



THURBER ENGINEERING LTD.

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Village of Bawlf
Box 40
Bawlf, Alberta
T0B 0J0

Attention: Ms. Tracy Stewart
Finance Officer

BAWLF EXISTING SEWAGE TREATMENT PLANT ASSESSMENT OF THE EXISTING LAGOON CONDITIONS

Dear Madam:

This report presents the results of an assessment carried out Thurber Engineering Ltd. (Thurber) for an existing wastewater lagoon in the Village of Bawlf, Alberta. The work was carried out in general accordance with our proposal letter to Ms. Tracy Stewart, Finance Officer of the Village of Bawlf. Authorization to proceed with the work was received from Ms. Stewart on November 5, 2014.

Use of this report is subject to the Statement of Limitations and Conditions which is included at the end of the text of this report. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

1. LAGOON

The wastewater lagoon is located within the legal land description NE ¼ 25-45-18 W4M and situated south of the Village of Bawlf, Alberta. The lagoon is part of the wastewater the treatment plant and include two anaerobic cells (1 and 2), a primary cell (5) and a secondary cell (6). Along the south berm of the wastewater lagoon there is an unnamed creek were the treated water is discharged once a year.

2. AVAILABLE INFORMATION

Based on conversation with Ms. Stewart and Mr. Justin Jacobson, of the Village of Bawlf, the unlined lagoon was built during the early 1980's. The lagoon berms were constructed with compacted native soil originating from the base of the excavation.

Ms. Stewart provided an overall site plan to Thurber, which shows that 8 test holes were drilled for the design of the sewage lagoon. The test holes were drilled to depths varying from 1.8 m to 2.9 m. The soil stratigraphy consisted mainly of sandy clay till with occasional sand lenses (present in 3 test holes).



Based on the drawing, the depths of the cells from top of the berm to the bottom of the cells were approximately 4 m for Cells 1 and 2, 2.3 m for Cell 5 and 3.0 m for Cell 6. All the berms slide slopes were inclined a 3H:1V slope.

3. SITE RECONNAISSANCE

3.1. General

A site reconnaissance was conducted on November 3, 2014 by Dr. Renato Clementino, P. Eng. of Thurber. The reconnaissance assessed the geotechnical conditions and the possibility of sewage leakage through the lagoons berms or base. Site photos were taken during the site visit and are presented in Appendix A.

3.2. Site Observations

The wastewater lagoon is located on relatively flat land surrounded by farmland. Approximately 20 m north of the north-west corner of the lagoon boundary line was a dug-out pond. At the south side there was an un-named creek that runs parallel to the toe of the south berm (Photo 1). Parallel to the toe of the east berm there was a ditch (Photo 2), the south end of the ditch was bermed and it appeared that the ditch discharged to the north.

Dr. Clementino inspected the entire berm slopes for signs of instability, distress, or seepage. The outside slopes were well vegetated and appeared in good condition, with a side slope of approximately 3H:1V. There were no signs of significant erosion or instability as shown in Photo 1, 2 and 3. Seepage was not visible on the outside slopes, however, the below freezing temperature and high vegetation during the site reconnaissance made it difficult to observe excessive moisture or signs of seepage.

The inner slope of the berms presented signs of subsidence at the bottom third of the slope, which caused an over-steepened of the middle third of the slope as shown in Photo 4.

Certain locations of the inner slope presented evidence of a shallow slump, which appeared inactive, but may retrogress and increase with time. There were also several features of animal activity throughout the inner berm slopes, such as boreholes (Photo 5 and 6) and a beaver dam (Photo 7).

4. ASSESSMENT AND RECOMMENDATIONS

Despite of the evidence of the deterioration of the inner berm slope, due to cyclic action of the water level over the years and animal activities, the overall stability of the berms appears to remain satisfactory. However, it will likely degrade with time and will require some remediation work to restore it to its original condition.

No evidence of seepage was detected during the site reconnaissance. However, as the native soil construction material consisted of sandy clay till and the lagoon has no liner, it is likely that sewer seepage is occurring through the base and slope of the lagoon. Sandy clay materials are relatively permeable and will not provide an adequate barrier to sewage seepage into the surrounding ground.

It is very difficult, if not impossible, to visually assess if the lagoon is leaking; therefore it is recommended that a monitoring program be undertaken to determine if there is leakage occurring. The recommended monitoring program should consist of a desktop study to identify the local geology and hydrogeology, followed by the installation of monitoring wells to collect and test the shallow groundwater around the lagoon. The number and depth of the monitoring wells will be defined after the completion of the desktop study, which will allow for a better understanding of local groundwater hydrology. As a minimum, it is anticipated that four monitoring wells will be required, one adjacent to each perimeter berm; however, additional wells may be required.

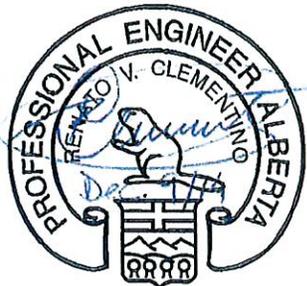
If the monitoring program confirms that the lagoon is leaking wastewater the recommended remedial option would consist of draining the lagoon and constructing a low permeability compacted clay liner or lining the existing basin and berms with a geosynthetic membrane. For the installation of the liner, the inner slope of the berms will need to be repaired to provide a stable foundation.

If the Village of Bawlf decided to proceed with the monitoring program we would be pleased to provide you a cost estimate for the proposed program.

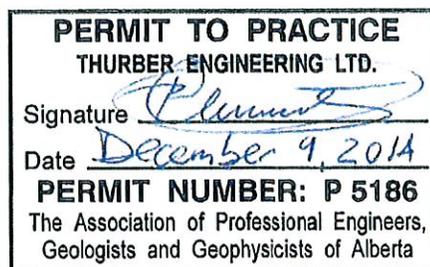
4. CLOSURE

We trust that this methodology and cost estimate provide the information you require at present. Should you have any questions, please contact the undersigned at your convenience.

Yours truly,
Thurber Engineering Ltd.
Renato Clementino, Ph.D., P.Eng.
Review Principal



Michael Halliwell., M. Sc., P. Eng.
Environmental Engineer
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Attachment:

- Statement of limitations and conditions
- Appendix A – Site Photos



APPENDIX A

SITE PHOTOS



Photo 1 – North berm outside side slope



Photo 2 – East berm outside side slope, and ditch.



Photo 3 – North berm outside side slope



Photo 4 – View of the inside slope of the lagoon berm.



Photo 5 – Central berm, south slope, animal activity borehole.



Photo 6 – South berm, inner slope, animal activity borehole.



Photo 7 – North berm, inner slope, beaver dam.