

1 **Q. Reference: Volume II, Refurbish MD-1 (2027–2030) – Ebbegunbaeg; Schedule 1, Appendix G**

2 The estimated cost is \$11,034,800. The external construction-contract estimate is AACE Class 4;
3 other costs were estimated internally. Hydro states that slope stability does not meet the
4 Canadian Dam Association factor of safety and that a boil indicates internal erosion. Design is
5 planned for 2027 and construction for 2028–2030.

6 **a)** Please provide the Canadian Dam Association consequence classification for MD-1 and
7 MD-1S.

8 **b)** The boil was first observed in 2006. Please provide the complete 2006–2026 monitoring
9 dataset, including seepage flow, boil dimensions, piezometric levels, survey movement,
10 inspection findings, dates, and measurement methods.

11 **c)** Please describe each drawdown or reservoir-restriction alternative considered and the
12 operating constraints and outage plan for Meelpaeg, Upper Salmon, and Bay d’Espoir
13 during construction.

14 **d)** Please allocate the \$11,034,800 between 2027 design and 2028–2030 construction.
15 Please state the date on which Hydro expects to have an AACE Class 3 estimate, and the
16 reason construction years are included in this annual Application before that estimate is
17 available.

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20 **A. a)** The consequence classifications for MD-1 & MD-1S are classified as ‘Significant’ given the
21 risk to temporary populations such as recreational or operational users of the access road,
22 and Newfoundland and Labrador Hydro (“Hydro”) employees visiting the operations
23 buildings downstream of the embankment/control structure.

b) Please refer to CA-NLH-080, Attachment 1 for the requested seepage data from weirs MD-1BO and MD-1BN for 2006–2026.^{1,2} Weir MD-1BO, originally installed as a 60-degree weir, was installed prior to 2006 to capture seepage flow from Dyke MD-1B, and later converted into a 90-degree weir to increase capacity. Weir MD-1BN was added in 2021, adjacent to MD-1BO, to help capture seepage flows bypassing MD-1BO, as the 90-degree weir did not have the capacity to accurately measure seepage³.

Please refer to CA-NLH-080, Attachment 2 for the boil dimensions recorded from 2006 to 2025.⁴ From 2015 to 2022, visual inspections were completed during the spring and fall inspections with no noted changes observed. Physical measurements resumed in 2023 following the 2022 Dam Safety Review results of the KGS Group (“KGS”) stability analysis, which indicated that MD-1B did not meet the required factor of safety under Canadian Dam Association Guidelines. KGS recommended that the boil continue to be monitored for any changes. The LiDAR measurement collected in 2025 by Atkins Realis indicates the true hole diameter and verifies that the dimensions have not notably increased;⁵ no survey measurements were collected for the boil or MD-1 dykes prior to this survey.

Please refer to CA-NLH-080, Attachment 3 for the bi-annual inspection findings from 2006–2026, which includes the following inspections:

- An annual internal Hydro engineering inspection, completed in the spring of each year; and
- An annual fall inspection completed by an external consultant, accompanied by Hydro engineers.⁶

¹ Seepage measurements from the weirs are measured by recording the depth of flow within the v-notch of the weir. The depth of flow is recorded in mm and later converted to flow (L/s) using known equations for the degree associated with the weirs.

² Periodic disruptions in the weir readings, denoted by weir flows of -1 or -2, reflect conditions that prevent or affect measurement, such as snow or ice cover, flooding, flow bypassing the weir, or beaver activity.

³ “2027 Capital Budget Application”, Newfoundland and Labrador Hydro, July 14, 2026, Vol. II, Project 1, Sec. 4, att. 3, pp. 16/18.

⁴ 2026 data is planned to be retrieved in the fall of 2026.

⁵ The apparent variation in hole diameters is a result of discrepancies in the collection of measurement data, with measurements varying from the true inner wall hole diameter and the outer edge diameter, taken across the ring of fine sand and silt. The boil is in a toe pond downstream of MD-1B which requires access by boat; the measurements in years 2012, 2014, 2023 and 2024 were taken from a boat using a measuring tape and measuring stick.

⁶ The annual fall inspection was not completed on MD-1 by the external consultant in 2007 or 2013.

1 Additional routine inspections are completed by operations personnel, trained in dam
2 inspections, on a set frequency.⁷ Since July 2022, the structure has been inspected with a
3 targeted bi-weekly frequency due to an observed increase in seepage near MD-1A. Prior to
4 July of 2022, the dam was inspected monthly as a part of the routine surveillance program.

5 In 2025, a piezometer was installed on Dyke MD-1A as part of the Atkins Realis geotechnical
6 investigation. Since installation, piezometer level data has been stored in an on-site data
7 logger. The data is planned to be retrieved during the 2026 fall inspection, scheduled for late
8 September.

- 9 **c)** For the recommended upgrade life extension alternative, no unit outages are anticipated to
10 be required due to reservoir restrictions. The placement of rip-rap material for slope
11 flattening on the upstream slopes (MD-1A and MD-1D) and the placement of granular filter
12 material on the downstream slope (MD-1B) will require the reservoir to be lowered with
13 restrictions in place to maintain levels at or below the target elevation. Survey data and
14 dyke cross sections produced by Atkins Realis indicate that the work can be completed
15 within the normal operating range of the reservoir,⁸ with an upper level of approximately
16 269.5 m suitable for construction. It is unlikely the placement of material on the
17 downstream slopes of MD-1A and MD-1D will require any restrictions on reservoir levels to
18 facilitate the work; however, this will be confirmed during detailed engineering design.
19 Overall impacts of the restricted water levels in the Meelpaeg Reservoir are being
20 considered by Hydro when evaluating the requirements of the Island Interconnected System
21 and long-term capital project requests during the project's construction period.

- 22 **d)** Please refer to Table 1 for the allocation between 2027 design and 2028–2030 construction.

⁷ Findings from the routine inspection program have not been provided, as issues identified would be captured within the bi-annual inspection.

⁸ The Meelpaeg Reservoir is operated between a low supply level ("LSL") of elevation 266.98 meters and a maximum operating level ("MOL") of elevation 272.45 meters. The MOL varies with the season, with the range varying between 271.59 meters to 272.45 meters depending on winter snowpack. For this project, construction will take place within the seasonal period with no snowpack.

Table 1: Project Design and Construction Cost by Year (\$000)

Year	2027	2028	2029	2030	Total
Design	665.8	41.1	-	-	706.9
Construction		1878.0	3312.4	5137.5	10327.9
Total	665.8	1,919.1	3312.4	5137.5	11,034.8

1 Hydro does not generally revisit estimates following project approval. Project forecasts are
2 revised throughout execution through Hydro's internal Management of Change process. In the
3 event that forecast costs are materially higher than that approved by the Board, Hydro notifies
4 the Board and, where necessary, seeks approval of the updated project budget, at which point a
5 revised estimate would be completed. Depending on the stage of project maturity at that time,
6 the estimate may constitute the equivalent an Association for Advancement of Cost Engineering
7 Class 3 estimate.

Ebbegunbaeg Wier Data

2006-2026

Time	1BO-WEIR D/S of MD-1B - L	*1BN-WEIR D/S of MD-1B - RS
1/27/2006 0:00	4.73	
2/21/2006 0:00	3.12	
3/21/2006 0:00	4.73	
4/18/2006 0:00	-2	
5/16/2006 0:00	8.59	
7/13/2006 0:00	4.29	
8/8/2006 0:00	3.88	
9/6/2006 0:00	5.2	
10/3/2006 0:00	6.22	
10/31/2006 0:00	15.7	
11/28/2006 0:00	15.7	
12/12/2006 0:00	10.68	
1/9/2007 0:00	14.78	
2/6/2007 0:00	7.96	
3/6/2007 0:00	7.96	
4/3/2007 0:00	3.88	
5/2/2007 0:00	10.68	
5/29/2007 0:00	10.68	
7/24/2007 0:00	3.12	
8/21/2007 0:00	0.55	
9/19/2007 0:00	4.73	
10/17/2007 0:00	-1	
11/14/2007 0:00	-1	
12/13/2007 0:00	-1	
2/5/2008 0:00	-2	
3/4/2008 0:00	-1	
4/1/2008 0:00	-1	
4/29/2008 0:00	5.7	
5/27/2008 0:00	12.23	
8/19/2008 0:00	-2	
9/17/2008 0:00	-2	
10/15/2008 0:00	-2	
11/12/2008 0:00	-2	
12/9/2008 0:00	-2	
1/6/2009 0:00	-2	
2/3/2009 0:00	-2	
3/5/2009 0:00	-1	
3/31/2009 0:00	-2	
4/29/2009 0:00	-2	
5/29/2009 0:00	24.28	
7/9/2009 0:00	-2	
8/4/2009 0:00	-2	
9/1/2009 0:00	24.28	
10/14/2009 0:00	46.79	
11/10/2009 0:00	38.3	
12/8/2009 0:00	64.7	
1/5/2010 0:00	73.8	
2/2/2010 0:00	52.37	
3/3/2010 0:00	38.3	
3/30/2010 0:00	30.81	

4/27/2010 0:00	29.43	
5/26/2010 0:00	30.81	
7/6/2010 0:00	41.57	
8/3/2010 0:00	56.31	
8/31/2010 0:00	46.79	
9/28/2010 0:00	26.78	
10/26/2010 0:00	32.23	
11/23/2010 0:00	28.09	
12/29/2010 0:00	36.73	
1/18/2011 0:00	25.51	
2/17/2011 0:00	21.93	
3/16/2011 0:00	17.64	
4/15/2011 0:00	25.51	
5/10/2011 0:00	38.3	
6/7/2011 0:00	35.19	
7/6/2011 0:00	38.3	
8/2/2011 0:00	50.47	
8/30/2011 0:00	38.3	
9/27/2011 0:00	29.43	
10/25/2011 0:00	29.43	
11/22/2011 0:00	35.19	
12/20/2011 0:00	35.19	
1/19/2012 0:00	13.05	
2/21/2012 0:00	26.78	
3/13/2012 0:00	21.93	
4/10/2012 0:00	24.28	
5/8/2012 0:00	21.93	
6/5/2012 0:00	30.81	
7/4/2012 0:00	19.71	
7/31/2012 0:00	5.2	
8/28/2012 0:00	15.7	
10/3/2012 0:00	13.05	
10/23/2012 0:00	45.01	
11/20/2012 0:00	45.01	
12/18/2012 0:00	45.01	
1/15/2013 0:00	45.01	
2/12/2013 0:00	45.01	
3/12/2013 0:00		
3/13/2013 0:00	41.57	
4/10/2013 0:00	41.57	
5/7/2013 0:00	78.63	
6/10/2013 0:00	78.63	
7/3/2013 0:00	69.16	
7/30/2013 0:00	-2	
8/27/2013 0:00	-2	
9/24/2013 0:00	-2	
10/22/2013 0:00	-2	
11/25/2013 0:00	26.78	
12/17/2013 0:00	28.09	
1/14/2014 0:00	23.09	
2/11/2014 0:00	-2	
3/11/2014 0:00	-1	
4/8/2014 0:00	19.71	
5/7/2014 0:00	-2	
6/3/2014 0:00	16.65	

7/2/2014 0:00	17.64	
7/29/2014 0:00	19.71	
8/26/2014 0:00	-2	
9/23/2014 0:00	-2	
10/21/2014 0:00	-2	
11/20/2014 0:00	1.89	
12/16/2014 0:00	-2	
1/14/2015 0:00	-2	
2/10/2015 0:00	-2	
3/10/2015 0:00	-1	
4/7/2015 0:00	-1	
5/5/2015 0:00	0.43	
6/4/2015 0:00	1.89	
7/7/2015 0:00	-2	
7/28/2015 0:00	-2	
8/25/2015 0:00	-2	
9/22/2015 0:00	-2	
10/20/2015 0:00	21.93	
11/17/2015 0:00	43.12	
12/15/2015 0:00	38.94	
12/25/2015 0:00		
1/12/2016 0:00	27.89	
2/11/2016 0:00	6.19	
3/10/2016 0:00	16.44	
5/3/2016 0:00	31.33	
6/6/2016 0:00	52.27	
7/7/2016 0:00	93.02	
8/23/2016 0:00	-2	
9/20/2016 0:00	52.27	
10/26/2016 0:00	29.58	
11/16/2016 0:00	31.33	
1/10/2017 0:00	-1	
5/18/2017 0:00	35.01	
5/27/2017 0:00	27.89	
5/30/2017 0:00	21.72	
6/28/2017 0:00	8.41	
8/21/2017 0:00	12.03	
9/19/2017 0:00	18.97	
10/3/2017 0:00	-1	
10/5/2017 0:00		
10/6/2017 0:00	12.03	
10/14/2017 0:00	6.88	
11/16/2017 0:00	1.22	
1/11/2018 0:00	-1	
2/8/2018 0:00	6.88	
3/7/2018 0:00	6.88	
3/21/2018 0:00	0.08	
4/3/2018 0:00	0.77	
5/2/2018 0:00	18.97	
5/31/2018 0:00	24.69	
6/24/2018 0:00	29.58	
8/21/2018 0:00	24.69	
9/16/2018 0:00	5.54	
10/22/2018 0:00	0	
11/16/2018 0:00	24.69	

12/13/2018 0:00	24.69	
1/9/2019 0:00	-1	
2/5/2019 0:00	-1	
3/7/2019 0:00	-1	
4/8/2019 0:00	0	
4/30/2019 0:00	8.41	
6/12/2019 0:00	-2	
6/27/2019 0:00	16.44	
7/25/2019 0:00	0.59	
8/21/2019 0:00	0	
10/17/2019 0:00	0	
11/12/2019 0:00	3.35	
12/11/2019 0:00	36.94	
1/7/2020 0:00	-1	
2/4/2020 0:00	-1	
3/3/2020 0:00	-1	
4/2/2020 0:00	-1	
4/28/2020 0:00	0	
6/24/2020 0:00	31.33	
8/19/2020 0:00	24.69	
9/11/2020 0:00	-2	
10/15/2020 0:00	38.94	
11/10/2020 0:00	-2	
12/10/2020 0:00	35.01	
1/5/2021 0:00	-2	
2/2/2021 0:00	52.27	
3/9/2021 0:00	-1	
4/14/2021 0:00	68.03	
4/29/2021 0:00	73.84	
5/26/2021 0:00	-2	
6/23/2021 0:00	57.25	
7/21/2021 0:00	12.03	
8/17/2021 0:00	33.14	6.22
10/13/2021 0:00	0.44	
11/5/2021 0:00	2.5	0.04
11/8/2021 0:00	2.5	0.04
12/8/2021 0:00	3.84	0.43
1/5/2022 0:00	21.72	6.77
2/1/2022 0:00	21.72	
3/1/2022 0:00	-2	16.65
3/29/2022 0:00	-2	18.66
5/25/2022 0:00	-2	17.64
5/26/2022 0:00	10.12	

6/19/2022 0:00	-2	23.09
7/20/2022 0:00	-2	24.28
8/16/2022 0:00	-2	21.93
9/9/2022 0:00	73.84	
9/13/2022 0:00	57.25	15.7
9/22/2022 0:00		
9/27/2022 0:00		
10/12/2022 0:00	-2	12.23
11/9/2022 0:00	-2	11.44
12/6/2022 0:00	57.25	2.16
1/5/2023 0:00	52.27	15.7
1/25/2023 0:00	-2	21.93
2/1/2023 0:00	68.03	18.66
2/15/2023 0:00	-2	17.64
3/14/2023 0:00	-2	17.64
4/11/2023 0:00	24.69	5.7
5/11/2023 0:00	16.44	15.7
6/8/2023 0:00	35.01	6.77
7/13/2023 0:00	16.44	3.88
8/1/2023 0:00	8.41	7.96
8/29/2023 0:00	18.97	6.77
9/26/2023 0:00	16.44	-2
10/24/2023 0:00	35.01	-2
1/8/2024 0:00	-2	-2
1/16/2024 0:00	-1	-1
3/27/2024 0:00	-2	-2
4/9/2024 0:00	-2	-2
5/7/2024 0:00	-2	-2
6/18/2024 0:00	-2	29.43
7/5/2024 0:00	-2	-2
7/26/2024 0:00	-2	-2
8/27/2024 0:00	43.12	2.46
9/24/2024 0:00	15.26	21.93
10/22/2024 0:00	41	8.59
12/12/2024 0:00	-2	-2
1/14/2025 0:00	49.89	17.64
2/11/2025 0:00	-1	-1
3/11/2025 0:00	31.33	-2
4/7/2025 0:00	31.33	-2
5/6/2025 0:00	35.01	26.78
6/3/2025 0:00	24.69	38.3
7/17/2025 0:00	31.33	7.96
8/4/2025 0:00	3.84	2.78
9/23/2025 0:00	6.88	2.16
10/27/2025 0:00	0.08	0.12
11/18/2025 0:00	18.97	4.73
12/17/2025 0:00	16.44	4.73
1/14/2026 0:00	27.89	6.77
3/10/2026 0:00	10.12	-2
4/7/2026 0:00	12.03	-2
6/2/2026 0:00	57.25	38.3
6/25/2026 0:00	68.03	32.23
7/3/2026 0:00		
7/29/2026 0:00	-2	17.64
8/25/2026 0:00	-2	-2

Year	Description
2006–2011	Visual inspections documented in Dyke Board Reports estimated a 1.5 m to 2.0 m diameter hole and a 4 m diameter ring of fine sand or silt.
2012	1.22 m diameter, 1.83 m depth
2014	1.98 m diameter, 1.52 m depth
2015-2022	No noted changes observed.
2023	3.66 m diameter, 1.52 m depth.
2024	3.66 m diameter, 1.52 m depth
2025	2.2 m diameter

Year	Inspection Type	Inspection Completed By	Findings
2006	Spring Inspection	Internal Engineering NL Hydro	- There was a small beaver dam, located to the right of the weir at MD-1B. This needs to be removed, once the beavers have been taken away. This should help to lower the level of the toe pond. - There is also a small dam 20 m to the left of the weir shelter that also should be removed. - There is extensive work required on the weir shelter, including replacement of the foundation and leveling of the weir shelter.
2006	Fall Inspection - Consultant	Dyke Board of Consultants	MD-1 (Ebbegunbaeg Cut-Off) consists of four shallow dykes MD-1A, 1B, 1C and 1D that range in height from 2 to 9 m and serve freeboard purposes in low zones adjacent to the MD-1S Control Structure. Toe drainage is poor and a large boil or sinkhole feature was observed in a pond at station 0+870 near the downstream toe of Dyke MD-1B. This feature appears to consist of a 2.0 m diameter hole surrounded by a 4.0 m diameter ring of fine sand or silt. There is no indication of flow into or out of the feature. It is known that the dyke in this area was founded on a boulder field and with the fine sand deposit around the hole perimeter it is suspected to be a boil structure caused by periodic upwelling of flow under the dyke at low flow gradients. It does not affect the stability of this dyke. Thus, all of the MD-1 dykes are in satisfactory condition.
2007	Spring Inspection	Internal Engineering NL Hydro	- There was a large diameter hole found in the toe pond during the Dyke Board trip last year. This hole was again seen from the air and appeared to be unchanged. This is located at 0+870. - Replace weir shelter MD-1B. - Efforts should be made to lower the toe pond by improving drainage along the side of the weir MD-1B. Environmental permits will be required to undertake this work.
2007	Fall Inspection - Consultant	Dyke Board of Consultants	MD-1 was not inspected
2008	Spring Inspection	Internal Engineering NL Hydro	- The hole in the downstream toe pond at 0+870 is still present and appears to be unchanged. - Weir shelter at weir MD-1B needs to be replaced. WOF 555860. In addition, low spot adjacent to weir should be filled in. - Drainage improvements planned for both sides of the weir last year have been cancelled and WOF 538500 has been closed.
2008	Fall Inspection - Consultant	Dyke Board of Consultants	A large boil or sinkhole feature observed in 2006 in a pond at station 0+870 near the downstream toe of Dyke MD-1B was not visible this year, and in any case was not considered to be a feature that would affect the stability of the dyke. For Dykes MD-1B, 1C and 1D, (especially 1B) vegetation control is needed on the crest and downstream slope. The weir located downstream from MD-1B is again blocked by beaver debris. The Board believes that if this weir was shifted a short distance downstream to a culvert under the main access road, equivalent flow measurements could be obtained with less risk of beaver interference. They would be left in peace to enjoy the large pond existing downstream of this dyke and would not be interested in blocking the road culvert because of the small drainage area between the pond and the road. Accordingly, the Board recommends that: "Vegetation control be done on dykes MD-1B, 1C and 1D and that the weir downstream of Dyke MD-1B be relocated downstream of its present location to the culvert under the nearby access road."
2009	Spring Inspection	Internal Engineering NL Hydro	- The hole in the downstream toe pond at 0+870 is still present and appears to be unchanged. - Weir shelter at weir MD-1B needs to be replaced. WOF 555860. In addition, low spot adjacent to weir should be filled in.
2009	Fall Inspection - Consultant	Dyke Board of Consultants	MD-1D Ebbegunbaeg Cut-off Dam This was the site of a large boil or sinkhole feature observed in 2006 in a pond at station 0+870 on the dyke, near its downstream toe. At the time of inspection no flow or movement of bottom material could be observed at this feature.
2010	Spring Inspection	Internal Engineering NL Hydro	Weir MD-1B was almost overflowing, so beavers do not appear to be a problem anymore. An attempt should be made to channel water through one location (old weir). Currently water is coming at the new weir from two areas.
2010	Fall Inspection - Consultant	Dyke Board of Consultants	A large boil or sinkhole feature was observed in 2006 in the toepond at Sta. 0+870. In 2009, no flow or movement of bottom material could be observed at this feature, as was the case in 2010. The new weir at MD-1B, which previously flowing full, in the order of 50 l/s, is not capturing all the flow, as some (~20 l/s) flow is now by-passing the weir.
2011	Spring Inspection	Internal Engineering NL Hydro	- Weir MD-1B is completely overwhelmed by the flow. It is flooded and not doing the job we need it to do. An additional weir should be considered adjacent to this one or possibly changing the V-notch in the existing weir to 90°, which would increase its capacity. - We were able to get a very clear view of crater/hole in D/S toe pond. It is possible that it may be increasing in size and it looks deep. Continue to monitor.
2011	Fall Inspection - Consultant	Dyke Board of Consultants	EBBEGUNBAEG CUT-OFF DAM MD-1B - Near the downstream toe of Ebbegunbaeg Cut-off Dam there is a large boil first observed in 2005 in a pond at station 0+870, near the downstream toe of the dam. The hole appears to be about 1.5 m in diameter but sounding would be required to determine its depth. It is considered likely that some water from the reservoir is flowing through the dam's foundation. The quantity of material eroded from the dam's foundation in the pond is difficult to assess since the hole is underwater and fines are most likely transported away with the flow. However, it is probable that some internal erosion of the dam / foundation is occurring at this location and the Board recommends that a reverse filter be constructed over the hole covering the area as shown in Photo 8.
2012	Spring Inspection	Internal Engineering NL Hydro	- Weir MD-1B is completely overwhelmed by the flow. It is flooded and not doing the job we need it to do. An additional weir should be considered adjacent to this one or possibly changing the V-notch in the existing weir to 90°, which would increase its capacity. - A new seep was reported at 0+850 through large stones at the groin leading to toe. This is in the area of the hole in the toe pond and should be monitored. - The hole in the toe pond below the dam needs to be measured and probed to determine its depth and if it is increasing in size. This was discussed in the field and is planned to be done.
2012	Fall Inspection - Consultant	Dyke Board of Consultants	REVIEW OF MAIN ISSUES FROM 2011 DYKE BOARD REPORT BOIL DOWNSTREAM OF EBBEGUNBAEG CUTOFF DAM Near the downstream toe of Ebbegunbaeg Cut-off Dam there is a large boil first observed in 2005 in a pond at station 0+870, near the downstream toe of the dam. The hole appears to be about 1.5 m in diameter but sounding would be required to determine its depth. It is considered likely that some water from the reservoir is flowing through the dam's foundation. The Board had recommended that a reverse filter be constructed over the hole but there are logistical problems in carrying this out successfully, without bringing in some very large equipment. As an intermediate step, Nalcor is planning to do some further investigation and probing in order to decide if this boil is increasing in size. The Board is supportive of this initial approach. 2012 INSPECTION MD-1 (Ebbegunbaeg Cutoff Dam) consists of four shallow rockfill dykes (MD-1A, 1B, 1C and 1D) which range in height from 2m to 9m, and serve as freeboard for low zones adjacent to the MD-1S Control Structure. Construction in 1967 resulted in high seepage through the pervious foundation under the structures. Some other seepage difficulties were due to lack of sufficient good core material for the dykes. There is also the possibility of other boils underwater viewed as shaded locations when seen through the water from the helicopter. NE-NLH staff plans to investigate the pond later this fall by boat using probing and survey measurements. The September 2012 Boil inspection did not reveal any sign of sink hole activity on the upstream face of the dyke above reservoir level. At some point, an underwater inspection for potential sinkholes should be carried out in the reservoir. Leakage is very high from this section of dyke (at least 50 l/s) and the total may be obscured by the pond at the toe. Boil(s) are apparent on the bottom of the pond. Piping may be occurring but is not detected. The following exercise is suggested to be carried out by Hydro staff before the next Board Meeting: The history of leakage flows recorded at the weir located at the outlet of the pond which drains this area should be plotted against reservoir level and reviewed for any increasing trends.
2013	Spring Inspection	Internal Engineering NL Hydro	- Weir MD-1B is completely overwhelmed by the flow. It is flooded and not doing the job we need it to do. A 90° v-notch weir plate should be installed to replace the existing 60° v-notch weir plate. - There appears to be more beaver activity in the area of the weir that will have to be addressed. - This hole appeared to be larger at the surface. New measurements should be taken in 2013.
2013	Fall Inspection - Consultant	Dyke Board of Consultants	MD-1 was not inspected
2014	Spring Inspection	Internal Engineering NL Hydro	- Weir MD-1B is completely overwhelmed by the flow. It is flooded and not doing the job we need it to do. A 90° v-notch weir plate should be installed to replace the existing 60° v-notch weir plate. Additionally some drainage improvements will be required to capture all flow. - There were fresh beaver cuttings in weir shelter. Beavers are again active and need to be removed. - The old weir shelter needs to be removed and beaver debris cleaned up. - This hole appeared to be larger at the surface. New measurements should be taken in 2014.
2014	Fall Inspection	NL Hydro	MD-1 (Ebbegunbaeg Cut-Off Dam) consists of four shallow rock-fill dykes (MD-1A, 1B, 1C & 1D). These dykes range in height from 2m to 9m. These dykes were built on a pervious foundation which has resulted in high seepages over the years. The dam was inspected on the ground and from the air on September 10. The boil in the pond at the toe of the dam near Sta. 0+870 was again reviewed. This has been present for a number of years. It actually appears to be getting larger in size. There was no activity observed around the boil but it should still be monitored during regular surveillance visits to this dam. There appears to be other small boils in this pond that should also be monitored. Access to this area may be improved in the future. If this is the case, a plan should be developed to fill this boil area with clean sand/stone. The main weir below this structure is completely overwhelmed and work is required. The V-notch steel plate should be increased from 60 deg to 90 deg. In addition, drainage improvements are required to ensure all seepage water is getting captured through the weir.
2015	Spring Inspection	Internal Engineering NL Hydro	- Beavers are a major issue at this structure. Currently the toe pond is estimated to be approximately 300 mm above normal level which impacted the ability to review the pressure area (hole) in the toe pond. Additionally, because of the height of the toe pond' it submerged an area of seepage that had previously been discovered at 0+800. - The weir in its current state is useless. The weir culvert is blocked. Beaver debris needs to be removed, a 90° v-notch needs to be installed, drainage improvements are required to direct flow to the weir. There are a few spots on the downstream side of the toe pond that are blocked with beaver cuttings. These cuttings need to be removed. - Weir shelter needs to be replaced.
2015	Fall Inspection - Consultant	DHB Consulting	Ebbegunbaeg Dam (MD-1)-Observations: a) Based on the fly-over, the rip rap and downstream slope both appear to be in good condition. b) At the left side of the control structure, there is a small depression in the rip rap with steep slopes around it and no visible rip rap at its base. See Recommendation 5.9 (a). c) There are several low areas along the top of the wave barrier. See Recommendation 5.9 (b). d) Vegetation work has recently been done on the crest and the upstream rip rap; however, additional work is required. See Recommendation 5.8 (c). e) The flow pipe at 0+340, at the left downstream wing wall of the control structure, was flowing normally with a small flow. f) The weir MD-1B has been refurbished with a 90° V-notch weir and is presently operating with a significant flow (almost full weir flow). g) The last five (5) years of records for the above noted flow pipe and weir were reviewed, indicating that the flows are within acceptable ranges. h) The hole near the toe of MD-1 at chainage 0+870 was clearly visible, possibly due to a low water level in the toe pond at the time of inspection. Water was visibly flowing from the hole and over the surrounding sand berm at the left side. The surrounding sand berm was partially above water. i) Three other small flows were noted emanating from the toe in the area of 0+870. RECOMMENDATIONS Ebbegunbaeg Dam (MD-1) a) Repair the rip rap depression at the left side of the control structure. b) Repair the several low areas along the top of the wave barrier. c) Vegetation work is required on the crest and the upstream rip rap to knock down vegetation remaining from the recent treatment.
2016	Spring Inspection	Internal Engineering NL Hydro	- Weir culvert is blocked by beaver debris, drainage improvements required - Spots downstream of toe pond are blocked by beaver cuttings. Remove cuttings - New seep at 0+800 was under toe pond water during last inspection.

2016	Fall Inspection - Consultant	Courage Projects Ltd.	FINDINGS AND RECOMMENDATIONS MD-1 Dam: In 2005, the note in the Dam Registry, Entry # 51, states: "There was open water noted through the ice on the toe pond at 0+875 – 0+975. This could be an indication of seepage or pressure". It appears that this could be the first indication of the Boil near the toe at 0+870+. In 2012 the hole in the toe pond at 0+870 was probed and measured to be four (4) feet in diameter and six (6) feet deep. A reverse filter was recommended by the Review Board in 2011 to be placed over the boil in the toe pond, as a preventative measure against potential piping. - In the mean time it is recommended that visual inspections continue along this section of dyke with special attention to any signs of settlement or sink hole activity on the crest, slopes, upstream blanket and along the shore line of the dyke. The quality of the leakage water, i.e. clear, cloudy or turbid, should be noted. - As recommended by The Board in 2011 a reverse filter should be installed DAM INSPECTIONS Background Information: The four (4) Ebbe freeboard dykes are built with impervious glacial till and are provided with a layer of rock riprap wave erosion protection along the upstream face. The dykes are built through a boulder field where it was not uncommon to encounter large boulders and slabs of rock within the foundation. In recall of discussions with the site engineer at the time of construction, there were times when the dyke foundation contact zone was cleaned, supposidly, to bedrock?, which, as foundation preparation progressed, turned out to be a large slab of rock. The Ebby structures were completed in 1967. Due to excessive leakage, especially at Dyke MD-1B, an upstream berm of glacial till was constructed between 0+840 and 1+036 in August of 1969. In October 1979 an additional upstream blanket was constructed between 0+820 and 0+910 and protected with riprap. In 2005, the note in the Dam Registry states: "There was open water noted through the ice on the toe pond at 0+875 – 0+975. This could be an indication of seepage or pressure". This appears that this could be the first indication of the Boil near the toe at 0+870+. In 2012 the hole in the toe pond at 0+870 was probed and measured to be four (4) feet in diameter and six (6) feet deep. Since construction of the upstream blanket in 1979 there has been no further significant enhancement to this section of dyke. The dyke has performed satisfactorily over the past 37 years without any signs of distress, such as sink hole activity or excessive settlement on the dyke or in the upstream blanketed area. The leakage appears clear, however NL Hydro advised that there is evidence of small material movement around the Boil which indicates some piping and internal erosion. A reverse filter was recommended as an enhancement to the boil in the toe pond by the Review Board in 2011. It is recommended that visual inspections continue with special attention given to any signs of settlement or sink hole activity on the crest, slopes and along the shore line of the dyke. <u>Todate such instability has not been observed.</u>
2017	Spring Inspection	Internal Engineering NL Hydro	• The weir downstream of the toe pond, in its current state, is not collecting the all the seepage from the dam. A significant amount of water is flowing around the weir in three locations. Work is required to redirect all the seepage from the toe pond back into the weir. There is also a beaver dam just upstream of the toe that should be lowered, but not fully removed as that would drain the toe pond and increase the pressure head on the dam, possibly resulting in more piping through the boil. • The boil downstream of the embankment dam should be filled in the next year while road access is newly cleared. The boil dimensions should be measured prior to infilling so as to determine the volume of material required. This boil should be filled with sandy material to allow water to percolate freely, while controlling the piping of material.
2017	Fall Inspection - Consultant	Courage Projects Ltd.	Ebbegunbaeg Dam & Control Structure (MD-1 & MD-15) Background. The Ebbegunbaeg Dykes consists of four separate sections 1A, 1B 1C & 1D varying in height from 2.4 to 9.0 metres located in low topographic areas right & left of the control structure. The dams are constructed of glacial till and provided with riprap erosion protection on the upstream and downstream faces. The dykes are built on stripped ground to impervious material or bedrock and were constructed through a field of large boulders. There were locations in the foundation where it was difficult to achieve a good cutoff when monster size erratics were encountered. Dyke 1B leaks readily through its foundation. Inspection. All of the dykes and the Control Structure were inspected from the air. Dykes MD-1A & MD 1B and the Control Structure were also inspected on the ground. There was no evidence of any crest settlement, displacement of riprap or sloughing of the slopes. All of the dykes appeared stable and structurally sound. There are ponds of water along the downstream toes of the dykes indicating leakage from the dykes to a variable degree. The boil in the pond at the downstream toe of MD-1B near Sta 0+870, first noticed in 2005, was near invisible due to wind, dark water, overcast and lack of sunlight. However a vague outline could be seen from the air. The dyke crest, slopes & shoreline in the proximity of the boil and high leakage was closely inspected for any signs of settlement or sinkholes. The reservoir was 2 metres below MOL at the time allowing a full inspection of the dyke slope and shoreline in this area. No settlement or sinkholes were observed. Beavers have constructed a dam along the downstream access road which has raised the pond along the toe of the dyke by a metre or so. It is acceptable for the beaver project to remain in place since it results in a favorable backwater which lowers the head on the dyke without any apparent adverse effects. However leakage is bypassing the weir located on the opposite side of the road and requires attention. At the Control Structure the concrete was inspected and found in good shape with the exception of a small void on the right side. It appears that an accumulation of laitance was left between pours at the formwork back of the reinforcing steel and has since washed out. The steel does not appear to be exposed. Repair is not warranted at this time. There is also some etching of the concrete surface within the reservoir fluctuation zone where aggregate is exposed but this is considered normal. The leak at the downstream side of the concrete gravity wall at the right abutment appears to be unchanged. The leakage flow is passing through pipes beneath the "V" notch weir and is not measured. The leak is a result of flow through the bedrock foundation and, as such, is not an immediate concern. Recommendations MD-1 & MD-15 Recommendations. - It is recommended that leakage monitoring be improved at MD-1B and at the right concrete gravity wall of the Control Structure. Leakage flows should be accurately recorded and plotted in relation to the reservoir level.
2018	Spring Inspection	Internal Engineering NL Hydro	Site inspection completed and findings communicated to Hydro Operations.
2018	Fall Inspection - Consultant	Courage Projects Ltd.	All of the dykes and the Control Structure were inspected from the air. Dykes MD-1A & MD 1B were inspected on the ground by walk about. There are ponds of water along the downstream toes of the dykes indicating leakage from the dykes to a variable degree. The boil in the pond at the downstream toe of MD-1B near Sta 0+870, first noticed in 2005, was near invisible due to wind, dark water, overcast and lack of sunlight. However as shown in Photo 45 a vague outline could be seen from the air. A comparison of the 2018 photos indicate that the size of the boil has not changed significantly since 2011. In 2012 the hole at the boil location was measured to be 1.2m Diameter and 1.8m deep. The dyke crest, slopes & shoreline in the proximity of the boil and high leakage was closely inspected for any signs of settlement or sinkholes. The reservoir was 2.75 metres below MOL at the time allowing an extensive inspection of the area. Two (2) sinkholes were observed near the water's edge upstream of the area of the boil located near the downstream toe. These were about 0.5 to 1.0 metres in diameter and 0.5 m deep. It is recommended that the upstream blanket be extended. In consideration of the Dyke Board recommendation made in 2011 it is recommended that a berm of material be placed along the toe to buttress the dyke and cover the boil. The berm should be constructed one metre higher than the highest pond level at the toe. There was no evidence of any crest settlement, displacement of riprap or sloughing of the slopes in the area of the downstream boil and upstream sinkholes All of the dykes, after 51 years of performance appeared stable and structurally sound. Nonetheless the improvements recommended above are important to mitigate the potential for internal erosion and preserve future integrity of Dyke MD-1B. Beavers have constructed a dam along the downstream access road at MD-1B near Sta 0+870, which has raised the pond along the toe of the dyke by a metre or so. In defiance of standard practice it is acceptable for the beaver dam to remain in place since it results in a favorable backwater surcharge on the dyke which lowers the head and lessens the potential for internal erosion (piping). However leakage is bypassing the weir located on the opposite side of the road and requires repair. It is recommended that the weir in the vicinity of 0+870 be repaired. Recommendations. - It is recommended that the upstream blanket be extended and a berm be constructed along the downstream toe of the dyke at Sat 0+880 to enhance the long term performance of Dyke MD-1B. - It is recommended that leakage monitoring be improved at MD-1B and at the right concrete gravity wall of the Control Structure. Leakage flows should be accurately recorded and plotted in relation to the reservoir level.
2019	Spring Inspection	Internal Engineering NL Hydro	• Install second weir wear MD-1B. WO # 1410375 • Monitor boil in the toe pond.
2019	Fall Inspection - Consultant	Courage Projects Ltd.	Summary & Recommendations Summary Internal Erosion Caused by Leakage: - A high percentage of dam failures are caused by internal erosion due to leakage, otherwise known as "piping". In general, the NL Hydro dams on The Island experience a normal rate of leakage without evidence of significant internal erosion with the exception of Dyke MD-1B at Ebbegunbaeg. At MD-1B leakage is high with associated sink holes and boil activity. Enhancement is recommended. All dams leak to some extent within a normal range relative to reservoir level. In accordance with Dam Safety guidelines the leakage is monitored regularly to detect any change in condition, i.e. internal erosion of the materials of which the dam is built including the foundation. - Sinkhole activity and a high rate of leakage has been identified at Ebbegunbaeg Dyke MD-1B since 2005. The actual cause of the leakage through the dyke is uncertain, but very likely is the result of water flowing beneath a large glacial erratic (large slab of rock) overlying bedrock on which the dyke could be founded. As a result of the leakage, sinkholes have been observed on the floor of the reservoir located in front of the dyke and a large hole in the form of a boil has developed on the backside near the toe. There has been no sign of deterioration to the dyke to date such as settlement, cracking or slope instability. However, to enhance the long-term stability of the structure the condition should be assessed with consideration given to substantial buttressing, by means of a berm and filter application, both upstream and downstream at this location. Recommendations MD-1 & MD-15 Recommendations. • It is recommended that consideration be given to the construction of an upstream blanket and a downstream berm at the toe of the dyke at Sat 0+880 to enhance the long-term performance of Dyke MD-1B. An Engineering Consultant should be engaged to review the problem and prepare details for the work. • Leakage from the reservoir be controlled and monitored at 0+880 as the reservoir rises. At present leakage flows bypass the weir at high reservoir level. MD-1A & 1B, MD-15. Inspection. These dykes and the Control Structure were inspected from the air and on the ground by walk about. There are ponds of water along the downstream toes of the dykes indicating that leakage flows occur from the dykes to a variable degree depending upon reservoir level. The boil in the pond at the downstream toe of MD-1B near Sta 0+870 first noticed in 2005 when open water through the ice cover on the pond was noticed, was exposed just above water level at the toe due to the low reservoir level being 3.54m below MOL. The dyke crest, slopes & shoreline in the proximity of the boil and high leakage was closely inspected for any signs of settlement of the dyke or the presence of sinkholes. The dyke appears unaffected by the leakage. However, two (2) sinkholes were observed near the water's edge upstream of the area of the boil located near the downstream toe. These were also inspected in 2018 and appear unchanged. The holes are about 0.5 to 1.0 metres in diameter and 0.5m deep. It is recommended that the upstream blanket be extended over this area. In consideration of the Dyke Board recommendation made in 2011 it is recommended that a berm of material be placed along the toe to buttress the dyke and cover the boil. The berm should be constructed one metre higher than the highest pond level at the toe. There was no evidence of any crest settlement, displacement of riprap or sloughing of the slopes of the dyke in the area of the downstream boil and upstream sinkholes. In discussion with Lev Kearley following the inspections on September 13th (L. Kearley, C. Sparkes, & L. Courage) it was agreed to fill the upstream holes with sand later this Fall 2019 as a temporary measure until a blanket can be placed on the upstream side in combination with a toe berm and filter on the downstream side. All of the Ebbe Dykes, after 52 years of performance appeared stable and structurally sound. Nonetheless the improvements recommended above for Dyke MD 1B are important to mitigate the potential for internal erosion, deterioration of the dyke and preserve future integrity. Beavers have constructed a dam along the downstream access road at MD-1B near Sta 0+870. At the time of the Sept 2019 inspection when the reservoir was at El 268.91 (3.54m below MOL) there was only a small trickle of leakage from the hole and nonvisible at the weir or crossing the road. The weir was dry.
2020	Spring Inspection	Internal Engineering NL Hydro	Site inspection completed and finding communicated to Hydro Operations.
2020	Fall Inspection - Consultant	Growler Energy	Recommendations - In the area of the sinkhole at 0+800, long term plans in place to install a berm over this area should be finalized. - Weir MD-1B should be upgraded to capture all seepage at this location.
2021	Spring Inspection	Internal Engineering NL Hydro	• The weir downstream of the toe pond, in its current state, is not collecting all the seepage from the dam. A significant amount of water is flowing around the weir in three locations. It is recommended to install an additional weir to capture the additional flow and the area should be graded to direct flow into the two weirs. • Monitor seepage at 0+800 on MD-1B. • Boil observed downstream of MD-1B. Routine inspection of depth and size of boil should be completed at minimum once per year. It is recommended to install a reverse filter over the boil downstream of the embankment dam (MD-1B). It is recommended to plan this work to be completed within the next 3-4 years. • Sinkholes upstream of the boil were observed a few years ago during a low reservoir level at Meelpaeg. It is recommended that this area have a silt blanket installed to reduce the flow into the piping/boil area. A reservoir level in the range of 269.5 m would be required for this work.

2021	Fall Inspection - Consultant	Courage Projects Ltd.	Inspection These dykes and the Control Structure were inspected from the air and on the ground by walk about. There are ponds of water along the downstream toes of the dykes indicating that leakage flows occur from the dykes to a variable degree depending upon reservoir level. The boil in the pond at the downstream toe of MD-1B near Sta 0+870 first noticed in 2005 when open water through the ice cover on the pond was noticed, was exposed just above water level at the toe due to the low reservoir level being 3.54m below MOL. The hole at the boil location was measure in 2012 as 4 ft in diameter and 6 feet deep. The dyke crest, slopes & shoreline in the proximity of the boil and high leakage was closely inspected during the 2021 inspection for any signs of settlement of the dyke or the presence of sinkholes. The dyke appears unaffected by the leakage. The area upstream of the dyke where sinkholes are known to exist were under water and not inspected. There was no evidence of any crest settlement, displacement of riprap or sloughing of the slopes of the dyke in the area of the downstream boil and upstream sinkholes. All of the Ebbe Dykes appeared stable and structurally sound. Nonetheless the improvements in past reports for Dyke MD 1B are important to mitigate the potential for internal erosion, deterioration of the dyke and preserve future integrity. Beavers have constructed a dam along the downstream access road at MD-1B near Sta 0+870. The beaver dam creates a backwater which reduces the head at the location of the boil and hence lowers the piping potential. Therefore, in this case, it is advisable to retain the industrious beaver and dam. Leakage was heavy at the time of the 2021 inspection with the reservoir at 270.45m. There are two weir shacks and additional flow over the road bypassing the weirs. Additional leakage control is required so that all of the flow can be monitored at the weirs.
2022	Spring Inspection	Internal Engineering NL Hydro	- Recent improvements have been completed to better capture the seepage flow from MD-1B. A second weir has been added adjacent to the old weir to improve capacity in an attempt to collect the seepage from the dam and toe pond area. At the time of inspection, a small amount of seepage was observed bypassing both weirs at low spots located as far as 20 m away from the weirs on the Noel Paul side of the access road. Sedimentation was also observed in the older weir that should be removed. It is recommended that sediment be removed from the old weir and to complete drainage improvements to ensure no flow is bypassing the weirs. The area should be graded to direct flow into the two weirs. Refer to Photo 20. - Monitor seepage at 0+800 on MD-1B. - Boil observed downstream of MD-1B. Routine inspection of depth and size of boil should be completed at minimum once per year. A review of the recent inspection history shows that this has not been completed in the last several years. Recommend a PM be created and inspection of the depth and size be completed on a semi-annual frequency. - As has been noted in previous inspections, it is recommended to install a reverse filter over the boil downstream of the embankment dam (MD-1B). It is recommended to plan this work to be completed within the next 3-4 years. - Sinkholes upstream of the boil were observed a few years ago during a low reservoir level at Meelpaeg. It is recommended that this area have a silt blanket installed to reduce the flow into the piping/boil area. A reservoir level in the range of 269.5 m would be required for this work.
2022	Fall Inspection - Consultant	Courage Projects Ltd.	MD-1A to MD-1D. Inspection. These dykes and the Control Structure were inspected from the air and on the ground by walk about. There are ponds of water along the downstream toes of the dykes indicating that leakage occurs from the dykes to a variable degree depending upon reservoir level. The boil in the pond at the downstream toe of MD-1B near Sta 0+870 first noticed in 2005 when open water through the ice cover on the pond was observed. Based on past observations the hole was exposed in the pond when the reservoir was low, around 3.54m below MOL. The hole at the boil location was measure in 2012 as 4 ft in diameter and 6 feet deep. The dyke appears unaffected, with no evidence of internal erosion (piping), such as sinkholes or settlement, by the leakage. The area upstream of the dyke where sinkholes are known to exist were under water and not visible at the time of the 2022. There was no evidence of any crest settlement, displacement of riprap or sloughing of the slopes of the dyke in the area of the downstream boil and upstream sinkholes at the time of the 2022 inspection. All of the Ebbe Dykes appeared stable and structurally sound. Beavers have constructed a dam along the downstream access road at MD-1B near Sta 0+870. The beaver dam creates a backwater which reduces the head at the location of the boil and hence lowers the piping potential. Therefore, in this case, (the opposite of normal procedure) it is advisable to retain the industrious beaver and the Beaver Dam. Leakage measuring should be reviewed so that all of the flow can be monitored at the weirs. The flow at 0+900 appeared clear and free of material transport. There is no ring around the boil which is atypical of piping where the eroded material forms a ring around the boil. The writer, permanently at Pudops Dam during construction, visited the Ebbe site has concluded that the dyke at this location is founded, inadvertently, on top of a large erratic boulder. In this case flow is passing over the bedrock surface beneath the boulder and piping erosion of the dyke material is not occurring. This hypothesis is supported by memory and by the fact that no settlement or sinkhole activity has occurred, within the dyke fill, at this location over the past 55 years. MD-1A to MD-1D Findings & Recommendations. - The Dykes and Control Structure were found to be structurally sound. The future integrity of the works can be maintained by ongoing maintenance. - It is recommended that the existing upstream blanket be enhanced, and a berm be placed along the downstream toe of the dyke at Sta 0+900+ to promote satisfactory long-term performance of Dyke MD-1B. An Engineering Consultant should be engaged to review the condition and prepare details for the work.
2023	Spring Inspection	Internal Engineering NL Hydro	- At the time of inspection, a small amount of seepage was observed bypassing both weirs at MD-1B at low spots located as far as 20 m away from the weirs on the Noel Paul side of the access road. It is recommended to complete drainage improvements to ensure no flow is bypassing the weirs. The area should be graded to direct flow into the two weirs. Refer to Photo 17. - Monitor seepage at 0+800 on MD-1B. - Boil observed downstream of MD-1B. Routine inspection of depth and size of boil should be completed at minimum once per year. A review of the recent inspection history shows that this has not been completed in the last several years. Recommend a PM be created and inspection of the depth and size be completed on a semi-annual frequency. - As has been noted in previous inspections, it is recommended to install a reverse filter over the boil downstream of the embankment dam (MD-1B). It is recommended to plan this work to be completed within the next 2-3 years. - Sinkholes upstream of the boil were observed a few years ago during a low reservoir level at Meelpaeg. It is recommended that this area have a silt blanket installed to reduce the flow into the piping/boil area. A reservoir level in the range of 269.5 m would be required for this work.
2023	Fall Inspection - Consultant	WSP	MD-1 (Ebbegunbaeg Cutoff Dam) consists of four shallow rock fill dykes. These dykes range in height from 2.4m to 9m. The structures were constructed on a foundation of till containing large boulders. In this area it is noted that high seepage has been observed over the years. There is a boil downstream of MD-1B that was first identified in 2005. This boil has been probed a number of times since. It has been determined that the boil is slowly deepening; however, the sediment ring around the boil is very small, suggesting that there has been minimal material transport. During a lower reservoir level period, two sinkholes were noted upstream of the MD-1B dyke that are somewhat in line with the downstream boil and could possibly be an entrance to a flow path under the structure and through the bolder foundation. In 1979, an upstream silt blanket was installed upstream of MD-1B and remnants of that blanket were visible around the upstream sinkholes as noted during the last 5 years when reservoir levels were lower than are typical. The dykes were inspected via helicopter; however, the downstream area of MD-1B was inspected on the ground. The following observations were noted during the inspection: - The boil located downstream of MD-1B was not visible from the helicopter due to weather conditions. From discussion on site, it is understood that the boil has not notably increased in size based on visual assessment. In the past, the boil has had its diameter and depth measured to determine more accurately if the boil has been increasing in size. It is understood that the boil was measured after this inspections and it was found that there is no change in depth or diameter since the last measurement. Recommend measuring the boil for diameter and depth changes on annual frequency at minimum. - Previous inspection reports have recommended the installation of a reverse filter at the toe of MD-1B where the boil is located. Recommend planning to add this reverse filter design and construction to the long term plan. - It appears that the old beaver dam at the downstream end of the toe pond is higher than previously noted which is potentially causing an increase in the toe pond elevation. Recommend installing a staff gauge in the toe pond to monitor the water level changes in the pond. - Flow from the toe pond was observed to be pooling on the access road and partially bypassing the two weirs downstream of the toe pond. All the flow should be captured in the weirs. During the site visit, ways to correct this issue were discussed, understanding that draining the toe pond is not desirable as it may increase the pressure on the boil and encourage piping through the dam. One option includes the following: - Lower the debris /beaver dam area to the old weir elevation (located directly in the beaver dam). As a result, the toe pond elevation would be lowered slightly to a previously acceptable pond level which should be determined by NLH and completed in consultation with the Dam Safety Engineering Supervisor. - Extend both weir culverts across the road to the beaver dam side of the road. - Install a ditch just below the beaver dam to collect flow from the beaver dam and direct it into the two weir culvert inlets. - Backfill the access road and provide sufficient cover over the culverts. The road approaches should be gradual over the culverts. - Overall, it is recommended that adjustments be made to this area so that all the seepage flow is captured in the weirs. RECOMMENDATIONS The following items are recommended for MD-1: 1. Recommend measuring the boil downstream of MD-1B for diameter and depth changes on an annual basis at minimum. 2. Recommend planning to add the design and construction of a reverse filter at the toe of MD-1B to the long term plan. 3. Recommend installing a staff gauge in the toe pond to monitor the water level changes in the pond. 4. It is recommended that adjustments be made to this area downstream of the toe pond so that all the seepage flow is captured in the weirs.
2024	Spring Inspection	Internal Engineering NL Hydro	- At the time of inspection, a small amount of seepage was observed bypassing both weirs at MD-1B at low spots located as far as 20 m away from the weirs on the Noel Paul side of the access road. It is recommended to complete drainage improvements to ensure no flow is bypassing the weirs and to remove debris from inside of the weir culverts and housing. The area should be graded to direct flow into the two weirs. Refer to Photo 18. - At the time of inspection, significant flow was observed exiting the toe pond immediately upstream of the weirs located at MD-1B. While changes have been made recently by operations to lower the toe pond, flow rates look to have increased significantly. It is recommended the structure continue to be monitored on a biweekly basis and close attention be paid to the seepage rates at both weirs. - Four areas of known seepage should be monitored closely moving forward. Flow was observed at: - 0+870 – high volume of seepage observed in this area along the toe of the downstream slope. - 0+900 – flow observed by operations during boil inspection in December of 2023 - 0+950 – minor flow noted at the toe of the downstream slope (location marked on the crest with flagging tape on rock). - 0+975 – flow observed by operations during boil inspection in December of 2023. - Boil observed downstream of MD-1B. Routine inspection of depth and size of boil should be completed at minimum once per year. A PM has recently been created to ensure annual measurement and inspection is completed. Operations completed inspection of the boil in December of 2023. At that time the boil measured 12 feet in diameter and was 5 feet in depth (following changes to the toe pond which lowered the level of the pond by 3 feet). Recommended to continue annual inspection and measurement of the boil. - As has been noted in previous inspections, it is recommended to install a reverse filter over the boil downstream of the embankment dam (MD-1B). A capital plan is scheduled to begin in 2027 (tentative). - Sinkholes upstream of the boil were observed a few years ago during a low reservoir level at Meelpaeg. It is recommended that this area have a silt blanket installed to reduce the flow into the piping/boil area. This work will be included within the planned capital project noted above. A reservoir level in the range of 269.5 m would be required for this work.

2024	Fall Inspection - Consultant	Atkins Realis	Inspection and Findings The dykes were inspected via helicopter; however, MD-1B including its downstream area was also inspected on the ground. The following observations were noted during the inspection: - The boil located downstream of MD-1B was somewhat visible from the helicopter. From discussion on site, it is understood that the boil has not notably increased in size based on visual assessment. In the past, the boil has had its diameter and depth measured to determine more accurately if the boil has been increasing in size. Recommend measuring the boil for diameter and depth changes on an annual frequency at minimum. It is understood a PM was established in 2023. - A small area of potentially unfiltered seepage observed close to the dam toe. Monitor this area for changes. Given that this potential unfiltered seepage exit is a new observation, it is recommended to complete a detailed aerial review of the downstream area of the entire dyke length of MD-1 when there is a thin ice cover on the toe pond so moving water can be more easily detected. - Previous inspection reports have recommended the installation of a reverse filter at the toe of MD-1B where the boil is located. Recommend engaging a consultant to design a reverse filter for the toe of the dam and also consider the augmentation of the existing upstream blanket. It is recommended to add the construction of the reverse filter berm and any recommended augmentation of the existing upstream impervious blanket to the long-term plan. - Previous engineering inspections noted new seepage downstream of MD-1A between the fence and the diesel building. There was no seepage visible during the inspection; however, the seepage could be linked to the reservoir level. Continue to monitor this seepage and correlate reservoir level with the presence/absence/intensity of seepage. - Previous reports have recommended to install a staff gauge in the downstream pool to determine fluctuations in the toe pond. Recommend installing a staff gauge in the toe pond to monitor the water level changes in the pond. - The V notch in the south (newer) weir is flooded and nearing capacity. It is recommended to replace the 60-degree V notch with a 90-degree V notch and relocate the large rock in the weir house so it does not encourage back flooding of the flow. - Flow from the toe pond was observed to be pooling on the access road and partially bypassing the weirs downstream of the toe pond. All the flow should be captured in the weirs. Since the last fall inspection, the toe pond was lowered below the old in-line concrete weir that is still currently located in the beaver dam but is not functioning. The beaver dam was lowered more than anticipated and the toe pond is now also lower than desired. This lower level may result in an increase in seepage in the weirs or an increase in the flow through the boil. A comprehensive review of this seepage collection system is recommended to develop a plan to capture all the seepage from the toe pond. - Vegetation is growing on all structures. It is recommended to include vegetation removal of these structures to the regular program. RECOMMENDATIONS The following items are recommended for MD-1: 1. Recommend measuring the boil downstream of MD-1B for diameter and depth changes on an annual basis at minimum. 2. Recommend monitoring and measuring the new boil for changes. 3. Complete a detailed aerial review of the entire downstream area of MD-1B when there is a thin ice cover in the toe pond to look for additional boils or areas of concentrated seepage. 4. Recommend engaging a consultant to design a reverse filter for the toe of MD-1B and consider augmenting the upstream impervious blanket. 5. Recommend installing a staff gauge in the toe pond to monitor the water level changes in the pond. 6. Changing the south (new) weir plate from a 60 degree V notch to a 90 degree V notch and relocate downstream boulder to reduce backflooding of the V notch plate. 7. Complete a comprehensive review of the seepage collection system at MD-1B and develop a plan to capture all the seepage from the toe pond. 8. Continue to monitor the seepage downstream of the diesel building in MD-1A and correlate seepage with reservoir level.
2025	Spring Inspection	Internal Engineering NL Hydro	• At the time of inspection, a small amount of seepage was observed bypassing both weirs at MD-1B at low spots located as far as 20 m away from the weirs on the Noel Paul side of the access road. It is recommended to complete drainage improvements to ensure no flow is bypassing the weirs and to remove debris from inside of the weir culverts and housing. The area should be graded to direct flow into the two weirs. Refer to Photo 18. • At the time of inspection, significant flow was observed exiting the toe pond immediately upstream of the weirs located at MD-1B. While changes have been made recently by operations to lower the toe pond, flow rates look to have increased significantly. It is recommended the structure continue to be monitored on a biweekly basis and close attention be paid to the seepage rates at both weirs. • Four areas of known seepage should be monitored closely moving forward. Flow was observed at: - 0+870 – high volume of seepage observed in this area along the toe of the downstream slope. - 0+900 – flow observed by operations during boil inspection in December of 2023 - 0+950 – minor flow noted at the toe of the downstream slope (location marked on the crest with flagging tape on rock). - 0+975 – flow observed by operations during boil inspection in December of 2023. • Boil observed downstream of MD-1B. Routine inspection of depth and size of boil should be completed at minimum once per year. A PM has recently been created to ensure annual measurement and inspection is completed. Operations completed inspection of the boil in December of 2023. At that time the boil measured 12 feet in diameter and was 5 feet in depth (following changes to the toe pond which lowered the level of the pond by 3 feet). Recommended to continue annual inspection and measurement of the boil. • As has been noted in previous inspections, it is recommended to install a reverse filter over the boil downstream of the embankment dam (MD-1B). A capital plan is scheduled to begin in 2027 (tentative). • Sinkholes upstream of the boil were observed a few years ago during a low reservoir level at Meelpaeg. It is recommended that this area have a silt blanket installed to reduce the flow into the piping/boil area. This work will be included within the planned capital project noted above. A reservoir level in the range of 269.5 m would be required for this work.
2025	Fall Inspection - Consultant	Atkins Realis	Executive Summary The dams were inspected the first week of October 2025 and are overall in satisfactory condition. Two structures; Hinds Lake Power Canal and Ebbegunbaeg dam, are noted as not in satisfactory condition. Ebbegunbaeg dam, primarily MD-1B, is in poor condition due to the unfiltered seepage/boil downstream of the dam that is slowly increasing in size as well as a downstream slope that does not meet the minimum recommended factor of safety for stability. - Seepage from MD-1B is bypassing the seepage collection and measuring weirs. Complete a comprehensive review of the seepage collection system at MD-1B and develop a plan to collect and measure all the seepage from the toe pond. Conclusion and Summary of Recommendations - The MD-1B dyke at Ebbegunbaeg is in poor condition as it has a downstream slope that does not meet the minimum factor of safety under normal operating conditions and has a boil located downstream that has been slowly increasing in size since it was first documented around 2006. - Recommend measuring the boil downstream of MD-1B for diameter and depth changes on an annual basis at minimum. - Recommend installing a staff gauge, or automated gauge, in the toe pond to monitor the water level changes in the pond. - Recommend changing the south (new) weir plate from a 60 degree V notch to a 90 degree V notch and relocate downstream boulder to reduce backflooding of the V notch plate. - Remove debris and sediment from both weirs. - Complete a comprehensive review of the seepage collection system at MD-1B and develop a plan to capture all the seepage from the toe pond. - Remove alders and conifers from the structure as part of the vegetation removal program. - Recommend continuing with daily camera observations and recording these observations so there is an official record including date, time, reservoir level, observation, observer name and other pertinent information
2026	Spring Inspection	Internal Engineering NL Hydro	• Weir MD-1B N to be changed to 90 degree weir to accurately track seepage • At the time of inspection, a small amount of seepage was observed bypassing both weirs at MD-1B at low spots located as far as 20 m away from the weirs on the Noel Paul side of the access road. It is recommended to complete drainage improvements to ensure no flow is bypassing the weirs and to remove debris from inside of the weir culverts and housing. The area should be graded to direct flow into the two weirs. - Four areas of known seepage should be monitored closely moving forward. Flow was observed at: - 0+870 – high volume of seepage observed in this area along the toe of the downstream slope. - 0+900 – flow observed by operations during boil inspection in December of 2023 - 0+950 – minor flow noted at the toe of the downstream slope (location marked on the crest with flagging tape on rock). - 0+975 – flow observed by operations during boil inspection in December of 2023. • Boil observed downstream of MD-1B. Routine inspection of depth and size of boil should be completed at minimum once per year. A PM has recently been created to ensure annual measurement and inspection is completed • As has been noted in previous inspections, it is recommended to install a reverse filter over the boil downstream of the embankment dam (MD-1B) • Sinkholes upstream of the boil were observed a few years ago during a low reservoir level at Meelpaeg. It is recommended that this area have a silt blanket installed to reduce the flow into the piping/boil area. This work will be included within the planned capital project noted above. A reservoir level in the range of 269.5 m would be required for this work. • Install a staff gauge on toe pond to monitor changes in depth.