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New York State Department of Environmental Conservation
Bureau of Resource Management & Development
Division of Mineral Resources
625 Broadway, Third Floor
Albany, NY 12233-6500

Attention: Mr. Matthew Podniesinski
Chief, Resource Development Section
Bureau of Resource
Management & Development

Subject: Annual Report Review - 2018
Cayuga Mine, Cargill, Inc.
Seneca and Tompkins Counties, New York

Gentlemen:

Dr. Vincent Scovazzo, Director of Geotechnical Services, John T. Boyd Company (BOYD) received an email message on November 28, 2018 from Steven Army, Region 8 Mining Program Supervisor, New York State Department of Environmental Conservation (NYSDEC) with the following attachment:

- The Annual Report[1] signed by Shawn G. Wilczynski as file Annual Report Signed Final.pdf last modified November 28, 2018.

Dr. Scovazzo received an email from Adam Skrobialowski, Senior Mine Engineer, Cargill Deicing Technology (Cargill) on April 30, 2019, inviting Dr. Scovazzo to join a secured "data room". This data room contained:

- Maps as Adobe Acrobat® files.
- Extensometer and closure readings as Excel® files.

[1] Wilczynski, Shawn G., 2018, "Annual Report for Mine File #709-3-29-0052; Cayuga Salt Mine, Permit ID#0-9999-00075-00001," Cargill Deicing Technology, to Matthew Podniesinski of New York State Department of Environmental Conservation, November 27.

- Consultant reports from Engineering Seismology Group (ESG).

On February 15, 2006, Mr. Steven M. Potter, then the Director, Bureau of Resource Management & Development, NYSDEC, requested that BOYD review all documents, digital data, and annual reports received by BOYD starting with the 2006 Annual Report.

The recently received documents were reviewed for their adherence to conditions of the revised Permit[2]. §12.8 of the revised permit limits cost for review of annual reports by Consulting Services to $15,000. BOYD is providing the Consulting Services for this annual review. It is noted that “Funding relating to permit modifications or alterations requiring consultant review shall be not be capped due to the varying nature of potential future applications. Cargill shall fund the cost of the annual meeting/underground inspections, and will share the cost of joint inspections with American Rock Salt Co., LLC.”

The Cargill 2018 Annual Report contained the ESG report but no other consultant reports. Previously, active mining location and mine progress over the last three years were determined from the royalty map. The current map from the data room does not include this level of detail.

Two maps that are normally provided in the annual report were not included in the 2018 Annual Report. These missing maps are Cayuga Mine Closure (in.) and Cayuga Mine Closure Rate (in./year). BOYD hereby requests these maps be provided when they become available.

The survey data provided by Cargill showed uplift. BOYD's review of these data indicated they were in error. Cargill later informed BOYD that the data did include a survey error, and are incomplete as the surveyor has not supplied results for all surveys completed in 2018. BOYD expects to review these data when they are provided.

[2] New York State Department of Environmental Conservation, Region 7, 2007, “Permit” DEC ID 0-9999-00075, expiration December 31, 2012, December 31, Modification # I Effective Date: November 8, 2013.

Discussion of Annual Report

The Permit has several conditions that affect the Annual Report and its review including:

Condition 9.

Condition 9.a.

Condition 9.a. requires investigation into the disturbed salt zone and this investigation to be completed and submitted before mining proceeds into the area. Based upon the additional seismic survey and consultant reports, Cargill will maintain the planned 1,000 ft setback around the Frontenac Point Anomaly. Further investigation is to be completed and submitted to the Department for review and approval prior to mining within this 1,000 ft buffer.

Condition 9.b.

Condition 9.b. requires investigations and reports on the adequacy of the thin rock overburden where the solid rock overburden is thinner, the glacial till and lake sediments thicken, and lake depth increases. The thin rock overburden and Frontenac Point Anomaly may overlap.

The required additional investigations and reports have been performed for Anomaly C. Undermining of Anomaly C will be completed using a large pillar configuration and not the more yielding production pillar typically used at the Cayuga Mine. Cargill has agreed that no additional mining will occur under Anomaly E and no mining will occur under Anomaly D and the Frontenac Point Anomaly. Additional investigations and reports will need to be undertaken for anomalies A and B, and mining in these areas should be avoided until reviewed and approved by the NYSDEC.

The 2018 Annual Report notes the inclusion of reports by ESG Canada Inc. which were in the data room as documents 2.1 through 2.12:

- ESG Solutions, “Seismic Data Processing Results and Health Analysis Report for Cayuga Monitoring System,” prepared for Cargill Salt Division, covering 12 months from December 2017 to January 2019.

  Cargill notes in the annual report that “The Cayuga Mine operates a micro-seismic monitoring network which now has over 70 geophones and covers over 5 square miles of mine workings. The data from this system is reviewed daily in-house, by ESG, and is reviewed weekly by RESPEC. This data indicates the mine is behaving as expected and is stable.”

Condition 12.a.

Condition 12.a. requires an Annual Report to be submitted by Cargill in response to 12.a. sub-conditions 1 through 8 and Condition 12.b through g. These conditions and Cargill's responses are summarized below.

Condition 12.a.1.

Condition 12.a.1. requires the inclusion of the Mine Manager's signed certification that "all mining related activities…were in conformance with this permit and the approved plans, or that variances have been reported and managed."

A certification was included on page 2 §15.a.(1) and the certification was signed by Mr. Shawn G. Wilczynski, Mine Manager, on November 27, 2018. This certification notes "…that all mining activities, to the best of my knowledge, conducted during the reporting period from November 1, 2017 to present were in conformance with the DEC Permit # 0-9999-00075/00001 and the approved plans. No variances occurred and none were reported."

Condition 12.a.2.

Condition 12.a.2. requires "A summary of all non-routine mining incidents as defined in Special Conditions Part b. …" Condition 12.b. defines non-routine as "incidents during mining, processing, or other mine related activities that may adversely affect mine stability, ground and surface water or other natural resources, or the health, safety, welfare or property of the general public." During a meeting held on August 17, 2004, among Cargill, NYSDEC, and BOYD, it was agreed that statements will be included in the Annual Report "to point out known, encountered, or discovered geologic and geotechnical anomalies and mine action to address such anomalies."

Cargill included a statement in the Annual Report page 2, Section 15.a.(2) that "[t]he Cayuga Mine is not aware of any non-routine incidents associated with the mining, processing, or other mine related activities that would have adversely affected any of the following;

- Mine stability
- Ground and surface water
- Natural resources
- Health, safety, welfare or property of the general public"

Condition 12.a.3.

Condition 12.a.3. requires "[a]n updated Mining Plan Map depicting the current extent of mining activities, and the proposed advancement of the working face for the subsequent

three years." At the August 2004 meeting, it was agreed that in addition "[a] mine map showing instrumentation location and type and shore line…" will be included in the Annual Report.

Cargill included a statement in the Annual Report, page 2, Section 15.a.(3) that "[t]he Cayuga Mine is currently operating in the northern region of the mine. Active mining is located in panels U-76, U-78, V-80, U-82 to the southwest, and NW-3 to the northwest." Mine maps as Adobe Acrobat files were supplied by Cargill to fulfill this condition. Included maps were:

- Adobe Acrobat file, 4.2 3 year plan for DEC NOV 2018-Model.pdf downloaded from Data Room on May 02, 2019, and contains Michalski, Brandon, 2018, "Cayuga Mine, 3 Year Mine Plan" November 15. The map shows planned extent of mining through 2021 without showing pillar configurations.
- Adobe Acrobat file, 4.4 5 year plan under C Anomaly-Layout1.pdf downloaded from Data Room on May 29, 2019, and contains; Cargill Deicing Technology, 2017, "Cayuga Mine 5 Yr Mine Plan Assuming, 2017/ 2018 Fiscal Yr," August. The map includes the planned mining to fiscal year 2019-2023 for all identified anomalies. No approval has been given to mine under Anomalies A and B.
- Adobe Acrobat file, 4.7 ROYALTY-Model.pdf, downloaded from Data Room on May 29, 2019, and contains; Cargill Deicing Technology, 2018, "Cayuga Mine, Mine Royalty Map, 2017/2018 Fiscal Yr." May. The map shows fiscal year production areas from June 1, 2017 through May 31, 2018. BOYD requires the production over the review periods October 2018 through October 2019 and preferably the two preceding years starting at October 2016.
- Adobe Acrobat file, 4.5 Baker update U38-36 Dust fill map-Model.pdf, downloaded from Data Room on May 29, 2019, and contains; 2018, "Dust Fill Plan," September 5. This map shows U38, U38A, and U36 areas filled.
- Adobe Acrobat file, 4.3 4 Level Pond Map MLRP 2Nov17.pdf, downloaded from Data Room on May 29, 2019, and contains; 2017, "Cayuga Mine, 4 Level Pond Map," November 2. This map shows filled levels to November 20, 2017, and remaining potential pond area.
- Adobe Acrobat file 1.5 4 Level Convergence Map-Model.pdf, downloaded from Data Room on May 02, 2019, and contains an untitled and undated map showing closure station locations.
- Adobe Acrobat file, 1.6 4A Level for JT Boyd-Model.pdf, downloaded from Data Room on May 02, 2019, containing undated, "4A Level Instrumentation Map." This map shows closure station locations.
- Adobe Acrobat file, undated and untitled, 3.4 PAMELPASS-Model.pdf, downloaded from Data Room on May 02, 2019, and contains the map "4 Level, Pamel Pass _ 13 Belt." This map shows locations of extensometers along the 13 belt.

- Adobe Acrobat file, 3.5 Screen Plant Horizontal_Roof Ext-Model.pdf, downloaded from Data Room on May 02, 2019. It shows an untitled map and cross-section view of installation locations of near horizontal extensometers in the roof of the screen plant gallery.
- Adobe Acrobat file, 3.6 Screen Plant Instrumentation-Model.pdf, downloaded from Data Room on May 02, 2019, and containing undated map, "Unit # 5 Screenplant," showing instrument locations in and around the screen plant gallery.
- Adobe Acrobat file, undated, 3.7 Surge Bin Map to JT Boyd-Model.pdf downloaded from Data Room on May 02, 2019, and containing undated, "Current Surge Bin Instrumentation Map as of 11-18," showing instrument locations in and around the screen plant gallery.
- Adobe Acrobat file, 1.7 Convergence map with basemap 2018-Model.pdf, downloaded from data room on May 02, 2019, and containing the map Cargill Deicing Technology, undated, "Cayuga Mine, 6 Level Workings, Convergence Stations" showing the locations of convergence stations.
- Adobe Acrobat file, 4.6 basemap_with_rock_layer_roof rock_floor rock rolls(updated9-13-18md)-Layout1.pdf, downloaded from data room on May 29, 2019, containing "Cayuga Mine, 6 Level Workings," by Cargill Deicing Technology. Also included on this map are roof and floor rolls.
- Adobe Acrobat file, 4.9 Control NAD83 Subsidence Map 1Feb2019.pdf, downloaded from Data Room on May 29, 2019, containing; untitled, undated map, which shows subsidence monument locations, shore line, and 6th Level workings.

Two maps are normally included in the annual report but were not included in the 2018 Annual Report. These maps as presented in the 2017 Annual Report were:

- Adobe Acrobat file, Cayuga Mine Contour Closure Dec - 2017.pdf modified January 24, 2018, and containing the undated map "Cayuga Mine Closure (Inches) Dec-2017."
- Adobe Acrobat file, Cayuga Mine Contour Rate Dec -2017.pdf modified January 24, 2018, and containing the undated map "Cayuga Mine Closure Rate (Inches/Year) Dec-2017."

The maps show the extent of mining, proposed mine plan, shorelines of both the 4 Level flooding and of Cayuga Lake, total closure, closure rate, and instrument locations.

Condition 12.a.4.

Condition 12.a.4. requires the annual report to include a "summary of in situ measurements of rock mechanics required by Part f. of this Special Condition." Condition 12.f. requires the measurement and collection of in situ rock mechanics data "in accordance with the approved Mined Land Use Plan." The data are to include "plots

of relevant graphs. …" Furthermore, "[e]xceptions to anticipated trends in rock behavior shall be noted and explained. …"

At the August 2004 meeting, it was agreed that "[a]ll rock mechanics data" would be incorporated in the Annual Report, "including, but not limited to, all instrumentation readings and observations from the initial readings to present. Data for subsidence, closure, and extensometers are to be provided electronically. These electronic files are to include raw and processed data, graphs, and explanations of any inconsistencies and anomalous readings including reasons for abandonment, reinstallation, etc., along with applicable observation in the vicinity of the instrument such as floor heave, water inflow, etc. Future reports are to contain comment on whether, in the opinion of Cargill, the instrument readings support or conflict with prior stability models especially in areas employing new mine, panel, or main configurations."

Cargill included a statement in the Annual Report on page 2, Section 15.a.(4) that "Evaluations of the convergence data indicate that overall no unusual trends have been identified and the mine is behaving as expected. There continues to be a few slight anomalies, which while showing elevated closure rates, are not elevated enough to be of a concern to global stability. These areas are being monitored more closely and areas are being outfitted with additional electronic instrumentation to help gather more data."

Closure measurements can be evaluated to indicate possible instability in three ways:

1. By studying the graphs of the rate of closure over time. The shape of these graphs indicates areas of instability, areas of concern, and areas of stability. Mr. Petersen of Rocktec Solutions (Cargill geotechnical consultant) evaluated the closure in this manner.
2. By establishing trigger values for total closure. This method is applicable in harder, less viscous rock but is not applicable for the Cayuga Mine, as stable closure in salt will continue until the openings are closed.
3. By establishing trigger values for long-term closure rates. Since this is not being completed by the other investigators, BOYD applied such trigger rates in its evaluation of the closure readings.

Closure rate data are significant because they offered insight into the collapses and the inundation of the Retsof Mine. Sustained closure rates of 15 in. per year or less were measured in stable areas of the Retsof Mine, while in the failure areas, closure was regularly measured with sustained rates over 230 in. per year with onset of failure around 600 in. per year. Although Retsof and Cayuga mines have different overburden

and material properties, in the general sense, a comparison seems warranted for a relative indicator of stability.

BOYD reviewed the 299 closure stations read in 2018 (10 less than last year; 292 in Level 6, 5 in Level 4A, and 2 in Level 4). Levels 4 and 4A readings show an overall trend of lowering closure rates.

None of these 299 closure stations showed readings that exceeded 230 in. per year. Below is a list of the 10 highest measured closure rates in 2018 for areas of recent mining defined as areas within 1,000 ft of mining that occurred since October of 2017.

Top 10 Closure Rates in Areas of Recent Mining

Closure Station	Rate of Closure (in./yr)	Last Recorded Rate of Closure (in./yr)	Notes
MW3PIN#62	68.62	3.02	1st Reading
MW3PIN#59	53.03	21.27	1st Reading
MW3PIN#65	47.82	11.42	2nd Reading
MW3PIN#66	43.85	18.35	1st Reading
MW3PIN#64	37.70	6.52	1st Reading
MW3PIN#63	35.43	8.88	1st Reading
MW3PIN#60	34.57	24.07	2nd Reading
MW3PIN#58	34.21	23.92	1st Reading
MW3PIN#61	31.09	28.20	1st Reading
U76PIN#15	17.83	0.45	2nd Reading

These rates are lower than the comparable rates for 2017. All of these rates substantially decreased over time showing that the ground is stable or stabilizing.

Also determined are the top 10 closure rates away from recent mining activity as shown below:

Top 10 Closure Rates Away from Recent Mining

Closure Station	Rate of Closure (in./yr)	Last Recorded Rate of Closure (in./yr)	Notes
U63EPIN#39	57.6179	11.4610	1st Reading
U63EPIN#37	56.8879	15.4864	2nd Reading
U63EPIN#38	43.2786	3.8823	1st Reading
U63EPIN#35	10.2200	10.2200	Last Reading
U63EPIN#34	7.6650	7.6650	Last Reading
U63EPIN#36	6.9350	6.9350	Last Reading
U63EPIN#32	5.1839	1.6616	

Top 10 Closure Rates Away from Recent Mining

Closure Station	Rate of Closure (in./yr)	Last Recorded Rate of Closure (in./yr)	Notes
U12PIN#51	3.1807	3.1807	Previous reading 2009
U12PIN#61	1.7033	1.1993	
U12PIN#28	0.9931	0.2433	

These rates are substantially higher than the comparable rates for 2017, due to the inclusion of U63 stations which narrowly missed being included in the "Top 10 Closure Rates in Areas of Recent Mining." Two of the U12 readings show a drop in closure rate over the reporting period. U12PIN#51 was only read once during 2018.

Data from 15 extensometers that were read in 2018 were evaluated (one more than in 2017). Extensometers were installed in various manners including vertically into the roof; at low angle (near horizontal); at an angle that resulted in the extensometer being installed over the pillars; vertically into the roof, and horizontally into pillars. These data are further complicated by the varying rod and bay lengths. (Bay length is the length difference between rods except for the first bay which is the length of the shortest rod.) Nevertheless, BOYD attempted to ascertain anomalies within these data.

Last year these data were evaluated using the rate of change (in. per day). This year BOYD evaluated the rate measure as strain per year. Using RESPEC's 1995 Cargill salts values:

Dilation Limit	$J_2^{0.5}/I_1 = 0.36$
Creep Rate	$\varepsilon^c = 8.3 \times 10^{-30}(\Delta\sigma)^{5.9}$

BOYD assessed the stress state to estimate that a strain rate greater than 8×10^{-3} in. per year is needed for destructive dilation. No calculated strain rate exceeded this standard.

The five highest extension rates measured during 2018 were:

Extensometer	Strain Rate (in./year)
Surgebin Ext Sta 22	0.540
Surgebin Ext Sta 25	0.430
I-Pillar B-Hole 3 Tun	0.389
G-Pillar B-Hole 3 Tun	0.306
G-Pillar B-Hole 1 Tun	0.216

These strain rates are acceptable.

Consultant Reports Concerning Conditions 12.a.4.
No consultant reports, other than ESG Solutions report, were available in the data room.

- ESG Solutions, 2017 and 2018, "Seismic Data Processing Results and Health Analysis Report for Cayuga Monitoring System," prepared for Cargill Salt Division, covering 12 months from December 2017 to November 2018.

This report is discussed in section Condition 9.b. above.

Condition 15.a.5.
Condition 15.a.5. requires the Annual Report include a "summary of subsidence monitoring data required by Part e. of this Special Condition." Condition 12.e. requires "[s]ubsidence monitoring shall be conducted in accordance with the approved subsidence monitoring plan contained within the approved Mine Land Use Plan." Furthermore, "[e]xceptions to the trends shall be noted and explained…" Points applicable to this condition were agreed upon at the August 2004 meeting and are noted above under Condition 15.a.4.

Cargill included a statement in the Annual Report page 3, Section 15.a.(5) that "The surface subsidence survey began during the spring of 2018, while the full data-set has not yet been received, previous surveys indicate that the mine is behaving as expected with no anomalous subsidence zones."

Adobe Acrobat file, 4.8 Cargill Subsidence 9-12-18.pdf, was downloaded from the data room on May 29, 2019, and provided subsidence survey results from May 15, 2018. At the June 6, 2019, meeting, Cargill noted that these data include a survey error, and the data are incomplete as the surveyor has not supplied results for all surveys completed in 2018. BOYD expects to review these data when they are provided.

Condition 15.a.6.
Condition 15.a.6. requires the inclusion of "[i]nformation regarding the source and volume of any water inflow into the mine, and the disposition of such water." At the August 2004 meeting, it was agreed that a discussion about water disposal in Level 4 would be included in the Annual Report, noting: "Updates of Level 4 filling including data on shore line advance." However in 2012 it was noted that "Access to view the pond is not possible due to ground conditions."

Section 15.a.(6) of the Annual Report, notes that “All of the water is directed to a settling pond located on the 4-level of the mine. The water is then pumped from the settling pond to abandoned areas at the far east end of 4-level as well as to various areas of the active mine for dust control.”

Water volume calculations are addressed in Adobe Acrobat file, 3.20 UG Pond Calc 1Nov18.pdf added to the data room on May 29, 2019, containing “ Water volume Calculation, Ultimate Pond Potential Volume.”

According to these calculations 14,835,103 gallons of water has been added to ponds in 2018 resulting in 5.1 years of pond life remaining.

Cargill lists the following water flows in the Annual Report:

- Production Shaft (#1 shaft) - 25 gallons per minute (gpm)
- Ventilation Shaft (#2 shaft) - Less than 1 gpm
- Service Shaft (#3 shaft) - 1 gpm
- ED Plant Concentrate discharge - 3 gpm
- Total Water Inflow = 30 gpm

The total water inflow rate is 6 gpm less than reported in 2017.

Condition 12.a.7.

Condition 12.a.7. requires the inclusion of “[a] summary of all other monitoring data required under the terms of this permit or Department SPDES permit issued to Cargill.” Cargill included a statement in the Annual Report page 3, Section 15.a.7. that “There was no exceedance of the SPDES limits for the storm water outfalls, and two exceedance for noncontact cooling water temperature at the brine water treatment plant. These were due primarily to the warm summer weather resulting in the intake water being at or above 75 degrees F, which is above the permitted discharge temperature. There were three exceedances for the Waste Water Treatment Plant during the past year.”

Back up data to this statement were not provided in the data room. Typically, an Excel spreadsheet, which documents MLRP outfall and provides information on outfall water quality including cyanide, chloride, zinc, total dissolved solids, and cooling and treatment water, is provided.

SPDES data and a discussion of these data are included in the Annual Report. These data are to be reviewed by NYSDEC. Discussion on June 6, 2019, suggests that direct

reporting requirements of SPDES data to the State of New York renders this requirement moot.

Condition 12.b. and c.
Condition 12.b and c. addresses Mine Safety and Health Administration (MSHA) reporting involving non-routine mining incidents as defined in Condition 12.b. Condition 12.c. requires Cargill to submit "all correspondence with the Mine Safety and Health Administration involving non-routine mining incidents…"

Cargill includes a statement in section 15.b. of the Annual Report that "[t]here were no incidents meeting the guidelines for notification as identified in section 15.a.(2)." and section 15.c. of the Annual Report that "[t]he Cayuga Mine has not received any citations or correspondence from MSHA regarding non-routinemining incidents as identified in section 15.a.(2)." The Annual Report does not note reports or letters from MSHA concerning any non-routine mining incidents.

Condition 15.d.
Condition 15.d. addresses reporting requirements "Prior to undertaking any material change in the approved mining methods or techniques … Cargill shall submit to the Department a description of such modification …" This condition does not require the reporting to occur in the Annual Report.

Cargill notes in section 15.d. that, "The mining methods used at the Cayuga Mine have not been changed in the last year."

Condition 15.g.
Condition 15.g. addresses the reporting and recording of citizen complaints.

Cargill includes a statement in section 15.g. of the Annual Report that "[n]o written complaints from citizens were received since the last report (November 2017)."

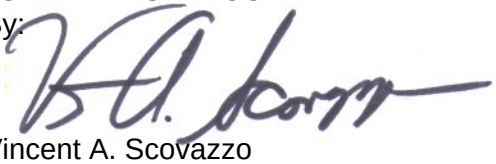
Site Visit

The site visit occurred on June 3, 2019. No conditions that would indicate global instability were observed.

Please contact us if you require additional information or if we may be of further service.

Respectfully submitted,

JOHN T. BOYD COMPANY
By:



Vincent A. Scovazzo
Director of Geotechnical Services

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