Keeyask Project
Water Power Act

General Layout and Supporting Data

Sections 11 to 13

KEEYASK
Hydropower Limited Partnership

May 2014

2014 05 22

Mr. Bruce Gray
Assistant Deputy Minister
Conservation & Water Stewardship
Box 11 - 200 Salteaux Crescent
Winnipeg, Manitoba R3J 3W3

Dear Mr. Gray:

RE: KEEYASK GENERATION PROJECT - INTERIM WATER POWER ACT LICENCE GENERAL LAYOUT AND SUPPORTING DATA SUBMISSION (SECTIONS 11 TO 13 OF THE WATER POWER ACT REGULATION)

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

From 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.

If you have any questions regarding this matter, please contact Halina Zbigniewicz at Manitoba Hydro at 204-360-5009 or hszbigniewicz@hydro.mb.ca.

Yours truly,

5900345 Manitoba Limited
As general partner of the
Keeyask Hydropower Limited Partnership

Originally Signed by Bruce Barrett

B.A. Barrett, P. Eng.
President

BB/dd

c: Doug Bedford
Rob Matthews

General Layout Plan and Supporting Data for Power Development Purposes Associated with the Keeyask Project (Generation and Transmission) on the Nelson River in accordance with Sections 11 to 13 of the Regulations under the Water Power Act (C.C.S.Mc. W60)

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.

5900345 Manitoba Ltd., on behalf of Keeyask Hydropower Limited Partnership (KHLP), hereby provides the General Layout Plan and Supporting Data for power development purposes associated with the Keeyask Project (Generation and Transmission) on the Nelson River based on the best available information at the time of this submission.

It should be noted that all transmission components required for this project will be owned by Manitoba Hydro and will not be owned by the Keeyask Hydropower Limited Partnership but are none the less necessary to transmit the power from the generating station to its point of interconnection with Manitoba Hydro's system.

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.

5900345 Manitoba Ltd., on behalf of Keeyask Hydropower Limited Partnership (KHLP), on July 2012 submitted to the Director, Environmental Approvals a report entitled “Keeyask Generation Project Environmental Impact Statement, June 2012”.

Under a separate cover, Manitoba Hydro filed the “Keeyask Transmission Project Environmental Impact Assessment Report” in November 2012 and a document entitled “Needs for and Alternatives To”, in August, 2013 to the Director, Environmental Approvals Branch.

These referenced documents describe a proposal to proceed with the construction of a 695 megawatt (932,000 HP) generating station called Keeyask at Gull Rapids on the Nelson River and the associated transmission lines and switching stations to connect the generating station to Manitoba Hydro’s existing integrated transmission system (Map 1).

In addition to the previously referenced EIS submission for the Keeyask Generating Station, the KHLP has undertaken to respond to several rounds of questions through the Federal Canadian Environmental Assessment Agency review process, which included questions from members of the provincial Technical Advisory Committee and the public; the Clean Environment

Commission (CEC) review that included questions from CEC technical experts and funded participants and an intensive question and answer session during the Clean Environment Commission public hearings held between September 2013 and January 2014.

The Keeyask Transmission Project required no federal approvals; however a series of consultations with the Generating Station Partners and others is underway.

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

The proposed Keeyask Project (Generation and Transmission) in-service-date is scheduled for 2019. The 4400 gigawatt hours average annual energy from the Keeyask Project will help meet growing Manitoba loads and assist in offsetting the decline in exports. The Keeyask Generation Project is advanced four years from the forecast date required to serve Manitoba load to facilitate new export opportunities and protect Manitobans in the event of higher than expected load growth.

The project concepts and preliminary engineering design that has resulted from the planning process for Keeyask Generating Station 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 in the design. The Keeyask Generating Station structures have been designed in accordance with the Dam Safety Guidelines published by the Canadian Dam Association (CDA). 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 Probable Maximum Flood and seismic loads have been taken into consideration in the design.

Workplace safety has seen a number of key safety measures included such as fall protection measures, non-slip stair treads/walkways, hazard guards, pre-engineered-maintenance platforms and engineered fall protection tie-off points. Along with workplace safety measures, "designing with maintenance in mind" and environmental stewardship are values engineered into Keeyask to make operations and maintenance at the new stations safer for employees, the public and the environment.

A third-party independent panel of experts conducted a design phase dam safety review that evaluated and reported on the Project's conformance against more than 220 criteria from the Canadian Dam Association (CDA) Guidelines. Dam safety was also considered in the assessment of the Project under the evidence-based Hydropower Sustainability Assessment Protocol, which included consideration of the results of independent dam safety review. The protocol was developed by the Internal Hydropower Association (IHA) in conjunction with industry, governments, NGOs and others, and is implemented by an independent team of accredited auditors.

In the final report issued in July 18, 2013, the auditors found that the panel of experts confirmed that, in accordance with the CDA Guidelines, infrastructure safety includes consideration of a broad range of scenarios, from multiple perspectives (including hydro-technical, seismic, geotechnical, structural, mechanical and electrical). The IHA report concluded that a thorough professional assessment was undertaken for the dam and other infrastructure safety risks (on land and water) for project preparation, construction and operation with no significant gaps, based on CDA's Dam Safety Guidelines.

The involvement of the public, particularly the extensive involvement of the KHLP partner First Nations in all facets of project planning and the environmental impact assessment studies, has contributed substantially to planning that has reduced adverse effects and enhanced positive effects of the Keeyask Generating Station project. Traditional Knowledge and Western Science have both contributed to an integrated planning process.

The Project planning was the primary means of mitigating potential adverse effects related to the proposed Project. Selection of a low head option and a narrow one meter operating range 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. An Environmental Protection Program (the Program) has been developed to mitigate, manage and monitor potential environmental effects during the construction and operation phases of the Keeyask Generation Project. The Program includes a collection of plans grouped in the following categories: Environmental Protection Plans, Environmental Management Plans, and Environmental Monitoring Plans. The Environmental Protection Plans (EnvPPs) provide detailed, site-specific environmental protection measures to be implemented by the contractors and construction staff to minimize environmental effects from construction of the generating station and south access road. They are designed for use as reference documents providing the best management practices to meet or exceed regulatory requirements. The three components of the Environment Protection Program are the following:

1. EnvPPs that are organized by construction activity, highlighting measures to reduce the impact of a specific work activity (e.g., tree clearing or material placement in water).
2. The Environmental Management Plans that focus on minimizing effects on specific environmental parameters. They outline specific actions that must be taken during construction and in some cases into the operational phase to mitigate Project effects. The management plans include

monitoring to determine success of the actions taken and to determine other actions that need to be undertaken (adaptive management).

3. The Environmental Monitoring Plans that are designed to measure the actual effects of the Project, test predictions or identify unanticipated effects. There will be both technical science monitoring and Aboriginal Traditional Knowledge (ATK) monitoring undertaken during the Keeyask Generation Project's construction and operation phases.

The Transmission Project will develop an EnvPP as indicated in the Keeyask Transmission Project Environmental Assessment Report.

The environmental investigations for the projects have spanned more than ten 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 Statement concludes that, with planned mitigation, the Keeyask Generation Project is expected to create no significant adverse residual effects on the biophysical environments.

The Keeyask Generation project will create a reservoir of about 93 km^2 (22,980 acres) when it is initially impounded, comprised of approximately 48 km^2 of existing waterways and 45 km^2 (11,120 acres) of newly flooded area. During operation, technical studies predict that backwater effects from Keeyask will not affect Split Lake water levels in open-water conditions, and only small changes during infrequent low-flow winter conditions (about once every 20 years). No change to the Churchill River Diversion Licence, as modified by the Augmented Flow Program, or to the Lake Winnipeg Regulation Interim Water Power Act Licence, will be required to operate the Project. The reservoir formed behind the dam will raise water levels on Gull Lake by approximately 7 m (23 ft), and will normally be operated within a narrow one meter range between the Full Supply Level of 159.0 m (521.7 ft) ASL and the Minimum Operating Level of 158.0 m

(518.4 ft) ASL. The station will typically be operated in one of two modes of operation: a peaking mode where discharge is higher during the day (drawing down the reservoir) and reduced at night (filling the reservoir) resulting in reservoir water level variations of up to one meter within a day; or a base loaded mode where reservoir level is held steady at full supply level. The generating station will have seven turbine units which combined have the capacity to pass up to 4,100 m^3/s (144,800 cfs), without spilling. The peaking mode of operation may be used when inflows are less than this capacity, or up to about 88% of the time based on historic flow records. Base loaded operation would occur during higher flow conditions, about 12% of the time. This mode of operation may also occur when the integrated power system is short of system energy which, based on historic inflow records, could occur approximately 15% of the time, typically during low inflow conditions.

Subsequent to the public hearings that concluded in January 2014, the Clean Environment Commission (CEC) submitted a report to the Minister of Conservation and Water Stewardship in April, 2014 recommending the Keeyask Generation Project be licensed under The Environment Act and listing the conditions of such license.

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;

Requirements duly noted

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

Requirements 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

Requirements 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."

5900345 Manitoba Ltd., on behalf of Keeyask Hydropower Limited Partnership (KHLP), has been working with other regulatory authorities charged with the various other federal and provincial statues to satisfy any pre-authorization requirements. Upon receiving appropriate authorizations and approvals, the KHLP intends 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:

This document describes the Project as it is currently envisioned. Specifics of the Project, including the proposed generating station and associated facilities, are subject to change as a result of the environmental assessment and during final design and construction.

Several figures in this document reference alternative axis GR-3. This alternative axis was considered during the early planning phase of the project. Axis GR-3 is located further east of axis GR-4, which was selected during the concept design phase. For further information, refer to the Keeyask Generating Station Environmental Impact Statement Project Description Supporting Volume.

The figures included in this document were used as part of the Keeyask Generating Station General Civil Contractor (GCC) tender documents. The GCC has already been selected and retained by KHLP. These figures were issued only with the purpose of tendering the project and not for construction activities. These figures form the basis of design for the final detailed design stage, which is currently taking place between the KHLP and the GCC.

(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;

Refer to the attached Maps and Figures:
Figure 1: Vicinity Plan
Figure 2: Project Site Access
Figure 3: Basis for Design General Arrangement Project Area
Figure 4: Basis for Design General Arrangement Project General Arrangement
Figure 5: Basis for Design General Arrangement Potential Borrow Area Locations – Plan
Map 2: Excavated Material Placement Areas

(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;

The survey permit application submitted to Conservation and Water Stewardship on June 6, 2013 and approved on December 23, 2013, includes additional information about past field explorations. Map 3 referenced below shows all boreholes and test pits conducted in past field investigations in the area of the Project, while Figure 6 to Figure 16 show boreholes and test pits at a greater detail. Refer to the referenced figures and text below:

Map 3: Keeyask Generating Station WPA Survey Permit – Location of Field Exploration Studies
Figure 6: Regional Bedrock Geology
Figure 7: Stage I Cofferdams - Location Of Explorations
Figure 8: Basis for Design General Arrangement Principal Structures Exploration Plan
Figure 8: Basis for Design General Arrangement Principal Structures Exploration Plan
Figure 9: Basis for Design General Arrangement Dyke Investigations Explorations Plans - 1 Of 3
Figure 10: Basis for Design General Arrangement Dyke Investigations Explorations Plans - 2 Of 3
Figure 11: Basis for Design General Arrangement Dyke Investigations Explorations Plans - 3 Of 3
Figure 12: Basis for Design General Arrangement Principal Structures Geological Section A-A 1 Of 5
Figure 13: Basis for Design General Arrangement Principal Structures Geological Section A-A 2 Of 5
Figure 14: Basis for Design General Arrangement Principal Structures Geological Section A-A 3 Of 5
Figure 15: Basis for Design General Arrangement Principal Structures Geological Section A-A 4 Of 5
Figure 16: Basis for Design General Arrangement Principal Structures Geological Section A-A 5 Of 5

The site of the proposed Keeyask Generating Station is located on the Precambrian Shield. Topographic relief in the area is limited and the morphology is generally planar, except where glacial deposits (eskers, kames, and crevasse fillings), abandoned or present day river channels, or bedrock highs are encountered. Thermokarst topographic features occur throughout the area of the site, especially south of the Nelson River. Figure 6 presents a geological map of the project area and Figure 8 through Figure 16 illustrate subsurface conditions at each of the Principal Structures, as determined by the current level of investigations.

The Gull Rapids site is located in an area of discontinuous permafrost. Discontinuous permafrost is present in the postglacial clays and silts below the peat and locally extends into the underlying tills. Permafrost affected bedrock also occurs locally. The higher and more densely wooded ridge crests and knoll tops are drier and usually contain little if any permafrost. The eskers are also generally free of permafrost. Ice rich peat plateaus are present throughout the area. Thermokarst collapse scars occur throughout the Gull Rapids area.

Overburden covering the site consists of a surficial organic layer overlying postglacial Lake Agassiz lacustrine silts and clays and/or glacial outwash, which in turn overlie glacial deposits. The lacustrine silty clays below the organic layer form a veneer up to several meters in thickness with the thickest deposits found in topographic low areas. Preglacial deposits, consisting of poorly graded sand interbedded with sandy silt/silty sand, have been encountered in some of the bedrock lows beneath the basal clay till. There are areas where some or all of the overburden units may be absent locally. The overburden mantles the underlying irregular bedrock surface, and varies in thickness from a thin organic cover, to over 30 m (98 ft) where bedrock troughs have been infilled.

Downstream, to the east, the bedrock consists of metasedimentary rocks and igneous intrusive rocks. At the site itself, the bedrock is primarily a greywacke gneiss and amphibolites predominant in the Powerhouse area, which lies in a band

650 m to 800 m (2,130 to 2,625 ft) wide crossing the area of the Principal Structures. The greywacke gneiss and the amphibolites commonly contain bands or sills of granitic material. Diabase dykes crosscut all rock types, and these dykes vary from short narrow features to continuous wider lineations.

In general, the bedrock at the site of the proposed Keeyask Generating Station is highly competent and tight, with local areas of higher permeability associated with the occasional open jointing.

North Dam

Bedrock below the north dam (Figure 16) is Precambrian rock, consisting of greywacke gneiss, granite gneiss and granites. The rock mass can be characterized as strong to very strong, with Rock Quality Designation (RQD) values in the 85% to 90% range. The blocky structure is characterized by tight or healed joints.

The bedrock foundation of the north dam will require treatment at the core contact and at depth. Open zones and fractured zones encountered during construction will be infilled with dental concrete to prevent seepage and piping at the bedrock contact. A single line grout curtain extending 13 m (43 ft) vertically below the bedrock surface will reduce seepage through the upper portion of the bedrock.

Central Dam

Bedrock below the central dam (Figure 13, Figure 14, Figure 15, Figure 16) consists of metasedimentary rocks and igneous intrusive rocks, primarily greywacke gneiss and granites, with both gabbro and diabase dykes cross-cutting all rock types. The blocky structure is characterized by tight or healed joints.

The bedrock foundation of the central dam will require treatment at the core contact and at depth. Open zones and fractured zones encountered during construction will be infilled with dental concrete to prevent seepage and piping at the bedrock contact. A single line grout curtain extending 13 m (43 ft) below the bedrock surface will reduce seepage through the upper portion of the bedrock.

South Dam

Bedrock below the south dam (Figure 8, Figure 12, Figure 13 and Figure 14,) consists of metasedimentary rocks and igneous intrusive rocks, primarily greywacke gneiss and granites, with gabbro and diabase dykes cross-cutting all rock types.

The bedrock foundation of the south dam will require treatment at the core contact and at depth. Open zones and fractured zones encountered during construction will be infilled with dental concrete to prevent seepage and piping at the bedrock contact. A single line grout curtain extending 13 m (43 ft) vertically below the bedrock surface will reduce seepage through the upper portion of the bedrock.

In the north section of the south dam (i.e., Spillway area), the bedrock is generally located at ground surface. Field exploration for the south dam was limited due to flow conditions.

North and South Dykes

The north and south dyke (Figure 8, Figure 9, Figure 10 and Figure 11) axes are located along several ridges and drumlins. For most of their length, the structures will be founded on till or intertill, with the overlying peat and lacustrine deposits being excavated beneath the entire dyke section. This will minimize any differential settlements that would be associated with the thawing of visible permafrost affected lacustrine deposits. On sections of the north shore, the lacustrine deposits are in excess of 4 m (13 ft) thick and the dyke will be founded on these deposits. In these sections, the dyke will be designed to accommodate differential settlements associated with the thawing of the permafrost. The freeboard dykes and the road connecting the freeboard dykes will also be founded on the lacustrine deposits.

Principal Concrete Structures and Channels

The principal concrete structures (Figure 8, Figure 12 to Figure 16) will be founded on either the existing bedrock surface or on an excavated bedrock surface.

Bedrock below the powerhouse and associated channels generally consists of Precambrian rock, consisting of mafic volcanic and metasedimentary rocks, primarily amphibolite and greywacke gneiss with granitic injection. In addition, both gabbro and diabase dykes cross-cut all rock types. The foliation of the mafic volcanic rocks in the powerhouse and associated channels area generally strikes south-southeast and dips at 85° to the south west. The foliation of the metasedimentary rocks in the powerhouse and associated channels area generally strikes northwest-southeast and dips vertically. The granitic injection, gabbro and diabase dykes are not foliated.

Bedrock below the spillway structure and associated channels generally consists of Precambrian rock, consisting of metasedimentary rocks metasedimentary rocks and igneous intrusive rocks, primarily greywacke gneiss and granites. In addition, both gabbro and diabase dykes cross-cut all rock types. The foliation of the metasedimentary rocks in the spillway and associated channels area generally strikes northeast and dips at 33° to the southeast. The granitic injection, gabbro and diabase dykes are not foliated.

For both the powerhouse and spillway areas, local zones of broken and/or core loss are present and are attributed to open joints and zones of closely spaced jointing. Water pressure testing indicated that the bedrock foundation is generally tight with some zones of higher permeability associated with open joints. There will be a single line grout curtain beneath the principal structures, extending 15 m (49 ft) vertically below the bedrock surface in the powerhouse area and 13 m (43 ft) vertically below the bedrock surface in the spillway area. This will reduce seepage through the upper portion of the bedrock.

Excavated Material Placement Areas

Approximately 4,200,000 m^3 (over 148 million ft^3) of unclassified material, which cannot be used for construction, will be placed within 35 designated excavated material placement areas (EMPAs) located near the principal structures as shown on Map 2.

Since the material placement areas can be found around the principal structures of Keeyask Project, the underlying material is best described in the first paragraphs of this section. Additional geological details can be found in the Keeyask Generating Station Environmental Impact Statement Physical Environment Supporting Volume (Section 5).

(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;

Refer to the attached figures in reference to the sections below:

Figure 4: Basis for Design General Arrangement Project General Arrangement
Figure 17: Basis for Design General Arrangement Principal Structures General Arrangement

Figure 45: Basis for Design General Arrangement Service Bay Plans At El 126.6 & El 141.7
Figure 46: Basis for Design General Arrangement Service Bay Plans At El 146.6 & El 152.1
Figure 47: Basis for Design General Arrangement Service Bay Plans At El 157.0, El 161.8 & El 173.5
Figure 48: Basis for Design General Arrangement Spillway Plan
Figure 49: Basis for Design General Arrangement Spillway Diversion Stage Cross Section
Figure 50: Basis for Design General Arrangement Spillway Final Configuration Cross Section
Figure 51: Basis for Design General Arrangement Spillway Elevation
Figure 52: Basis for Design General Arrangement Powerhouse Transition Structures - Plans & Sections
Figure 53: Basis for Design General Arrangement Powerhouse South Transition - Plans & Sections
Figure 54: Basis for Design General Arrangement South Transition - Sections
Figure 55: Basis for Design General Arrangement Spillway Transition Structures Plans & Sections
Figure 56: Basis for Design General Arrangement Spillway Walls 'A', 'B', 'C', & 'D' Plans, Elevations & Sections
Figure 57: Basis for Design General Arrangement Powerhouse Wall 'E' Plan, Elevation, & Section

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

Refer to the attached maps:

Map 12-1 to 12-11 – Keeyask Project – Elevation Contours

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

Refer to the attached figures and maps:

Figure 4: Basis for Design General Arrangement Project General Arrangement
Figure 17: Basis for Design General Arrangement Principal Structures General Arrangement
Figure 35: Basis for Design General Arrangement Concrete Structures Excavation
Figure 36: Basis for Design General Arrangement Powerhouse Plan

Figure 37: Basis for Design General Arrangement Powerhouse Cross Section At Centerline Of Units
Figure 38: Basis for Design General Arrangement Service Bay Cross Section
Figure 44: Basis for Design General Arrangement Powerhouse Longitudinal Section
Figure 48: Basis for Design General Arrangement Spillway Plan
Figure 49: Basis for Design General Arrangement Spillway Diversion Stage Cross Section
Figure 50: Basis for Design General Arrangement Spillway Final Configuration Cross Section
Map 11: Keeyask Generating Station Elevations Contour and Bathymetry

Map 12-1 to 12-11 – Keeyask Project – Elevation 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;

Refer to the attached figures and maps:

Figure 3: Basis for Design General Arrangement Project Area

Map 11: Keeyask Generating Station Elevations Contour and Bathymetry

Map 12-1 to 12-11 – Keeyask Project – Elevation Contours

(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 Keeyask transmission lines, including the locations of the construction power and switching stations required to deliver electricity from the proposed Keeyask Generating Station into the existing Manitoba Hydro system are illustrated in the following figures and maps (note that the maps only show the right-of-way for the transmission lines). The alignment for the construction transmission lines and the generation outlet lines are shown in the following figures and maps:

Figure 58: Construction Power Station 138- 12kV Station Site Layout
Figure 59: Switching Station Concept Layout For 138kv Station

Figure 60: Radisson Station Overall Station Layout
Map 4: Keeyask Land Acquisition Master Plan
Map 5: Keeyask Transmission Project Preliminary Transmission Corridors during Keeyask Construction Phase
Map 6: Keeyask Transmission Project Preliminary Transmission Corridors during Keeyask Operation Phase

The Keeyask Transmission Project will be developed, owned and operated by Manitoba Hydro to provide construction power to the Project site during the construction phase and to transmit power from the generating station during the operation phase. Manitoba Hydro made a separate application for regulatory approval under The Environment Act for this project. It includes the following:

- A 22 km (13.7 miles) transmission line and substation to provide construction power to the Project. The construction power line will connect the Project site to an existing 138 kV transmission line (KN 36) located south of the construction site.
- Three transmission lines and switching station to transmit electricity within a single corridor (approximately 35 km (21.7 miles)) from the Keeyask Generation Project to the Radisson converter station (near Gillam), where the power will enter Manitoba Hydro’s Integrated Power System. One of these lines will be built earlier than the other two to serve as a back-up source of construction power.
- Four 4-km (2.5 miles) long unit lines transmitting power from the seven generators located at the Keeyask Generating Station to the switching station.
- The construction power station will be located immediately north of the Keeyask Generation Project.
- The switching station will be located approximately 3.5 km (2.17 miles) southeast of Keeyask Generation Project.

(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;

The Keeyask Hydropower Limited Partnership has a lease for the lands required for the north access road, camps, contractor work areas and other facilities on the north and south sides of the Nelson River. This lease grants a purchase right to the Partnership. The Partnership intends to purchase the leased lands and additional lands on the north and south side of the Nelson River and water lots in the Nelson River (Map 4). These lands will be used for the principal structures and the south access road. After the Project is commissioned, the Partnership will re-convey surplus lands to Manitoba. The estimated area of lands required for the project was first presented in the Interim Water Power Act Application document on February 8, 2012. The updated estimates of Crown Lands described below have been reduced because they exclude lands that will be purchased by the Keeyask Hydropower Limited Partnership and Manitoba Hydro (Map 7 to Map 10).

Part 1: Crown Lands

The following is an estimate of the Crown lands required under Water Regulation 25/88R, section 24(2):

Category A

“lands of the province not covered by water required for main diverting works, powerhouse, and similar works”, including construction work area, campsite, south dam, central dam, north dam and transition structures, Powerhouse, Spillway, rock quarries, granular and impervious borrow areas (Figure 5) intake and tailrace excavated channels, disposal areas for surplus excavated materials (Map 2) and dykes (portions of this land will be covered by water during the Stage II river diversion) located in portions of Twp. 84-R12 EPM, Twp. 84-R13 EPM, Twp. 85-R13 EPM, Twp. 85-R14 EPM, Twp. 85-R15 EPM, Twp. 84-R14 EPM and Twp. 84-R15 EPM.

… **745** hectares (1,840 acres) during construction

… **323** hectares (798 acres) during operation

Category B

"lands of the province covered by water required for the said purpose", including cofferdams, spillway, south dam, central dam, north dam and transition structures, Powerhouse, Spillway, rock quarries, disposal areas for surplus excavated materials, development, construction or enhancement of aquatic and terrestrial habitat within the Project area[1], located in portions of Twp. 84-R13 EPM, Twp. 85-R14 EPM, Twp. 85-R15 EPM, Twp. 84-R14 EPM and Twp. 84-R15 EPM.

… **53** hectares (131 acres) during construction

… **82** hectares (203 acres) during operations

Category C

"lands of the province required only to be flooded in connection with the storage or pondage of water". This area includes the reservoir clearing area during the construction phase and the reservoir expansion that is predicted to occur during the first 30 years of the plant's operation, much of it occurring within the first

1 Aquatic and terrestrial mitigation and compensation measure details can be found in the Keeyask Generating Station Environmental Impact Statement Project Description Supporting Volume.

15 years of operation. This area is located in portions of Twp. 85-R15 EPM, Twp. 84-R15 EPM, Twp. 85-R14 EPM, Twp. 84-R14 EPM, Twp. 85-R13 EPM, Twp. 84-R13 EPM, Twp. 84-R12 EPM and Twp. 84-R11 EPM

… **2,495** hectares (6,166 acres) during construction

… **3,190** hectares (7,885 acres) during operation

The KHLP is currently in the process of acquiring the land for the Generating Station, including the north and south access roads.

Category D

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

i. One 138 kV transmission line connecting the construction power station, located north of Gull Rapids, to transmission line KN-36 located 22 km (13.7 miles) south of the site (right of way shown on Map 5). This transmission line will be used as the primary source of construction power and as an off-site source of backup power during the operating phase. The current alignment and corridor width is conceptual and subject to change. Lands are located in portions of Twp. 85-R15 EPM, Twp. 84-R15 EPM, Twp. 84-R16 EPM and Twp. 83-R16 EPM.

… **80.5** hectares (199 acres) during the construction and operation phase.

ii. Three generation outlet transmission lines connecting a switching station located on the south side of the river to the

Radisson Converter Station located 38 km (23.6 miles) from the site, where the power will enter Manitoba Hydro's integrated system (right of way shown on Map 6). One of these lines will be built earlier than the other two to provide a back-up source of power during construction. The current alignment and corridor width is conceptual and subject to change. The transmission lines are located in portions of Twp. 85-R15 EPM, Twp. 84-R15 EPM, Twp. 84-R16 EPM, Twp. 84-R17 EPM, Twp. 84-R18 EPM and Twp. 85-R18 EPM.

… **664** hectares (1,640 acres) is a preliminary estimate during the construction and operation phase.

iii. Unit transmission lines connecting the switching station and the generating station (right of way shown on Map 6). This line is approximately 4 km (2.5 miles) in length. The transmission lines are located in portions of Twp. 84-R15 EPM and Twp. 85-R15 EPM,

… **0** hectares (0 acres) during the construction and operation phase.

iv. A north access road (Figure 64) from Provincial Road 280 to Gull Rapids will have a length of approximately 25 km (15.5 miles). The access road will have a right-of-way width of 100 m (328 feet). Upon completion of the Keeyask Generating Station, ownership of the road may be transferred to Manitoba Infrastructure and Transportation and become a provincial road. The north access road is located in portions of Twp. 85-R13 EPM, Twp. 85-R14 EPM and Twp. 85-R15 EPM.

… **0** hectares (0 acres)
during the construction and operation phase.

v. A south access road (Figure 65) will have a length of approximately 34 km (21.1 miles) from Gull Rapids to Gillam. The south access road will include 14 km (8.7 miles) of new and 20 km (12.4 miles) of upgraded roadway. Upon completion of the Keeyask Generating Station, ownership of the road may be transferred to Manitoba Infrastructure and Transportation and become a provincial road. This road will have a right-of-way width of 100 m (328 feet) and will be 34 km (21.1 miles) long (only the newly constructed section of the south access road is included in the lands required estimates. The upgraded roadway between Butnau Marina and the town of Gillam will remain public and will not be owned by the Partnership). The south access road is located in portions of Twp. 84-R15 EPM, Twp. 84-R16 EPM, Twp. 84-R17 EPM, Twp. 85-R17 EPM, Twp. 85-R18 EPM.

… **0** hectares (0 acres)
during the construction and operating phase

vi. Borrow areas N-5 and G-3 are expected to be the two primary sources of material for the construction of the principal structures. Erosion between 2000-2010 has created new channels in the Nelson River to the northeast of Gull Rapids causing N-5 and G-3 to become islands in Stephens Lake. At the start of the construction phase, two temporary rock fill causeways will be constructed to access borrows G-3 and N-5 Both causeways will be removed at the end of the construction phase. The causeways will be rock fill embankments designed to accommodate two-way traffic for large rock wagons. They will consist of a free draining rock fill groin, with a 0.6 m (2 ft) thick layer of road topping material placed on the crest of the causeway. Typical cross-sections and longitudinal sections of the causeways are shown in Figure 18. The causeway crest elevations are set at the same level as the powerhouse Stage I cofferdam crest elevation to account for winter water conditions and provide winter access to the deposits.

... **2.2** hectares (5.4 acres) during the construction phase

... **0** hectares (0 acres) during the operation phase

<u>Category E</u>

"lands of the province, if any, required for substations, distributing stations, terminal stations, and similar works" including the following:

A construction power station located on the north side of the project will be used during construction and as a backup source of power during the operating phase and the switching station located on the south side of the Nelson River which connects transmission lines from Keeyask Generating Station to the Radisson Converter Station near Gillam (included in the lands required under this category). The construction power station and the switching station are located in portions of Twp. 85-R15 EPM and Twp. 84-R15 EPM.

... **0** hectares (0 acres)
during the construction and operation phase

Manitoba Hydro is currently in the process of acquiring the land with general permits for the transmission lines right of way located outside the land to be purchased by the Partnership. Manitoba Hydro is also purchasing the land required for the construction power and switching stations. Easements for the transmission line corridors located within Partnership lands and the north and south access roads will be set in place between the Partnership and Manitoba Hydro. Refer to Map 4 for the current Crown Lands acquisition plan.

Total estimate of Crown lands required during the construction phase (Map 7 and Map 8)

4,040 hectares (9,980 acres)

Total estimate of Crown lands required during the operation phase (Map 9 and Map 10)

4,340 hectares (10,725 acres)

Note: this area includes the area of the project footprint, newly flooded area and reservoir expansion.

Part II - Private Lands

There are no known private lands within the designated Crown Lands described in Part I, Categories A through E.

(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 2000 people. These facilities are temporary and will be removed and the area rehabilitated following construction. The site for the Keeyask Generating Station is contained within the Canadian Shield physiographic region and consists of overburden of variable thickness (up to 30 m – 98 ft) over competent Precambrian bedrock. In general, the overburden stratigraphy consists of thin organic cover overlying postglacial lacustrine clay which in turn overlies deposits of glacial outwash, till or the bedrock directly. Preglacial deposits of sand and silty sand are also occasionally found in the bedrock lows. The Gull Rapids site is located in an area of discontinuous permafrost.

The Project will be located in the boreal forest of the Canadian Shield on provincial Crown land approximately 180 km (112 miles) northeast of Thompson, 60 km (37.3 miles) northeast of Split Lake, and 30 km (18.6 miles) west of Gillam. The Project will be located entirely within the Split Lake Resource Management Area (SLRMA). The coordinates of the proposed generating station are 95°11’44”W and 56°20’55”N (0364316E, 6247045N, UTM NAD1983 Zone 15). Gull Rapids has three large channels with a total length of approximately 3.7 km (2.3 miles) and a drop in elevation of approximately 12 m (39.4 ft) between Gull Lake and Stephens Lake. The river is approximately 2.5 km (1.6 miles) wide at the widest part of Gull Rapids.

The Generation Project consists of principal structures and supporting infrastructure. The principal structures consist of a powerhouse and service bay complex, spillway, dams and dykes. A reservoir will be created upstream of the principal structures.

The selected arrangement consists of two long dykes, one on the north and one on the south river bank, linked to the principal structures which span the Nelson River at Gull Rapids. The principal structures will consist of a powerhouse complex constructed on the north side of the river, which will be connected to the north dyke, via the north dam and the powerhouse north transition (a concrete gravity section). The spillway structure will be located on an existing island, approximately 1.6 km (1 mile) south of the powerhouse complex. The powerhouse south transition (Figure 52 and Figure 53), the central dam and the spillway north transition will connect the spillway and the powerhouse. On the south riverbank, the south dyke will be connected to the spillway by the south dam (Figure 31) and the spillway south transition (Figure 55).

The 2-bay service bay, located at the north end of the powerhouse complex, will provide maintenance and construction access to the powerhouse through a north facing main door from a large parking area (refer to Figure 36, Figure 37, Figure 45, Figure 46, Figure 47).

With the exception of a small portion of the central dam, the dams will be founded on prepared bedrock. A small portion of the central dam’s length will be founded on bedrock for its impervious core and on till deposit on the upstream and downstream sections of the dam. The dams will be earth and rock fill embankments consisting of a central impervious core, granular and crushed rock filters, and outer rock fill shells and riprap (Figure 30, Figure 31). There are four embankment cross-sectional designs used for the north and south dykes (Figure 32). Usage of these various designs is generally related to the local foundation conditions present along the length of the dykes.

During the first two years of construction (Stage I Diversion), a series of six cofferdams and two rock fill groins will be constructed to permit dewatering of the river channels in the locations of the powerhouse and spillway structures as well as the central dam. The following cofferdams and rock groin will be constructed during Stage I Diversion: north channel rock groin, quarry cofferdam, north channel Stage I cofferdam, Stage I Island cofferdam, powerhouse cofferdam, spillway cofferdam, central dam Stage I cofferdam, and central dam rock fill groin (Figure 29).

During Stage II Diversion, the following four cofferdams will be constructed: Stage II Island cofferdam, south dam upstream cofferdam, south dam downstream cofferdam and tailrace summer level cofferdam (refer to Figure 19, Figure 20). The Stage II island cofferdam is not shown on the previous figures. This cofferdam's typical cross section will be similar to the Stage I Island cofferdam, however, it's crest will be at el 152.9 m (502 ft).

As the Project is completed, some of the cofferdams will be removed and some remnants of the balance of the cofferdams and rock groins will be incorporated into other permanent structures such as the south dam, central dam and transmission tower spur. The cofferdams consist of rock and granular fill, impervious glacial till, and riprap. In total, they will contain of approximately 1,165,000 m^3 (over 41 million ft^3) of rock fill, granular and impervious materials.

Materials required for the Project include impervious fill, granular fill/crushed rock, rock fill, riprap and concrete aggregates (Figure 5). Site investigations have identified a number of natural sources for these materials. A preliminary material utilization plan was developed to demonstrate the amount of materials that could be extracted from each material source to construct the Generation Project. The Partnership has applied for quarry leases for potential sources of material in the area that may be utilized.

A substantial amount of earth and rock materials will be excavated during the construction of principal structures and much of this material will be used during the construction phase. Approximately 4,200,000 m^3 (over 148 million ft^3) of unclassified material, which cannot be used for construction, will be placed within 35 designated excavated material placement areas (EMPAs) located near the principal structures as shown on Map 2.

(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,

The KHLP has contracted with Manitoba Hydro to design, construct, operate and dispatch the station as part of the Manitoba Hydro integrated power system. Manitoba Hydro will also provide operations and maintenance services to the Keeyask Generating Station. All of the power generated by the project will be sold to the Manitoba Hydro-Electric Board.

It should be noted that all transmission required for this project will be owned by Manitoba Hydro and will not be owned by the KHLP.

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,

Manitoba domestic load is growing, resulting in the need for new power resources around 2020 considering just load growth from Manitoba customers and not including any new export contracts. In addition, consistent with its mandate, Manitoba Hydro has entered into new firm export contracts with Minnesota Power starting 2020, Wisconsin Public Service starting 2021 and Xcel Energy. These export contracts would also involve development of additional export interconnections that will support Manitoba's electricity supply in terms of energy security, reliability and economy. The contracts require electrical energy with the following attributes:

- Reliable and secure source of power in a fixed time frame;

- Accredited capacity;
- Portion of energy priced at a fixed price (certainty in long term energy costs) with annual escalators; and
- Fixed capacity price with annual escalators.

Furthermore, Minnesota Power and Wisconsin Public Service also require the electrical energy to have:

- Environmental attributes associated with a predominately hydroelectric resource, including:
  - Low or no carbon energy; and/or
  - Recognized as renewable as part of a state Renewal Portfolio Standard (RPS) (for Wisconsin).

The renewable, low carbon reliable energy produced at the Keeyask Generation Project with an in-service date of 2019 meets the requirements of these export contracts.

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

All of the power generated by the project will be sold to the Manitoba Hydro-Electric Board, which 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 Needs For and Alternatives To (NFAT) Business Case Appendix 4.2 tables submitted to the Public Utilities Board on August 16, 2013 show that by the end of the study period (2047/48), there will be a power demand of over 7000 MW (including domestic, contracted and proposed exports).

The NFAT Business Case can be found at:
http://www.hydro.mb.ca/projects/development_plan/nfat.shtml

The demand for power within the territory is described in detail in the Needs For and Alternatives To document (Chapter 4 The Need for New Resources).

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

Requirements for power in Manitoba and export markets have presented an opportunity for the Partnership to develop the Keeyask Generation Project.
Manitoba Hydro, the purchaser of the energy produced by the Keeyask Hydropower Limited Partnership, is mandated by *The Manitoba Hydro Act* to:

> …provide for the continuance of a supply of power adequate for the needs of the province, and to engage in and to promote economy and efficiency in the development, generation, transmission, distribution, supply and end-use of power and, in addition, are
>
> (a) to provide and market products, services and expertise related to the development, generation, transmission, distribution, supply and end-use of power, within and outside the province; and
>
> (b) to market and supply power to persons outside the province on terms and conditions acceptable to the board.

The energy produced annually from the Keeyask Generation Project will assist in fulfilling export requirements as well as support the demand from within Manitoba. Such advancement of the Project 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,

Gull Rapids has a natural height of approximately 12 meters (39.4 ft).

(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,

As part of the Northern Flood Agreement, a severance line at elevation 169.47 m (556 ft) m has been established for all reserve lands on Split Lake. This has been taken as the upper limit for water that, together with setup and run-up allowances, in any reservoir created by the impoundment of the Nelson River downstream of Split Lake for all events having annual return periods more frequent than 1:100 years.

The operating range for the proposed Keeyask Generating Station reservoir, as selected by Manitoba Hydro, satisfies this criterion:

- normal full supply level (FSL) el 159.0 m (521.7 ft)
- minimum operating level (MOL) el 158.0 m (518 ft)
- maximum surcharge level (during PMF) el 160.3 m. (525.9 ft)

A nominal surcharge of 0.1 m (0.3 ft) above the FSL has been assumed to accommodate difficulties in precisely balancing inflow and outflow. In a peaking mode of operation the water level will be drawn down and raised on a daily basis, typically varying through the full 1m operating range each week, though it could vary up to 1m in a day. The live storage in the reservoir is small, representing less than half a day of flow in the Nelson River at the river's average flow rate. Due to the small volume of the reservoir, the net streamflow made available from storage is negligible on a daily basis when operating in a typical peaking mode.

The FSL has been based on studies by Manitoba Hydro regarding the size and operation of a generation station at this site that would best meet future load requirements. The minimum operating level is based on the maximum expected drawdown from the operation of the Powerhouse.

The maximum surcharge level is the stage that would be required within the reservoir to pass the PMF with the Powerhouse in a speed-no-load operating condition (passing 1,400 m^3/s – 49,440 cfs). The speed-no-load discharge is the amount of water that can be passed through the powerhouse without risking damage to the generating units when no electricity is being produced. During such an event, it has been determined that the water level in the reservoir will rise to elevation 160.3 m (525.9 ft) and as a result, the Keeyask Generating Station operation will not impact Split Lake levels.

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

Based on a calculation of historical flow records at Split Lake and Kettle Generating Station for the period of November 1977 to September 2011 the minimum, average and maximum discharges are approximately 1,330 cms (46,900 cfs), 3,170 m^3/s (112,100 cfs) and 6,600 m^3/s (223,100 cfs), respectively.

Approximate rates of discharge through the Keeyask Generating Station Powerhouse will be:

- Maximum: 4,100 m^3/s (144,800 cfs)[1]

- Average: 3,130 m^3/s (110,400 cfs) [2]
- Minimum: 570 m^3/s (20,100 cfs)[3]

Where:

[1]Maximum rate of discharge occurs when Keeyask Generating Station reservoir is at its FSL and the Kettle Generating Station reservoir is at 139.6 m (458 feet).

[2]Average rate of discharge is based on synthesized monthly long term flow data from the period of 1912 to 2006.

[3]Minimum rate of discharge is based on one unit operating at best gate when Keeyask Generating Station and Kettle Generating Station are at their respective FSLs.

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

The average low stage inflow is estimated to be 1,400 m^3/s (49,440 cfs). The total drop over Gull Rapids is approximately 12 m (39.4 ft). Therefore, the estimated capacity in horsepower available under natural conditions assuming the efficiency of conversion to be about 91% would be 150 MW (201,000 Horsepower).

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

The reservoir created by the Keeyask Project will extend approximately 42 km (26.1 miles) from the generating station to about 3 km (1.9 miles) downstream of the outlet of Clark Lake. The normal FSL of the reservoir will be 159.0 m (521.7 feet) and the minimum operating level will be 158.0 m (518.4 feet) (wind eliminated water levels) as measured near the principal structures. During normal operations, the reservoir level will fluctuate as much as 1 meter (3.3 feet) in a 24 hour period to utilize the available storage. Approximately 45 km^2 (11,120 acres) of land will be flooded immediately as a result of the Keeyask Project. The estimated surface area of the reservoir at elevation 159.0 m (521.7 feet) is approximately 93 km^2 (22,980 acres) during 50th percentile reservoir inflow conditions. Live reservoir storage at initial impoundment will be approximately 81.4 million m^3 (66,000 acre-feet). The reservoir area is predicted to increase by 7 to 8 km^2 (1,730 acres to 1,977 acres) during the first 30 years of operations due to shoreline erosion and peat land disintegration. The total live reservoir storage with the additional reservoir expansion is predicted to be approximately 84.9 – 85.4 million m^3 (68,800 – 69,200 acre-feet). Map 8 and Map 12-1 to 12-11 – Keeyask Project – Elevation Contours show the flooded area in the reservoir for Keeyask Generating Station.

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

The generating station will have seven turbine units which combined have the capacity to pass up to 4,100 m^3/s (144,800 cfs), without spilling. The peaking mode of operation may be used when inflows are less than this capacity, or up to about 88% of the time based on historic flow records since Lake Winnipeg Regulation and Churchill River Diversion operation (1977-2006 period). Base loaded operation would occur during higher flow conditions, about 12% of the time. However, it could also occur when the integrated power system is short of system energy, typically during low flow conditions that occur about 15% of the time based on historic flow records.

During base loaded mode of operation the reservoir level is held steady so that inflows will balance outflows. In a peaking mode of operation the inflow and outflow will typically be balanced each week, resulting in a negligible contribution to stream flow on a weekly basis. For more detailed information, refer to the Keeyask Generation Project Environmental Impact Statement Physical Environment Supporting Volume (Section 4).

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

The Partnership was directed to include a description of the setting into which these projects will be constructed. The existing physical environment of the project areas are extensively described in supporting volumes that form part of the Keeyask Generation Project Environmental Impact Statement. The existing physical environment along the Nelson River system has been altered, and continues to be influenced, by changes brought about by the CRD and LWR projects in the mid-1970's. The CRD increased flows on the lower Nelson River while LWR altered seasonal flow patterns on the Nelson, both of which resulted in immediate changes in water regime and ice processes along the river system.

The Keeyask Generation Project and the Keeyask Transmission Project Environmental Impact Statement documents also provide a comprehensive discussion of 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 available for power production according to the development plan is approximately 18.3 m (60 feet). The head is expected to fluctuate between approximately 19.6 m (64.3 feet) and 17.8 m (58.4 feet).

The Project will use approximately 18.3 m (60 feet) of the 27 m (88.6 ft) of hydraulic head (*i.e.*, drop in elevation) available between Split Lake and Stephens Lake. About 12 m (39.4 ft) of this drop occurs through Gull Rapids. The Project operating water levels have been discussed in Section (viii).

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

Figure 3 and Figure 4 show the location of the principal structures required for the construction of the Keeyask Generating Station. The principal works are described below:

1. The Powerhouse Complex will contain seven vertical shaft fixed blade turbines and generators, each with an intake, scroll case and a draft tube. The intake for each turbine unit will have three openings, each with a service gate. The Powerhouse Complex will be located within and adjacent to the north channel of the Nelson River. Two permanent concrete transition structures will connect the powerhouse complex to the North Dyke and Central Dam. A roadway that meets provincial requirements for a provincial road will be constructed on the Powerhouse Complex and the concrete transition structures. The Powerhouse Complex will have an approximate width of 248 m (813 feet), length of 68 m (224 feet), and a maximum height (from the bottom of the structure to the top of the intake hoist housing) of 62 m (203 feet). Refer to Figure 36 and Figure 37.
2. A reinforced concrete overflow Spillway will be located within the south channel of Gull Rapids approximately 1.5 km (0.9 miles) south of the Powerhouse. The Spillway will be approximately 119 m (390 feet) wide and 42 m (139 feet) long and will have seven (7) bays. Each of the seven bays will have hoist controlled gates approximately 13 m (43 feet) wide and 16 m (53 feet) high separated by 3.5 m (12 feet) thick piers. From the bottom of the structure to upstream bridge deck and excluding the gate hoist tower, the height will be approximately 24 m (77 feet). Two concrete transition structures will connect the Spillway to the

Central and South Dams. The peak discharge during a probable maximum flood (PMF), is 12,700 m^3/s (448,500 cfs) with the spillway passing 11,300 m^3/s (399,000 cfs), and the remaining flow passing through the Powerhouse operating 6 units at speed no load. The seventh unit is assumed to be out of service. The peak water level immediately upstream of the Powerhouse during the PMF would be approximately 160.3 m (526 feet). The Spillway is designed to pass a flow of 9,960 m^3/s (351,700 cfs) at a normal full supply level of 159.0 m (522 feet). A roadway that meets provincial requirements for a provincial road will be constructed on the Spillway and transition structures between the Spillway and central and south dams. Refer to Figure 48 and Figure 51.

3. Three earthfill dams (north, central and south) will be constructed across Gull Rapids, creating a reservoir upstream of the powerhouse. The dams will be zoned earth fill embankments consisting of an impervious core with granular and crushed rock filters and outer rock shells. A roadway that meets provincial requirements for a provincial road will be constructed on the three earthfill dams. The north dam will have a maximum height of approximately 25 m (82 feet) and will be approximately 100 m (328 feet) in length. To the north, it will connect with the north dyke and to the south with the powerhouse. The central dam will have a maximum height of approximately 28 m (92 feet) and will be approximately 1,600 m (5,300 feet) in length. It will extend from the powerhouse to the spillway. The south dam will have a maximum height of approximately 22 m (72 feet) and a length of approximately 565 m (1,900 feet). It will be constructed across the south channel of the river, extending from the spillway to the south dyke. The crest elevation for all three dams will range

approximately between 162.0 m (532 feet) and 162.6 m (534 feet). Refer to Figure 30 and Figure 31.

4. A series of discontinuous earth fill dykes will be located along both sides of the river. To facilitate inspection and maintenance, a roadway will be constructed on top of the dykes, on high ground between the sections of the dykes and on transition structures. The combined length of the roadway sections and dykes will be approximately 11.6 km (7.2 miles) on the north side of the river and 11.2 km (7 miles) on the south side. The north and south dykes will have a maximum height of approximately 20 m (66 feet) and 13 m (43 feet) respectively..

   The length of the north dyke is composed of approximately:

   - 2,900 m (9,500 feet) of zoned impervious core dykes on glacial tills;
   - 185 m (600 feet) of granular dyke;
   - 4,800 m (15,750 feet) of freeboard dykes; and
   - 3,700 m (12,100 feet) of road sections.

   The length of the south dyke is composed of approximately:

   - 5,100 m (16,700 feet) of zoned impervious core dykes on glacial tills;
   - 5,400 m (17,700 feet) of freeboard dykes; and
   - 700 m (2,300 feet) of road sections.

   Typical cross sections for the dykes are shown in Figure 32.

5. A transmission tower spur (TTS) constructed with earth materials located along the southern edge of the tailrace channel will support four self supported transmission towers and foundations. The towers will support the transmission lines crossing the river to the south. The transmission tower spur is approximately 200 m (656 feet) long and the top of structure will be at approximately

elevation 145.5 m (477 feet). Figure 4 shows the location of the TTS and Figure 33 shows the cross section of the structure.

(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,

The creation of the reservoir will submerge Gull Rapids by increasing water levels 10 m to 15 m (32 to 42 ft.) above existing environment conditions immediately upstream of the Generating Station, while levels on Gull Lake will be raised approximately 6 to 7 m (20 to 23 ft).

The area of land to be flooded as a consequence of the construction of the Keeyask Generating Station (that is not already subject to flooding without the generating station in place) is approximately 45 km^2 (11,120 acres). Initially, the reservoir area will be 93 km^2 (22,980 acres, under the 50^{th} percentile flow), consisting of approximately 48 km^2 of existing waterways and the remaining as newly inundated lands. The reservoir area will increase by approximately 7 to 8 km^2 (1730 to 1977 acres) during the first 30 years after it is impounded due to the erosion of mineral shorelines and peatland disintegration. The extent of the reservoir can be seen in Map 8 and on Map 12-1 to 12-11 – Keeyask Project – Elevation Contours.

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

Spillway

The spillway will be a seven bay concrete overflow structure with each bay having a vertical lift gate. Based on preliminary design, each bay will be about 13 m (43 ft) wide, separated by 3.5 m (12 ft) thick piers. The spillway will be about 119 m (390 ft) long along the axis of the primary structures, about 42 m

(138 ft) wide and 28 m (92 ft) high from rock to the upstream bridge deck (not including the gate hoist tower).

Initially, the spillway will be only be partially completed, in order to utilize it to pass the river's flow during the Stage II Diversion construction phase of the project. Each of the seven bays will be constructed as simple sluices for this diversion stage. Nearing the end of Stage II Diversion the spillway gates will be used to close the sluices, which will then be dewatered, one or two bays at a time, following placement of stop logs at the upstream and downstream extremities of the piers. Rollways will then be constructed in each bay, in a sequenced schedule, using the downstream bridge deck for access. Once the Project is operating, flows that are larger than the powerhouse discharge capacity will pass through the spillway. The spillway is designed to protect the Project from flows up to the PMF. A PMF would result in a peak discharge of 12,700 m^3/s (448,500 cfs), and if this extreme circumstance were ever to occur under no load on the turbines, the upstream water level would rise to 160.3 m (526 ft), which is the basis for selecting the elevation for the crest of the spillways' concrete structures. The spillway would pass 11,300 m^3/s (399,000 cfs) of the river flow while the remaining flow would pass through the powerhouse, which is assumed to be operating with six of seven units operating with a speed-no-load discharge of 1,400 m^3/s (39,440 cfs). The seventh unit is assumed to be out of service. The spillway is designed to accommodate a flow of 9,960 m^3/s (351,700 cfs) at the Project's normal full supply level of 159.0 m (521.7 ft) (this number was updated since the Interim Water Power Licence Application was submitted). The Keeyask Generating Station is designed to be able to pass the PMF without surcharge of the reservoir if the turbines are all operating.

Vertical lift gates, will seal onto steel sill beams embedded in the crests of the rollways and, along their sides, to steel guides embedded in the piers. The gates will be controlled by individual hoists supported on structural steel bridges, which, in turn, will be supported by structural steel towers founded on the piers. The hoist bridges will be enclosed by an insulated metal clad hoist housing which will extend across the seven bays and will also enclose the two end towers, one of which will contain the access stairs, the other a system of ladders and platforms providing alternative egress. A monorail, supported by brackets off the upstream side of the towers, will be used to place and remove the stoplogs. Stoplogs, located in gate guides to the upstream of the vertical lift gates, will be installed during maintenance of a gate. The stoplogs will be stored in the stoplog slots, at deck level, when not in use. Refer to Figure 48.

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

Table 1: Spillway Details

Type	Ogee (operated as a sluice during construction diversion)
Gates	
- number	Seven
- type	Fixed Roller Vertical lift
- size (opening)	13 m x 16.0 m
- hoists	Individual wire rope double drum
Full Supply Level (FSL)	159.0 m (521.7 ft)
Probable Maximum Flood (PMF) Level	159.0 m (521.7ft) – with all powerhouse units operating 160.3 m (525.9 ft) - powerhouse in a speed-no-load operating condition
Minimum Operating Level (MOL)	158.0 m (518.4 ft)
Construction Design Flood (CDF)	6,358 m^3/s (224,530 cfs)
Spillway Design Flood (SDF)	9,960 m^3/s (351,700cfs)
Probable Maximum Flood (PMF)	12,700 m^3/s (448,496 cfs)
Spillway Crest Elevation	144.5 m (474 ft)
Spillway Discharge Invert	138.9 m (456 ft)
Spillway Approach Invert	137.9 m (452 ft)

Powerhouse

The arrangement for the seven-unit powerhouse for the Keeyask Generating Station is shown in Figure 36, Figure 37, Figure 40, Figure 41, Figure 42, Figure 43, and Figure 44. 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 seven units operating at full gate with Stephen Lake at 139.6 m (458 ft), the discharge capacity of the plant will be 4,100 m^3/s (144,800 cfs) at a forebay level of el 159.0 m (521.7 ft) and a net rated head of 19.1 m (63 ft).

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 close automatically to stop flow through the turbine. Space will be provided on the downstream side of the gate to vent the water passage during emergency closure.

The intakes will include a roadway at the deck level, trashracks, individual bulkhead gate shafts and guides and individual Intake service gate shafts, guides and hoists. Each intake will have a maintenance gallery for the Intake service gates, which will be accessed via a watertight steel door from the generator floor.

The intake gate hoists will be enclosed by a structural steel frame supporting insulated metal cladding, which will extend the full length of the intakes. The upstream columns of the hoist housing will be founded on the concrete at the gate hoist support level and the downstream wall will be supported by the Powerhouse roof. The steel frame of the housing and its concrete foundation will support a monorail hoist cantilevered out from its upstream side. The monorail hoist will be designed to handle the bulkhead gate sections and the concrete gate slot covers. The hoist housing will contain the Intake gate hoisting equipment and the Powerhouse and Intake gate hoist housing ventilation equipment. The downstream wall of the housing will be louvered to provide the inflow of air required during an emergency closure of the Intake service gates. When necessary, the main gates can be removed through the housing by a mobile crane after a section of the roof has been removed.

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

Channel Improvements

Forebay channel improvements may required to improve ice forming conditions and flow near the powerhouse intake channel.

Forebay channel improvements (Figure 34) were initially developed during the planning phase, but were later removed based on modelling results; however, a final decision regarding the need for channel improvements will be made during the final design stage.

Spillway Approach Channel

The function of the spillway approach channel is to convey river flow from upstream of the axis of the partially completed structures to the Spillway with minimal head loss during the Stage II Diversion phase of the project.

The spillway approach channel will have a maximum width and length of 220 m (722 ft) and 128 m (420 ft), respectively. The approach channel will have a minimum invert of 137.9 m (452 ft).

The channels will be cut through bedrock once the related cofferdams are in place. Controlled perimeter blasting techniques will be used to ensure the near-vertical faces of the excavation conform to the design requirements. Refer to Figure 35 for additional details.

Spillway Discharge Channel

During spillway operation flow will discharge directly into the channel excavated in the rock immediately to the downstream of the structure. Due to high resultant velocities, some erosion of the natural riverbed will occur with time. A decision as to whether or not to pre-excavate a scour hole will be based on an examination of the bedrock geology during the construction of the spillway structure and discharge channel in advance of Stage II Diversion.

Currently, it is anticipated that pre-excavation will not be required. The bedrock at the Project site has been assessed to be typically fresh and strong, to very strong. It is considered to be of sufficient quality to preclude the requirements for a stilling basin located downstream of the spillway discharge channel. When the Spillway is not being used, water may pond between the structure and downstream end of the excavated discharge channel, due to the adverse slope of the channel. To prevent the isolation of this area from the river tailwater, a 2 m (6.6 ft) wide low flow channel is proposed for construction in the center of the Spillway discharge channel at an elevation of 138.9 m (456 ft). The spillway discharge channel will have a maximum width and length of approximately 133 m (436 ft) and 261 m (856 ft) respectively.

In combination to the spillway approach channel, the function of the spillway discharge channel is to convey the discharge from the spillway back to the river.

The hydraulic performance of the Spillway Approach and Spillway Discharge Channels and the Spillway arrangement has been studied by physical and numerical modeling. Due to the satisfactory quality of the rock in the Spillway discharge channel, energy dissipation studies were not undertaken in the Physical Model. Refer to Figure 35 for additional details.

Spillway

The spillway (Figure 48) will be a seven bay concrete overflow structure with each bay having a vertical lift gate. Based on preliminary design, each bay will be about 13 m (43 ft) wide, separated by 3.5 m (12 ft) thick piers. The spillway will be about 119 m (390 ft) long along the axis of the primary structures, about 42 m wide (138 ft) and 28 m (92 ft) high from rock to the upstream bridge deck (not including the gate hoist tower). The spillway will be located within a channel excavated on the south side of one of the large islands within Gull Rapids, approximately 1.6 km (1 mile) south of the powerhouse. Two concrete transition structures will connect the spillway to the central dam (to the north) and the south dam (to the south). Four of the seven vertical lift gates will have heated guides to permit operation in the winter

Intake Channel

The area immediately upstream of the powerhouse intakes will be excavated downward through the bedrock to direct the flow from the higher riverbed to the intakes. The remainder of the riverbed in the area of the intakes will also be shaped as required to minimize head loss and to assure the formation of a competent upstream ice cover with minimal risk of frazil ice generation. Establishing smooth, non-turbulent flow in the approach (intake) channel also helps to minimize erosion along the channel's floor and near-vertical sides. To accomplish this, the channel floor will gently drop at a 1:25 slope, 22 m (72 ft) from its upstream end to the entrance to the intake. Over the intake channel distance, the channel's width will converge in a bell-mouth shape to a width of approximately 212 m (700 ft). Refer to Figure 35 for a plan view of the channel.

Erosion protection for the excavated overburden slopes near the intakes will be designed to ensure that erosion does not occur. The alignment of the intake channel was established such that it promotes an even distribution of inflow to the Intake passages. A rock trap will be provided immediately upstream of the intake to reduce the risk of local bed material entering the units.

Tailrace Channel

The tailrace channel is designed to convey the discharge from the powerhouse draft tubes to the upper reaches of Stephens Lake with a minimum of head loss. The tailrace channel will be excavated in bedrock. The channel walls will be formed by controlled perimeter blasting techniques and the invert by limitation of sub-grade drilling and loading. At the draft tube exit the floor of the channel first slopes upwards at a rate of 1:20 over a distance of approximately 115 m (377 ft) to an elevation of 130 m (430 ft). It then remains flat over a distance of approximately 371 m (1,217 ft) resulting in a depth of water of approximately 10 m (33 ft). The floor of the channel then slopes upwards at a rate of 1:25 until it matches the natural riverbed.

Several design considerations for the tailrace channel have been identified to enhance the movement of lake sturgeon through the tailrace channel, as well as improvements to sturgeon spawning habitat immediately downstream of the powerhouse. These design considerations include a 1:1 bedrock slope cut along the north side of the tailrace channel, as well as creating a bench along the north end of the tailrace channel near the powerhouse. Refer to Figure 35 for additional details.

Intake

Intakes will consist of three water passages separated by two intermediate piers which will extend from the upstream face of the Intake to the entrance of the semi-spiral scroll case. The elevation of the soffit of the water passages at the upstream face of the Intake head block will be set to provide sufficient submergence to prevent the development of any vortices in the forebay, and to ensure maintenance of a stable ice cover during the winter.

An examination of concrete quantities and stability requirements with respect to uplift pressures indicated that there will be no incremental benefit associated with the provision of a pressure relief system beneath the Intakes. Consequently, a drainage gallery will not be provided. Meanwhile, to help reduce seepage and uplift pressures, a grout curtain will be installed by drilling and grouting through sleeves embedded in the Intake base slab.

In the current arrangement, the soffit of the Intake water passages, upstream of the bulkhead gate slots, will be formed using precast concrete elements. The cost effectiveness of this arrangement, as opposed to cast-in-place concrete, has not been irrevocably established and may be reviewed at the beginning of the final design stage.

Each of the three water passages in an Intake will have a set of vertical trashracks that will be supported by guides embedded in primary concrete at the upstream limit of each pier. To mitigate trashrack vibrations, the height of the trashracks, will be determined by the criteria of maximum acceptable design flow velocity of the water through the trashracks of 1.25 m/s (4.1 ft/s).

The Intakes will include a roadway at the deck level, trashracks, individual bulkhead gate shafts and guides and individual Intake service gate shafts, guides and hoists. Each Intake will have a maintenance gallery for the Intake service gates which will be accessed via a watertight steel door from the generator floor.

The Intake gate hoists will be enclosed by a structural steel frame supporting insulated metal cladding, which will extend the full length of the Intakes. The upstream columns of the hoist housing will be founded on the concrete at the gate hoist support level and the downstream wall will be supported by the Powerhouse roof. The steel frame of the housing and its concrete foundation will support a monorail hoist cantilevered out from its upstream side. The monorail hoist will be designed to handle the bulkhead gate sections and the concrete gate slot covers. The hoist housing will contain the Intake gate hoisting equipment and the Powerhouse and Intake gate hoist housing ventilation equipment. The downstream wall of the housing will be louvered to provide the inflow of air required during an emergency closure of the Intake service gates.

When necessary, the main gates can be removed through the housing by a mobile crane after a section of the roof has been removed.

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 68.3 m (224 ft). 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 pier.

(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 Keeyask Generating Station, shown in Figure 4, is to be a 7 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. The Keeyask Generating Station will operate as a modified peaking plant, meaning that it will operate in a peaking mode of operation with a weekly cycling pattern or a base loaded mode of operation. The extent of peaking or base loaded mode of operation will be determined by the flows in the Nelson River and the requirements of the Integrated Power System. There will also be occasions when the Keeyask Generating Station will be required to operate in a special or emergency mode of operation. The plant will operate within the limited live storage range of 1 m (3.3 ft) (el 159.0 m (521.7 ft) to el 158.0 m (518.4 ft). The full gate discharge capacity of the plant will be 4,100 m^3/s (144,800 cfs) at a forebay level of el 159.0 m (521.7 ft) and a net rated head of 19.1 m (63 feet). With the forebay level and the plant discharge capacity, as stated above, the nominal plant output capacity will be 695 MW (932,000 HP) for open water conditions. The average annual energy that will be generated is 4,400 GW h. The following table presents key design parameters of the Keeyask Generating Station power generation and transformation.

Table 2: Power Generation and Transformation

Power Generation and Transformation	
Plant output at 4,100 m^3/s or 144,800 cfs (open water) Stephens Lake = at 139.6 m (458 ft)	695 MW (932,000 HP)
Number of units	Seven
Unit spacing	29.8 m (98 ft)
Turbines	
• type	Vertical shaft, fixed blade propeller
• rated power at full gate	101.4 MW (135,980 HP) each
• scroll case type	Concrete semi-spiral
• runner diameter	8.85 m (29 ft)
• governor type	Digital electro-hydraulic
Generators	
• type	Vertical umbrella
• rated capacity (each)	117 MVA at 7 units full gate
• rated power factor	0.85
Net operating head	20.2 m (66 ft) maximum 16.6 m (54 ft) minimum 19.1 m (63 ft) rated, based on 7 units operating at full gate and the forebay at el 159.0 m (521.7 ft)
Average annual generation	4,400 GW h
Main transformers	
• number	Seven
• type	Outdoor, oil filled, natural/forced air cooled

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

Keeyask Generating Station could produce in excess of 700 MW when Stephens Lake is at or below 139.6 m (458 ft) and plant discharge approaches 4,100 m^3/s (144,800 cfs). The maximum rated total output power (i.e. name plate rated capacity) for the Keeyask Generating Station has been set to 695 MW (932,000 HP). Keeyask will be designed to generate approximately 630 MW (844,800 HP) at the full gate plant discharge of 4,000 m^3/s (141,200 cfs) when both the Keeyask Generating Station forebay and Stephens Lake (effectively the tailrace for the Keeyask Project) are at their respective FSL.

The Keeyask Generating Station will have a capacity factor of approximately 78% (average river flow to peak plant discharge). This is a much higher ratio than the 62% factor of the other Lower Nelson River Stations.

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

The proposed routes for the Keeyask Transmission Project components are illustrated on Map 5 and Map 6.

The Keeyask Transmission project will be developed, owned and operated by Manitoba Hydro to provide construction power to the Project site. Manitoba Hydro made a separate application for regulatory approval for this project under The Environment Act. It includes the following transmission lines:

- A 22 km (13.7 miles) transmission line and substation to provide construction power to the Project. The construction power line will connect the Project site to an existing 138 kV transmission line (KN 36) located south of the construction site.
- Three transmission lines and switching station to transmit electricity within a single corridor (approximately 35 km (21.7 miles)) from the Keeyask Generation Project to the Radisson converter station (near

Gillam), where the power will enter Manitoba Hydro's Integrated Power System. One of these lines will be built earlier than the other two to serve as a back-up source of construction power.

- Four 4-km (2.5 miles) long unit lines transmitting power from the seven generators located at the Keeyask Generating Station to the switching station.

A 60 to 70 metre (197 to 230 ft) right-of-way width will be required for the single transmission line proposed. The three parallel lines proposed between the Keeyask Switching Station and Radisson Converter Station will require a 200 metres (656 ft) right-of-way width. Map 5 and Map 6 show the right-of-way width and not the alignment of the transmission lines. The alignments are shown in Map 12-1 to 12-11 – Keeyask Project – Elevation Contours.

Based on prior design experience in northern Manitoba, guyed lattice steel structures have been identified as the preliminary design standard for straight (tangent) sections of the transmission lines. Guyed structures provide flexibility for tower construction and maintenance in difficult foundation and terrain conditions. Self-supporting lattice steel structures will be used for all angle or dead-end tower locations.

The typical lattice angle anchor structure is based on a single point foundation, stabilized by four guy wires placed diagonally to the route of the line. The tangent structures will be approximately 38 m (125 ft) in height. Taller structures with larger footprints will be used where warranted by land use or conditions. The typical lattice angle anchor structure has four legs requiring individual foundations and a footprint approximately 15 m^2 (161 ft^2). The typical structure height is approximately 30 m (98 ft). The average span between structures will be approximately 420 m (1,378 ft), resulting in approximately 2.4 structures per kilometer (or 3.8 structures per mile).

(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 Needs For Alternatives To (NFAT) Report submission of August, 2013, the total in-service cost of the Keeyask Project, including the Generating Station and associated infrastructure and transmission facilities, is estimated to be $6.5 billion, including interest and escalation, and represents the current best estimate.

(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 Conservation and Water Stewardship at the time of submission of this report. The above information is maintained on file by the Partnership 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.

Neighboring works consist of the following and referenced in Figure 60, Figure 61 and Figure 62:

- Manitoba Hydro's Kelsey Generating Station, approximately 92 km (57 miles) upstream on the Nelson River. The forebay's minimum and maximum water levels are 182.3 m and 184.4 m (605 ft); and,
- Manitoba Hydro's Kettle Generating Station, approximately 35 km (22 miles) downstream on the Nelson River. Normal reservoir elevations during summer as well as winter maximum and minimum are 139.6 m, 141.1 m and 138.1 m (458 ft, 463 ft and 453 ft), respectively. Maximum tailwater elevation is 372 ft, while minimum tailwater elevation (3 units operating at rated head and full gate flow of 13,600 CFS per unit) is 351 ft.

All elevations are above sea level.

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]

5900345 Manitoba Ltd., on behalf of Keeyask Hydropower Limited Partnership (KHLP) has been directed to provide 11” by 17” 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) unless otherwise stated.

Basic horizontal survey control was established in the winter of 1987/88 with Global Positioning System (GPS) Surveys for the reach of the Nelson River from Stephens Lake to Split Lake. The datum used was North American Datum 1927 (NAD27) with coordinates referenced in Universal Transverse Mercator (UTM) Zone 15. Additional control was installed in subsequent years utilizing a combination of GPS and conventional traverse surveys. The datum used for the work areas was North American Datum 1983 (Canadian Spatial Reference System), or NAD83(CSRS), UTM Zone 15.

Vertical survey control for Keeyask Generating Station is based on the following datum:

Geodetic Survey of Canada, Canadian Geodetic Vertical Datum 1928, 1929 Adjustment (Generating Station of C, CGVD28, 1929 Adjustment).

The KHLP and Manitoba Hydro have been acquiring and/or producing mapping and ortho imagery in the proposed Keeyask Generating Station project area since

1962. The mapping and imagery was acquired and produced using a variety of technologies and techniques over the years. These technologies and techniques have evolved over the years, increasing the level of accuracy and subsequently the use of the data. The main change in technology was the migration from working in an analogue process to a digital process.

Contour maps were developed using Lidar (Light Detection and Ranging) datasets, which were commissioned in 2010 through Manitoba Hydro’s Engineering Survey Services (ESS) and Geospatial Data Services (GDS), as an addition to the Bipole III Transmission Line Project Aerial Lidar/Ortho Imagery Surveys. The data is currently archived in Manitoba Hydro’s Geospatial Data Warehouse and managed by Geospatial Data Services (GDS).

The following section lists all figures and maps referenced in this document, along with the corresponding Manitoba Hydro reference numbers and Conservation and Water Stewardship file numbers.

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LIST OF FIGURES AND MAPS

Figure Number	Figure Title	Figure Reference Number	Conservation Water Stewardship File number
	ARRANGEMENT		
18	BASIS FOR DESIGN GENERAL ARRANGEMENT CAUSEWAYS - PLANS, SECTIONS, & DETAIL	1-00195-DE-06200-0062-0001	WULS-1-00195-DE-06200-0062-0001
19	BASIS FOR DESIGN GENERAL ARRANGEMENT CONSTRUCTION DIVERSION AND STAGING	1-00195-DE-06200-0014-0001	WULS-1-00195-DE-06200-0014-0001
20	BASIS FOR DESIGN GENERAL ARRANGEMENT COFFERDAM SECTIONS	1-00195-DE-06200-0015-0001	WULS-1-00195-DE-06200-0015-0001
21	STAGE I COFFERDAMS STAGE I DIVERSION PLAN	1-00195-DE-11430-0001-0001	WULS-1-00195-DE-11430-0001-0001
22	STAGE I COFFERDAMS QUARRY COFFERDAM PLAN AND SECTION	1-00195-DE-21600-0002-0001	WULS-1-00195-DE-21600-0002-0001
23	STAGE I COFFERDAMS NORTH CHANNEL STAGE I COFFERDAM PLAN AND SECTIONS	1-00195-DE-21600-0003-0001	WULS-1-00195-DE-21600-0003-0001
24	STAGE I COFFERDAMS NORTH CHANNEL ROCK GROIN PLAN AND SECTIONS	1-00195-DE-21600-0004-0001	WULS-1-00195-DE-21600-0004-0001
25	STAGE I COFFERDAMS STAGE I ISLAND COFFERDAM PLAN, SECTION AND DETAILS	1-00195-DE-21600-0005-0001	WULS-1-00195-DE-21600-0005-0001
26	STAGE I COFFERDAMS SPILLWAY STAGE 1 COFFERDAM PLAN, SECTIONS, PROFILES & DETAIL	1-00195-DE-21600-0006-0001	WULS-1-00195-DE-21600-0006-0001
27	STAGE I COFFERDAMS SPILLWAY STAGE 1 COFFERDAM PLAN, SECTIONS, PROFILES & DETAIL	1-00195-DE-21600-0006-0002	WULS-1-00195-DE-21600-0006-0002
28	STAGE I COFFERDAMS POWERHOUSE STAGE 1 COFFERDAM, PLANS, SECTION & DETAIL	1-00195-DE-21600-0007-0001	WULS-1-00195-DE-21600-0007-0001
29	STAGE I COFFERDAMS CENTRAL DAM STAGE I COFFERDAM PLAN SECTION AND DETAILS	1-00195-DE-21600-0008-0001	WULS-1-00195-DE-21600-0008-0001
30	BASIS FOR DESIGN GENERAL ARRANGEMENT NORTH AND CENTRAL DAM - SECTIONS	1-00195-DE-06200-0043-0001	WULS-1-00195-DE-06200-0043-0001
31	BASIS FOR DESIGN GENERAL ARRANGEMENT SOUTH DAM – SECTIONS AND PROFILE	1-00195-DE-06200-0044-0001	WULS-1-00195-DE-06200-0044-0001
32	BASIS FOR DESIGN GENERAL ARRANGEMENT NORTH AND SOUTH DYKES AND ROAD - SECTIONS	1-00195-DE-06200-0045-0001	WULS-1-00195-DE-06200-0045-0001
33	BASIS FOR DESIGN GENERAL ARRANGEMENT TRANSMISSION TOWER SPUR - PLAN, SECTIONS AND DETAILS	1-00195-DE-06200-0055-0001	WULS-1-00195-DE-06200-0055-0001
34	BASIS FOR DESIGN GENERAL ARRANGEMENT FOREBAY IMPROVEMENT AREAS PLAN	1-00195-DE-06200-0057-0001	WULS-1-00195-DE-06200-0057-0001
35	CONCRETE STRUCTURES - EXCAVATION	1-00195-DE-06200-0016-0001	WULS-1-00195-DE-06200-0016-0001
36	BASIS FOR DESIGN GENERAL	1-00195-DE-06200-0017-0001	WULS-1-00195-DE-06200-0017-0001

Figure Number	Figure Title	Figure Reference Number	Conservation Water Stewardship File number
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38	SERVICE BAY CROSS SECTION	1-00195-DE-06200-0029-0001	WULS-1-00195-DE-06200-0029-0001
39	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE UNITS 1 TO 7 DEWATERING GALLERY PLAN	1-00195-DE-06200-0020-0001	WULS-1-00195-DE-06200-0020-0001
40	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE UNITS 1 TO 3 PLAN AT CENTERLINE OF DISTRIBUTER	1-00195-DE-06200-0021-0001	WULS-1-00195-DE-06200-0021-0001
41	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE UNITS 4 TO 7 PLAN AT CENTERLINE OF DISTRIBUTER	1-00195-DE-06200-0022-0001	WULS-1-00195-DE-06200-0022-0001
42	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE UNITS 1 TO 3 PLAN AT GENERATOR FLOOR	1-00195-DE-06200-0025-0001	WULS-1-00195-DE-06200-0025-0001
43	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE UNITS 4 TO 7 PLAN AT GENERATOR FLOOR	1-00195-DE-06200-0026-0001	WULS-1-00195-DE-06200-0026-0001
44	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE LONGITUDINAL SECTION	1-00195-DE-06200-0027-0001	WULS-1-00195-DE-06200-0027-0001
45	BASIS FOR DESIGN GENERAL ARRANGEMENT SERVICE BAY PLANS AT EL 126.6 & EL 141.7	1-00195-DE-06200-0030-0001	WULS-1-00195-DE-06200-0030-0001
46	BASIS FOR DESIGN GENERAL ARRANGEMENT SERVICE BAY PLANS AT EL 146.6 & EL 152.1	1-00195-DE-06200-0031-0001	WULS-1-00195-DE-06200-0031-0001
47	BASIS FOR DESIGN GENERAL ARRANGEMENT SERVICE BAY PLANS AT EL 157.0, EL 161.8 & 173.5	1-00195-DE-06200-0032-0001	WULS-1-00195-DE-06200-0032-0001
48	BASIS FOR DESIGN GENERAL ARRANGEMENT SPILLWAY PLAN	1-00195-DE-06200-0033-0001	WULS-1-00195-DE-06200-0033-0001
49	BASIS FOR DESIGN GENERAL ARRANGEMENT SPILLWAY DIVERSION STAGE CROSS SECTION	1-00195-DE-06200-0034-0001	WULS-1-00195-DE-06200-0034-0001
50	BASIS FOR DESIGN GENERAL ARRANGEMENT SPILLWAY FINAL CONFIGURATION CROSS SECTION	1-00195-DE-06200-0035-0001	WULS-1-00195-DE-06200-0035-0001
51	BASIS FOR DESIGN GENERAL ARRANGEMENT SPILLWAY ELEVATION	1-00195-DE-06200-0036-0001	WULS-1-00195-DE-06200-0036-0001
52	BASIS FOR DESIGN GENERAL ARRANGEMENT POWERHOUSE TRANSITION STRUCTURES - PLANS & SECTIONS	1-00195-DE-06200-0037-0001	WULS-1-00195-DE-06200-0037-0001
53	BASIS FOR DESIGN GENERAL	1-00195-DE-06200-0038-0001	WULS-1-00195-DE-06200-0038-0001

Figure Number	Figure Title	Figure Reference Number	Conservation Water Stewardship File number
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54	BASIS FOR DESIGN GENERAL ARRANGEMENT SOUTH TRANSITION - SECTIONS	1-00195-DE-06200-0039-0001	WULS-1-00195-DE-06200-0039-0001
55	BASIS FOR DESIGN GENERAL ARRANGEMENT SPILLWAY TRANSITION STRUCTURES PLANS & SECTIONS	1-00195-DE-06200-0040-0001	WULS-1-00195-DE-06200-0040-0001
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62	KELSEY GENERATING STATION GENERAL ARRANGEMENT OF DEVELOPMENT	1-00111-DD-10100-0004-0001	WULS-1-00111-DD-10100-0004-0001
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64	NORTH ACCESS ROAD – SITE ACCESS ROAD (B) KEY PLAN	1-00195-DE-16100-0001 0001	WULS-1-00195-DE-16100-0001 0001
65	SOUTH ACCESS ROAD – GENERAL ARRANGEMENT	1-00195-DE-16100-0006 0001	WULS-1-00195-DE-16100-0006 0001

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1	Project Location	1-00195-07310-D-0001_0001	WULS-1-00195-07310-D-0001_0001
2	Excavated Material Placement Areas	1-00195-07310-D-0002_0001	WULS-1-00195-07310-D-0002_0001
3	Keeyask Generating Station WPA Survey Permit – Location of Field Exploration Studies	1-00195-07310-D-0003_0001	WULS-1-00195-07310-D-0003_0001
4	Keeyask Land Acquisition Master Plan	1-00195-07310-D-0004_0001	WULS-1-00195-07310-D-0004_0001
5	Keeyask Transmission Project Preliminary Transmission Corridors During Keeyask Generation Project Construction Phase	1-00195-07310-D-0005_0001	WULS-1-00195-07310-D-0005_0001
6	Keeyask Transmission Project Preliminary Transmission Corridors During Keeyask Generation Project Operation Phase	1-00195-07310-D-0006_0001	WULS-1-00195-07310-D-0006_0001
7	Keeyask Lands Requiered During Construction – Full Extent	1-00195-07310-D-0007_0001	WULS-1-00195-07310-D-0007_0001
8	Keeyask Lands Required During Construction – Site Level	1-00195-07310-D-0008_0001	WULS-1-00195-07310-D-0008_0001
9	Keeyask Lands Requiered During Operation – Full Extent	1-00195-07310-D-0009_0001	WULS-1-00195-07310-D-0009_0001
10	Keeyask Lands Required During Operation – Site Level	1-00195-07310-D-0010_0001	WULS-1-00195-07310-D-0010_0001
11	Keeyask Generating Station Elevation Contours and Bathymetry	1-00195-07310-D-0011_0001	WULS-1-00195-07310-D-0011_0001
12-1 to 12-11	Keeyask Project – Elevation Contours	Not Available	Not Available

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GLOSSARY

Aboriginal traditional knowledge (ATK): Aboriginal traditional knowledge is knowledge that is held by, and unique to, Aboriginal peoples. It is a living bit of knowledge that is cumulative and dynamic and adapted over time to reflect changes in the social, economic, environmental, spiritual and political spheres of the Aboriginal knowledge holders. It often includes knowledge about the land and its resources, spiritual beliefs, language, mythology, culture, laws, customs and medicines (Canadian Environmental Assessment Act).

Above sea level (ASL): Elevations are referenced to Geodetic Survey of Canada, Canadian Geodetic Vertical Datum 1928, GS of C, CGVD28, 1929 Adjustment.

Adaptive management: The implementation of new or modified mitigation measures over the construction and operation phases of a project to address unanticipated environmental effects. The need for the implementation of adaptive management measures may be determined through an **effective follow-up program.**

Average annual energy: The average amount of energy generated by a power plant over one year, usually reported in megawatt hours or gigawatt hours.

Base Loaded Mode of Operation: A generating station mode of operation based on a constant forebay elevation and gradual flow changes in response to changing inflows.

Bedrock: A general term for any solid rock, not exhibiting soil-like properties, that underlies soil or other surface materials.

Best gate: The wicket gate setting at which a hydraulic turbine operates most efficiently. The wicket gates are the main flow control to the turbine.

Boreal: Of or relating to the cold, northern, circumpolar area just south of the tundra, dominated by coniferous trees such as spruce, fir, or pine. Also called taiga.

Bridge deck: The travelling surface of a bridge structure.

Camp: A temporary residence for employees working on a construction project at a remote location, consisting of bunkhouse dormitories, a kitchen and other facilities.

Canadian Shield: A broad region of Precambrian rock that encircles Hudson Bay. In total it covers 8 million km^2 and is made up of some of the planet's oldest rock, largely granite and gneiss.

Cantilevered: A cantilever is a beam anchored at only one end. Cantilevered construction allows for overhanging structures without external bracing.

Churchill River Diversion (CRD): The diversion of water from the Churchill River to the Nelson River via and the impoundment of water on Southern Indian Lake as authorized by the CRD Licence.

Cofferdam: A temporary dam, usually made of rockfill and earth, constructed around a work site in the river, so the work site can be dewatered or the water level controlled during construction.

Concrete: A mixture of sand, gravel, water and cement which hardens to a stone like condition when dry, capable of bearing significant load.

Construction power: The electrical requirements during the construction of the project, including the camp, batch plants, cranes, heaters and other equipment.

Construction design flood (CDF): The flow magnitude used to determine the design parameters (i.e. design crest elevations, rock sizes, etc) for all instream structures during the construction phase project.

CNP: See **Cree Nation Partners.**

Cree Nation Partners (CNP): A partnership between Tataskewayk Cree Nation and War Lake First Nation.

Crest: The top surface of a dam or roadway, or the high point of the spillway overflow section.

Dam: A barrier built to hold back water.

Datum: A reference point for measuring elevations.

Dewater: Removing the water from or draining an area behind a cofferdam so that construction activities can be undertaken.

Draft tube: The part of the water passage immediately downstream of a turbine runner, through which the water exits the powerhouse into the tailrace.

Drawdown: Lowering a reservoir by discharging more flow than is coming into it.

Dyke: An earth embankment constructed to contain the water in the reservoir and limit the extent of flooding.

Egress: A means or place of going out; an exit.

EIS: See **Environmental Impact Statement**.

Energy: The capacity of an electric generating station to do work, usually measured in megawatts.

Environment: The components of the Earth and includes: a) land, water and air, including all layers of the atmosphere, b) all organic and inorganic matter and living organisms, and c) the interacting natural systems that include components referred to in paragraphs a) and b) (Canadian Environmental Assessment Act).

Environmental Assessment (EA): Process for identifying project and environment interactions, predicting environmental effects, identifying mitigation measures, evaluating significance, reporting and following-up to verify accuracy and effectiveness leading to the production of an Environmental Assessment report. EA is used as a planning tool to help guide decision making, as well as project design and implementation.

Environmental effect: In respect of a project, a) any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act, b) any effect of any change referred to in paragraph a) on i) health and socio-economic conditions, ii) physical and cultural heritage, iii) the current use of lands and resources for traditional purposes by Aboriginal persons, or iv. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or any change to the project that may be caused by the environment; whether any such change or effect occurs within or outside Canada (Canadian

Environmental Assessment Act).

Environmental Impact Statement (EIS): A document that presents the findings of an environmental assessment in response to specific guidelines or terms or reference. The term EIS is often used in the context of an assessment by a review panel and in the environmental assessment regimes of other jurisdictions.

Environmental monitoring: Periodic or continuous surveillance or testing, according to a pre-determined schedule, of one or more environmental components. Monitoring is usually conducted to determine the level of compliance with stated requirements, or to observe the status and trends of a particular environmental component over time.

Environmental Protection Program (EPP): Provides a framework for delivery, management and monitoring of environmental protection activities in keeping with issues identified in the environmental assessment, regulatory requirements and public expectation.

Erosion: A natural process, which is either naturally occurring or anthropogenic in origin, by which the Earth's surface is worn away by the actions of water and wind.

Fill: Natural soils or loose rock that may or may not have been processed and are placed to construct an earth fill structure or to construct a grade, dyke or dam.

Footprint: The surface area occupied by a structure or activity; the land or water area covered by a project. This includes direct physical coverage (*i.e.*, the area on which the project physically stands) and direct effects (*i.e.*, the disturbances that may directly emanate from the project, such as noise). (Cumulative Effects Assessment)

Forebay: Impoundment area immediately upstream from a dam or hydroelectric plant intake structure that forms the downstream portion of the reservoir. The term “reservoir” is used throughout this document to describe the entire reservoir, including the forebay.

Frazil ice: Fine, small, needle-like structures of thin, flat circular plates of ice formed in super-cooled, turbulent water.

Freeboard: The amount of watertight surface between a given level of lake, sea or river water and the lowest possible entry point during flooding or large waves

Full gate discharge: The maximum possible flow through a single hydraulic turbine at a turbine efficiency that is normally less than at best gate discharge.

Full supply level (FSL): The normal maximum controlled level of the forebay (reservoir).

Generating station (GS): A complex of structures used for the production of electricity, including a powerhouse, spillway, dam(s), transition structures and dykes.

Generator: Machine that coverts mechanical energy into electrical energy.

Gigawatt (GW): One billion watts (1,000,000,000 watts) of electricity.

Glacial till: Material deposited by glaciers, usually composed of a wide range of particle sizes, which has not been subjected to the sorting action of water.

Granular: Composed of granules or grains of sand or gravel.

Granular fill: Fill material including sand and gravel.

Groin: A rock fill structure extending out into a river or lake from the bank or shore. Used to protect the bank from erosion.

Grouting: Filling cracks and crevices with a slurry composed of a cement and sand mixture or other material to prevent or reduce flow through them.

Guides: Steel channels embedded in concrete, used to guide gates when they are raised or lowered.

Hectares: A metric unit of square measure equal to 10,000 square metres or 2.471 acres.

Head: Refers to the hydraulic elevation head at a generating station which is calculated as the difference between the water level upstream of the station (forebay level) and the water level downstream (tailrace level) measured in meters. The amount of hydraulic head results in a specific amount of pressure that would be applied to the turbines to generate power due to the weight of the water.

Hydraulic: 1) of or relating to liquid in motion; and, 2) of or relating to the pressure created by forcing a liquid through a relatively small orifice, pipe, or other small channel.

Hydroelectric: Electricity produced by converting the energy of falling water into electrical energy (i.e. at a hydro generating station).

Impoundment: The containment of a body of water by a dam, dyke, powerhouse, spillway or other artificial barrier.

Impervious core: A zone of low **permeability** material in an earth dam used to prevent or reduce water flowing through the dam. In northern Manitoba the impervious core of a dam is often composed of glacial till.

Impervious fill: Fill that has low permeability (usually clay) and used in an embankment structure to reduce leakage through the dam. It can also be used as a liner of a pond or lagoon to prevent leakage into the surrounding area.

Inflow Design Flood (IDF): The most severe inflow flood for which a dam and its associated facilities are designed to safely pass without damaging or overtopping the principle structures.

Infrastructure: Permanent or temporary structures or features required for the construction and operation of the principal structures, including access roads, construction camps, construction power, batch plant and cofferdams.

Integrated Power System: means the system of hydraulic, thermal and other electric generation and power transmission facilities in the Province of Manitoba owned and operated or operated by Manitoba Hydro or from which Manitoba Hydro purchases the energy generated by that facility, which system is interconnected with other power systems, which for greater certainty does not include the transmission lines interconnecting such system with the other power systems.

Inundated: Land covered by water which is not normally covered by water.

Lacustrine: Of or having to do with lakes, and used herein in reference to soils deposited as sediments in a lake.

Lake Winnipeg Regulation (LWR): The LWR project was constructed by Manitoba Hydro in the 1970s to regulate the outflow from Lake Winnipeg to the

Nelson River and store water in the lake as authorized by the LWR Licence. The project includes three excavated channels, the Jenpeg generating station and control structure and a dam at Kiskitto Lake. Lake Winnipeg is regulated for hydropower generation and flood control.

Megawatt (MW): A unit of power equal to one million watts. One megawatt is enough to power approximately 50 typical homes in Manitoba.

Minimum operating level (MOL): The normal minimum controlled level of the forebay.

Mitigation: A means of reducing adverse Project effects. Under CEAA, mitigation is "the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means."

Mode of operation: The method of operating a generating station for meeting electrical demands. The operation method, or mode, will determine the pattern of the outflows from the powerhouse.

Modified peaking plant: A plant with a mode of operation that includes either a peaking mode of operation with a weekly cycling pattern or a base-loaded mode of operation.

Monitoring: Continuing assessment of conditions at and surrounding an activity. This determines if effects occur as predicted or if effects during the construction and operations phases remain within acceptable limits and if mitigation measures are as effective as predicted.

MW (Megawatts): A unit of power equal to one million watts. One megawatt is enough to power 50 average homes.

Organic: The compounds formed by living organisms.

Overburden: Soil (including organic material) or loose material overlaying bedrock.

Parameter: Characteristics or factor; aspect; element; a variable given a specific value.

Peaking: For the purposes of the EIS, the mode of operation that begins with reducing the flow through the generating station during off-peak periods (night time), thereby storing some water in the reservoir, and then increasing the flow and using the stored water to generate extra energy during on-peak periods (daytime).

Peatland: Wetland where organic material has accumulated because dead plant material production exceeds decomposition.

Peatland disintegration: Processes related to flooded peat resurfacing; breakdown of non-flooded and resurfaced peatlands and peat mats; and peat formation on peatlands and peat mats that have hydrological connections to a regulated area.

Permafrost: Ground where the temperature remains below 0°C for two or more consecutive years.

Permeability: The degree to which fluids or gases can pass through a barrier or material.

Plant discharge: Rate of flow of water that passes through the powerhouse and spillway combined.

Power: The instantaneous amount of electrical energy generated at a hydroelectric generating station, usually expressed in megawatts.

Powerhouse: Structure that houses turbines, generators, and associated control equipment, including the intake, scroll case and draft tube.

Precambrian bedrock: Bedrock formed in the Precambrian era, which began with the consolidation of the earth's crust and ended approximately 4,000 million years ago.

Primary structures: The main structures of a hydroelectric development that when combined, work together to contain the water on the upstream side of the structures so that the flow can be directed through the intake gates towards the turbines which turn the generator.

Probable Maximum Flood (PMF): is the flood that would result from the most severe combination of hydrologic and meteorological conditions that could reasonably occur. It is based on analyses of precipitation, snowmelt and other factors conducive to producing maximum flows.

Project component: A component of the project that may have an effect on the environment. Example project components include access road, construction camp, wastewater treatment facility, etc.

Project Footprint: The maximum potential spatial extent of clearing, flooding and physical disturbances due to construction activities and operation of the Project, including areas unlikely to be used.

Rated capacity: The maximum power that a generator is designed to deliver without exceeding mechanical safety factors or allowable temperatures.

Reach: A section, portion or length of river.

Relief: Variation in elevation on the surface of the earth.

Reservoir: A body of water impounded by a dam and in which water can be stored for later use. The reservoir includes the forebay.

Resource Management Area (RMA): An area to be jointly managed by a Resource Management Board established by agreement between Manitoba and a First Nation or a local Aboriginal community.

Right-of-Way (ROW): Area of land controlled or maintained for the development of a road, pipeline or transmission line.

Riprap: A layer of large stones, broken rock, boulders, or other suitable material generally placed in random fashion on the upstream and downstream faces of embankments, or other land surfaces to protect them from erosion or scour caused by current, waves, and/or ice action.

RMA: See **Resource Management Area.**

Rock groin: A rock fill structure extending out into a river or lake from the bank or shore. Used to protect the bank from erosion.

Rollway: The concrete portion of the spillway that water flows over when the spillway is in operation.

ROW: see Right-of-Way

Runner: The part of a turbine upon which water impinges, causing the turbine shaft to rotate.

Semi-spiral scroll case: A reinforced concrete semi-spiral part of the turbine water passage, located between the intake and the turbine runner, with a gradually contracting cross-section (much like a snail shell), designed to distribute the water evenly over the turbine runner.

Service bay: An open area of the powerhouse where turbine and generator components are assembled during construction, and later, where maintenance and repairs are performed to major generating equipment.

Service gate: Gates that are used to dewater a unit to allow inspections, maintenance and repairs to occur within the water passage.

Shore: The narrow strip of land in immediate contact with the sea, lake or river.

SLRMA: See **Split Lake Resource Management Area.**

Sluice: Control water levels and flow rates in rivers and canals.

Spillway: A concrete structure that is used to pass excess flow so that the dam, dykes, and the powerhouse are protected from overtopping and failure when inflows exceed the discharge capacity of the powerhouse.

Split Lake Resource Management Area (SLRMA): Formed by a Comprehensive Implementation Agreement between Tataskweyak Cree Nation and Manitoba in 1992 the area covers about 4,150 ha in northern Manitoba.

Stage: A point, period, phase or step in a process or development.

Stop logs: Fabricated steel units, designed to be placed horizontally on top of one another while fitting tightly into guides at their ends and sealing against a frame so as to close a water passage in a dam or spillway.

Stratigraphy: Scientific study of rock strata, especially the distribution, deposition, correlation, and age of sedimentary rocks.

Sub-grade drilling: Extra depth drilled below the grade level to assure that the full face of the rock can be broken to the desired excavation level.

Surcharge: A condition in a forebay in which the water level rises above the full supply level.

Switching Station: A facility used to terminate transmission lines operating at the same voltage, and enable individual lines to be taken out of service or connected to other lines to redirect or control the flow of power.

Tailrace: A channel immediately downstream from a powerhouse that directs the water away from the turbine and into the river channel.

Tailwater: Water located in the powerhouse tailrace area or area immediately downstream of the powerhouse.

Till: An unstratified, unconsolidated mass of boulders, pebbles, sand and mud deposited by the movement or melting of a glacier.

Transformer: A device which uses electromagnetic induction to transform electric energy in one circuit into energy of similar type in another circuit, but with different values of voltage and current.

Transition structure: A concrete structure that connects an earth structure such as a dyke or dam to a concrete structure such as the powerhouse or spillway.

Transmission: The electrical system used to transmit power from the generating station to customers.

Transmission line: A conductor or series of conductors used to transmit electricity from the generating station to a substation or between substations.

Transmission tower spur: A rock filled structure located in the river channel adjacent to the powerhouse that supports a transmission tower.

Turbine: A machine for converting the power of flowing water to rotary mechanical power that is then transferred by a large metal shaft to the generator for conversion to electric power.

Vertical datum: The elevation of a specific point on the earth's surface to which other elevations are referenced.

Vertical lift gates: Rectangular gates set in vertical guides which open by being lifted straight up, such as the intake gates or spillway gates.

Water regime: A description of water body (i.e., lake or river) with respect to water levels, flow rate, velocity, daily fluctuations, seasonal variations, etc.

Watt: A unit of electrical power.

Weir: A low dam built across a river to raise the level of water upstream or regulate its flow.

Wicket gate: A series of movable gates between the fixed stay vanes and the turbine runner that control the amount of water flowing through the turbine.