Keeyask Generation Project

Environmental Impact Statement

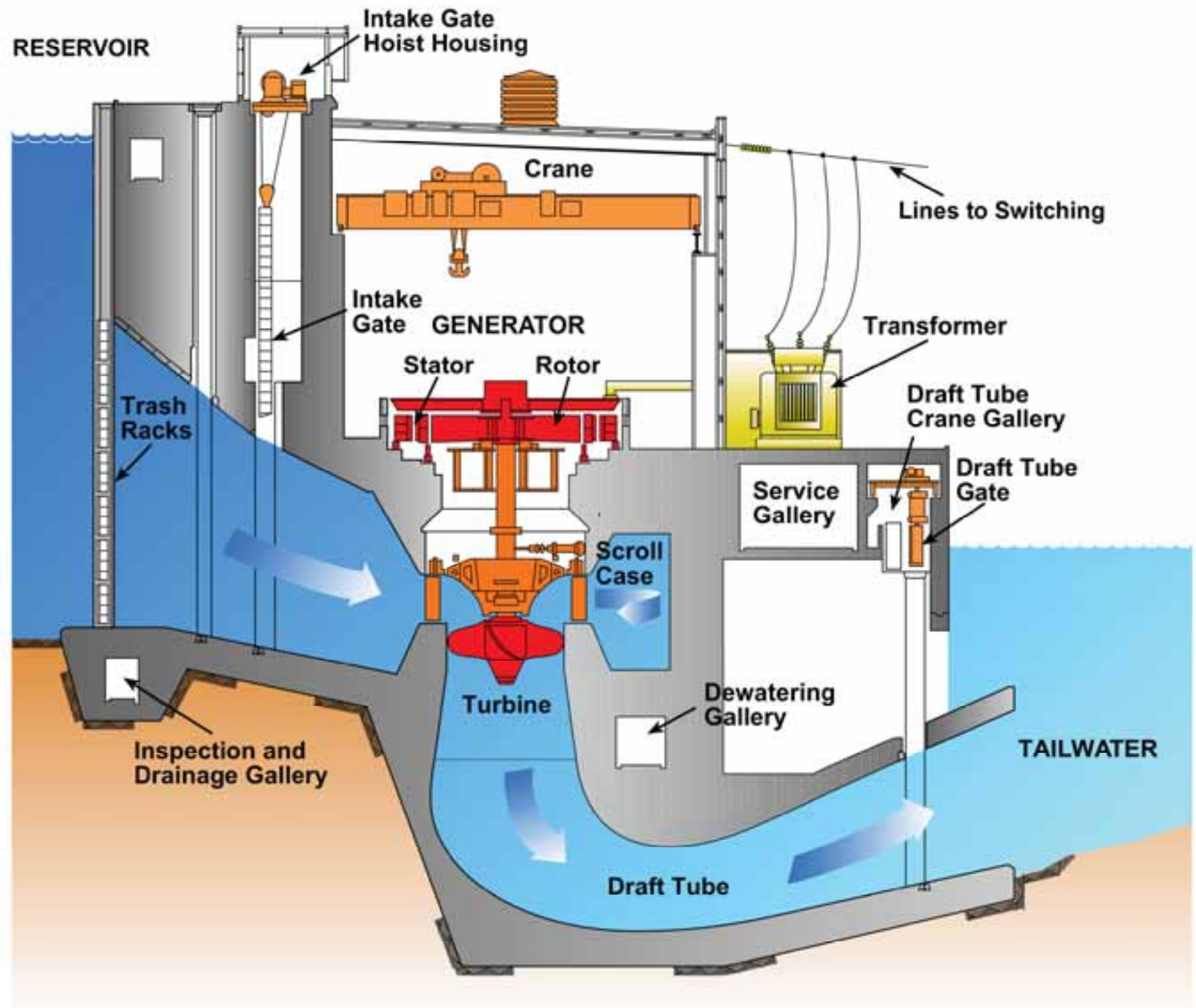
Supporting Volume

Project Description

KEEYASK

Hydropower Limited Partnership

June 2012



KEEYASK Hydropower Limited Partnership

DATA SOURCE:
Manitoba Hydro

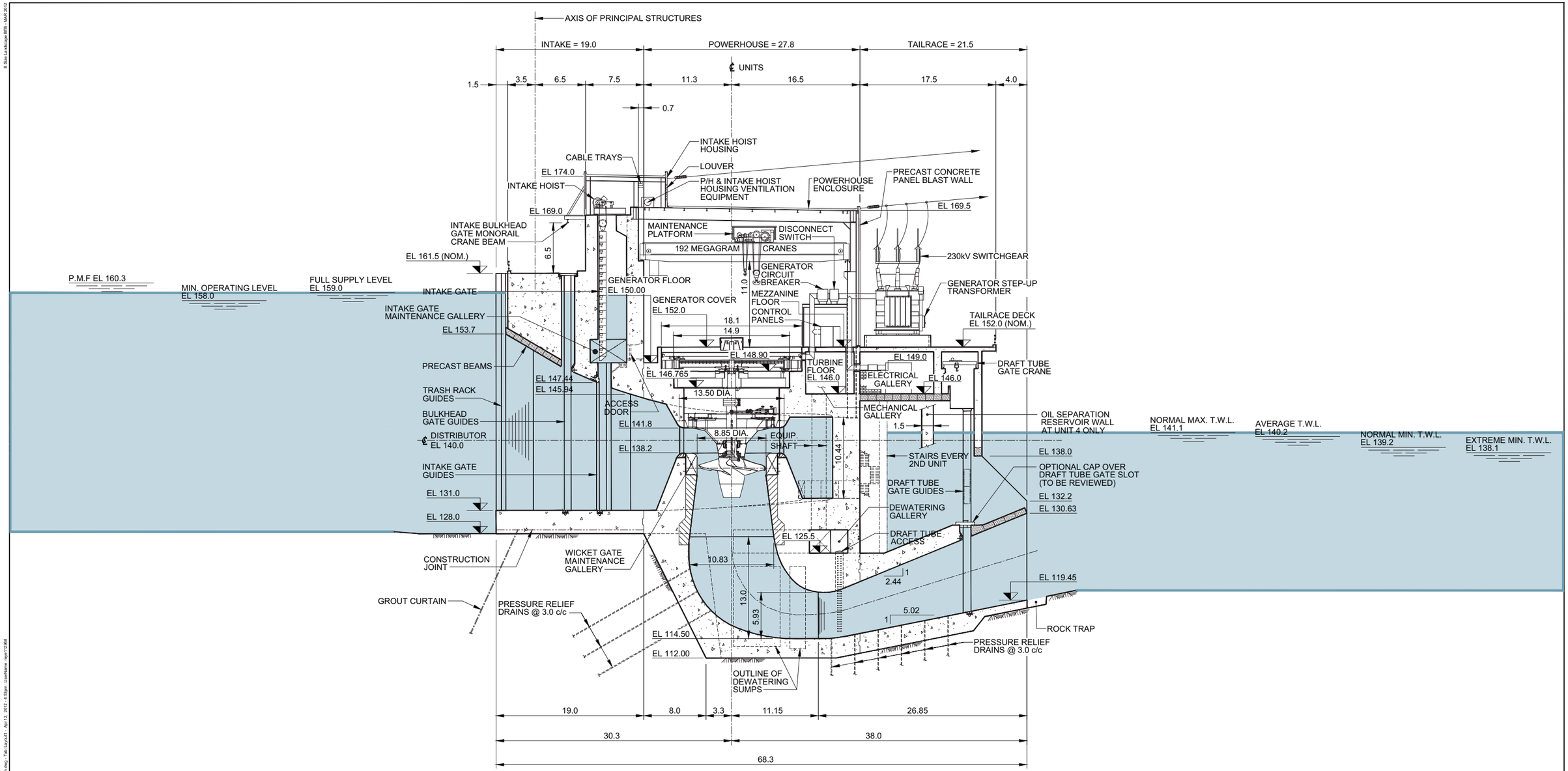
CREATED BY:
Manitoba Hydro - Hydro Power Planning - Keeyask & Burntwood Planning

NOTE(S):	DATE CREATED:	REVISION DATE:
Artist's Rendering - Concept Only	17-JAN-12	23-APR-12
	VERSION NO: 2.0	QA/QC: APPROVED

Typical Powerhouse Cross Section

Vertical Shaft Turbine

Figure 2-1



KEEYASK Hydropower Limited Partnership

DATA SOURCE: Drawing 1-00195-DE-06200-0018, Rev. 00.		
CREATED BY: KGS Acres		
COORDINATE SYSTEM: Not Applicable	DATE CREATED: 11-APR-12	REVISION DATE: 11-APR-12
SCALE: 1:500	VERSION NO: 1.0	QA/QC: APPROVED

Legend

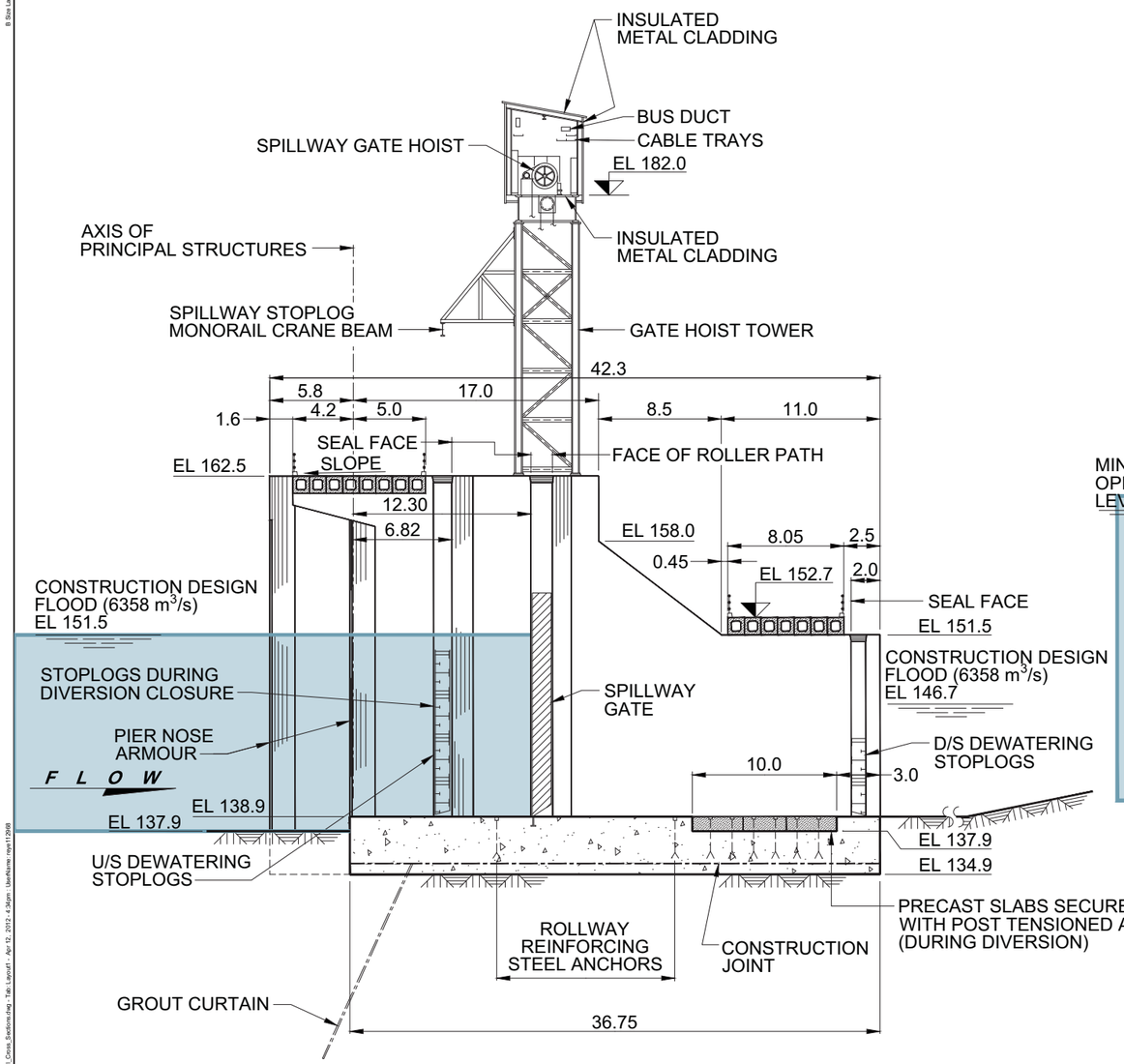
Water

Water Level

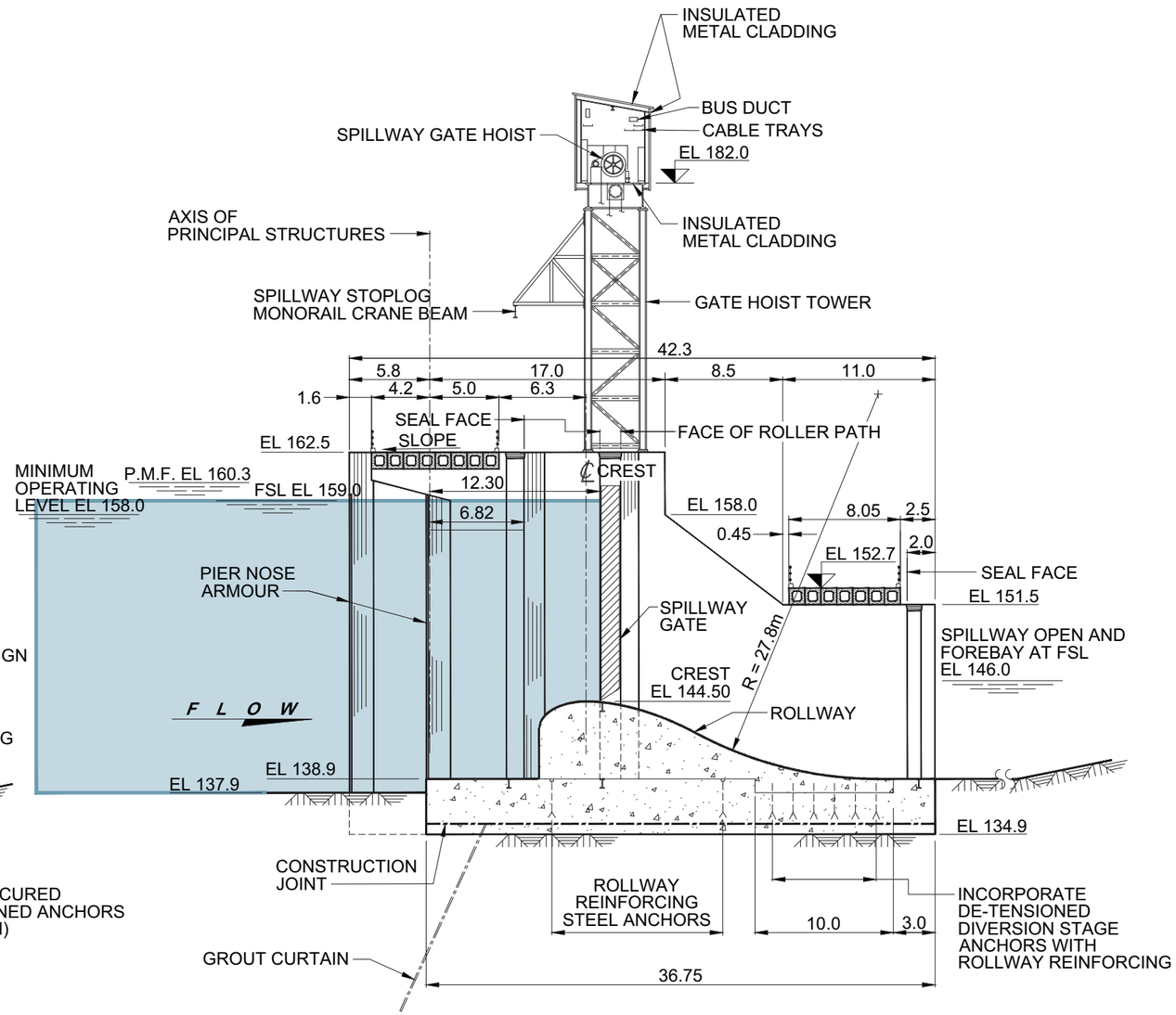
Infrastructure

Powerhouse Cross Section

Figure 2-2



SECTION
DURING DIVERSION CLOSURE



SECTION
FINAL CONFIGURATION

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Drawing 1-00195-DE-06200-0034 0001, Rev. 00. Drawing 1-00195-DE-06200-0035 0001, Rev. 00.		
CREATED BY: KGS Acres		
COORDINATE SYSTEM: Not Applicable	DATE CREATED: 12-APR-12	REVISION DATE: 12-APR-12
SCALE: 1:400	VERSION NO: 1.0	QA/QC: APPROVED

Legend

Water

Water Level

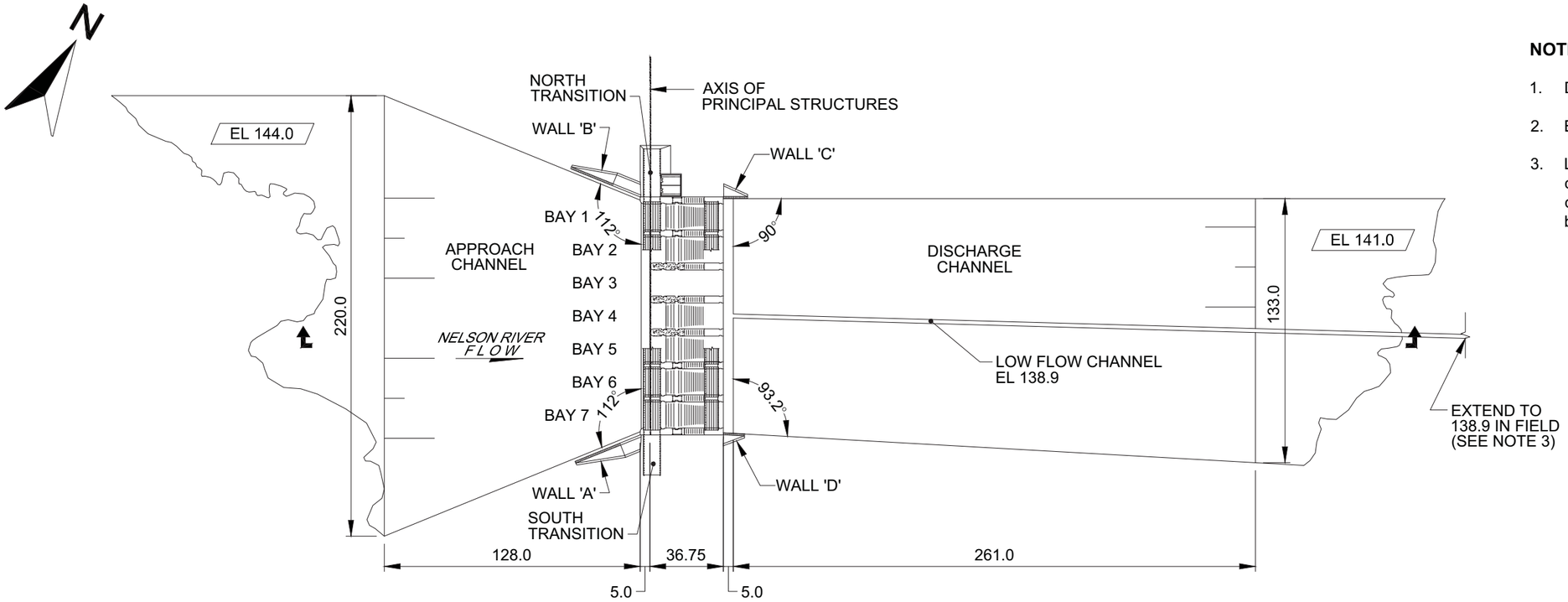
Infrastructure

Spillway

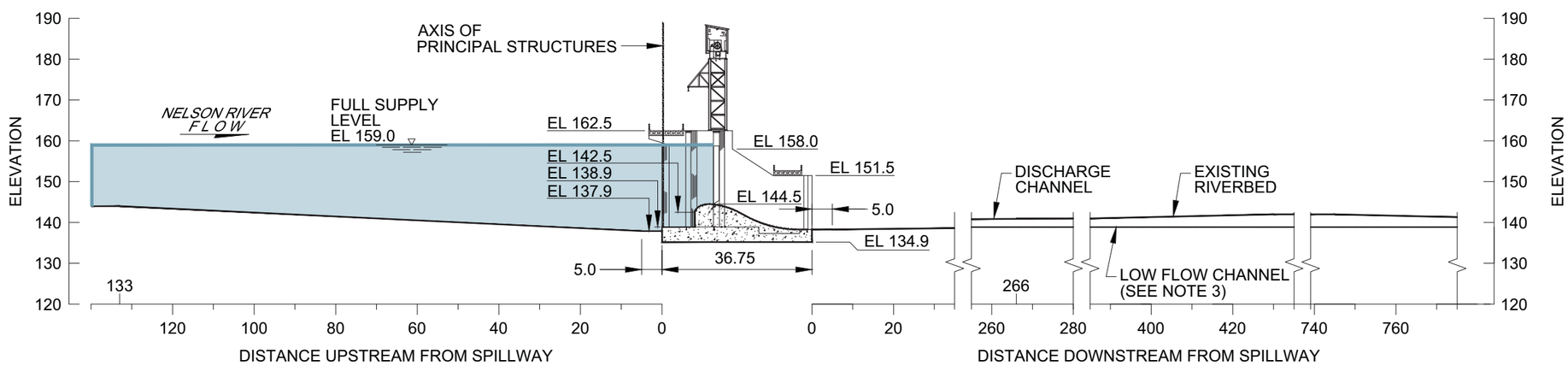
Diversion Stage and Final Configuration

Cross Sections

Figure 2-3



PLAN



SECTION

NOTES:

1. Dimensions, distances and elevations are in metres.
2. Elevations are based on CGVD 1928.
3. Low flow channel invert 138.9 m and 2 m wide. This channel is to connect into the river channel downstream of the discharge channel. Location to be determined in the field.

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Memorandum GN-4.3.6, Rev. 2, Figure 3.			
CREATED BY: KGS Acres			
COORDINATE SYSTEM: UTM NAD 1983 Z15N	DATE CREATED: 11-APR-12	REVISION DATE: 11-APR-12	
SCALE: PLAN 1:2500, SECTION 1:1250	VERSION NO: 1.0	QA/QC: APPROVED	

Legend

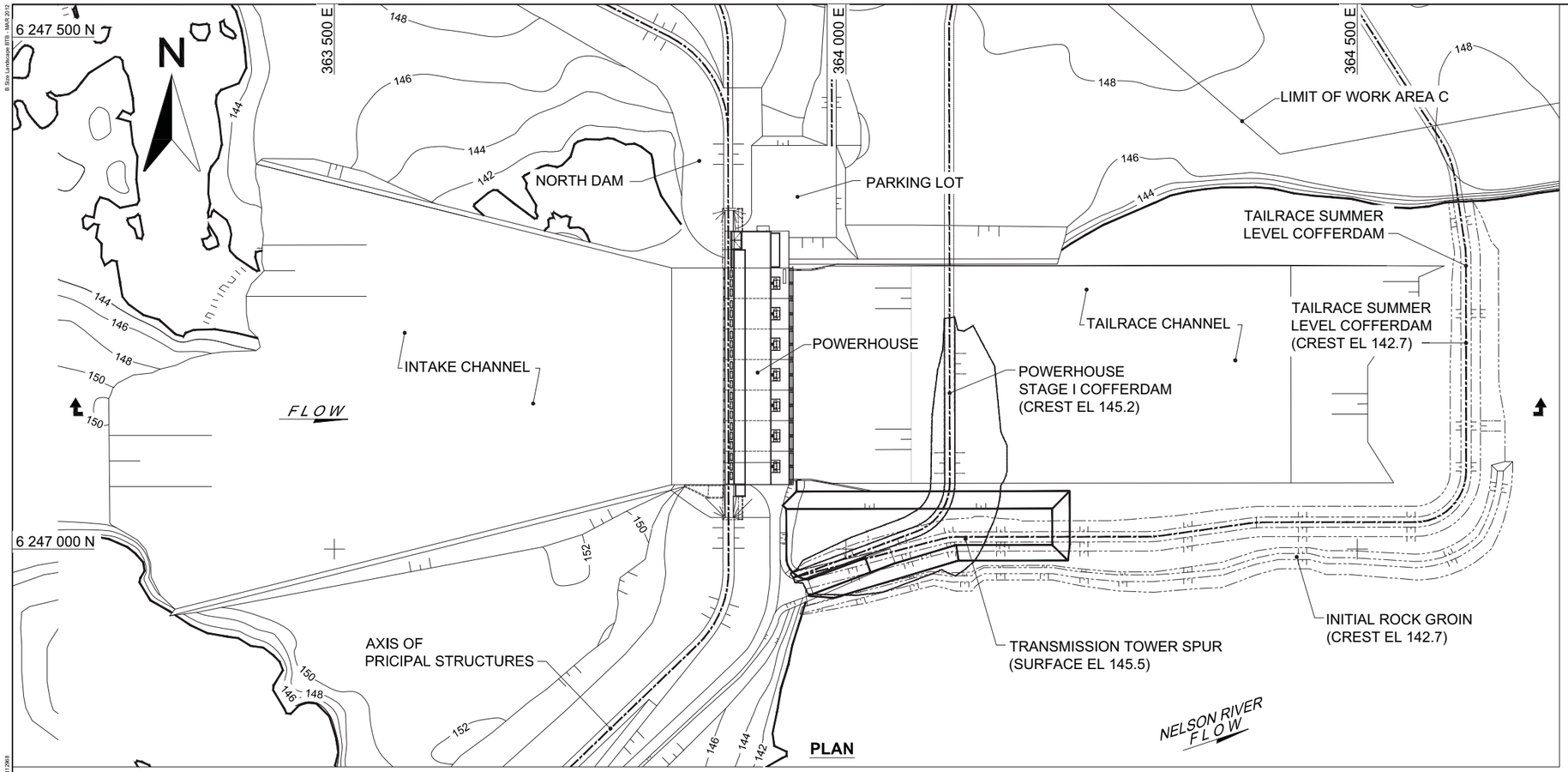
Water

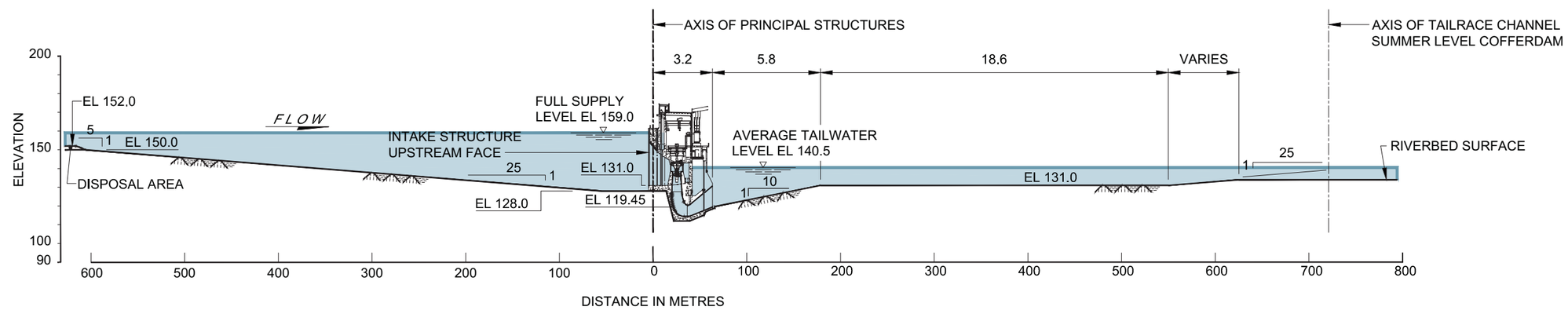
Water Level

Infrastructure

Spillway Approach and Discharge Channels Plan View and Cross Section

Figure 2-4





SECTION

NOTES:

1. Topography is based on mapping received from Manitoba Hydro May, 2000.
2. Mapping was produced using photogrammetric methods based on 1:20 000 scale photography dated October, 1986.
3. Coordinate grid shown is based on Universal Transverse Mercator Projection, Zone 15, North American Datum 1983.
4. Coordinates, distances and elevations are in metres.
5. Elevations are based on Canadian Government Vertical Datum 1928.
6. Water levels shown are approximate only and relate to the date of photography.
7. Contour interval is 2 metres.
8. Location and presentation of concrete and earthfill structures is preliminary.
9. This figure presents the minimum recommended cofferdam crest elevations based on hydraulic conditions; however, geotechnical requirements such as settlement and consolidation will need to be considered during final design.

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Memorandum GN-4.2.1.1, Rev. 0, Figure 12			
CREATED BY: KGS Acres			
COORDINATE SYSTEM: UTM NAD 1983 Z15N	DATE CREATED: 11-APR-12	REVISION DATE: 11-APR-12	
SCALE: 1:5000 1:2500 Vertical	VERSION NO: 1.0	QA/QC: APPROVED	

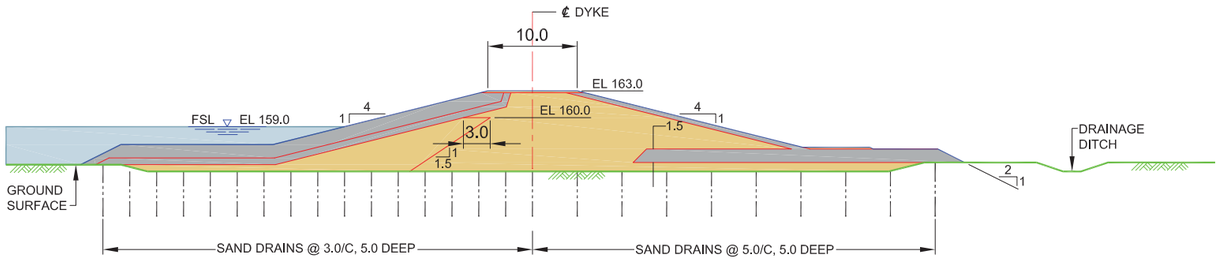
Legend

- Water
- Shoreline (See Note 6)
- 144 Ground Surface Contour (See Note 7)
- Rapids
- Access Road
- Cofferdam Removed
- Coordinate Grid Marker (located at 500 metre intervals)
- Water Level
- Bedrock

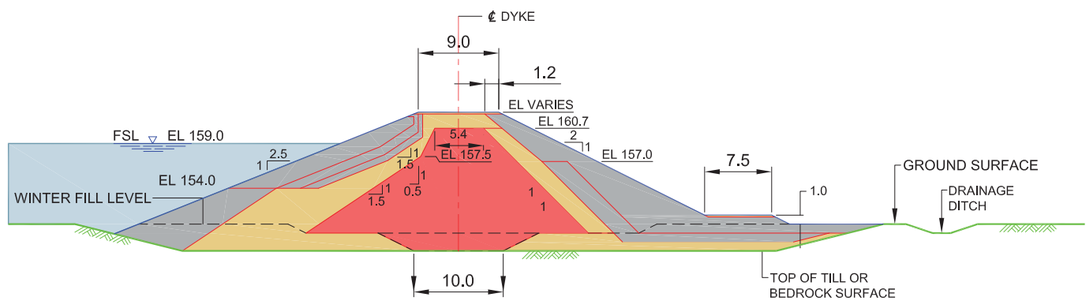
Infrastructure

Intake and Tailrace Channels Plan View and Cross Section

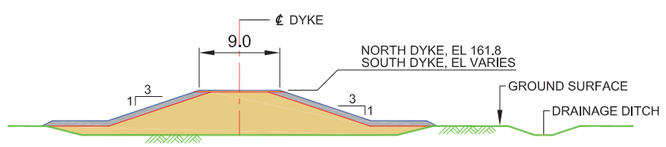
Figure 2-5



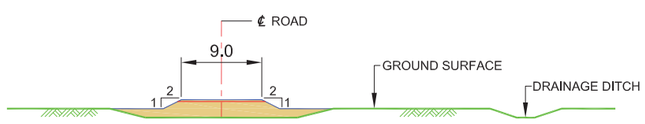
GRANULAR DYKE



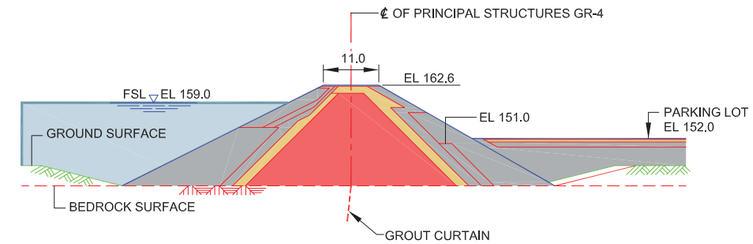
ZONED IMPERVIOUS CORE DYKE



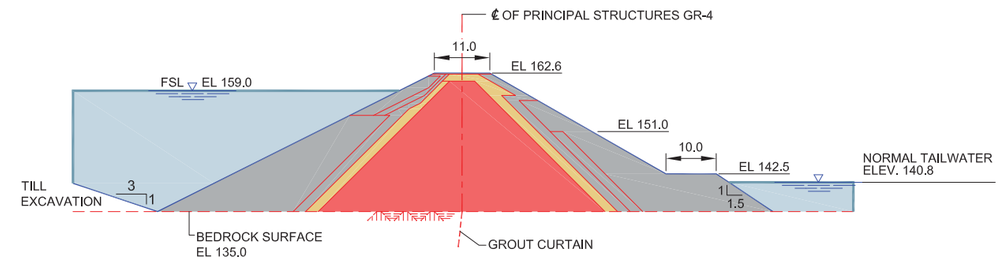
FREEBOARD DYKE



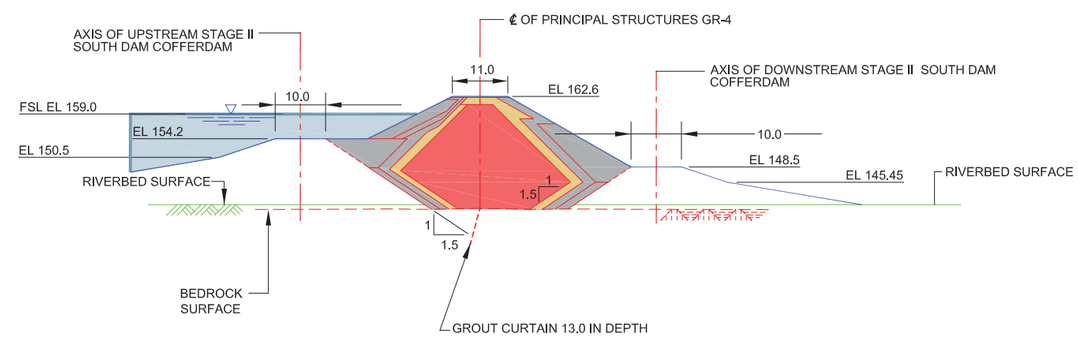
ROAD SECTION



NORTH DAM
MAIN SECTION



CENTRAL DAM
NEAR POWERHOUSE



SOUTH DAM
RIVER SECTION

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Memorandum GN-4.2.2.2, Rev. 0, Figure 5		
CREATED BY: KGS Acres		
COORDINATE SYSTEM: Not Applicable	DATE CREATED: 12-APR-12	REVISION DATE: 12-APR-12
SCALE: NTS	VERSION NO: 1.0	QA/QC: APPROVED

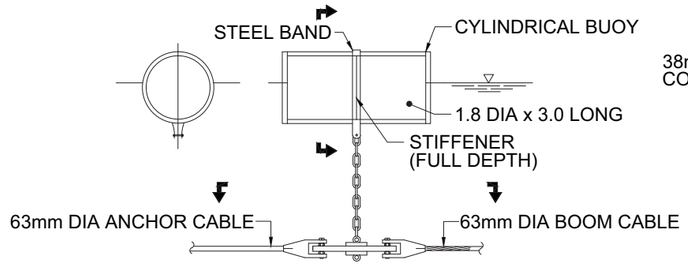
Legend

- Water
- Impervious Fill
- Granular Transition Fill
- Rockfill
- Water Level
- Overburden
- Bedrock

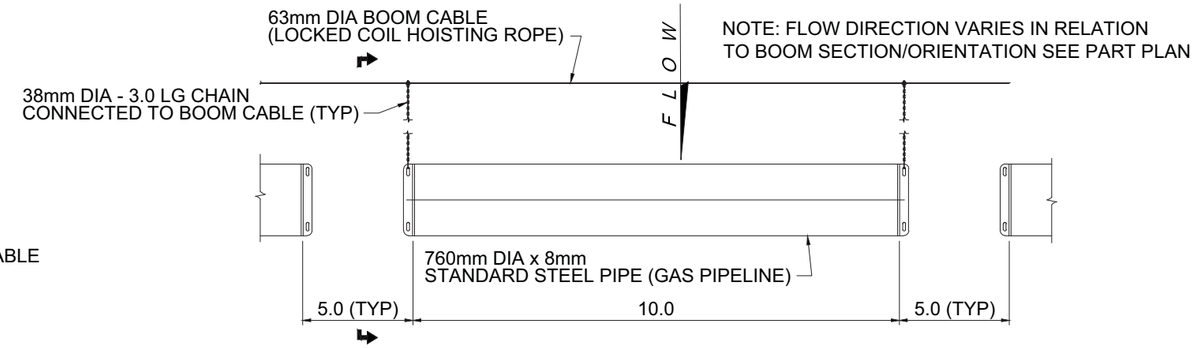
Dykes and Dams

Typical Cross Sections

Figure 2-6

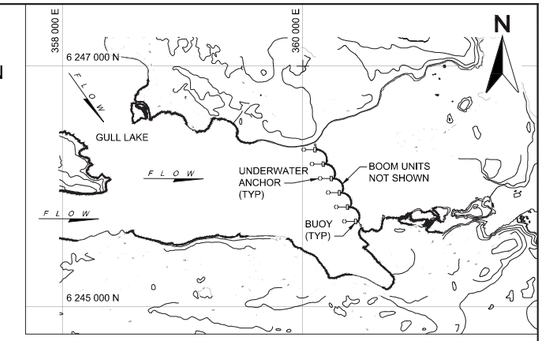


TYPICAL BUOY ARRANGEMENT

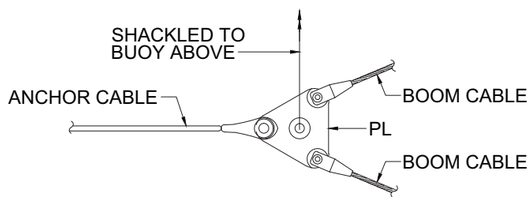


NOTE: FLOW DIRECTION VARIES IN RELATION TO BOOM SECTION/ORIENTATION SEE PART PLAN

PLAN

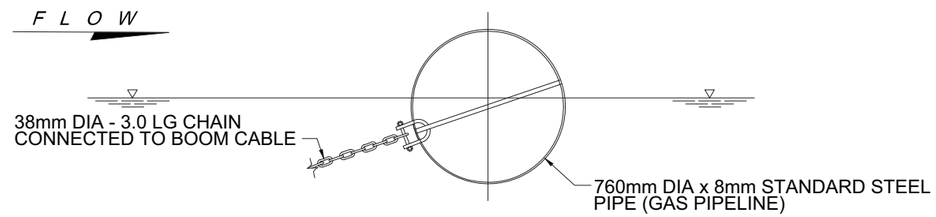


KEY MAP
SHOWING ICE BOOM LOCATION
UPSTREAM OF GULL RAPIDS



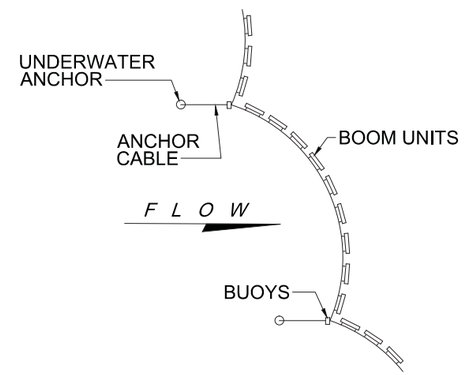
PLAN

TYPICAL JUNCTION PLATE

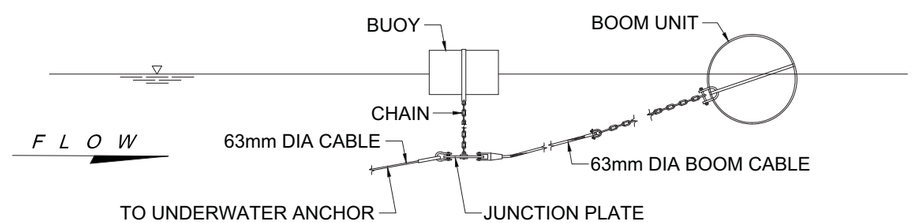


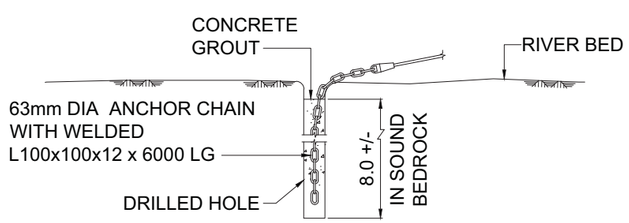
END VIEW

TYPICAL BOOM UNIT



PART PLAN
SHOWING BOOM UNIT ARRANGEMENT





UNDERWATER ANCHORS

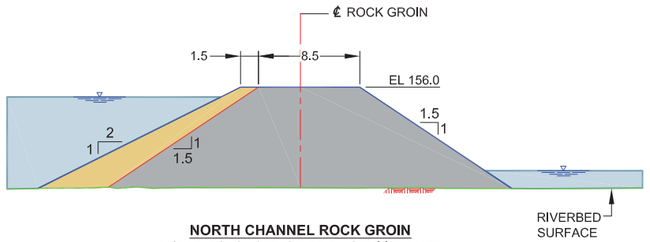
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

KEEYASK Hydropower Limited Partnership

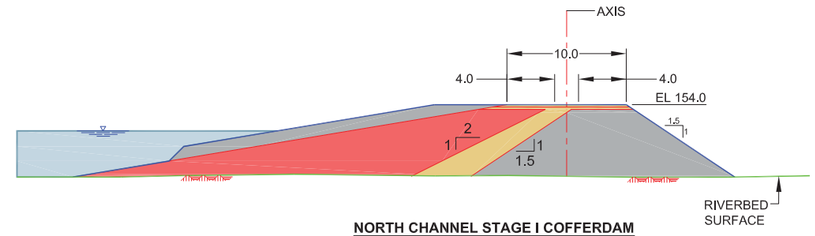
DATA SOURCE: GN-4.2.1.1, Rev. 0, Figure 16.			
CREATED BY: KGS Acres			
COORDINATE SYSTEM: UTM NAD 1983 Z15N (KEY MAP ONLY)	DATE CREATED: 02-APR-12	REVISION DATE: 02-APR-12	
SCALE: N.T.S.	VERSION NO: 1.0	QA/QC: APPROVED	

Ice Boom
Cross Section

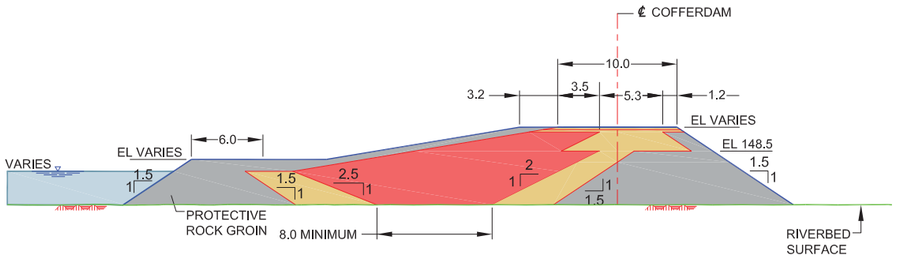
Figure 2-7



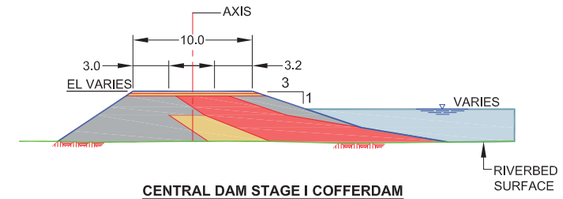
NORTH CHANNEL ROCK GROIN
FLOW-THROUGH STRUCTURE PLACED IN THE WET



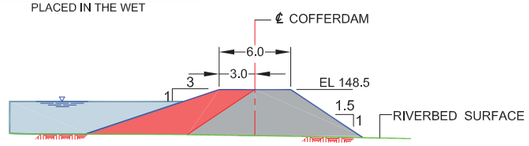
NORTH CHANNEL STAGE I COFFERDAM
PLACED IN THE WET



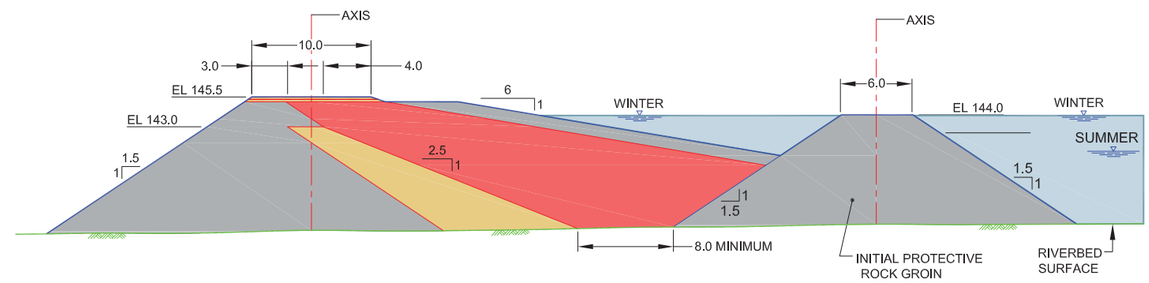
SPILLWAY STAGE I COFFERDAM
PLACED IN THE WET



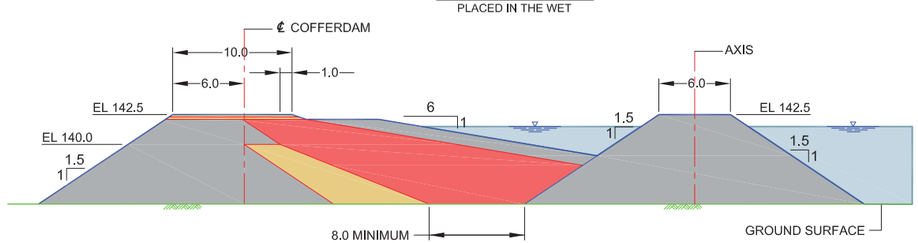
CENTRAL DAM STAGE I COFFERDAM
PLACED IN THE WET



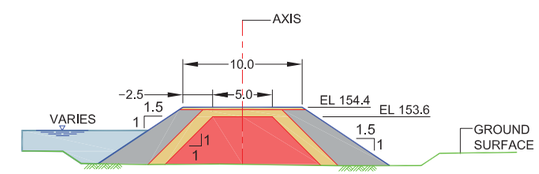
QUARRY COFFERDAM
PLACED IN THE WET



POWERHOUSE STAGE I COFFERDAM
PLACED IN THE WET



TAILRACE SUMMER LEVEL COFFERDAM - TYPICAL SECTION
PLACED IN THE WET



STAGE I ISLAND COFFERDAM
PLACED IN THE DRY

NOTES:

1. DIMENSIONS AND ELEVATIONS SHOWN ARE IN METRES.
2. ELEVATIONS ARE BASED ON CANADIAN GEODETIC VERTICAL DATUM 1928 (CGVD 1928).
3. CREST ELEVATION VARIES FROM ELEV. 146.5 AT ITS LEFT ABUTMENT TO ELEV. 147.5 AT ITS RIGHT ABUTMENT.
4. INITIAL PROTECTIVE ROCK GROIN NOT REQUIRED FOR POWERHOUSE COFFERDAM DOWNSTREAM OF TAILRACE CHANNEL.
5. PROTECTIVE ROCK GROIN NOT REQUIRED FOR SPILLWAY STAGE I COFFERDAM SECTION DOWNSTREAM OF DISCHARGE CHANNEL.
6. CREST ELEVATIONS SET AT 1.0 METRE ABOVE THE PREVAILING WATER LEVEL AT TIME OF CONSTRUCTION.
7. THE CRESTS SHALL BE ELEV. 151.0 AT THE LEFT ABUTMENT OF THE UPSTREAM LEG SLOPING TO ELEV. 150.5 AT THE RIGHT CORNER OF THIS LEG. THEN SLOPING ALONG THE RIVER LEG TO ELEV. 148.0 AT THE RIGHT CORNER OF THE DOWNSTREAM LEG. THE DOWNSTREAM LEG SHALL HAVE A CREST AT ELEV. 148.0 FOR ITS ENTIRE LENGTH.
8. VARIOUS SIZES AND GRADATIONS OF ROCKFILL (CLASSES C1, C2 AND C3) WILL BE UTILIZED. PRECISE LOCATIONS OF UTILIZATION WILL BE BASED ON FLOW CONDITIONS.

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Memorandum GN-4.2.2.2, Rev. 0, Figure 5		
CREATED BY: KGS Acres		
COORDINATE SYSTEM: Not Applicable	DATE CREATED: 12-APR-12	REVISION DATE: 12-APR-12
SCALE: 1:500	VERSION NO: 1.0	QA/QC: APPROVED

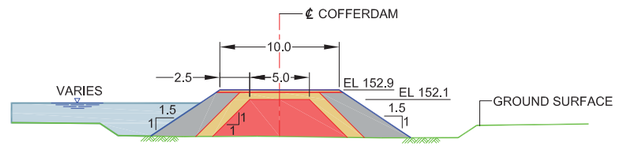
Legend

- Water
- Impervious Fill
- Granular Transition Fill
- Rockfill
- Water Level
- Overburden
- Bedrock

Stage I Cofferdam and Groin

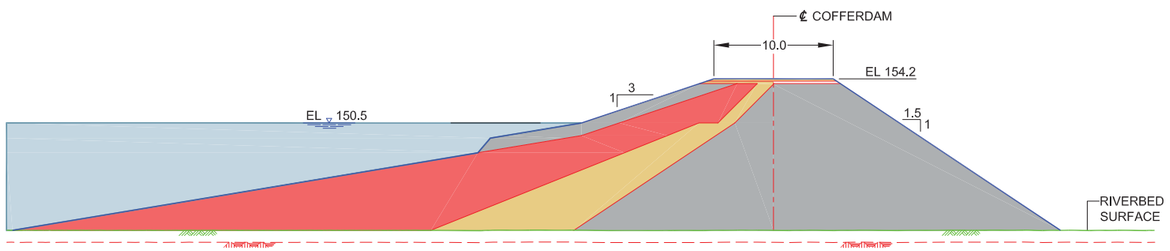
Cross Sections

Figure 2-8

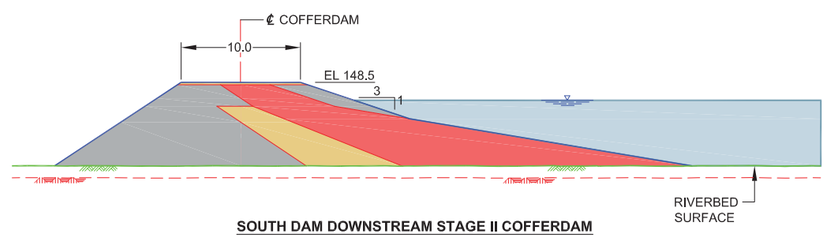


STAGE II ISLAND COFFERDAM

PLACED IN THE DRY



SOUTH DAM UPSTREAM STAGE II COFFERDAM



SOUTH DAM DOWNSTREAM STAGE II COFFERDAM

NOTES:

1. DIMENSIONS AND ELEVATIONS SHOWN ARE IN METRES.
2. ELEVATIONS ARE BASED ON CANADIAN GEODETIC VERTICAL DATUM 1928 (CGVD 1928).
3. VARIOUS SIZES AND GRADATIONS OF ROCKFILL (CLASSES C1, C2 AND C3) WILL BE UTILIZED. PRECISE LOCATIONS OF UTILIZATION WILL BE BASED ON FLOW CONDITIONS.

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Memorandum GN-4.2.2.2, Rev. 0, Figure 5		
CREATED BY: KGS Acres		
COORDINATE SYSTEM: Not Applicable	DATE CREATED: 12-APR-12	REVISION DATE: 12-APR-12
SCALE: 1:500	VERSION NO: 1.0	QA/QC: APPROVED

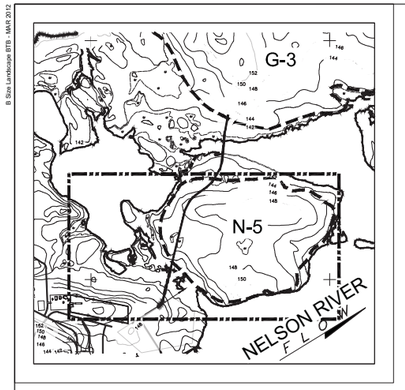
Legend

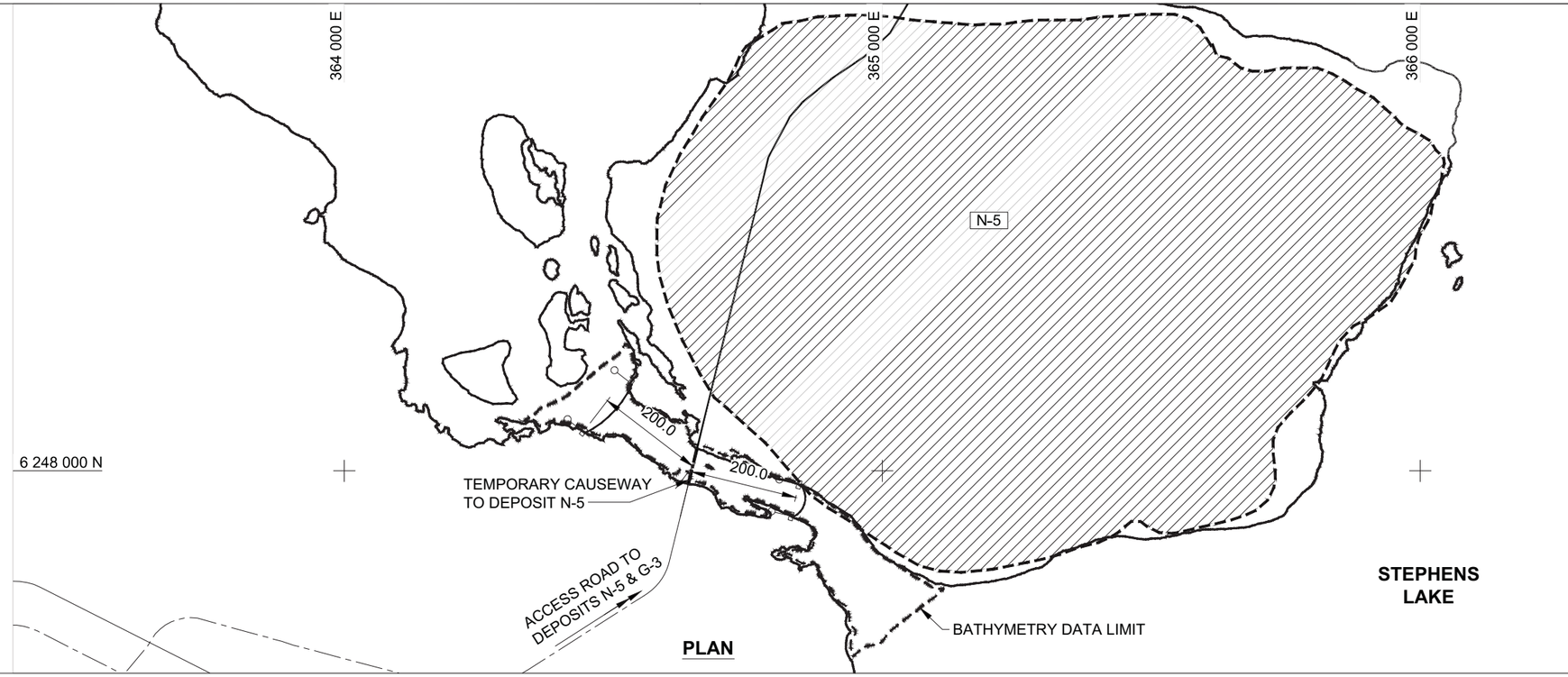
- Water
- Impervious Fill
- Granular Transition Fill
- Rockfill
- Water Level
- Overburden
- Bedrock

Stage II Cofferdams

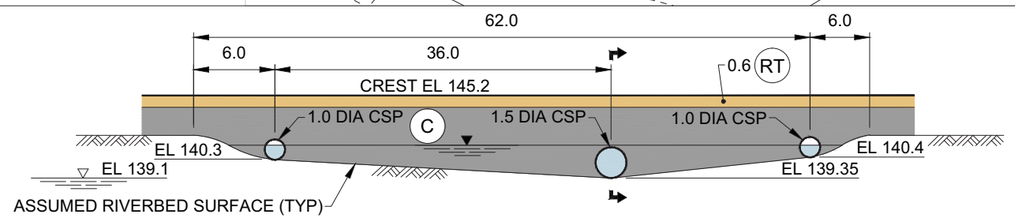
Cross Sections

Figure 2-9

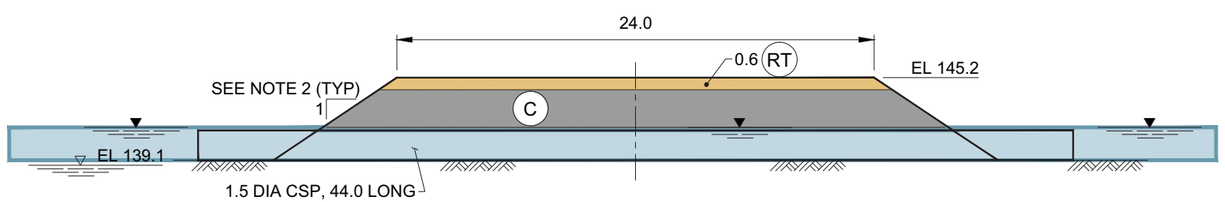




PLAN



LONGITUDINAL SECTION
TEMPORARY CAUSEWAY TO DEPOSIT N-5
N.T.S.



SECTION
TEMPORARY CAUSEWAY TO DEPOSIT N-5
N.T.S.

NOTES:

1. Deposit outlines have been interpreted from topography and may not reflect the exploitable limits of the deposits.
2. Shoreline locations based on data received from Manitoba Hydro June 29, 2011.
3. Full supply level for Kettle forebay, el 141.0 m.
4. Side slope will be constructed to under water angles of repose for design, assumed 1v:1.5h.
5. Minimum required CSP cover is 1.2 m, design assumed 1.5 m.
6. Dimensions are in metres.
7. Elevations are based on GS of C, CGVD28, 1929 adjustment.
8. Culvert placement and size to be optimized during final design.
9. Class A - Impervious Fill
10. Class B - Granular Transition Fill
11. Class C - Rockfill
12. Class RT - Granular Road Topping

KEEYASK Hydropower Limited Partnership

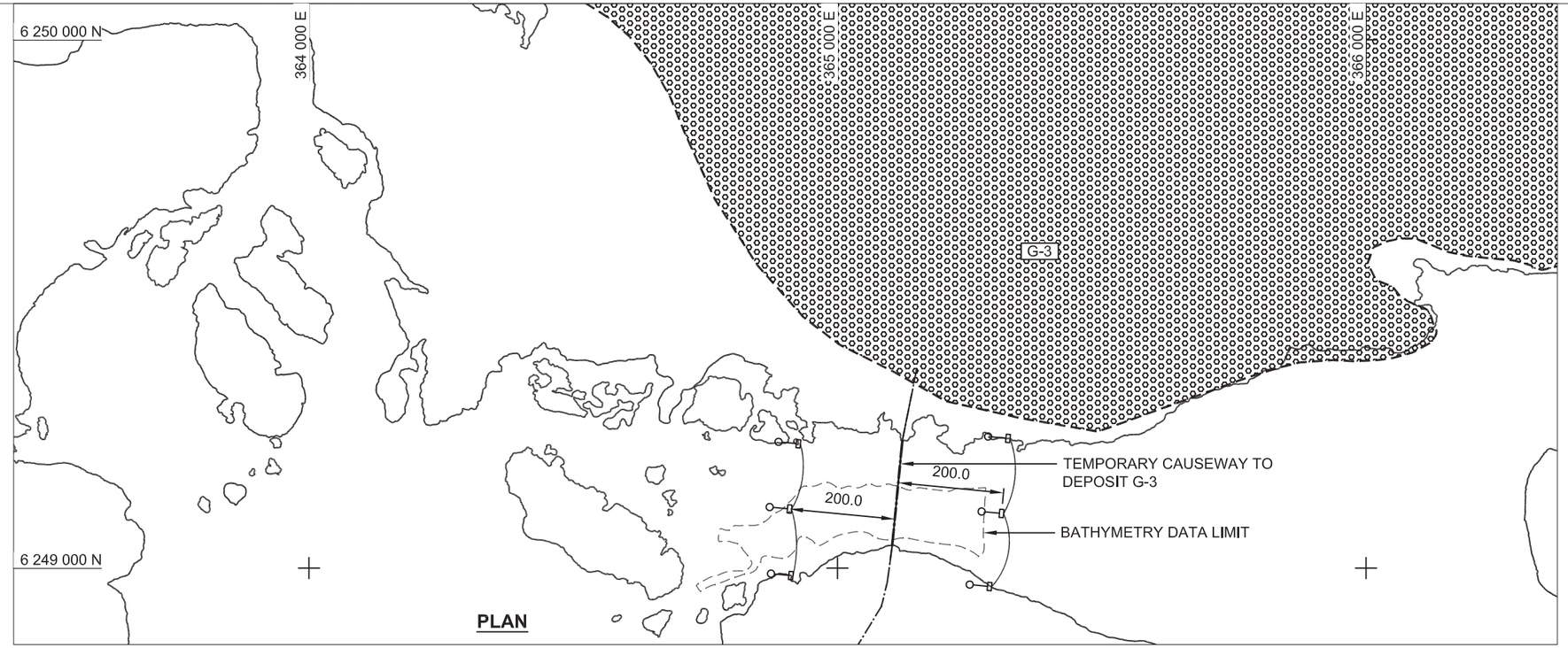
DATA SOURCE: Memorandum GN-4.2.2.17, Rev.0, Figure 1, 2, AND 3.		
CREATED BY: KGS Acres		
COORDINATE SYSTEM: UTM NAD 1983 Z15N	DATE CREATED: 16-APR-12	REVISION DATE: 04-JUN-12
SCALE: 1:10 000 Unless Noted	VERSION NO: 1.2	QA/QC: APPROVED

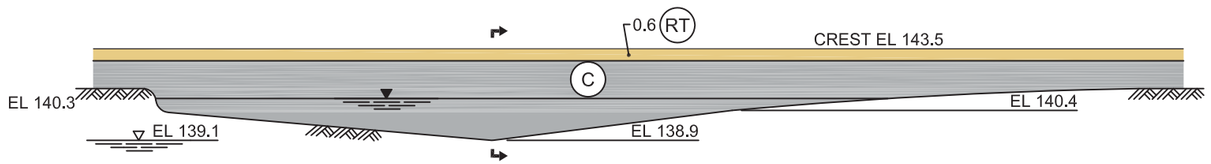
Legend

- Water
- Impervious Fill
- Granular Transition Fill
- Rockfill
- Water Level
- Overburden
- Bedrock
- Safety Boom
- Full Supply Level (See Note 3)
- Outline of Deposit or Quarry (See Note 1)
- Potential Impervious Deposit

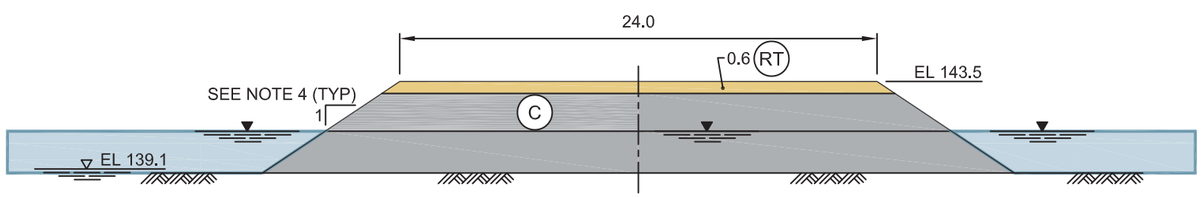
Infrastructure
Crossing to N-5
Plan View and Sections

Figure 2-10





LONGITUDINAL SECTION
TEMPORARY CAUSEWAY TO DEPOSIT G-3
N.T.S.



SECTION
TEMPORARY CAUSEWAY TO DEPOSIT G-3
N.T.S.

NOTES:

1. Deposit outlines have been interpreted from topography and may not reflect the exploitable limits of the deposits.
2. Shoreline locations based on data received from Manitoba Hydro June 29, 2011.
3. Full supply level for Kettle forebay, el 141.0 m.
4. Side slope will be constructed to under water angles of repose for design, assumed 1v:1.5h.
5. Dimensions are in metres.
6. Elevations are based on GS of C, CGVD28, 1929 adjustment.
7. Class A - Impervious Fill
8. Class B - Granular Transition Fill
9. Class C - Rockfill
10. Class RT - Granular Road Topping

KEEYASK Hydropower Limited Partnership

DATA SOURCE:
Memorandum GN-4.2.2.17, Rev.0, Figures 1, 2, AND 3.

CREATED BY:
KGS Acres

COORDINATE SYSTEM	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	16-APR-12	31-MAY-12
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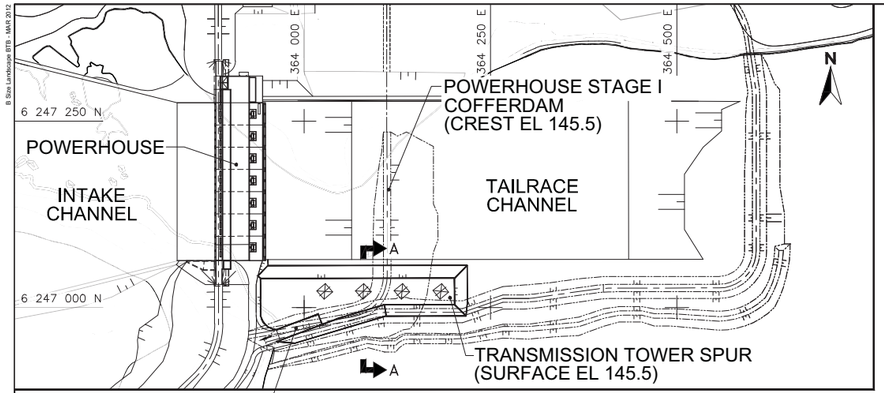
Legend

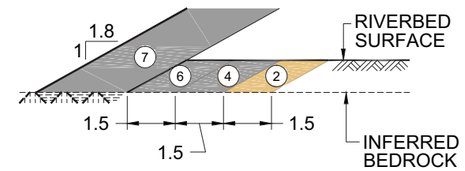
- Water
- Impervious Fill
- Granular Transition Fill
- Rockfill
- Water Level
- Overburden
- Bedrock
- Safety Boom
- Full Supply Level (See Note 3)
- Outline of Deposit or Quarry (See Note 1)
- Potential Granular Deposit

Infrastructure
Crossing to G-3
Plan View and Sections

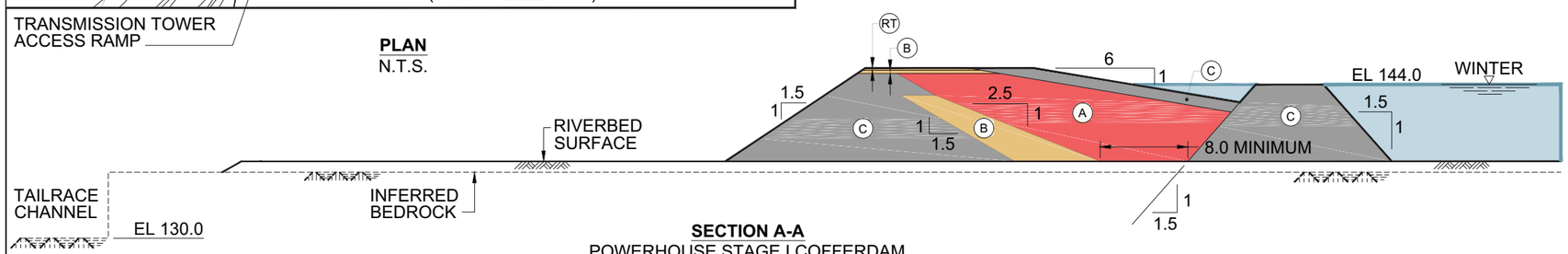
Figure 2-11



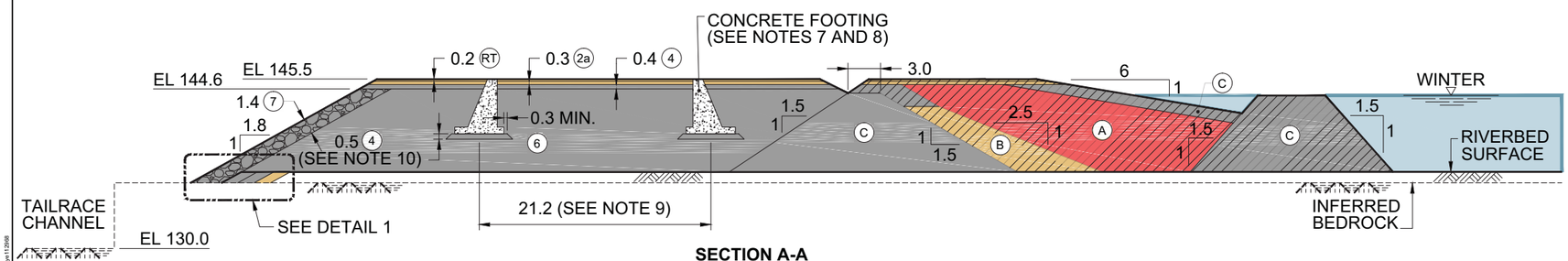
PLAN
N.T.S.



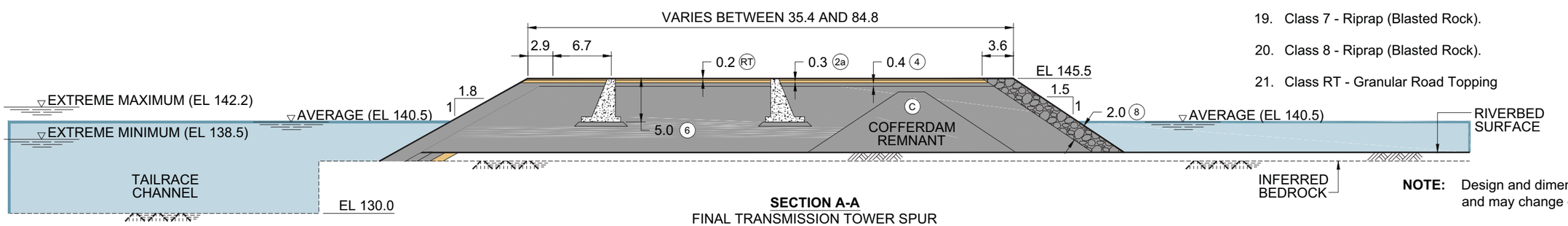
DETAIL 1
N.T.S.



SECTION A-A
POWERHOUSE STAGE I COFFERDAM



SECTION A-A
COFFERDAM REMOVAL FOLLOWING CONSTRUCTION OF TRANSMISSION TOWER FOOTINGS



SECTION A-A
FINAL TRANSMISSION TOWER SPUR

NOTE: Design and dimensions are preliminary and may change during final design stage.

NOTES:

1. Elevations and dimensions are in metres.
2. Elevations are based on CGVD 1928.
3. Freeboard allowance approximately 3.3 metres above maximum tailwater elevation.
4. Additional rock armour shall be placed as required, where higher velocities are anticipated.
5. Class 7 or 8 (2 x d_{50}) rockfill armour protection.
6. Prior to the removal of the powerhouse cofferdam, all exposed riverbed slopes within the tailrace channel shall have filters and riprap installed to minimize the hydraulic forces acting on the alluvium. This is to prevent the powerhouse discharge flows from undermining the transmission tower spur.
7. Footings are shown for illustration purposes only. Footings will be reviewed during the final design.
8. Concrete footings will extend into the transmission tower spur.
9. The center-to-center spacing of the tower footings will be 15.0 m, however the orientation of the towers relative to the location at which the cross-section is viewed results in the increased distance indicated.
10. Class 4 to be wrapped with non-woven geotextile filter fabric.
11. Class A - Impervious Fill.
12. Class B - Granular Transition Fill.
13. Class C - Rockfill.
14. Class 2a & 2b - Granular Transition Fill.
15. Class 3 - Fine Granular Filter.
16. Class 4 - Coarse Filter (Crushed Rock).
17. Class 5 - Riprap Bedding (Crushed Rock).
18. Class 6 - Rockfill (Blasted/Crushed Rock).
19. Class 7 - Riprap (Blasted Rock).
20. Class 8 - Riprap (Blasted Rock).
21. Class RT - Granular Road Topping

KEEYASK Hydropower Limited Partnership

DATA SOURCE:
Memorandum GN-4.2.2.6, Rev. 0, Figure 4.

CREATED BY:
KGS Acres

COORDINATE SYSTEM	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N (Plan View Only)	13-APR-12	13-APR-12
SCALE: 1:500	VERSION NO: 1.0	QA/QC: APPROVED

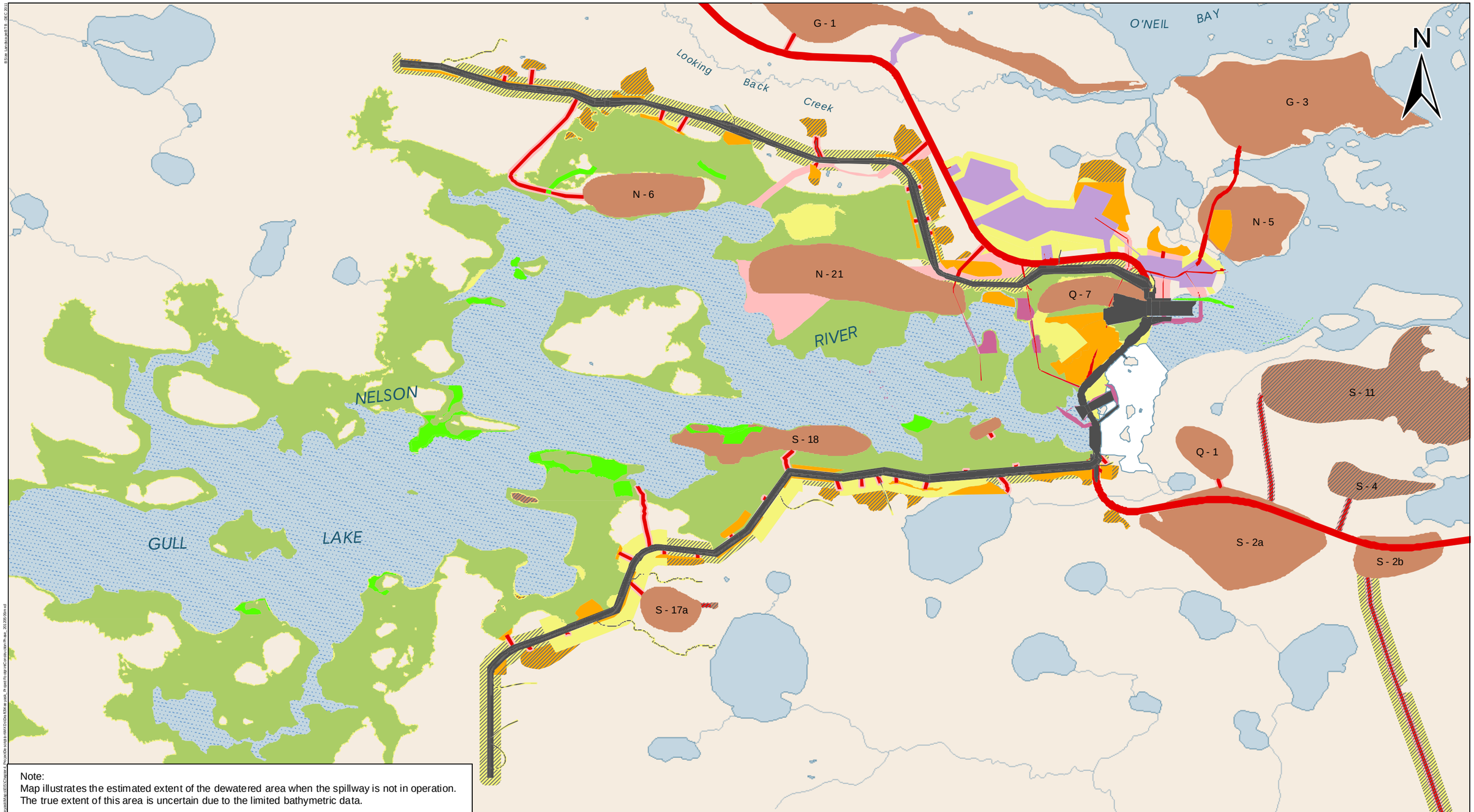
Legend

- Water
- Impervious Fill
- Granular Transition Fill
- Rockfill
- Concrete
- Water Level
- Overburden
- Bedrock
- Cofferdam Removal
- Riprap (See Note 5)

FSL Normal Full Supply Level

Infrastructure
Transmission Tower Spur
Plan View and Cross Sections

Figure 2-12



Note:
Map illustrates the estimated extent of the dewatered area when the spillway is not in operation.
The true extent of this area is uncertain due to the limited bathymetric data.

KEEYASK Hydropower Limited Partnership

DATA SOURCE:
Manitoba Hydro; Government of Manitoba;
Government of Canada; ECOSTEM

CREATED BY:
Hydro Power Planning - Keeyask & Burntwood Planning Section

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	18-JAN-12	09-MAY-12
0 0.55 1.1 Kilometres / 0 0.45 0.9 Miles	VERSION NO: 3.0	QA/QC: APPROVED

Legend

- Road
- Road Corridor
- Infrastructure
- River Management
- Borrow Area
- Camp and Work Area
- Excavated Material Placement Area
- Mitigation Area
- Possible Disturbed Area
- Reservoir Clearing
- Altered Water Level or Flow
- Potential Dewatered Area
- Existing Water Surface Area
- Areas Unlikely to be Used

Project Footprint Construction Phase

Site Level

Map 2-1