Manitoba Hydro

P.O. Box 815 • Winnipeg, Manitoba Canada • R3T 2P4
Telephone / N° de téléphone : (204) 474-3557 • Fax / N° de télécopieur : (204) 474-4312
bjosiowy@hydro.mb.ca

2005 04 12

Mr. St. Topping, P.Eng.
Executive Director
Manitoba Water Stewardship
200 Saulteaux Crescent
Winnipeg, MB R3J 3W3

Dear ~~Sir~~: Steve

WUSKWATIM PROJECT, INTERIM WATER POWER LICENSE GENERAL LAYOUT PLAN AND SUPPORTING DATA SUBMISSION

Attached is a submission of the information available at this time provided in accordance with the provisions of *The Water Power Act* (C.C.S.M.c. W60) and Sections 11 to 13 of Regulation M.R. 25/88R in support of an application for an Interim Water Power Licence for the Wuskwatim Project.

From the applicant's perspective, the attached submission demonstrates that the Project facilitates the most beneficial utilization of the resources of the stream, is feasible and practicable, is in the public interest and should be approved to proceed.

In order that approvals process continues to progress, the applicant will submit a set of construction plans for the first phase of construction within the next 90 days. A schedule of when the remaining drawings and specifications will be submitted will be included with the next submission. If you have any questions please do not hesitate to contact us at your convenience.

Yours truly.

Original signed by: B.J. Osiowy

B.J. Osiowy, P.Eng.
Hydro Power Planning Dept.
Power Planning & Development

BJO/rlm/00184-07310-0134-00
Attach

xc:	K.R.F. Adams	
	E. Wojczynski	M. Moody, Co-Manager, NCN Future Development
	D. Cormie	N. Linklater, Co-Manager, NCN Future Development
	W.C. Everett	V. Matthews-Lemieux, NCN
	R.D. Bettner	K.M. Tennenhouse
	R.R. Raban	J. Markowsky
	J.R. Kustra	D. Bedford

MANITOBA HYDRO SUBMISSION
REGARDING THE
GENERAL LAYOUT PLAN AND SUPPORTING DATA
ASSOCIATED WITH THE WUSKWATIM PROJECTS
(GENERATION AND TRANSMISSION)
ON THE BURNTWOOD RIVER

Manitoba Hydro hereby provides the General Layout Plan and Supporting Data associated with the Wuskwatim Projects (Generation and Transmission) on the Burntwood River.

(a) **Applicant:**
Manitoba Hydro

(b) **Address:**
820 Taylor Avenue
P.O. Box 815
Winnipeg, Manitoba
R3C 2P4

Occupation:
Electric & Gas Utility

(c) **River:**
Burntwood River

(d) **Purpose:**
This information is provided in accordance with the provisions of the Water Power Act C.C.S.Mc. W60 and Sections 11 to 13 of Regulation M.R 25/88R in support of an application for an Interim Water Power Licence for the

Wuskwatim Project. The submission has been organized to follow the specific requirements of Sections 11 to 13 by including the text from the regulation in bold text and the response in normal text.

(e) Background to Submission:

Manitoba Hydro has previously submitted to Mr. S. Topping, then Director, Water Branch, Dept. of Conservation (now – Executive Director, Infrastructure and Operations Division, Water Stewardship) the following documents as part of the Water Power Licencing process in accordance with Sections 3 and 7 of the Water Power Regulation;

- Wuskwatim Project Interim Water Power Application on 2003 06 04,
- Wuskwatim Project Interim Water Power Licence Survey Permit Application on 2004 05 05,

Water Stewardship issued;

- Survey Permit on 2004 06 29.

DATED at Winnipeg, Manitoba the 12 day of April, 2005.

MANITOBA HYDRO

Per: Original signed by: B.J. Osiowy

B.J. Osiowy, P. Eng. Manager

Hydro Power Planning Department

General Layout Plan and Supporting Data for Power Development Purposes Associated with the Wuskwatim Project on the Burntwood River in accordance with Sections 11 to 13 of the Regulations under the Water Power Act

11 Forthwith after the issuance of the Survey Permit, the applicant shall proceed with the preparation of general layout plans and data, and shall file them within the time the director specifies.

Manitoba Hydro hereby provides the General Layout Plan and Supporting Data for power development purposes associated with the Wuskwatim Projects (Generation and Transmission) on the Burntwood River based on the best available information at the time of this submission.

12(1) The general layout plans and data shall be such as in conjunction with the data already available in the department will enable the director to determine whether the proposed works are of suitable design to accomplish the purpose intended, whether the proposed development is in general accord with the most beneficial utilization of the resources of the stream, and whether the proposed undertaking is feasible and practicable and in the public interest, and such plans shall further conform to any requirements of the director not inconsistent with this regulation.

Manitoba Hydro and the Nisichawayasihk Cree Nation (NCN, Manitoba Hydro's potential partner) on April 2003 submitted to the Director, Environmental Approvals, Manitoba Conservation, a report entitled "Environmental Impact Statement, Wuskwatim Generation, April 2003".

Under a separate cover, Manitoba Hydro filed the “Environmental Impact Statement for the Wuskwatim Transmission Project, April 2003” report and a document entitled ”Need for and Alternatives to the Wuskwatim Project’ April 2003 to the Director, Environmental Approvals.

The referenced documents described a proposal to proceed with the construction of a 200 megawatt generating station called Wuskwatim at Taskinigup Falls on the Burntwood River and the associated transmission lines and switching stations to connect the generating station to Manitoba Hydro’s existing integrated transmission system (Figure 1).

In addition to the previously referenced submission, Manitoba Hydro and NCN have undertaken to respond to several rounds of questions from members of the Technical Advisory Committee, questions from funded participants through a series of Interrogatory sessions, as well as an intensive question and answer session as part of the Clean Environment Commission public hearings held in the March to June period of 2004.

The following summarizes the information previously submitted and addresses the specific questions raised in Section 12(1).

The proposed Wuskwatim Projects (Generation and Transmission) in-service-date is being advanced from its domestic load requirement of 2020 in order to benefit from additional export revenues and the potential for profit. The 1550 gigawatt hours of energy produced annually from the Wuskwatim Project will assist in offsetting the decline in exports resulting from growth in demand from within Manitoba. Such advancement will also contribute to the reliability of power supply for Manitobans in the early time period and will provide the additional power to Manitobans in the event of higher than expected load growth. Current economic evaluations of the Project show an attractive rate of return on investment, consistent with the relatively low risks associated with the Project. Manitoba Hydro concluded at the CEC hearings in June of 2004 that there is a net positive effect on Manitoba Hydro customer rates and that there would be no negative effect on Manitoba Hydro's financial stability as a result of proceeding with the Wuskwatim Project. The partnership between the proponents was described to the degree such information was required to understand the financial analysis and this information was fully tested throughout the pre-hearing and hearing processes.

The project concepts and preliminary engineering design that has resulted from the planning process for Wuskwatim have been prepared by an experienced and mature team of Professional Engineers from both Manitoba Hydro and its Engineering Consultants. Workplace Safety and Dam Safety have been emphasized into the design. The Wuskwatim Generating Station structures have been designed in accordance with the Dam Safety Guidelines published by the Canadian Dam Association. All design parameters are based on the appropriate incremental consequence classification criteria as described in the Guidelines. The Inflow Design Flood is considered to be the PMF and seismic loads have been taken into consideration in the design (See Appendix 1 for more details on the Dam Safety considerations). Workplace safety has seen a number of key safety measures included such as, fall protection measures such as non-slip, stair treads/walkways, hazard guards, pre-engineered-maintenance platforms and engineered fall protection tieoff points. Along with workplace safety measures, “designing with maintenance in mind” and environmental stewardship are values engineered into Wuskwatim to make operations and maintenance at the new stations safer for employees and the environment.

The involvement of the public, particularly the extensive involvement of NCN in all facets of project planning and the environmental impact assessment studies, has contributed substantially to planning that has limited adverse effects and enhanced positive effects of the Project. Traditional Knowledge and Western Science have both contributed to an integrated planning process.

The project will result in minimal new flooding of less than one half square kilometre which will be the smallest amount of flooding of any generating station in Manitoba Hydro's system. The design and planning for Wuskwatim has assumed that the Churchill River Diversion (CRD) would continue to be operated as it is currently, including the annual modifications to the Interim Water Power License (the "Augmented Flow Program" or AFP). The CRD seasonal flow patterns that are currently experienced would continue. No water level or flow effects of the project would be experienced upstream of Early Morning Rapids. The Wuskwatim Generating Station was designed to operate within the CRD Interim Water Power License conditions including the AFP and to operate efficiently at the most frequent historic diversion flow of approximately 990 m^3/s. Wuskwatim Lake, which is the station forebay, will be operated near the upper end of its post CRD range at 234.0 m (historic post CRD range from 232.7 – 234.3 m). The generating station will have three turbine units which combined have the capacity to pass up to 1,100 m^3/s, without spilling. The 1,100 m^3/s flow is within the historic flow range for the reach (historic range from ~ 430 to 1,250 m^3/s) resulting in flow through the spillway structure being required less than 7% of the time. The existing hydro power benefits of the CRD will be further enhanced by the production of hydroelectricity from the Wuskwatim Project such that the most beneficial utilization of the resource will be further realized. The terms and conditions described in the CRD 1973 Interim Water Power License (Water Resources Branch 1973), as modified by the annual CRD Augmented Flow Program, the City of Thompson Agreement (City of Thompson 1976), the Northern Flood Agreement (NFA, Northern Flood Agreement 1977), and the 1996 NFA Implementation Agreement (NFA Implementation Agreement 1996) and any downstream water related agreements, will not change as a result of the Wuskwatim Project.

The Project planning was the primary means of mitigating potential adverse effects related to the proposed Projects. Selection of the low head option and the shaping mode of operation for the Generation Project significantly reduced environmental effects typically associated with hydroelectric developments, which are in large part related to alteration of water regimes and flooding of terrestrial areas. Likewise, route selection for the access road ensured that key areas (such as cultural sites and important wildlife habitat) were avoided. Measures to avoid, reduce, or mitigate potential impacts during construction and operation will be described in the Environmental Protection Plans (EnvPPs) and associated documents such as the Access Management Plan, Sediment Management Plan, and Monitoring Programs. The EnvPPs are site-specific user friendly documents that provide practical approaches to legislation, licenses, permits, standards, contracts, agreements, designs and specifications for specific situations at specific locations. For example, the EnvPP provides a guide to appropriate clearing and grubbing practices based on terrain for each section of the access road and each stream crossing. The EnvPPs will incorporate licence conditions, and will be finalized following receipt of the various licences, subject to review by the various regulatory agencies.

The environmental investigations for the projects have spanned five years and have had a level of aboriginal participation in the management, direction, fieldwork investigations and consultation activities not seen in any other Manitoba project and rarely, if ever, elsewhere in Canada. The Environmental Impact Statements conclude that the Project is expected to create no significant adverse effects on the biophysical environments.

Positive biophysical effects are likely to result from displacing global green house gas emissions as well as reducing annual fluctuations in water levels at Wuskwatim Lake that were caused by CRD. Positive effects for people are likely to result from construction-related employment and business benefits for NCN and other communities in the Northern Region, improved access to the Wuskwatim Lake area for NCN, and a Transmission Development Fund to provide ongoing community benefits to Aboriginal communities whose traditional use areas are traversed by the Transmission Project.

Subsequent to the public hearings that concluded in late spring of 2004, the Clean Environment Commission (CEC) report was submitted to the Minister of Conservation on September 22, 2004 recommending the Projects be licensed. The Commission reported that they believe that MH and NCN had adequately justified the Projects and the Commission was satisfied that the Projects are economic. The Commission reported that adequate evidence was presented to allow the Commission to determine, that, if the appropriate mitigation and monitoring regime is put in place and the Projects are constructed and operated as proposed, the adverse impacts on the biophysical, socio-economic and cultural environment will not be significant. If managed and developed in an appropriate manner, the benefits for Aboriginal people, northerners, and all Manitobans could be significant. For these reasons, the Commission recommended licensing the projects subject to a series of terms and licensing conditions contained within the report.

12(2) The plans and specifications referred to in section 11 and subsection (l) shall:

(a) be carefully prepared, and based upon actual and thorough surveys and investigations on the ground;

- These requirements have been duly noted.

(b) be in sufficient detail to enable the department engineers to determine exactly what is proposed to be done by the applicant;

- These requirements have been duly noted.

(c) show the position of the proposed works with reference to surrounding objects, so that the exact scope of what is desired may be readily located and ascertained; and

- These requirements have been duly noted.

(d) show what provision is made for navigation, logging, and other interests, as required by section 87; "(Section 87) Notwithstanding any rights granted or approval given by any licence, every licensee shall comply fully with the provisions of the *Navigable Waters Protection Act* (Canada) and any rules and regulations promulgated there under, and shall also comply fully with the provisions of any provincial statutes or regulations governing the preservation of the purity of waters or governing logging, forestry, fishing, wildlife or other interests present or future conservation which might be affected by any operations conducted under the licence and shall also observe and carry out any instructions of the minister concerning any of those matters not inconsistent with the said statutes and regulations."

Manitoba Hydro and NCN have been working with other regulatory authorities charged with the various other federal and provincial statues to satisfy any preauthorization requirements. Upon receiving appropriate authorizations and approvals, Manitoba Hydro and NCN intend to comply fully with the associated provisions.

12(3) The plans and specifications referred to in subsections (1) and (2) and section 11 shall ordinarily include the following items but in certain cases the applicant may be excused by the director in writing from supplying some part or parts of the information called for by this subsection:

(a) a general map with scale so selected as to clearly define the location of all dams, reservoirs, conduits, powerhouses and other works, except transmission lines;

Please refer to the attached figures:

Figure 1 Wuskwatim Project Location Plan

Figure 2 Stage 4 Studies Project Area Plan

Figure 3 Stage 4 Studies Principal Structures General Arrangement

Figure 4 Wuskwatim Generating Station Access Road Key Plan

Figure 5 Camp Site, Work Area & Site Access Area Buildings Number & Location General Arrangement.

(b) a cross section of each dam site along the centre line of the proposed dam with graphical log of each boring, test pit, or other exploration, and a brief statement of the character and dip of the underlying material;

Please refer to the attached figures and table below:

Figure 6 Stage 4 Studies 1971 Investigations Taskiningup Falls Area Surface Geology

Figure 7 General Legends, Tables and Notes

Figure 8 1999 Site Investigation Report Principal Structures Area Locations of Explorations & Geological Sections

Figure 9 1999 Site Investigation Report Principal Structures Area Bedrock Geological Sections

Figure 10 1999 Site Investigation Report Principal Structures Area Bedrock Geological Sections

Table 12(3) b – Foundation Materials	
Structure	**Foundation Materials**
Main Dam – on South Abutment and North Dyke (where founded on overburden)	Lacustrine clays consisting of varved silts and clays, plus a thin, discontinuous layer of granular material which immediately overlies bedrock. The lacustrine clays are of low to high plasticity. Desiccation has produced an overconsolidated surficial crust. The varving is highly variable, but tends to be approximately horizontal.
Main Dam – river section South Transition Structure	Greywacke gneiss Precambrian bedrock, which is typically dark grey, fine to medium grained, strong, weak to strong foliation, fresh to faintly weathered, typically moderately spaced joints, good to excellent rock quality, and low permeability. Two foliation sets have been identified below the Main Dam – river section and South Transition Structure: (i) generally has a northeasterly strike and dips at 33° to the southeast; (ii) generally has a southwesterly strike and dips at 49° to the northwest.
Intakes/Powerhouse Service Bay Non-Overflow Dam Spillway North Dyke – where founded on bedrock	Greywacke gneiss Precambrian bedrock, which is typically dark grey, fine to medium grained, strong, weak to strong foliation, fresh to faintly weathered, typically moderately spaced joints, good to excellent rock quality, and low permeability. The foliation generally has a northeasterly strike and dips at 41° to the southeast.

Table 12(3) b – Foundation Materials (continued)	
Structure	**Foundation Materials**
Excavated Material Placement Area	Lacustrine clays consisting of varved silts and clays, a discontinuous layer of granular material, which immediately overlies bedrock. The lacustrine clays are of intermediate to high plasticity, soft to stiff. The top 4 to 8 m of the overburden forms a relatively stiff overconsolidated crust as a result of desiccation, and is underlain by up to 17 m of soft normally consolidated clays. The central portion of the area contains a wide band of permafrost affected soils, containing high ice contents, which extend to a depth of 7 m. The area also contains two linear depressions in the bedrock surface, which trend southwest-northeast, and which are infilled at the base by granular material. These infilled zones are covered by more than 18 m of lacustrine clay.

(c) plans, elevations and cross sections of the dams, showing spillways, sluiceways or sluice pipes and other outlet or control works, and of the other principal structures which may be required;

Please refer to the attached figures:

Figure 3 Stage 4 Studies Principal Structures General Arrangement

Figure 11 River Diversion During Construction Plans

Figure 12 River Diversion During Construction Sections

Figure 13 Principal Concrete Structures Plan

Figure 14 Intake and Powerhouse Sections

Figure 15 Service Bay Section

Figure 16 Powerhouse Plans

Figure 17 Intake and Powerhouse Water Passage Plans

Figure 18 Intake and Powerhouse & Service Bay Plans

Figure 19 Intake and Powerhouse & Service Bay Plan Above Generator Floor

Figure 20 Service Bay Plans

Figure 21 Intake and Service Bay Longitudinal Sections

Figure 22 Powerhouse and Service Bay Longitudinal Section at CL Units

Figure 23 Powerhouse and Service Bay Longitudinal Section Through Dewatering Gallery

Figure 24 Spillway and Non-Overflow Dam Plan and Sections

Figure 25 Walls, Diesel Generator Room & South Transition Structure Plan and Sections

Figure 26 Stage 4 Studies Spillway Approach and Discharge Channels Sections

Figure 27 Earth & Rock Fill Structures Sections

Figure 28 Upstream Channel Improvements Plan and Sections

(d) a satisfactory contour plan showing the proposed powerhouse and other works;

Please refer to the attached figures:

Figure 2 Stage 4 Studies Project Area Plan

(e) a satisfactory contour plan of the entire water conduit location and a plan, elevation and cross section of each type of water conduit;

Please refer to the attached figures:

Figure 3 Stage 4 Studies Principal Structures General Arrangement

Figure 14 Intake and Powerhouse Sections

Figure 17 Intake and Powerhouse Water Passage Plans

Figure 22 Powerhouse and Service Bay Longitudinal Section at CL Units

Figure 24 Spillway and Non-Overflow Dam Plan and Sections

Figure 26 Stage 4 Studies Spillway Approach and Discharge Channels Sections

Figure 28 Upstream Channel Improvements Plan and Sections

Figure 29 Stage 4 Studies Site Area Bedrock Surface Contours

(f) a satisfactory contour plan of each reservoir site showing the amount of flooding involved, and the location and character of each proposed dam and of other contingent works;

Please refer to the attached figures:

Figure 2 Stage 4 Studies Project Area Plan

(g) a map or plan of the survey of the proposed final location of the centre line of all main transmission lines to and including the receiving stations;

The proposed routes for the Wuskwatim transmission lines, including the approximate locations of the existing and proposed transformer and switching stations required to deliver electricity from the proposed Wuskwatim Generating Station into the existing Manitoba Hydro system are illustrated in Figure 1 – Wuskwatim Project Location Plan and described below;

- At the Wuskwatim site, the lines to Birchtree Station and Herblet Lake Station will be terminated into the Wuskwatim Switching Station which will be connected to the Wuskwatim Generating Station via three transmission lines. The construction power line will be temporarily terminated (during the construction period) at the Wuskwatim construction power station located adjacent to the main access road from Provincial Road 391 and north of the proposed site for the permanent switching station. Figure 30 Wuskwatim Construction Power 230-12kV Switchyard Structure and Equipment Plan View.
- A new 230 kV transmission line from Wuskwatim to the a proposed new switching station to be called Birchtree Station, located south of the City of Thompson in the Local Government District of Mystery Lake. This transmission line would provide construction power for the proposed generating station. Figure 34 – Transmission Line B76W Plan showing Construction Power TL Route from Thompson-Birchtree Station to Wuskwatim GS.
- Two new 230 kV transmission lines from Wuskwatim to the existing Herblet Lake Station, north of Snow Lake. Figure 35 – Transmission Line H73W & H74W Plan Showing Transmission Line Route from Herblet Lake Station to Wuskwatim Generating Station.
- One new 230 kV transmission line from Herblet Lake Station to the existing Rall's Island Station at The Pas. Figure 36 – Transmission Line H75P Plan Showing Transmission Line Route from Herblet Lake Station to The Pas-Ralls Island Station.

A detailed map or plans of survey of the proposed final location of the centre line of the transmission line from Wuskwatim to Birchtree Station is currently in final preparation and will be provided for regulatory approvals prior to construction. As the Wuskwatim to Herblet Lake Station and Herblet Lake to Rall's Island Station's 230 kV transmission lines are not required to be in-service until the generating station is completed, in-service dates for these lines occur later, and hence detailed maps or plans of survey are not currently available at this time and will be forwarded for regulatory approval prior to construction.

Please refer to the attached figures:

Figure 31 Thompson - Birchtree Station Concept Layout w/Typical Mitsubishi SVC

Figure 32 Herblet Stn. Stage 4 Development Wuskwatim H73W, H74W & The Pas Ralls Is. H75P Line Terminations Complete with Associated Equipment

Figure 33 The Pas - Rall's Island Station Concept Plan Photo Base 2000-05-22

(h) plans or maps in every case showing the location and area of the lands which are required to be occupied, used, or flooded in connection with the proposed works, described by section, township and range or by lot number, if in surveyed territory, and, if other than Crown lands, by the name of the registered owner in fee, of any registered mortgagee or lessee, and of any claimant in actual possession other than a registered owner, mortgagee or lessee;

Please refer to the attached figures:

Figure 1 Wuskwatim Project Location Plan

The following has been extracted from the Licence application Section (k) and modified to include additional lands that may be included within the Severance Line Drawing- Description of Land Area Required;

Part I - Crown Lands

The following is an estimate of the Provincial Crown lands required:

(1) "lands of the province not covered by water required for main diverting works, powerhouse, and similar works" including construction work area, campsite, dam abutments, powerhouse, spillway, main dam, granular and impervious borrow areas, intake and tailrace excavated channels and disposal areas for surplus excavated materials as located in portions of Twp. 75-R7W of the Principle Meridian, Twp. 76-R7WPM, Twp. 76-R6WPM, Twp. 77-R6WPM, Twp. 77-R5WPM and Twp. 78-R5WPM.

200 hectares (494 acres)

(2) "lands of the province covered by water required for the said purpose," including cofferdams, spillway, main dam, and channel excavations as located in portion of Twp. 75-R7WPM:

26 hectares (64 acres)

(3) "lands of the province required only to be flooded in connection with the storage of pondage of water (Figure 9) as located in portion of Twp. 75-R7WPM:

37 hectares (91.4 acres)

(4) "lands of the province required only for rights of way for water conduits, transmission lines, and similar works" including the following:

(i) One 230-kV transmission line corridor from the Wuskwatim Switching Station to a new "Birchtree" Station just south of the City of Thomspon, with a right-of-way 60 m wide and 45 km long. Located in portions of Twp. 76-R7WPM, Twp. 76-R6WPM, Twp. 76-R5WPM, Twp. 76-R4WPM, Twp. 77-R4WPM and Twp. 77-R3WPM.

270 hectares (667 acres)

(ii) Two 230 kV transmission lines within one corridor from the Wuskwatim Switching Station to the existing station at Herblet Lake Station with a right-of-way 110 m wide and 137 km long. Located in portions of Twp. 68-R17WPM, Twp. 69-R17WPM, Twp. 69-R16WPM, Twp. 70-R16WPM, Twp. 70-R15WPM, Twp. 71-R15WPM, Twp. 71-R14WPM, Twp. 71-R13WPM, Twp. 72-R13WPM, Twp. 72-R12WPM, Twp. 72-R11WPM, Twp. 72-R10WPM, Twp. 72-R9WPM, Twp. 73-R9WPM, Twp. 73-R8WPM, Twp. 74-R8WPM, Twp. 74-R7WPM, Twp. 75-R7WPM and Twp. 76-R7WPM.

1507 hectares (3724 acres)

(iii) One 230-kV transmission line corridor from the existing Heblet Lake Station to the existing Rall's Island Station near The Pas with a right-of-way 60 m (197 ft) wide and 165 km (103 miles) long. Located in portions of Twp. 56-R26WPM, Twp. 57-R26WPM, Twp. 57-R25WPM, Twp. 57-R24WPM, Twp. 58-R24WPM, Twp. 58-R23WPM, Twp. 59-R23WPM, Twp. 59-R22WPM, Twp. 59-R21WPM, Twp. 60-R21WPM, Twp. 60-

Part II - Private Lands

There are no known private lands within the designated area categories listed in 12(3) (h) **Part I - Crown Lands** above, other than the lands that are held by Manitoba Hydro for part of the Birchtree Station, and all of the Herblet Lake and Rall's Island Stations. There are several land selections within the lands required for the project area that are currently in various stages of the Treaty Land Entitlement selection process. Manitoba Hydro is currently in the process of acquiring the land for the Generating Station and the access road on behalf of the potential Wuskwatim business partnership.

(i) a general report outlining and describing the plan by which the applicant proposes to develop the water privilege, setting out:

(i) the dams, weirs, tunnels, races, flumes, sluices, pits and other structures or works which it is proposed to build or make in connection therewith,

The camp facilities and infrastructure have been provisionally designed to accommodate a construction work force of approximately 625 people. These facilities are temporary and will be removed and the area rehabilitated following construction. Wuskwatim is located on the Precambrian Shield. The topographic relief in the area is low, seldom exceeding 30 m, with broad expanses of peat plains overlying deep lacustrine deposits. Permafrost is sporadic throughout the area. The overburden consists primarily of lacustrine varved silty layers and there is generally a thin layer of dense semi-pervious granular till mantling the bedrock surface below the varved clay. The bedrock is garnetiferous gneiss, and is competent and suitable for the foundation of the Principal Structures at this site.

The proposed Wuskwatim Generating Station (Wuskwatim GS) will be constructed downstream of the outlet of Wuskwatim Lake at Taskinigup Falls in northern Manitoba, Canada, at Latitude 55° 32' 29", and Longitude 98° 30' 14", Section 33, Township 75, Range 7 West of the Principal Meridian.

The site is located approximately 48 km southwest of Thompson, and 37 km southeast of Nelson House. It is located on Provincial Crown land and falls within the Nelson House Resource Management Area. The location of Wuskwatim GS is shown on Figure 1. Wuskwatim Generating Station will consist of a three unit close-coupled Intake/Powerhouse complex with an adjacent three bay Spillway.

These principal concrete structures will be linked by a short gravity section non-overflow concrete dam and flanked by concrete elements that will tie into earth and rockfill embankment closure sections. Each of the main elements, including the concrete structures, and the earth and rockfill Main Dam and North Dyke will be founded on competent bedrock. A short distance to the north and west, and completing the containment of the reservoir, an engineered excavated material placement area will be founded on overburden. Overburden and rockfill materials from the excavations required for the construction of the Principal Structures and which are surplus to the project construction requirements, will be disposed of in this area.

The project area plan and the principal structures general arrangement are shown on Figures 2 and 3. The optimum arrangement of the structures places the Powerhouse and Spillway on the left (north) bank of the river and the Main Dam immediately above the crest of Taskinigup Falls. This arrangement takes advantage of the local surface and bedrock topography to produce the best hydraulic entrance and exit conditions, to minimize rock excavation quantities and costs, and to allow the most expedient construction diversion sequencing. In consequence, the 630 m long south-westerly trending axis of the main structures is articulated through 47 degrees about the South Transition that is approximately at the one-third point of the axis.

The Powerhouse, to be constructed close to the north bank of the original river channel, will have semi-spiral concrete scroll cases to accept the three vertical axis, fixed-blade, propeller turbines. The overall rated plant capacity is estimated to be 204 MW. A Service Bay, housing station services and providing maintenance and equipment assembly areas for the turbines and generators, will be located at the north side of the Powerhouse. The road to the main Service Bay entrance door will be accessed from the crest of the Non-Overflow Dam via a descending ramp to a large parking area at the Service Bay floor level.

The Spillway, to the north of the Powerhouse, will be a three-bay sluice with heated vertical lift gates operated by wire rope hoists. A concrete Non-Overflow Dam will link the Powerhouse and the Spillway, and will provide continuous access from the

North Dyke to the Main Dam crest. The Non-Overflow Dam structure will also house a standby diesel generator.

To improve flow approach conditions to the Powerhouse and to reduce head losses through the area of the natural flow control of Wuskwatim Falls, a channel will be excavated through the peninsula to the north of the Wuskwatim Falls.

The Main Dam and North Dyke will be zoned earth and rockfill embankments each with a compacted clay core, granular filters and transitions, and rockfill shells. Both structures will be founded on bedrock and, while the North Dyke will close completely to bedrock, the south abutment of the Main Dam will close to impervious native overburden.

To the north of the Spillway, a low saddle at el 231.0 m will be the site of an engineered excavated material placement area for surplus clay and rockfill materials. A portion of the disposed fill will be placed on permafrost-affected overburden.

Construction of the project will be carried out in two stages. Stage I will involve the construction of the Powerhouse and Spillway in the north bank spur, under the protection of an upstream cofferdam and a downstream plug and cofferdam. Following partial completion of the Powerhouse/Intake structure (sufficient to permit inundation of the Intake Approach Channel) and the completion of the North Dyke, along with the Spillway and its Discharge Channel, the Burntwood River will be diverted from Taskinigup Falls into the Spillway Approach Channel, through the partial removal of the Stage I Upstream Cofferdam, and the construction of the Stage II Upstream Cofferdam (to the upstream of the Main Dam's axis). The second stage of the construction will involve the construction of a cofferdam across the river to the downstream of Taskinigup Falls, followed by completion of the Main Dam earthfill, and excavation of the Powerhouse Tailrace Channel.

With the exception of concrete sand and fine filters, materials for construction will be obtained and processed from the necessary excavations or within a short distance of the project site. The concrete sand and fine filters will be obtained from borrow areas located 20 km to 25 km from the site, adjacent to the main access road.

(ii) the form in which the power developed is to be used, namely direct mechanical connection, generation of electricity or otherwise, and the purpose for which it is to be used,

Wuskwatim Generating Station will generate electricity for the purpose of supplying power and energy to Manitoba Hydro's integrated system. Manitoba Hydro's integrated system serves domestic and export commitments, and includes sales to Ontario, Saskatchewan and certain areas within the United States of America.

(iii) any contemplated sale, delivery or transfer of the power to other than the licensee,

No specific sale has been negotiated for the Wuskwatim Project. The average annual production of 1550 gigawatt hours of energy from the Wuskwatim Project will provide additional supply which will be available to Manitoba Hydro's integrated system which serves domestic and export commitments, and includes sales to Ontario, Saskatchewan and certain areas within the United States of America. The Wuskwatim Project will provide additional export revenues which will contribute to Manitoba Hydro's profits. Without the Wuskwatim Project, there would be a decline in exports as a result of growth in electricity demand from within Manitoba.

(iv) if the power is to be transmitted, the territory within which such sale, delivery or transfer is to be exercised,

Manitoba Hydro will export all surplus power and energy to export customers which includes Ontario, Saskatchewan and certain areas within the United States of America.

(v) the estimated demand for power within such territory,

The demand for power within the export territory continues to be strong and evidence presented to the CEC demonstrated that the market risk for Wuskwatim power is low - that over the next 20 years, 9,600 megawatts of new generation capacity will be required in nearby U.S. markets where Manitoba Hydro could look to sell Wuskwatim's 200 MW.

(vi) any other data necessary to a full understanding of the nature and objects of the undertaking,

To restate from above, the proposed Wuskwatim Projects (Generation and Transmission) in-service-date is being advanced from its domestic load requirement of 2020 in order to benefit from additional export revenues and the potential for profit. The 1550 gigawatt hours of energy produced annually from the Wuskwatim Project will assist in offsetting the decline in exports resulting from the growth in demand from within Manitoba. Such advancement will also contribute to the reliability of power supply for Manitobans in the early time period and will provide the additional power to Manitobans in the event of higher than expected load growth.

(vii) the natural height of the fall or rapid,

There are two sets of falls in the immediate vicinity of the proposed site for the Wuskwatim GS, Wuskwatim Falls (approximately 7 m) and Taskinigup Falls (approximately 15 m). Together, the two falls account for a drop of approximately 22 m.

(viii) the extreme high and low water levels at the power dam site and the power station site, and of all bodies of water proposed to be used as storage reservoirs,

The high and low water levels for the reservoir, as well as the extreme levels for the forebay and tailrace, are summarized below; if for licencing purposes it is necessary to reference a particular water level, it is understood that such references will be based on daily average wind and wave eliminated elevations above sea level;

- The normal Full Supply Level (FSL) for the reservoir, as measured on Wuskwatim Lake, will be 234.0 m asl.
- Up-to one metre of storage has been designated for utilization for operations.
- The minimum reservoir level will be 233.0 m asl.
- Extreme high water level for the reservoir will be 235.6 m asl under the Probable Maximum Flood (PMF).
- Extreme low water level for the reservoir will be maintained at or above 233 m asl.

- Extreme high water level for the immediate forebay will be 235.5 m asl under the PMF.
- Extreme high water level for the downstream side of the power station site is expected to be 217.8 m asl under thePMF.
- Extreme low water level for the downstream side of the power station site is expected to be 209.8 m asl under one unit operation.

(ix) the flow of water in cubic feet per second at the high, low, and average stages,

Manitoba Hydro has developed an estimate of the long-term (1912 to 1997) monthly average inflows or project inflows to Wuskwatim Lake, to assess the operation of the Wuskwatim GS under a much longer time period of flow conditions than is available using the 25-year post-CRD (existing) record. The high flow that is expected over the long term is 1 126 m^3/s, the low flow that is expected is 435 m^3/s with the average expected to be 941 m^3/s.

Wuskwatim Generating Station outflows through the Powerhouse are estimated to be the following:

330 m^3/s - 3% of the time;
660 m^3/s - 18%;
990 m^3/s - 52%;
990 to 1 100 m^3/s - 20%; and,
over 1 100 m^3/s - 7% (the excess flow above 1 100 will be passed through the Spillway).

A significant amount of water regime information has been collected at various sites within the Project area and can be made available, if required.

(x) the estimated capacity in horsepower of the fall or rapid in its natural condition at the average low stage of water,

The average long term minimum monthly inflow into Wuskwatim Lake is estimated to be 435 m^3/s. The total drop over both Wuskwatim Falls and Taskinigup Falls is approximately 22 m. Therefore, the estimated capacity in horsepower available under natural conditions over the 22 metre drop, for a long term minimum flow of 435 m^3/s assuming the efficiency of conversion to be about 91% would be 115,000 horsepower or approximately 85 MW (435 * 22 * 0.91 * 9.806 /1000).

(xi) the area and available capacity of each proposed storage reservoir,

There will be one integrated reservoir formed by the Wuskwatim Project. The reservoir created by the project comprises the immediate forebay area and Wuskwatim Lake. The normal Full Supply Level (FSL) for the reservoir, as measured on Wuskwatim Lake, will be 234.0 m above sea level (wind and wave eliminated water level). Wuskwatim Lake water levels will be stabilized within the existing Wuskwatim Lake water regime near the FSL most of the time. Up-to one metre of storage has been designated for utilization for operations. Approximately 37 ha of land will be flooded as a result of the construction of Wuskwatim GS in the immediate forebay area. The estimated surface area of the reservoir at elevation 234.0 m is approximately 8 840 ha. The storage is separated into two areas; the immediate forebay area, with a surface area of approximately 90 ha, and Wuskwatim Lake, with a surface area of approximately 8 750 ha. The live storage is estimated at 8 840 ha – m.

(xii) the estimated percentage of stream flow to be made available from storage,

A modified run-of-river mode of operation is proposed for the Wuskwatim Project. The plant will operate in the modified run-of-river mode of operation approximately 97.5 percent of the time by shaping daily outflows to balance daily inflows. Therefore, for the majority of operation, the percentage of stream flow made available from storage is negligible.

(xiii) all other data necessary to a full consideration of the natural features of the site or sites of the proposed works,

Manitoba Hydro was directed to include a description of the setting into which these projects will be constructed. The physical environment of the project areas is extensively described in supporting volumes to the Generation and Transmission EIS's. The existing physical environment along the Burntwood River system has been altered, and continues to be influenced, by changes brought about by the CRD in the mid-1970's. The CRD resulted in immediate changes in water regime and ice processes along the river system. Volume 4 of the Generation EIS provides an extensive description of the current situation and the anticipated changes that will result from the project.

(xiv) the estimated total average effective head it is proposed to develop,

The estimated average head during open water conditions available for power production will be 21 to 22 m, and ranges as high as 24.4 m which would occur with one unit operating during the summer or as low as 20.8 m which would occur with three units operating at full gate during the winter.

(xv) the height and full description of any dams, or weirs, which it is proposed to construct,

Figures 2 and 3 show the location of the principal structures required for the construction of the Wuskwatim Generating Station. A description of the dams and weirs are listed below:

1. A reinforced concrete three-unit close-coupled Intake/Powerhouse will be constructed, including a South Transition Structure and Service Bay. These structures will have an overall length of approximately 159 m, with upstream deck access across the structure at a nominal elevation of 235.5 m, and a maximum height above the elevation of the structure's foundation of 57 m. Please also refer to Figures 13 through 23 for more information.
2. On the north side of the Powerhouse, there will be a reinforced concrete overflow Spillway. The Spillway will be 43 m in length and will have three (3) bays. Each of the bays will have gates 9 m wide and 16 m high. The concrete deck of the structure will be at nominal el 235.5 m and the nominal Spillway crest elevation will be 219.7 m. The height of the Spillway is 19.3 m. The Powerhouse and Spillway will be separated by a 42 m long reinforced concrete gravity Non-Overflow Dam. The height of the Non-Overflow Dam is approximately 4 m. For details of the Spillway and Non-Overflow Dam please refer to Figure 24.
3. Connecting the north end of the concrete structures and the left bank of the river will be the North Dyke. The structure will be a zoned earth and rockfill embankment, approximately 4.5 m high. It will have a 22 m wide crest, at a nominal elevation of 236.6 m with an overall crest length of approximately

85 m. The structure will have a storage area for the Spillway stoplogs. See Figures 3 and 27 for more information on the North Dyke.

4. Connecting the south end of the concrete structures and the right bank of the river will be the Main Dam. The structure will be a zoned earth and rockfill embankment, with a maximum height above foundation level of approximately 14 m, with a 9 m wide crest at a nominal elevation of 236.6 m and an overall crest length of approximately 330 m See Figure 27 for sections through the Main Dam.
5. An earth and rockfill embankment will be constructed on the left bank as part of the excavated material placement area, it will serve two purposes. Firstly, it will create a permanent disposal area for surplus overburden materials and blast rock excavated during the course of construction. Secondly, the embankment will fill in a low topographic saddle point to complete the confinement of the reservoir. The part of the excavated material placement area adjacent to the Burntwood River will have an elevated section, more specifically referred to as the Upstream Rock Berm. Its height varies along its length; at its maximum the embankment is approximately 7 m high. The total length of the Upstream Rock Berm is 700 m. See Figures 2 and 27 for further details.

(xvi) the increase in the level of the water to be brought about, and the area and character of lands to be flooded by such dams or weirs,

Flooding will be restricted to the area upstream of the concrete and earth structures, and to the downstream of Wuskwatim Lake, that is, within the area between Wuskwatim Falls and Taskinigup Falls. The vegetation growth in the area that is flooded is consistent with that of a coniferous forest. The area that will be flooded is confined to 37 ha of land. The water level in the immediate forebay area will increase approximately 7 m as a direct result of the Project. Water levels on Wuskwatim Lake will not rise above the previously established High Water Mark. Wuskwatim Lake water levels will be stabilized within the existing (post CRD) Wuskwatim Lake water regime near the Full Supply Level most of the time The extent of flooding due to construction of Wuskwatim GS is shown in Figure 2.

(xvii) the effective discharging capacity of such dams or weirs and the type of the proposed control works,

Spillway

The Spillway, shown in Figure 24, will be a gated three-bay concrete structure situated approximately 42 m north of the Service Bay. Each bay will be configured as a flat sluice with upstream and downstream guides and sill beams for upstream stoplogs, a vertical lift gate, and downstream temporary barriers for protecting maintenance operations. Neither a stilling basin nor an apron slab will be required due to the soundness of the bedrock in the Discharge Channel.

During Stage II Diversion, forebay impoundment and unit commissioning, the three Spillway gates will be used to provide regulation of flows and water levels. Upon completion of construction, the Spillway will be operated to manage flow conditions that may exist and cannot be controlled satisfactorily by regulation of the flow through the turbine units, such as during scheduled maintenance, and management of flood flows. The turbines can generally handle all flow conditions up to and including the plant outflow capability of 1100 m^3/s. A defined set of procedures will be developed to ensure safe passage of flood flows and that all regulations and license constraints are maintained to the extent practicable.

The Spillway has been designed to allow the passage of water in the unlikely event that the Probable Maximum Flood (PMF) occurs when all three units are disabled, forcing all flow through the Spillway. Spillway gates regulate the amount of flow passing through the Spillway. The Spillway gates are controlled through a hoist mechanism that must be operated by qualified plant personnel. Manitoba Hydro's System Operations Centre in Winnipeg determines how much water must be diverted through the Spillway. Once the desired amount of spill has been determined, the gates are adjusted by the plant personnel as required. Most of the time, the Spillway Gates will be in the closed position.

The Spillway gates will be of the fixed-roller vertical lift type, with vertical guides and individual wire rope hoists supported by a tower and bridge structure. All gates and guides will be heated. Each gate will have two lifting points and will be raised and lowered by an independent, electrically powered, double drum wire rope hoist mounted in the hoist housing on the bridge structure. An emergency power supply will be provided from the diesel generator in the event that the station service supply is lost.

A listing of discharge capacity and other related data are shown in the table below.

Table 12(3) (xvii) – Spillway Details	
Type	Concrete Sluiceway
Gates	
- number	Three
- type	Vertical lift
- size (opening)	15.3 m x 9.0 m
- hoists	Wire rope
Discharge capacity at normal full supply level	2320 m^3/s
Discharge capacity at incipient overtopping of concrete structures (el 235.5 m) (i.e. PMF)	2650 m^3/s

Powerhouse

The arrangement for the three-unit Powerhouse for Wuskwatim GS is shown in Figures 14 to 24. During normal operating conditions, opening and closing the wicket gates of the unit will regulate flows. Manitoba Hydro's System Operations Centre determines how much water must be passed through the Powerhouse at any given time. With all three units operating at full gate, the discharge capacity of the plant will be 1100 m^3/s at a forebay level of el 234.0 m and a net rated head of 21.0 m.

There will be three Intake openings per unit, each equipped with a gate. The gates will normally be lowered under balanced head conditions to permit inspection and/or maintenance of the turbines. In an emergency, such as a predetermined overspeed condition of the turbine, the three gates for that unit will automatically and simultaneously close to stop flow through the turbine. Provisions will be made on the downstream side of the gate to vent the water passage during emergency closure.

Each gate will have an electric motor driven wire rope hoist mounted on a structural steel frame. Each hoist assembly will include a wire rope drum assembly, sheave blocks, electromechanical brake, fan brake, electric clutch to isolate the electric motor, limit switches, cross shafting, position indicator, push button control station, and all other components necessary to operate the gate. This design isolates the electric motor from the hoist drive system and allows for a high gate closing speed in order to minimize the duration of rough turbine/generator operation encountered during emergency gate closure at unit runaway speed. Isolation of the Intake Gate hoist motors during closure ensures that they do not exceed their maximum safe rotational speed.

(xviii) the length and full description of the proposed water conduits,

Spillway Approach Channel

The Spillway Approach Channel, shown in Figure 3 and Figure 27, has two functions. As part of the completed project, its primary function is to convey water with minimal head loss to the Spillway. As part of the construction diversion works, it is also sized to enable the advancement and final closure of the Stage II Cofferdam and then to serve as the diversion channel once the cofferdam is in place above Taskinigup Falls. The river diversion sequence during construction is shown in Figure 4.

The entrance to the Spillway Approach Channel will share a deep section of the Forebay with the entrance to the Intake Channel for the Powerhouse. To avoid large excavations on the left, the channel will be curved into the Forebay on the right. The channel will be limited to a length of approximately 157 m. The invert of the channel entrance will be set at el 224 m, which is the approximate riverbed elevation at this location. The channel will be cut through overburden and bedrock. The overburden is mainly composed of lacustrine clays. Within the bedrock, the channel sides will be cut at 1H:20V. Within the overburden, the side slopes will be 5H:1V.

In areas where the invert of the channel lies within the bedrock, the toe of the overburden excavation will be locally steepened to 2H:1V and an inverted filter will be provided to control seepage from the bank and to protect against erosion. At the bedrock/over-burden contact, a minimum 4 m wide berm will be provided. To facilitate construction, all the overburden covering the bedrock area between the Spillway Approach Channel and the Intake Channel will be removed.

From the channel’s entrance, the invert will slope downward on a uniform grade over a length of 58 m to el 220.8 m. Concurrently, the channel sides will gradually narrow from a channel width, as measured at the invert, of 72 m to 50 m. This point is located just downstream of the approximate contact between the overburden and the bedrock. The grade of the invert will then become somewhat flatter, falling to el 218.7 m over a distance of 85 m. Concurrently, the channel will continue to narrow from 50 m to 37.5 m, the width between the outside piers of the Spillway. Over the last 14 m, the channel width and invert will remain constant at 37.5 m and el 218.7 m respectively.

Riprap slope protection will be provided along the base of the excavated overburden slopes below el 229 m in the area immediately upstream of the Spillway. At the upstream extremity of the Spillway Approach Channel the flow velocity is expected to increase by 3 m/s, erosion protection will be installed to prevent erosion of the clays on the sides and invert of the channel if required.

Spillway Discharge Channel

The Spillway Discharge Channel, shown in Figures 3 and Figure 27, has been designed to convey water from the Spillway to the Burntwood River, without backwater effect at the Spillway structure. The channel will be excavated through clay varying from zero to 15 m in thickness and into the underlying bedrock. In bedrock, the Channel's side slopes will be near vertical (1H:20V). In the clay however, side slopes will be 5H:1V with a minimum 4 m wide berm at the rock/overburden contact. For the most part, the flow of water in the channel will be contained within the bedrock. Where this is not possible however, the overburden surface will be protected by either a concrete wall or riprap.

The bedrock is generally a sound and competent gneiss that has been locally intruded by pegmatite or granite sills and dykes and narrow veins of quartz. It is weathered at the clay/bedrock contact and has a distinct layering and foliation striking across the channel and dipping in the direction of flow. Drilling results show that approximately at its midpoint, the channel crosses Lineament L-4, a zone in the bedrock where the surface elevation is low and which may be more erodible than the surrounding bedrock. This area will therefore require the special protective treatment noted above.

The maintenance of an appropriate separation between the outlets of the Spillway Discharge Channel and the Powerhouse Tailrace Channel will be necessary to permit construction of the Stage II Downstream Cofferdam.

The Spillway Discharge Channel will be about 500 m long and 34 m wide at its invert, the same width as the Spillway. The upstream invert will be at el 219.7 m, the same as the invert elevation of the Spillway, and will slope downward at a slope of 3% over a distance of 27.5 m. Over the next 147.5 m, the channel will have a 5% downward slope. For the remaining 150 m, the channel invert will be horizontal at el 209.2 m, allowing this reach of the channel to act as a stilling basin. The resulting minimum 3% grade will be approximately twice the estimated critical slope of the channel. This will ensure that, within an adequate margin of safety, the flow along the sloping portions of the channel will be supercritical.

Spillway

The Spillway, shown in Figure 26, will be a three-bay concrete structure situated approximately 42 m north of the Service Bay. Each bay will be configured as a flat sluice with 15.3 m by 9.0 m opening and approximately 24 m in length. Each bay will include guides and sill beams for upstream stoplogs, a vertical lift gate, and downstream temporary barriers for protecting maintenance operations. Neither a stilling basin nor an apron slab will be required due to the soundness of the bedrock in the Discharge Channel. Three Spillway gates will be used to provide regulation of discharge in the final operating arrangement of the station. The gates will be of the fixed-roller vertical lift type, with vertical guides and individual wire rope hoists supported by a tower and bridge structure. All gates and guides will be heated.

Intake Channel

The Intake Channel, shown in Figure 3, has been designed to convey flows of up to the maximum plant capacity of 1100 m^3/s from the Forebay to the Powerhouse Intakes with minimal head loss. The reach immediately upstream of the Intakes will be excavated in rock, with the balance being excavated through up to 6 m of lacustrine silty clay overlying a thin layer of granular outwash or glacial till.

During winter, and with a flow of 1100 m^3/s, the Intake Channel will have a competent ice cover. To assure the formation of the ice cover, the channel has been designed for a Froude number that will not exceed 0.07 and a vertically averaged velocity that will not exceed 0.7 m/s. The channel geometry has been developed to minimize hydraulic losses. Flow velocities will be limited, to prevent the entrainment of material into the flow.

The channel will have a rectangular cross-section that converges as it approaches the Intake Structure. The Intake Channel will start in a deep section of the Forebay approximately 147 m upstream of the Intake structure. The invert of the channel entrance has been set at el 224 m, which is the approximate riverbed elevation at that location. At that point, the channel is approximately 190 m wide. From the entrance, the channel invert will slope downward at 10H:1V over a distance of 70 m to el 217.0 m and then slopes downward at 5H:1V over a distance of 54 m to el 206.2. Concurrently, the channel sides will gradually bell-mouth inward to maintain a constant cross-sectional area. For the remaining 23 m, the channel cross section will stay constant with the invert at el 206.2 m and the width at 72.4 m. A 3-m wide and 1.5-m deep rock trap will be provided in front of the Intake structure.

Tailrace Channel

The Tailrace Channel, shown in Figure 3, has been designed to convey the Powerhouse flow from the draft tube exits to the Burntwood River with minimum head loss. The design of the Tailrace Channel has been based on an economic optimization that balances the incremental costs of excavation with the incremental value of generation and maximizes the present value of the net benefits. As the head loss through the Tailrace Channel is an important economic consideration, ensuring that the sides of the rock channel are formed by controlled perimeter blasting techniques and the invert of the channel formed by the limitation of subgrade drilling and trim blasting, as required, will minimize roughness.

The assessment of the optimum arrangement showed a channel 72 m wide with an invert at el 201.0 m to be the most economic. The invert of the Tailrace Channel slopes upward at approximately 4.5H:1V from el 194.0 m to el 201.0 m. The invert then remains horizontal to a location approximately 240 m downstream from the Powerhouse. The channel bottom is then feathered in to match the riverbed levels near the toe of the cofferdam. Horizontally, the width of the Tailrace Channel remains at approximately 72 m, the width of the Powerhouse. The downstream portion of the channel matches the river cross section near the toe of the cofferdam. Within the bedrock, the sides will be excavated at 1H:20V. Within the overburden, the side slopes will be at 5H:1V. At the bedrock/overburden contact, a 4 m wide berm will be provided.

Intake

There will be three water passages through each Intake separated by two intermediate piers extending from the upstream face of the Intake to the entrance to the semi-spiral scroll case. The number of openings has been optimized by relating the costs of the bulkhead and main Intake service gates to the costs of the intermediate piers. The length of the Intake is 18.9 m. Each of the three water passages in the Intake will have a set of vertical trashracks supported by guides embedded in primary concrete at the upstream limit of each pier. To mitigate trashrack vibrations, the height of the upstream end of the Intake water passages has been determined on the basis of a flow velocity of 1.2 m/s. The effective flow area was based on the width of the water passages downstream of the tapered portions of the piers.

Downstream of the trashracks, there will be individual slots for the bulkhead and the main Intake service gates. The maintenance gallery for the main Intake service gates will be just above the soffit of the water passage and will interconnect all three gate-slots. The main Intake service gates will be provided with steel guides embedded in secondary concrete and will be operated by wire-rope hoists located just above deck level and enclosed in the heated hoist housing. This structure will also house the electrical load centres for the hoists. The housing will be a single storey annex to the rigid-frame superstructure of the Powerhouse and will be enclosed by means of an insulated steel roof and wall cladding system.

When necessary, the main gates can be removed through the housing by a mobile crane after a section of the roof has been removed. In addition, the hoist housing will be provided with flaps and louvers to allow the inward and outward flow of air caused by level surges in the water passages. A gantry crane, supported on the road deck, will be used to handle the bulkhead gates and, when required, clean or remove the trashracks. The bulkhead gates will be stored in slots in the concrete gravity section along the upstream side of the Service Bay. Sufficient bulkhead gate sections will be provided to isolate one unit.

The Intake has been designed as follows:
The flow into the water passages is to be free from air entraining vortices. Gordon's criteria, 3-D numerical model results and other standard criteria were used to ensure air entrainment is not an issue. The cross flow velocity at the bulkhead gates will not deviate from the axial velocity by more than 5 degrees. The discharge through the three Intake water passages for each unit will not differ by more than plus or minus 10% of the total unit discharge. The pier noses will be of the USACE Type 2 design.

Powerhouse and Draft Tube
The geometry of the semi-spiral scroll cases, draft tubes and generator parts are based on a set of dimensions provided by one of the potential turbine suppliers. The relative position of each generator and turbine has been set to correspond to the minimum length and cost of the interconnecting shaft. The remainder of the Powerhouse dimensions have been based on estimated spatial requirements, including access, for ancillary equipment.

During the process of final design, it may be necessary to make adjustments to various dimensions and equipment settings to suit final equipment selections. The combined length of Powerhouse and Draft Tube is 42.37 m. The concrete substructure for each Intake and Powerhouse unit will be separated from adjacent units, and from the Service Bay, by contraction joints. Each substructure will enclose a semi-spiral scroll case water passage to distribute the water from the Intake over the full circumference of the turbine. Discharge from the turbine will pass through a draft tube, which will be divided into two sections downstream of the elbow by a centre pier.

Channel Improvements at Wuskwatim Falls
The immediate forebay is separated from the main reservoir (Wuskwatim Lake) by Wuskwatim Falls. Wuskwatim Falls are located at the outlet of Wuskwatim Lake approximately 1.5 km upstream of the proposed site of the Wuskwatim Generating Station. Under existing conditions, Wuskwatim Falls are a natural control for Wuskwatim Lake outflows. To regulate the lake within the prescribed limits of el 234.0 to 233.0 m and minimize head losses through the area, it is necessary to construct a channel through the peninsula to the left of the falls, shown in Figure 21. The size of this channel has been based on an economic comparison between the cost

of excavation and the value of the head gain. Sizing optimization was undertaken so as to maximize the net present value of the benefits. The most economic was found to consist of a 125 m wide channel with an invert at el 229 m and approximately 100 m in length. It also remained at or near the most economic alternative when various sensitivity tests for discount rate, cost of excavation and value of energy, were applied. The channel excavation will be carried out behind an upstream rock plug that will be removed after forebay impounding.

(xix) a full description of the power station including the type, number and rated capacity of the waterwheels and generators proposed to be used, both in the initial and in the final development,

The Wuskwatim Generating Station, shown in Figure 3, is to be a 3 unit Powerhouse with close-coupled Intake and Powerhouse with fixed blade, vertical-shaft propeller turbines driving vertical umbrella generators. Details of the turbines and generators are contained in the following table. Studies, with respect to hydromechanical equipment selection and plant operation mode, concluded that the most efficient utilization of the water resource would be provided by vertical axis fixed blade propeller turbines operated, on an average daily basis, in a run of river manner.

The outflows from the plant will be "shaped" in such a way as to maintain operation of the turbine units at generally peak efficiency at all times. This will be achieved by shutting down one or two units temporarily, as required to maintain high efficiency, and to balance inflows and outflows from the reservoir on a daily basis. In consequence, the mode of operation is neither one of base loading nor peaking, but in between. The plant will therefore operate with one, two or three units running, within the limited live storage range of 1 m (el 234.0 m to el 233.0 m). The full gate discharge capacity of the plant will be 1100 m^3/s at a forebay level of el 234.0 m and a net rated head of 21.0 m. With the forebay level and the plant discharge capacity, as stated above, the nominal plant output capacity will be 204 MW for open water conditions. The average annual energy that will be generated is 1550 GWh.

Power Generation and Transformation	
Nominal plant output	200 MW 268 097 horsepower
Plant output at 1100 m^3/s (open water)	204 MW 273 459 horsepower
Number of units	Three
Unit spacing	24.12 m
Turbines	
• type	Five fixed blades
• rated power at full gate	69.5 MW 93,164 horsepower each
• scroll case type	Concrete semispiral
• runner diameter	6.7 m
• governor type	Electrohydraulic
Generators	
• type	Vertical umbrella
• rated capacity (each)	87.4 MVA (2 units full gate)
• rated power factor	0.85
Net operating head	22.2 m maximum, based on 2 units full gate 20.0 m minimum 21.0 m rated, based on 3 units operating at full gate and the forebay at el 234.0 m
Average annual generation	1550 GW·h
Main transformers	
• number	Three
• type	Outdoor, air/oil cooled

(xx) the probable load factor of the power system,

Wuskwatim G.S. will be capable of producing as much as 204 MW of power at any time. The average potential power, estimated by Manitoba Hydro, is about 180 MW resulting in a plant capacity factor of just over 85%.

(xxi) the length in miles and a full description of all main transmission lines,

The proposed routes for the Wuskwatim transmission lines are illustrated on the attached figures as noted in 12 (3) (g). Based on the outcome of the route selection process, the approximate line lengths for the various Wuskwatim transmission lines are as follows:

- Wuskwatim Generating Station to Wuskwatim Switching Station (three lines): less than one km each.
- Birchtree Station to Wuskwatim Switching Station: approximately 45 km. Figure 34 – Transmission Line B76W Plan showing Construction Power TL Route from Thompson-Birchtree Station to Wuskwatim GS Wuskwatim Switching Station to Herblet Lake Station (two lines): approximately 137 km each. Figure 35 – Transmission Line H73W & H74W Plan Showing Transmission Line Route from Herblet Lake Station to Wuskwatim Generating Station
- Herblet Lake Station to Rall's Island Station: approximately 165 km . Figure 36 – Transmission Line H75P Plan Showing Transmission Line Route from Herblet Lake Station to The Pas-Ralls Island Station

A 60 metre right-of-way width will be required for the single transmission line proposed between the Wuskwatim Switching Station and Birchtree Station, and between Herblet Lake and Rall's Island stations. The two parallel lines proposed between Wuskwatim Switching Station and Herblet Lake Station will require a 110 metre right-of-way width. The 110 metre width provides the same 30 metre distance between the line centerlines and the edge of the right-of-way as in the case of the 60 metre single line right-of-way, and provides a 50 metre separation between the centerlines of the adjacent lines.

Based on prior design experience in northern Manitoba, a guyed lattice steel structure has been chosen as a standard design for tangent locations along the transmission lines. A self-supporting (free standing) lattice steel structure will be used in all angle locations where rock is present. A guyed lattice steel structure will be used in angle locations where soil conditions are poor. A typical guyed lattice steel suspension tangent structure has a single point foundation and is stabilized by four diagonal guys with a spread of 33 to 45 metres. The structure's overall height varies from 29 to 38 metres. The average span between structures will be approximately 420 metres, resulting in approximately 2.4 structures per km.

(xxii) all other data necessary to a full consideration of the proposed works;

None identified at this time.

(j) the report mentioned in clause (i) shall in all cases be accompanied by preliminary estimates of cost;

As reported in the NFAAT submission of April 2003, the total in-service cost of the Wuskwatim Project, including the G.S. and associated transmission facilities, is estimated to be $901 million, including interest and escalation. The base estimate (i.e. in 2002 'overnight' dollars, before interest during construction and escalation to the date of expenditure, are applied) on which this is based is $568 million for the generating station portion and $109 million for the transmission facilities portion, for a total of $678 million (rounded).

The most recent best estimate (November 2004) of the total in-service cost of the Wuskwatim Project, including the G.S. and associated transmission facilities, is to be $1 078 million, including interest and escalation. The base estimate (i.e. in 2004 'overnight' dollars, before interest during construction and escalation to the date of expenditure, are applied) on which this is based is $682 million for the generating station portion and $137 million for the transmission facilities portion, for a total of $819 million.

(k) copies of field notes of the entire survey of water conduits, transmission lines, exterior boundaries, powerhouse and reservoir sites, or of such parts thereof as the director may require, tied in wherever possible to the existing system of the Manitoba Land Surveys;

No specific requirements were identified by Water Stewardship at the time of submission of this report. The above information is maintained on file by Manitoba Hydro and is available upon request.

(l) if there are other works already constructed or in course of construction in the neighbourhood of the proposed works, for diverting or using water from the same or tributary streams, the said plans shall indicate the location and give the distance from the proposed works, of the nearest of such other existing works both above and below the proposed works, and, if a power development, the normal elevation of the headwater and tailwater thereof, or if other than a power development, the elevation of the sill of the headgate or headgates, such elevations in every case to be referred to the same system of elevations as are used to designate elevations at the site of the proposed works; and if there are any other works or structures, such as bridges, railways, highways and canals, or any other public or private works whatsoever which might affect or be affected by the construction, maintenance or operation of the proposed works, the said plans shall indicate the location and set out the governing elevations of such other works or structures.

Manitoba Hydro's neighbouring works consist of the Notigi Control Structure, approximately 90 km upstream on the Rat River and the Manasan Falls Control Structures, approximately 52 km downstream on the Burntwood River. The Wuskwatim Project will not alter the operation of the CRD and will not affect water levels and flows upstream of Early Morning Rapids on the upstream side of the Project. The Wuskwatim Project operation will result in daily water level fluctuations downstream of the generating station in the Burntwood River. The daily water level fluctuations diminish with distance downstream from the generating station. The typical daily water level fluctuations are dampened to the point that they are not noticeable at Birch Tree Lake (just upstream of the Manasan Falls Control Structures) and would be hard to distinguish from wind-generated waves. Manitoba Hydro to provide additional information upon request.

The elevation of the sill beam of the Notigi Control Structure is el 248.50 m. For detailed information on the Notigi Control Structure please refer to Figures 37, 38, 39 and 40. Please note that elevations, dimensions and distances shown are in Imperial Units. Also note that the elevations shown in these plates are based on a different datum. To convert the elevations shown on Figures 37, 38, 39 and 40 to the datum used for Wuskwatim, 0.22 m must be added to all elevations shown.

Please refer to Figure 41 for details of the Manasan Control Structure.

13 The plans shall be on tracing film and cut to a uniform size of 20 X 17 or 30 X 26 inches and be either printed or typed; and both plans and specifications shall be signed by a professional engineer of recognized standing in Canada, satisfactory to the director, and shall be filed with the director. Elevations wherever possible should be tied in to mean sea level datum.[1]

Manitoba Hydro has been directed to provide 11 X 17inches reproducible drawings as well as electronic reproducible copies in Adobe Portable Document Format, which shall be signed by a professional engineer of recognized standing in Canada.

All water levels referenced in this document are to be inferred as measured in terms of elevations Above Sea Level (ASL), GS of C CGVD28, 1971 Local Adjustment unless otherwise stated. The vertical survey control, topographic mapping, geotechnical and water level information required for the planning and design of the Wuskwatim GS has been based upon the Geodetic Survey of Canada, Canadian Geodetic Vertical Datum 1928, 1971 Local Adjustment (GS of C CGVD28, 1971 Local Adjustment), which Manitoba Hydro generally refers to as GS of C CGVD28, 1969 Local Adjustment. Information about the benchmarks that were established at Wuskwatim GS by the Geodetic Survey of Canada at the request of Manitoba Hydro was published in Geodetic Survey of Canada - Vertical Control Data, Quadrangle Sheet No. 55098, Revision 3, March 1971.

Horizontal survey control in the immediate Project area has been established for planning, explorations, design and construction using a local planar grid referred to as the Revised Station Grid. Permanent control monuments (survey bench-marks) have been established at the site using various survey techniques and are correlated to the regional geo-reference system, please refer to Figure 42 - Plan Showing Survey Control at Wuskwatim G.S. Site.

Horizontal survey control has also been established in the region using Global Positioning System (GPS) techniques. Most of the early surveys utilized the North American Datum 1927 (NAD27), and the Universal Transverse Mercator (UTM) Projection, Zone 14. Recent surveys have utilized the Canadian Spatial Reference System based on the North American Datum 1983 (NAD83 (CSRS)), and the Universal Transverse Mercator (UTM) Projection, Zone 14. All regional geo-referenced information has been transformed to NAD83 (CSRS), UTM Zone 14. All Geographic Information System (GIS) support information that has been collected or generated for this Project has been geo-referenced using NAD83 (CSRS), UTM Zone 14.

Vertical and Horizontal Control for the planning of the access road has been established by the Department of Transportation and Government Services using GPS techniques. The access road control has been established based on the regional control established by Manitoba Hydro and uses the same vertical and horizontal reference systems as described above.

The topographic mapping for the Wuskwatim GS site has been prepared from air photos taken in 1986 at a photo scale of 1:10,000 and used to produce a topographic map at a scale of 1:2,000. Contours, based on GS of C CGVD28, 1971 Local Adjustment, were established at an interval of one metre.

LIST OF FIGURES

APPENDIX 1

Taken from J.B. Rogers, Acres Memrandum, Dated October 14, 2004

Wuskwatim Generating Station

Stage V Studies

Dam Safety – Water Power License Application

1. Introduction

The purpose of this memo is to document the dam safety aspects of the design of Wuskwatim Generating Station to be included as part of the Water Power License Application. The report is broken into sections as follows; a summary of the work performed to date on the design of the generating station, an overview of the final design stage, a description of the design team assembled for the final design of the generating station and management of construction related activities, and the operation, maintenance and surveillance that will take place once construction of the generating station is complete.

2. Previous Studies

The design of Wuskwatim Generating Station (Wuskwatim GS) has evolved through engineering studies carried out in sequential stages in accordance with Manitoba Hydro's Generating Planning Procedures. The stages, listed below, are defined in terms of the scope of work, level of detail, and range of confidence expected in cost estimates for each stage:

Stage I - Inventory
Stage II - Feasibility
Stage III - Concept
Stage IV - Preinvestment
Stage V - Final Design/Construction.

The engineering studies for development of the Wuskwatim GS date back to 1965. Throughout this process, data have been collected and various development concepts have been explored. The Stage IV Studies, initiated in June 1999 and completed in 2003, brought the conceptual design of Wuskwatim GS to a preinvestment level of study. The Stage V – Final Design for Wuskwatim GS has commenced, however, the finalization of the dimensions, various design calculations, etc, awaits the award of the turbine and generator contract, which will establish many of the final dimensions.

The Stage IV Studies for Wuskwatim GS incorporated the following dam safety related work:

- development of a preliminary water management action plan for safe passage of river flows during construction, as well as throughout the operational life of the project
- preliminary design of major concrete and earthfill structures to substantiate their acceptability, from a dam safety perspective, for the conditions that exist at the WGS site
- subsurface investigation programs and findings
- investigations of sources of construction materials
- preliminary stability calculations for all concrete and earthfill structures
- establishment of design criteria to be utilized in the Stage IV Studies and followed in the Stage V - Final Design of structures and equipment. The criteria were developed to, as a minimum, be in compliance with guidelines, design standards and code requirements of the Canadian Dam Association (CDA), Manitoba Hydro, the Canadian Standards Association (CSA) and the National Building Code of Canada (NBCC).

3. Final Design

All design parameters to be utilized in the station's final design will be based on the appropriate incremental consequence classification criteria, as described in the Canadian Dam Association Guidelines (Canadian Dam Association 1999).

The design and planning for Wuskwatim GS assumes that the Churchill River Diversion (CRD) will continue to operate as it has been operated to date and therefore the CRD water regime will remain unchanged.

The terms and conditions described in the CRD 1973 Interim Water Power License (Water Resources Branch 1973), as modified by the annual CRD Augmented Flow Program, the City of Thompson Agreement (City of Thompson 1976), the Northern Flood Agreement (NFA, Northern Flood Agreement 1977), and the 1996 NFA Implementation Agreement (NFA Implementation Agreement 1996) and any downstream water related agreements, will not change as a result of the Wuskwatim Project.

The water management action plan for safe passage of river flows throughout the construction period, as well as throughout the life of the Project, are based on the combined experience, interpretation and application of the Canadian Dam Association Guidelines (Canadian Dam Association 1999) by Manitoba Hydro and their design consultants. In this regard, the Notigi Control Structure has been assumed to continue operating in its normal mode and that further, its operation will not be altered to accommodate the passage of the design floods.

The Construction Design Flood (CDF) has been established as having an annual probability of exceedance of 1:20 years or less (i.e., 5% annual probability of exceedance). The CDF is used to determine the elevations of the various Cofferdams that will be required to protect the site during construction. Several scenarios, including lesser flows under winter ice conditions have also been reviewed as part of the investigation.

The Inflow Design Flood (IDF) has been set to be equal to the Probable Maximum Flood (PMF). The PMF is an estimate of the most severe “reasonably possible” flood at a particular location, as derived from meteorological and hydrological studies. The PMF is derived from coincident occurrence of a series of worst case antecedent meteorological conditions and a design rainfall/snow melt event in the upstream watershed. This event has an annual probability of exceedance of approximately 1:10,000 years. The IDF is used to determine the appropriate elevations of the Primary and Secondary structures. During the passage of the PMF, the Wuskwatim immediate forebay would surcharge by 1.5 m above the FSL, to 235.5 m. Due to the backwater effect through the Wuskwatim Falls channel excavation area, the level of Wuskwatim Lake would rise to 235.6 m during this event.

Seismic loads, based on a review of the pending changes to the National Building Code of Canada (NBCC 2005), have been taken into consideration in the design.

4. Design Team

The Manitoba Hydro personnel involved in the project’s final design, as well as those of their design consultants, are highly knowledgeable in regards to hydroelectric station design and dam safety issues. These personnel have all worked extensively on projects located in northern Manitoba and are familiar with the local geological and climatic conditions and design constraints.

In the last ten years, the lead design consultant’s firm has reviewed dam safety aspects of over 250 earth and concrete water retaining structures for a variety of clients. In addition, Manitoba Hydro and their consultants have taken active roles in the development of the CDA Guidelines and the formulation of dam safety programs. The project’s design team is very knowledgeable in the interpretation and application of the various tasks identified in the CDA Guidelines, including:

- selection of hazard classification
- detailed hydraulic studies, dam break assessments, hydrological reviews with PMF assessment, and freeboard analyses
- assessment of flow control and discharge facilities
- assessment of embankment and foundation conditions
- condition and stability assessment of concrete structures
- preparation of inundation maps
- preparation of Emergency Preparedness Plans, and
- preparation of Operation and Maintenance Manuals.

5. Operation, Maintenance and Surveillance of the Completed Generating Station

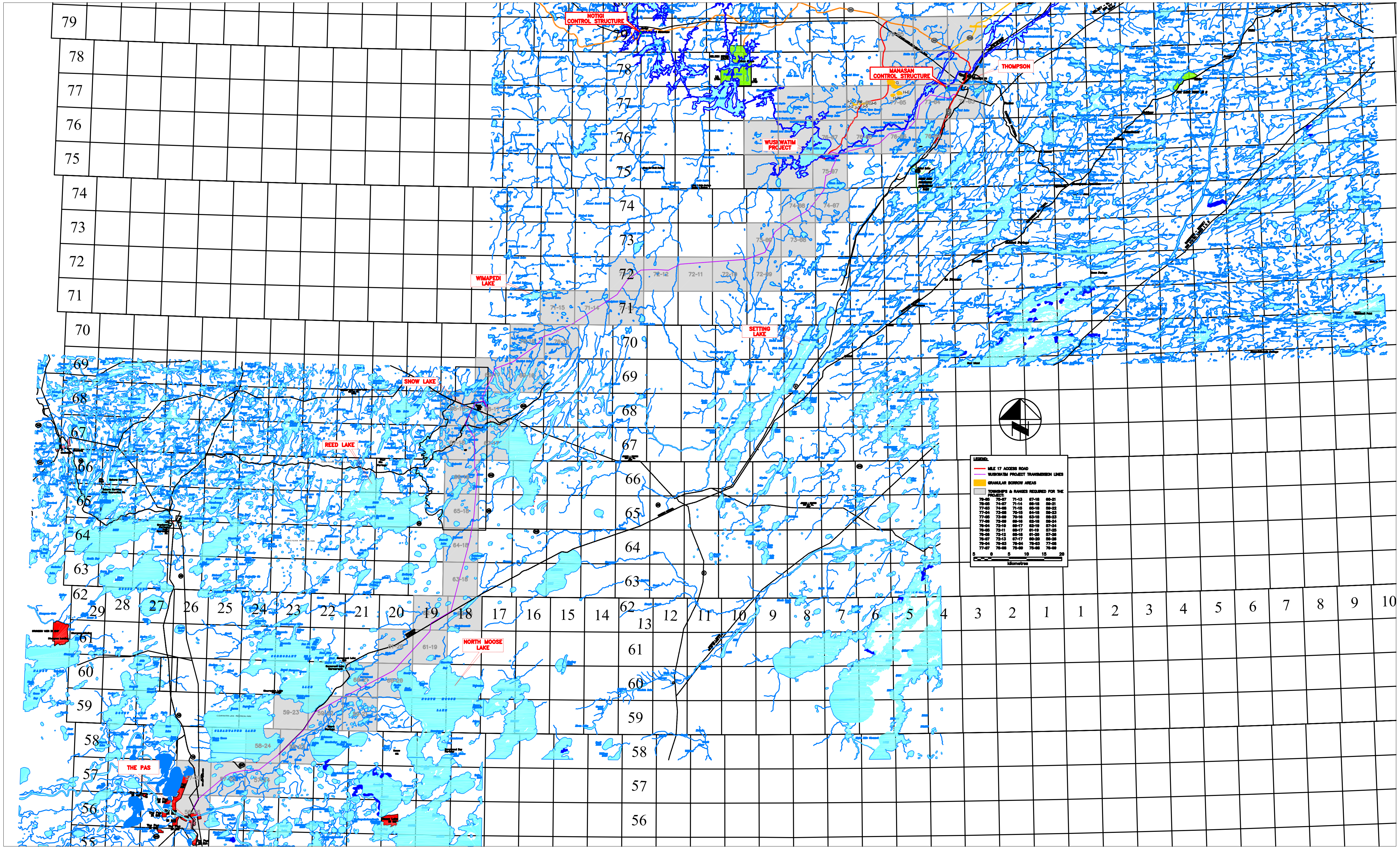
Once construction of the Wuskwatim GS is complete, the maintenance and operation of the generating station will be the responsibility of the Manitoba Hydro-NCN Partnership. The generating station will be treated the same as any of the other generating stations in Manitoba Hydro’s inventory of dams and will therefore undergo on-going monitoring and surveillance through Manitoba Hydro’s Dam Safety Program. The operation and maintenance of the generating station will be based on Manitoba Hydro experience, their interpretation and application of Canadian Dam Association Guidelines and the operational constraints noted above. Manitoba Hydro’s Dam Safety Program includes the installation and monitoring of instrumentation both within the generating station and the project’s associated earthfill dams, dykes and structure foundations.

MANITOBA WATER STEWARTSHIP NO. 57-2-1019

1-00184-DD-07311-0033 | SHT. 001 | REV. 00

D SIZE – 566 x 801 | SHT. 01 | REV. 00

1-00184-DD-07311-0033



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NO.	DATE	REVISIONS	BY	CKD.	APP.
0	05 03 17	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION & REVISED TITLE SURROUND	DGM		

FIGURE 1

APPROVED

ORIGNIAL SIGNED BY GLEN COOK

DRAWN LMT

CHECK GNC

SCALE AS SHOWN

DATE 2003 05 29

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

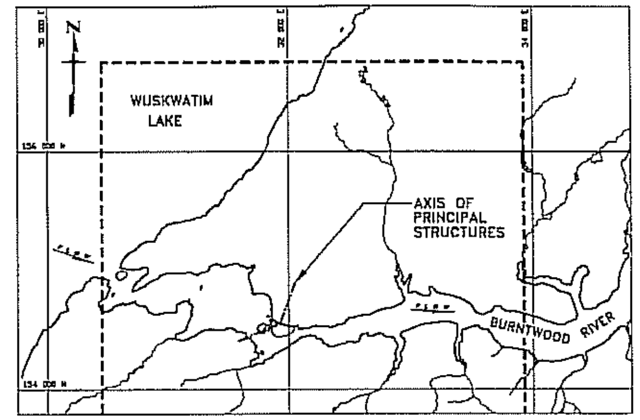
WUSKWATIM PROJECT LOCATION PLAN

1-00184-DD-07311-0033 | SHT. 001 | REV. 00

AUTOCAD ORIGINAL

MANITOBA WATER STEWARDSHIP No. 57-2-1020

1-00184-DE-07311-0002 | SHT. 0001 | REV. 00



KEY PLAN

LEGEND:

- LIMITS OF CLEARING
- GROUND SURFACE CONTOUR (SEE NOTE 5)
- FOREBAY OUTLINE EL 234.0
- STREAM
- GROUND SURFACE CONTOUR, SUBMERGED
- SHORELINE, SUBMERGED (SEE NOTE 6)
- COORDINATE GRID MARKER (LOCATED AT 1000 METRE INTERVALS)
- TUBULAR TRANSMISSION LINE TOWER
- SQUARE TRANSMISSION LINE TOWER
- FLOODED AREA

NOTES:

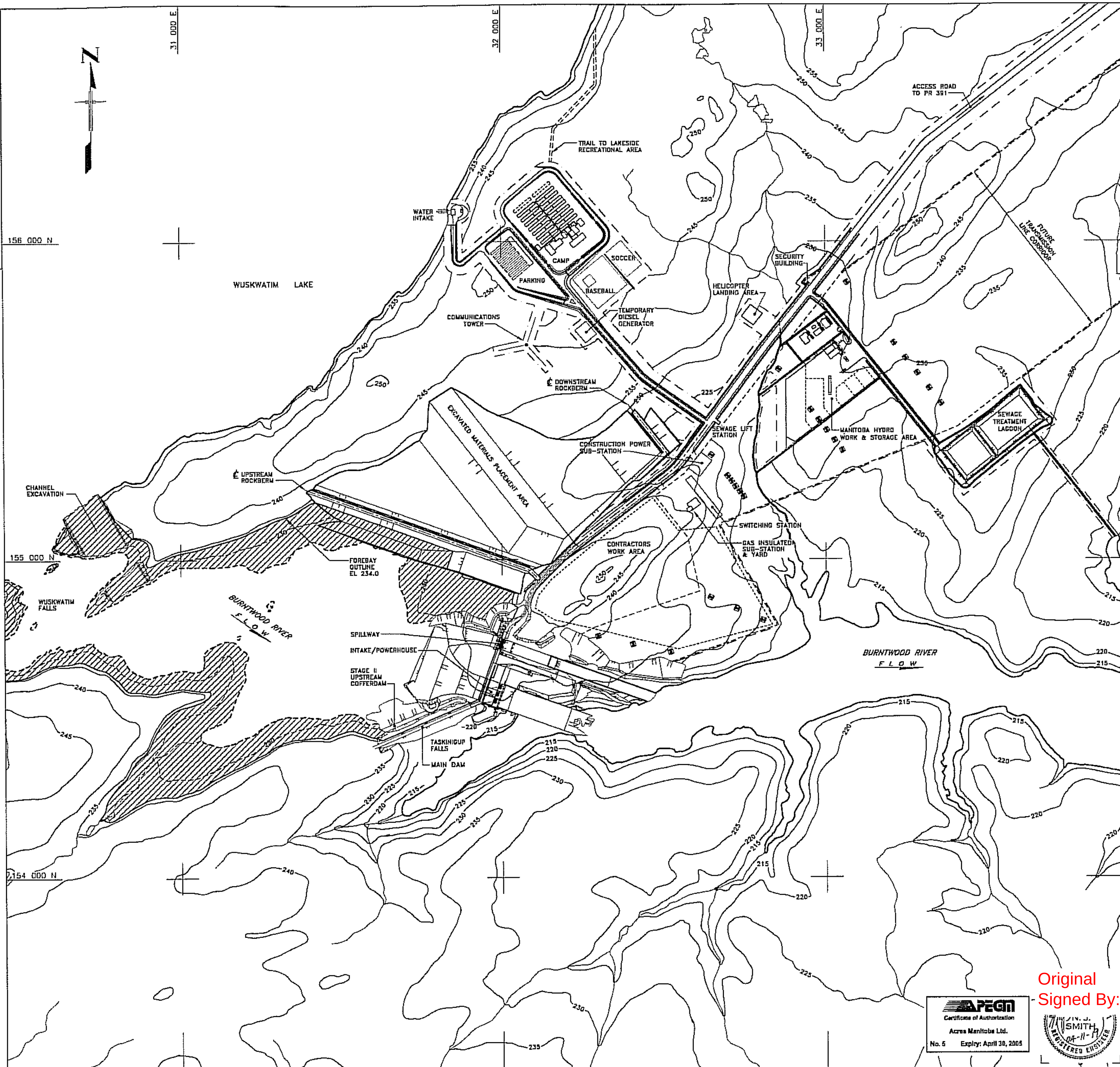
1. COORDINATE AND ELEVATION VALUES SHOWN ARE IN METRES.
2. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON MANITOBA HYDRO WUSKWATIM GENERATING STATION REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. TOPOGRAPHY AND SURFACE FEATURES SHOWN WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10,000 SCALE PHOTOGRAPHY DATED JUNE 15,1986. SEE REFERENCE DRAWINGS BELOW.
5. CONTOUR INTERVAL IS 5 METRES.
6. LOCATIONS OF SHORELINES ARE APPROXIMATE AND RELATE TO THE DATE OF PHOTOGRAPHY.

REFERENCE DRAWINGS:

07062-E-00008 SHTS 1 TO 8, REV 0, WUSKWATIM GENERATING STATION - PHOTOGRAMMETRIC PLAN SHOWING LOCATIONS OF DRILL HOLES AND AUGER HOLES 1:2000.

1-00184-DE-11510-0001 SHTS 1 TO 8, REV 1, WUSKWATIM GENERATING STATION - TOPOGRAPHIC PLAN IN VICINITY OF THE PROPOSED WUSKWATIM G.S. SITE 1:2000.

1-00184-DE-80000-0001 SHT 1, REV C, WUSKWATIM GENERATING STATION - STAGE 4 STUDIES, CONSTRUCTION FACILITIES SITE PLAN



SCALE 1:5000 — 100 0 100 200 300 400 500 METRES

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

STAGE 4 STUDIES
PROJECT AREA
PLAN

FIGURE 2

DRAWN / CHECK / SCALE 1:5000 / APPROVED / DATE

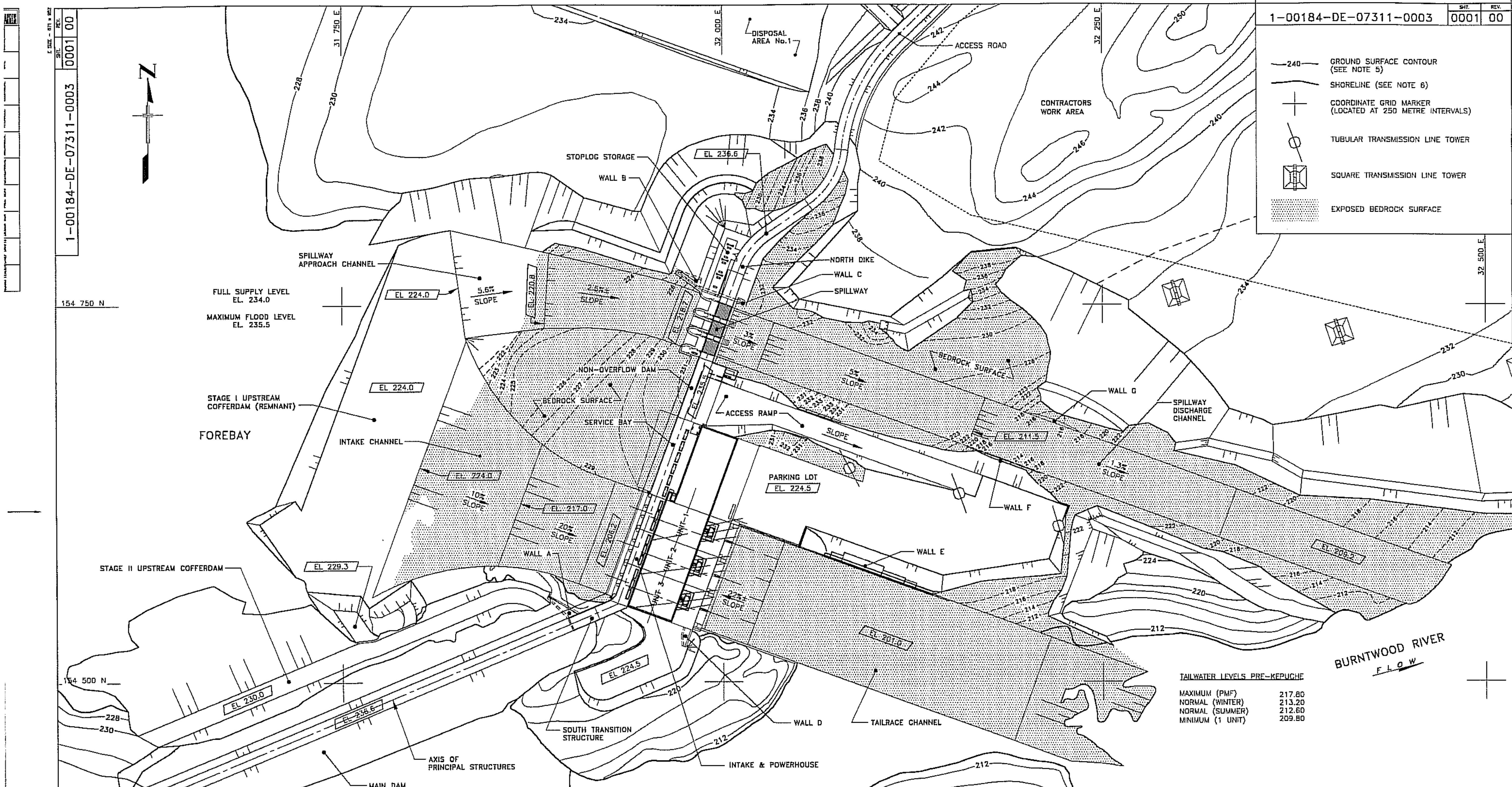
1-00184-DE-07311-0002 | SHT. 0001 | REV. 00

Original Signed By:

APEGM Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

N. J. SMITH 04-11-19 REGISTERED ENGINEER

FOR MANITOBA USE ONLY



TAILWATER LEVELS PRE-KEPUCHE

MAXIMUM (PMF)	217.80
NORMAL (WINTER)	213.20
NORMAL (SUMMER)	212.60
MINIMUM (1 UNIT)	209.80

NOTES:

1. COORDINATE AND ELEVATION VALUES SHOWN ARE IN METRES.
2. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON MANITOBA HYDRO WUSKWATIM G. S. REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. TOPOGRAPHY AND SURFACE FEATURES SHOWN WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10,000 SCALE PHOTOGRAPHY DATED JUNE 16, 1986. SEE REFERENCE DRAWINGS BELOW.
5. CONTOUR INTERVAL IS 2 METRES.
6. LOCATIONS OF FOREBAY OUTLINE AND TAILWATER LEVEL BASED ON TOPOGRAPHY AND ARE APPROXIMATE.

REFERENCE DRAWINGS:

07062-E-00008 SHTS 1 TO 8, REV 0, WUSKWATIM GENERATING STATION - PHOTOGRAMMETRIC PLAN SHOWING LOCATIONS OF DRILL HOLES AND AUGER HOLES 1:2000.

1-00184-DE-11510-0001 SHTS 1 TO 8, REV 1, WUSKWATIM GENERATING STATION - TOPOGRAPHIC PLAN IN VICINITY OF THE PROPOSED WUSKWATIM G. S. SITE 1:2000.

1-00184-DE-60000-0001 SHT 1, REV C, WUSKWATIM GENERATING STATION - STAGE 4 STUDIES, CONSTRUCTION FACILITIES SITE PLAN.

APEGM Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

Original Signed By:

W. J. SMITH
04-11-19
REGISTERED ENGINEER

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

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MANITOBA HYDRO

WUSKWATIM GENERATING STATION

STAGE 4 STUDIES
PRINCIPAL STRUCTURES
GENERAL ARRANGEMENT

ACRES

FIGURE 3

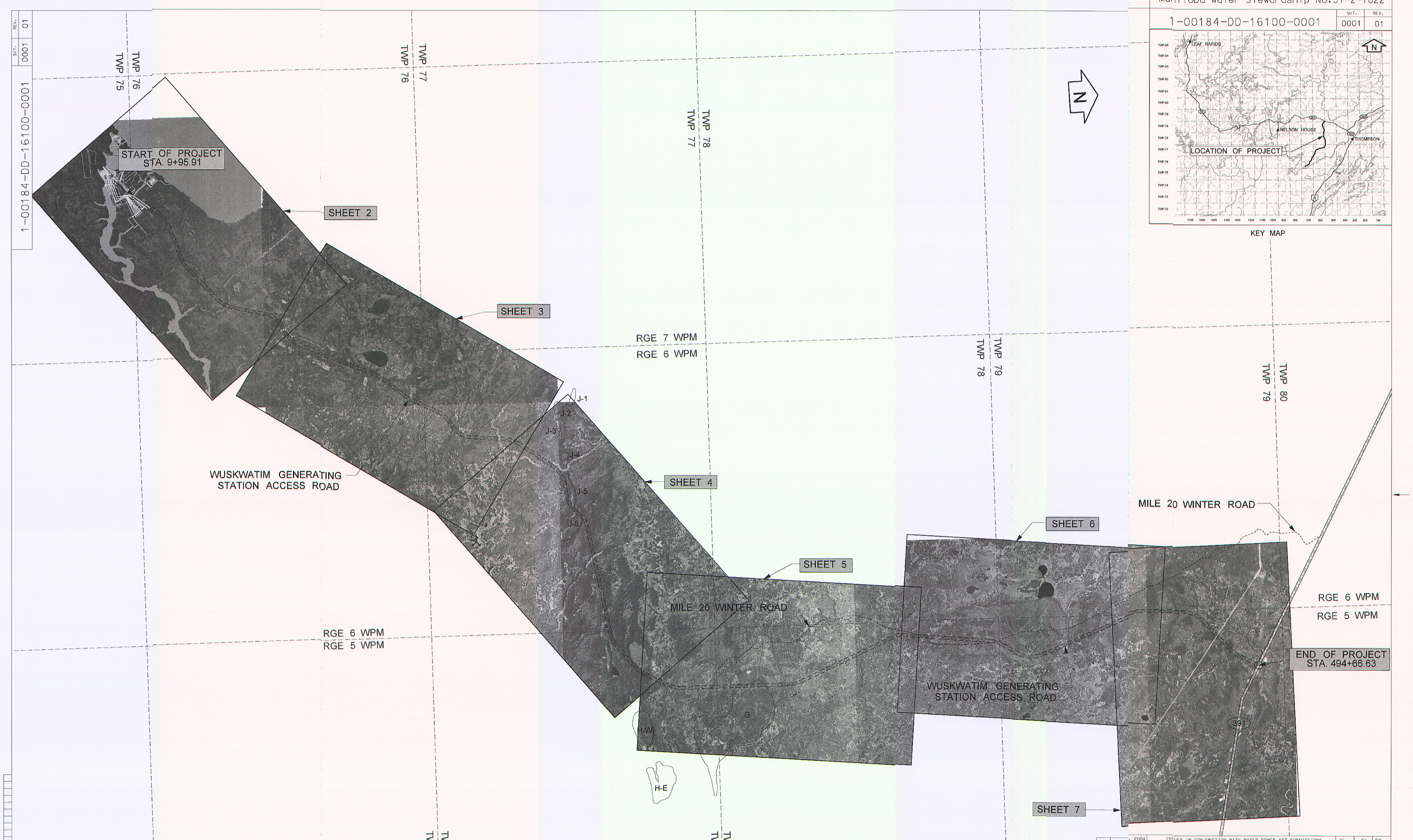
DRAWN
CHECK
SCALE 1:1000
APPROVED
DATE

1-00184-DE-07311-0003 SHT. 0001 REV. 00

1-00184-DE-07311-0003 SHT. 0001 REV. 00

Manitoba Water Stewardship No.57-2-1022

1-00184-DD-16100-0001 SHT. 0001 REV. 01



SUBJECT TO ENVIRONMENTAL APPROVAL

SHT NO.	DESCRIPTION	SHT NO.	DESCRIPTION
SHT 0001	KEY PLAN	SHT 0011	TYP. DOUBLE CULVERT INSTALLATION & DETAILS
SHT 0002	ROAD LAYOUT	SHT 0012	PR 391 INTERSECTION & GATE HOUSE TURN AROUND DETAILS
SHT 0003	ROAD LAYOUT	SHT 0013	EROSION CONTROL DETAILS
SHT 0004	ROAD LAYOUT	SHT 0014	TRAFFIC SIGNING DETAILS
SHT 0005	ROAD LAYOUT		
SHT 0006	ROAD LAYOUT		
SHT 0007	ROAD LAYOUT		
SHT 0008	CROSS SECTION DETAILS		
SHT 0009	CROSS SECTION DETAILS		
SHT 0010	TYP. SINGLE CULVERT INSTALLATION & DETAILS		

NO.	DATE	REVISIONS	BY	CKD.	APP.
01	OCT.26, 2004	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSIONS	KL	AH	BW

NOTED

FIGURE 4

Original Signed By:

D.P. KUENSTER
Member 22387
REGISTERED PROFESSIONAL ENGINEER

DRAWN MTGSION(K.L.) NORTHERN REG

CHECK A.H./B.W

SCALE 1:5000

APPROVED

DATE SEPT.26, 2002

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

WUSKWATIM GENERATING STATION ACCESS ROAD KEY PLAN

1-00184-DD-16100-0001 SHT. 0001 REV. 01

AUTOCAD ORIGINAL

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1-00184-DD-16100-0001 SHT. 0001 REV. 01

MANITOBA WATER STEWARDSHIP No. 57-2-1023

1-00184-DE-82000-0001 | SHT. 0001 | REV. 02

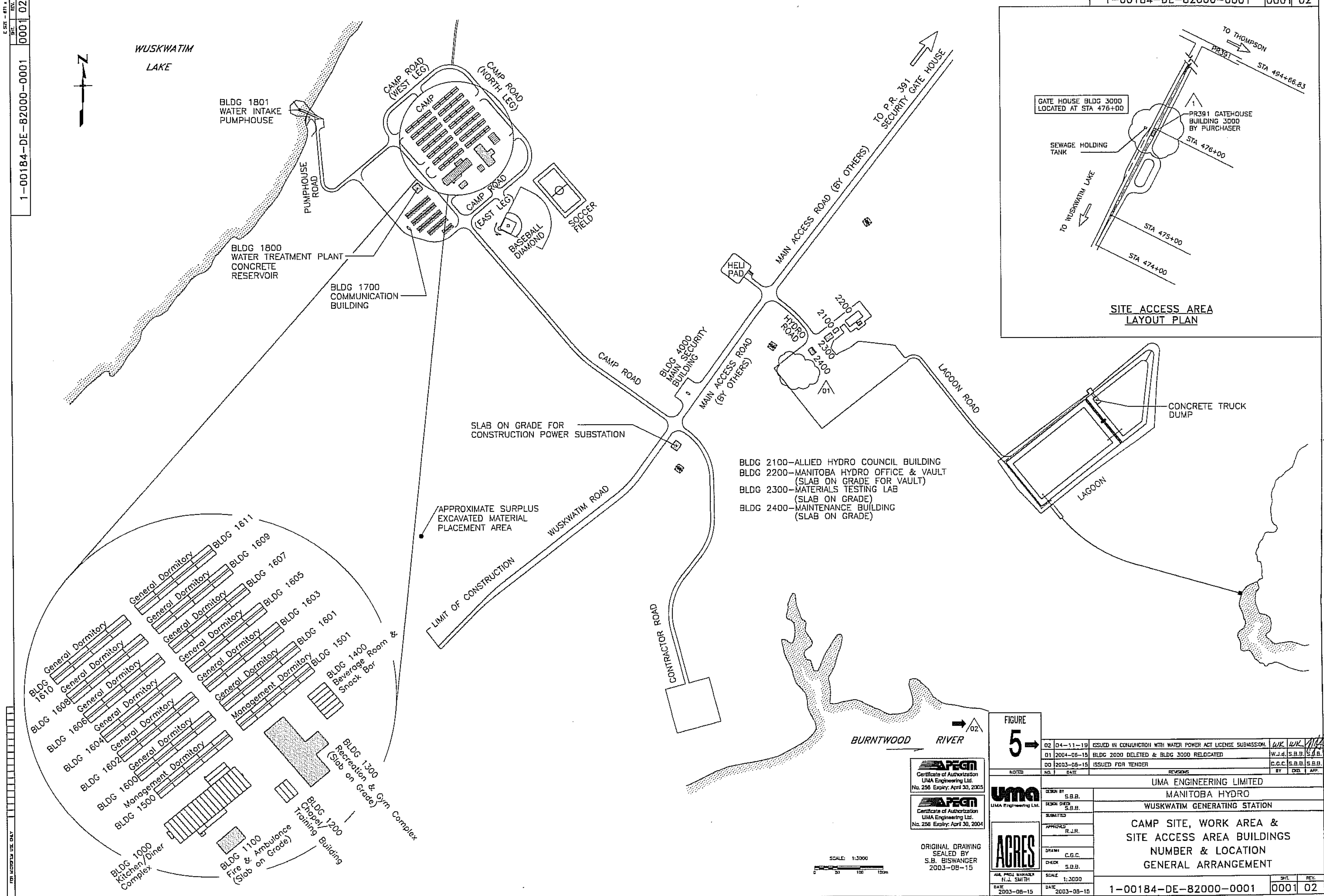


FIGURE 5

REV.	DATE	REVISIONS	BY	CKD.	APP.
02	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	MA
01	2004-05-15	BLDG 2000 DELETED & BLDG 3000 RELOCATED	W.J.d.	S.B.B.	S.B.B.
00	2003-08-15	ISSUED FOR TENDER	C.G.C.	S.B.B.	S.B.B.

APEGM Certificate of Authorization UMA Engineering Ltd. No. 256 Expiry: April 30, 2005

APEGM Certificate of Authorization UMA Engineering Ltd. No. 256 Expiry: April 30, 2004

ORIGINAL DRAWING SEALED BY S.B. BISWANGER 2003-08-15

UMA ENGINEERING LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

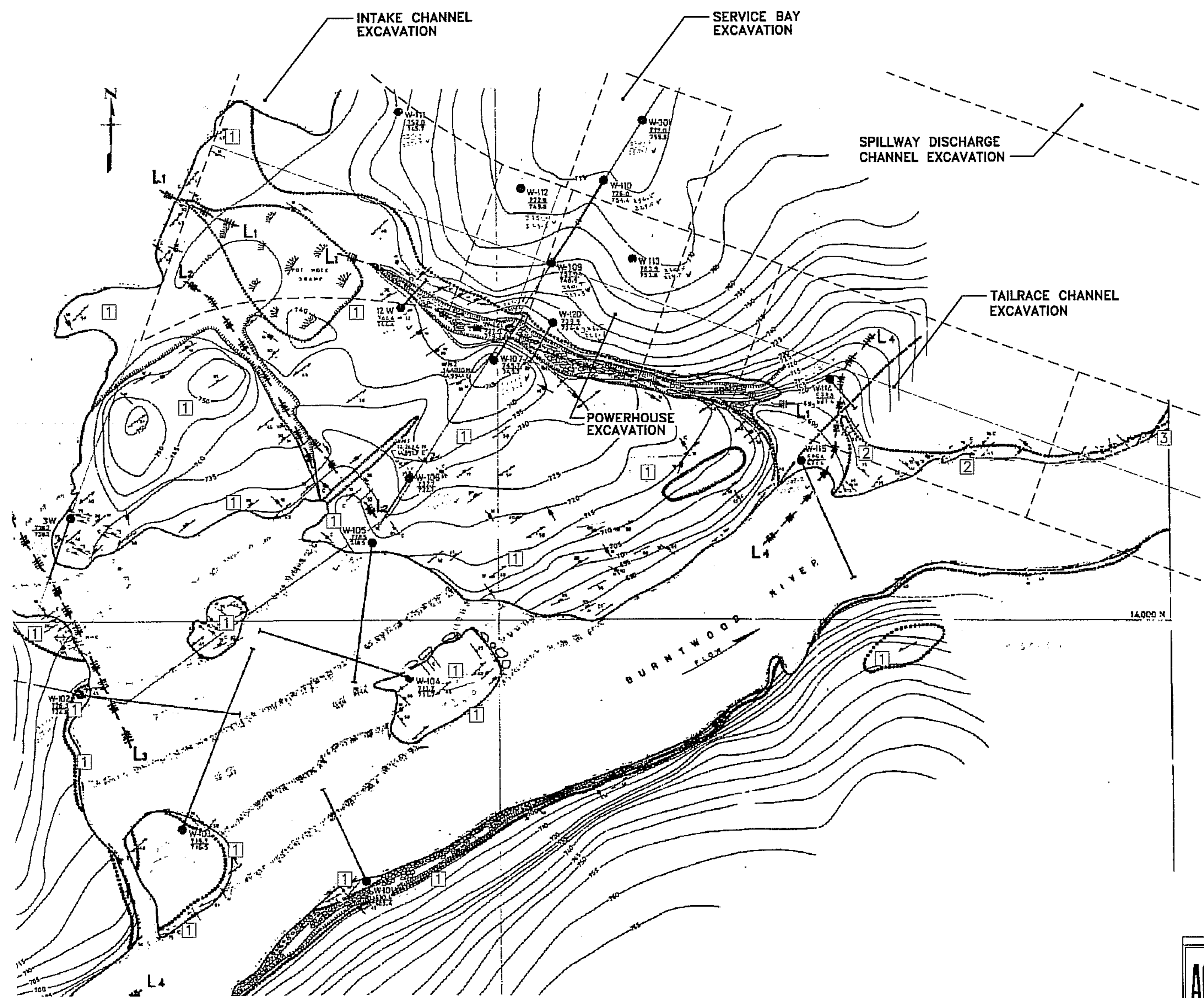
CAMP SITE, WORK AREA & SITE ACCESS AREA BUILDINGS NUMBER & LOCATION GENERAL ARRANGEMENT

DESIGN BY S.B.B. · DESIGN CHECK S.B.B. · APPROVED R.J.R. · DRAWN C.G.C. · CHECK S.B.B. · SCALE 1:3000 · A/M. PROJ. MANAGER N.J. SMITH · DATE 2003-08-15 · DATE 2003-08-15

1-00184-DE-82000-0001 | SHT. 0001 | REV. 02

MANITOBA WATER STEWARDSHIP No. 57-2-1024

1-00184-DE-07311-0022 | SHT. 0001 | REV. 00



LEGEND:

1 - GARNETIFEROUS PARAGNEISS: Layered Gneissic Sequence consisting of the following composition: Plagioclase, Garnet, Quartz and Biotite, with younger quartzo-feldspathic bodies.

2 - GARNETIFEROUS PARAGNEISS: With frequent biotite - rich layers. Quartzo-feldspathic material still present.

3 - GRANITIC: Massive

- Foliation & Layering (Inclined, Vertical, Dip Unknown)
- Joints (Inclined, Vertical, Dip Unknown)
- C - Close Spacing of Joints (< 1')
- M - Medium Spacing of Joints (1 → 5')
- W - Wide Spacing of Joints (> 5')
- Sheeting (Strike & Dip)
- Glacial Striae (Ice movement known)
- Glacial Striae (Ice movement unknown)
- Original Ground Surface Contours
- Major Lineament
- Limit of Rock Outcrop
- Geological Boundary (Approximate)
- Talus (Rubble and Boulders)
- Depression
- Diamond Drill Hole
- W-101 - Hole Number
- 721.C - Ground Elevation
- 535.C - Rock Elevation
- Swamp

NOTE:

1. GROUND SURFACE CONTOURS SHOWN ON THIS DRAWING ARE BASED FROM CROSS SECTIONING CONDUCTED IN 1971.

REFERENCE DRAWING:

7001-E-42 OCT 2, 1972, SURFACE GEOLOGY MANITOBA HYDRO REPORT NO. 72-8, FILE NO. 218A1-4.

SCALE 20 0 20 40 60 80 100 METRES

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

APEGM Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

Original Signed By:

N. J. SMITH 04-11-19 REGISTERED ENGINEER

NOTED

ACRES

6

APPROVED

ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

STAGE 4 STUDIES
1971 INVESTIGATIONS
TASKINIGUP FALLS AREA
SURFACE GEOLOGY

DRAWN CAC
CHECK
SCALE AS SHOWN
DATE

1-00184-DE-07311-0022 | SHT. 0001 | REV. 00

1-00184-DE-07311-0022 SHT. 0001 REV. 00

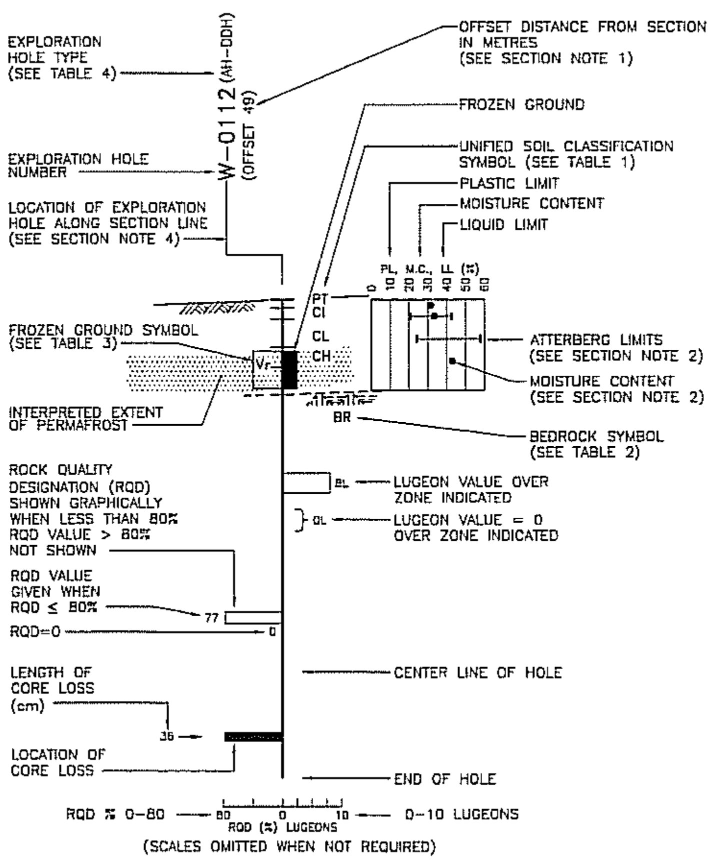
FOR MICROFILM USE ONLY

LEGEND: (PLAN)

(SEE NOTES (PLAN))

—220—	GROUND SURFACE CONTOUR
	SHORELINE
SL99-01	REFRACTION SEISMIC SURVEY LINE NO. SL99-1
EM99-01	ELECTROMAGNETIC INDUCTION SURVEY (EM-31, EM-34) LINE NO. EM99-01
WL	WATER LEVEL
W-0822	EXPLORATION HOLE NUMBER
	COORDINATE GRID POINT
Q-1	OUTLINE AND DESIGNATION OF BORROW AREA, DEPOSIT, OR QUARRY
	(KEY PLAN) AREA COVERED ON THIS SHEET
A — A	GEOLOGICAL SECTION A-A

LEGEND: (SECTION)



	GROUND SURFACE
	INFERRED BEDROCK SURFACE
▽	GROUNDWATER LEVEL IN EXPLORATORY HOLE AT TIME OF EXPLORATION
▽	WATER LEVEL
	PROFILE OF EXCAVATION FOR PRINCIPAL CONCRETE STRUCTURES AND CHANNELS PROJECTED TO SECTION

TABLE 1

SOIL CLASSIFICATION SYMBOLS:

BASED UPON THE UNIFIED SOILS CLASSIFICATION SYSTEM (SEE SECTION NOTE 3)

PT	PEAT, MUSKEG, HIGHLY ORGANIC SOILS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
CI	INORGANIC CLAYS OF INTERMEDIATE PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS
OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS WITH SLIGHT PLASTICITY
SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
SP	POORLY GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES
SW	WELL GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES
GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES
CL-ML, GP-GC, SP-SM, ETC.	TYPICAL BORDER LINE CLASSIFICATION REQUIRING THE USE OF DUAL SYMBOLS
CBLS	COBBLE(S)
BLDR	BOULDER(S)
OB	UNDIFFERENTIATED OVERBURDEN
N/R	NO RECOVERY

TABLE 2

BEDROCK SYMBOLS:

AGGN	ALTERED GREYWACKE GNEISS
GGN	GREYWACKE GNEISS
GRANITE	GRANITE
PEG	PEGMATITE
BR	UNDIFFERENTIATED BEDROCK

TABLE 3

FROZEN GROUND SYMBOLS:

Frozen	SEASONAL FROST
Nf	POORLY BONDED OR FRIABLE ICE
Nbn	WELL BONDED, NO EXCESS ICE
Nbe	WELL BONDED, EXCESS ICE
Vx	INDIVIDUAL ICE CRYSTALS OR INCLUSIONS
Vc	ICE COATINGS ON PARTICLES
Vr	RANDOM OR IRREGULARLY ORIENTED ICE FORMATIONS
Vs	STRATIFIED OR DISTINCTLY ORIENTED ICE FORMATIONS
Ice + UNIFIED SOILS CLASSIFICATION	ICE WITH SOIL INCLUSIONS
Ice	ICE WITHOUT SOIL INCLUSIONS

TABLE 4

EXPLORATION HOLE SYMBOLS:

PLAN	SECTION	
×	(EP)	EXPLORATION POINT
▮	(TRENCH)	TRENCH
■	(TP)	TEST PIT
⊠	(HDTP)	HAND DUG TEST PIT
●	(AH)	AUGER HOLE
	(SDH)	SONIC DRILL HOLE
	(SDH-DDH)	SONIC/DIAMOND DRILL HOLE
⊙	(DDH)	DIAMOND DRILL HOLE
	(AH-SDH)	AUGER/SONIC DRILL HOLE
	(AH-DDH)	AUGER/DIAMOND DRILL HOLE
	(PH)	PERCUSSION DRILL HOLE
	(CPTU)	CONE PENETROMETER TEST HOLE
	(PMH)	PRESSUREMETER TEST HOLE
	(VANE)	VANE SHEAR TEST HOLE
Ⓦ	(WELL)	WELL
		INCLINED DRILL HOLE

NOTES: (PLAN)

1. COORDINATES AND ELEVATIONS ARE IN METRES.
2. COORDINATES ARE BASED ON MANITOBA HYDRO WUSKWATIM GENERARTING STATION REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. THE GROUND SURFACE CONTOURS AND SURFACE FEATURES WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS, DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10 000 SCALE PHOTOGRAPHY DATED JUNE 16, 1986. SEE REFERENCE DRAWINGS BELOW.
5. WATER SURFACE ELEVATION AND LOCATIONS OF SHORELINES ARE APPROXIMATE AND RELATE TO THE DATE OF PHOTOGRAPHY.
6. LOCATIONS OF EXPLORATIONS CONDUCTED IN 1965 (i.e. BOREHOLES W-0001 TO W-0013) ARE APPROXIMATE.
7. ELECTROMAGNETIC INDUCTION AND REFRACTION SEISMIC SURVEYS CONDUCTED OVER SAME PATH. SURVEYS LINE WORK OFFSET EQUALLY FOR CLARITY.

NOTES: (SECTION)

1. OFFSET DISTANCE SHOWN ONLY IF OFFSET IS GREATER THAN 5 METRES.
2. LABORATORY TEST RESULTS ARE PLOTTED AT THE MIDDLE OF THE SAMPLE DEPTH INTERVAL. WHERE THE LENGTH OF THE SAMPLE IS NOT KNOWN, THE TEST RESULTS ARE PLOTTED AT THE DEPTH OF THE SAMPLE.
3. SOIL CLASSIFICATIONS ARE BASED ON LABORATORY TEST RESULTS AND/OR VISUAL-MANUAL PROCEDURES.
4. CENTER LINE OF EXPLORATION HOLE SHIFTED IN SECTION FOR CLARITY.
5. GROUND SURFACE PROFILES HAVE BEEN ADJUSTED TO CONFORM TO EXPLORATORY HOLE INFORMATION AND MAY VARY FROM THE TOPOGRAPHY SHOWN ON THE EXPLORATION PLAN DRAWINGS.

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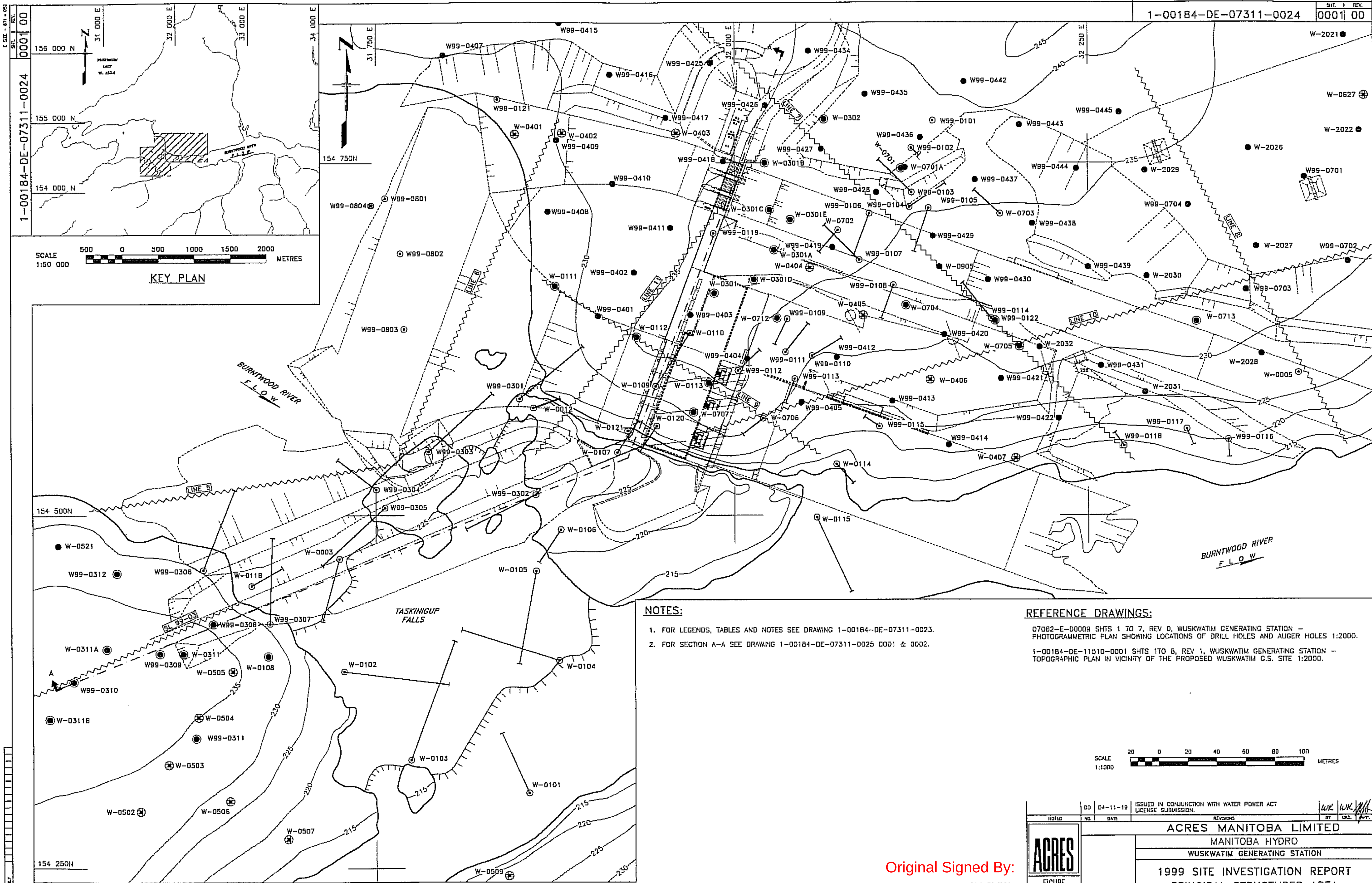
FIGURE 7

ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

GENERAL
LEGENDS, TABLES AND NOTES

DRAWN: GAC
CHECK:
SCALE: N.T.S.
APPROVED:
DATE:



NOTES:

1. FOR LEGENDS, TABLES AND NOTES SEE DRAWING 1-00184-DE-07311-0023.
2. FOR SECTION A-A SEE DRAWING 1-00184-DE-07311-0025 0001 & 0002.

REFERENCE DRAWINGS:

07062-E-00009 SHTS 1 TO 7, REV 0, WUSKWATIM GENERATING STATION – PHOTOGRAMMETRIC PLAN SHOWING LOCATIONS OF DRILL HOLES AND AUGER HOLES 1:2000.

1-00184-DE-11510-0001 SHTS 1TO 8, REV 1, WUSKWATIM GENERATING STATION – TOPOGRAPHIC PLAN IN VICINITY OF THE PROPOSED WUSKWATIM G.S. SITE 1:2000.

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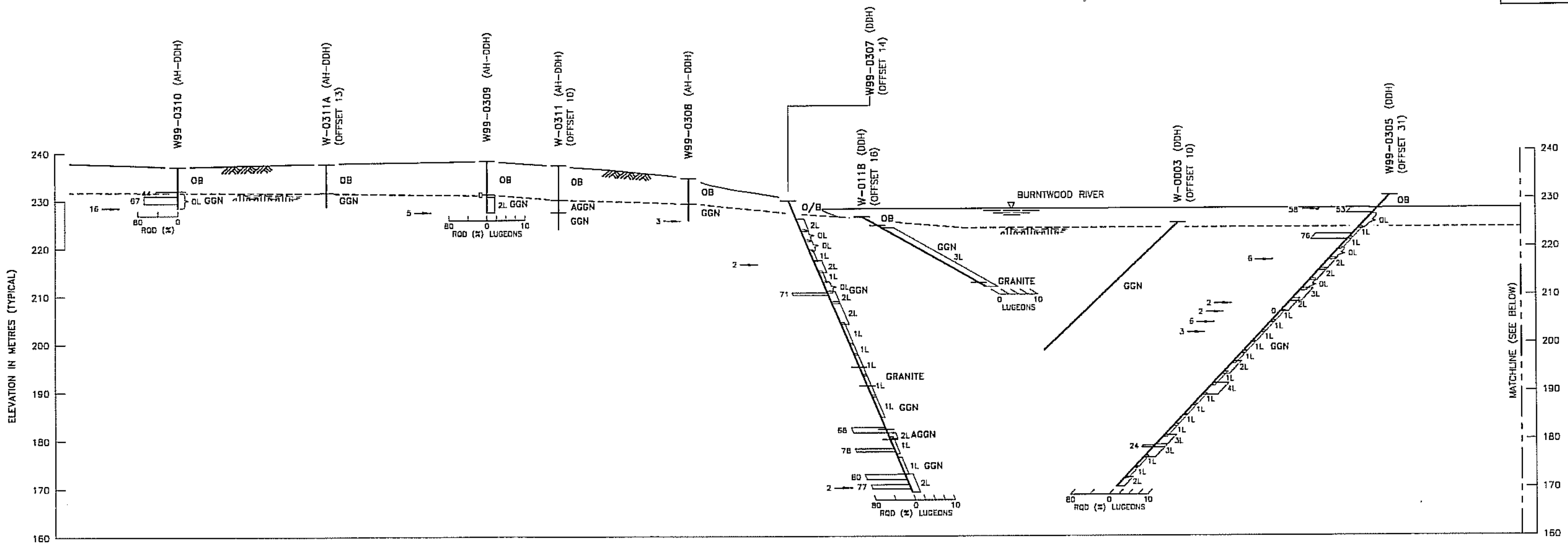
ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

1999 SITE INVESTIGATION REPORT
PRINCIPAL STRUCTURES AREA
LOCATIONS OF EXPLORATIONS & GEOLOGICAL SECTIONS

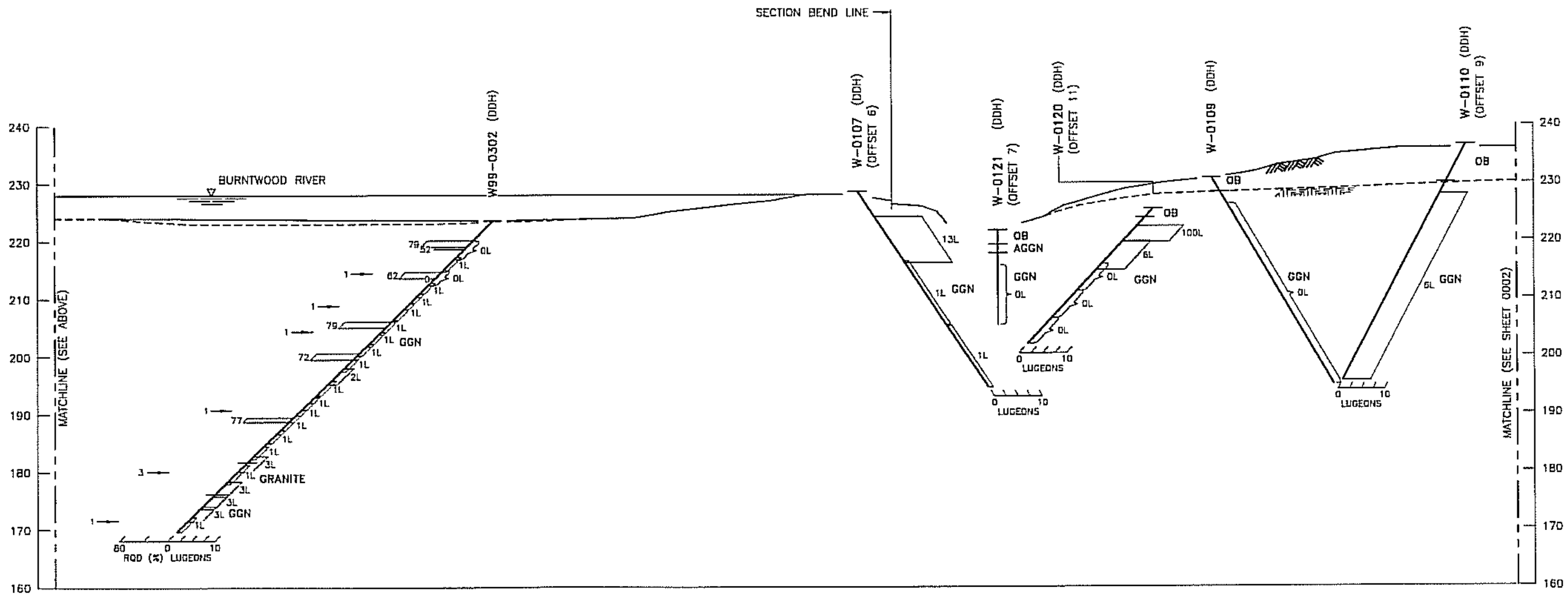
FIGURE 8

DRAWN GAC
SCALE AS SHOWN

1-00184-DE-07311-0024 SHT. 0001 REV. 00



SECTION A–A



SECTION A–A (CONTINUED)

CONTINUED ON SHEET 0002

NOTES:

1. FOR LOCATION OF SECTION A–A SEE DRAWING 1-00184-DE-07311-0024.
2. FOR LEGENDS, TABLES AND NOTES SEE DRAWING 1-00184-DE-07311-0023.

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ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

1999 SITE INVESTIGATION REPORT
PRINCIPAL STRUCTURES AREA
BEDROCK GEOLOGICAL SECTIONS

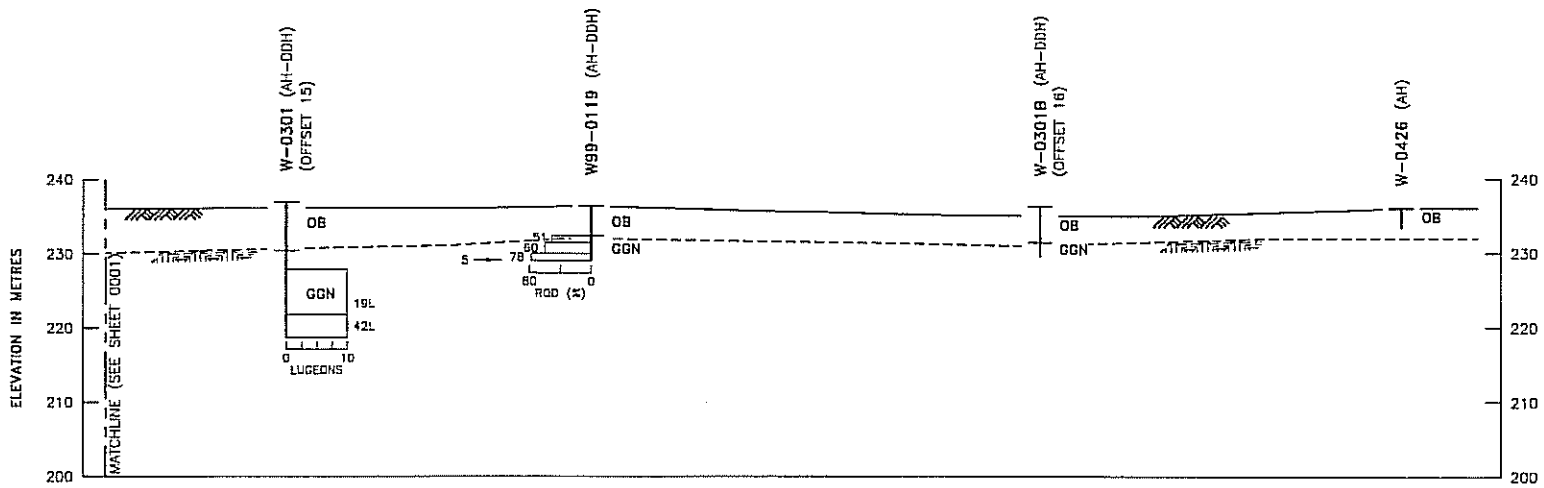
FIGURE 9

DRAWN: CAC
SCALE: 1:400

1-00184-DE-07311-0025 | SHT. 0001 | REV. 00

MANITOBA WATER STEWARDSHIP NO. 57-2-1027 Sht. 2

1-00184-DE-07311-0025 | SHT. 0002 | REV. 00



SECTION A–A (CONTINUED)

HORIZONTAL SCALE 1:400 — 10 0 10 20 30 40 METRES

NOTES:

1. FOR LOCATION OF SECTION A–A SEE DRAWING 1-00184-DE-07311-0024.
2. FOR LEGENDS, TABLES AND NOTES SEE DRAWING 1-00184-DE-07311-0023.

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

1999 SITE INVESTIGATION REPORT
PRINCIPAL STRUCTURES AREA
BEDROCK GEOLOGICAL SECTIONS

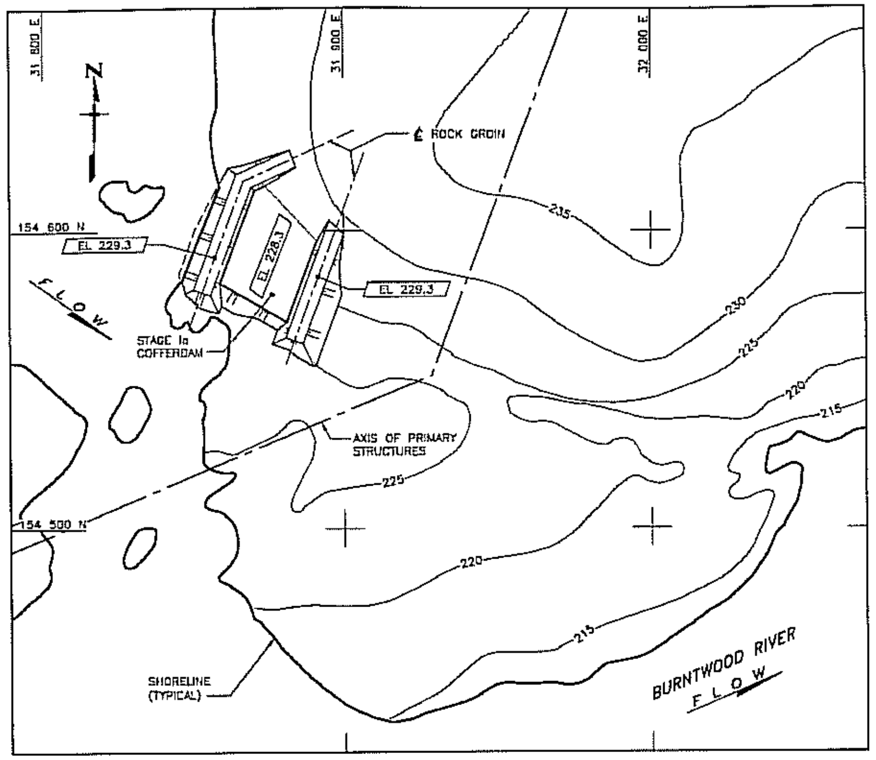
FIGURE 10

DRAWN GAC — SCALE 1:400

1-00184-DE-07311-0025 | SHT. 0002 | REV. 00

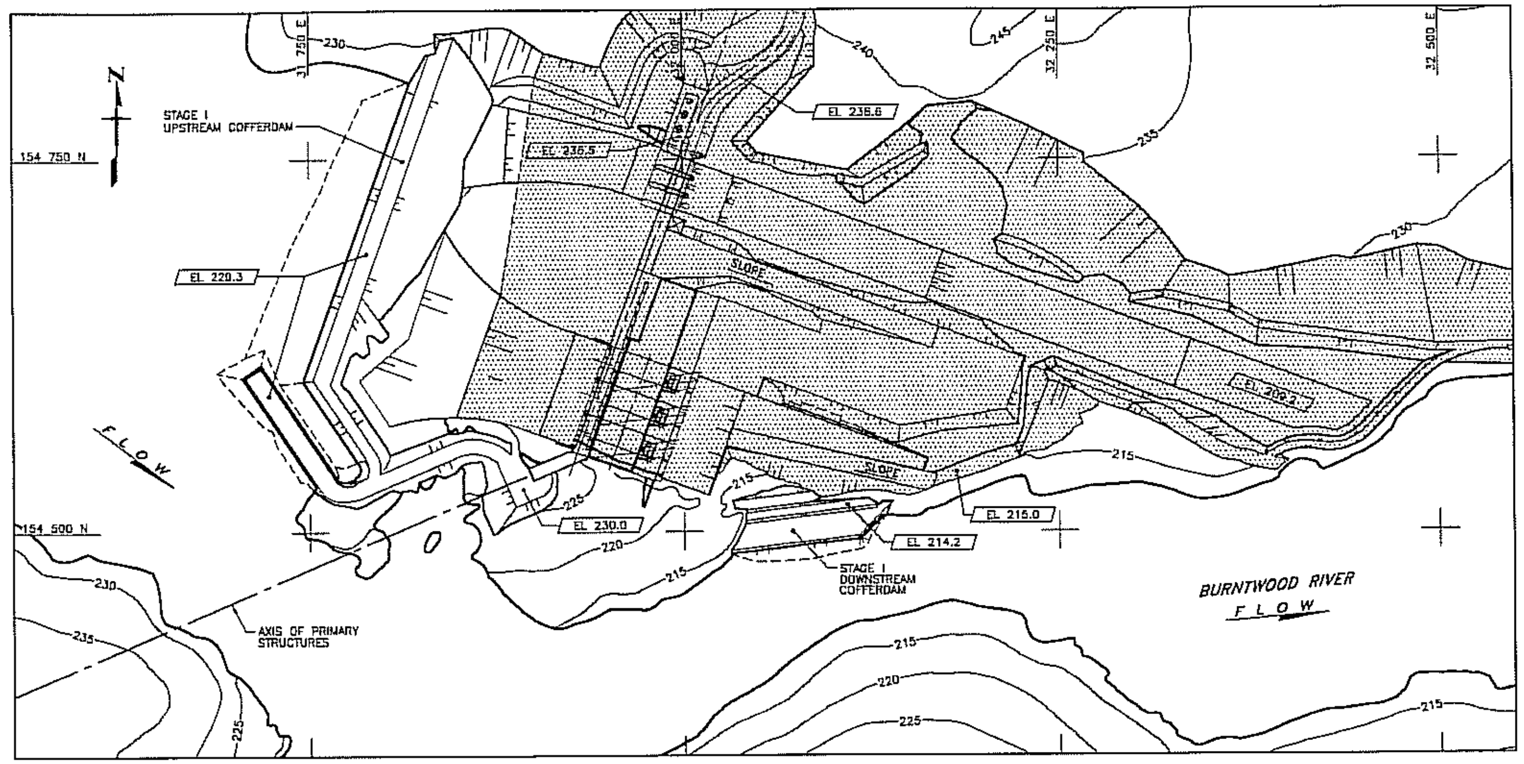
MANITOBA WATER STEWARDSHIP No. 57-2-1028

	SHT.	REV.
1-00184-DE-07311-0004	0001	00



STAGE Ia

SCALE 1:1000



STAGE I

SCALE 1:2000

LEGEND:

APPROXIMATE LIMITS OF PHASE 1 EXCAVATION

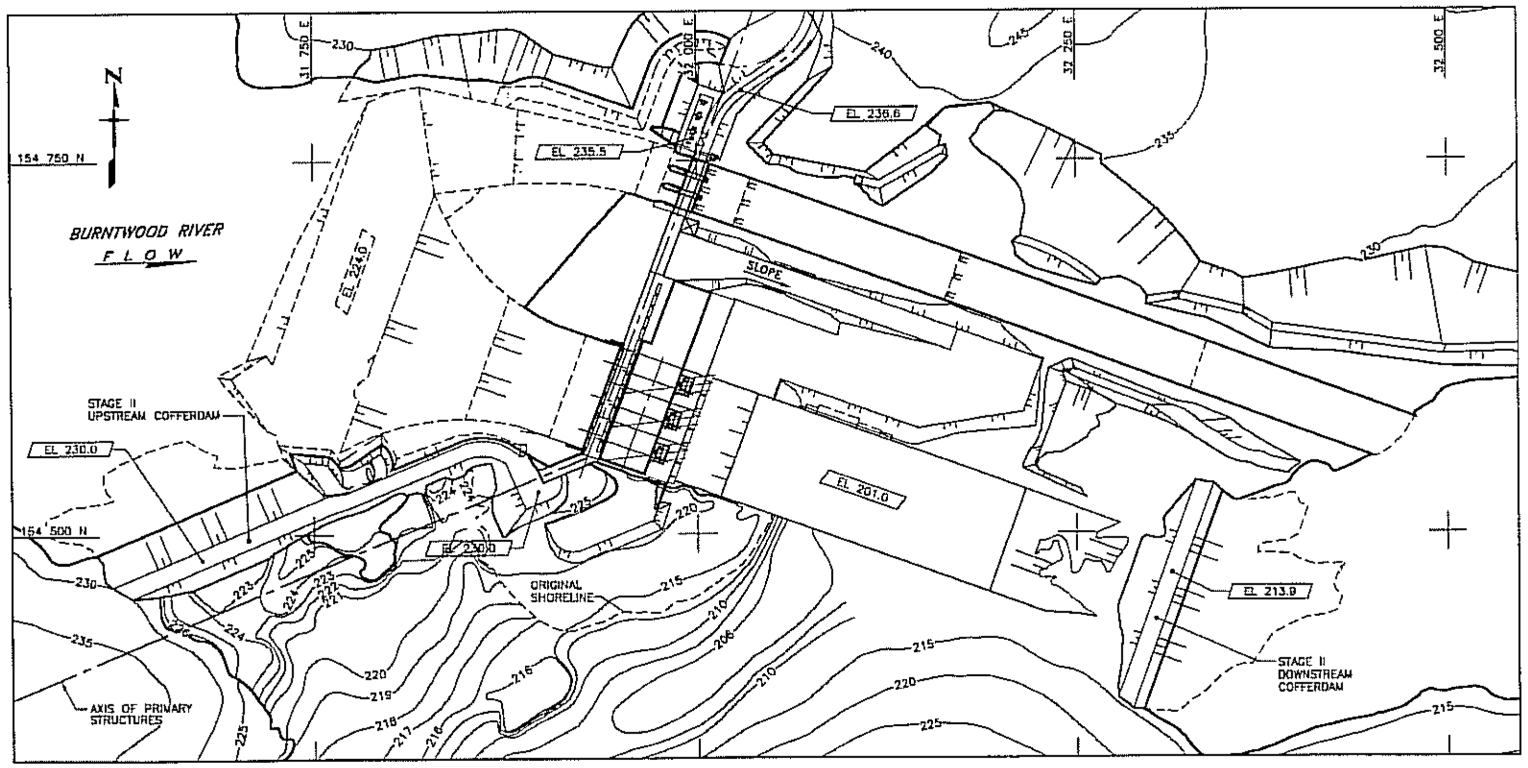
215 GROUND SURFACE CONTOUR

217 RIVERBED SURFACE CONTOUR

SHORELINE

NOTE:

1. COORDINATES AND ELEVATIONS ARE IN METRES.



STAGE II

SCALE 1:2000

SCALE 1:1000 — 20 0 20 40 60 80 100 METRES

SCALE 1:2000 — 50 0 50 100 150 200 METRES

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No. 5 Expiry: April 30, 2005

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

FIGURE 11

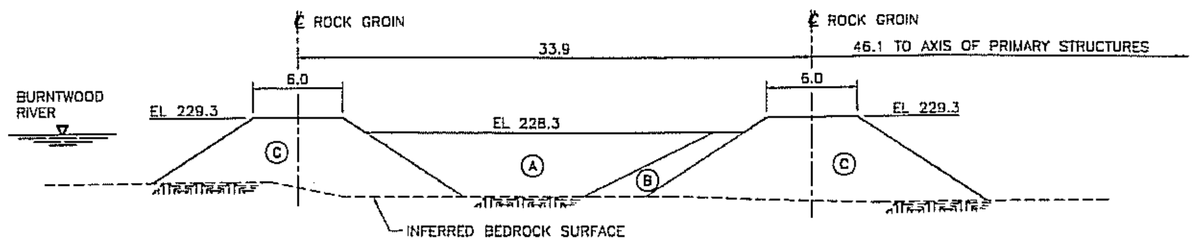
RIVER DIVERSION DURING CONSTRUCTION PLANS

SCALE AS SHOWN

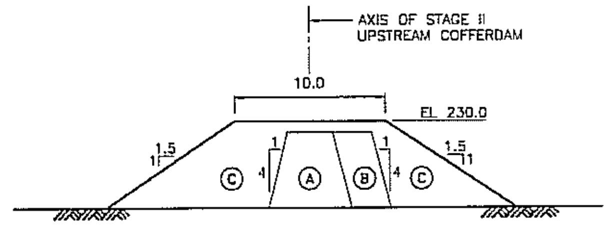
	SHT.	REV.
1-00184-DE-07311-0004	0001	00

MANITOBA WATER STEWARDSHIP No. 57-2-1029

1-00184-DE-07311-0005 | SHT. 0001 | REV. 00



STAGE Ia UPSTREAM COFFERDAM



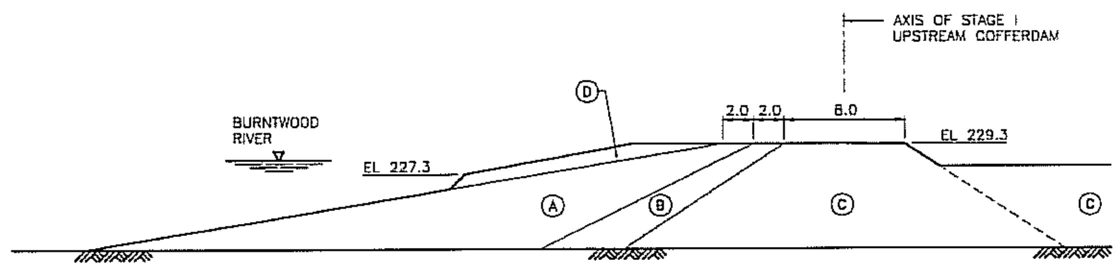
STAGE II UPSTREAM COFFERDAM
(PORTION CONSTRUCTED IN THE DRY)

LEGEND

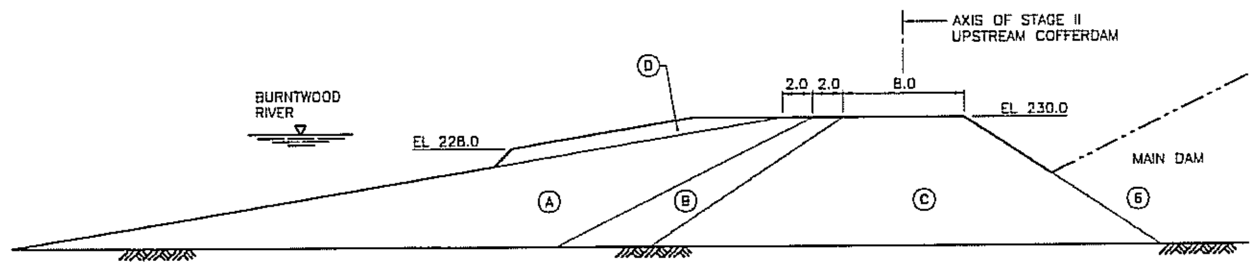
- (A) IMPERVIOUS FILL
- (B) TRANSITION FILL
- (C) ROCKFILL
- (D) RIPRAP
- GROUND SURFACE, RIVERBED SURFACE
- WATER LEVEL

NOTE:

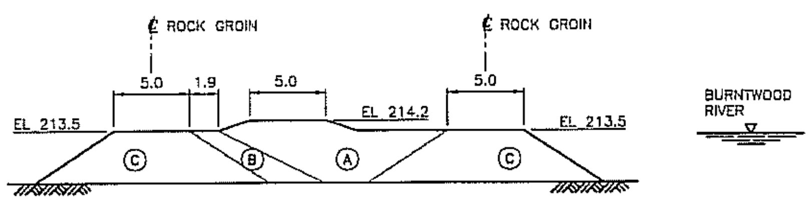
1. DIMENSIONS AND ELEVATIONS ARE IN METRES.



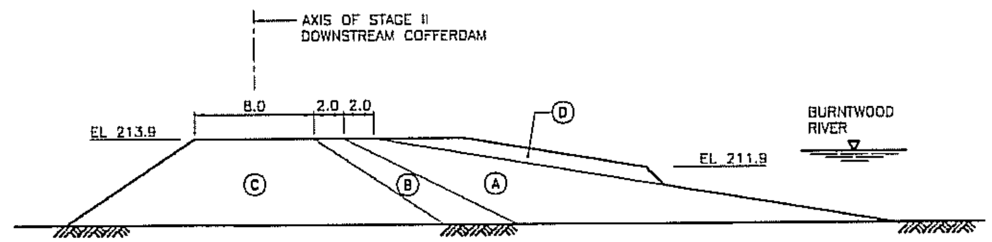
STAGE I UPSTREAM COFFERDAM



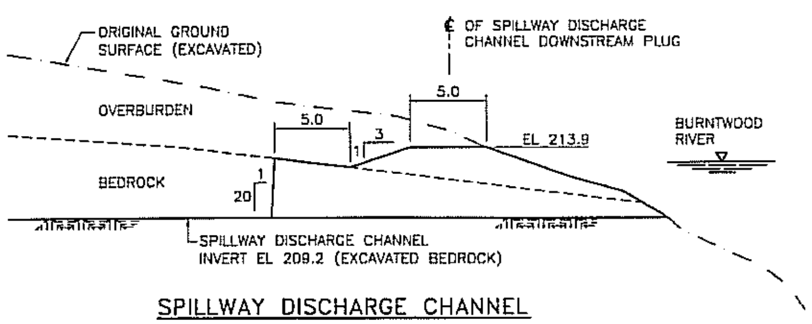
STAGE II UPSTREAM COFFERDAM
(PORTION CONSTRUCTED IN THE WET)



STAGE I DOWNSTREAM COFFERDAM



STAGE II DOWNSTREAM COFFERDAM



SPILLWAY DISCHARGE CHANNEL
DOWNSTREAM PLUG

SCALE 1:200 — 5 0 5 10 15 20 METRES

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MANITOBA HYDRO

WUSKWATIM GENERATING STATION

FIGURE 12

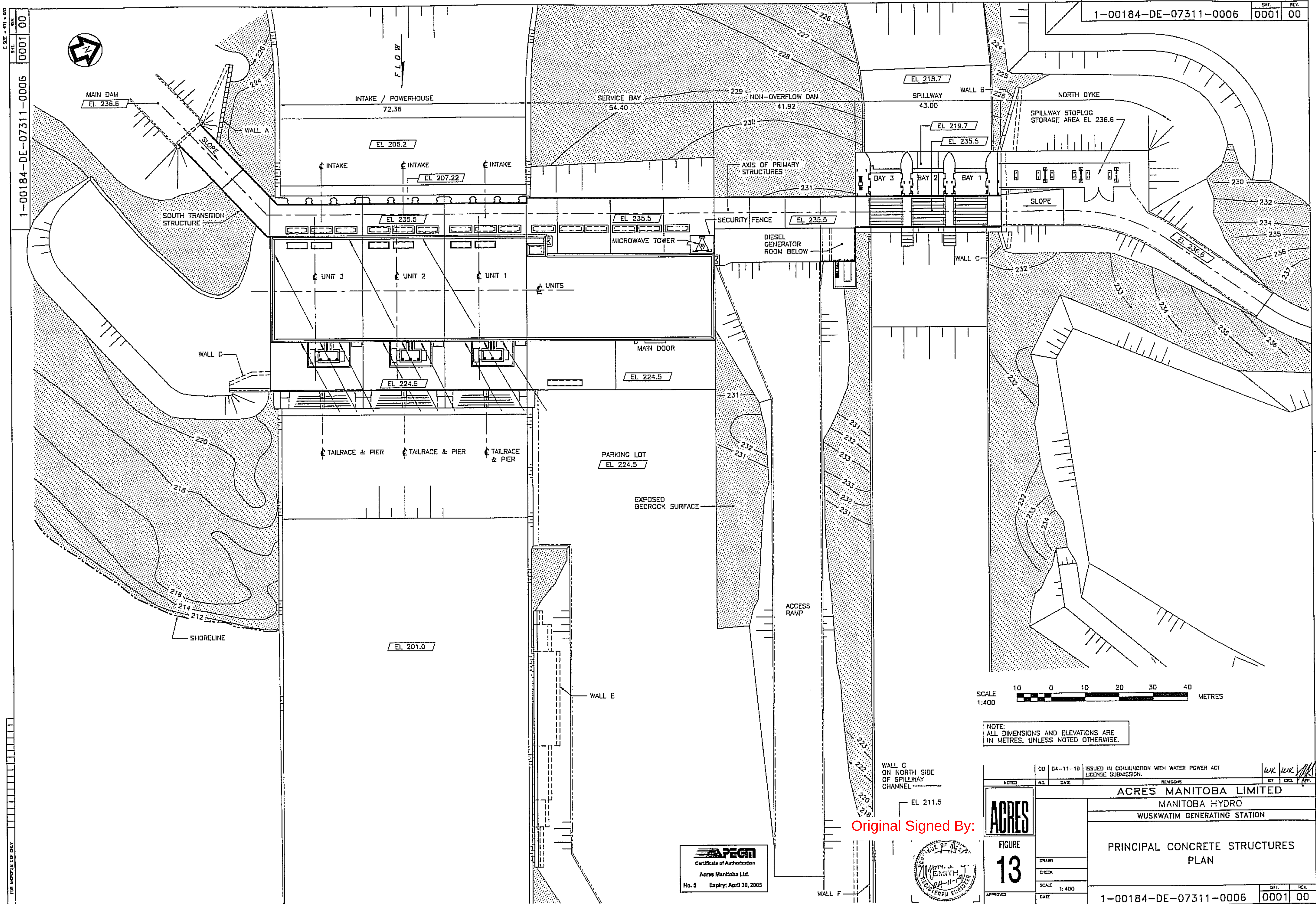
RIVER DIVERSION DURING CONSTRUCTION SECTIONS

SCALE 1:200

1-00184-DE-07311-0005 | SHT. 0001 | REV. 00

MANITOBA WATER STEWARDSHIP No. 57-2-1030

1-00184-DE-07311-0006 SHT. 0001 REV. 00



NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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PRINCIPAL CONCRETE STRUCTURES PLAN

FIGURE 13

SCALE 1:400

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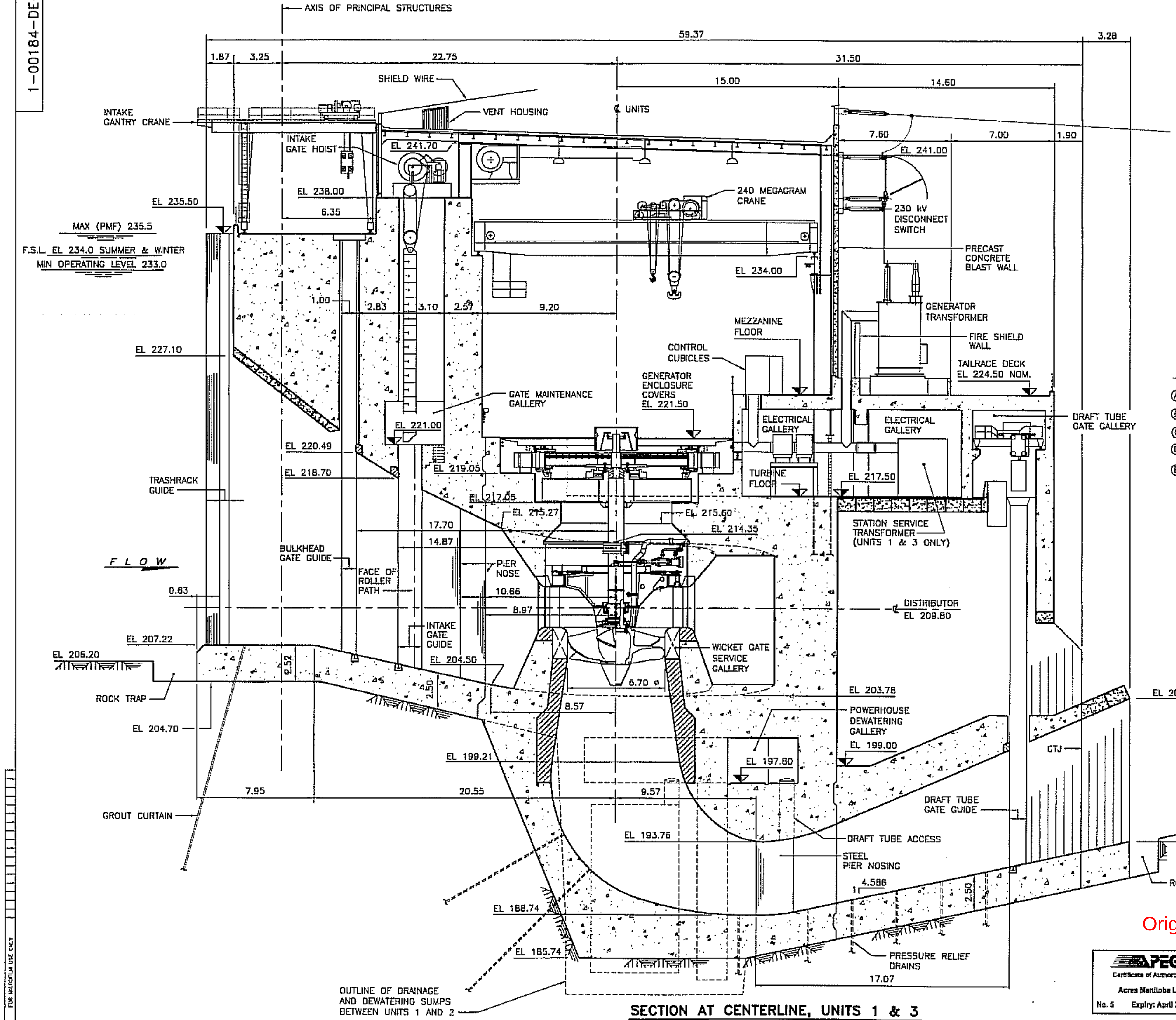
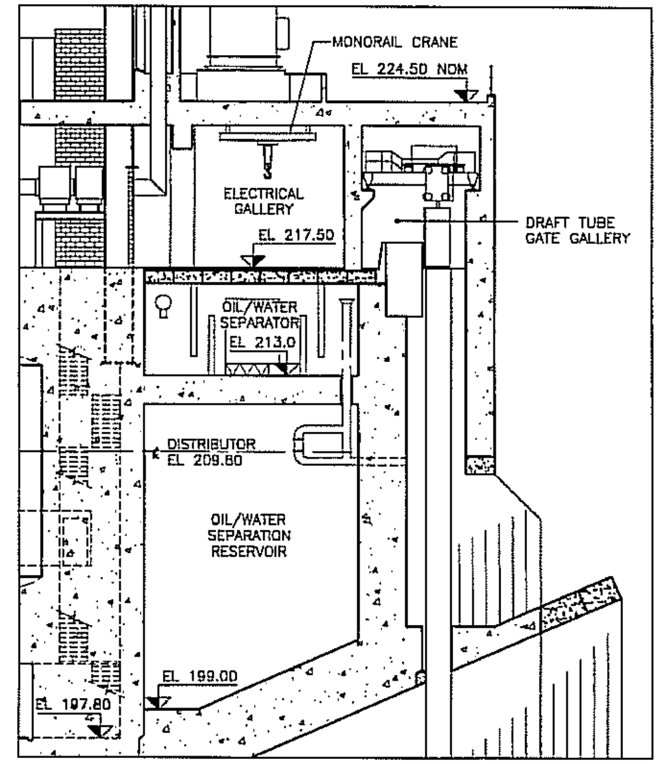
1-00184-DE-07311-0006 SHT. 0001 REV. 00



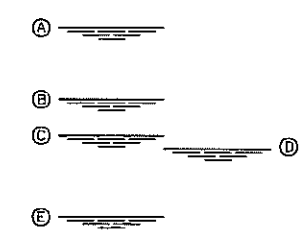
SECTION AT CENTERLINE, UNITS 1 & 3

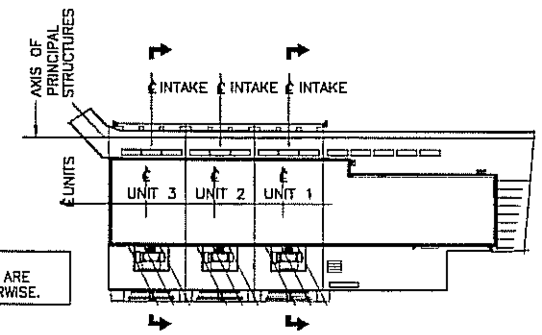


PART SECTION THROUGH OIL/WATER SEPARATOR, UNIT 2

TAILWATER LEVELS

	PRE-KEPUCHE	POST-KEPUCHE
Ⓐ MAXIMUM (PMF)	217.8	217.8
Ⓑ 1:1000-YR FLOOD	214.7	215.9
Ⓒ NORMAL (WINTER)	213.2	216.0
Ⓓ NORMAL (SUMMER)	212.6	215.2
Ⓔ MINIMUM (1 UNIT)	209.8	214.6





KEY PLAN

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE 1:125 — 2.5 0 2.5 5 7.5 10 12.5 METRES

NO.	DATE	REVISIONS	BY	CKD.	APP.
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MANITOBA HYDRO
WUSKWATIM GENERATING STATION

FIGURE 14

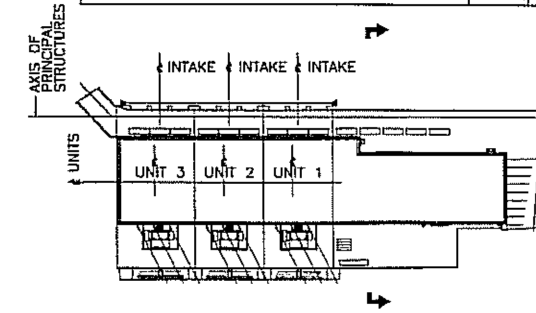
INTAKE AND POWERHOUSE SECTIONS

DRAWN
CHECK
SCALE 1:125
APPROVED
DATE

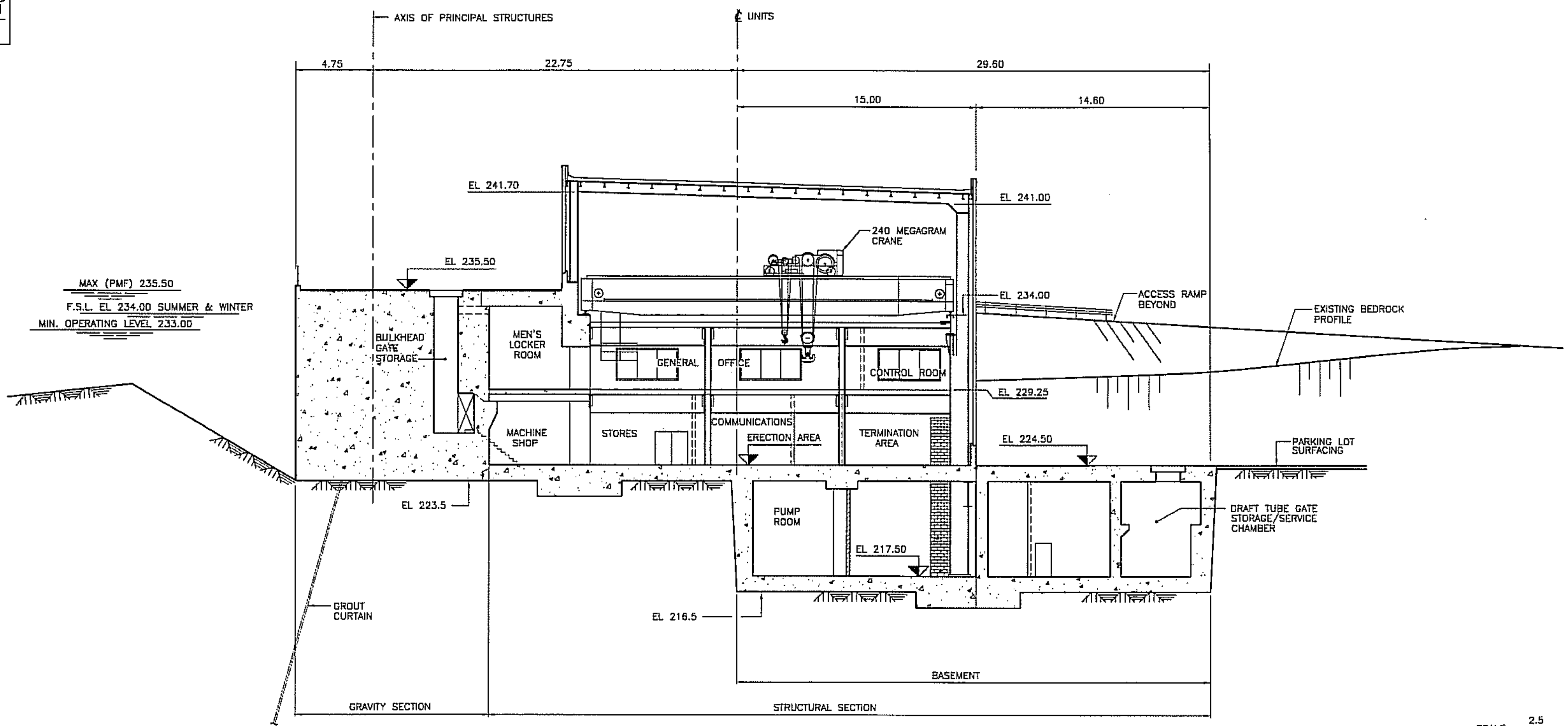
AUTOCAD ORIGINAL
FOR MICROFILM USE ONLY

MANITOBA WATER STEWARDSHIP No. 57-2-1032

1-00184-DE-07311-0008 | SHT. 0001 | REV. 00



KEY PLAN



SCALE 1:125 — 2.5 0 2.5 5 7.5 10 12.5 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

SERVICE BAY SECTION

FIGURE 15

SCALE 1:125

1-00184-DE-07311-0008 | SHT. 0001 | REV. 00

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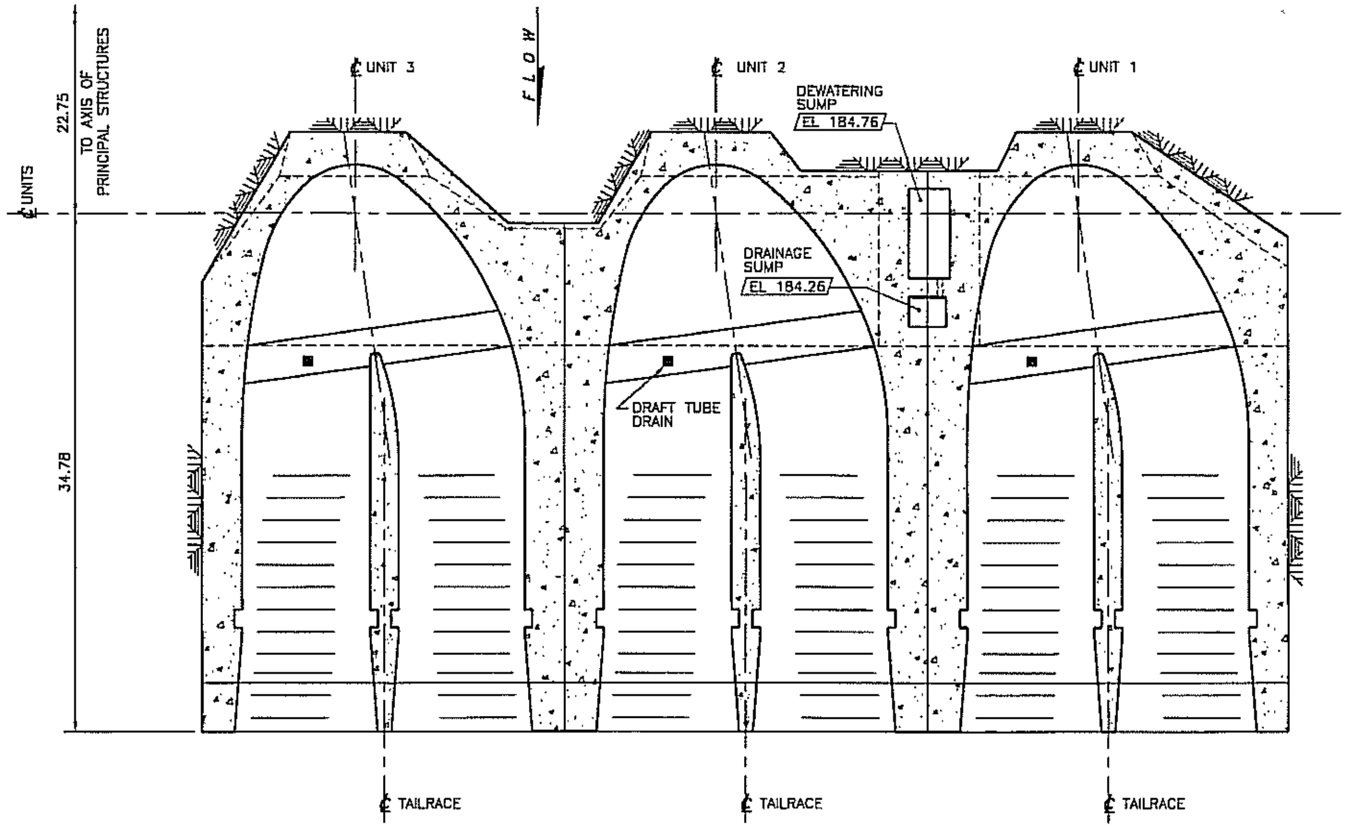
FOR MICROFILM USE ONLY

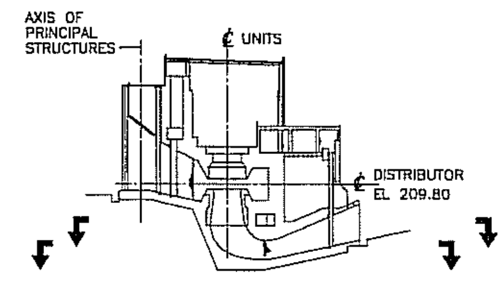
AUTOCAD ORIGINAL

1-00184-DE-07311-0008 SHT. 0001 REV. 00

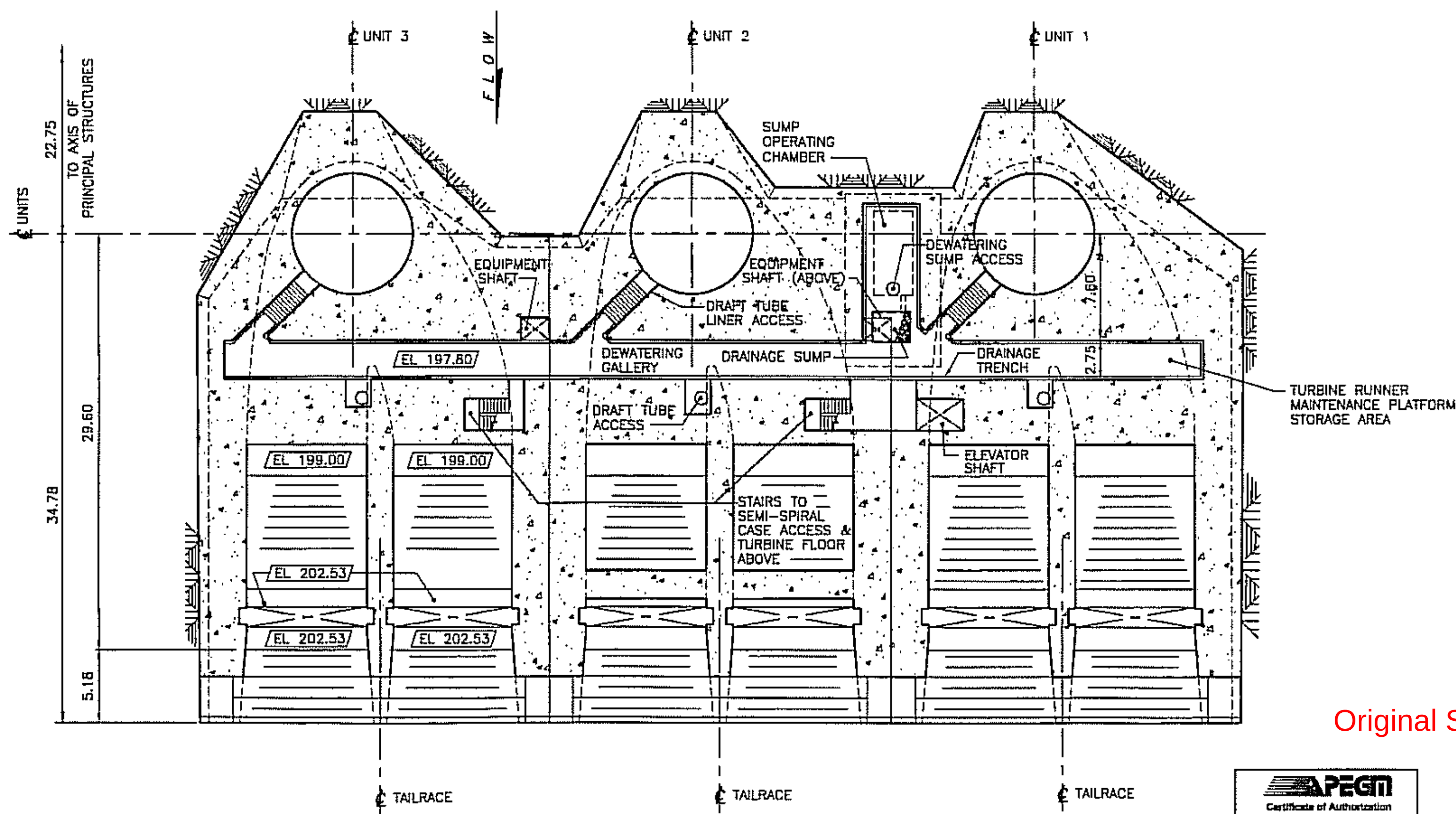
MANITOBA WATER STEWARDSHIP No. 57-2-1033	SHT.	REV.
1-00184-DE-07311-0009	0001	00



SECTIONAL PLAN THROUGH DRAFT TUBE



KEY SECTION



SECTIONAL PLAN AT DEWATERING GALLERY

SCALE 1:200 — 5 0 5 10 15 20 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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SMITH
04-11-19

ACRES

FIGURE 16

ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

POWERHOUSE PLANS

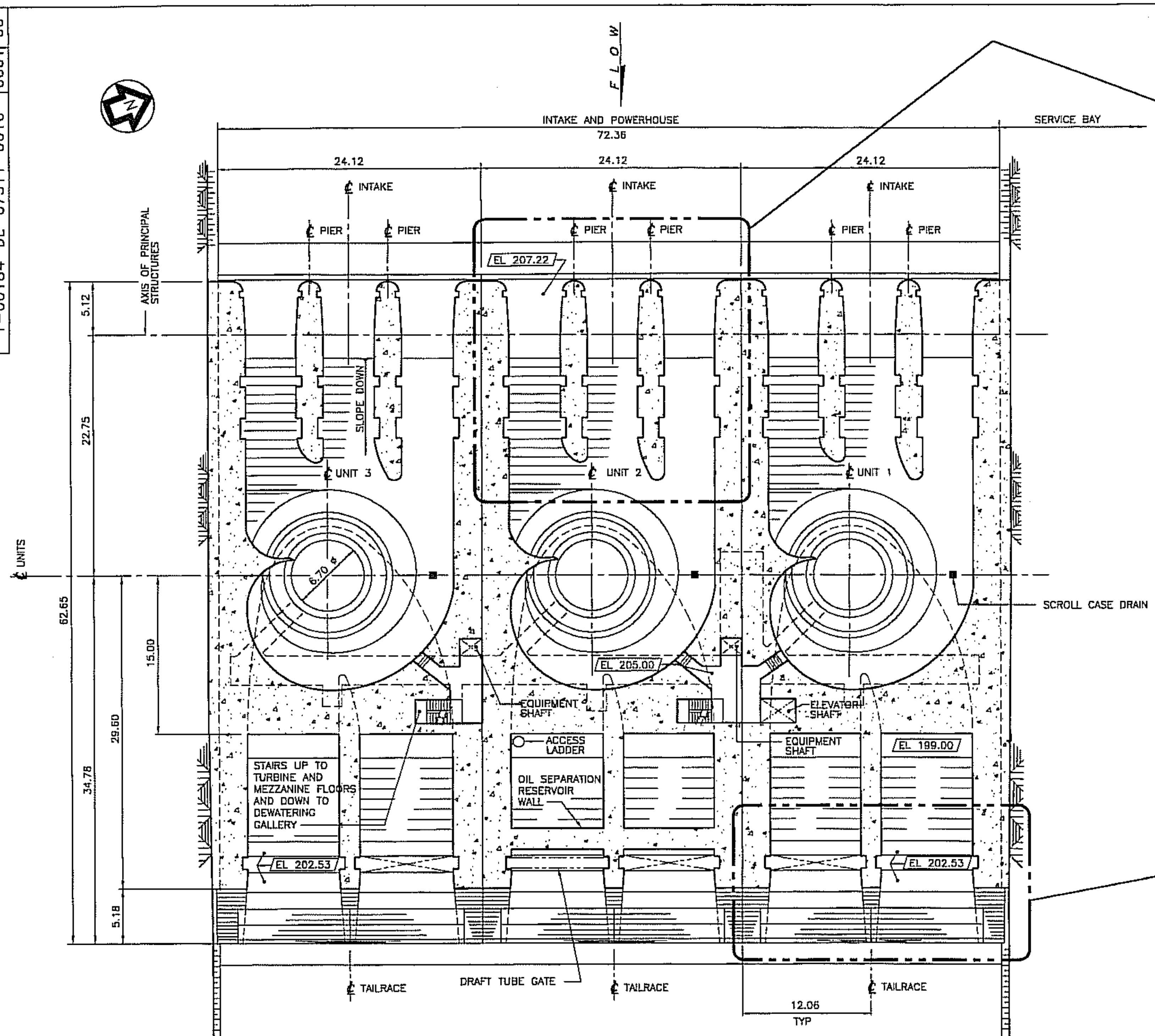
SCALE 1:200

	SHT.	REV.
1-00184-DE-07311-0009	0001	00

1-00184-DE-07311-0009 0001 00

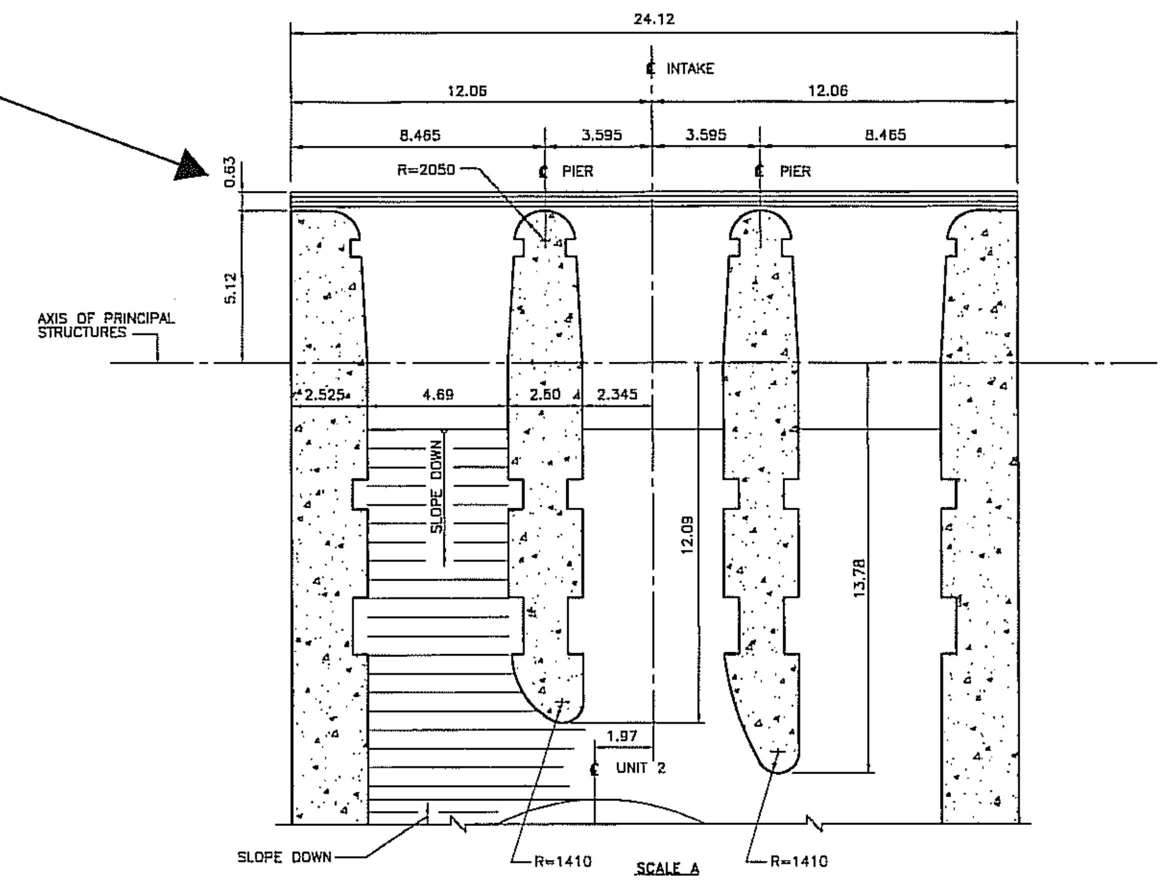
MANITOBA WATER STEWARDSHIP No. 57-2-1034

1-00184-DE-07311-0010 | SHT. 0001 | REV. 00

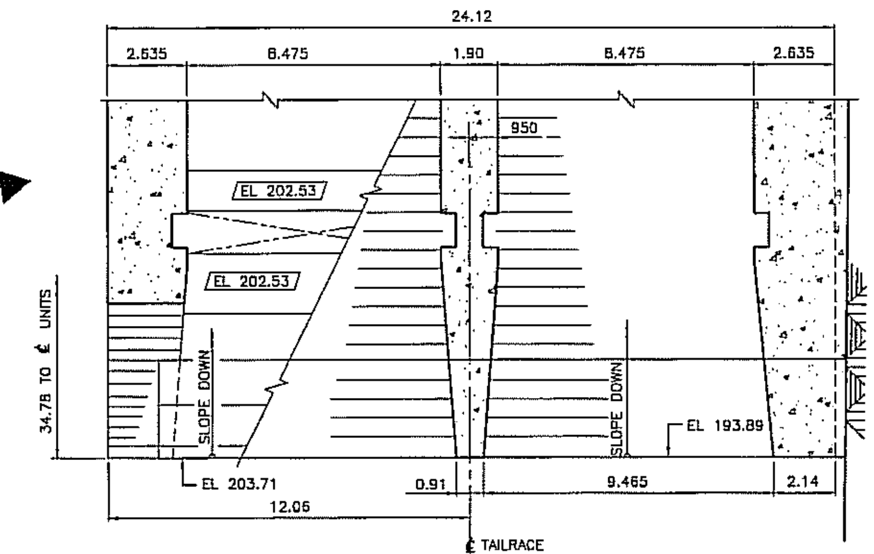


SECTIONAL PLAN AT CENTRELINE OF DISTRIBUTOR

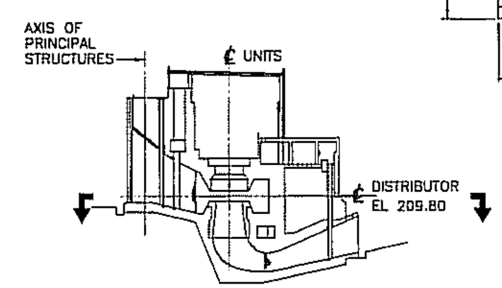
SCALE B



SCALE A



SCALE A



KEY SECTION

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 1:100 — 2.5 0 2.5 5 7.5 10 METRES

SCALE B 1:200 — 5 0 5 10 15 20 METRES

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

ACRES

FIGURE 17

INTAKE AND POWERHOUSE
WATERPASSAGE
PLANS

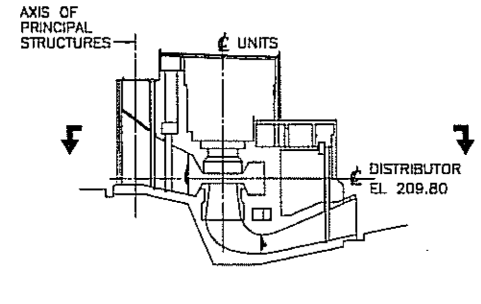
SCALE 1:200

1-00184-DE-07311-0010 | SHT. 0001 | REV. 00

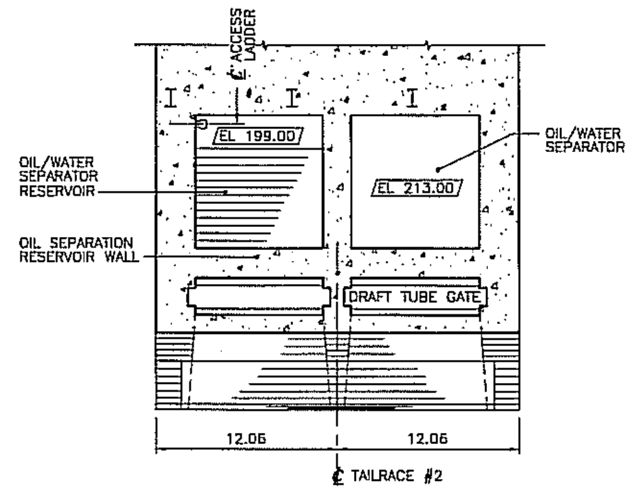
AUTOCAD ORIGINAL

MANITOBA WATER STEWARDSHIP No. 57-2-1035

1-00184-DE-07311-0011 SHT. 0001 REV. 00

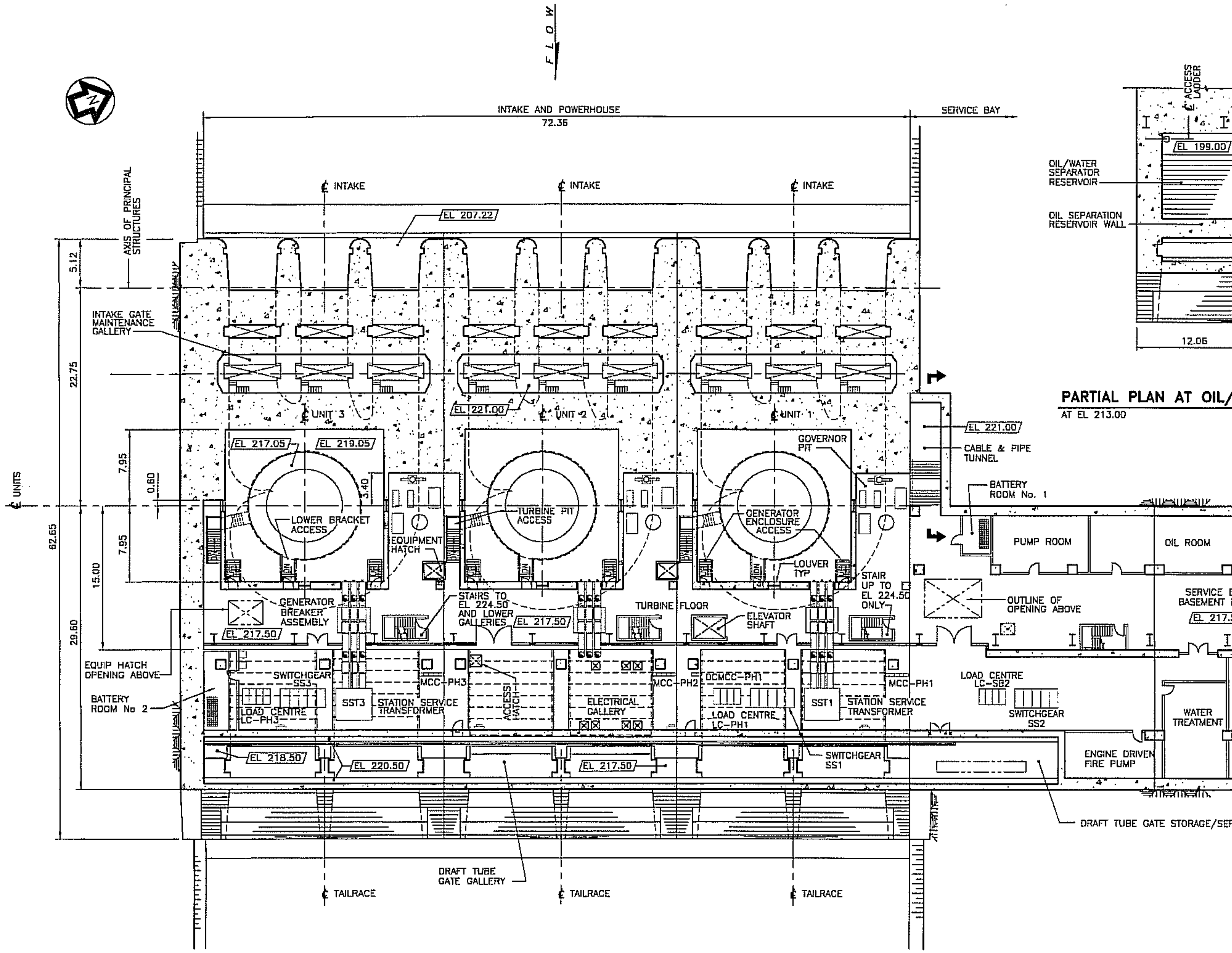


KEY SECTION



PARTIAL PLAN AT OIL/WATER SEPARATOR (UNIT 2 ONLY)

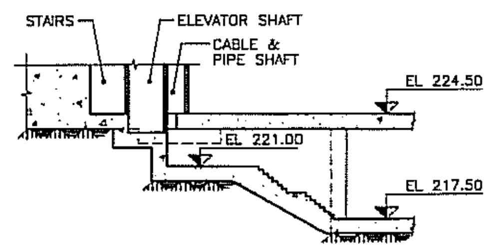
AT EL 213.00



SCALE 1:200 5 0 5 10 15 20 METRES

SECTIONAL PLAN AT POWERHOUSE TURBINE FLOOR AND SERVICE BAY BASEMENT (EL 217.50)

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.



SECTION THROUGH CABLE & PIPE TUNNEL

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

FIGURE 18

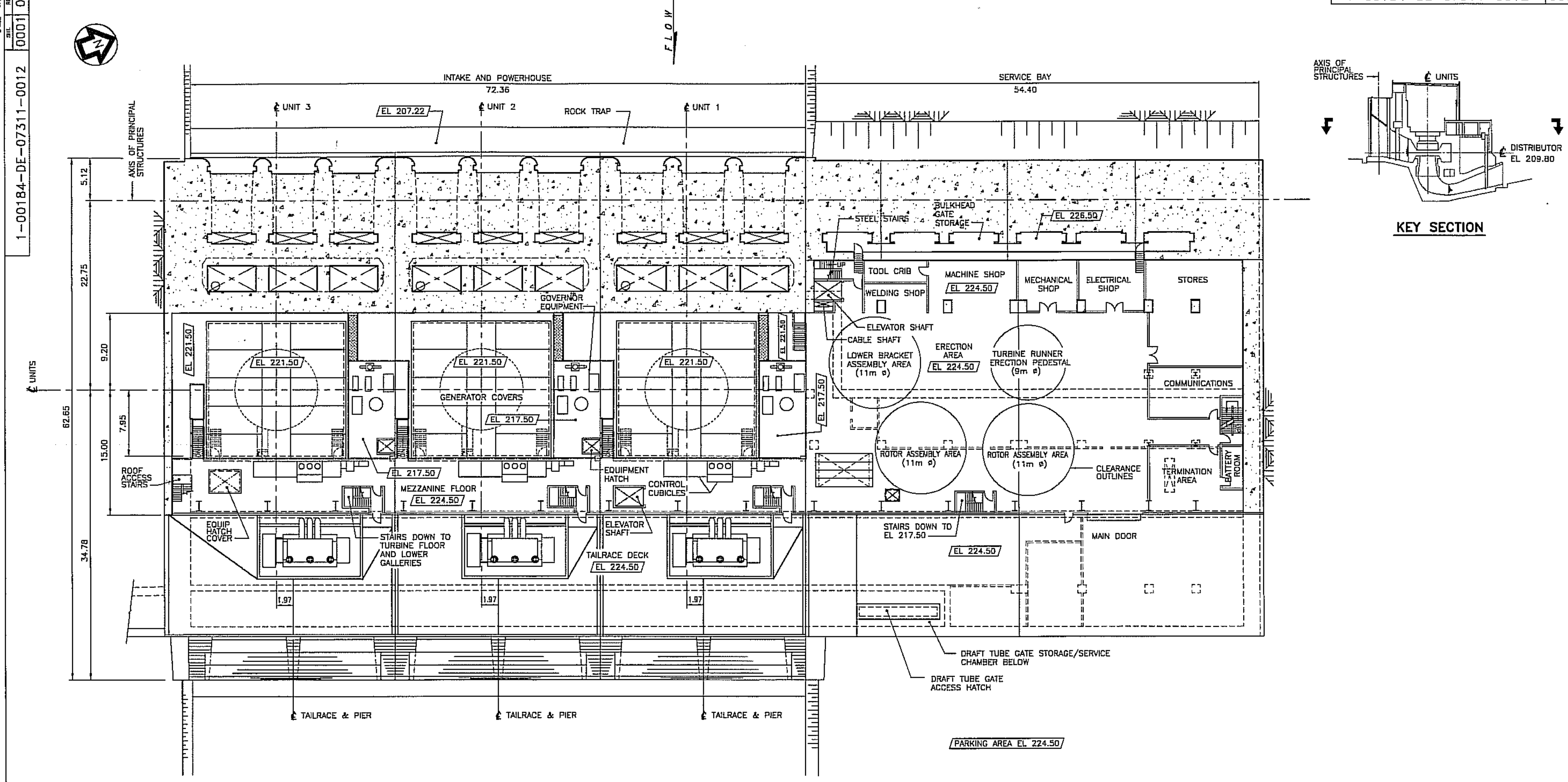
INTAKE AND POWERHOUSE & SERVICE BAY PLANS

SCALE 1:200

1-00184-DE-07311-0011 SHT. 0001 REV. 00

MANITOBA WATER STEWARDSHIP No. 57-2-1036

1-00184-DE-07311-0012 | SHT. 0001 | REV. 00



SECTIONAL PLAN AT EL 224.50

SCALE 1:200 — 5 0 5 10 15 20 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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FIGURE 19

ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

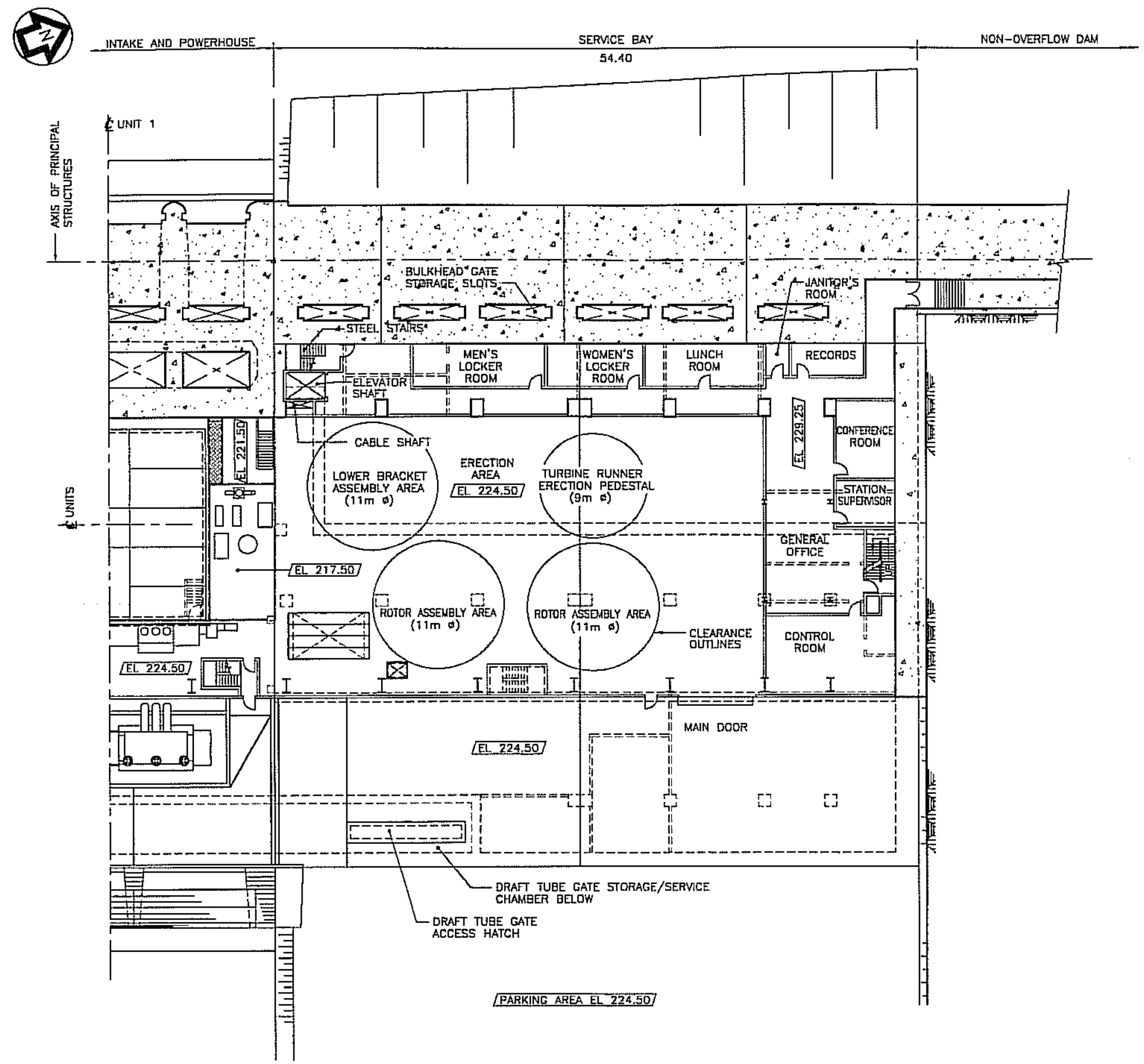
INTAKE AND POWERHOUSE & SERVICE BAY PLAN ABOVE GENERATOR FLOOR

SCALE 1:200

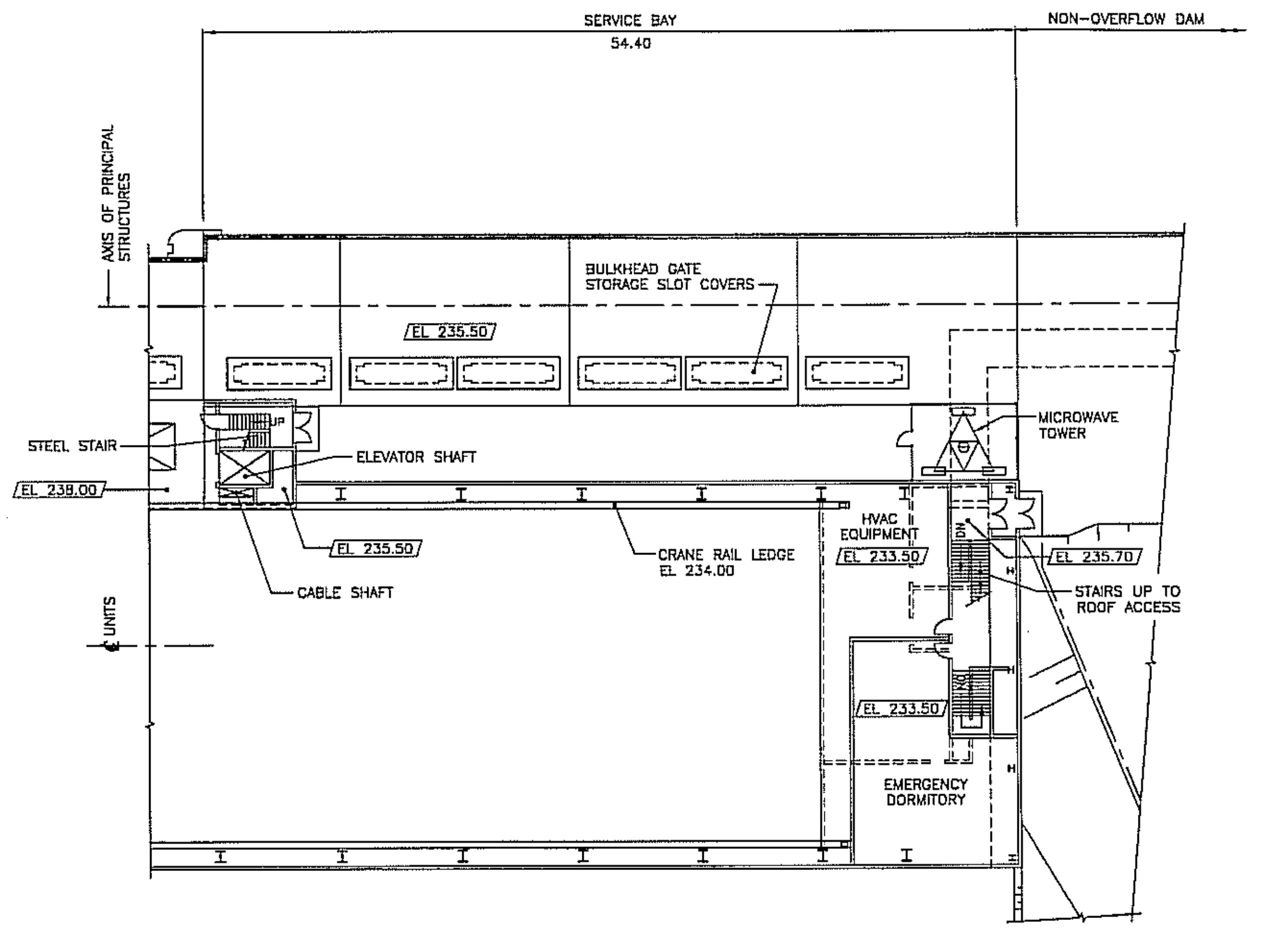
1-00184-DE-07311-0012 | SHT. 0001 | REV. 00

MANITOBA WATER STEWARDSHIP No. 57-2-1037

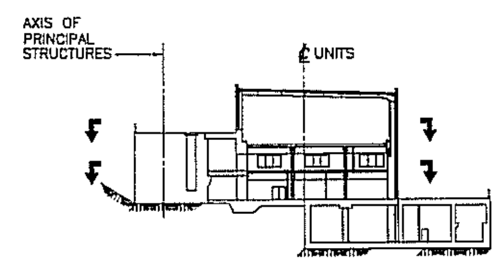
1-00184-DE-07311-0013 | SHT. 0001 | REV. 00



PLAN AT EL 229.25



PLAN AT EL 233.50, EL 235.50 & EL 238.00



KEY SECTION

SCALE 1:200 — 5 0 5 10 15 20 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

ACRES

FIGURE 20

SERVICE BAY PLANS

SCALE 1:200

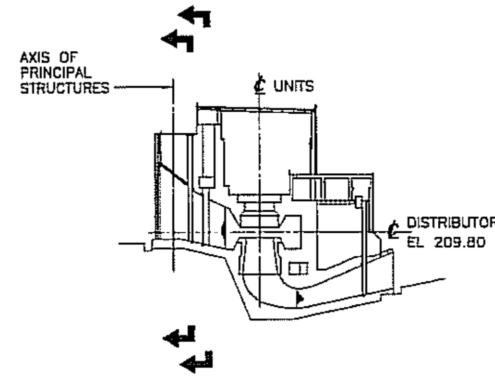
1-00184-DE-07311-0013 | SHT. 0001 | REV. 00

FOR MICROFILM USE ONLY

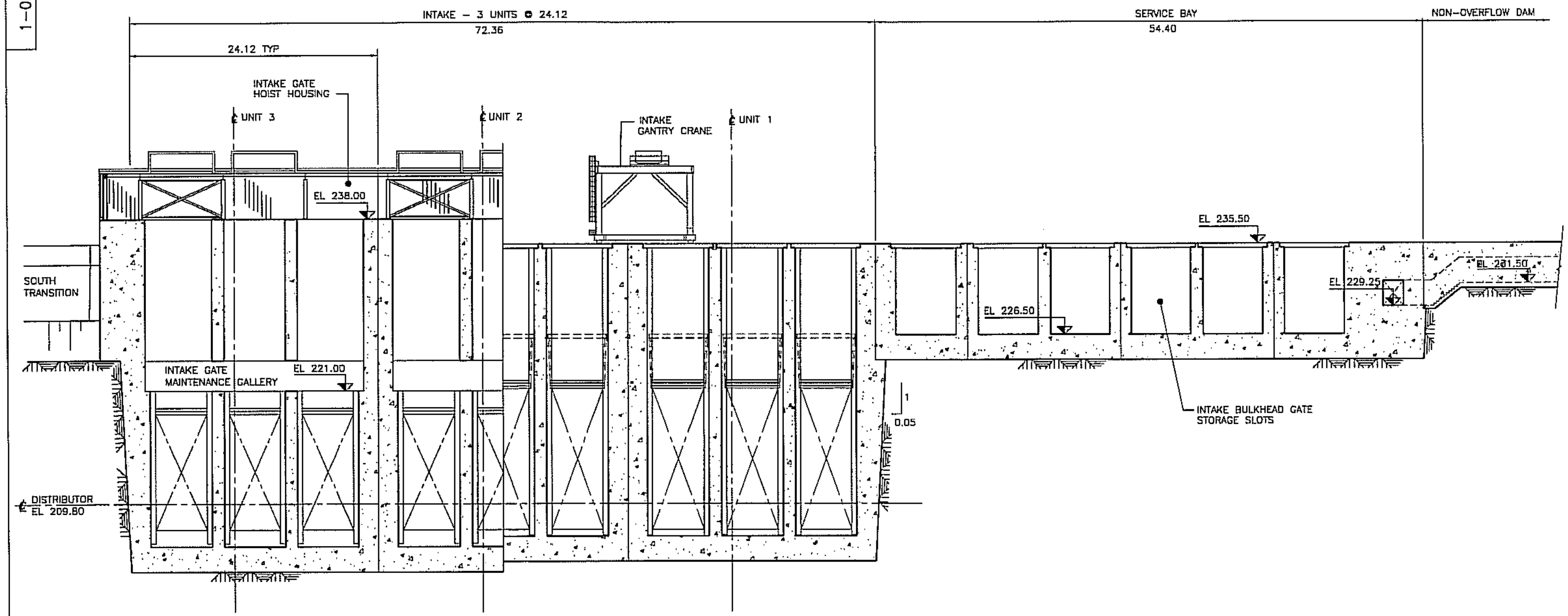
AUTOCAD ORIGINAL

MANITOBA WATER STEWARDSHIP No. 57-2-1038

1-00184-DE-07311-0014 | SHT. 0001 | REV. 00



KEY SECTION



LONGITUDINAL SECTION AT INTAKE GATES

LONGITUDINAL SECTION AT BULKHEAD GATES

LONGITUDINAL SECTION AT BULKHEAD GATE STORAGE SLOTS

SCALE 1:200 — 5 0 5 10 15 20 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

FIGURE 21

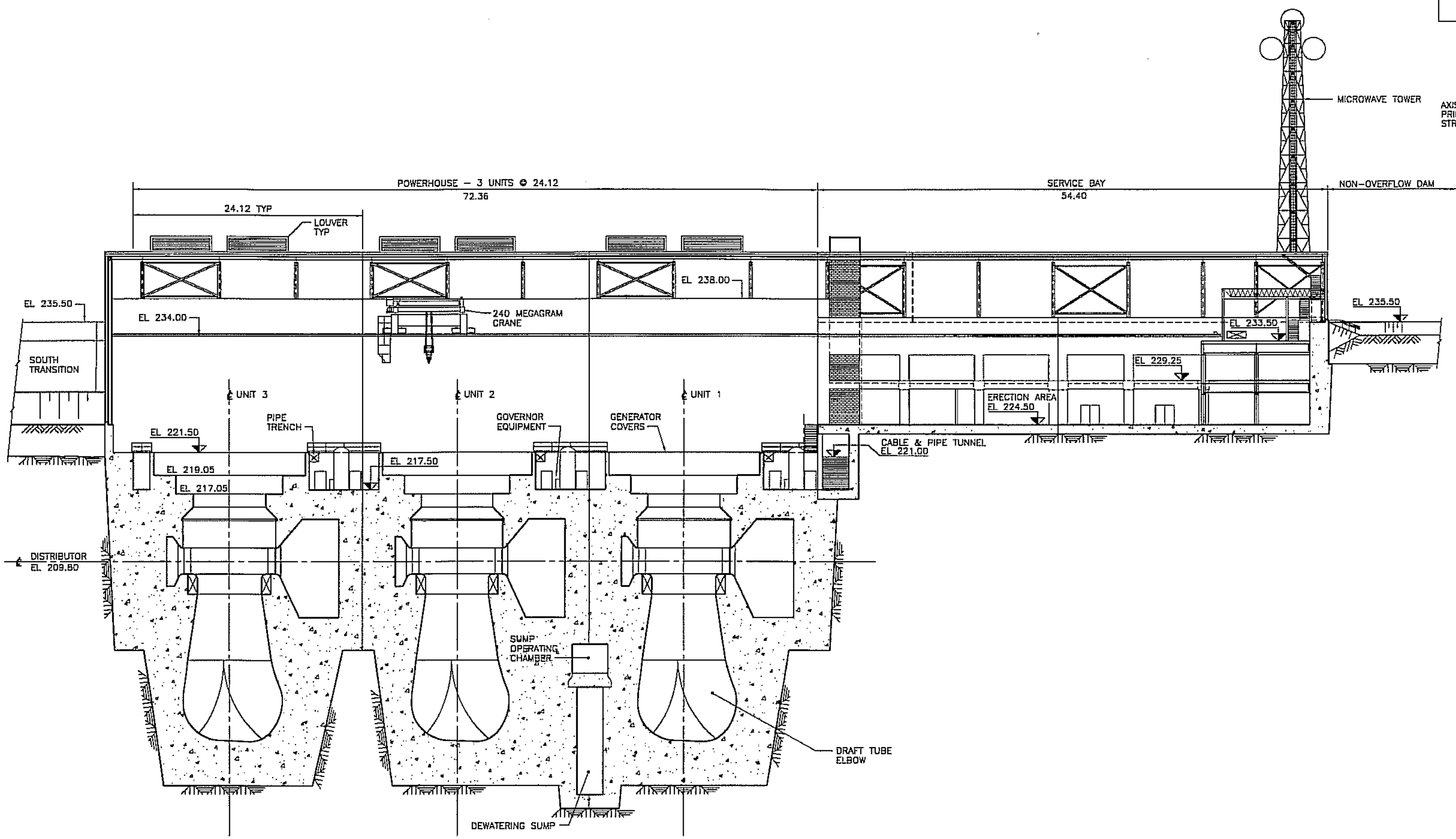
INTAKE AND SERVICE BAY LONGITUDINAL SECTIONS

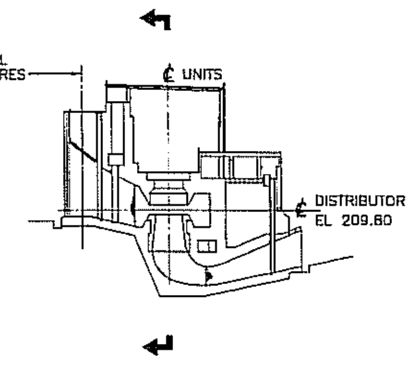
SCALE 1:200

1-00184-DE-07311-0014 | SHT. 0001 | REV. 00

MANITOBA WATER STEWARDSHIP No. 57-2-1039

1-00184-DE-07311-0015 | SHT. 0001 | REV. 00





KEY SECTION

SCALE 1:200 — 5 0 5 10 15 20 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

NO.	DATE	REVISIONS	BY	CKD.	APP.
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ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

FIGURE 22

POWERHOUSE AND SERVICE BAY LONGITUDINAL SECTION AT CL UNITS

SCALE 1:200

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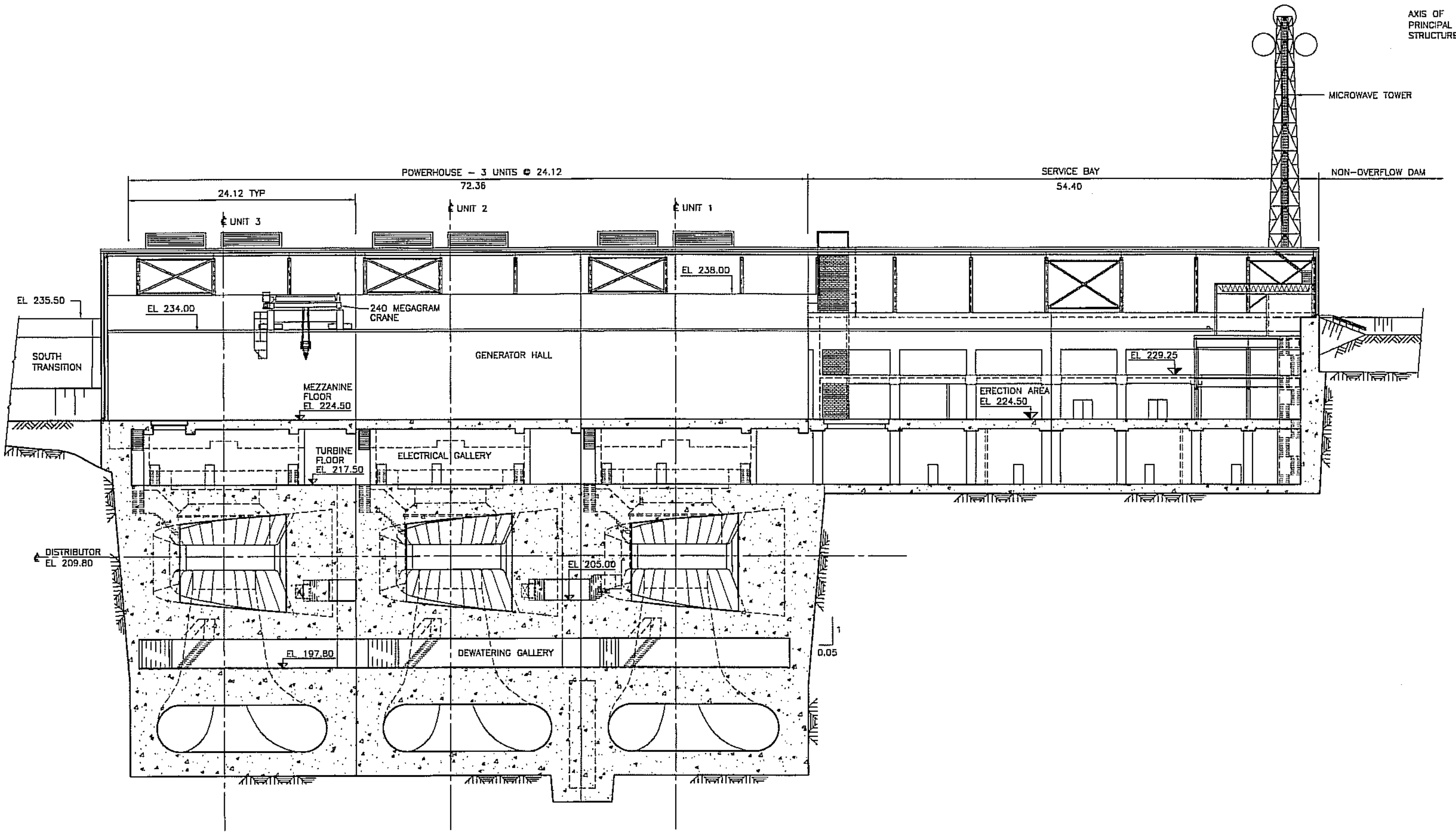
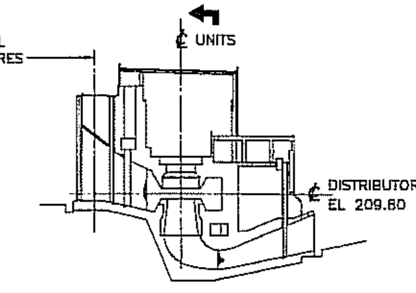
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

1-00184-DE-07311-0015 | SHT. 0001 | REV. 00





KEY SECTION

SCALE 1:200 5 0 5 10 15 20 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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No. 5 Expiry: April 30, 2005

04-11-19

ACRES MANITOBA LIMITED

MANITOBA HYDRO
WUSKWATIM GENERATING STATION

FIGURE 23

POWERHOUSE AND SERVICE BAY
LONGITUDINAL SECTION
THROUGH DEWATERING GALLERY

SCALE 1:200

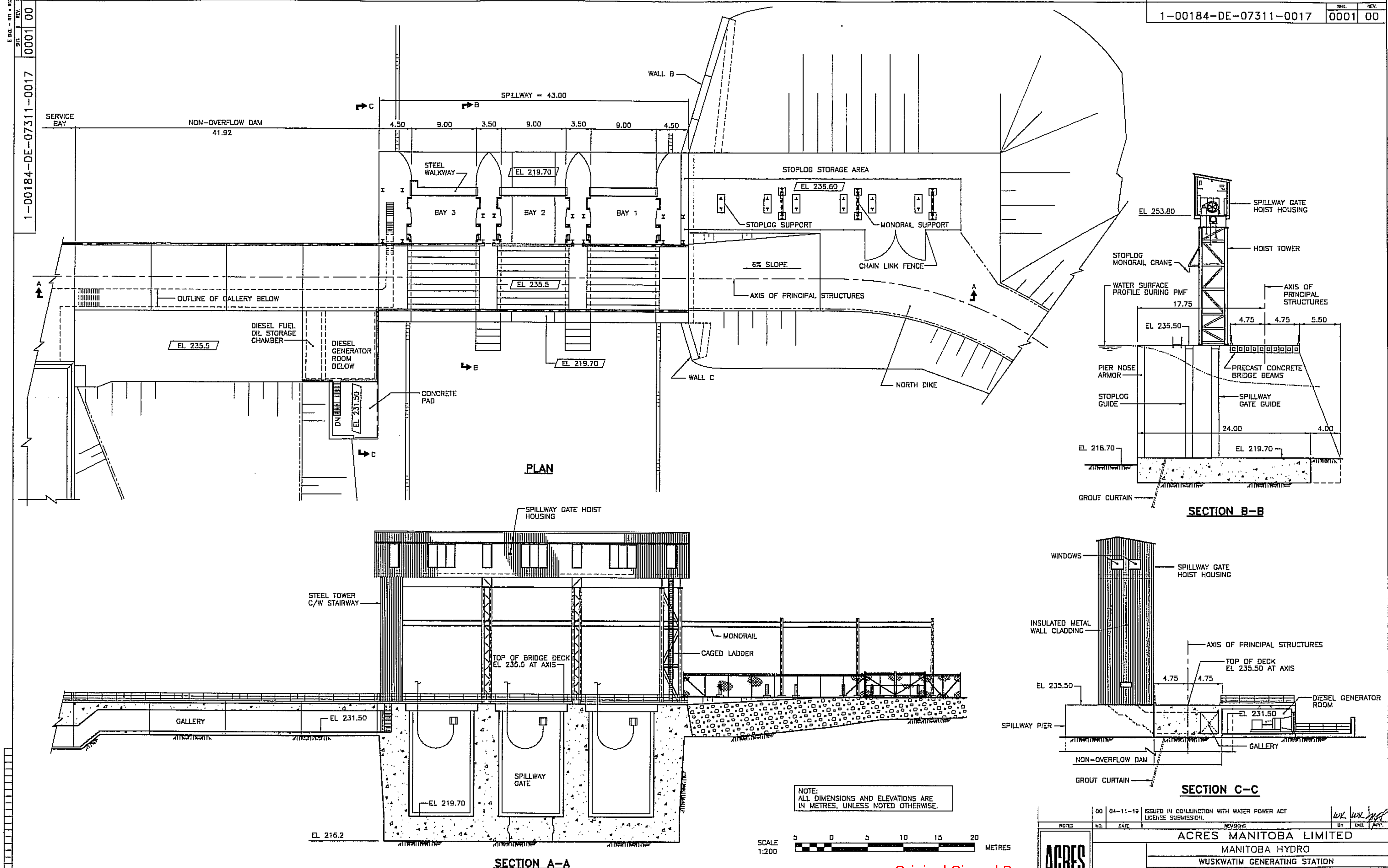
1-00184-DE-07311-0016 SHT. 0001 REV. 00

AUTOCAD ORIGINAL

FOR MICROFILM USE ONLY

MANITOBA WATER STEWARDSHIP No. 57-2-1041

1-00184-DE-07311-0017 SHT. 0001 REV. 00



NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE 1:200 — 5 0 5 10 15 20 METRES

Original Signed By:

APEGM Certificate of Authorization — Acres Manitoba Ltd. No. 5 Expiry: April 30, 2005

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ACRES MANITOBA LIMITED

MANITOBA HYDRO

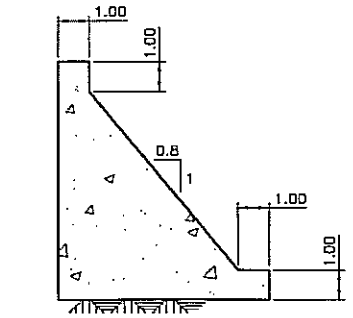
WUSKWATIM GENERATING STATION

FIGURE 24

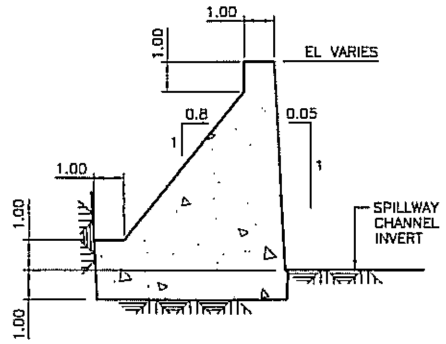
SPILLWAY AND NON-OVERFLOW DAM PLAN AND SECTIONS

SCALE 1:200

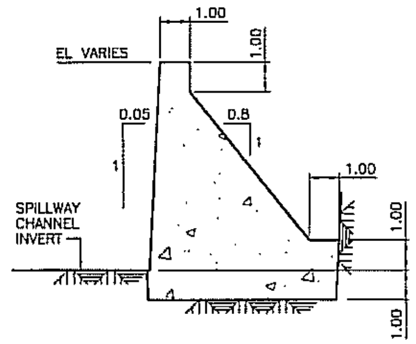
1-00184-DE-07311-0017 SHT. 0001 REV. 00



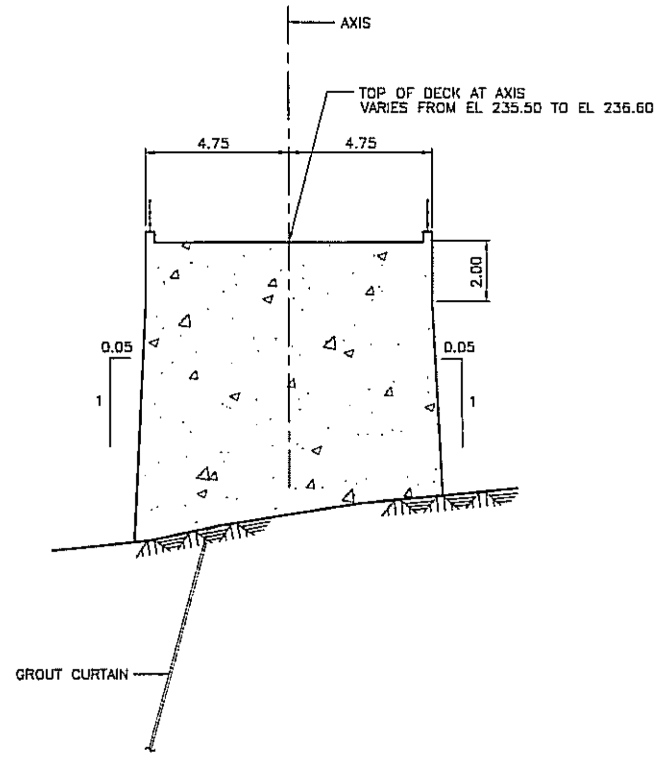
RETAINING WALLS A TO E
TYPICAL SECTION



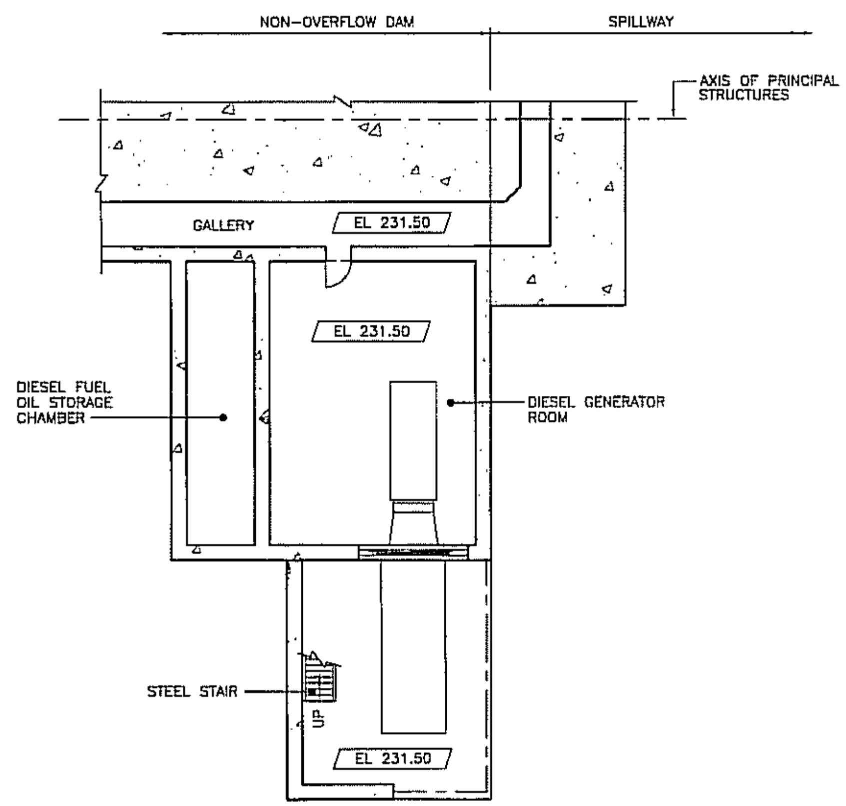
WALL G
TYPICAL SECTION



WALL F
TYPICAL SECTION



SOUTH TRANSITION STRUCTURE



SECTIONAL PLAN THROUGH DIESEL GENERATOR ROOM

SCALE 1:100 — 2 0 2 4 6 8 10 METRES

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

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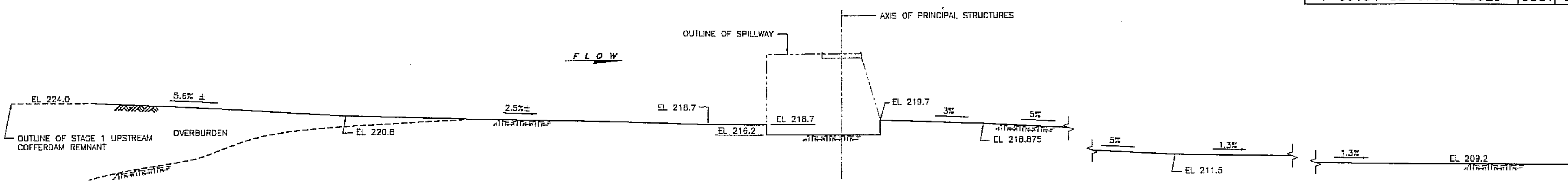
FIGURE 25

WALLS, DIESEL GENERATOR ROOM & SOUTH TRANSITION STRUCTURE
PLAN AND SECTIONS

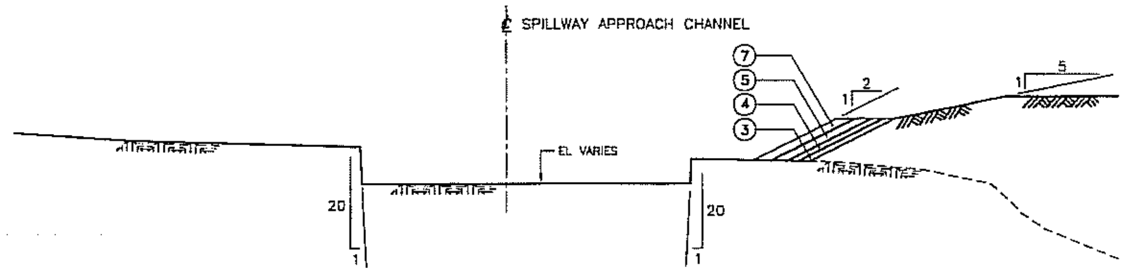
SCALE 1:100

1-00184-DE-07311-0018 | SHT. 0001 | REV. 00

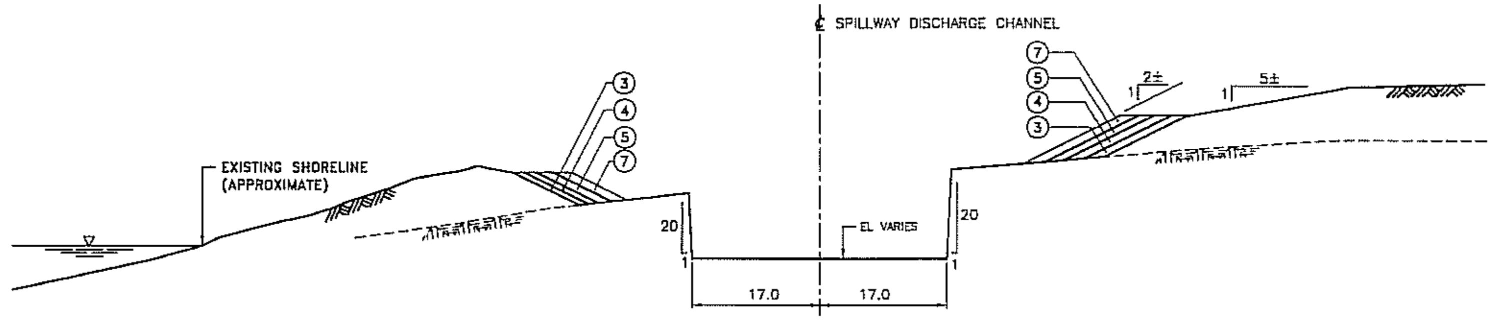
AUTOCAD ORIGINAL



SECTION ALONG SPILLWAY APPROACH & DISCHARGE CHANNELS



SPILLWAY APPROACH CHANNEL SECTION
(LOOKING UPSTREAM)



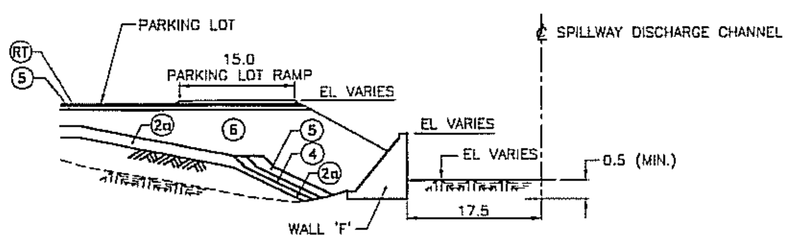
SPILLWAY DISCHARGE CHANNEL
SECTION NEAR D/S SECTION
(LOOKING UPSTREAM)

LEGEND

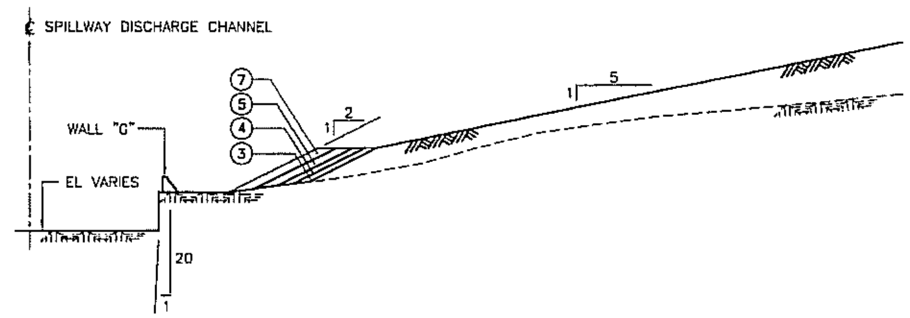
- GROUND SURFACE (STRIPPED/EXCAVATED)
- BEDROCK SURFACE (STRIPPED/EXCAVATED)
- INFERRED BEDROCK SURFACE
- 2a GRANULAR FILL
- 3 FINE FILTER
- 4 COARSE FILTER
- 5 FINE ROCKFILL
- 6 ROCKFILL
- 7 RIPRAP
- RT ROAD TOPPING
- WATER LEVEL

NOTE:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES.



SPILLWAY DISCHARGE CHANNEL AT PARKING LOT
(LOOKING UPSTREAM)



SPILLWAY DISCHARGE CHANNEL
SECTION AT WALL "G"

SCALE 1:400 — 10 0 10 20 30 40 METRES

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No. 5 Expiry: April 30, 2005

ACRES MANITOBA LIMITED
ACRES
FIGURE 26
MANITOBA HYDRO
WUSKWATIM GENERATING STATION
STAGE 4 STUDIES
SPILLWAY
APPROACH AND DISCHARGE CHANNELS
SECTIONS

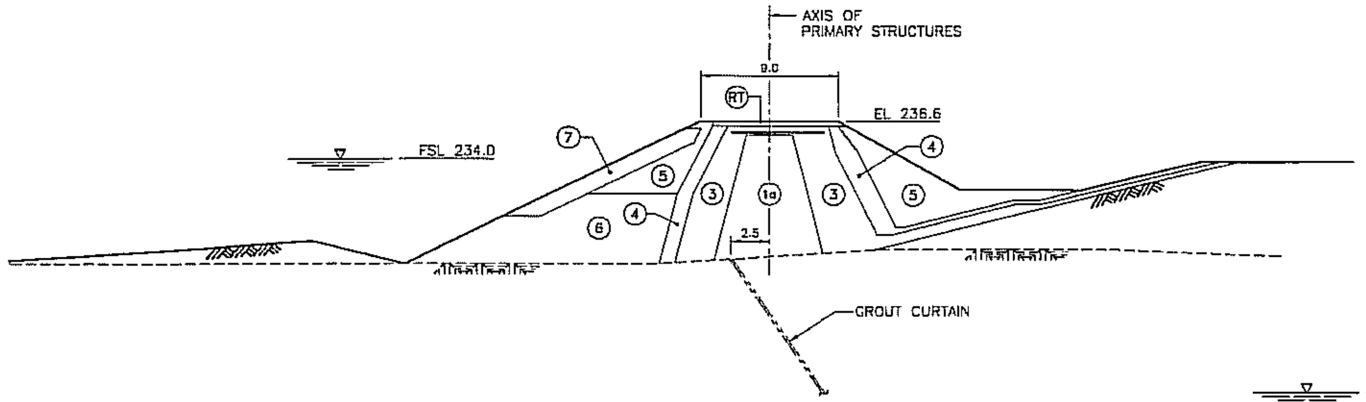
SCALE 1:400

1-00184-DE-07311-0020 SHT. 0001 REV. 00

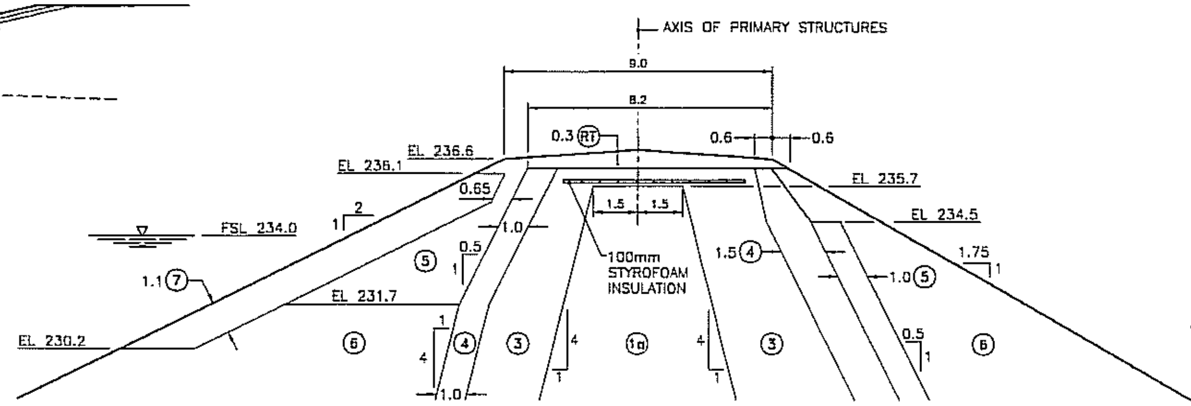
AUTOCAD ORIGINAL

MANITOBA WATER STEWARDSHIP No. 57-2-1044

1-00184-DE-07311-0019 | SHT. 0001 | REV. 00



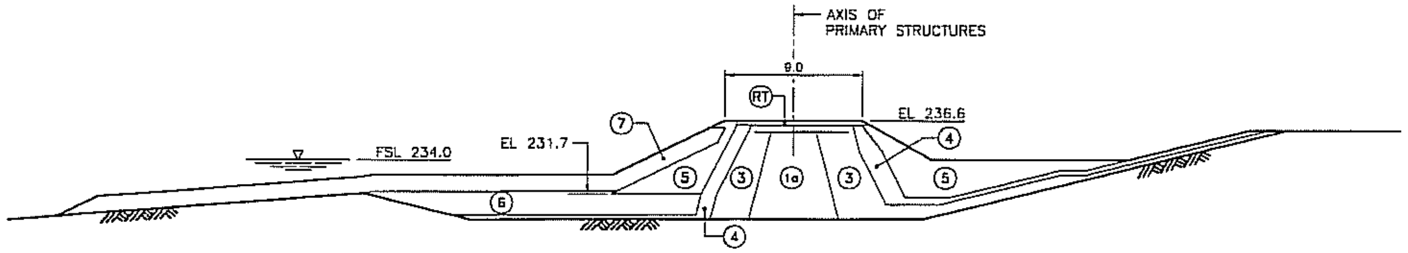
MAIN DAM – RIGHT ABUTMENT
FOUNDED ON BEDROCK
SCALE 1:200



CREST DETAIL
SCALE 1:100

LEGEND

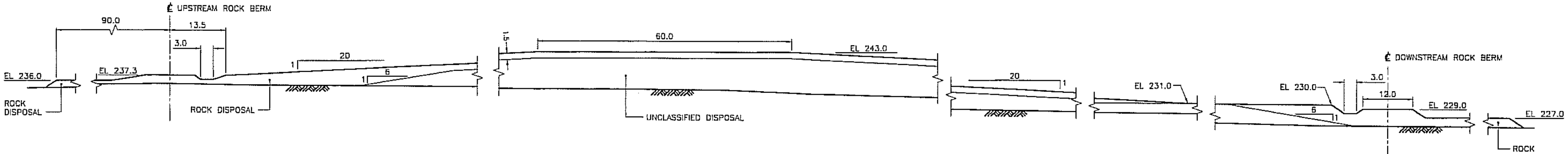
- A IMPERVIOUS FILL
- B TRANSITION FILL
- C ROCKFILL
- D RIPRAP
- 1a IMPERVIOUS FILL
- 3 FINE FILTER
- 4 COARSE FILTER
- 5 FINE ROCKFILL
- 6 ROCKFILL
- 7 RIPRAP
- RT ROAD TOPPING
- GROUND SURFACE (STRIPPED/EXCAVATED)
- INFERRED BEDROCK SURFACE
- WATER LEVEL



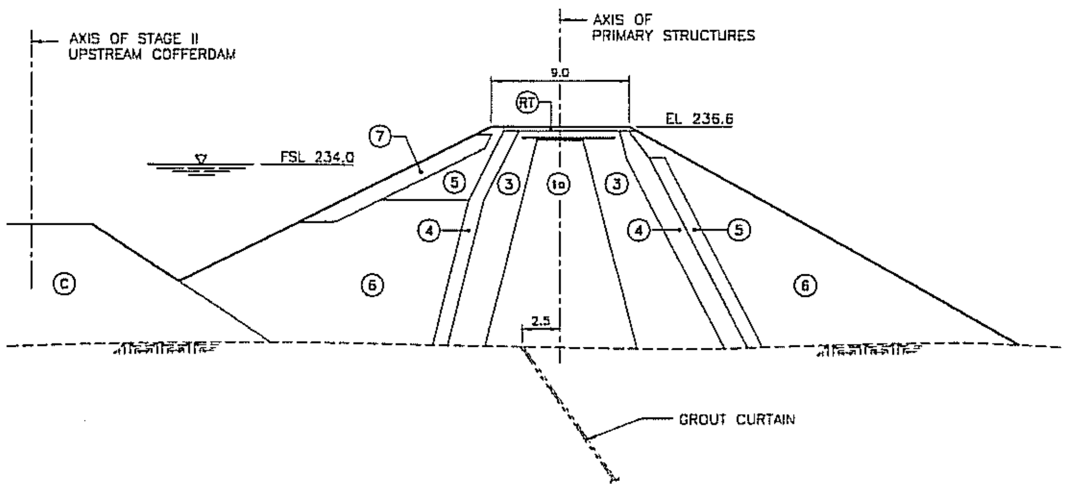
MAIN DAM – RIGHT ABUTMENT
FOUNDED ON CLAY
SCALE 1:200

NOTE:

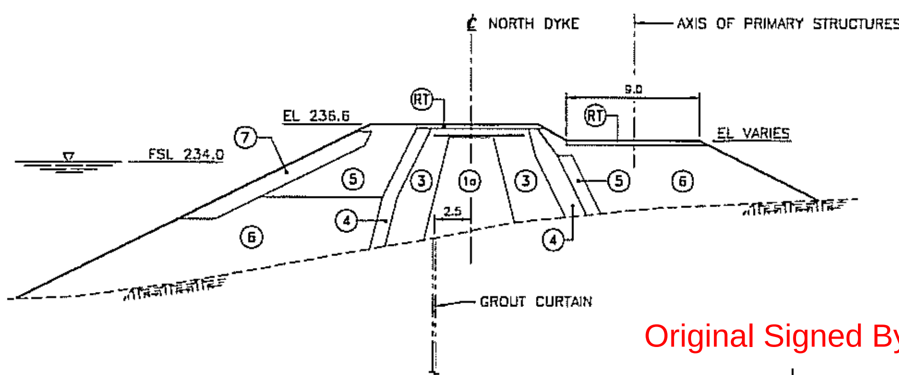
1. DIMENSIONS AND ELEVATIONS ARE IN METRES.



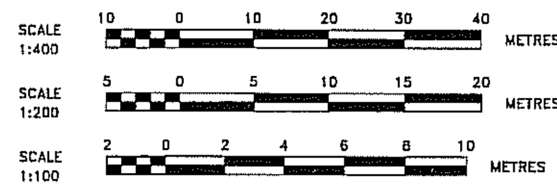
DISPOSAL AREA
SCALE 1:400



MAIN DAM – RIVER
SCALE 1:200



NORTH DYKE
SCALE 1:200



NO.	DATE	REVISIONS	BY	CKD.	APP.
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ACRES

FIGURE 27

ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

EARTH AND ROCK FILL STRUCTURES
SECTIONS

SCALE AS SHOWN

1-00184-DE-07311-0019 | SHT. 0001 | REV. 00

AUTOCAD ORIGINAL

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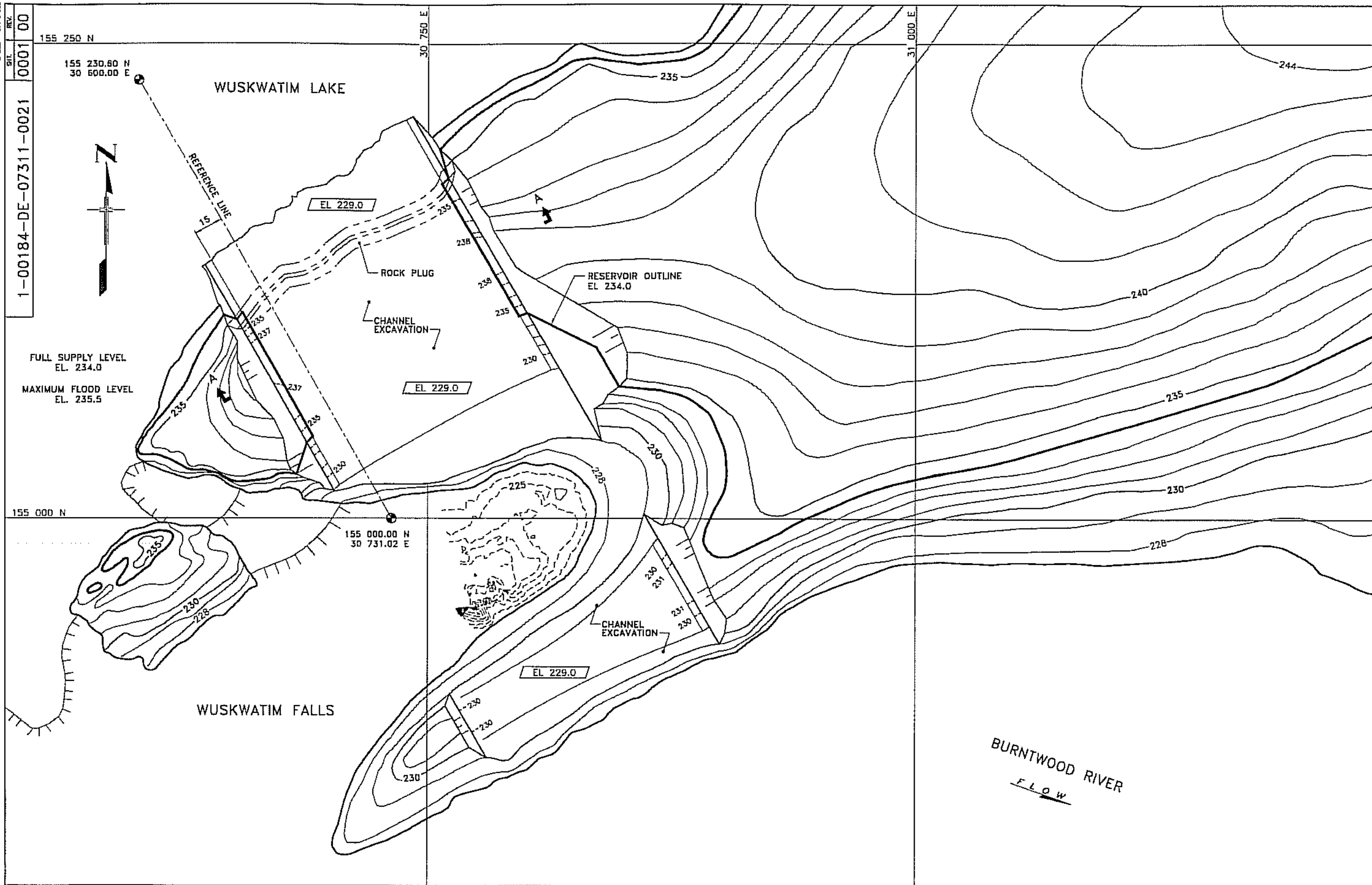
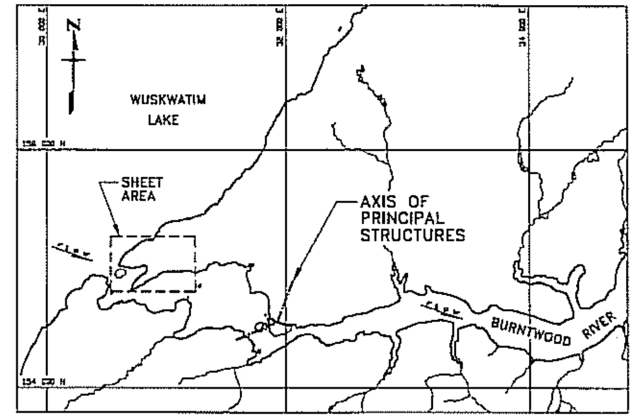


PLAN
SCALE 1:1000



KEY PLAN

LEGEND:

240	GROUND SURFACE CONTOUR (CONTOUR INTERVAL IS 2 METRES)
	FALLS
	EXISTING SHORELINE
225	RIVERBED, LAKE BOTTOM CONTOUR
	GROUND SURFACE
	BEDROCK SURFACE (STRIPPED/EXCAVATED)
	INFERRED BEDROCK SURFACE
	REFERENCE POINT

NOTES:

1. COORDINATES, DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON MANITOBA HYDRO WUSKWATIM GENERATING STATION REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. TOPOGRAPHY AND SURFACE FEATURES SHOWN WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10,000 SCALE PHOTOGRAPHY DATED JUNE 16,1986. SEE REFERENCE DRAWINGS BELOW.

REFERENCE DRAWINGS:

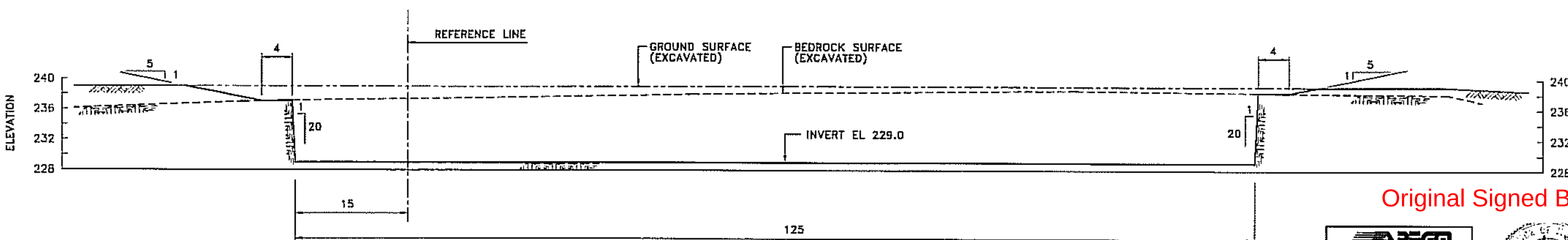
07062-E-00008 SHTS 1 TO 8, REV 0, WUSKWATIM GENERATING STATION – PHOTOGRAMMETRIC PLAN SHOWING LOCATIONS OF DRILL HOLES AND AUGER HOLES 1:2000

1-00184-DE-11510-0001 SHTS 1 TO 8, REV 1, WUSKWATIM GENERATING STATION – TOPOGRAPHIC PLAN IN VICINITY OF THE PROPOSED WUSKWATIM G.S. SITE 1:2000

1-00184-DE-80000-0001 SHT 1, REV C, WUSKWATIM GENERATING STATION – STAGE 4 STUDIES, CONSTRUCTION FACILITIES SITE PLAN

SCALE 1:300 — 5 0 5 10 15 20 25 30 METRES

SCALE 1:1000 — 20 0 20 40 60 80 100 METRES



SECTION A-A
SCALE 1:300

NO.	DATE	REVISIONS	BY	CKD.	APP.
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No. 5 Expiry: April 30, 2005

04-11-19

ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

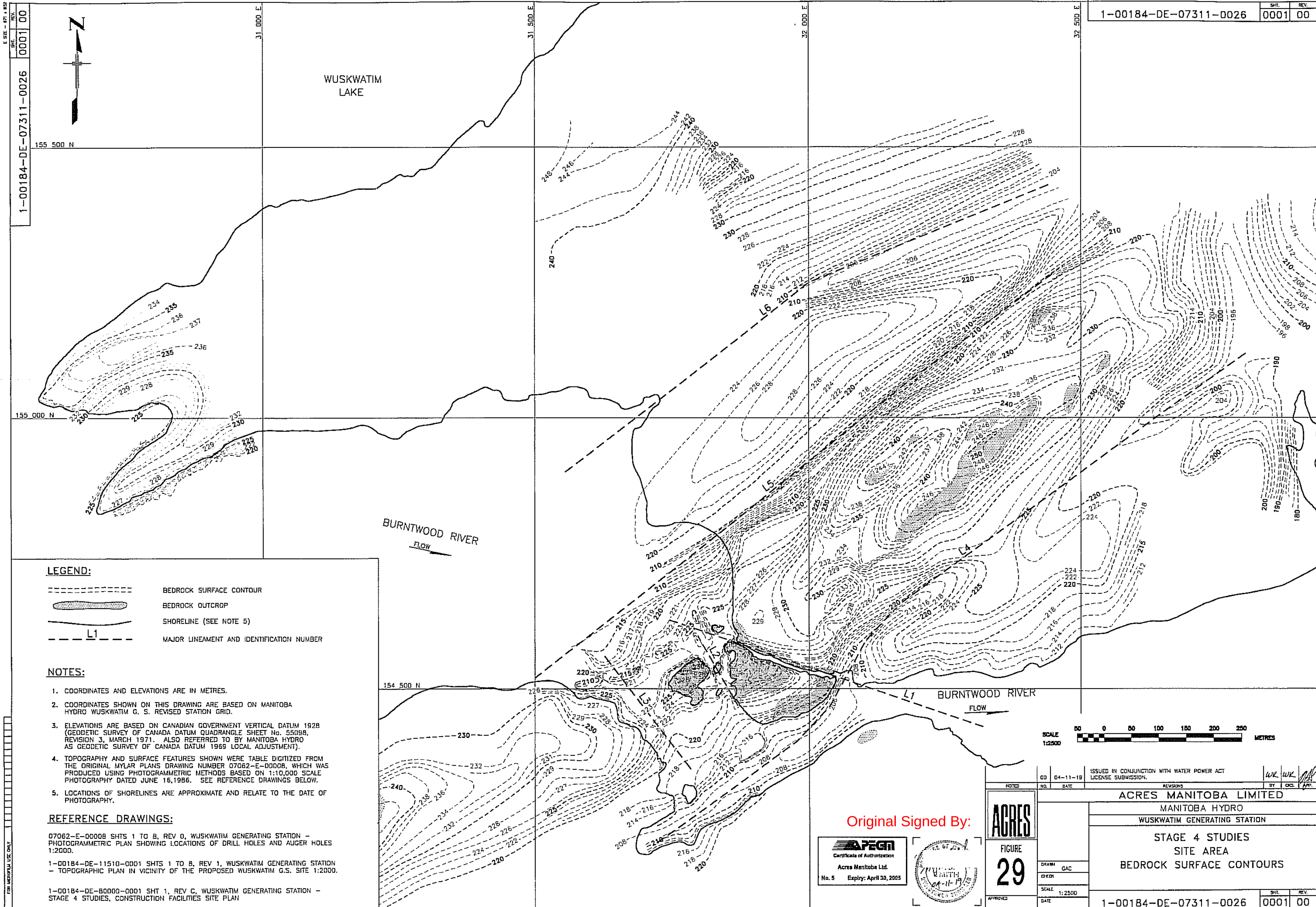
UPSTREAM CHANNEL IMPROVEMENTS
PLAN AND SECTIONS

ACRES
FIGURE 28

SCALE AS SHOWN

MANITOBA WATER STEWARDSHIP No. 57-2-1046

1-00184-DE-07311-0026 SHT. 0001 REV. 00



LEGEND:

BEDROCK SURFACE CONTOUR

BEDROCK OUTCROP

SHORELINE (SEE NOTE 5)

L1 — MAJOR LINEAMENT AND IDENTIFICATION NUMBER

NOTES:

1. COORDINATES AND ELEVATIONS ARE IN METRES.
2. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON MANITOBA HYDRO WUSKWATIM G. S. REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. TOPOGRAPHY AND SURFACE FEATURES SHOWN WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10,000 SCALE PHOTOGRAPHY DATED JUNE 16,1986. SEE REFERENCE DRAWINGS BELOW.
5. LOCATIONS OF SHORELINES ARE APPROXIMATE AND RELATE TO THE DATE OF PHOTOGRAPHY.

REFERENCE DRAWINGS:

07062-E-00008 SHTS 1 TO 8, REV 0, WUSKWATIM GENERATING STATION - PHOTOGRAMMETRIC PLAN SHOWING LOCATIONS OF DRILL HOLES AND AUGER HOLES 1:2000.

1-00184-DE-11510-0001 SHTS 1 TO 8, REV 1, WUSKWATIM GENERATING STATION - TOPOGRAPHIC PLAN IN VICINITY OF THE PROPOSED WUSKWATIM G.S. SITE 1:2000.

1-00184-DE-80000-0001 SHT 1, REV C, WUSKWATIM GENERATING STATION - STAGE 4 STUDIES, CONSTRUCTION FACILITIES SITE PLAN

Original Signed By:

APEGM Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

FIGURE 29

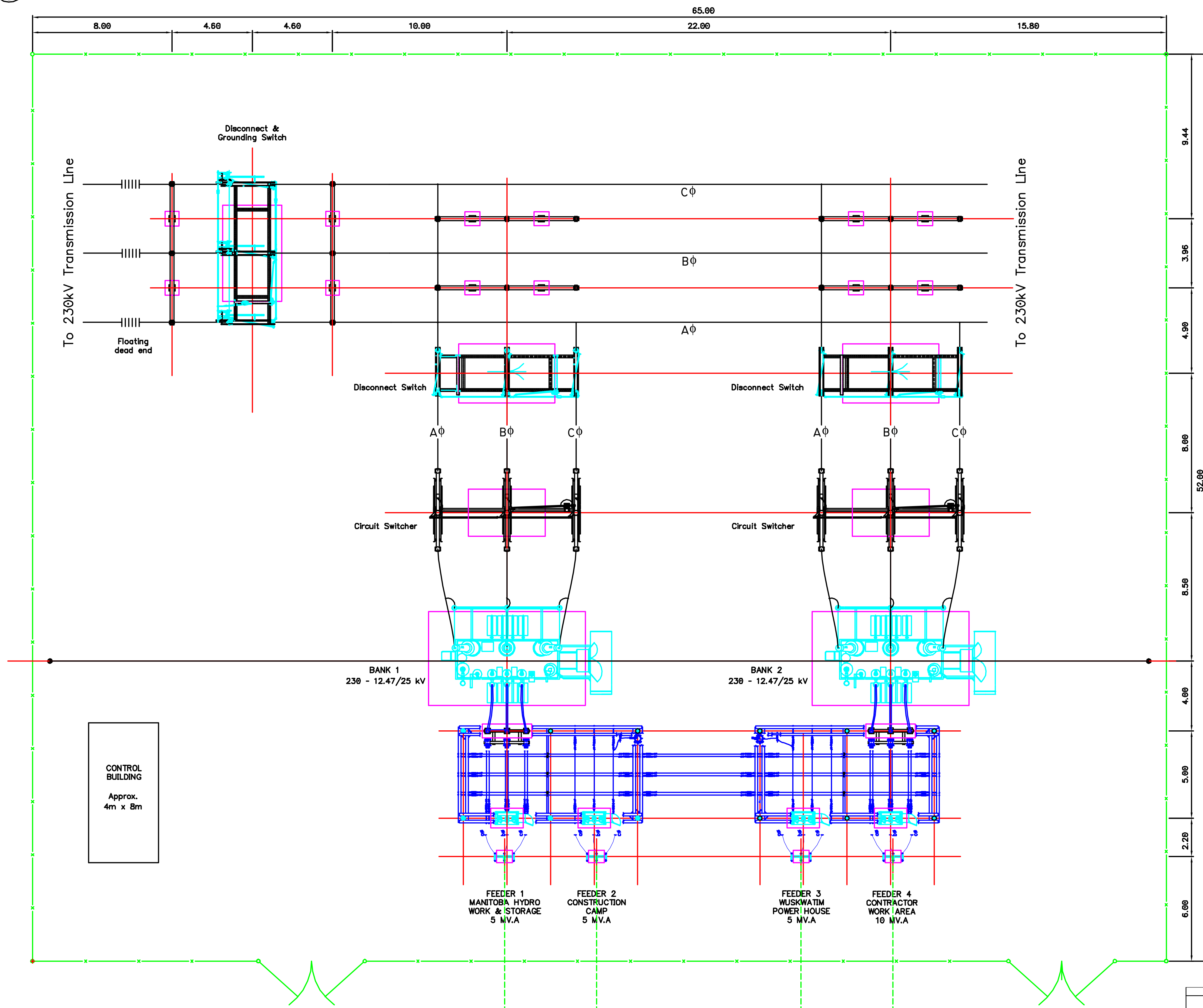
STAGE 4 STUDIES
SITE AREA
BEDROCK SURFACE CONTOURS

DRAWN GAC
SCALE 1:2500

1-00184-DE-07311-0026 SHT. 0001 REV. 00

MANITOBA WATER STEWARDSHIP NUMBER 57-2-1047

1-00184-DE-51000-00001 | SHT. 0001 | REV. 00



PRELIMINARY

SUBJECT TO CHANGE

BY: B. EDWARDS DATE: 04-11-02

0 2.5 5m

SCALE 1:100

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	2004-11-02	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION	R.E.	R.E.	K.L.

NOTED

FIGURE 30

APPROVED

ORIGINAL SIGNED BY: KWAN LEUNG

DRAWN R.C. & S.H.

CHECK R.E. & S.H.

SCALE 1:100

DATE 2004/11/01

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

WUSKWATIM CONSRUCTION POWER
230 – 12 kV SWITCHYARD
STRUCTURE & EQUIPMENT
PLAN VIEW

1-00184-DE-51000-00001 | SHT. 0001 | REV. 00

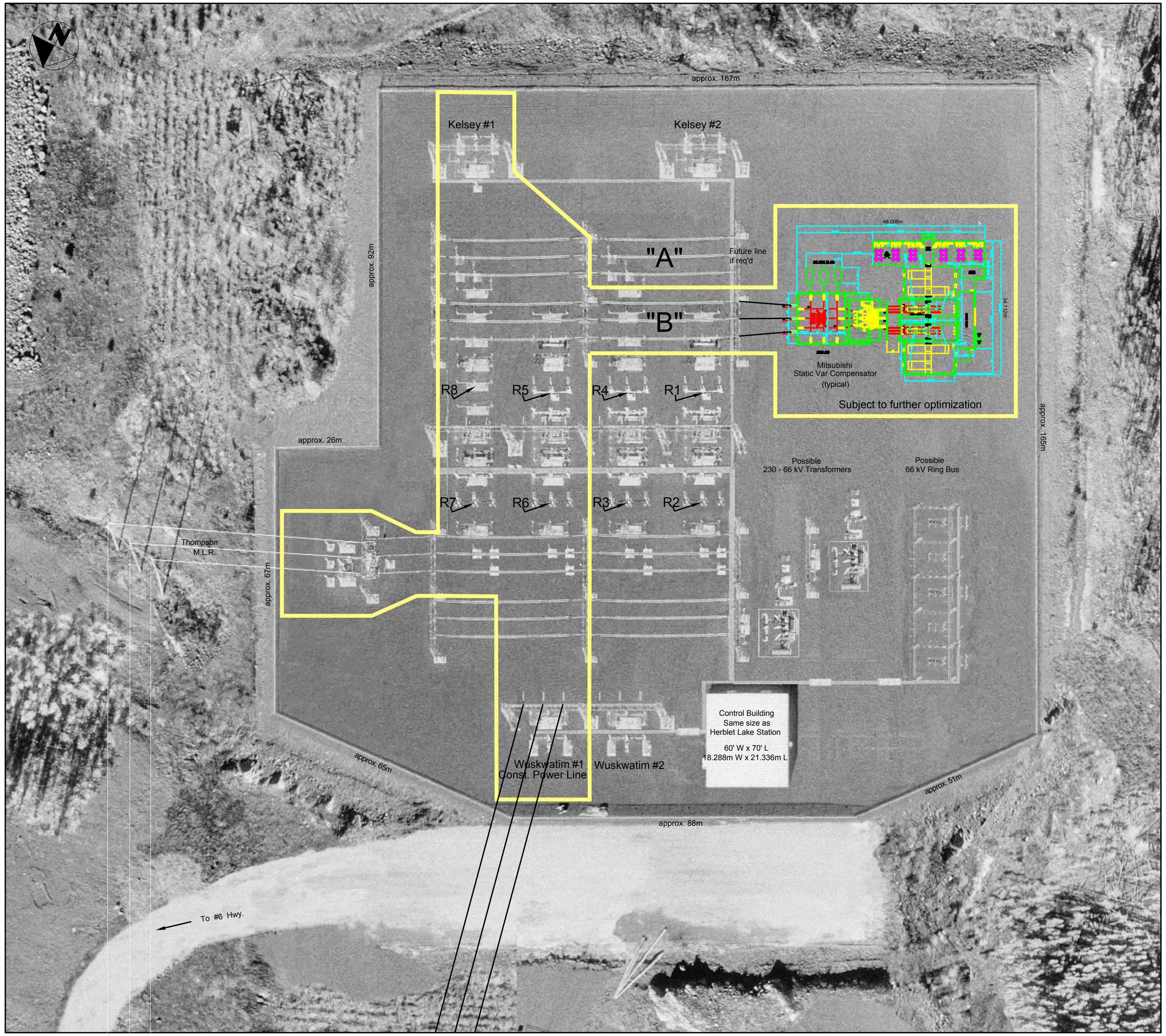
AUTOCAD ORIGINAL

FOR MICROFILM USE ONLY

1-00184-DE-51000-00001 SHT. 0001 REV. 00

MANITOBA WATER STEWARDSHIP NUMBER 57-2-1048

	SHT.	REV.
1-00184-PE-50200-0002	0001	00



Concept:
R. Edwards Feb. 5, 2002
Revised: July 10, 2003

Subject to further input from;
System Planning
Distribution Planning
Civil Design
Environmental Licensing & Assessment

PRELIMINARY
SUBJECT TO CHANGE
BY: B. EDWARDS DATE: 04-11-02

SCALE: 1 : 500

METRES 10 0 20 40 60

FEET 50 0 50 100 150 200

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	2004-11-02	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION	R.E.	R.E.	B.J.

NOTED

FIGURE 31

approved

Original Signed by: Brent Joworski

DRAWN S.H.
CHECK R.E.
SCALE 1:500
DATE 2004/11/04

MANITOBA HYDRO
WUSKWATIM GENERATING STATION
THOMPSON – BIRCHTREE STATION
CONCEPT LAYOUT
w/TYPICAL MITSUBISHI SVC

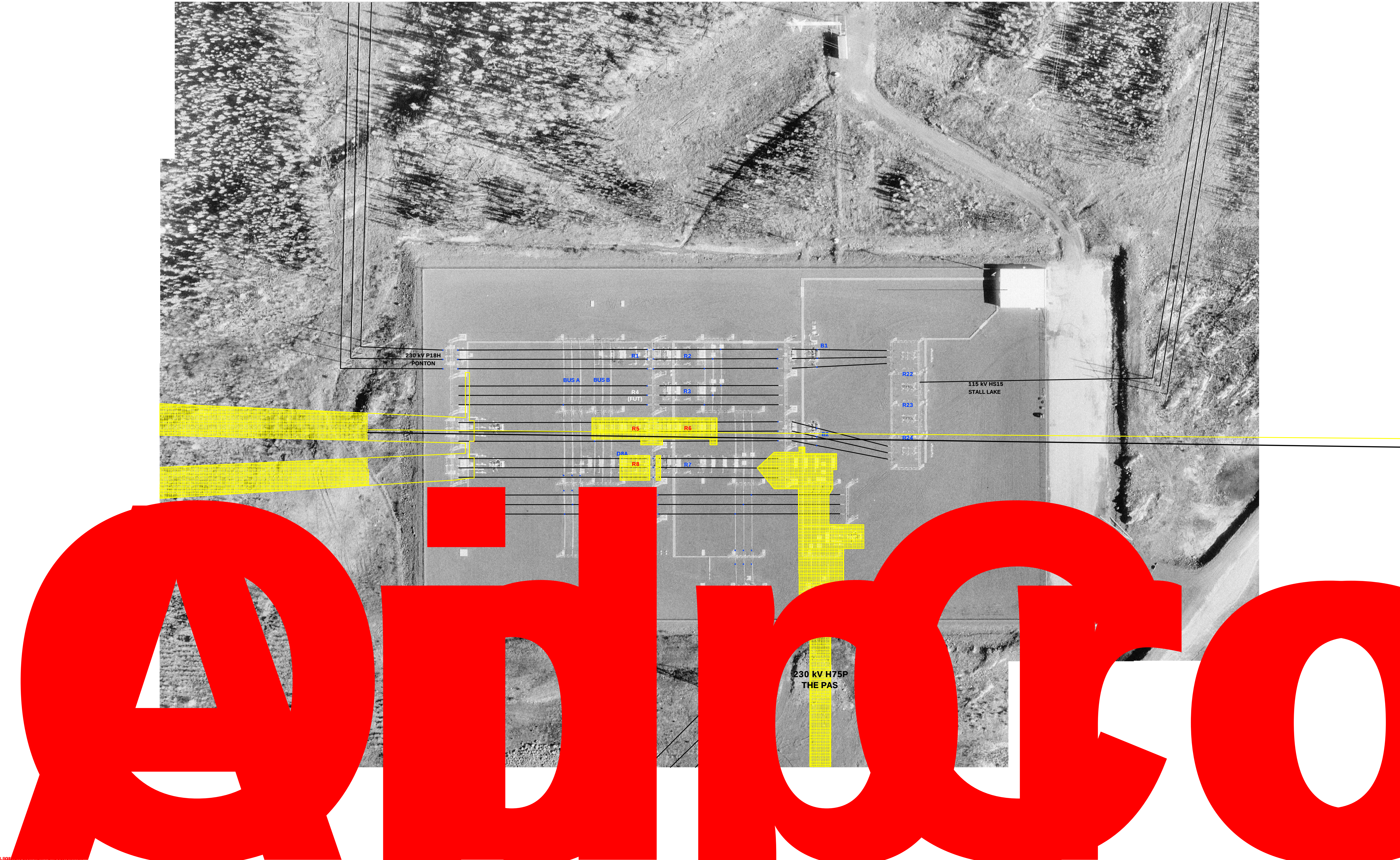
	SHT.	REV.
1-00184-PE-50200-0002	0001	00

AUTOCAD ORIGINAL

E SIZE - 671 x 982
1-00184-PE-50200-0002 SHT. 0001 REV. 00

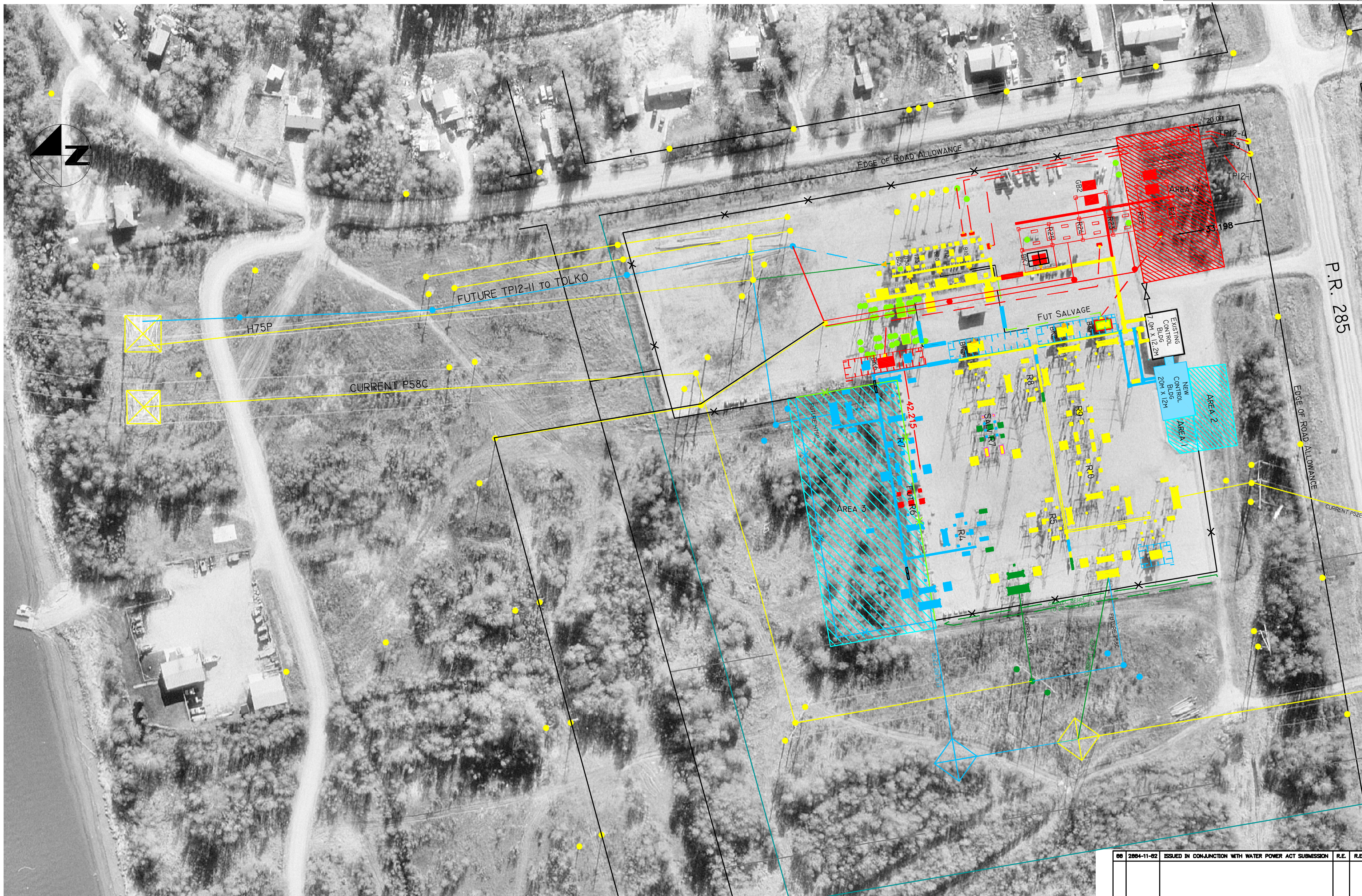
FOR MICROFILM USE ONLY

FUTURE


230 kV P18H
PONTON
R1
R2
B1
BUS A
BUS B
R4
(FUT)
R3
R22
115 kV HS15
STALL LAKE
R23
R5
R6
B2
R24
D8A
R8
R7
230 kV H75P
THE PAS

MANITOBA WATER STEWARDSHIP NUMBER 57-2-1050

	SHT.	REV.
1-00184-PE-50200-0003	0001	00



LEGEND

- Existing Facilities
- Stage 1 Development - Wuskwatim/Herblet Lk. H75P 230kV line Addition. ISD 2009-05-01.
- Stage 1 Salvage
- Stage 2 Development - Load Serving Capability Improvements. ISD Approximately 2010.
- Stage 2 Salvage

PRELIMINARY CONCEPT

SUBJECT TO CHANGE

BY: R. Edwards DATE: 2004/11/02

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	2004-11-02	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION	R.E.	R.E.	B.J.

NOTED

FIGURE 33

ORIGINAL SIGNED BY: BRENT JOWORSKI

DRAWN S.H.

CHECK R.E.

SCALE 1:500

APPROVED

DATE 2004/11/02

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

THE PAS – RALL'S ISLAND STATION CONCEPT PLAN PHOTO BASE 2000-05-22

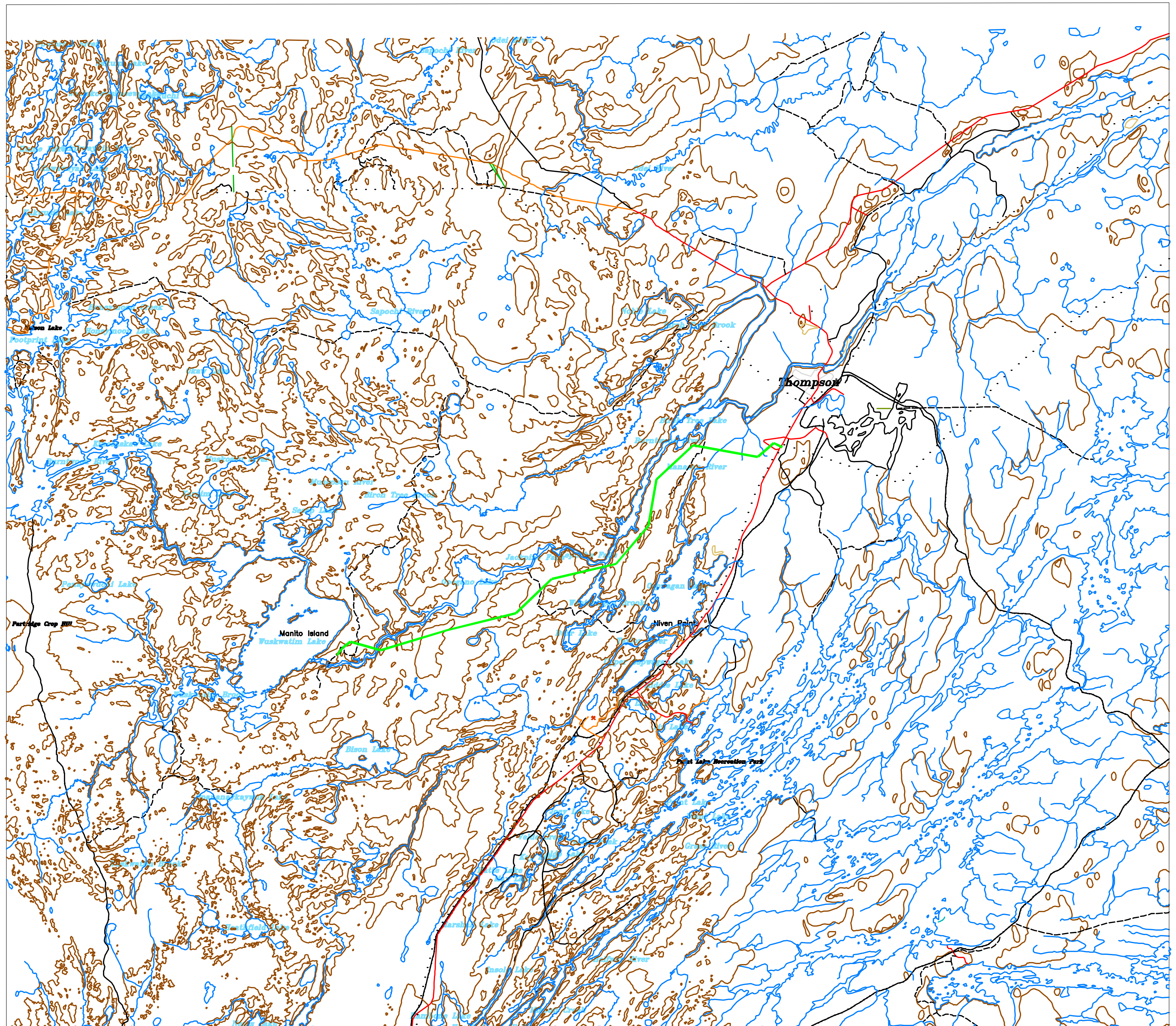
	SHT.	REV.
1-00184-PE-50200-0003	0001	00

AUTOCAD ORIGINAL

FOR MICROFILM USE ONLY

MANITOBA WATER STEWARDSHIP NUMBER 57-2-1052

	SHT.	REV.
1-00184-PE-10200-0003	0001	00



PRELIMINARY
SUBJECT TO CHANGE
BY: B. EDWARDS DATE: 04-11-02

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	2004-11-02	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION	R.E.	R.E.	Z.K.

NOTED

FIGURE 34

Original Signed by: Zibby Kieloch

DRAWN S.H.
CHECK R.E.
SCALE 1:125 000
APPROVED
DATE

MANITOBA HYDRO
WUSKWATIM GENERATING STATION

TRANSMISSION LINE B76W
PLAN SHOWING CONSTRUCTION POWER TL ROUTE from THOMPSON-BIRCHTREE STATION to WUSKWATIM GS

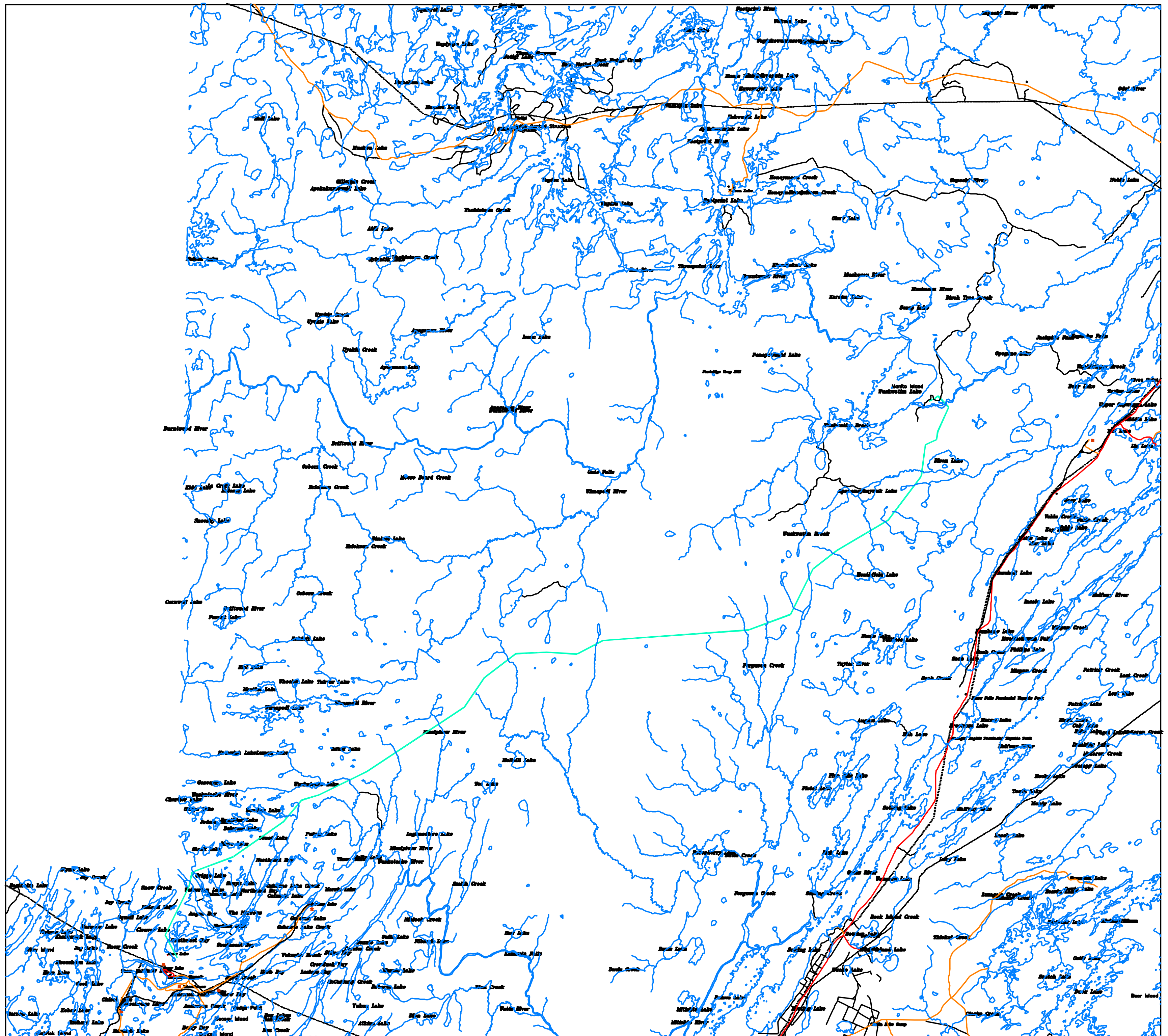
	SHT.	REV.
1-00184-PE-10200-0003	0001	00

AUTOCAD ORIGINAL

FOR MICROFILM USE ONLY

MANITOBA WATER STEWARDSHIP NUMBER 57-2-1053

	SHT.	REV.
1-00184-PE-10200-0004	0001	00



PRELIMINARY

SUBJECT TO CHANGE

BY: B. EDWARDS DATE: 04-11-02

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	2004-11-02	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION	R.E.	R.E.	Z.K.

NOTED

FIGURE 35

Original Signed by: Zibby Kleloch

DRAWN S.H.

CHECK R.E.

SCALE 1:250 000

APPROVED

DATE

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

TRANSMISSION LINE H73W & H74W
PLAN SHOWING TRANSMISSION LINE
ROUTE FROM HERBLET LAKE STATION
TO WUSKWATIM GENERATING STATION

	SHT.	REV.
1-00184-PE-10200-0004	0001	00

E SIZE - 871 x 032

FOR MICROFILM USE ONLY

AUTOCAD ORIGINAL

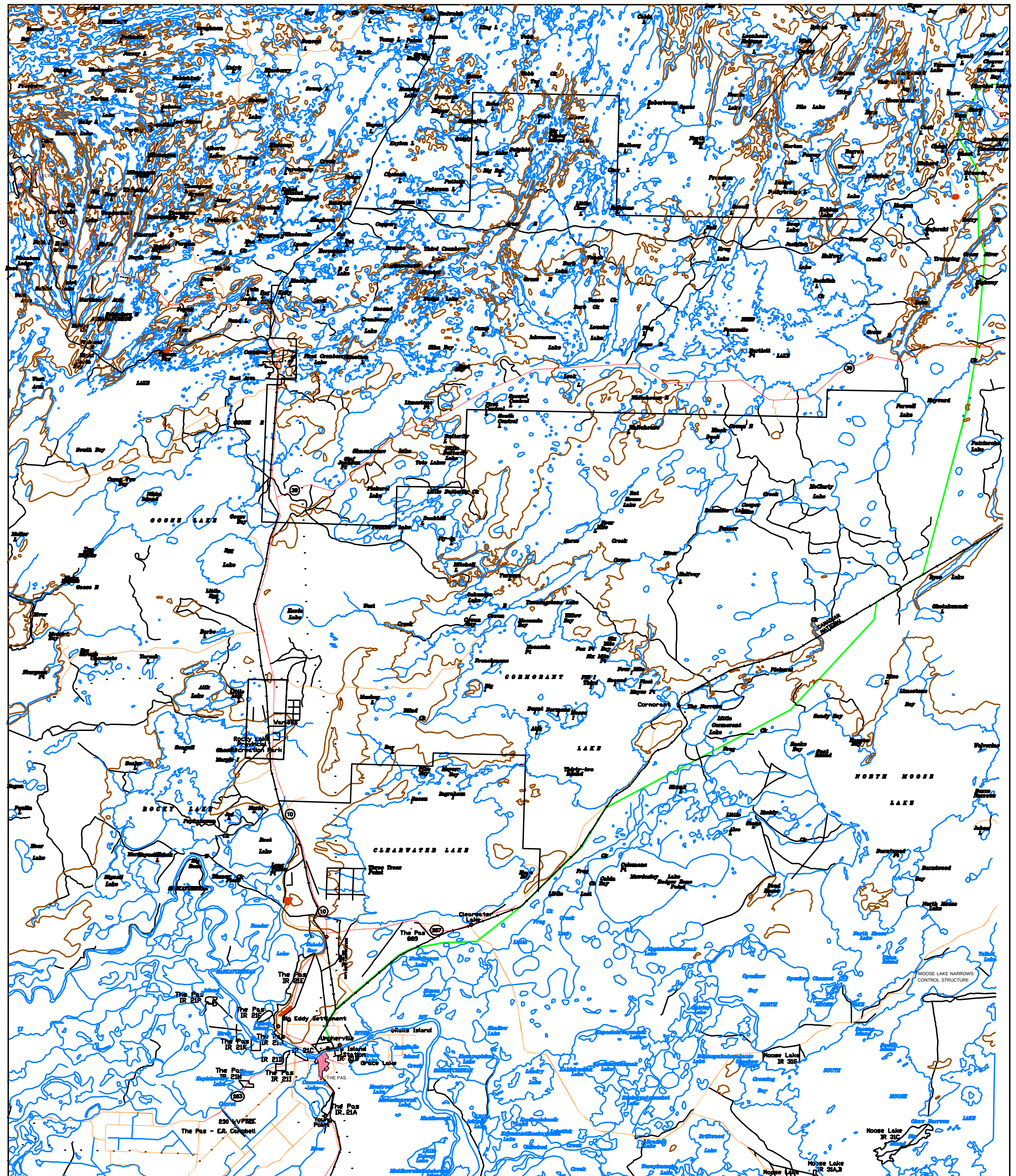
MANITOBA WATER STEWARDSHIP NUMBER 57-2-1054

	SHT.	REV.
1-00184-PE-10200-0005	0001	00

E SIZE - 871 x 692

SHT.	REV.
0001	00

1-00184-PE-10200-0005



PRELIMINARY

SUBJECT TO CHANGE

BY: B. EDWARDS DATE: 04-11-02

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	2004-11-02	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION	R.E.	R.E.	Z.K.

NOTED

APPROVED

FIGURE 36

Original Signed by: Zibby Kinloch

DRAWN S.H.

CHECK R.E.

SCALE 1:250 000

DATE

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

TRANSMISSION LINE H75P
PLAN SHOWING TRANSMISSION LINE
ROUTE FROM HERBLET LAKE STATION
TO THE PAS-RALLS ISLAND STATION

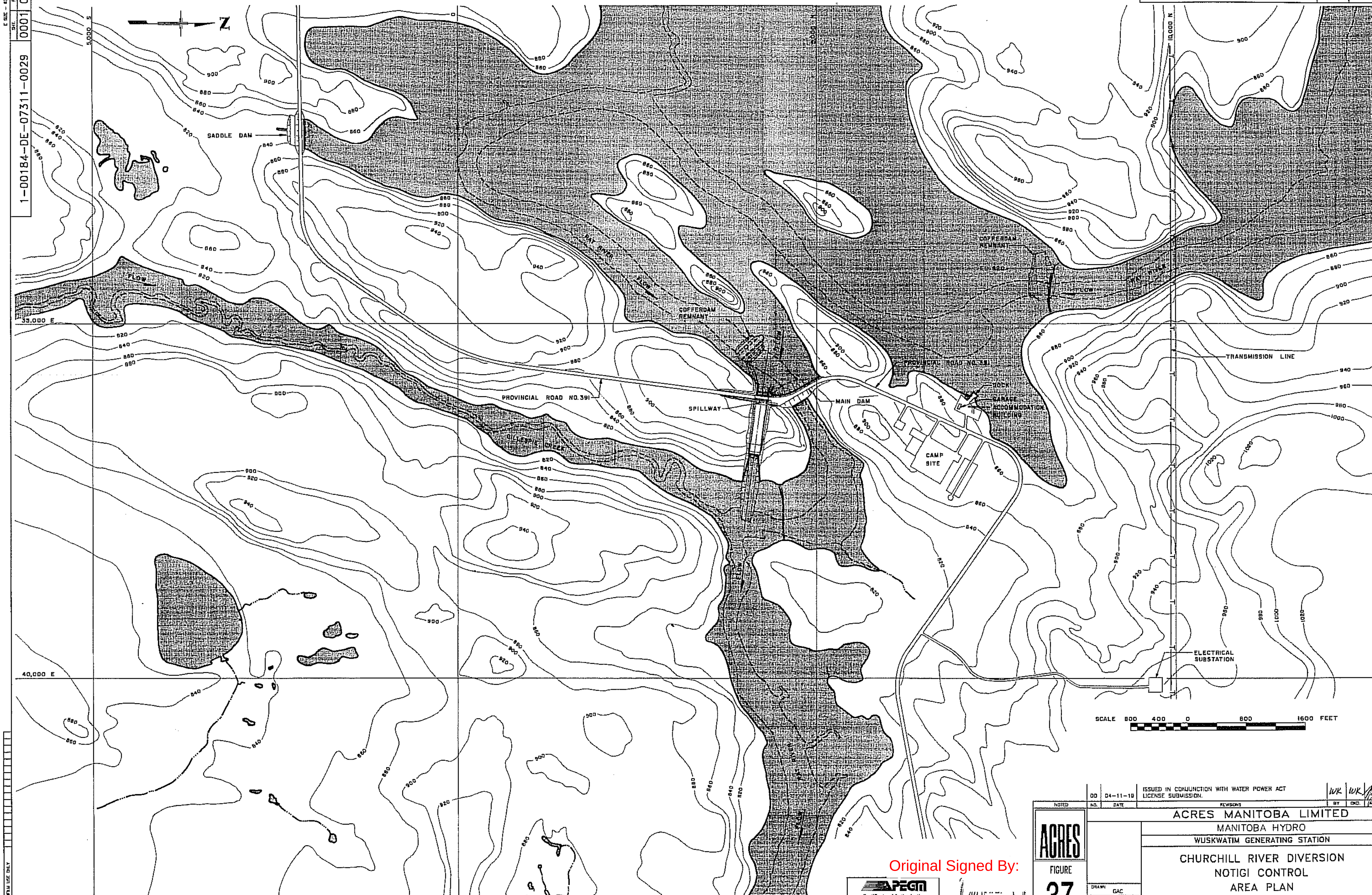
	SHT.	REV.
1-00184-PE-10200-0005	0001	00

AUTOCAD ORIGINAL

FOR MICROFILM USE ONLY

MANITOBA WATER STEWARDSHIP No. 57-2-1055

	SHT.	REV.
1-00184-DE-07311-0029	0001	00



NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

Original Signed By:

APEGM Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

SMITH
REGISTERED ENGINEER
04-11-19

NOTED
ACRES
FIGURE 37
APPROVED

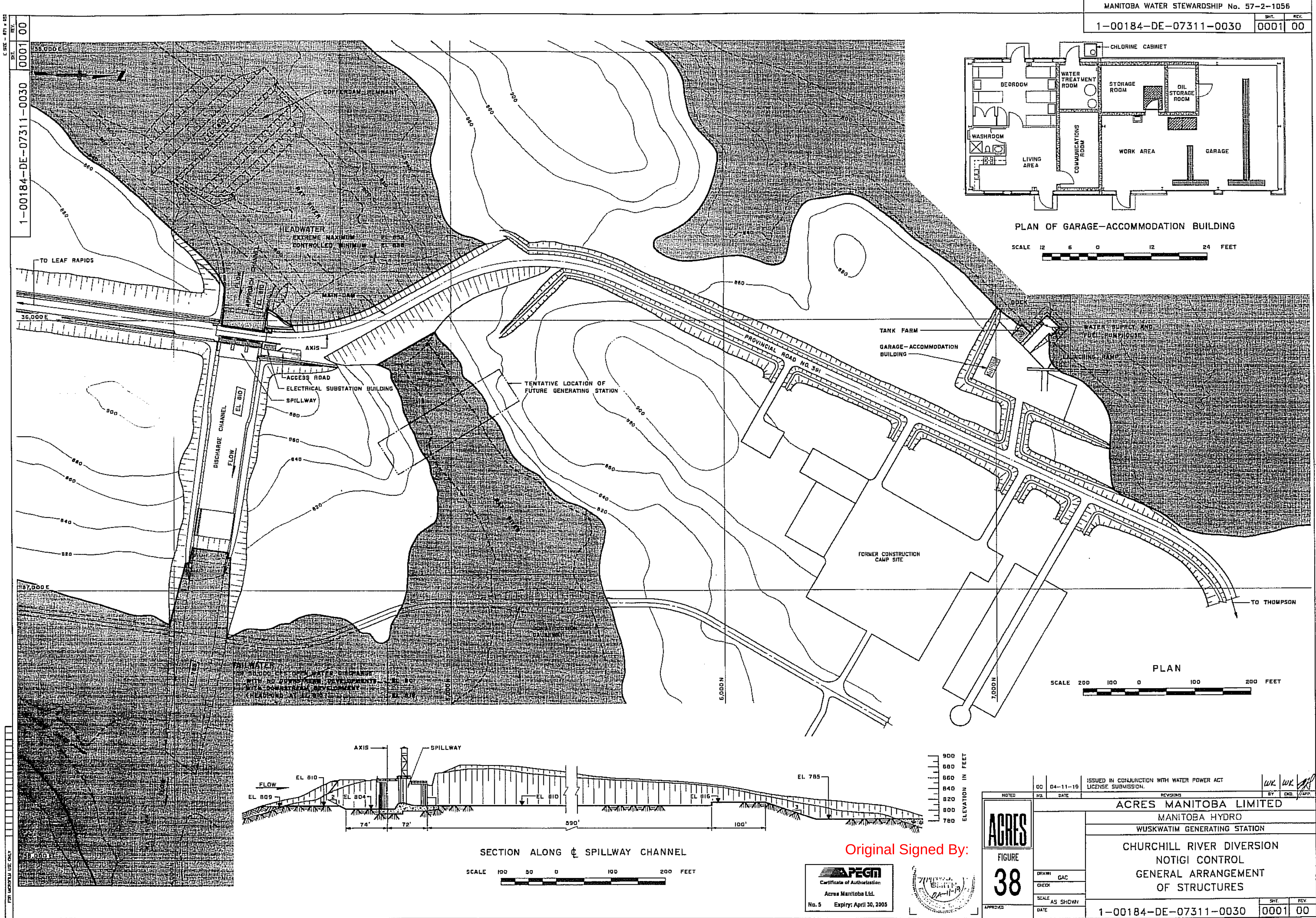
ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

CHURCHILL RIVER DIVERSION
NOTIGI CONTROL
AREA PLAN

DRAWN GAC
CHECK
SCALE AS SHOWN
DATE

	SHT.	REV.
1-00184-DE-07311-0029	0001	00

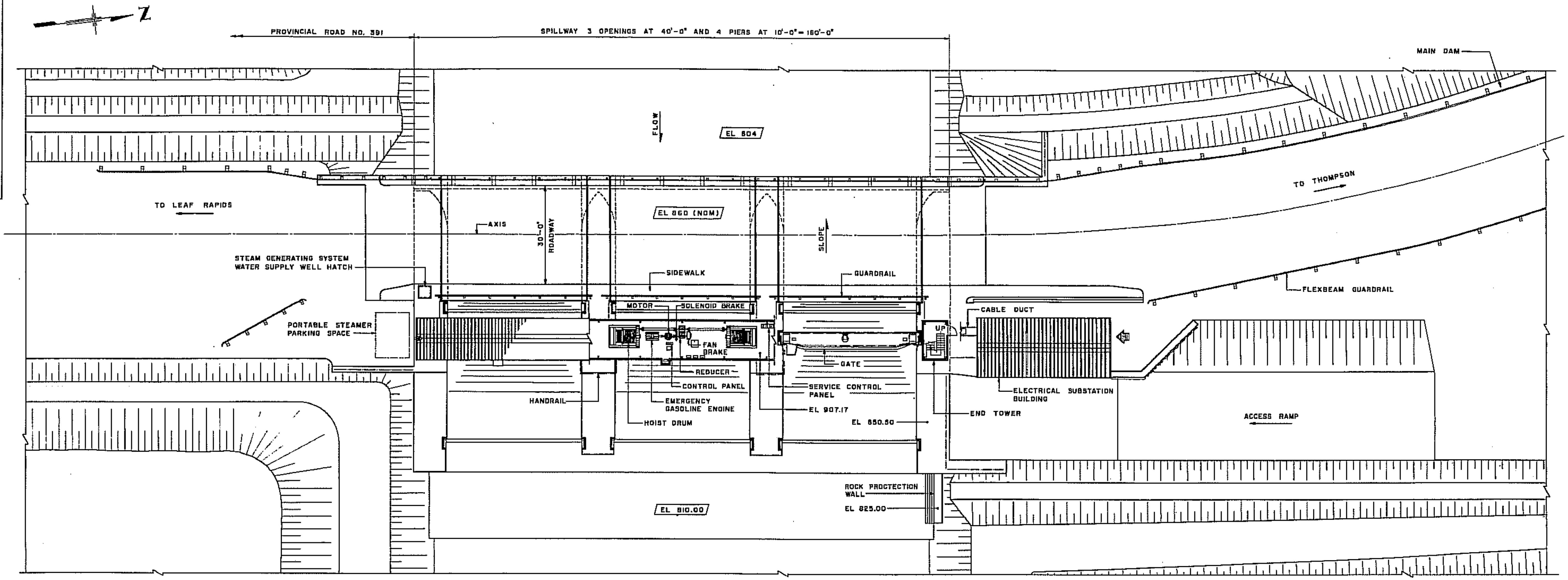
AUTOCAD ORIGINAL



MANITOBA WATER STEWARDSHIP No. 57-2-1056
1-00184-DE-07311-0030
SHT. 0001
REV. 00
CHLORINE CABINET
BEDROOM
WATER TREATMENT ROOM
STORAGE ROOM
OIL STORAGE ROOM
WASHROOM
LIVING AREA
COMMUNICATIONS ROOM
WORK AREA
GARAGE
PLAN OF GARAGE-ACCOMMODATION BUILDING
SCALE 12 6 0 12 24 FEET
COFFERDAM REMNANT
HEADWATER
EXTREME MAXIMUM
CONTROLLED MINIMUM
TO LEAF RAPIDS
36,000 E
AXIS
ACCESS ROAD
ELECTRICAL SUBSTATION BUILDING
SPILLWAY
DISCHARGE CHANNEL
FLOW
EL 810
TENTATIVE LOCATION OF FUTURE GENERATING STATION
PROVINCIAL ROAD NO. 391
TANK FARM
GARAGE-ACCOMMODATION BUILDING
DOCK
WATER SUPPLY AND FUEL PUMPHOUSE
LAUNCHING RAMP
FORMER CONSTRUCTION CAMP SITE
TO THOMPSON
37,000 E
TAILWATER
6,000 N
7,000 N
PLAN
SCALE 200 100 0 100 200 FEET
AXIS
SPILLWAY
FLOW
EL 810
EL 809
EL 804
EL 810
EL 816
EL 785
74'
72'
590'
100'
ELEVATION IN FEET
900
880
860
840
820
800
780
SECTION ALONG ℄ SPILLWAY CHANNEL
SCALE 100 50 0 100 200 FEET
Original Signed By:
APEGM Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005
00 04-11-19 ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.
ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION
ACRES
FIGURE 38
CHURCHILL RIVER DIVERSION
NOTIGI CONTROL
GENERAL ARRANGEMENT
OF STRUCTURES
DRAWN GAC
SCALE AS SHOWN
1-00184-DE-07311-0030
0001 00
FOR MANITOBA USE ONLY
AUTOCAD ORIGINAL

MANITOBA WATER STEWARDSHIP No. 57-2-1057

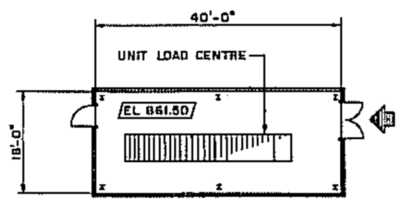
1-00184-DE-07311-0031 SHT. 0001 REV. 00



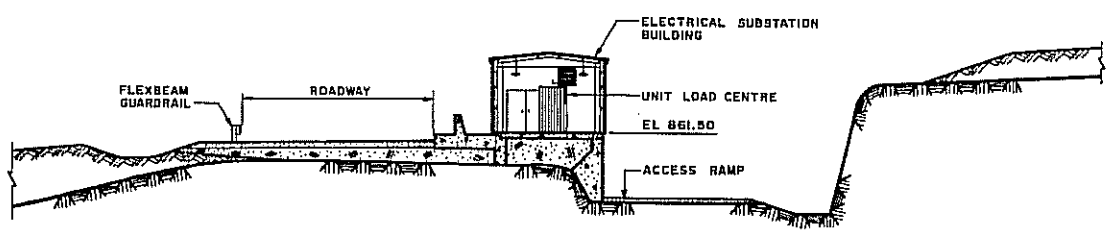
SPILLWAY

PLAN

SCALE 20 10 0 20 40 FEET



PLAN



CROSS SECTION

ELECTRICAL SUBSTATION BUILDING

Original Signed By:

APEGM Certificate of Authorization Acres Manitoba Ltd. No. 5 Expiry: April 30, 2005

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

ACRES MANITOBA LIMITED

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

CHURCHILL RIVER DIVERSION
NOTIGI CONTROL
PLAN OF SPILLWAY

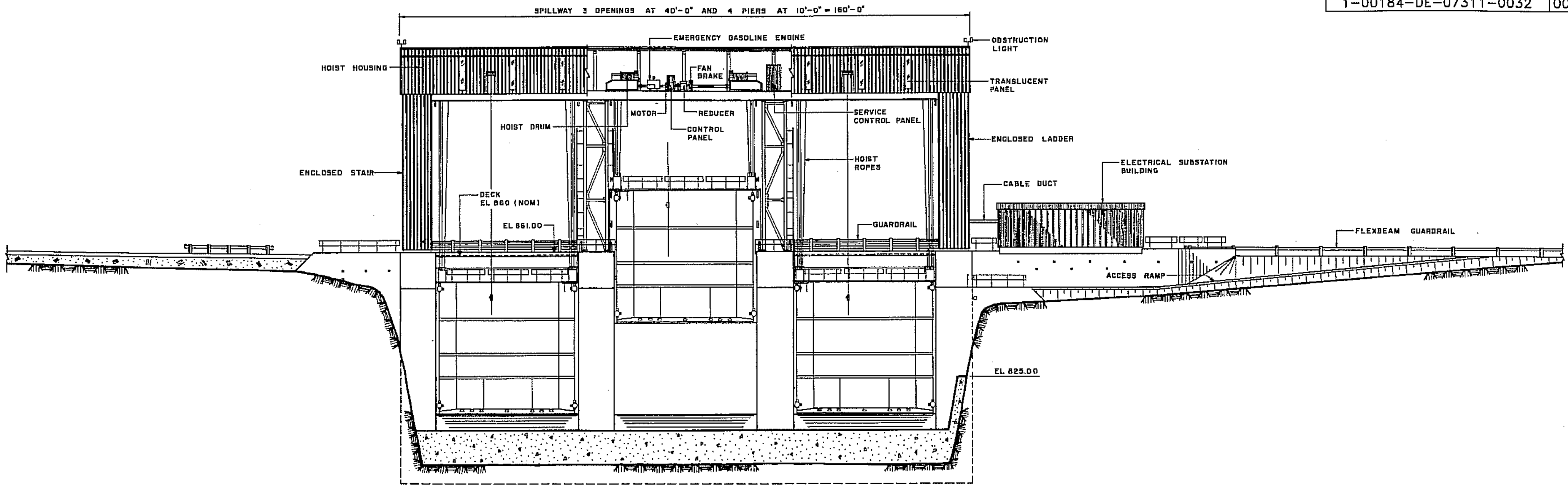
ACRES FIGURE 39

DRAWN GAC
CHECK
SCALE AS SHOWN
APPROVED
DATE

1-00184-DE-07311-0031 SHT. 0001 REV. 00

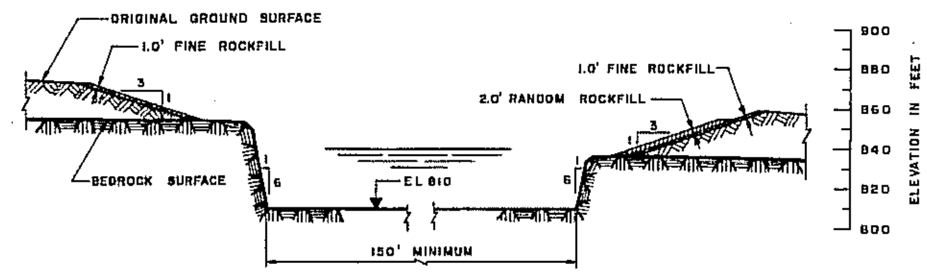
AUTOCAD ORIGINAL

FOR MICROFILM USE ONLY



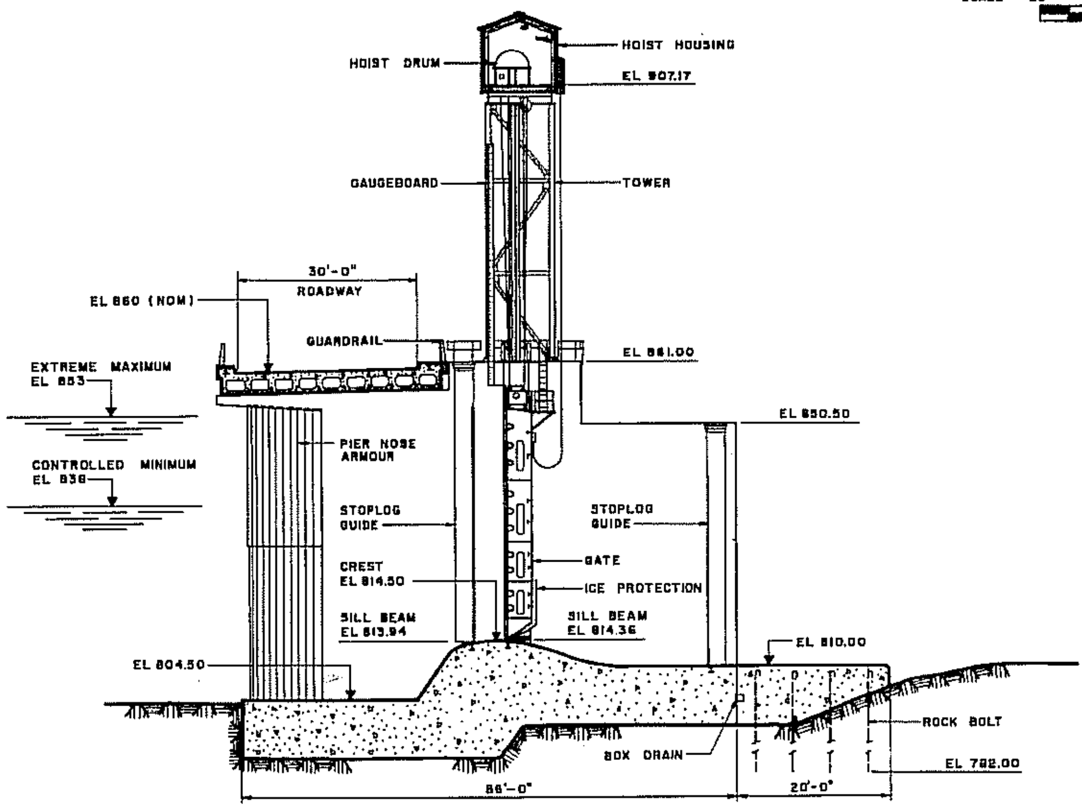
DOWNSTREAM ELEVATION

SCALE 20 10 0 20 40 FEET



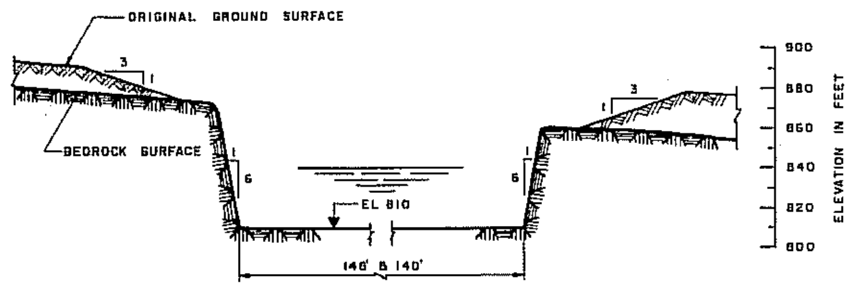
APPROACH CHANNEL

SCALE 60 30 0 60 120 FEET



SPILLWAY

SCALE 20 10 0 20 40 FEET



DISCHARGE CHANNEL

SCALE 60 30 0 60 120 FEET

CROSS SECTIONS

Original Signed By:

APEGM
Certificate of Authorization
Acres Manitoba Ltd.
No. 5 Expiry: April 30, 2005

NO.	DATE	REVISIONS	BY	CKD.	APP.
00	04-11-19	ISSUED IN CONJUNCTION WITH WATER POWER ACT LICENSE SUBMISSION.	WK	WK	

ACRES MANITOBA LIMITED
MANITOBA HYDRO
WUSKWATIM GENERATING STATION

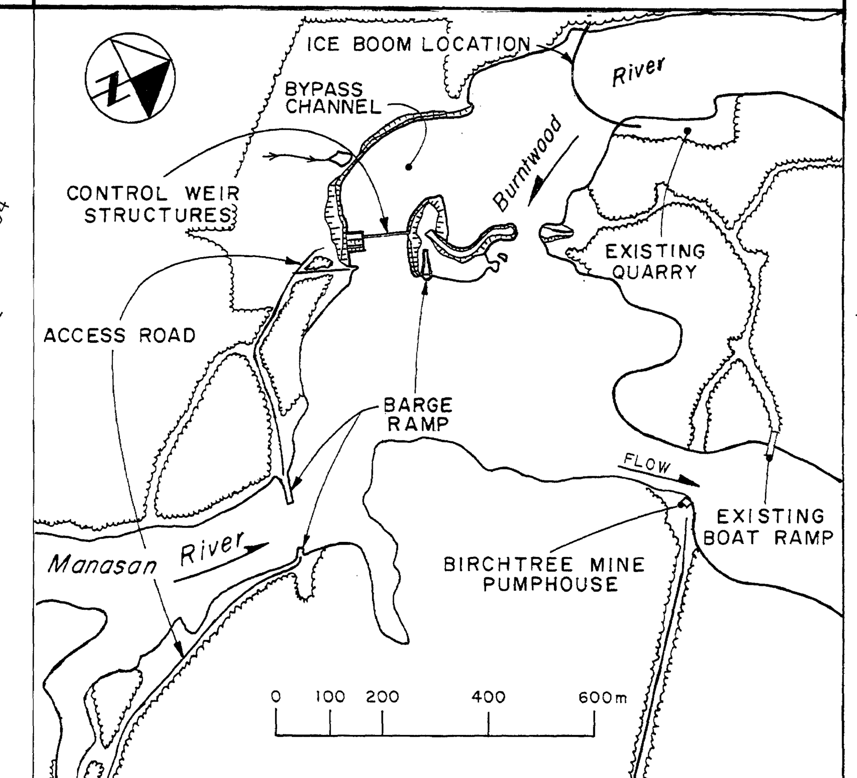
CHURCHILL RIVER DIVERSION
NOTIGI CONTROL
SPILLWAY-DOWNSTREAM ELEVATION
AND CROSS SECTIONS

FIGURE 40

DRAWN GAC
CHECK
SCALE AS SHOWN
APPROVED
DATE

1-00184-DE-07311-0032 | SHT. 0001 | REV. 00

MANITOBA WATER STEWWADSHIP No.57-2-1059



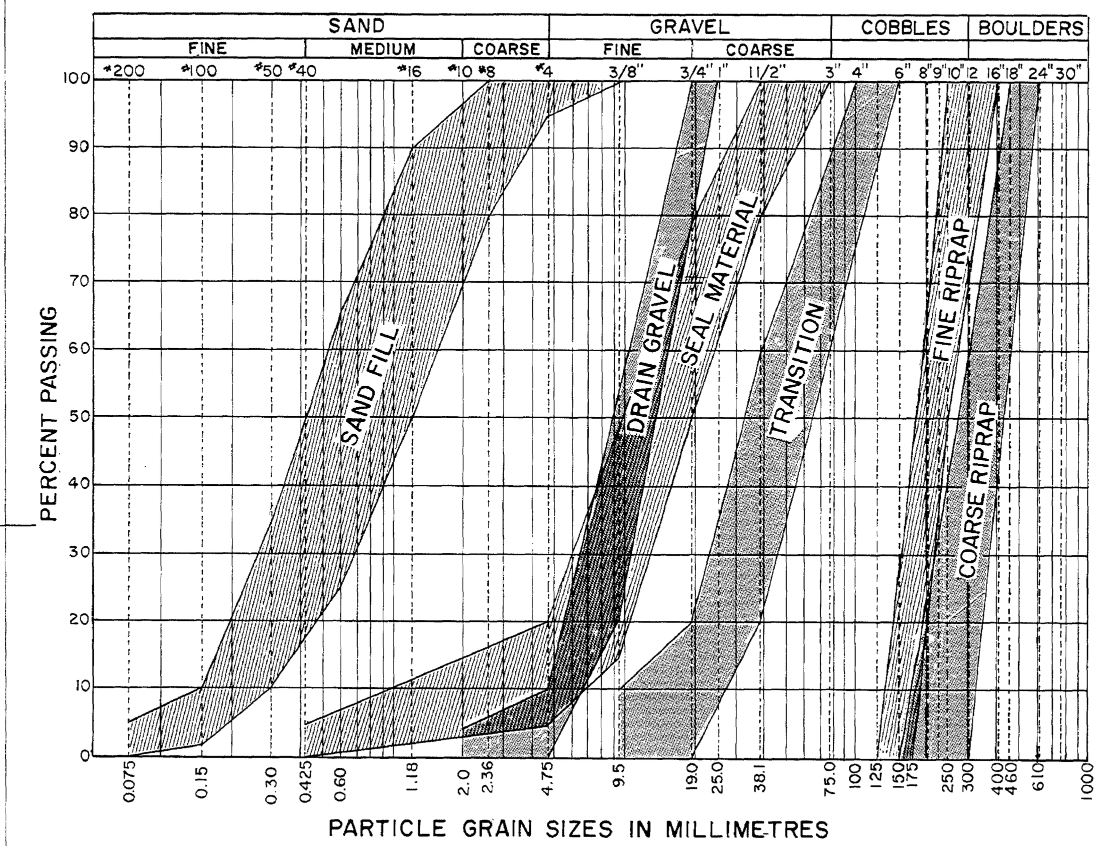
KEY PLAN

NOTES

1. ALL ELEVATIONS SHOWN ARE IN METRES.
2. GRID SHOWN IS A LOCAL GRID.
3. LOCATION OF STOCKPILE AREAS ARE APPROXIMATE ONLY.
4. DRAWING PRODUCED FROM MANASAN BYPASS CHANNEL - SURVEY BOOKS 1-11 (RETAINED BY REHABILITATION & MITIGATION CONSTRUCTION DEPARTMENT).

LEGEND

- DYNAMITE CONTAINMENT TUBES
- SETTLEMENT PIN
- THERMISTOR



MATERIAL GRADATIONS

REFERENCE DRAWING

00188-E-03914 SHT. 2 COMPLETED STRUCTURE - PLAN & SECTIONS
00188-B-03919 MANASAN RIVER - TEMPORARY CAUSEWAY REMOVAL

0 5 10 20 40 60 m
1 : 500

NO.	DATE	REVISIONS	BY	CKD.	APP.
2	2004 11 16	ISSUED IN CONJUNCTION WITH WATERPOWER ACT SUBMISSION & REVISED TITLE SURROUND	B.W.B	B.W.B	V.P.L
1	90 01 12	MATERIAL GRADATIONS CHART AND INSTRUMENTATION LOCATION ADDED			

NOTED
CIVIL
GEOTECHNICAL
FIGURE 41
1989/11/23
P. Janzen
DRAWN
CHECK
CONSTRUCTION
MANAGER
SCALE SHOWN
DATE 89 10 27

MANITOBA HYDRO
ENGINEERING AND CONSTRUCTION
CHURCHILL RIVER DIVERSION

MANASAN BYPASS CHANNEL

AS BUILT STRUCTURES

00188 - E - 03920

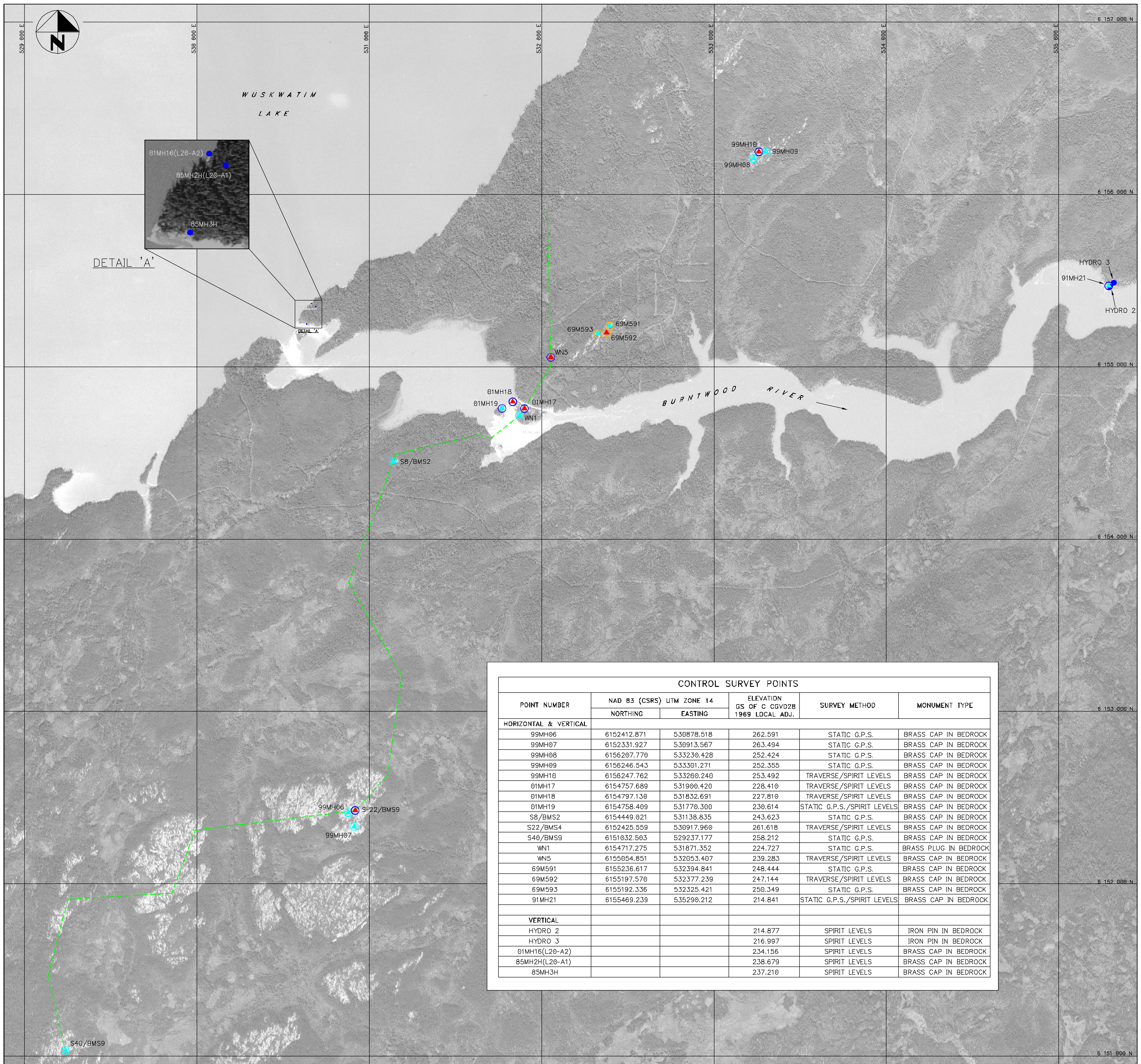
SHT. 01 REV. 02

PROVINCE OF MANITOBA 1989-11-22 V.P.H. LIU. Original Signed By:

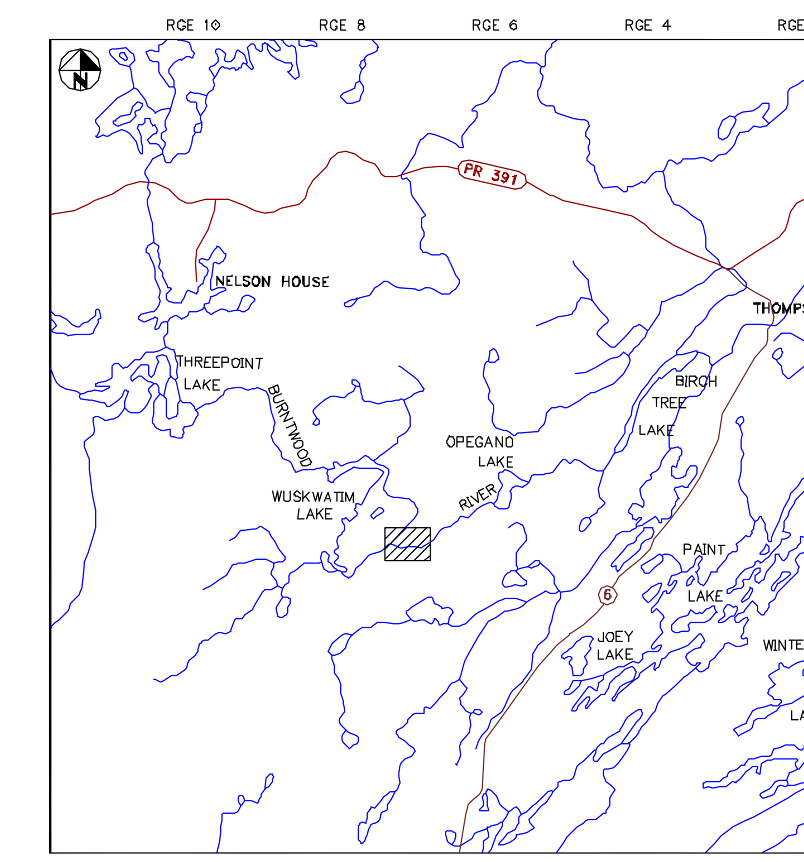
FOR MICROFILM USE ONLY

MANITOBA WATER STEWARDSHIP NO. 57-2-1051

1-00184-DE-11520-0001 | SHT. 0001 | REV. 02



CONTROL SURVEY POINTS					
POINT NUMBER	NAD 83 (CSRS) UTM ZONE 14		ELEVATION GS OF C CGVD28 1969 LOCAL ADJ.	SURVEY METHOD	MONUMENT TYPE
	NORTHING	EASTING			
HORIZONTAL & VERTICAL					
99MH06	6152412.871	530878.518	262.591	STATIC G.P.S.	BRASS CAP IN BEDROCK
99MH07	6152331.927	530913.567	263.494	STATIC G.P.S.	BRASS CAP IN BEDROCK
99MH08	6156207.770	533230.428	252.424	STATIC G.P.S.	BRASS CAP IN BEDROCK
99MH09	6156246.543	533301.271	252.355	STATIC G.P.S.	BRASS CAP IN BEDROCK
99MH10	6156247.762	533260.240	253.492	TRAVERSE/SPIRIT LEVELS	BRASS CAP IN BEDROCK
01MH17	6154757.689	531900.420	228.410	TRAVERSE/SPIRIT LEVELS	BRASS CAP IN BEDROCK
01MH18	6154797.130	531832.691	227.810	TRAVERSE/SPIRIT LEVELS	BRASS CAP IN BEDROCK
01MH19	6154758.409	531770.300	230.614	STATIC G.P.S./SPIRIT LEVELS	BRASS CAP IN BEDROCK
S8/BMS2	6154449.021	531138.835	243.623	STATIC G.P.S.	BRASS CAP IN BEDROCK
S22/BMS4	6152425.559	530917.960	261.618	TRAVERSE/SPIRIT LEVELS	BRASS CAP IN BEDROCK
S40/BMS9	6151032.503	529237.177	258.212	STATIC G.P.S.	BRASS CAP IN BEDROCK
WN1	6154717.275	531871.352	224.727	STATIC G.P.S.	BRASS PLUG IN BEDROCK
WN5	6155054.851	532053.407	239.283	TRAVERSE/SPIRIT LEVELS	BRASS CAP IN BEDROCK
69M591	6155236.617	532394.841	248.444	STATIC G.P.S.	BRASS CAP IN BEDROCK
69M592	6155197.570	532377.239	247.144	TRAVERSE/SPIRIT LEVELS	BRASS CAP IN BEDROCK
69M593	6155192.336	532325.421	250.349	STATIC G.P.S.	BRASS CAP IN BEDROCK
91MH21	6155469.239	535290.212	214.841	STATIC G.P.S./SPIRIT LEVELS	BRASS CAP IN BEDROCK
VERTICAL					
HYDRO 2			214.877	SPIRIT LEVELS	IRON PIN IN BEDROCK
HYDRO 3			216.997	SPIRIT LEVELS	IRON PIN IN BEDROCK
01MH16(L20-A2)			234.156	SPIRIT LEVELS	BRASS CAP IN BEDROCK
85MH2H(L20-A1)			238.679	SPIRIT LEVELS	BRASS CAP IN BEDROCK
85MH3H			237.210	SPIRIT LEVELS	BRASS CAP IN BEDROCK



KEY MAP

INDICATES AREA COVERED BY THIS SHEET

LEGEND:

- MANITOBA HYDRO STATIC GPS HORIZONTAL AND VERTICAL CONTROL POINT
- MANITOBA HYDRO PRIMARY GPS HORIZONTAL AND SPIRIT LEVELED VERTICAL CONTROL POINT
- MANITOBA HYDRO SPIRIT LEVELLED VERTICAL CONTROL POINT
- MANITOBA HYDRO TRAVERSED HORIZONTAL AND SPIRIT LEVELLED VERTICAL CONTROL POINT
- FEDERAL GEODETIC MONUMENT WITH MANITOBA HYDRO STATIC GPS HORIZONTAL COORDINATES
- FEDERAL GEODETIC MONUMENT WITH MANITOBA HYDRO TRAVERSED HORIZONTAL COORDINATES
- ORIGINAL DYKE LINE (APPROXIMATE)

NOTES:

1. ALL VALUES SHOWN ARE IN METRES.
2. HORIZONTAL CONTROL IS BASED ON NAD83 (CSRS) UTM ZONE 14.
3. VERTICAL CONTROL IS BASED ON GS OF C CGVD28, 1969 LOCAL ADJUSTMENT.
4. SCALE FACTOR IS 0.99957.

SCALE:

1 : 10000

METRES 200 0 500 1000 1500

NO.	DATE	REVISIONS	BY	CKD.	APP.
2	2004-10-29	ISSUED IN CONJUNCTION WITH WATER POWER ACT SUBMISSION & REVISED TITLE SURROUND.	TL	TL	RAC
1	2003-10-30	REVISED CONTROL SURVEY TABLE AND LEGEND, DELETED 91MH21Z AND 85MH1H, CHANGED SYMBOLS FOR 01MH16, 85MH2H AND 85MH3H AND ADDED 91MH21 TO PLAN	RWB	TL	RAC

NOTED

FIGURE 42

ORIGINAL SIGNED BY: Rezso A Csupak 2002-04-04

DRAWN R.W.B.

CHECK T.L./C.E./R.A.C.

SCALE 1:10000

APPROVED

DATE 02-04-04

MANITOBA HYDRO

WUSKWATIM G.S.

PLAN SHOWING SURVEY CONTROL AT WUSKWATIM G.S. SITE

1-00184-DE-11520-0001 | SHT. 0001 | REV. 02

AUTOCAD ORIGINAL

E SIZE - 671 x 952

FOR MICROFILM USE ONLY