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Date: July 15, 2021

To: Minnesota Department of Natural Resources

From: Enbridge Line 3 Replacement Team

Re: **Clearbrook Groundwater Investigation Plan – Revision 1**

This Groundwater Investigation Plan (GIP) outlines the work proposed to complete six (6) test borings for soil evaluation and groundwater pressure monitoring instrumentation installation near the alignment for Line 3R at MP910.0, which is located west of the Clearbrook Terminal. Limited existing groundwater pressure data exists in this area, especially at depths that penetrate the confining layer. This GIP is intended to be responsive to requests contained in the June 16, 2021 email from Randall Doneen (DNR CAR Section Manager). The purpose of this plan is to provide an overview of the GIP goals and an overview of the approaches for drilling in known artesian groundwater conditions.

Enbridge's proposed scope of work includes the advancement of four (4) borings proximal to the new pipeline alignment and two (2) borings approximately 2800 and 4000 feet east-southeast, at locations shown on the attached Figure 1. As described in subsequent sections, three (3) of the borings are planned to penetrate through the confining layer into the likely artesian groundwater conditions, with the remaining three (3) borings to be terminated within the confining layer.

Instrumentation will be installed in each of the six (6) borings to evaluate and monitor groundwater pressure over time (both above and below the confining layer), as summarized below.

2021 Soil Boring and Pressure Monitoring Locations

The proposed boring locations and depths are outlined in Table 1 and are shown on the attached Figure 2.

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Table 1 Boring Location Summary

Borehole ID	Approximate Boring Depth (ft)	Boring Use	Sampling
CB-21-1A	10 feet below bottom of confining layer	Define native stratigraphy interfaces and confined groundwater pressure	Continuous, minimally disturbed samples with targeted undisturbed sampling
CB-21-1B ⁽¹⁾	5 feet above bottom of confining layer	Offset for instrumentation	No sampling required
CB-21-1C ⁽¹⁾	10 feet above bottom of confining layer	Offset for instrumentation	No sampling required
CB-21-2	Into the confined layer	Understand backfill conditions	Continuous, minimally disturbed samples with targeted undisturbed sampling
CB-21-3	10 feet below bottom of confining layer	Instrument installation into confined layer	Continuous, minimally disturbed samples with targeted undisturbed sampling
CB-21-4	10 feet below bottom of confining layer	Instrument installation into confined layer	Continuous, minimally disturbed samples with targeted undisturbed sampling

(1) Borings will be completed as close as safely feasible to CB-21-1A

Drilling Approach

Based on the previous investigations and review of nearby water well logs, artesian conditions are anticipated at each boring location. As a result, the drilling fluid used for the planned borings will be designed to mitigate artesian pressures. A licensed and experienced contractor familiar with dealing with artesian conditions will be hired to complete the borings in accordance with Minnesota Rules, part 4725.3450 (Flowing Well or Boring).

Each boring will be advanced by drilling and continuously sampling to identify the interfaces between the stratigraphy, with the exceptions of CB-21-1B and CB-21-1C. Borings CB-21-1B and CB-21-1C will be placed immediately adjacent to CB-21-1A and may be blind drilled since the lithology will be observed in CB-21-1A. For each boring, a casing will be installed approximately 5 to 10 feet into the confining layer; the actual depth will be determined in the field. A casing affixed with a gate valve located at the ground surface will be cement grouted in place and allowed to cure for at least 24 hours. Following curing, the casing will be reamed out and the boring will be advanced using heavy drilling mud designed to prohibit artesian groundwater flow to the surface from developing. Following the completion of drilling, a vibrating wire piezometer will be placed in each boring at depths specified in Table 2. The full depth of the borehole will subsequently be backfilled with neat cement grout using tremie pipe methodology. The grout used will be higher density than the drilling mud to ensure displacement during injection of the neat cement grout.

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Instrumentation

Vibrating Wire (VW) piezometers will be installed in the borings at depths identified in Table 2. The VWs will be installed by being taped to a 1-inch diameter sacrificial grout rod and lowered into the borehole. All borings will be grouted in accordance with Minnesota Department of Health requirements or variances will be submitted, if required.

In addition, a weather station will be installed to monitor precipitation and atmospheric conditions proximal to the site to apply a barometric pressure correction to the piezometers. The VW piezometers will be monitored with near-real-time collection of pressure head via cellular telephone modems powered by a solar panel array installed near the borings. The VWs and weather station will be connected to a fully automated monitoring system with telemetry to provide remote monitoring of all instrumentation at a 15-minute interval after installation and setup. This frequency may be increased for critical tasks, such as during sealing activities.

Table 2 Instrumentation Summary

Borehole ID	Instrumentation Depth	Instrumentation Goal
CB-21-1A	At least 2 feet into the confined layer	Confined layer pressure
CB-21-1B	5 feet above bottom of confining layer	Gradient within confined layer
CB-21-1C	10 feet above bottom of confining layer	Gradient within confined layer
CB-21-2	Through the base of the disturbed material and strapped to the outside of the casing within the disturbed zone	Understand the pressures in the disturbed material and the effectiveness of future remediation
CB-21-3	At least 2 feet into the confined layer	Confined layer pressure
CB-21-4	At least 2 feet into the confined layer	Confined layer pressure

The goal of the instrumentation installation is to:

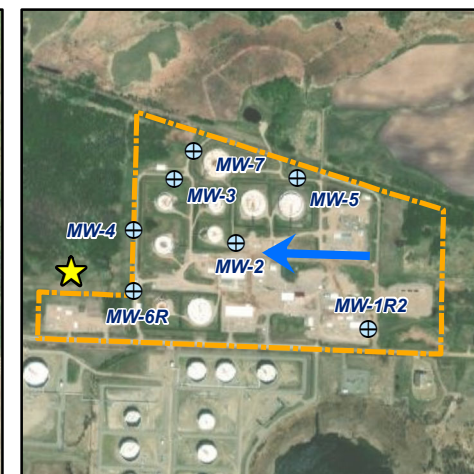
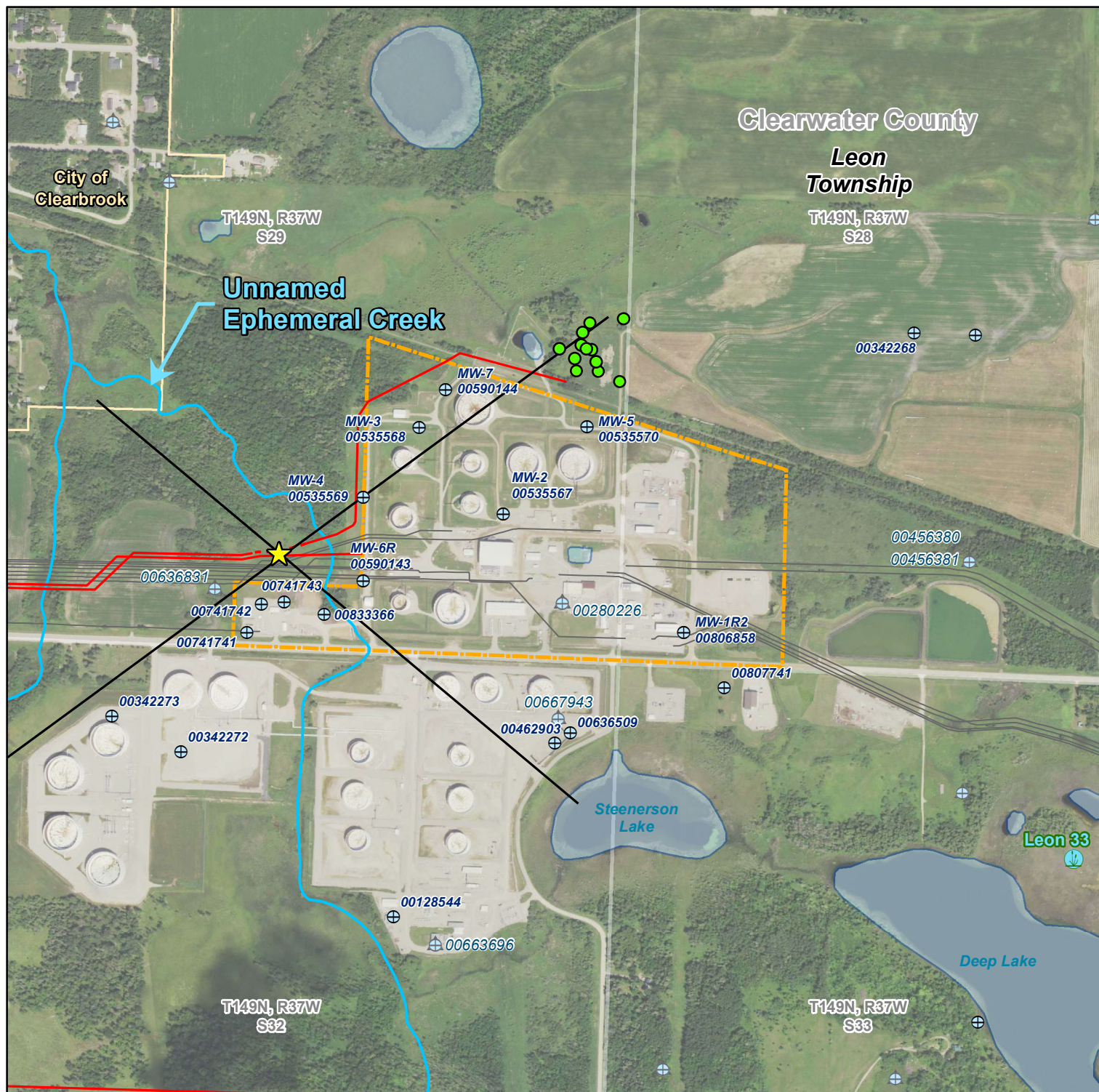
- Evaluate the pressure in the confined layer
- Evaluate the gradient within the confining layer
- Evaluate the effectiveness of future remediation
- Evaluate the differences in pressure between the uncontrolled flow and the Leon 33 fen
- Provide data necessary to develop a sealing plan

Figures

Figure 1 Clearbrook Existing Boring Locations

Figure 2 Clearbrook Proposed Boring Locations

Figures



- ★ Site Location
- Previous Geotechnical Exploration Locations
- ⊕ Wells - Minnesota Well Index
- ⊕ Unverified Well - Minnesota Well Index
- ➔ Groundwater Flow Direction
- Constructed Line 3 Replacement
- - - Line 3 Replacement (Not Constructed)
- Enbridge Pipelines
- Cross Sections
- - - Terminal Property Boundary
- Calcareous Fen Location
- Rivers & Streams



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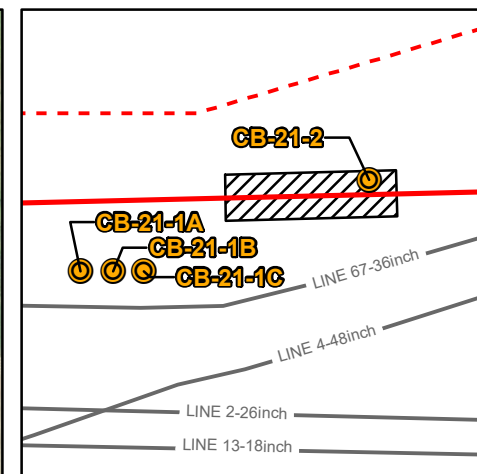
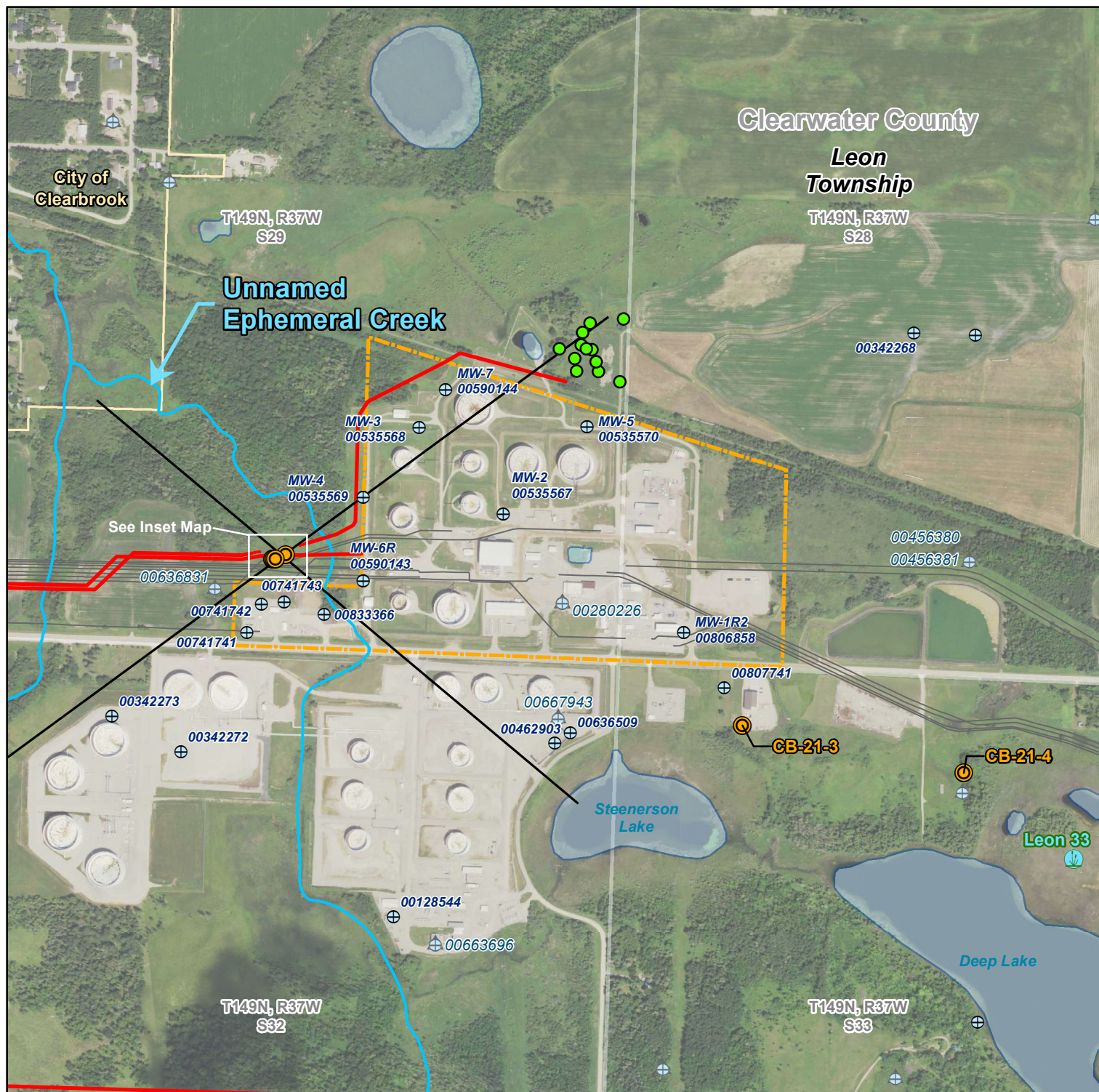
Feet

1 Inch = 800 Feet

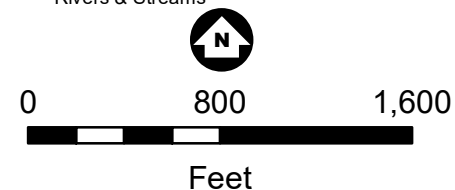
Figure 1

**CLEARBROOK
EXISTING BORING LOCATIONS**
Clearbrook Terminal
Enbridge Energy, L.P.
Clearbrook, Minnesota





- Proposed Boring Locations
- Excavation/Trench Box
- Previous Geotechnical Exploration Locations (Completed by Barr)
- ⊕ Wells - Minnesota Well Index
- ⊕ Unverified Well - Minnesota Well Index
- Constructed Line 3 Replacement
- - - Line 3 Replacement (Not Constructed)
- Enbridge Pipelines
- Cross Sections
- - - Terminal Property Boundary
- Calcareous Fen Location
- Rivers & Streams



1 Inch = 800 Feet

Figure 2

**CLEARBROOK
PROPOSED BORING LOCATIONS**
Clearbrook Terminal
Enbridge Energy, L.P.
Clearbrook, Minnesota

