurface flows.

EXCERPTS FROM:

YUKON ENVIRONMENTAL TERMS, CONDITIONS AND RELATED GUIDELINES ALASKA HIGHWAY GAS PIPELINE

DRAFT II FEBRUARY 1, 1979

ISSUED BY:

THE NORTHERN PIPELINE AGENCY

P.O. BOX 1605, STATION B

OTTAWA, ONTARIO

K1P 5A0

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4.1.8 - Wherever disturbance of the landscape is inevitable, leave a buffer strip of undisturbed vegetation between the disturbed site and waterbodies and public roads including the following:

Guidelines for Buffer Strips and Separation Distances

	Minimum desirable separation (in metres)
Between waterbody and	
- road	100
- borrow pit	100
- sewage lagoon	100
- pipeline right-of-way	100
- fuel storage	300
- construction camp	300
- solid waste disposal site	300
- stockpile site	300
- cleared area	100
- burning site	100
- spoil pile	100
- oil change area	100
Between public road and	
- borrow pit	100
- compressor station	100
- stockpile site	100
Between fish spawning or overwintering area and - water intake	300

4.4 Water Quality

Guidelines designed to minimize changes in water quality may include the following:

4.4.1

Where effluent is released into a lake or river, or where any other project activity results in physical, chemical or biological changes to a lake or river, environmental protection can be attained by adopting the following standards for the quality of the receiving waters:

a) total coliform density not to exceed 5000/100 ml and fecal coliform density not to exceed 200/100 ml;

b) dissolved oxygen not to be reduced below 6 mg/l and reduction not be by more than 20% of its natural concentration;

c) pH not to be altered by more than 0.5 from ambient conditions; maintain in the 6.5 to 8.5 range wherever practicable;

d) water temperature not to be altered by more than 2°C of natural;

e) colour not to be increased by more than 30 colour units above natural;

f) phenolics not to exceed 0.005 mg/l;

g) oils and greases arising from project sources not to exceed concentrations that produce a visible iridescent sheen;

h) only non-persistent air-fogging pesticides to be permitted

i) toxic substances not to exceed concentrations recommended in Water Quality Criteria, 1972 (U.S. National Academy of Sciences and the National Academy of Engineering);

j) levels of total nitrogen and phosphorus not to exceed 1.0 and 0.05 mg/l respectively.

4.4.2

Procedures designed to maintain water quality and protect aquatic habitat include the following. Desirable suspended sediment concentrations during construction or operation would not exceed the following maxima in waterbodies identified as providing important aquatic habitat as measured at designated locations:

a) the average concentration not to exceed natural levels by more than 500 mg/l or 5 times the natural levels, whichever is greater, during an 24-hour period;

b) the average concentration not to exceed natural levels by more than 100 mg/l or 2 times the natural level, whichever is greater, during an 5-day period;

c) when the natural level is less than 25 mg/l then it is not to be exceeded by more than 5 mg/l during any 30-day period;

d) when the natural level is greater than 25 mg/l then it is not to be exceeded by more than 20% during any 30-day period.

<u>4.4.3</u>

Turbidity, measured in nephelometric turbidity units (NTU), may be used as an index for suspended sediment monitoring.

<u>4.4.4</u>

Specify the frequency and location of water sampling. Include sampling sites at agreed upon locations. Locate control sites in unaffected parts of the same waterbody. Develop sampling frequency sufficient to adequately assess changes in water quality during periods of disturbance and recovery.

<u>4.4.5</u>

Adopt analytical procedures in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater developed by the American Public Health Association, American Water Works Association and Water Pollution Control Federation.

<u>4.4.6</u>

In waterbodies identified as containing important aquatic habitat, institute monitoring programs, as appropriate, that will measure the effects of construction disturbances on water quality.

4.7 WILDLIFE

4.7.1

Critical or sensitive wildlife and periods referred to in 2.7.1 include, but are not limited to, the following:

a) Dall's Sheep

i) within winter range during the period October 15 to April 30;

ii) within 2 km of lambing areas during the period May 1 to June 15; and

iii) within 2 km of mineral lick during the period May 1 to August 31.

b) Woodland Caribou

i) within migration routes during the perids March 15 to May 31 and September 15 to November 30 when they are on or approaching such routes; and

ii) within winter range from December 1 to March 31.

c) Raptors

i) within 2 km of nesting sites of: peregrine falcons from April 15 to August 31; gyrfalcons from February 1 to August 31; and ospreys, golden eagles and bald eagles from March 1 to August 31. Areas encompassed by this item henceforth will be referred to as Raptor Protection Zones.

d) Waterfowl

i) within 1 km of spring and fall staging areas from April 1 to June 15 and August 15 to October 15, respectively; and

ii) within 1 km of nesting and moulting areas from May 15 to August 31.

Additional critical or sensitive wildlife zones and periods reflecting the potential impact of blasting on some wildlife species are recorded in the guidelines for blasting.

4.7.2

With respect to critical and sensitive wildlife habitat and periods as referred to in 2.7.1 other species will be considered including: moose, wapiti and mule deer, wolf, fox, grizzly bear, fur-bearers and sharp-tailed grouse. Specific guidelines defining periods and distances to be used in determining safe distances between project activities and habitat will be established by the Agency in concert with the company.

4.7.3

In order to reduce or avoid impact on wildlife from low-altitude aircraft and helicopters during pipeline construction and operation, the following measures are appropriate:

a) establish aircraft flight corridors; and

b) establish minimum flight altitudes along these corridors avoiding, as far as practicable, those areas and times identified as sensitive to wildlife. Site and time specific routing and altitude constraints along the corridor may be required where or when such areas cannot be avoided.

4.7.4

Measures to prevent obstruction, disturbance or entrapment to big game animals during pipeline construction or operation should take into account:

a) open trenching, pipe, or snow fencing as potential obstacles to the movement of animals; and

b) vehicle traffic scheduling to avoid harassment and vehicle operation to avoid accidents.

4.7.5

The appropriate wildlife monitoring program referred to in 2.21 and 3.3 may include, but is not limited to: Dall's sheep, woodland caribou, raptors and waterfowl, and aspects of their life cycles which could be affected by pipeline activities such as timing of movements, reproductive activities, and use of ranges.

4.8 FISHERIES RESOURCES

Measures to protect fish and aquatic habitat include the following:

4.8.1

Avoid in-stream pipeline construction and other activities during sensitive periods for fish in areas required for spawning, migrating or overwintering. Scheduling of stream crossings to avoid sensitive periods will be determined on a site-specific basis by the Agency in concert with the company.

4.8.2

Adopt construction and operation practices to minimize the release of silt into waterbodies frequented by fish. Where silt loads from project activities are expected to be significant, institute silt control measures before construction activities start. These measures should satisfy the suspended sediment standards (Water Quality 4.4.2).

4.8.3

Prohibit gravel removal within the wetted perimeter of areas frequented by fish and immediately upstream thereof (Granular Resources, Pits and Quarries 4.14.3 and 4.14.5).

4.8.4

Protect fish habitat from spills of fuels and hazardous materials by instituting the measures outlined in Fuels and other Hazardous Materials 4.12, Waste Management 4.13.3, and Hydrostatic Testing 4.20.4 and 4.20.5.

4.8.5

Adopt construction and operation practices so that the water temperature in areas frequented by fish is not altered by more than 2°C from the ambient temperature.

4.8.6

Avoid changes to the chemistry of waterbodies frequented by fish during construction and operation in order to meet the criteria outlined in Water Quality 4.4.1.

4.8.7

Apply construction and operation practices that ensure the dissolved oxygen concentration in waterbodies frequented by fish is not reduced more than 20% of its natural concentration. Avoid project activities that will reduce the dissolved oxygen concentration to less than 6mg/l.

4.8.8

Design and schedule installations and activities in waters that are frequented by fish to minimize effects on sensitive areas for fish and to allow their uninterrupted movement and safe passage.

4.8.9

Provide fish passage facilities for any unavoidable structures or stream channel changes that may cause blockage to fish, or that may create velocity barriers to fish movements.

4.8.10

Schedule several stages for construction and use of temporary coffer-dams, berms and diversion dykes in any watercourse frequented by fish to ensure that the changed water velocity and depth do not prevent fish passage. Plug and stabilize abandoned water diversion structures in a manner to avoid trapping or stranding fish.

4.8.11

Avoid making changes in stream channels affecting fish spawning beds, nursery or overwintering areas. Where changes cannot be avoided in such beds, construct new channels providing suitable habitat for fish.

4.8.12

Remove, as soon as practicable, any debris from clearing operations that may hinder fish passage.

4.8.13

Ensure that culverts placed in watercourses frequented by fish conform to the requirements outlined in Guidelines for the Protection of the Fish Resources of the Northwest Territories During Highway Construction and Operation (Fisheries and Marine Service Technical Report Series No. CEN/T-75-1).

4.8.14

Mitigate adverse effects of water withdrawal from waterbodies frequented by fish by conforming to Water Withdrawal 4.17.

4.8.15

Protect fish resources from blasting operations by adopting Blasting Guidelines 4.15.

4.8.16

Develop and implement monitoring programs to facilitate the protection of fish and aquatic habitat. Carry out monitoring before construction and during construction and operation. The programs could include the following aspects:

a) compare suspended sediment concentrations with pre-construction levels. During construction compare levels downstream from construction activities with upstream levels;

b) monitor dissolved oxygen to ensure adequate oxygen levels in water frequented by fish. Measure dissolved oxygen, which is most critical in winter, in waters that may be disturbed during construction or operation;

c) observe and record low water levels and flows to facilitate maintenance of adequate quantities of water for fish;

d) monitor nutrient levels in waste disposal areas to facilitate prevention of overenrichment of fish habitat and high biological oxygen demand;

e) observe and record fish and bottom sediment contaminant levels as a baseline measure that will warn of any contamination of a fishery resource;

f) monitor water temperatures to ensure that acceptable limits for aquatic resources are maintained, and that water temperature is low enough to maintain adequate oxygen levels;

g) monitor water quality in locations where pipeline related activities may create chemical changes detrimental to fish;

h) observe and record water velocities through culverts and diversion structures to establish whether velocities exceed the capabilities of fish migrating upstream; and

i) monitor pipeline crossing sites to establish whether erosion control devices are working and whether disturbed areas are returned to a stable condition.

Excerpts From:

AIR POLLUTION GUIDELINES APPLICABLE TO INCINERATORS AT FEDERAL ESTABLISHMENTS

Regulations, Codes and Protocols

Report EPS 1-EC-78-5

Environmental Impact Control Directorate

Environmental Protection Service

August 1978

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Summary of Emission Limits From Incinerators on Federal Establishments

	Visible Emissions	Particulate Emission	Stack Height Installation Requirements
New Installation	opacity of gases emitted into ambient air should not exceed 5% incinerator should be tested in presence of Regional EPS rep. within 90 days of start up	should not exceed a) .75 gm/kg (1.5 lb/ton)of solid wastes of types on following page and capacity less than 908 kg/hr b) 1 gm/kg (2 lb/ton)when capacity greater than 908 kg/hr (2000 lb/hr)	designed so that flue gases containing air contaminant levels specified in guideline are discharged at sufficient height, velocity and temperature so as to cause hourly concentrations no greater than 450 ugms SO_2/m^3 of air 200 ugms NO_2/m^3 of air 120 ugms particulates/m^3 of air
Existing Installation	opacity of gases emitted into ambient air should not exceed 20%	particulate matter should not create nuisance/ air pollution as defined in guideline complaints to this effect handled by EPS contacting facility and requesting alleviating procedures	gases discharged at sufficient height, velocity and temperature so as to cause concentration no greater than 900 ugms SO_2/m^3 of air 400 ugms NO_2/m^3 of air 220 ugms particulate/m^3 of air

TYPES OF SOLID WASTES FOR INCINERATION

Type	Description	Examples
A	Cellulosic solids, up to 15 per cent moisture (wet basis)	dry paper cardboard boxes wooden pallets furniture photographic film
B	Cellulosic solids, 10-50 per cent moisture (wet basis)	wet paper moist sawdust damp rags or clothing residential refuse bark
C	Cellulosic solids, over 40 per cent moisture (wet basis)	fruits & vegetables garden trimmings kitchen wastes
D	Plastics & asphaltic solids non-halogenated	polyethylene containers polystyrenes asphaltic shingles waxes
E	Plastics & asphaltic solids, halogenated	PVC (polyvinyl chloride) DDT powder
F	Rubber	tires
G	Animal materials	leather hair & wool feathers glue fur
H	Animal & human wastes	manure dried sewage sludge
I	Non-combustible solids	glass cans ashes & sand salt crockery metal objects
J	Pathological remains	dead animals

Excerpts From:

ENVIRONMENTAL CODE OF GOOD PRACTICE FOR HIGHWAYS AND RAILWAYS

by Storgaard and Associates

for

The Federal Activities Branch
Environmental Impact Control Directorate
Environmental Protection Service
Environment Canada

Report EPS-1-EC=79-2
December 1979

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3.2 Environmental Study

3.2.1.2

- Harassment of birds and mammals by equipment or aircraft of any kind should not take place. Aircraft should fly at least 300m (1000') above animal concentrations and if possible these concentrations should be avoided altogether.

3.5.5 Lakes and Watercourses

3.5.5.1

- Avoid locating roads on the edges of watercourses and lakes. Allow at least 100 m (328') between the road and high water mark of a lake, stream, river or productive marsh to permit percolation of road surface runoff into vegetation before it reaches the water.

3.5.6.2

- Locate bridge crossings at narrowest points (of stream) where there is no evidence of active bank erosion. Streams should not be paralleled before being crossed.

3.5.6.4

- As a precaution against washouts, roads should be located upstream from beaver dams.

3.5.7 Natural Sensitive Areas

3.5.7.2

- A 500 m (1,640') buffer zone should be maintained between the road and designated natural sensitive area or critical wildlife habitat.

SECTION 4 - DESIGN

4.1 Clearing

4.1.4

- The clearing method should be decided upon after consideration of:

  a) terrain sensitivity
  b) nature of tree cover
  c) time of year
  d) quality of timber

4.1.5

- Proper precautions to minimize surface disturbance should be taken. Dozer blades should be equipped with skid shoes and all equipment utilized in clearing operations should be adequately powered.

4.1.9

- In northern areas, heavy equipment should only be employed when a) ground is frozen to a depth of 20cm (8") to provide the necessary bearing capacity and b) the ground is covered with at least 13cm (5") of snow to protect the vegetation mat. Clearing should be scheduled for completion by the end of February, with daily work proceeding until active layer thaws.

4.1.12

- All cleared terrain with an area that slopes towards a water body should be considered as a possible source of siltation. Right of way clearing should be discontinued a minimum of 100m (328') from the design flood high water mark, until just prior to commencement of permanent river crossing structures. On slopes that exceed 18° the clearing should be stopped at the beginning of the downslope.

4.1.16

- Burn areas should not be located within 200m (656') of any watercourse/body except where burning is carried out on sleds or racks. Residue from burning should be disposed of.

1.1.18

- Logging activities within 2km (1.24 miles) radius of active bald eagle nesting sites or those of any other species which nest in large trees should be carried out so as to leave intact and undisturbed a minimum of 1 in 10 of the largest trees.

4.5 **Borrow Areas**

4.5.3

- Gravel removal operations should be limited to areas above the design flood high water stage and no closer than 100m (328') to any active river channel.

4.7 Drainage and Erosion Control

4.7.14

- Water velocity in ditches can be reduced by limiting ditch gradient and by designing the ditch with an appropriate cross section. A trapezoidal or parabolic cross section should be specified; V-shaped ditches are prone to erosion and should not be considered unless protected with coarse granular material.

4.7.15

- Scour erosion in roadway ditches is dependent upon numerous factors including: discharge; channel gradient; and soil characteristics such as grain size, density, organic binder, cementation and ice content. Some methods used in road construction to control or prevent scour erosion are:

  a) blanketing the ditch with stable, free-draining granular materials;

  b) reducing the effective ditch gradient by constructing a series of properly spaced ditch checks on the ditch floor; and

  c) diverting runoff water out of the ditch onto natural vegetation by using ditch blocks.

4.8.3 Culvert Velocities

4.8.3.2

- To avoid interference with fish passage, culverts should be designed such that the average cross-sectional velocity through any culvert section does not exceed 0.9 m/s (3 fps) during fish migration periods, unless it can be satisfactorily demonstrated that the culvert design includes a selected region wherein velocities are low enough to permit fish passage. This selected region should be continous throughout the culvert length and of sufficient size to permit the fish to locate it and to swim through it. Velocity criteria need not be adhered to during the delay period in which culverts are permitted to be impassable to fish, as described in section on period of delay (Section 4.8.4).

4.8.4 Period of Delay

4.8.4.2

- The discharge at which the culvert becomes impassable to fish is defined as the "critical fish migration discharge". It is recommended that a 7-day impassable period should not be exceeded more than once in the design period of 50 years. The 7-day delay discharge is the discharge represented, on the design flood (generally a 1 in 50 year recurrence interval) hydrograph and parallel to the time axis for a period of 7 days. A 3-day impassable period should not be exceeded during average annual flood, defined as a flood having a recurrence interval of 2.33 years. The 3-day delay discharge is represented on the average annual flood hydrograph and encompasses a time period of 3 days. For culvert designs to satisfy this criteria, neither the 7-day nor the 3-day delay discharges should exceed the critical fish migration discharge.

4.8.4.3

- As a general rule, the 3-day or 7-day delay period is intended to coincide with the timing of fish migration past the culvert site. If it can be satisfactorily demonstrated that peak flows and fish movement at the culvert do not coincide, then it may be possible to adjust the design procedure to accommodate fish movement at the non-peak period. It will, however, generally require several years data on each individual stream, in order to properly define the fish movement vs. flood peak time-frame.

4.8.5.2

- The minimum desirable water level within culverts during periods of fish movement and open-water season should be 20 cm (8 in.), unless it can be shown that there is no requirement for fish movement through the culvert.

4.8.9 Culvert Location

4.8.9.1

- Feasible locations for installation of culverts include:

  a) water stretches where there are no sudden increases in water velocity above/below/ at crossing location.

  b) areas of channel where gradient is as close to zero as possible.

c) stretches where the stream reach is of similar alignment, above and below culvert entrance and exit sites for at least 100 m (328').

4.8.11.1

- When implementing multiple culverts, it is suggested that a minimum distance of 1.8 m (6') be established between adjacent culvert walls within the arrangement. This spacing will provide a backwater area (downstream end) for the fish to rest in before attempting passage.

4.9 Wind Erosion

4.9.1

- Wherever sand dune ridges are to be traversed with cuts, wind erosion problems may result. To offset these problems, the road surface and the shoulders should be capped with silt-clay material 10 cm (4 in) thick. Where this method is not economically feasible, alternate methods of prevention of wind erosion of the sand material such as revegetation, seeding or mulching should be investigated.

4.11 Consideration for Wildlife

4.11.2

- In northern areas, structures should not impede the movement of caribou or moose or deflect their migrations more than 3 km (2 miles).

4.11.4

- Speed limits of 30 km/hr (20mph) should apply to all vehicles on any road when caribou are crossing or travelling along such a road.

4.11.8

- To offset human impact upon wildlife, the imposition of a refuge extending 2 km (1.2 miles) or more on each side of a highway (depending on biological circumstances) is favourable.

SECTION 5 - CONSTRUCTION

5.4 Clearing and Grubbing

5.4.7

- Clearing and grubbing activities in the vicinity of stream beds should be performed with care to minimize damage to the natural condition of the area. Machine clearing should not be permitted within 100 m (328') of any stream bed.

5.8 Winter Road Construction

5.8.2

- Vehicles used beyond existing rights-of-way of winter roads should not exert ground pressures in excess of 28 kpa (4 psi).

5.11 Explosives

5.11.5

- Blasting, unless so approved by regulatory agencies, should not take place:

  a) within 15km (9.3 miles) of any designated natural sensitive areas

  b) within 400m (1312') of streams, rivers or lakes

- Further measures to reduce the impacts of blasting (taken from Northern Pipeline Socio-Economic and Environmental Terms and Conditions for Southern B.C ...) may include scheduling to avoid critical periods of time; maintaining a distance of 300 metres (975') from areas in which concentrations of fish eggs are present; restricting areas where fish are spawning or overwintering, or areas where fish are migrating in dense schools; temporarily blocking fish access to blast areas; using blast deflectors or absorbers; using minimum size charges necessary, and instituting appropriate suspended sediment controls.

5.13 Fuel Storage and Handling

5.13.1

- Sites of all fuel, lubricant and petrochemical depots should be located a minimum of 200m (656') from any lake, stream or river, preferably 300m (975').

5.13.3

- Adequate oil spill containment dykes or other structures of impervious material should be provided for all above-ground storage tanks and pump facilities. Capacity of containment should be at least 125% of total storage volume of the tanks in the depot with an additional volume sufficient to contain the maximum trapped precipitation and runoff which may be impounded. The minimum depth provided for such precipitation/runoff within dyked areas should be 60cm (2').

5.13.8

- Fueling and lubricating of on-line equipment should be done in a manner to avoid spilling. Fueling of equipment should not take place within 100 m (328') of river, lake or stream.

SECTION 6 - OPERATION AND MAINTENANCE

6.9 Animal Collisions

6.9.1

- To mitigate problem of train-animal collisions and lower the number of animal mortalities, possible measures include:

  a) gradual increase in train speeds and frequency through the first year of operation, decreasing at migration times.

  b) outriders in air or land vehicles to clear the rail line of animal concentrations

  c) convoy type operations eg. 3 trains moving through critical area as a unit.

Excerpts from:

Code of Good Practice for Management* of Hazardous and Toxic Wastes at Federal Establishments

Environmental Protection Service

Environment Canada

January 1977

*This section ends with a table outlining Pesticides Permitted for Use in National Parks: p. 11-15-11-17

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2.5.1 Waste Generation Reduction

- Hazardous and toxic substances should be purchased in the smallest container sizes required and in such quantities that large stocks of materials in excess of requirements are not held. Excess materials may eventually lead to disposal problems.

  Personnel should be made aware of the reasons for the adoption of improved practices. A program of this nature should be developed in conjunction with the regional office of the Environmental Protection Service (EPS).

2.5.2.1 Labelling

- In the case of new purchases and products, the manufacturer's label is usually sufficient if it contains:

  a) Manufacturer's name and address

  b) Description of contents.

  Manufacturers should be requested to provide a description of the associated hazards, first-aid procedures, and handling and disposal procedures where this information is not on the original containers. It is desirable to keep a master file system for each type of chemical handled.

  Whenever a chemical is transferred to another container or reacted with another chemical, a new label must be prepared to identify the contents of the container and the person responsible for that container. Waste material of a chemical nature must never be accepted by a second person unless the container is properly labelled.

4. HANDLAND GUIDELINES (COLLECTION, STORAGE AND TRANSPORTATION) OF HAZARDOUS WASTES

4.1 General

- Wastes should be collected as soon as possible and should not be allowed to accumulate at the point of generation. Retension time in storage should also be minimized.

- Before transporting any hazardous/toxic waste, regional office of the EPS should be contacted.

4.2 Labelling

- User is responsible for proper containment and labelling of hazardous and toxic wastes.

- The person responsible for collection and storage of wastes should be specifically directed not to accept for storage/disposal any waste material which does not have the name and location or telephone number of the originator of the waste.

1. Do not store food, beverages or tobacco, eating utensils or smoking equipment in the work area.

2. DO NOT drink, eat, or smoke tobacco in work area.

3. Wear rubber gloves and other designated protective clothing while handling containers.

4. DO NOT put fingers to mouth or rub eyes while working.

5. Wash hands before eating, smoking or using the toilet. Also wash immediately after loading, unloading or transferring a shipment of poisons.

6. Inspect containers for leaks before handling them.

7. DO NOT mishandle containers and thereby create emergencies by carelessness.

8. Keep people away if a leak or spill occurs and report it immediately to your supervisor.

9. DO NOT store waste substances next to food or other articles intended for consumption by humans or animals.

10. Inspect vehicles for contamination after unloading. DO NOT release a contaminated vehicle.

4.4.5 Emergency Preparedness

- To minimize possible pollution hazards and exposure of personnel to toxic materials and vapours, both during and after an emergency, the following procedures should be followed:

1. A complete record of all hazardous and toxic wastes in storage should be available and should include data on hazardous properties of these materials, as well as first aid procedures and disposal methods.

2. Personnel handling hazardous and toxic wastes should be supplied with data (from the manufacturer when possible or alternately from literature) pertaining to:

Flammability (flash point)
Product of combustion
Toxicity and related hazards
Reactivity (with other materials)
First aid treatment

3. Hazardous and toxic waste storage locations should be identified using prominent water-proof signs at doorways and at windows.

4. Keep containers, especially glass containing flammable waste materials, away from windows and out of the sunlight.

5. An effective "mopping-up" procedure must be developed to handle spills of hazardous and toxic wastes.

4.6.1 Pesticide Collection

- Waste pesticides should be collected in their original containers or in strong plastic bags or containers.

- An adequate supply of sound, properly prepared, used 45 gallon containers should be maintained in the storage areas to receive poorly packaged pesticides and leaking containers.

4.7 Storage

Waste materials should be stored in a dry, well ventilated area, preferably in a separate, fireproof building. The building should be kept locked except when being used by authorized personnel. The entire storage area should be surrounded by a climb-proof fence. The outside of each storage area should be lighted and signed on all sides with "DANGER", "POISON", "HAZARDOUS AND TOXIC WASTE STORAGE". A list of the types of wastes should be posted on the outside of the storage area.

Inside the building each hazardous and toxic formulation should be segregated and stored under a sign containing the name of the formulation. All containers should be stored in an upright position off the ground, preferably on pallets. Wastes and containers should be further segregated according to the method of disposal. This ensures that entire shipments of the same class of substance are disposed of properly, and that accidental mixing of containers of different categories does not occur during the removal operation. Any unidentifiable container or any containers suspected of being mis-labelled, must be segregated and stored separately.

4.8 Special Waste Handling Procedures

- Waste substances requiring special handling include:

  1) PCB's
  2) Flammable Liquids
  3) Flammable Solids
  4) Gases
  5) Oxidizing Materials
  6) Corrosive Materials
  7) Poisonous Liquids and Solids
  8) Water Reactive Materials
  9) Slight Hazard Materials
  10) Explosives - see "Handling of Explosives" pamphlet published by Department of Energy; Mines and Resources for further information.

- For further information on methods of handling each of these categories of waste refer to pages 35 to 45 in the Code.

4.9 Transportation

4.9.1 Preparation for Transport

- Packages should be designed and constructed and contents limited so that, under conditions normal to transportation, there will be no significant release of hazardous materials to the environment.

- Packages containing liquids in inside containers should be marked plainly "THIS SIDE UP" to indicate position of inside container.

- Each package should be labelled according to the highest hazards associated with its transportation and be handled accordingly.

- Containers for flammable liquids or solids should not be placed in the same package as oxidizing materials or corrosive liquids. Oxidizing materials, poisons, corrosive liquids should not be packaged together with other substances, the mixture of which may cause dangerous emissions of gas or heat.

- Substances which are liable to decompose or polymerize violently should not be offered for transportation. They should be stabilized prior to storage or transportation.

- Special care should be taken in the loading and transporting of water-sensitive materials, to keep them dry during the loading and transit process. Avoid sudden cooling of partially filled containers as condensation of water droplets on the inside of the container may occur.

- There should be no smoking allowed while loading or unloading flammable materials.

- Containers filled with flammable, corrosive, or noxious gases must have their valves protected. This can be done by loading the containers compactly in an upright position and securely bracing or lashing them to prevent overturning.

- On the day of collection, wastes to be transported to the disposal site should be placed in the collection area. The transporter should then place the waste containers in appropriate outside packages and ensure that the outside package bears the same transport labels as the waste containers placed therein. The packages should be placed or secured so that no movement takes place during transportation, particularly during sudden stops and starts and changes of direction.

- No tools or equipment should be used which are likely to damage the effectiveness of the package or other container during the loading or unloading process.

5. DISPOSAL OR RECOVERY OF HAZARDOUS AND TOXIC WASTES

5.2.3 Disposal/Recovery

- Warning: When disposing of combinations of hazardous and toxic waste substances the combined properties may be considerably more hazardous than the original substances.

- When waste components are unknown use utmost caution.

5.4.3 <u>Pesticides</u>

- In determining methods of disposal for pesticides, the nature of active ingredients and physical/chemical properties must be considered.

  1) In the case of non-persistent pesticides, liquid formulations should be collected for shipment to a commercial incinerator.

  2) It is also possible to have materials in powder form slurried and blended with a flammable liquid such as waste-oil and incinerated.

3) Non-persistent pesticides that are absorbed on inert carriers can be landfilled in a properly chosen landfill site, providing that the quantity is not too large (contact regional E.P.S. office).

4) Persistent pesticides such as the arsenic, lead, mercury, cyanide and halogen based pesticides should be inventoried and these lists presented to the regional EPS office for advice on disposal procedures. Such procedures should be based on consideration of the individual properties of the pesticides.

5.4.4 Petroleum, Oils & Lubricants

- There are five main alternatives for the recovery or disposal of POL waste. Local regulations and economic factors may, however, preclude the use of some of these alternatives. The alternatives are:

  1. Recovery and re-use of some or all waste components

  2. Recovery of the heat value of some or all waste components

  3. Incineration of some or all waste components without recovery of heat.

  4. Road spraying (oils).

  5. Road stabilization (oils).

5.4.4.1 Recovery and Re-Use of Some or ALL POL Waste Components

- Recovery firms are interested in the following components of POL waste:

  1. Thinners and cleaning solvents
  2. Hydraulic fluids
  3. Oils

  Where these components are present the monthly volume produced should be analyzed for contaminants. Solvent or oil recovery firms will supply an approximate recovery feasibility based on:

  1. New cost of the component to be recovered
  2. Cost of alternate disposal methods
  3. Cost of recovery operation
  4. Cost of transport

If preliminary analysis indicates economical recovery is feasible, one sample of POL waste should be sent to interested recovery companies for detailed analysis and cost estimates.

5.4.4.2 Recovery of Heat Value of Some or All POL Waste Components

- Alternate methods of heat recovery which may prove to be a feasible solution to the POL waste disposal problem as well as be an economic asset in the operation of a facility include:

  1. Incineration of POL waste in a boiler furnace.

  2. Incineration by injection of POL waste into an existing solid waste incinerator with a heat recovery unit attachment (the waste POL would reduce the use of auxiliary fuel)

  3. Removal by private contractor for use in special application heating units.

5.4.4.3 Incineration of POL Waste Without Recovery of Heat Value

- This solution may be the most feasible one in many cases, particularly for non-recoverable fractions of POL waste. The objective should be to dispose of the waste at low cost with acceptable environmental effects. The following alternatives should be considered:

  1. Incineration at own permanent installation - feasible only where cost of transport and subsequent disposal warrant the capital and operating costs of a POL waste incinerator.

  2. Incineration at own portable installation - feasible where cost of transporting and operating the portable rig is less than the cost of transporting the waste to a permanent Federal disposal unit, or the combined transportation and disposal charges of independent disposal companies.

  3. Employing the services of independent disposal companies - feasible where private disposal incinerators for liquid wastes are located close to Federal facilities.

5.4.4.4 Road Spraying (Oils)

- Waste crank case oils may be used for dust control by spraying on roads, if the oil is free of contaminants and other POL fractions. If the oil contains tricesyl phosphate (as in extreme pressure lubricants, some hydraulic fluids and heat exchange mediums) it must not be used, since environmental contamination may result. Oils from transformer and large capacitors which contain polychlorinated biphenyls (PCB's) should be segregated from regular waste oils and disposed of as per instruction from the regional EPS office.

5.4.4.5 Road Stabilization (oils)

- This application is similar to dust control in that oil is used to stabilize particles. The oil may be mixed with tar, etc., to obtain the desired viscosity. The oil mixture is sprayed onto a sandy layer which is subsequently compacted. This will then be covered by a wearing surface of bitumen or concrete and any leachable impurities will be immobilized.

HAZARDOUS AND TOXIC SUBSTANCES

The following pages contain a complete list of pesticides currently permitted for use by Parks Canada. Comprehensive use information for these pesticides i.e., cautions, toxological information, first aid, labelling information, application etc. may be obtained from the Natural Resources Division of the National Parks Branch, Ottawa/Hull or from Agriculture Canada in Ottawa. For up to date information, review PRM 40-1.

PESTICIDES PERMITTED FOR USE IN NATIONAL PARKS

Common Name	Others Names	Code
I - INSECTICIDES		
a) Biting Insects: Pyrethrin mixed with stabilizing compounds	Riddex	PYR
- Malathion	Cythion	MAL
- Dishlarvos	Vapona	DVP
- Mineral Oil		MOI
b) Insects and worms in Golf Course Turf		
- Chlorpyrifos	Durban	DUB
c) Aphids on Flowers		
- Nicotine		NIA
d) Forest Insects		
- Dylox	Trichlorfon	TRI
e) Wasps, Ants, Roaches		
- Propoxur	Baygon, Raid	BAY
II - HERBICIDES		
a) General		
- 2.4D - Amines		DXB
- 2.4D - Butyl Esters		DXE
- 2.4D - Iso Octyl Esters		DXF
- Mecoprop	Compitox	MEC
- Paraquat	Gramoxone	PAQ
- Ammonium Sulfamate	Ammate	AMS
- Amminotriazole	Amitrole	AMI
b) Soil Sterilants		
- Atrazine		ATR
- Simazine		SMZ
- Aquatic Weeds		
- 2.4D	Aquakleen	DXG

III - FUNGICIDES

- Chloroneb	Tersoan SP	CNB
- Benomyl	Tersan 1991	BML
- Thiophanate-methyl	Easout	TPM
- Captan		CAP
- Methy Bromide		MBR

IV - RODENT CONTROL IN BUILDINGS

- Phoszzetim		GDP*
- Warfarim		WAR
- Fumarin	Coumafuryl	FUM
- Thiram	Aborgard	THI
- Zinc Phosphide		ZNP*

V - WOOD PRESERVATIVES

- Copper Naphthenate		CUN
- Zinc Naphthenate		ZNN*
- Cooper - 8 - quino - linoate		CUQ
- Creosote		CRT

* No Information Available

Excerpts from:

ENVIRONMENTAL CODE OF GOOD PRACTICE

FOR GENERAL CONSTRUCTION

Environmental Protection Service

Environment Canada

Regulations, Codes and Protocols

Report EPS 1-EC-80-1

Environmental Impact Control Directorate

March 1980

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3.1.4

Access road grades should not exceed 12%. Access roads located near river banks should not exceed grades of 5%.

3.1.5

A road or airstrip should be located to provide a buffer strip of at least 100 m (328') of undisturbed land between itself and any water body.

3.1.9 & 3.3.11

Transmission lines should follow existing transportation corridors where possible and should avoid open expanses of water and wetlands particularly those located within flight paths of migratory birds.

Wildlife concentrations and endangered species habitats should be avoided.

3.2.4

New borrow sites should blend with the natural land pattern as much as possible. High ground locations separated from streams or lakes by a buffer zone of at least 100 m (328') are desirable.

3.2.6

Wherever possible, borrow sites should be used for additional purposes; stormwater retension, recharge, sediment collection.

3.3.5

Whenever possible, clearing for roads and airstrips should be limited to the width required for roadbed, drainage, and user safety.

3.3.10

Vegetation and topsoil should not be removed to obtain fill for road construction within 30 m (100') of wetlands, lakes or major streambeds.

3.3.14

Where possible, organic debris and topsoil removed during grading operations should be stored for use during site restoration. Such stockpiles should be located away from water courses/bodies and should be covered with coarse material to minimize wind and water erosion.

3.3.15

Trees should be cut as flush to ground as possible. Where snow cover prevents this, a stump removal program should take place the following summer.

3.3.16

Where feasible, merchantable timber should be delimbed and stacked for pick up at a designated pre-cleared site.

3.4.1

Grubbing operations should only be carried out where required to ensure subgrade support for shallow road fills and to remove unsatisfactory materials from soil required for embankment construction.

3.4.3

Stumps within 2 m (6.5') of standing timber at the edge of an area to be cleared should be grubbed. This minimizes potential blowdown.

3.7.1

Cut and fill slopes should not exceed 33°.

3.9.3

Blasting within 400 m (1312') of a water body should not be permitted without specific approval in order to protect fish and mammal populations, spawning beds, overwintering areas, bank stability.

3.9.5

Millisecond delays should be used to decrease the vibration level from blasting. In addition, the number of holes per shot should be limited, using millisecond delays in series to minimize concussion and noise.

3.10.3

Prior to construction, an erosion and sediment control plan should be prepared by trained personnel, in consultation with appropriate agencies. The plan should include:

a) location of critical features such as streams, groundwater recharge zones, soil types, topography, water table and vegetation cover type;

b) areas where ground cover will be altered;

c) sites for borrow pits, material stock piles and spoil areas;

d) location of temporary and permanent stream crossings and areas where stream modifications such as straightening will be carried out;

e) location of erosion and sediment control structures, along with pertinent design information and a description of areas to be stabilized;

f) location of monitoring stations;

g) procedures for maintenance and sediment control structures including plans for the disposal of materials from such structures;

h) mapping of land drainage;

i) mapping of streams to indicate pattern and speed of channel migration.

From: Jain, Urban and Stacey, p. 320

"Major variables affecting erosion are soil composition or texture, degrees of slope, uninterrupted length of slope, nature and extent of vegetative cover, and intensity and frequency of exposure to the eroding forces. The interaction of these variables is complex, and difficult to measure directly. Magnitude of the impact is also directly dependent on the extent of the affected area.

Soil texture is determined by the percentage of its sand, silt, and clay components. Generally accepted textural classes in order of decreasing particle size (coarse to fine) are:

Sand	Silt loam	Silty clay loam
Loamy sand	Silt	Sandy clay
Sandy loam	Sandy clay loam	Silty clay
Loam	clay loam	clay

While such a statement is subject to contradiction on a specific site, finer textured soils are usually more susceptible to water erosion. Sandy soils and granulated clays are those most easily eroded by wind.

Erosion increases with the length and steepness of slope. A general rule is that if the length of slope is doubled, soil loss from erosion will increase by a factor of 1.5. The relationship between degree of slope (gradient)* and erosion potential can be specified in general terms as follows:

10 percent	highly erodible
2-10 percent =	moderately erodible
2 percent	slightly erodible

The erosion hazard depends upon the intensity and frequency of rain and wind storms. While the amount of yearly rainfall is important, of greater significance is the force with which it strikes the ground, volume in a given time, and return frequency of intense storms. The impact of wind varies with velocity, direction, and soil moisture content."

* Slope gradient is the relationship between the vertical height and the horizontal length of the slope.

3.10.4

Since compaction of fill is an important factor in erosion control, the upper '3m (1') of sloped surface should be compacted to 90% of maximum density at optimum moisture as identified.

3.10.5

To mitigate the effects of erosion on traversed sand dunes, cut slope and embankment surfaces should be capped with a silt-clay material approximately 2 cm (1") thick wherever possible. Where this is economically unfeasible, revegetation and mulching procedures should be investigated.

3.10.8

Slopes greater than approximately 33° should not be used because of vegetation and soil stability problems. Generally, slopes with a gradient less than 33° may be considered if soil is not highly erodible and there is adequate moisture holding capacity. However, for optimum stability, slopes having gradient below 25° are most desirable.

3.11.1

Impoundments and diversions should be used to control runnoff at the crossing site. They should allow the release of runoff at controlled rate, so as not to exceed the natural flow in the stream, and trap sediment.

3.12.1

Scour erosion prevention in roadway ditches

1) blanket ditch floors with stable free draining granular material

2) reduce ditch gradient by constructing series of properly spaced dike checks on ditch floor

3) divert runnoff out of ditch onto natural vegetation, using ditch blocks.

Where bridge/culvert construction is underway, no more than 1/3 of stream width should be blocked.

3.12.28

Pipeline/cable placed beneath river beds should be covered with backfill material similar to dredged material. Fill should not be taken from elsewhere in the streambed nor should it contain debris. Section above the low water mark on each side of the river should be completely backfilled and all underwater contours re-established.

Trenching in a Watercourse

3.13.2

When watercourse must be crossed by trenching, do so at right angles and at time of year when resident fish are not migrating. Crossings should be not planned within 450 m (1476') of river mouth, lake outlets or known spawning grounds.

3.13.4 (in part)

c) Excavations on land should terminate at least 15 m (49') from water crossings, leaving adequate plugs of undisturbed material at each bank. Plugs should be left in place until 1) excavation is completed, 2) absolutely necessary.

d) Stockpile dredging spoil on river banks within dyked areas to prevent sediment from washing back into river.

e) Pump particularly silty water from the trench into an upland area well back from river bank.

f) Use an impervious clay plug around pipe to avoid sluicing of blackfilled material; slope river banks to natural contours after pipe is installed using rip-rap if erosion is a problem; above rip-rap, terrace according to the natural gradient and soil wherever it is necessary to catch runoff and prevent sediment from entering watercourse.

Snow Road Construction

3.15.1

Snow clearing and snow road construction equipment should be tracked, gross weight should not exceed 11,000 kg (25,000 lbs.) and ground pressure should not exceed 55 kPa (8 psi).

3.15.2

Transport vehicles required for access to emergency snow sources outside pre-cleared rights-of-way should not exceed 28 kPa (4 Psi) pressure.

3.19.2

When selecting plant materials to stabilize soils on construction sites, the following criteria should be considered

a) high degree of resistance to heat, cold, insects and diseases

b) capacity for low, compact growth

c) potential for a rapidly proliferating root system

d) potential for nitrogen fixation by root system

e) low maintenance requirements

f) high drought resistance

g) responsiveness to fertilizers

h) successful local plant species

i) attractiveness to wildlife

4.2 Revegetation

4.2.3

Care should be taken not to disturb slope with maintenance equipment. When mowing vegetation, mowed area should not exceed 12-15' in width except at bends in the road. Mowing should not be permitted within 10 m (30') of streams, lakes, wetlands. Road grader should not be used for vegetation maintenance clearing.

4.3.5 Borrow Pit Maintenance

Topsoil from borrow pit should be stripped and stockpiled for later distribution on disturbed area.

Stock piles should be placed uphill to reduce or divert runoff. Borrow areas should be shaped, covered with topsoil and seeded. No slope should exceed 25°.

6. Permafrost Construction

6.3.1

Workcamp clearing should not be commenced until frost has penetrated active layer to minimum of 20 cm (8") and should be scheduled for completion by end of February: clearing halts when active layer thaws.

6.4.5 Construction Stipulations

a) sensitive slopes in excess of 10% should not be cleared

b) stream banks and approaches to streams should not be cleared

c) ice rich areas should not be cleared

d) only traffic directly related to clearing operations should be allowed to use access roads

e) terrain disturbances should not be allowed in environmentally sensitive areas.

6.4.8

Burning should not take place within 200 m (656') of a stream, river or lake unless sleds or rafts are used and contamination threat is minimal.

6.5.2

When ditching is needed in a permafrost area, (e.g. to eliminate ponding problem), the following guidelines should be used.

a) if soil materials are stable both during and after thaw, then ditching should be carried out in theconventional manner

b) if soil materials are unstable, then the use of narrow vertical sided ditches should be considered

c) because of the general susceptibility of permafrost materials to erosion when thawed or thawing, the gradient of any unnecessary ditches should be kept as flat as possible. Where a gradient is unavoidably steeper than that considered safe for the material in question, or where there is a likelihood of uncontrolled thermal and hydraulic erosion, then the ditch should be lined with emosion resistant material.

Excerpts From:

ENVIRONMENTAL DESIGN FOR NORTHERN ROAD DEVELOPMENTS

H.J. Brian Curran P. Eng.
and
H.M. Etter, PHD., P.A.G.

Environmental Protection Service
Northwest Region
Environment Canada,
March 1, 1976

Environmental Impact and Assessment
Report EPS-8-EC-76-3

Environmental Conservation Directorate
October 1976.

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1.2 Selecting a Right-of-Way

4.2.1 Design Stipulations for Clearing

Heavy equipment may be used for clearing and piling timber provided that blades are fitted with invert mushroom pods and are kept 15-20 cm (6-8') above ground surface to avoid scuffing the vegetation mat.

APPENDIX

A. CULTURE AND MANAGEMENT FOR ESTABLISHING GRASSES

1. Soils

The upper 31 centimetres (12 inches) of soil should consist of a loamy material and be able to hold at least 1.9 centimetres (0.75 inches) of water to permit the establishment of good vegetative cover. The soil must be porous enough to allow root penetration, and tillable for good seedbed preparation. In areas where good turf is desired, it may be necessary to replace the soil material. At least 10 centimetres (4 inches) of loamy material should be available as topsoil before seeding.

2. Seedbed Preparations

Proper seedbed preparation is an important factor in establishing a good stand of grass. In many areas incorporation of dead vegetation and organic matter by intensive cultivation is necessary in order to get a satisfactory seedbed. After tilling and packing, the seedbed should be firm; a heel imprint should barely show after walking over the ground. The soil should be weed-free and moist. When the seedbed is well prepared, the amount of seed needed will be less and the success of the planting will be greater. On steep sloping land or construction sites where tillage implements cannot be used, the soil should remain in a rough condition. Slopes should be prepared as well as possible and roughened with construction equipment so the broadcast seed will have a chance to remain in place long enough to germinate and produce a stand.

3. Seed Specifications

Certified seed should be used whenever it is available. Germination and purity tests should be used to determine the proper seeding rates for each grass or legume variety. Legumes should be scarified if necessary and inoculated with the proper strain of nitrogen-fixing bacteria before seeding. Use only northern strains of grasses and legumes.

4. Time of Seeding

For the best results seedings should be made in early June. Successful seedings can be made later in the summer but grass and legumes should not be seeded later than mid August to avoid winterkill. Annual ryegrass or cereal grain can be seeded until September 1 to secure a temporary cover to reduce erosion. The area should then be seeded to a perennial grass the next spring.

5. Seeding Methods

a) Drill

A grass drill is the best method of seeding on nearly level to sloping land, but the preferred method will depend on slope, and conditions of the planning site. Very small seed must be seeded no more than 0.6 to 1.3 centimetres (0.25 to 0.50 inches) deep. A packer should be pulled behind the drill unless the equipment already has a packer combination. On steep slopes where drilling is not feasible, the hydroseeder method is preferred. When applying seed, fertilizer or mulch materials with the hydroseeder, use not more than 45.3-68.0 kilograms (100-150 pounds) of solids per 378.5 litres (100 gallons) of water. It is best to apply seed or seed and fertilizer first, to ensure seed contact with the soil, followed by the mulch. Fertilizer can be added to the water slurry as long as the material is used within a few hours after mixing, preferably when the soil is already moist.

b) Hydroseeding

Hydroseeder Operation 3,785 litre (1,000 gallon) tank

1.	Seeding -	0.8 hectares (2 acres)
	Seed:	18.1-45.3 kilograms (40-100 pounds)
	Fertilizer:	800-1, 90.6 kilograms (200 pounds)
	Water:	3,785 litres (1,000 gallons)
2.	Mulching -	0.2 hectares (0.5 acres)
	Fiber mulch:	226.5-271.8 kilograms (500-600 pounds)
	Water:	3,785 litres (1,000 gallons)

If necessary to seed, fertilize, and mulch in one operation, each 3,785 (1,000 gallon) load should cover 0.13 hectares (0.33 acres) and the mixture for each load would be as follows:

Seed:	3.2-7.7 kilograms (7-17 pounds)
Mulch:	15.0-181.2 kilograms (33-400 pounds)
Fertilizer:	61.2-90.6 kilograms (135-200 pounds)
Water:	3,785 litres (1,000 gallons)

<u>CAUTION</u>: Add seed and fertilizer first and mix thoroughly in tank at least 1/3 full of water before adding mulch.

c) Broadcast

If the broadcast method of seeding is used, rates of seed application should be twice that recommended for drilling

d) Sprigging

Sprigging (planting a shoot, root or sprout of a plant) and sodding (covering with sections of sod) are special methods which are costly, but necessary for some grasses. Sodding and sprigging may be preferable to seeding in critical situations.

6. Fertilization

Fertilization is important to ensure a good growth of grass. Grass should be fertilized each year for best results.

The general recommendations for fertilizer are 27.2 kilograms (60 pounds) N (nitrogen) - 27.2 kilograms (60 pounds) P_2O_5 (phosphate) - 27.2 kilograms (60 pounds) K_2O (potash) per 0.41 hectares (1 acre) the first year and a maintenance application of 30-60-30 each ensuing year on construction sites. Where soil testing service is available fertilizer application should be based on soil tests. Some possible combinations of commercially available fertilizers to obtain the indicated amounts of N, P, and K are:

60-60-60-	135.9 kilograms (300 pounds) of 10-20-20 plus 45.3 kilograms (100 pounds) of 33-0-0 or 135.9 kilograms (300 pounds) of 10-20-10 plus 45.3 kilograms (100 pounds) of 33-0-0 plus 22.7 kilograms (50 pounds) of 0-0-60
120-60-60	135.9 kilograms (300 pounds) of 10-20-20 plus 135.9 kilograms (300 pounds) of 33-0-0 or 135.9 kilograms (300 pounds) of 10-20-10 plus 135.9 kilograms (300 pounds) of 33-0-0 plus 22.7 kilograms (50 pounds) of 0-0-60
30-60-30	135.9 kilograms (300 pounds) of 10-20-10

Any other combinations are possible. For best results, at least one-half of the nitrogen added should be in the form of nitrate. Urea is not generally recommended because of its slow release of nitrogen in northern soils.

7. Maintenance

Grass seedings must be kept moist after seeding and until the grass has reached a height of 3-6 centimetres (1-2 inches). If possible, supplement water should be supplied especially during prolonged periods of drought while grass is becoming established. Critical sites may need watering, some reseeding or sodding, and maintenance applications of mulch and fertilizer.

8. Mulching

Mulching is important in establishing vegetation on steep construction sites or other critical areas. A mulch cover will help hold moisture, protect the soil from erosion, hold seed in place and keep soil temperatures more constant. It should be applied uniformly by mechanical means or by hand after seeding. Common types of mulching material used in critical-area plantings are hay, small grain straw, straw-asphalt, wood-fiber mulches, peat moss, and jute matting. Grass seed straw, or native bluejoint hay, cut when seed is about mature, often contains viable seed and is excellent for mulching. Some bare soil should still be visible through a straw mulch. Mulching is necessary on steep and critical areas, but is expensive and not always necessary to establish grass stands on favorable sites. Very early spring applications may retard the rate at which soils warm up.

On north-facing slopes a dark colored binder with a mulch will increase the surface temperature and promote early growth. Care must be taken in applying a binder simultaneously with mulch and seed to ensure that there is contact between the seed and the soil. Seeds coated with binder may be slow to germinate or may fail completely.

Methods of anchoring mulch are important. They include pressing the mulch into the soil with a mulch anchoring tool, tacking with various binders, and tying down with cotton netting or wire mesh.

9. Annual Seedings

Annual ryegrass (*Lolium multiflorum*) is recommended for a quick catch on burned or critical areas for erosion control. Seedings at rates of 11.1-27.9 kilograms per hectare (10-25 pounds per acre) or more for thick growth should be made before August 1 for best results. Plan on seeding to perennial species the following spring. Annual ryegrass is also recommended for seeding with a perennial grass mixture to control erosion until the perennial grass becomes established.

10. Native Seeds

Native bluejoint (*Calamagrostis canadensis*) and fall arcticgrass (*Arctagrostis latifolia*) have been found to be excellent colonizers of disturbed areas of the northern forest and tundra although they are not as fast growing as some of the hardier agronomic grasses. Unfortunately seed for these grasses is in limited supply and may not yet be available in commercial quantities.

2. Culvert Design

The ideal river crossing will attempt to minimize interference with natural river conditions. The much preferred solution from the environmental view involves bridging each stream. However, there are many situations in which both economics and terrain may dictate that a culvert crossing is more realistic than a bridge.

2.1 Culvert Shapes

The following culvert shapes are listed in order of preference to Fisheries and Marine Service.

i) Arch Culvert. This type of culvert may have either an open or a closed bottom. The open bottom type allows for natural riverbed material to be retained. The use of this type of culvert is dependent on suitable foundation conditions and depth of fill.

ii) Horizontal Ellipse. By lowering the culvert invert below the stream bed elevation it is possible to take advantage of the wide middle portion of this culvert for maintaining stream flow width and at the same time maintain natural river bed material in the culvert. Small barrier dams placed on the culvert bottom will provide some protection against the material washing out.

iii) Circular. This is the most familiar culvert shape. It is very impractical for fish passage, however, due to the circular geometry. As river flows decrease, the flow area within the culvert also decreases and the high velocities are retained.

The following conditions all contribute to good culvert design. All of these condtions, where applicable, should be detailed on drawings and plans submitted for Fisheries and Marine Service approval or comments.

2.2 Installation and Gradient

Culvert inverts must be laid a minimum of 15 centimetres (6 inches) below normal stream bed elevation. When foundation conditions are such that a sagging of the central portion of the culvert is anticipated, the central portion should be installed with an upward camber design. Anticipated sag will then tend to reform the culvert to a constant gradient. Sag in a non-cambered culvert can impose a passage problem for fish due to the increased culvert gradient on the upstream side of the sag.

Inverts must be designed to prevent hydrostatic uplift at the downstream or upstream end.

The culvert gradient is to be kept as close to 0% gradient as foundations and stream conditions permit, with the condition that upstream velocity barriers are not formed as a result. The maximum culvert slope that should be installed when employing a baffle configuration is 5%. Beyond the 5% slope, baffle effectiveness is inversely proportional to any increase in slope (Engel, 1974).

If construction procedures permit, the bolt connections should be installed with the bolt head on the culvert interior. This will help prevent fish being damaged on the sharp, nut and bolt end.

2.3 Capacity

The culvert should have sufficient capacity to pass the design flood (generally a 1 in 50 year flood) with no back-watering or ponding at the upstream end of the culvert. There should also be a freeboard allowance for passage of debris.

When water flow enters or leaves a culvert, it generally undergoes an abrupt and localized change in water surface elevation. An abrupt reduction of water levels causes an abrupt increase in water velocities which can form a localized velocity barrier to upstream fish movement. The maximum "draw down" through any section of the culvert should not exceed 0.3 metres (1 foot).

2.5 Erosion Prevention

The stream bed at the downstream end of the culvert may require armouring with heavy rip rap material to prevent bed scour. This should extend at least 2 pipe diameters past the culvert outlet. A suggested method of treatment would involve a 0.6 metre (2 foot) thick rip rap blanket placed on top of a 0.3 metre (1 foot) thick graded gravel blanket. If bed scour cannot be controlled by armouring of the stream bed, then artificial controls such as downstream rock weirs or gabions may be used. Such controls must, however, allow for fish passage. Both the upstream and downstream faces of the roadway should be resistant to erosion through turbulence and back eddies. The upstream end treatment must allow for floating debris.

8.3 Subsurface Disposal (Septic tank with tile field, leach pits)

The leachate that percolates from the sub-surface system through the soil must not contaminate groundwater which may have value as a public or private water supply. The disposal system must also be constructed in such a manner that odour problems do not occur. Although the ground surface over the system should not be used as a thoroughfare, it should be able to support pedestrian traffic but clearly delineated so that heavy vechicles are not inadvertently driven on top.

The minimum recommendation distances of subsurface disposal facilities from sources of water supply and natural water bodies are as follows:

a) Water tight septic tanks or pumpout tasks:

3.0 metres (10 feet) from any cistern,
7.6 metres (25 feet) from any well.

b) Leach pits:

15.2 metres (50 feet) from any dwelling having a subsurface foundation
15.2 metres (50 feet) from any cistern.
45.7 metres (150 feet) from any well, spring or watercourse.

c) Weeping tile fields:

30.5 metres(100 feet) from any well,
45.7 metres(100 feet) from any spring or watercourse.

The required separation between a particlar subsurface disposal system and a water supply or watercourse will depend upon soil characteristics, sewage flow, direction of drainage etc.

Since leaching and percolation are not possible in permafrost soil, this method of treatment shall not be used in camps that are operated throughout winter where such soil conditions are present.

8.4 Holding Tanks

All holding tanks should be adequately vented and, if not located in a heated enclosure, insulated to prevent sewage freezing on the wall of tank. The tanks should have sufficient capacity to contain sewage flow over two days. Consideration should be given to using minimum flush toilets in conjunction with holding tanks to reduce water consumption and tank size.

11.2 Sanitary Landfill

The two common methods of operation of a sanitary landfill are the trench and area fill. The objectives of both methods are identical; to compact refuse thoroughly and cover it promptly and completely.

The area fill method (or progressive slope or ramp) is used for low elevation sites such as quarries, pits, ravines and canyons.

The following operating techniques for area fill are recommended:

1. Deposit refuse at bottom of slope for best compaction and control of blowing litter.

2. Spread and compact refuse against slope of previous lift, progressing horizontally along slope.

3. Cover with earth excavated from adjacent area or from off-site borrow area and compact. The thickness of the compacted layer should be at least 16 centimetres (6 inches).

4. A uniform layer of suitable cover material compacted to a minimum depth of 0.6 metres (2 feet) should be placed over the entire surface of each portion of the final lift, not later than one week following the placement of refuse within that portion.

The trench method is adapted to flat terrain. The following operation techniques for the trench method are recommended:

1. Excavate the trenches to a maximum depth of 2.4 metres (8 feet). This will result in a more economical use of the area for landfill operation. Trenches should be excavated on the windward edge of the site and perpendicular to the prevailing wind direction to minimize the scattering of paper. The width of the trench should be about two times the width of a crawler tractor to allow for maximum compaction. Trenches should be parallel to each other and cover material should be obtained either from excavation of the trench or from the adjacent trench which will be filled next.

2. Dump the refuse, preferably at the bottom of the trench, and spread and compact in layers. Cover layers with at least 15 centimetres (6 inches) of compacted earth.

3. A uniform layer of suitable cover material compacted to a minimum depth of 0.6 metres (2 feet) should be placed over the entire surface of each portion of the final lift, not later than one week following the placement of refuse within that portion.

   In both methods of operation it may be impossible to cover refuse during the winter when soil cannot reasonably be obtained. During this time, adequate controls must be maintained to prevent refuse from blowing about the site. Snow fences around trenches or around the working faces, if area fill is used, should considerably reduce blowing litter. Immediately after the soil has thawed and covering is possible, the whole area should be cleaned up and the required soil cover put in place.

   Except during the winter, all putrescent refuse should be covered and compacted, as directed in the manner above, the same day that the refuse is hauled to the landfill site. In order to reduce cover operations, a separate area of the site may be set aside for the deposition of inert refuse, such as wood, metal, abandoned vehicles and equipment, etc. Coverage of such refuse would only be required once a year.

11.3 Incineration

All incinerating equipment should:

1. be approved by the appropriate government agency for adherence to atmospheric emission objectives,

2. comply with all safety regulations,

3. be housed or enclosed in a manner so that it can be operated during all inclement weather,

4. be capable of operating on a 24-hour basis,

5. produce an ash which contains little or no in cineratable material,

6. be operated by designated responsible, properly trained personnel.

The incinerated residue may be buried in a suitable location which is above the water table and covered over with at least 0.6 metres (2 feet) of soil.

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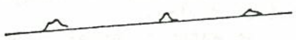
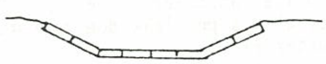
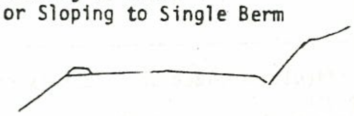
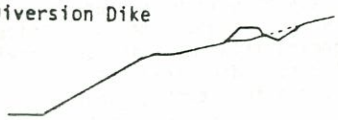
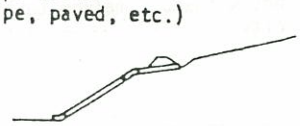
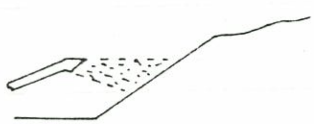
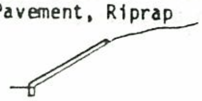
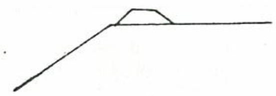
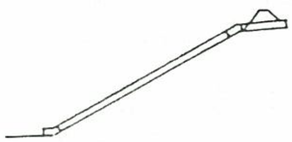
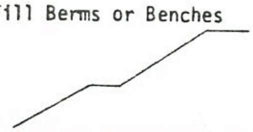
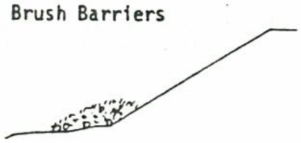
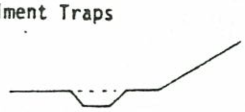
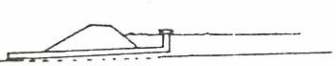
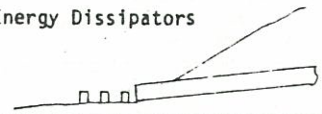
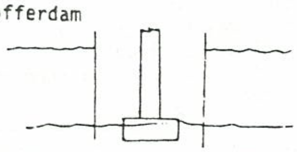
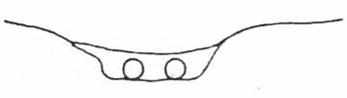
EROSION CONTROL PRACTICES

Treatment Practice	Advantages	Problems
ROADWAY DITCHES		
Check Dams 	Maintain low velocities Catch sediment Can be constructed of logs, shot rock, lumber, masonry or concrete	Close spacing on steep grades Require clean-out Unless keyed at sides and bottom, erosion may occur
Sediment Traps/ Straw Bale Filters 	Can be located as necessary to collect sediment during construction Clean-out often can be done with on-the-job equipment Simple to construct	Little direction on spacing and size Sediment disposal may be difficult Specification must include provisions for periodic clean-out May require seeding, sodding or pavement when removed during final cleanup
Sodding 	Easy to place with a minimum of preparation Can be repaired during construction Immediate protection May be used on sides of paved ditches to provide increased capacity	Requires water during first few weeks Sod not always available Will not withstand high velocity or severe abrasion from sediment load
Seeding with Mulch and Matting 	Usually least expensive Effective for ditches with low velocity Easily placed in small quantities with inexperienced personnel	Will not withstand medium to high velocity
Paving, Riprap, Rubble	Effective for high velocities May be part of the permanent erosion control effort	Cannot always be placed when needed because of construction traffic and final grading and dressing Initial cost is high
ROADWAY SURFACE		
Crowning to Ditch or Sloping to Single Berm 	Directing the surface water to a prepared or protected ditch minimizes erosion	None - should be part of good construction procedures
Compaction	The final lift of each day's work should be well compacted and bladed to drain to ditch or berm section. Loose or uncompacted material is more subject to erosion	None - should be part of good construction procedures
Aggregate Cover 	Minimizes surface erosion Permits construction traffic during adverse weather May be used as part of permanent base construction	Requires reworking and compaction if exposed for long periods of time Loss of surface aggregates can be anticipated
Seed/Mulch	Minimizes surface erosion	Must be removed or is lost when construction of pavement is commenced

U.S.A. Highway Research Board. National Cooperative Highway Research Program Synthesis of Highway Practice 18. Erosion Control On Highway Construction. 1973.

Treatment Practice	Advantages	Problems
CUT SLOPES		
Berm @ top of cut 	Diverts water from cut Collects water for slope drains/paved ditches May be constructed before grading is started	Access to top of cut Difficult to build on steep natural slope or rock surface Concentrates water and may require channel protection or energy dissipation devices Can cause water to enter ground, resulting in sloughing of the cut slope
Diversion Dike 	Collects and diverts water at a location selected to reduce erosion potential May be incorporated in the permanent project drainage	Access for construction May be continuing maintenance problem if not paved or protected Disturbed material or berm is easily eroded
Slope Benches 	Slows velocity of surface runoff Collects sediment Provides access to slope for seeding, mulching, and maintenance Collects water for slope drains or may divert water to natural ground	May cause sloughing of slopes if water infiltrates Requires additional ROW Not always possible due to rotten material etc. Requires maintenance to be effective Increases excavation quantities
Slope Drains (pipe, paved, etc.) 	Prevents erosion on the slope Can be temporary or part of permanent construction Can be constructed or extended as grading progresses	Requires supporting effort to collect water Permanent construction is not always compatible with other project work Usually requires some type of energy dissipation
Seeding/Mulching 	The end objective is to have a completely grassed slope. Early placement is a step in this direction. The mulch provides temporary erosion protection until grass is rooted. Temporary or permanent seeding may be used. Mulch should be anchored. Larger slopes can be seeded and mulched with smaller equipment if stage techniques are used.	Difficult to schedule high production units for small increments Time of year may be less desirable May require supplemental water Contractor may perform this operation with untrained or unexperienced personnel and inadequate equipment if stage seeding is required
Sodding 	Provides immediate protection Can be used to protect adjacent property from sediment and turbidity	Difficult to place until cut is complete Sod not always available May be expensive
Slope Pavement, Riprap 	Provides immediate protection for high risk areas and under structures May be cast in place or off site	Expensive Difficult to place on high slopes May be difficult to maintain
Temporary Cover	Plastics are available in wide rolls and large sheets that may be used to provide temporary protection for cut or fill slopes Easy to place and remove Useful to protect high risk areas from temporary erosion	Provides only temporary protection Original surface usually requires additional treatment when plastic is removed Must be anchored to prevent wind damage
Serrated Slope 	Lowers velocity of surface runoff Collects sediment Holds moisture Minimizes amount of sediment reaching roadside ditch	May cause minor sloughing if water infiltrates Construction compliance

Treatment Practice	Advantages	Problems
FILL SLOPES		
Berms at Top of Embankment 	Prevent runoff from embankment surface from flowing over face of fill Collect runoff for slope drains or protected ditch Can be placed as a part of the normal construction operation and incorporated into fill or shoulders	Cooperation of construction operators to place final lifts at edge for shaping into berm Failure to compact outside lift when work is resumed Sediment buildup and berm failure
Slope Drains 	Prevent fill slope erosion caused by embankment surface runoff Can be constructed of full or half section pipe, bituminous, metal, concrete, plastic, or other waterproof material Can be extended as construction progresses May be either temporary or permanent	Permanent construction as needed may not be considered desirable by contractor Removal of temporary drains may disturb growing vegetation Energy dissipation devices are required at the outlets
Fill Berms or Benches 	Slows velocity of slope runoff Collects sediment Provides access for maintenance Collects water for slope drains May utilize waste	Requires additional fill material if waste is not available May cause sloughing Additional ROW may be needed
Seeding/Mulching	Timely application of mulch and seeding decreases the period a slope is subject to severe erosion Mulch that is cut in or otherwise anchored will collect sediment. The furrows made will also hold water and sediment	Seeding season may not be favorable Not 100 percent effective in preventing erision Watering may be necessary Steep slopes or locations with low velocities may require supplemental treatment
PROTECTION OF ADJACENT PROPERTY		
Brush Barriers 	Use slashing and logs from clearing operation Can be covered and seeded rather than removed Eliminates need for burning or disposal off ROW	May be considered unsightly in urban areas
Straw Bale Barriers 	Straw is readily available in many areas When properly installed, they filter sediment and some turbidity from runoff	Require removal Subject to vandal damage Flow is slow through straw requiring considerable area
Sediment Traps 	Collect much of the sediment spill from fill slopes and storm drain ditches Inexpensive Can be cleaned and expanded to meet need	Do not eliminate all sediment and turbidity Space is not always available Must be removed (usually)
Sediment Pools 	Can be designed to handle large volumes of flow Both sediment and turbidity are removed May be incorporated into permanent erosion control plan	Require prior planning, additional ROW and/or flow easement If removal is necessary, can present a major effort during final construction stage Clean-out volumes can be large Access for clean-out not always convenient

Treatment Practice	Advantages	Problems
PROTECTION OF ADJACENT PROPERTY (continued)		
Energy Dissipators 	Slow velocity to permit sediment collection and to minimize channel erosion off project	Collect debris and require cleaning Require special design and construction of large shot rock or other suitable material from project
Level Spreaders 	Convert collected channel or pipe flow back to sheet flow Avoid channel easements and construction off project Simple to construct	Adequate spreader length may not be available Sodding of overflow berm is usually required Must be a part of the permanent erosion control effort Maintenance forces must maintain spreader until no longer required
PROTECTION OF STREAM		
Construction Dike 	Permits work to continue during normal stream stages Controlled flooding can be accomplished during periods of inactivity	Usually requires pumping of work site water into sediment pond Subject to erosion from stream and from direct rainfall on dike
Cofferdam 	Work can be continued during most anticipated stream conditions Clear water can be pumped directly back into stream No material deposited in stream	Expensive
Temporary Stream Channel Change	Prepared channel keeps normal flows away from construction	New channel usually will require protection Stream must be returned to old channel and temporary channel refilled
Riprap	Sacked sand with cement or stone easy to stockpile and place Can be installed in increments as needed	Expensive
Temporary Culverts for Haul Roads 	Eliminate stream turbulence and turbidity Provide unobstructed passage for fish and other water life Capacity for normal flow can be provided with storm water flowing over the roadway	Space not always available without conflicting with permanent structure work May be expensive, especially for larger sizes of pipe Subject to washout
Rock-lined Low-Level Crossing 	Minimizes stream turbidity Inexpensive May also serve as ditch check or sediment trap	May not be fordable during rainstorms During periods of low flow passage of fish may be blocked

Treatment Practice	Advantages	Problems
BORROW AREAS		
Selective Grading and Shaping	Water can be directed to minimize off-site damage Flatter slopes enable mulch to be cut into soil	May not be most economical work method for contractor
Stripping and Replacing of Topsoil	Provides better seed bed Conventional equipment can be used to stockpile and spread topsoil	May restrict volume of material that can be obtained for a site Topsoil stockpiles must be located to minimize sediment damage Cost of rehandling material
Dikes, Berms Diversion Ditches Settling Basins Sediment Traps Seeding & Mulch	See other practices	See other practices

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Departmental Library
Department of the Environment
Ottawa, Ontario
K1A 1C7
Telephone: (819) 997-1767

National Parks Documentation Centre
Parks Canada
Ottawa, Ontario
K1A 1G2
Telephone: (819) 994-2844

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