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**PROVINCE OF BRITISH COLUMBIA
MINISTRY OF ENVIROMENT
AND PARKS
WATER MANAGEMENT BRANCH**

**MUD BAY DYKING DISTRICT
SERPENTINE AND NICOMEKL RIVERS
FLOOD CONTROL WORKS
OPERATION AND MAINTENANCE MANUAL**

**Victoria, British Columbia
September, 1987
File Nos. P83-7 and P84-3**

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RECORD OF AMENDMENTS

<u>AMENDMENT DATE</u>	<u>DESCRIPTION</u>
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MUD BAY DYKING DISTRICT
NICOMEKL AND SERPENTINE RIVERS FLOOD CONTROL WORKS
OPERATION AND MAINTENANCE MANUAL

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<u>Drawing No.</u>	Prov. 105 mm <u>Neg. No.</u>	<u>Title</u>
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5452-10-1 ✓	280275	Key Plan, Site Plan, Index to Drawings
5452-10-9 ✓	280276	Type A,B,C,D Cross Sections
5452-10-2 ✓	280277	Miscellaneous Details
<u>1984-1985 Flood Control Program</u> Colebrook, Mud Bay Dyking Districts - Contract No. 1 - Serpentine River		
84-6-1 ✓	280278	Key Plan, Site Plan, Index to Drawings
84-6-13 ✓	280279	Typical Dyke Cross Sections
84-6-14 ✓	280280	Type G Cross Sections and Standard Details
84-6-15 ✓	280281	Standard Details and Floodbox Replacement on Nicomekl River
<u>Elevation Survey of Top of Dyke, 1986</u>		
BG-1986-D-01 ✓	280282	- courtesy of Mud Bay Dyking District

**MUD BAY DYKING DISTRICT
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A. GENERAL

MUD BAY DYKING DISTRICT
SERPENTINE AND NICOMEKL RIVERS FLOOD CONTROL WORKS
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1. INTRODUCTION

1.1 Background

Under the terms of an Agreement dated April 28, 1983 between the Mud Bay Dyking District and the B.C. Ministry of Environment and Parks, construction of flood control works on the Serpentine and Nicomekl Rivers were undertaken during 1983-85. Costs of the construction program were paid by the Province of British Columbia under the 1983-84 and 1984-85 Flood Control Programs. The Mud Bay Dyking District (hereinafter known as the Local Authority) accepted responsibility for maintenance under the terms of the Agreement.

1.2 Purpose

The purpose of this manual is to provide general instructions, methods, techniques and data pertinent to the operation and maintenance of the Serpentine and Nicomekl Rivers flood control works.

1.3 Description of Works

The work carried out under the 1983-85 flood protection programs included upgrading of the dykes along the Serpentine and Nicomekl Rivers.

The subject dykes which are located along the south bank of the Nikomekl River and the north bank of the Serpentine River just upstream of Mud Bay, protect the low lying farmland against flooding during high tides.

On the downstream end both dykes connect to the Burlington Northern Railway embankment which protects the land between the two dykes against flooding from Mud Bay.

The upstream end of the dykes terminate at the river dams. The dams contain flood gates which open during low tides to allow discharge of the river water downstream and close on the rising tide to protect the low lying land above the dams against flooding by the tidal water.

Under the 1983-85 programs the existing dykes were upgraded to improve flood protection and reduce maintenance costs. In general the height of the dykes was increased and brought to the uniform minimum elevation, the crest of the dyke was widened and capped with gravel to provide a good driving surface for inspection and emergency vehicles. The dykes were widened at the base to improve their stability, new rock bank protection was installed on the river side, and the trees and brush were cleared from the land side of the dyke.

The improvements were made to:

1. Approximately 4.8 km of dyke along the north bank of the Nicomekl River between Elgin Road and the Burlington Northern Railway trestle at Mud Bay.
2. Approximately 3.8 km of dyke along the south bank of the Serpentine River between Highway No. 99A and the Burlington Northern Railway.

1.4 Stream Behaviour and Historical Records

The Serpentine and Nicomekl Rivers water levels are governed by the tide in Mud Bay. The height of the tide in Mud Bay can be estimated using the Tide and Current Tables published for each year by the Federal Government of Canada, Fisheries and Oceans.

For Mud Bay the tide levels predicted for Point Atkinson in conjunction with corrections listed for Crescent Beach in the Tide and Current Tables can be used to estimate the height and time of the tide.

It should be noted that the actual tide levels may vary significantly from the predicted values due to weather conditions. The wind and resulting waves; and low barometric pressure may substantially increase the tide levels. Different climatic conditions at Point Atkinson and Mud Bay may not necessarily produce coincidental extreme tides and waves at both locations.

The height and timing of the extreme tides vary slightly during each year. Record high tides as measured at Point Atkinson and as estimated for Crescent Beach (using the conversion in the 1987 Tide Tables) are listed below.

<u>Date</u>	<u>Point Atkinson Tide (m)</u>	<u>Estimated Crescent Beach Tide Elevation</u>	
		<u>Tide Datum (m)</u>	<u>Geodetic Datum (m)</u>
Dec. 16, 1982	5.61	5.06	2.06
Jan. 3, 1987	5.55	5.00	2.00

1.5 Dyke Right-of-Way

In general the dykes are located on private land and are maintained by the Local Authority. Prior to the construction of the dyke improvements carried out under this program the Local Authority submitted to the Ministry a written authorization to enter the private property and carry out the work.

2. GENERAL INSTRUCTIONS

2.1 Maintenance Requirements

Regular inspection and maintenance of flood control works is necessary to maintain the integrity of the system.

2.1.1 The responsibility for routine dyke maintenance rests with the Mud Bay Dyking District. Provincial legislative authority relative to the construction and maintenance of dykes is covered under the "Dykes Maintenance Act", a consolidated version of which is attached in Appendix A. A list of agencies concerned with the dyke is attached in Appendix B.

2.1.2 Maintenance requirements are detailed in subsequent sections and generally comprise the following:

- a. inspection of all works on a regular basis and particularly prior to and during the winter and mid-summer high tide periods and during the summer low tides;
- b. removal of trees and brush as growth occurs, and mowing grass as required;
- c. excavation and backfill of all animal holes;
- d. repair of sod, cobblestone and rock rip-rap bank protection along the water face of dyke;
- e. repair of dyke slopes damaged by sloughing, vehicles, cattle and wind or rain erosion;
- f. reseeding of slopes as required;
- g. inspection, cleaning and repair of drainage ditches, floodboxes and/or pumps constructed to remove seepage water and internal drainage;
- h. restoration of the dyke crest to grade to compensate for settlement by adding fill as required, and regrading to a reasonably smooth driving surface;
- i. checking and repairing fences and gates;
- j. repairing culverts, headwalls, flap gates, etc.;
- k. removal of debris and garbage;
- l. inspection of new structures constructed in the vicinity of the dyke to verify that the standard of flood protection has not been reduced.

2.1.3 Maintenance includes the control of development and construction on, through or in the vicinity of flood control works, to ensure that the standard of protection is maintained.

2.1.4 All work in and about streams is subject to regulatory controls. In addition to local bylaws, maintenance may be subject to Approval under the Water Act. Further information may be obtained from the Regional Water Manager, Water Management Branch. Also, work affecting wildlife and fisheries habitat and/or water quality is subject to regulation under the Fisheries Act as administered by the Fish and Wildlife Branch, B.C. Ministry of Environment and Parks; and Fisheries and Oceans Canada. (Addresses of pertinent agencies are included in Appendix B.)

2.2 Local Authority Controls

Warning signs should be posted at all gates to inform the public of dangers and restrict vehicular access. All gates should be locked with keys released to authorized personnel only.

Livestock should not be allowed access to the dykes.

The Local Authority in conjunction with the Municipality should ensure that development or construction on, through or in the vicinity of the flood control works does not reduce the provided standard of flood protection nor impede ready access for patrolling, inspection and/or maintenance.

2.2.1 Excavation adjacent to and very close to the dykes, bank protection and other flood protection structures should be discouraged. Where excavation is unavoidable, expert advice should be obtained to ensure that the excavation is compatible with stability of the flood control works.

2.2.2 Where pipes, cables or other works must pass through the dyke, the correct use of seepage collars and compacted backfill materials is recommended. Rupture resistant pipe, with mechanical or equivalent joints which will not separate under settlement, shall be used where pipe is laid within the design dyke section. Soils removed should be replaced by a material of equivalent flood resistant quality, in a manner that will not reduce the standard of protection.

2.2.3 Trees, shrubs and buildings shall not be allowed to encroach on the dyke.

2.2.4 Access to the dyke crest, slopes and adjacent bank protection shall be maintained to permit inspection and repairs of the dyke, bank protection, and adjacent flood control works. The access road should be all weather and not subject to internal flooding.

2.2.5 Any work or works proposed on or in the immediate vicinity of flood control works comprising the dykes, bank protection, structures or internal drainage works, should be reviewed by the Local Authority, the Inspector of Dykes, and other affected regulatory agencies before work is approved to proceed.

2.2.6 Local bylaws and regulations may be required to regulate work on, through or in the vicinity of flood protection works and to ensure that future development is in accordance with accepted floodplain management practice. Advice on this aspect can be obtained from B.C. Ministry of Environment and Parks, Water Management Branch.

2.2.7 Where work or a new structure is proposed on or adjacent to flood control works and the stability of the works under the new conditions is suspect, an engineering evaluation should be made before the proposed work is approved.

2.3 Emergency Response Planning

Contingency plans and response procedures should be developed to cope with possible emergency conditions.

2.4 Inspections and Patrols

Arrangements should be made for routine inspections of the flood control works by staff of the local authority. Additional patrols shall be carried out during and after high tide periods.

2.5 Technical Advice and Assistance

Technical advice and assistance may be obtained through the Inspector of Dykes, B.C. Ministry of Environment and Parks, and other agencies listed in Appendix B.

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B. OPERATION AND MAINTENANCE

3. DYKE

3.1 Basis of Dyke Design

The dyke has been improved to comply with the standards for agricultural dykes approved by the Ministry of Environment and Parks. Under this standard the dyke has been constructed to:

- a. Crest elevation - 3.00 metres geodetic
- b. Crest width - 3.60 metres
- c. 100 mm gravel on crest to provide access for patrolling and/or maintenance along the entire length of dyke
- d. Side slopes - 2:1
- e. Bank protection designed for expected current and waves.

3.1.1 Dyke design crest elevations are provided in metres above sea level, related to the Geodetic Survey of Canada Datum B.M. No. CM5630, located at the left side of Highway No. 99A over Highway 99 overpass set at elevation 8.54 metres GSC.

3.2 Seepage

Seepage at the landside toe along the length of dyke is to be expected at higher tide levels. This seepage is considered to be normal, provided flows are not concentrated in the form of boils, and provided that flow does not carry material. Close attention should be paid to seepage, as the safety of the dyke could be threatened by an unnatural increase or concentration of seepage flows.

3.2.1 Special attention should be paid to the landside toe of the dyke. This area should be cropped or mowed prior to high tide seasons so that it can be properly inspected for boils and seepage that could cause piping or slumping.

3.3 Maintenance of Dyke

3.3.1 Routine inspections and work should be undertaken to ensure that the dyke slopes are kept clear of tall weeds and brush on both water and land sides to facilitate inspection. Grass growth on dyke slopes should be preserved to prevent surface erosion.

3.3.2 The growth of trees or shrubs within the dyke should not be allowed since the roots encourage the development of 'pipes', through which flows may develop with sufficient velocity to carry soil particles, and possibly threaten the dyke with a piping failure. Furthermore, trees that are uprooted may reduce the dyke cross section, thus reducing the degree of protection.

3.3.3 The river side dyke slope should be examined for soil slips and instability which could be caused by the rapid drawdown of river levels or other conditions and for possible damage to bank protection (Section 4).

3.3.4 The dyke landside slope should be inspected for cracking and slumping, which could be caused by seepage during sustained high tide periods.

3.3.5 The dyke slopes should be periodically cleared of all debris and garbage.

3.3.6 The dyke should be checked to ensure that no damage has been caused by wave, current or rain erosion, excavations, pedestrians, vehicles, cattle or other animals. Points of access to the dyke should receive special attention, as damage will occur most frequently at points of greatest traffic. Where damage has occurred, the section should be rehabilitated to its original state.

3.3.7 The dyke crest should periodically be graded to achieve a reasonably smooth driving surface. Care must be exercised so that no material is graded over the edges, thus reducing available freeboard. About every five years the dyke should be surveyed to determine the crest profile and, if necessary, brought up to grade.

3.3.9 The dyke should be provided with vehicle barriers. Fences and gates should be checked prior to high tide periods to ensure that they are in good condition. The gates should open and close freely. Locks should be in working order, keys readily available, and all obstacles to patrolling should be removed from the dyke crest.

3.3.10 If animal holes or burrows are discovered during inspection, they should be excavated and backfilled with compacted fill. Trapping of the animals may be advisable in such areas after consultation with local Fish and Wildlife authorities.

4. BANK PROTECTION

4.1 Basis of Bank Protection Design

Portions of the riverside face of the dyke and riverbank have been seeded, provided with a layer of cobblestone or shot rock rip-rap to protect against erosion by wave action and stream flows.

4.1.1 Cobblestone and quarried rock rip-rap was used as bank protection because it forms a flexible layer not impaired or weakened by slight movement resulting from settlement or other minor adjustments. Local damage or loss is readily repaired by the addition of rock where required. An additional thickness has been provided at the toe of new bank protection to offset possible scour.

4.1.2 Suitable durable cobblestone of required size and gradation was obtained from B&B Contracting Ltd. of Cloverdale. Shot rock was obtained from Texada Island. Refer to Drawing Nos. 5452-10-9 and 84-6-13 for gradation specifications of cobblestones and quarry tailings. These sources of material may be used in the future repair or extension of the bank protection.

4.1.3 The specifications for cobblestone and rock rip-rap were stipulated on the construction drawings provided with the Contract and Specifications entitled Ministry of Environment, Water Management Branch, Surrey Dyking District, Serpentine and Nicomekl Rivers Dyke Upgrading, by Dayton & Knight Ltd. Consulting Engineers Ltd., dated May 1983 and March 1984. Reference to those specifications should be made when preparing for maintenance of the works.

4.2 Maintenance of Bank Protection

The bank protection will require varying degrees of maintenance, depending upon location, degree and frequency of exposure to attack by stream flow or wave action, as well as frost action, weathering processes, and possible dislodgement by foot traffic, floating logs, ice or debris.

4.2.1 Maintenance personnel should acquaint themselves with the areas where bank protection has been constructed and be aware of critical locations where impingement of high wave action and high velocity flows is most acute.

4.2.2 The bank protection works should be thoroughly inspected after the winter high tide period, during the summer low tide period and during the summer high tide period. The need for repair, strengthening or extension should be determined to permit completion of required work before the next high tide period. Subsequent inspection during the dry season should be made to check earlier observations. During the inspections attention should be given to:

- a. possible dislodgement or loss of material from the protective layer;
- b. possible slumping;
- c. possible development of holes which may allow displacement or loss of filters or backing material;
- d. deterioration of rock particles by weathering and/or abrasion.

4.2.3 Routine maintenance of the cobblestone and rip-rap layer to design top elevation and required thickness could best be accomplished by using a backhoe (hydraulic excavator) or clamshell, particularly where additional rock is required at the toe of the bank.

4.2.4 Where severe erosion has occurred or is occurring at points of concentrated attack, redesign of protection should be undertaken before permanent repairs are effected.

5. FLOODBOXES

5.1 Basis of Design of Floodboxes

The original dyke had been provided with flapgated floodboxes to allow passage of internal drainage into the river as located on Drawing Nos. 5452-10-1 and 84-6-1. Additional floodboxes installed under the 1983-85 program are detailed on Drawing Nos. 5452-10-10, 84-6-14 and 84-6-15. These have been designed in accordance with local drainage works in existence at the time of construction of the dyking system.

During high tide levels, the flapgates will automatically close under pressure from the rising water and prevent intrusion of river water. At such times, it is possible that local runoff, snowmelt and rising groundwater tables will cause temporary disruption to local drainage within the dyked area. In extreme circumstances it may be advisable to employ temporary pumping to alleviate such conditions.

5.2 Maintenance of Floodboxes

5.2.1 The inlets, trashracks and outlets of all floodboxes should be regularly cleared and cleaned of debris and sediment. At the same time the floodbox barrels should be examined and cleared of blockages.

5.2.2 The slopes adjacent to structures should be periodically cleared and trimmed as necessary to ensure that material cannot slough over the openings. A check should be made that neither the inlet nor outlet has been undermined by erosion or scour, and appropriate repairs made. Drainage ditches leading to and/or from the floodbox should be cleared.

5.2.3 The flapgates should be periodically cleaned and lubricated ensuring that they swing freely and close properly with a good seal. The gates should be painted as required with a high quality rust resistant primer and paint.

6. INSPECTIONS AND PATROLS

6.1 Routine Inspections

Inspections should be undertaken during low tide periods specifically in early fall before winter high tides and also in early summer prior to summer high tides. The purpose of these inspections would be to assess the need for routine maintenance as discussed in Sections 3 and 4 of this manual.

6.2 Patrols During High Tide and Extreme Storm Periods

Additional inspections should be undertaken as conditions warrant during high tide periods and storms. During very high tide events, frequent patrols along the dyke crest would be advisable.

The Local Authority should establish a local control headquarters and prepare a contingency plan for activities during the extremely high tides and/or during forecast or unexpected extreme storms, after earthquakes, or during or after any other event which may impact on stability of the dykes and related facilities.

The local control headquarters should be:

- located above the potential flood levels;
- accessible via roads not affected by the potential flooding and within easy reach of the dykes;
- equipped with telephone and other communication equipment warranted.

The contingency plan should provide for:

- a. appointment of a coordinator responsible for preparation and activation of the local control headquarters and the contingency plan;
- b. yearly review of the tide tables and preparation of a dyke patrol schedule for the duration of the extreme high tides (two person patrols are desirable);
- c. regular monitoring of weather forecasts for extreme storms and regular monitoring of weather in the Local Authority area for unexpected extreme storms; provision for activation of the dyke patrols when conditions warrant;
- d. preparation of a list of personnel who can be called for unscheduled dyke patrols during the extreme storms and after earthquakes (two person patrols are desirable);

- e. purchase, storing and maintenance of material and equipment for the patrols including:
 - two way portable radios
 - keys to all dyke, farm and pumping station gates
 - equipment and tools for minor repairs and flood gate opening
 - lights
 - life jacket preservers
 - life lines and reaching poles
 - first aid kit
- f. arrangements for mobilization of working crews, equipment and materials for emergency dyke repairs.

6.2.1 Local Authority patrols should observe and report to their local control headquarters any occurrence that could signal a weakening of the works such as:

- a. excessive seepage on the landside slopes;
- b. slumping slopes or other signs of slope instability;
- c. boiling near the landside toe of the dyke;
- d. seepage along cables or pipes through the dyke;
- e. problems experienced with culverts;
- f. areas of low freeboard;
- g. erosion or slumping of bank protection;
- h. cracking or settlement of the dyke crest;
- i. floodbox blockages.

Coordination of emergency work should be the sole responsibility of the local control headquarters.

6.3 Dyke Inspection Log

A log, similar to that illustrated in Appendix C, and signed by the inspector, should be kept of all inspections, and reported to the office of the local control headquarters daily. The log should include the following data:

- a. date and times commencing and completing inspection;
- b. location of areas of seepage, with comments on changes in conditions;
- c. location of boils, with comments on number and size, rate of flow, and change in conditions;
- d. description of problems experienced at floodboxes;
- e. description of any other damage to dykes, bank protection, structures and/or property;
- f. description of the condition of dyke crest and sideslopes.

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C. EMERGENCY RESPONSE PLANNING

7. EMERGENCY MEASURES AND REPAIR WORK

7.1 Men and Equipment

The Local Authority should ensure that there is adequate equipment and materials readily available to respond to emergency conditions, and that contingency plans are prepared for more serious circumstances. As the high tide season approaches or extreme storms are forecasted, crews should be advised that they may be called upon, at short notice, to cope with emergencies related to the flood protection works.

7.2 Flood Emergency Procedures

7.2.1 Patrols During High Tide Periods - Inspections should be undertaken as conditions warrant during high tide and extreme storm periods as specified in Section 6.2. Attention should be directed to detection of possible damage to the works. Special attention should be paid to items identified in Section 6.2.1 of this manual.

7.2.2 The Local Authority's work crews should be equipped and on short notice called to undertake emergency work to correct conditions such as:

- a. Active Boiling - Active boils can be identified by the seepage water which will be observed to be carrying fine silts and sands. Active boils should be controlled by coverage with a blanket of free draining filter gravel. Care must be exercised so that the punctured surface layer is not extended or disturbed at other areas. All active areas which cannot be arrested should be reported immediately to the local dyke emergency organization. All "springs" and flowing inactive boils should be flagged and closely monitored throughout the high tide period in case soil transportation is initiated.
- b. Excessive Slope Seepage - Where seepage on the dyke landside slope leads to soggy unstable conditions, free draining fill berms may be added; however, in critical situations expert advice should be obtained, if possible, before taking corrective action.
- c. Wave Erosion - Where waves are eroding the face of the dyke, additional rock bank protection may be placed; however, expert advice should be obtained if critical conditions occur.
- d. Local Overtopping - Patrols should pay close attention to occurrence of local overtopping. If a danger of local overtopping presents itself, fill should be added to bring up the crest level.
- e. Blocked and Damaged Floodgates - When floodgates become blocked or damaged patrols should be equipped to remove any debris from the floodgate.
- f. Special Considerations - Close attention should be paid to areas of special concern as discussed in other sections of this manual.

7.2.3 Under extreme circumstances, should the possibility of uncontrollable dyke failure arise, appropriate emergency warning of the population located in the floodplain would be advisable. Endangered residents should be advised of the nature of the situation and recommendations should be made regarding possible temporary evacuation or other action. Such procedure would best be implemented through the cooperative effort of Local Authority officials with the local R.C.M.P. detachment and the local Provincial Emergency Program Coordinator. The local control headquarters should initiate emergency procedures by informing the local R.C.M.P. detachment and the local Provincial Emergency Program Coordinator. Contingency plans should be developed in anticipation of such conditions by the local control headquarters.

7.2.4 Engineering advice should be obtained regarding permanent corrective action following emergency situations. The Inspector of Dykes should be advised promptly of emergencies so that the area may, if possible, be inspected under critical conditions.

7.3 Records

Cases of severe damage should be recorded. Photographs with locations and dates should be obtained, if possible, before repairs are effected, but this must not in any way interfere with or prejudice emergency work.

APPENDIX A

"Dykes Maintenance Act"

DYKE MAINTENANCE ACT

CHAPTER 99

[Act administered by the Ministry of Environment]

[Consolidated October 15, 1982.]

Interpretation

1. In this Act

- “dyke” means an embankment, wall, fill, piling, pump, gate, floodbox, pipe, sluice, culvert, canal, ditch, drain or any other thing that is constructed, assembled or installed to prevent the flooding of land;
- “dyking authority” means the commissioners of a district to which Part 2 of the *Drainage, Ditch and Dyke Act* applies, a person owning or controlling a dyke other than a private dyke, a regional district, a municipality or an improvement district;
- “improvement district” means an improvement district within the meaning of the *Municipal Act*;
- “Inspector of Dykes” means the Inspector of Dykes referred to in section 2 and includes the Assistant Inspector of Dykes;
- “municipality” means a municipality as defined for the purposes of the *Municipal Act*;
- “order” includes a decision or direction of the Inspector of Dykes;
- “private dyke” means a dyke built on private property without public funds to protect only the property of the person owning the private dyke.

RS1960-123-2; 1965-11-2; 1977-75-8; 1978-18-2; 1980-36-17, effective January 1, 1980.

Inspector of Dykes

2. (1) There shall be an official of the Ministry of Environment known as the Inspector of Dykes.

(2) The Inspector of Dykes has general supervision of all dykes and the operation of all dyking authorities relative to the construction and maintenance of dykes, and without limiting the generality of the foregoing he has the power to

- (a) enter on any land and on a dyke at any time;
- (b) require a dyking authority to repair, replace, renew, alter, add to, improve or remove a dyke, or a part of a dyke, or anything used in connection with a dyke;
- (c) require a dyking authority to construct or install a work or thing that in the opinion of the Inspector of Dykes is necessary to protect a dyke or to increase its efficiency;
- (d) require a person who is physically fit and over 17 and under 60 years of age, except a railroadman, telegrapher or dispatcher on duty, or a medical practitioner, to do or assist in any work of dyke construction or repair believed necessary to prevent the flooding of property;
- (e) require a person to make available to the Inspector of Dykes equipment or material owned or controlled by the person and believed by the Inspector of Dykes to be necessary to prevent the flooding of property;

(f) authorize and empower any person, on conditions the Inspector of Dykes may impose, to place, construct, renew, alter, repair, maintain, operate and use any buildings, structures, machinery, ways, rails, roads, pipes, poles, towers, cables, wires, conduits, conveyers or other works on, along, across, through, over or under any dyke in charge of a dyking authority or any land, so far as an interest in it is held by a dyking authority, and to enter into and on a dyke or land, so far as an interest in it is held by a dyking authority.

(3) The Inspector of Dykes, Assistant Inspector of Dykes and those employees considered necessary may be appointed under the *Public Service Act*.

(4) Except with the approval in writing of the Inspector of Dykes, no dyking authority shall

- (a) lower, or cause or allow to be lowered, the elevation or decrease, or cause or allow to be decreased, the width or cross section of a dyke;
- (b) install, or cause or allow to be installed, any culvert, pipe, flood box or any structure through a dyke;
- (c) construct, or cause or allow to be constructed, any works on or over a dyke or dyke right of way;
- (d) alter, or cause or allow to be altered, the foreshore adjacent to a dyke.

RS1960-123-3; 1965-11-3; 1975-73-7; 1977-75-39; 1978-18-3.

Failure to carry out order of inspector

3. If a dyking authority fails to carry out an order or direction of the Inspector of Dykes by the date required, the Inspector of Dykes may do the things required, either by contract or otherwise, and that cost, including any interest he may have to pay, is a debt owing by the dyking authority to Her Majesty the Queen in right of the Province.

RS1960-123-4; 1965-11-4.

Failure by dyking authority to fulfil obligations

4. If a dyking authority fails to pay to Her Majesty the Queen in right of the Province any sum payable by the dyking authority under section 3, the sum may be recovered at the suit of Her Majesty the Queen in right of the Province in any court of competent jurisdiction.

RS1960-123-6; 1965-11-6.

Appeals

5. (1) An appeal lies to the minister from every order of the Inspector of Dykes.

(2) Every appeal under this section shall be taken within 15 days from the date on which the Inspector of Dykes makes the order appealed from.

(3) An appeal is taken within the meaning of this section when notice of intention to appeal has been delivered to the minister and a copy delivered to the Inspector of Dykes.

(4) The appellant from an order of the Inspector of Dykes shall give such further notice of his intention to appeal as may be directed by the Inspector of Dykes.

(5) The minister may, on an appeal under this section, confirm, quash, vary or add to the order appealed from and make any order as to costs as he deems just, and his decision is final.

1965-11-8.

Offence

6. A person commits an offence who
- (a) injures or interferes with a dyke or its operation;
 - (b) hinders a dyking authority, the Inspector of Dykes, or a person acting on behalf of either of them from protecting property from flooding; or
 - (c) contravenes section 2 (4) or an order of the Inspector of Dykes or the minister.

1978-18-5.

Orders made by inspector

7. Every order made by the Inspector of Dykes shall be in writing, signed by the Inspector of Dykes, and shall be delivered or sent by registered mail to the person or authority to whom it is directed.

RS1960-123-10; 1965-11-10.

Regulations

8. The Lieutenant Governor in Council may make regulations.

RS1960-123-11.

APPENDIX B

**List of Agencies Concerned with the
Flood Control Works**

**List of Project Personnel
Contractors, Engineers, Suppliers**

APPENDIX B

Agencies Concerned with the Flood Control Works

AGENCY	INTEREST
<p>Mud Bay Dyking District Box 1180, Cloverdale Surrey, B.C. V3S 4R2</p>	<p>Safety of the dyke; Structures on or near the dyke; Operation and Maintenance.</p>
<p>Inspector of Dykes Water Management Branch Ministry of Environment and Parks 34345 Vye Road Abbotsford, British Columbia V2S 4N2</p>	<p>Safety of the dyke; Technical advice.</p>
<p>Ministry of Environment and Parks Water Management Branch Office of the Director Parliament Buildings Victoria, British Columbia V8V 1X5</p>	<p>Safety of the dyke; Future adequacy of the dyke; Floodplain management; Technical advice.</p>
<p>Regional Water Manager Lower Mainland Region Ministry of Environment and Parks 10334 - 152A Street Surrey, B.C. V3R 7P8</p>	<p>Administration of Water Act; Approvals in and about stream; Floodplain management.</p>
<p>Fisheries & Oceans Canada 1090 West Pender Street Vancouver, British Columbia V6E 2P1</p>	<p>Environment, habitat protection; Recreation and commercial fisheries propagation and protection; Fisheries Act.</p>
<p>Regional Manager Fish & Wildlife Branch Ministry of Environment and Parks 10334 - 152A Street Surrey, B.C. V3R 7P8</p>	<p>Environment, habitat protection; Recreational fishing and fish propagation; Fisheries Act.</p>
<p>Manager, Land Administration Ministry of Forests and Lands Lower Mainland Regional Operations (Lands) 210 - 4240 Manor Street Burnaby, B.C. V5G 1B2</p>	<p>Dyke right-of-way on Crown land.</p>

APPENDIX B

List of Project Personnel, Engineers, Contractors, Suppliers

INTEREST

Dayton & Knight Ltd.
626 Clyde Avenue
West Vancouver, B.C.
V7V 3N9

Consulting Engineer

Golder Associates Ltd.
224 West 8th Avenue
Vancouver, B.C.
V5Y 1N5

Soil Consultant

Bray Enterprises Ltd.
2215 - 164th Street
Surrey, B.C.
V4B 4Z5

General Contractor
(1983-1984 Flood Control Program)

Ocean Point Contractors Ltd.
1 - 155 Riverside Drive
North Vancouver, B.C.
V7H 1T6

General Contractor
(1984-1985 Flood Control Program)

APPENDIX C

Dyke Inspection Reports

SEMI ANNUAL DYKE INSPECTION REPORT

File _____

Inspector _____

Date _____

The condition of the _____ Flood Control works is as reported below:

DYKES: (slumping, settlement, cracking, erosion, seepage, holes, vegetative growth, garbage, obstructions, access.)

BANK PROTECTION: (Loss of material, settlement, slumping, deterioration of rock)

FLOODBOXES: (sediment, ditches, flapgates)

OTHER: (Water Level Gauges, fences, obstructions on dyke, debris accumulations, emergency materials, sandbags, pumps)

ACTION TAKEN:

Foreman's Signature/Date

Note to Inspector: Circle Applicable Items, give location and describe. Attach photographs and plans as required.

HIGH WATER INSPECTION REPORT

Inspector _____

Date _____

1. River Levels

2. Freeboard

3. Debris accumulations

4. Riverside erosion

5. Saturation and Slope Seepage

6. Slope stability, cracking

7. Active boils

8. Culverts/Floodboxes, Internal Drainage

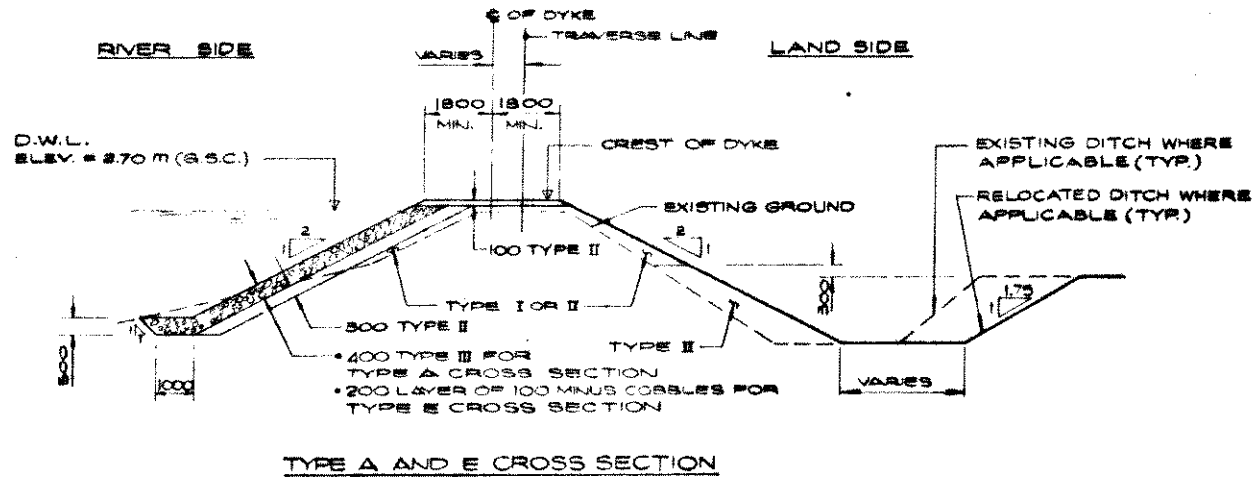
9. Other, Access, etc.

ACTION TAKEN:

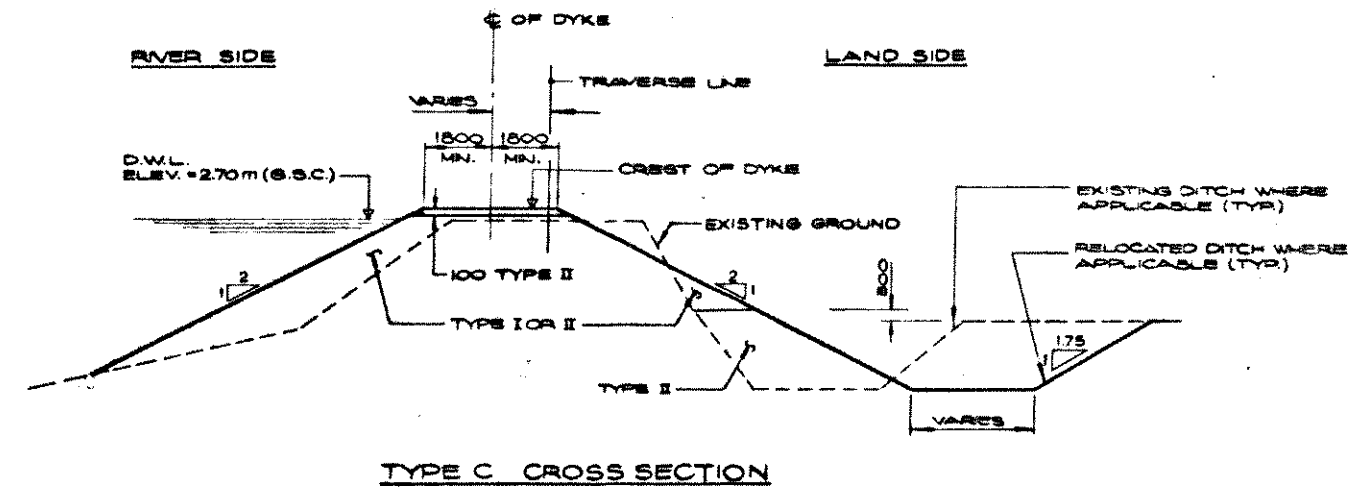
Note to Inspector: For use during highwater patrol as per Section 7.2. Attach sketches as required.

APPENDIX D

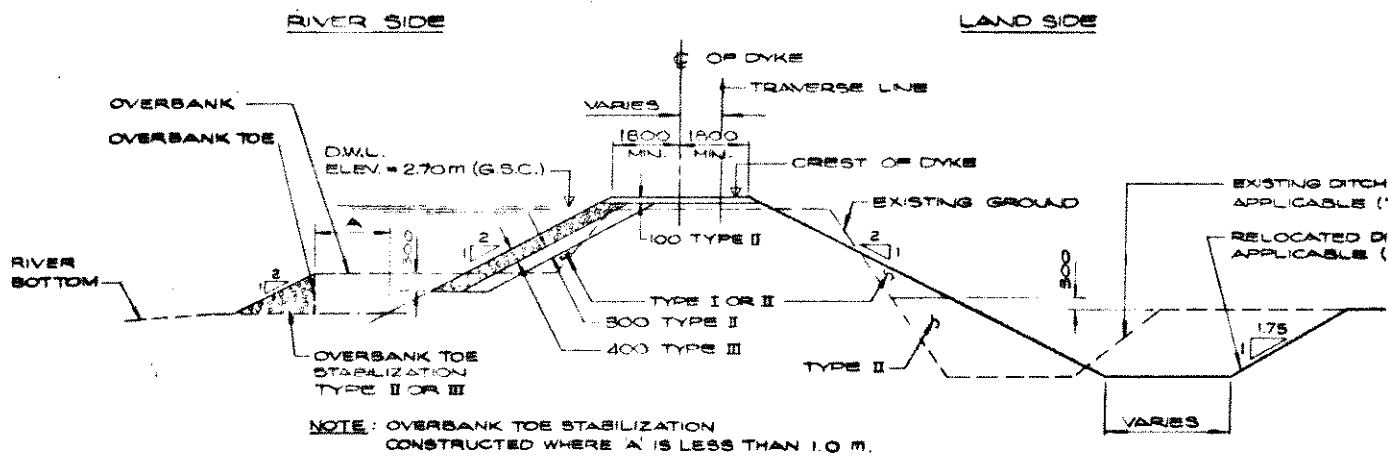
As-Constructed Drawings



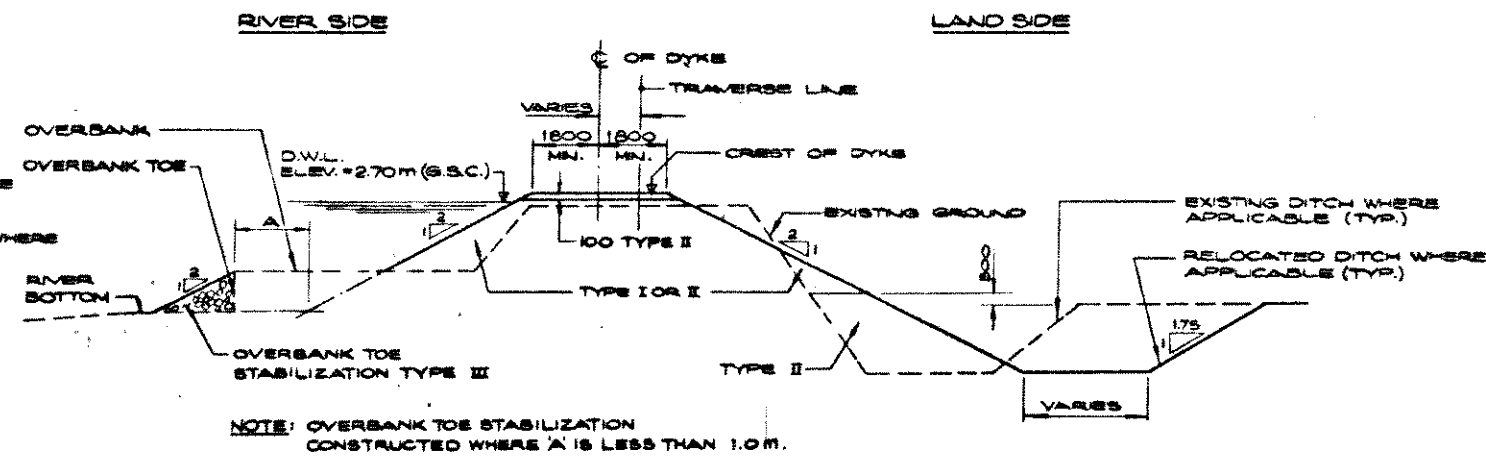
TYPE A AND E CROSS SECTION



TYPE C CROSS SECTION



TYPE B CROSS SECTION



TYPE D CROSS SECTION

TYPE I - GENERAL FILL
 TYPE II - IMPORTED FILL
 TYPE III - COBBLES

TYPE III - COBBLESTONE	
PARTICLE SIZE	PERCENTAGE BY WEIGHT FINER THAN
200.00 mm	100
150.00 mm	65-100
75.00 mm	15-30
5.00 mm	not exceeding 10

THIS DRAWING REDUCED TO HALF SIZE
DAYTON & KNIGHT LTD.
 CONSULTING ENGINEERS
 DWG. NO. 196-1 SHT. 9 OF 10

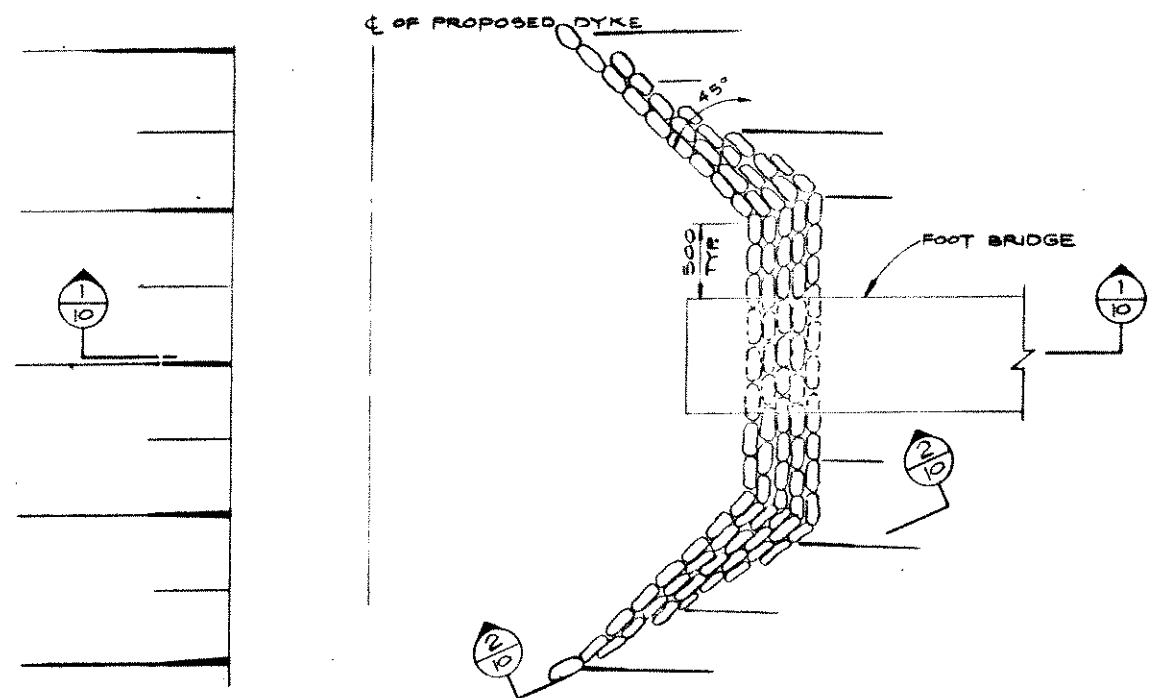
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								R.H.		J.H.W.		MAY 6/83	

Province of British Columbia
 Ministry of Environment
 WATER MANAGEMENT BRANCH

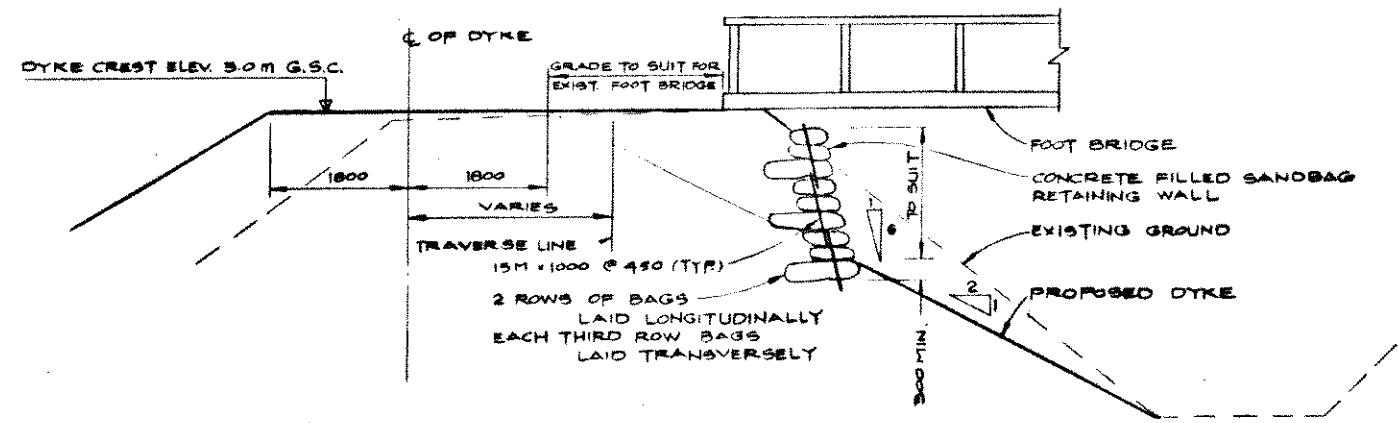
1983-1984 FLOOD CONTROL PROGRAM
 MID BAY DYKING DISTRICT
 CONTRACT NO. 1
 NICOMECH RIVER
 ELGIN ROAD TO RAILWAY
 TYPE A, B, C, D CROSS SECTIONS

FILE NO. P83-7
 ENG. PROJECT NO.
 NTS MAP NO.
 SCALE N.T.S.
 DRAWING NO. 5452-10-9
 SHEET 9 OF 10

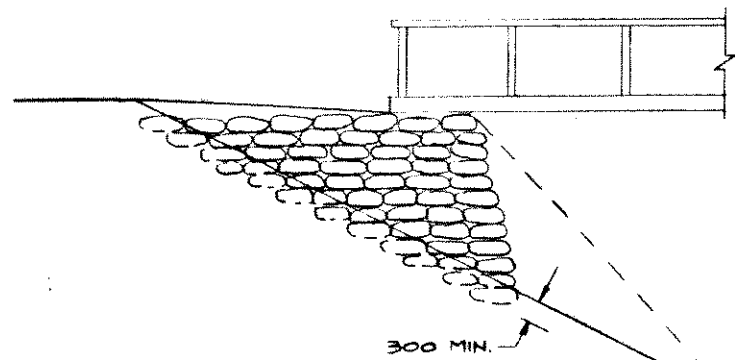




TYPICAL CONCRETE FILLED SANDBAG RETAINING WALL
FOOT BRIDGES ACROSS DITCH STA. 0+299, 0+369, 0+709
(3 REQ'D)



SECTION 1/10

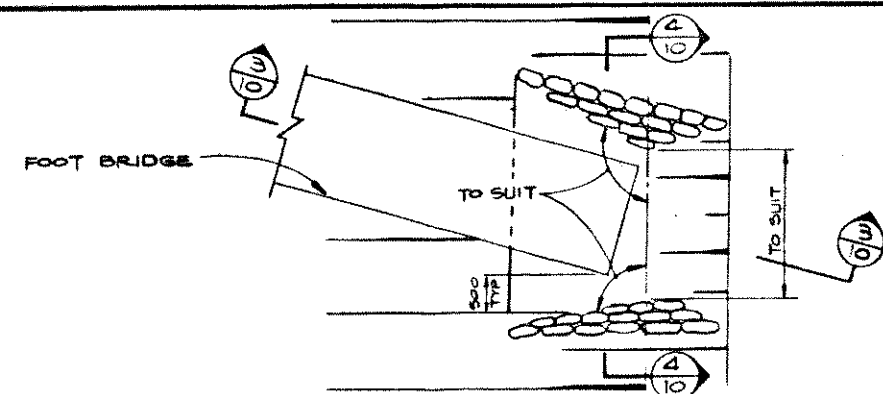


VIEW 2/10

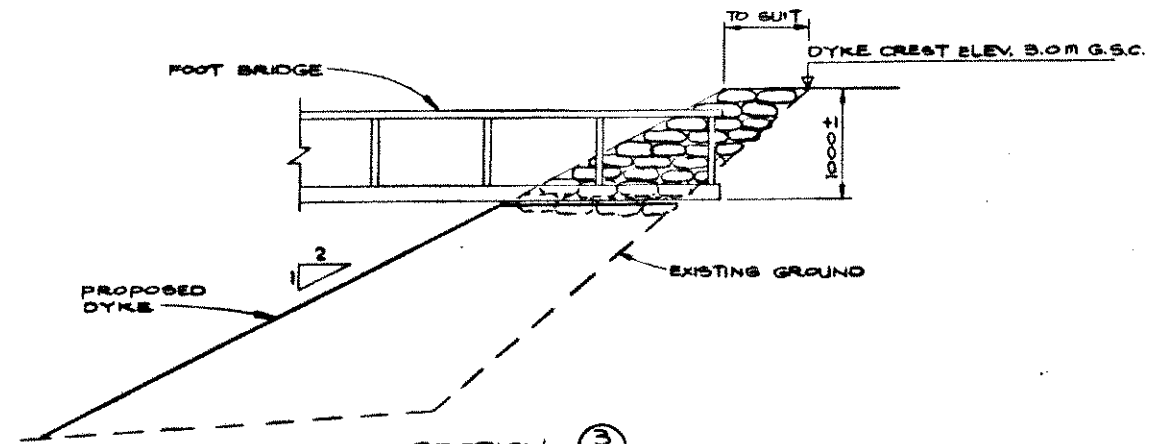
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DAYTON & KNIGHT LTD.
CONSULTING ENGINEERS

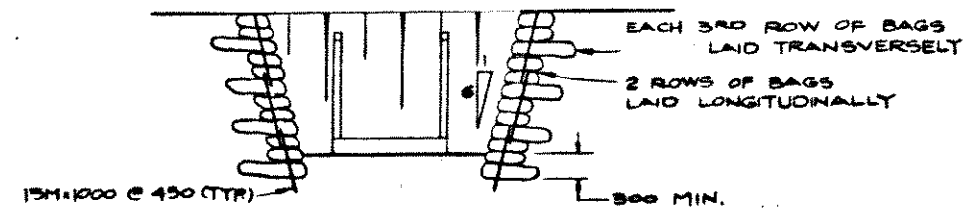
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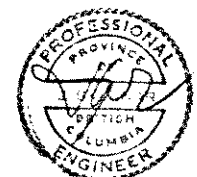
CONCRETE FILLED SANDBAG RETAINING WALL
FOOT BRIDGES TO BOAT HOUSE STA. 0+559 & 0+720
(2 REQ'D.)



SECTION 3/10



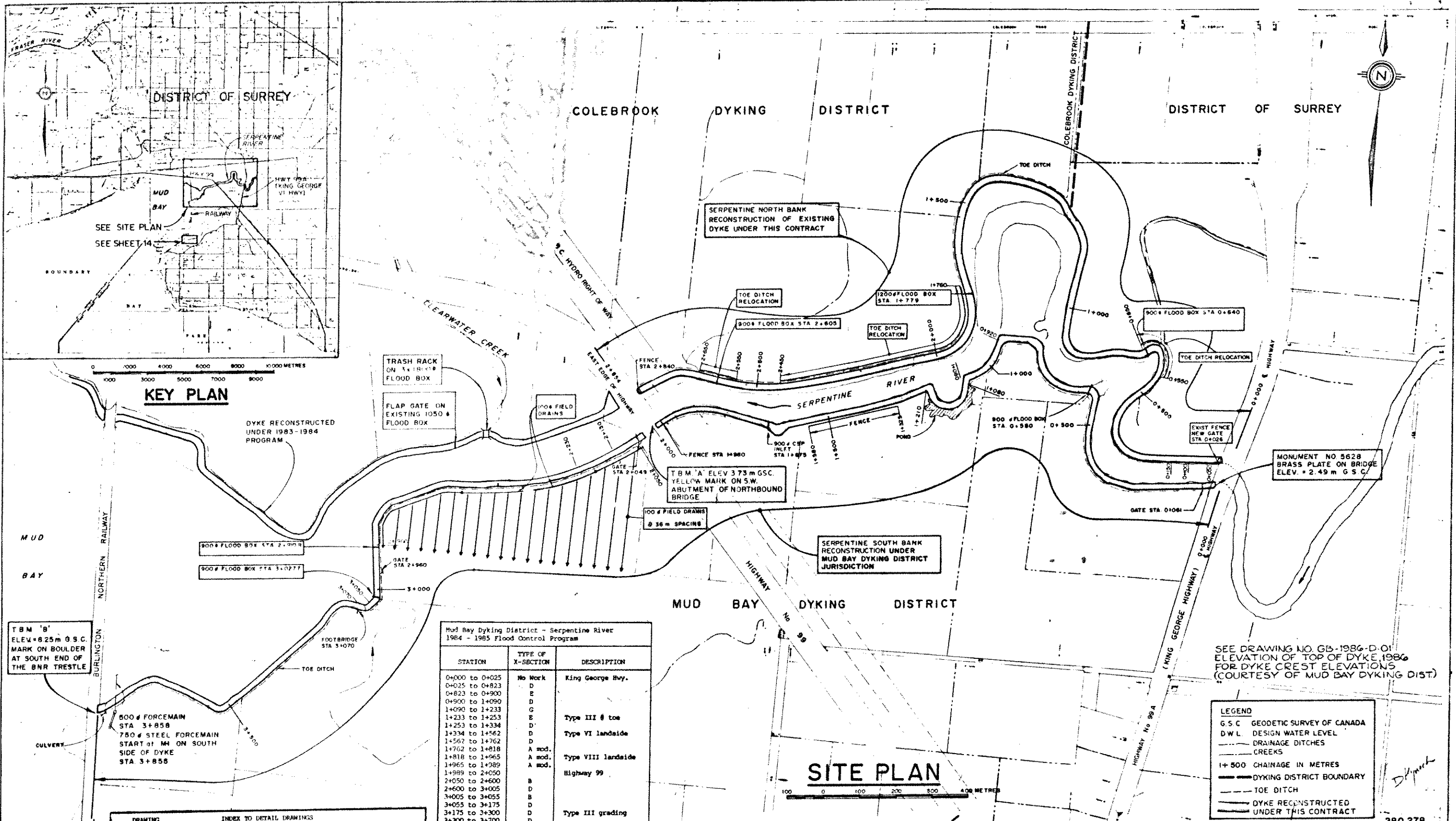
SECTION 4/10



280 277

REFERENCES			REVISIONS			DESIGNED		Province of British Columbia Ministry of Environment WATER MANAGEMENT BRANCH		FILE NO.
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			1	RECORD DRAWING	MAR/87	MAY 6/83	J.S.			
							Checked			
							DATE			
							DESIGNED			
							Checked			
							DATE			
							Drawn			
							Checked			
							DATE			
							Engineer			
							DATE			
							Recommended			
							DATE			
							Approved			
							Director			
							DATE			

DRAWING NO. 5452-10-2
SHEET 10 OF 10



Mud Bay Dyking District - Serpentine River
1984 - 1985 Flood Control Program

STATION	TYPE OF X-SECTION	DESCRIPTION
0+000 to 0+025	No Work	King George Hwy.
0+025 to 0+823	D	
0+823 to 0+900	D	
0+900 to 1+090	D	
1+090 to 1+233	G	
1+233 to 1+253	E	Type III toe
1+253 to 1+334	D	
1+334 to 1+562	D	Type VI landside
1+562 to 1+762	D	
1+762 to 1+818	A mod.	
1+818 to 1+965	A mod.	Type VIII landside
1+965 to 1+989	A mod.	
1+989 to 2+050		Highway 99
2+050 to 2+600	B	
2+600 to 3+005	D	
3+005 to 3+055	B	
3+055 to 3+175	D	
3+175 to 3+300	D	Type III grading
3+300 to 3+700	D	
3+700 to 3+825	C	
3+825 to 3+875	C	
3+875 to 3+900	No Work	BNR Tracks

INDEX TO DETAIL DRAWINGS

DRAWING NO.	DESCRIPTION
84-6-1	KEY PLAN, SITE PLAN, INDEX TO DRAWINGS
84-6-2	MUD BAY DYKING DISTRICT (SERPENTINE SOUTH BANK)
84-6-3	DYKE CROSS SECTION - STA. 0+000 TO 0+731.5
84-6-4	DYKE CROSS SECTION - STA. 0+823 TO 1+463
84-6-5	DYKE CROSS SECTION - STA. 1+544.5 TO 1+981.2
84-6-6	DYKE CROSS SECTION - STA. 2+118.4 TO 2+758.4
84-6-7	DYKE CROSS SECTION - STA. 2+849.9 TO 3+490
84-6-8	DYKE CROSS SECTION - STA. 3+581.4 TO 3+852.7
84-6-9	COLEBROOK DYKING DISTRICT (SERPENTINE NORTH BANK)
84-6-10	DYKE CROSS SECTION - STA. 0+000 TO 0+640
84-6-11	DYKE CROSS SECTION - STA. 0+700 TO 1+200
84-6-12	DYKE CROSS SECTION - STA. 1+250 TO 1+779
84-6-13	DYKE CROSS SECTION - STA. 1+800 TO 2+500
84-6-14	DYKE CROSS SECTION - STA. 3+581.4 TO 3+852.7
84-6-15	TYPICAL DYKE CROSS SECTION
84-6-16	TYPE G CROSS SECTIONS AND STANDARD DETAILS
84-6-17	STANDARD DETAILS AND FLOODBOX REPLACEMENT

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CONSULTING ENGINEERS

DWG. NO. 196-9 SHT. 1 OF 15

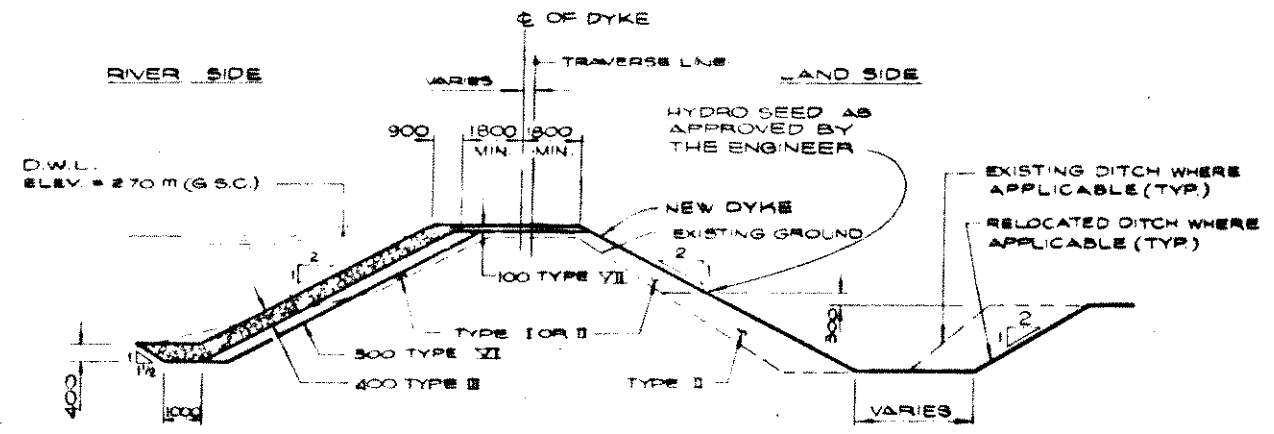
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Province of British Columbia Ministry of Environment WATER MANAGEMENT BRANCH

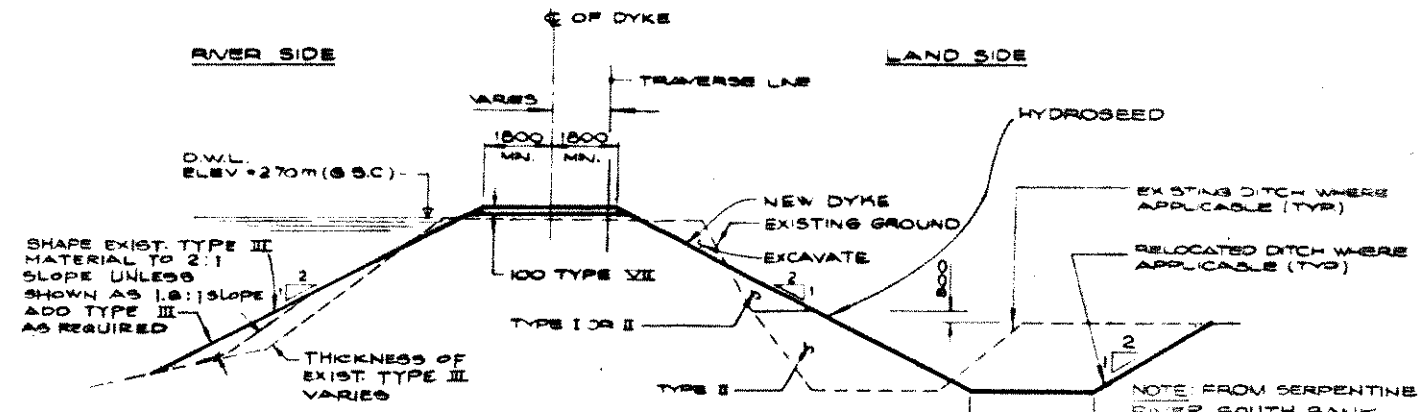
1984-1985 FLOOD CONTROL PROGRAM
COLEBROOK/MUD BAY DYKING DISTRICTS
CONTRACT NO. 1
SERPENTINE RIVER
KING GEORGE HWY. TO BURLINGTON NORTHERN RAILWAY
KEY PLAN, SITE PLAN, INDEX TO DRAWINGS

FILE NO. PB4-3
ENG. PROJECT NO.
N.T.S. MAP NO.
SCALE AS SHOWN
DRAWING NO. 84-6-1
SHEET 1 OF 15

APPROVED: [Signature] DATE: [Date]

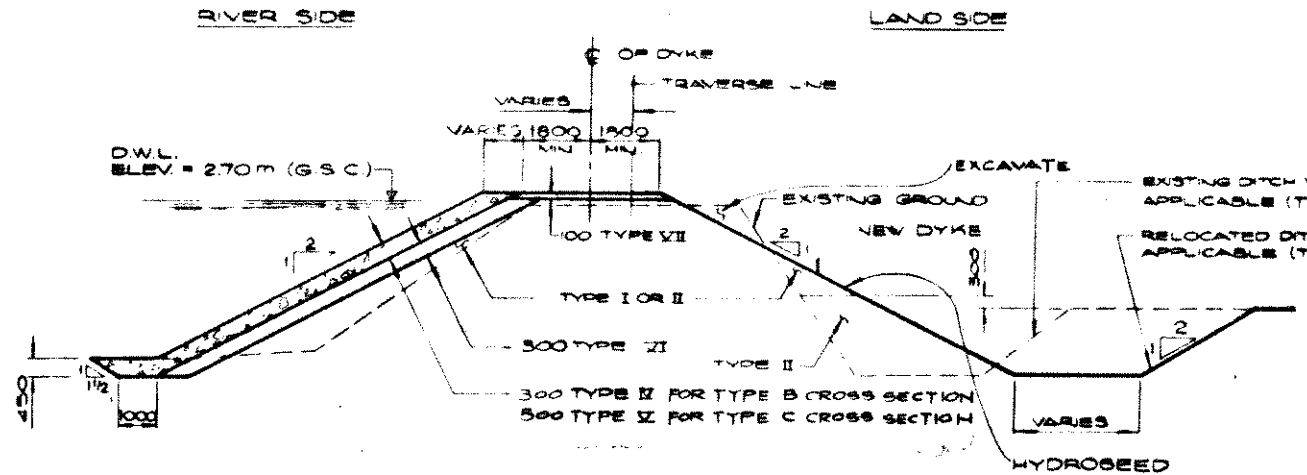


TYPE A CROSS SECTION

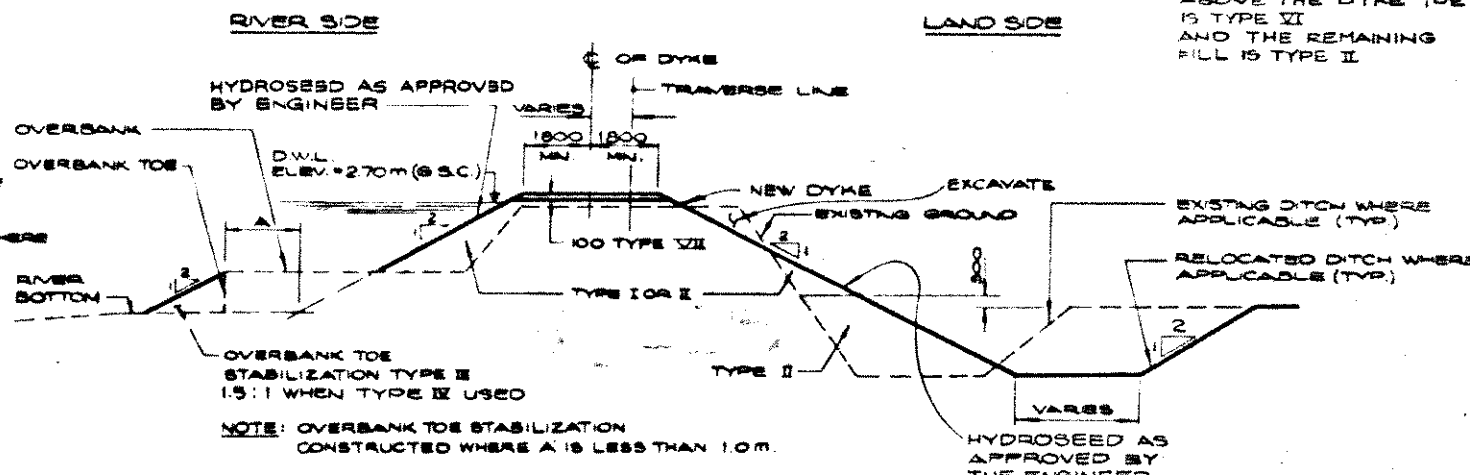


TYPE D CROSS SECTION

NOTE: FROM SERPENTINE RIVER SOUTH BANK STATION 1+450 TO 1+600, WHERE THE LAND SIDE SLOPE IS SPECIFIED AS 1.5:1, THE 500 MM HORIZONTAL LAYER ABOVE THE DYKE TOE IS TYPE VI AND THE REMAINING FILL IS TYPE II



TYPE B AND C CROSS SECTION



TYPE E CROSS SECTION

TYPE III - COBBLESTONE	
PARTICLE SIZE	PERCENTAGE BY WEIGHT FINER THAN
200.00 mm	100
150.00 mm	65-100
75.00 mm	15-30
50.00 mm	not exceeding 10

TYPE IV - QUARRY TAILING	
PARTICLE SIZE	PERCENTAGE BY WEIGHT FINER THAN
220.0 mm	100
150.0 mm	65-85
125.0 mm	40-60
75.0 mm	15-35
25.0 mm	not exceeding 10

- TYPE I - GENERAL FILL
- TYPE II - IMPORTED FILL
- TYPE III - COBBLES
- TYPE IV - QUARRY TAILINGS
- TYPE V - RIP-RAP
- TYPE VI - FILTER MATERIAL
- TYPE VII - DYKE SURFACING MATERIAL
- TYPE VIII - TOE DRAIN MATERIAL

NOTE:
 1. WHERE THE EXISTING DYKE CREST ELEVATION IS 3.0m G.S.C. OR MORE AND THE WIDTH AND THE LOCATION OF THE CREST CONFORMS TO THE NEW DYKE CROSS SECTION, A 100mm LAYER OF TYPE VII MATERIAL WAS PLACED ON THE TOP OF THE EXISTING DYKE CREST
 2. IN AREAS WHERE THE EXISTING DYKE CREST SURFACING IS UNSUITABLE A 200 mm LAYER OF TYPE II MATERIAL PLACED TO PROVIDE A COARSE BASE FOR THE 100 mm LAYER OF TYPE VII MATERIAL AS DIRECTED BY THE ENGINEER.

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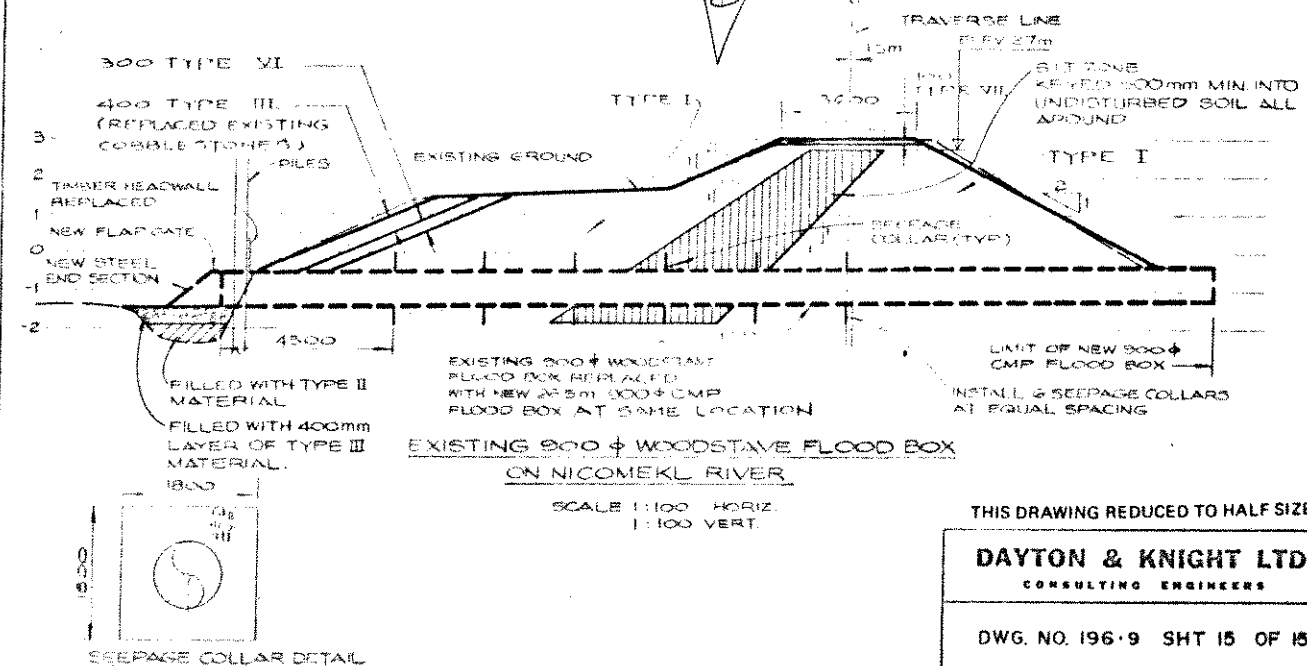
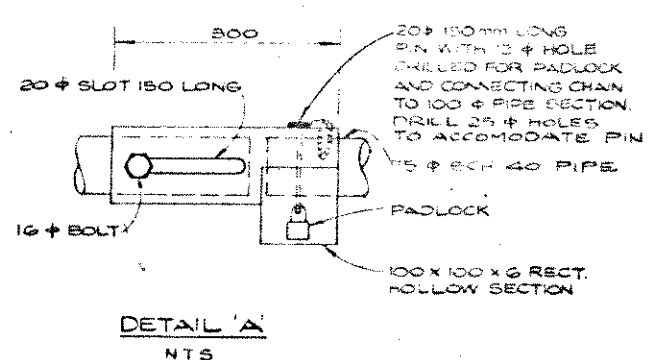
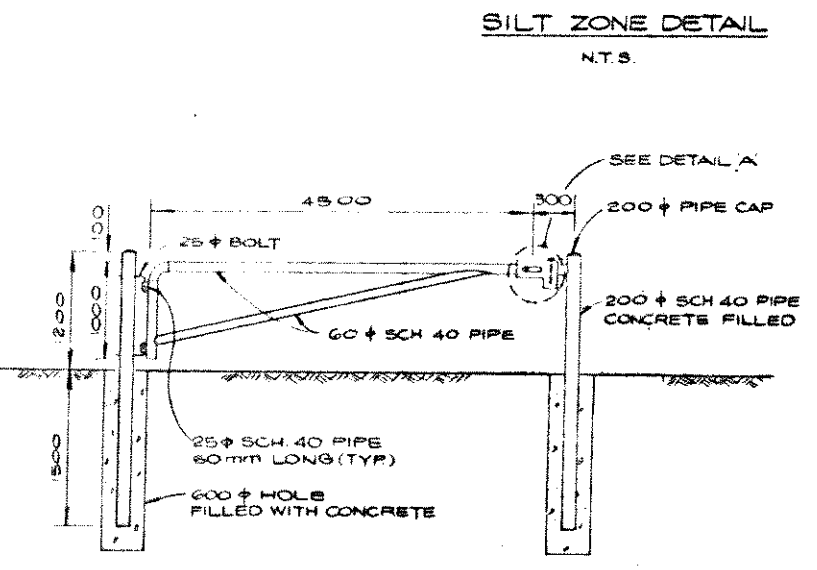
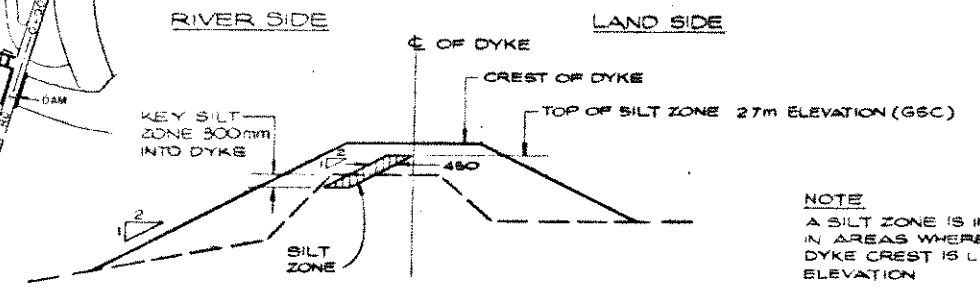
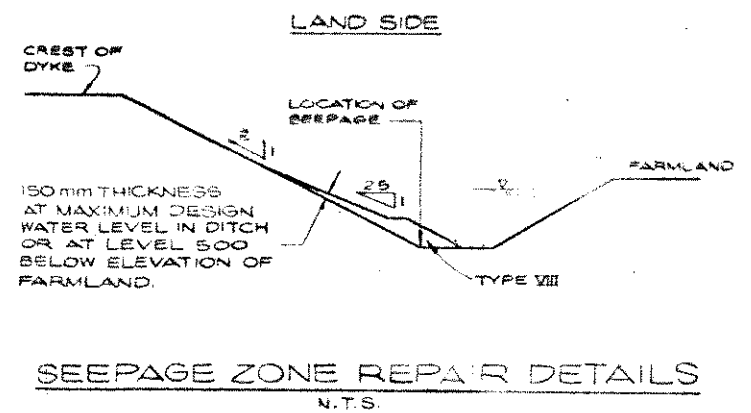
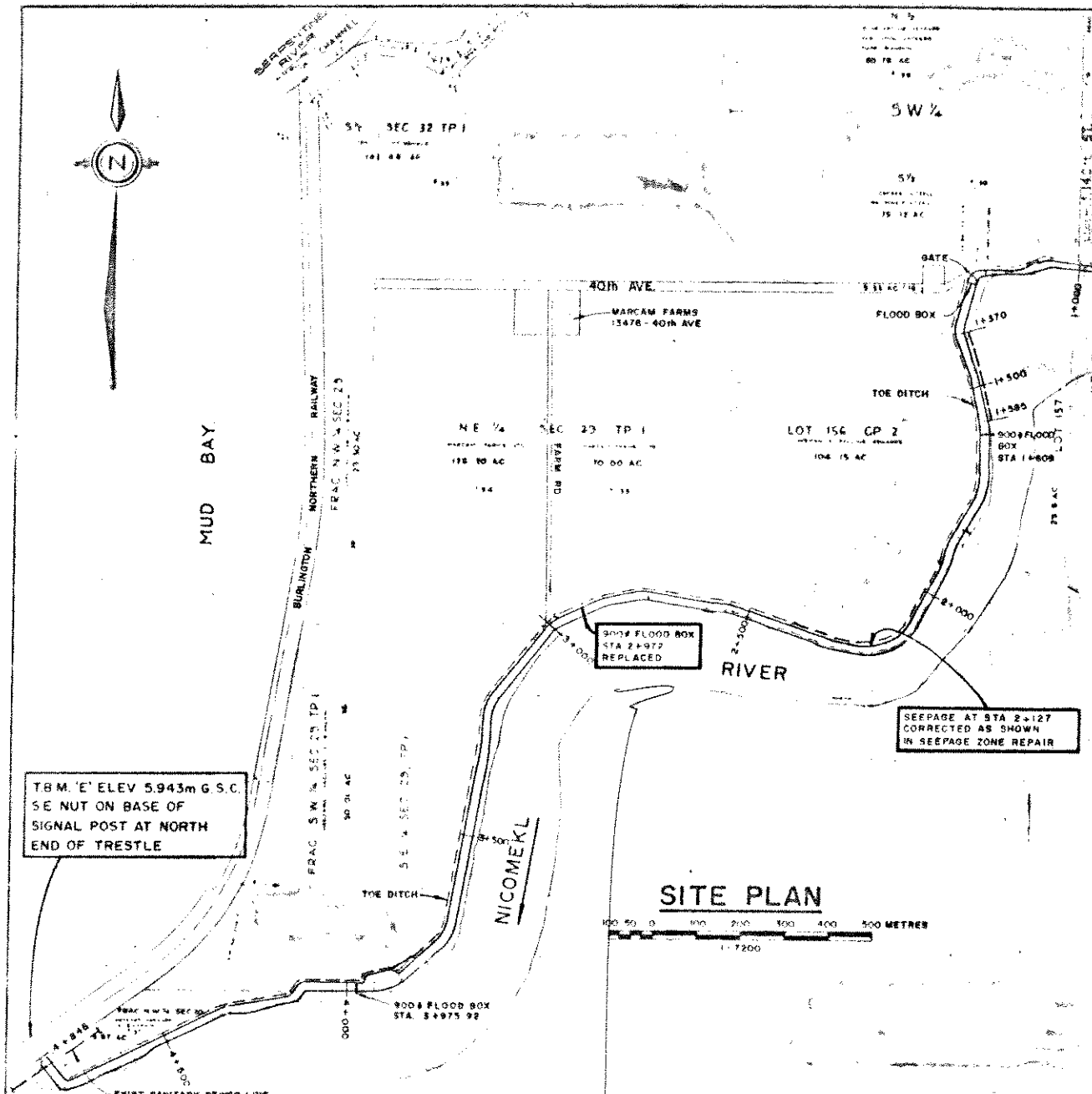
DAYTON & KNIGHT LTD.
CONSULTING ENGINEERS

DWG NO 196-9 SHT 13 OF 15

REFERENCES			REVISIONS			SURVEYED M.M.C.H.		Province of British Columbia Ministry of Environment WATER MANAGEMENT BRANCH		FILE NO
DWG No	DESCRIPTION	DATE	No	DESCRIPTION	DATE	DATE	DESIGNED	1984-1985 FLOOD CONTROL PROGRAM COLEBROOK/NEED BAY DYKING DISTRICTS CONTRACT NO. 1 SERPENTINE RIVER KING GEORGE HWY. TO BURLINGTON NORTHERN RAILWAY TYPICAL DYKE CROSS SECTIONS		D84-3
			1	RECORD DRAWING	NOV. 1984	APRIL 1985	D.K.			
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							DATE			
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							CHECKED			
							DATE			
							ENGINEER			
							DATE			
							RECORDED			
							DATE			
							APPROVED			
							DATE			

280 279

END PROJECT NO	
NTS MAP NO	
SCALE	NTS
DRAWING NO	84-6-13
SHEET	13 OF 15



REFERENCES		REVISIONS		SURVEYED M.M. DATE FEB. 1984		Province of British Columbia Ministry of Environment WATER MANAGEMENT BRANCH		280 281 FILE NO. P 84-3	
DWG No.	DESCRIPTION	DATE	No.	DESCRIPTION	DATE	DESIGNED D.K.	1984-1985 FLOOD CONTROL PROGRAM COLEBROOK, MUD BAY DYKING DISTRICTS STANDARD DETAILS AND FLOODBOX REPLACEMENT ON NICOMEKL RIVER	ENG PROJECT NO.	
			1	RECORD DRAWING	MAR 87	CHECKED H.H.		N.T.S. MAP NO.	
						DATE April 3 87		SCALE AS SHOWN	
						DRAWN R.H.U.		DRAWING NO. 84-0-15	
						CHECKED J.K.		SHEET 15 OF 15	
						DATE	DATE	DATE	DATE
						APPROVED	DATE	APPROVED	DATE