PITCH RECLAMATION PROJECT

COLORADO MINED LAND RECLAMATION BOARD

2020 ANNUAL RECLAMATION REPORT

RECLAMATION PERMIT NUMBER M-1977-004

Prepared for:

Division of Reclamation, Mining, and Safety

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EXECUTIVE SUMMARY

Homestake Mining Company of California (HMC) operated the Pitch Uranium Mine (mine) located in Saguache County, Colorado from 1979 until 1984. The mine extracted uranium ore and trucked it to their mill in Grants, New Mexico. In 1984, operations were suspended, and the mine was placed into care and maintenance. Mine site disturbances were incrementally reclaimed and revegetated from 1985 to 1993. In 1993, HMC initiated permanent closure of the mine.

Since 1993, closure and reclamation has included pit wall grade-down and partial backfilling of the North Pit to improve pit wall stability, contouring and revegetation of the approximately 230 acres of disturbed area, construction of a plug in the historical Pinnacle underground mine adit to reduce seepage and improve water quality, monitoring of slope stability in the North Pit and South Mine area, monitoring of the phreatic surface in the Indian Rock Dump (IRD) and Tie Camp Rock Dump (TCRD), construction of surface water controls, and dismantling and removal of the Radium Treatment Plant (RTP) and associated foundation materials and soils that were placed in the Tie Camp Disposal Cell.

HMC submitted a 112d-3 Reclamation Plan amendment to Permit No. M-1977-004 in June 2019. The amendment package includes a comprehensive update of the site reclamation plan and addresses the existing conditions and remaining work to be performed to adequately reclaim and close the mine. The Division of Reclamation, Mining, and Safety (DRMS) approved the amendment application in a letter dated January 6, 2020.

During 2020, HMC maintained the remaining mine facilities and fulfilled permit- and license-related compliance programs, which included the following:

- Installed a diversion channel lined with a geosynthetic clay liner (GCL) around the North Pit Lake, regraded slopes in the South Pit, and installed GCL on the embankment of the sediment pond. The work was performed in accordance with the Reclamation Plan submitted on June 28, 2019 and approved by DRMS on January 6, 2020.
- Monitored water quality at the Colorado Discharge Permit System (CDPS) permit (No. CO0022756) compliance point Outfall 001A (also known as SW-33) and submitted monthly and quarterly discharge monitoring reports to the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) per the requirements of the CPDS permit effective January 1, 2010 and extended under timely renewal.
- Performed inspection and reporting per the terms and conditions of the Radioactive Materials License (RML) issued by the CDPHE – Hazardous Materials and Waste Management Division (HMWMD) (Permit No. 150-01). HMC submitted a License Amendment Application on July 27, 2020. It was approved by HMWMD on September 25, 2020 and Amendment No. 20 renewed the license through April 30, 2023.
- Monitored the drainage, stabilization, and reclamation in the constructed marsh areas near the location of the former RTP and the drainages upstream from the sediment control pond.
- Monitored pit wall slopes on the south and east walls of the North Pit, the east wall of the South Mine area, and the IRD and TCRD.
- Monitored the drainage channel constructed in 2013 between the 10,800 and 10,600 benches on the east wall of the North Pit.
- Monitored erosion and drainage repairs on the northwestern side of the IRD above the clay and low-grade ore stockpiles.
- Monitored the continued effectiveness of grading on the top three benches and slope face of the TCRD to reduce sedimentation on the benches, facilitate movement of stormwater and snowmelt off the benches, and reduce rill erosion on the dump slope.

- Inspected cover repair completed in 2011 on the drainage channel on the Tie Camp Low Grade Ore Stockpile/Disposal Cell.
- Monitored precipitation at the mine. Installation of a weather station at the mine was completed in 2020. Precipitation at the site totaled 7.95 inches. Historically precipitation has been monitored at the Porphyry Creek SNOTEL site (701). During Water Year 2020 (monitoring period from October 1, 2019 through September 30, 2020), 26.3 inches of precipitation were recorded however this includes snow water equivalent precipitation.
- Monitored groundwater levels in monitoring wells within and adjacent to the underground mine workings and monitored springs and seeps potentially influenced by the re-saturation of the underground mine workings.
- Monitored groundwater levels in monitoring wells and piezometers in both the IRD and TCRD.
- Continued noxious weed control.
- Monitored monuments and piezometers on the sediment control pond embankment per the requirements of the Colorado Division of Water Resources.
- Operated the advanced monitoring system at SW-33, which includes water quality sondes to monitor pH, oxidation-reduction potential, conductivity, turbidity, and temperature, as well as sensors that monitor phosphate and radiometric data.

Best management practices (BMPs) continued to be evaluated to achieve surface water uranium load reduction at the mine. Field work in 2020 focused on continued operation and expansion of the source control and treatment BMPs. Specific field work included:

- Operated phosphate injection systems to evaluate uranium load reduction in the underground mine workings and IRD.
- Operated three field-scale bioreactor engineered treatment cells (ETCs), containing organic-based media (e.g., woodchips, manure, hay), as an additional BMP to evaluate the effectiveness of uranium removal via passive treatment.
- Operated three drum-scale biochemical reactors to evaluate media amendments to prolong lifetime and effectiveness of the bioreactor ETCs in potential future large reactor construction.
- Installed two piezometers at the toe of IRD and one piezometer at the toe of TCD to further inform site conceptual model and water balance.
- All surface disturbance associated with the lowest practical level (LPL) advancement was approved by DRMS in June 2019 under the Reclamation Plan submitted on June 28, 2019 and approved on January 6, 2020.

1. INTRODUCTION

This 2020 Annual Reclamation Report (report) has been prepared to fulfill the Homestake Mining Company (HMC) annual reclamation reporting requirements to the Colorado Division of Reclamation, Mining, and Safety (DRMS) for Reclamation Permit Number (No.) M-1977-004 for the Pitch Reclamation Project. The Pitch Reclamation Project is in Township 48 North, Range 6 East, Saguache County, Colorado (Figure 1). The Pitch Reclamation Project consists of approximately 230 disturbed acres situated at 10,000 to 11,000 feet above mean sea level (amsl) on fee land owned by HMC. Reclamation activities conducted in 2020 at the Pitch Reclamation Project are shown on Figure 2. This report focuses on reclamation, monitoring, and remediation performed at the Pitch Reclamation Project during the 2020 calendar year. Documentation of reclamation conducted in previous years is provided in previous annual reports.

2. LAND DISTURBED IN 2020

Surface disturbances in 2020 were associated with the diversion of water around the north pit, south pit grading, and lining the sediment pond embankment. Additional surface disturbances in 2020 were associated with uranium load reduction best management practices (BMPs) being implemented to establish the lowest practical level (LPL) for uranium at the Colorado Discharge Permit System (CDPS) permit (No. CO0022756) compliance point Outfall 001A (also known as SW-33). Associated work included piezometer well drilling and completion, placement of drill cuttings in the Tie Camp Disposal Cell, and long-term reagent storage as described below. The work summarized below was approved by DRMS under the Reclamation Plan submitted on June 28, 2019 and approved on January 6, 2020.

The following work resulted in surface disturbances of less than 13 acres of previously disturbed or reclaimed ground:

- Reconstructed the diversion channel (including installation of a geosynthetic clay liner [GCL]) at the 10500-foot elevation level in the North Pit to reduce infiltration into the slope.

- Graded and stabilized slope degradation associated with tension cracks in the South Pit.

- Installed GCL on the embankment of the sediment control pond. Improvement at the sediment control pond also included installation of a new riser and valving as well as grouting of the existing piping through the dam.

- Two new wells at the toe of IRD and one new well at the toe of the Tie Camp Rock Dump (TCRD) were installed to facilitate source zone characterization and conceptual site model updates.

The areas associated with uranium load reduction systems will continue to be used in the future. The areas will be reclaimed once the infrastructure, wells and piezometers/inclinometers are no longer being used as part of reagent injections and/or long-term monitoring program. Areas determined to no longer need uranium load reduction will be reclaimed. Eventual closure and reclamation will include plugging and abandonment of wells, piezometers and/or inclinometers in accordance with Rule 16 of the Colorado Water Well Construction Rules. Following removal of piping and engineered structures associated with uranium load reduction BMPs, disturbed ground will be recontoured and revegetated, with grading for drainage, scarifying/harrowing, and fertilizing to be conducted as necessary for proper reclamation.

3. RECLAMATION ACTIVITIES IN 2020

During 2020, reclamation efforts focused on the installation of a diversion channel around the North Pit Lake, regrading at the South Pit, and installation of a liner at the sediment control pond. Additionally, maintenance and regrading of roads to repair seasonal damage and maintain positive drainage to minimize erosion and noxious weed control were completed. This work is described in the following subsections and depicted on Figure 2. Several areas that were not reclaimed in 2020 are also discussed to illustrate the success of previous reclamation activities and summarize planned activities.

3.1 Drainage and Erosion Control – North Pit and South Mine Area

3.1.1 North Pit

Earthwork was performed to reconstruct the diversion channel at the 10500-foot level in the North Pit. The channel, lined with GCL and rip rap, was reestablished to reduce infiltration into the slope. Water captured by the channel now diverts to the marsh area at the former RTP location. Construction was completed in July 2020, and the diversion channel performed as expected.

3.1.2 South Mine Area

Earthwork was performed to stabilize slope degradation associated with tension cracks in the South Pit. Previous slope creep and cracking was removed and refilled while incorporating drainage features at two benches along the South Pit slope. Earthwork was completed in October 2020. The disturbed areas will be reseeded during 2021, and the area will be monitored.

3.2 Drainage and Erosion Control – Indian and Tie Camp Rock Dumps

3.2.1 Tie Camp Rock Dump

In 2012, repair work was completed on the top three benches and dump slope faces between benches of the TCRD to remove sediment buildup that was directing snowmelt and stormwater down the dump face and creating rill erosion. This area was not inspected by DRMS in 2020; however, site reconnaissance performed during the field season showed that the repairs completed in 2012 have resolved issues on the top three benches and that the repairs continue to function as planned.

3.2.2 Indian Rock Dump

Erosion on the IRD was identified in 2010. Repairs were completed in 2012 that included grading and placement of boulders and riprap in the groin areas west of the IRD. The repairs continue to be effective in 2020.

3.3 Sediment Control Pond

3.4 Noxious Weed Control

Noxious weed control was undertaken on isolated occurrences of Canadian thistle (*Cirsium arvense*) and scentless chamomile (*Matricaria perforata*) on the mine site. Pest Away has assisted with noxious weed control since 2012, resulting in a large reduction in both noxious weeds. On July 30, 2020, Pest Away sprayed approximately 110 gallons of Milestone with Telar XP at 7 ounces per acre and Escort XP w/R-11 Activator at 2 ounces per acre near roads and reclaimed areas.

3.5 Access Road

The Pitch Reclamation Project access road was graded and reseeded in 2016 due to sloughing that occurred in 2015. In 2017, the revegetation adjacent to the road was not well established; however, in 2019, vegetation cover was noted by DRMS as becoming well established. No additional work was conducted in 2020.

3.6 Constructed Marsh Areas

In 2020, the constructed marsh area near the location of the former Radium Treatment Plant (RTP) and the drainages above the sediment control pond were inspected. Growth of cattails and sedges are still apparent in the marsh area in 2020.

3.7 Tie Camp Disposal Cell

In 2020, drill cuttings from the installation of piezometers were placed into a small disposal excavation in the Tie Camp Disposal Cell. An approximate 20-foot by 20-foot excavation approximately 4 feet deep was created. Following drilling cuttings disposal, the cell was backfilled with locally stockpiled sericite-clay materials and topsoil. The area was graded and reseeded to shed snowmelt and stormwater without ponding.

4. MONITORING AND ANNUAL REPORTING

Installation of an internet connected weather station was completed in 2020. The station monitors air temperature, relative humidity, wind speed and direction, solar radiation, barometric pressure, snow depth and rainfall. The weather station recorded 7.95 inches of precipitation during Water Year 2020 (the monitoring period from October 1, 2019 through September 30, 2020.

4.1 Slope Movement Vector Analysis

Survey monuments (monitoring points) have been installed at the Pitch Reclamation Project to monitor surficial slope displacement in the North Pit and South Mine areas. The area east of the North Pit and south of Northing 113,500 is referred to as the south wall of the North Pit, and the area east of the Pit Lake and north of Northing 113,500 is referred to as the east wall of the North Pit. Monitoring points are also present on the east wall of the South Mine area. There are currently 45 monitoring points in the North Pit and 7 monitoring points in the South Mine area to monitor surficial slope movement. From 2019 to 2020, 39 monitoring points were discontinued because they were either removed during construction or because movements measured in past years were less than the survey equipment error. Surveys are conducted as close to 1-year intervals as possible, allowing the magnitude of total displacement to be reported as a velocity in terms of feet per year.

Seven of the 52 monitoring points had displacement values greater than associated survey error values and zero of the 52 showed greater than the established movement threshold. This is compared to 42 of 89 and 7 of 89, respectively, in 2019. Due to construction, areas where monitoring points have previously shown movement greater than the threshold were removed due to necessary earthwork. The amount of displacement is comparable to the displacement from the 2012-2013 and 2017-2018 monitoring cycle.

A detailed discussion of historical and 2020 monitoring point displacement data is presented in the 2020 Annual Inclinometer and Survey Monitoring Report in Appendix B.

4.2 Inclinometer Evaluation

In 2017, three additional inclinometers were installed in the IRD to monitor the potential for movement (IN1, IN2, and IN3; Figure 3). These inclinometers supplement three slope inclinometers that were installed in 1998 to monitor areas of the North Pit (I98-1, I98-2, and I98-3). Inclinometer readings in 2020 for IN-1, IN-2, IN-3 and 198-3 did not indicate movement for the monitoring cycle. Data for 198-3 indicates uphill movement, was suspected of reading error, and was not taken into consideration for movement. The 198-2 inclinometer data was not evaluated due to erroneous data. Inclinometer 198-1 indicates similar incremental displacement observed in 2019 which is generally lower than the overall rate since 2008. Trends within 198-1 indicate slope creep is the primary form of ground movement. A detailed discussion of inclinometer data is described in the 2020 Annual Inclinometer and Survey Monitoring Report included in Appendix B.

4.3 Pinnacle Underground Mine Workings Monitoring

A concrete plug was constructed in the Pinnacle adit in September 1995. Authorization for the placement of the Pinnacle adit plug was requested by HMC in April 1995, and conditional approval was granted by the Colorado Division of Minerals and Geology (now DRMS) as TR-3 in May 1995. The intention of the plug was to seal the Pinnacle adit and allow the underground mine workings and adjacent country rock to resaturate. The resaturation of the underground mine workings was expected to re-establish a geochemically reducing environment and lower the solubility of uranium and radium within the underground mine workings.

The Colorado Division of Minerals and Geology approval required HMC to monitor the effects of resaturation in the underground mine workings for 5 years or until hydrologic conditions stabilized. Components in the Monitoring Plan outlined in TR-3, included continuation of discharge water quality monitoring at SW-33, monitoring of groundwater resaturation levels, annual spring and seep surveys in areas downgradient from the underground mine workings, and monitoring for changes in water quality that could be attributable to resaturation. The stated purpose of the monitoring program is to verify the intended effectiveness of the adit plug. Per the requirements of TR-3, the following monitoring was performed in 2020 and described in the subsections below:

- Survey of springs and seeps
- Groundwater levels in monitoring wells installed in and adjacent to the underground mine workings
- Water quality and flow from the Pinnacle adit at sampling point PP-01
- Discharges from the property at SW-33

4.3.1 Spring and Seep Monitoring

Spring and seep surveys were conducted to monitor changes in shallow groundwater conditions due to construction of the Pinnacle adit plug. These surveys have been conducted annually since July 1995 and were repeated in 2020. In general, flow from some springs and seeps increased for a brief period after the adit plug installation and have declined to a steady state since the spring of 1997. Small variances noted since 1997 can be attributable to a variety of conditions, including precipitation, depth of snowpack, timing of snowmelt, and the potential for infiltration with respect to frozen ground. The “active” spring and seep locations are shown on Figure 3. Spring and seep flow measurements since monitoring was initiated are presented in Table 1. Typically, the springs flow in the early summer months and then decrease rapidly to a point where there is little to no flow in the Fall. Springs CFS and CFS-2 show higher flows in the Fall, which can be attributed to the phosphate injections occurring over the summer months into the underground mine workings.

4.3.2 Groundwater Levels

Monitoring wells and piezometers have been installed across the mine for multiple purposes, including water level monitoring, water quality sampling, and/or injection and extraction as part of the chemical reagent injection program for uranium load reduction. For the purposes of this report, cased borings installed for water level monitoring that are not known to have been completed with well screens are referred to as piezometers, while monitoring installations completed with well screens for water level and water quality monitoring are referred to as wells.

There are currently 13 active wells installed in or near the underground mine workings (P-4 through P-16). The locations of these wells are provided on Figure 3. These wells are used to monitor water levels throughout the underground mine workings area and/or to inject/extract reagents (phosphate and tracers) as part of the uranium load reduction BMP infrastructure to further support LPL establishment, specifically:

- Recirculation wells P-4, P-5, P-11, and P-12 are located within and/or in immediate hydraulic connection of the underground mine workings. P-4 and P-5 were installed in 1995 prior to installation of the adit plug, whereas P-11 and P-12 were installed in 2015.
- Monitoring wells P-7, P-8, P-9, and P-10 are located outside of the underground mine workings, with P-7 located immediately upgradient of the adit plug. P-7 was installed as a replacement for P-6, which was monitored until approximately 1 year after plug grouting/construction. P-8 lies just to the north of the underground mine workings and was also constructed to monitor bedrock water levels upgradient of the Pinnacle adit plug. This is also the closest monitoring well to the Chester Fault Zone. P-8 was converted to a dual-purpose inclinometer in 1999 by installing inclinometer casing inside the well casing. P-10 has not been sampled since 2018 due to a blockage and is no longer monitored for water levels.
- Recirculation wells P-13, P-14, P-15, and P-16 are screened outside of, but adjacent to the 10,300 drift, and were installed in 2017 and 2018 as additional uranium load reduction BMP infrastructure.

Water levels in the wells fluctuate seasonally, with the highest levels observed in late May or early June, coinciding with snowmelt (Figure 4a). Water levels in Figure 4b represent the data obtained during low- and high-flow sampling events from 2012 to 2020 to provide additional clarity. Spring and summertime water levels vary from year to year due to the magnitude and timing of snowmelt and heavy summer precipitation events; however, water levels under low-flow or “base-flow” conditions can be used to assess long-term trends. Overall, the base-flow water levels indicate a groundwater gradient to the north/northwest. This gradient is steepest on the southern end of the North Pit, as demonstrated by the decrease in water levels moving from wells P-4/P-11 toward P-7, and further to P-8.

The following additional observations have been noted since the adit plug was installed in 1995:

- Base-flow water levels in recirculation well P-7 have stabilized at just under 10,385 feet amsl. This value has not changed substantially since 2002, indicating that water levels behind the Pinnacle adit plug are stable.

- Water levels in recirculation wells P-4 and P-5, which are in direct hydraulic connection with the underground mine workings, have been very similar in low-flow since 1997. Well P-5 water levels are higher during the summer months due to active phosphate injections. Since their installation in 2015, water levels in wells P-11 and P-12 are also comparable to each other and comparable to P-4 and P-5. Recirculation well P-12 exhibits higher water levels during summer month injections, like P-5.

- Recirculation wells in hydraulic connection with the underground mine workings (P-4, P-5, P-11, and P-12) show a stronger sensitivity to seasonal snowmelt (i.e., greater water level rise) compared to monitoring wells P-8, P-9, and P-10, suggesting more connection with infiltrating water. Seasonal

response in recirculation well P-7 is generally greater than P-8 and P-9, but less than observed in P-4, P-5, P-11 and P-12.

- Base-flow water levels in recirculation well P-4 has been generally stable since 1997. Monitoring well P-8 has consistently displayed the lowest water level in the mine vicinity, although it has increased since the adit was plugged.

Springs CFS and CFS-2 are located on the south wall of the North Pit (Figure 3). The flow from CFS has been measured since Fall 1999 and has ranged from 0.1 to 7.2 gallons per minute (gpm). The flow from CFS-2 has been measured since fall 2002 and has a similar range from 0.4 to 5.7 gpm.

Water levels during the July to October timeframe in 2018 through 2020 as shown on Figure 4a are influenced by underground injection activities, and therefore do not represent steady-state water levels. Measurements during 2020 that were not influenced by injection activities are similar to water levels observed in previous years.

4.3.3 Pinnacle Adit Flow and Water Quality

The flow rate from the Pinnacle adit at PP-01 has been monitored since November 1993. The flow generally consists of a seasonal pattern of high flows during the short period of spring melt in late May or early June and stable flows of less than 10 gpm throughout the year (Figure 5). The spike in flows observed at PP-01 each spring are a result of snowmelt and runoff, likely from sources originating between the Pinnacle plug and the PP-01 monitoring point. Once the snowmelt is over, the flow rate at PP-01 decreases and stabilizes at normal levels. In 2020, average amounts of snowpack were observed, and flows at PP-01 remained similar to the flows in 2018 and 2019.

Dissolved radium 226 and total uranium have been monitored at PP-01 since March 1994. After construction of the Pinnacle adit plug in September 1995, both dissolved radium 226 and total uranium concentrations have stabilized at reduced concentrations (Figure 6). Reduced total uranium and dissolved radium 226 were also observed in 2020.

4.4 Sediment Control Pond

Runoff from snowmelt and precipitation primarily flows across the property via the Indian and Tie Camp drainages. In 1980, an approximately 80-foot-high earthen embankment was constructed at the confluence of Indian and Tie Camp drainages to allow settlement of suspended solids from surface water prior to its release to Indian Creek. The embankment is a jurisdictional structure under the Colorado Division of Water Resources (Permit No. 280110). A Sediment Control Pond Embankment Report is submitted annually to the Colorado Division of Water Resources, providing the results of the embankment-monitoring program.

4.4.1 Embankment Monitoring

The safety and efficiency of the sediment control pond embankment is monitored with a network of surface and subsurface systems. Following completion of construction in 1981, five permanent survey monuments and five piezometers were installed to monitor physical movement of the embankment and changes in phreatic surface within the embankment, respectively. The Sediment Control Pond Embankment Report is expected to be completed by May 2021.

4.4.2 Sediment Control Pond Silt/Turbidity Curtain Installation

A new silt/turbidity curtain was installed at the sediment control pond in early July 2017 and has been maintained since installation to further control suspended solids that may not readily settle using iron- and aluminum-based dosing during treatment residuals management associated with establishing the LPL for uranium as described in Section 4.6.3. During dewatering of the pond for the 2020 Sediment Control Pond

projects, the silt curtain was not fully installed. Upon refilling of the sediment control pond, the silt curtain was reinstalled similar to the previous position.

4.5 Rock Dumps

Monitoring and annual reporting associated with the IRD and TCRD are discussed in the following subsections.

4.5.1 2020 Indian Drainage and Tie Camp Drainage Well Completion

In 2020, two new monitoring wells (IC-9995 and IC-10000) were installed in the Indian drainage. One monitoring well was installed in the Tie Camp drainage (TC-10105). The monitoring wells were installed to total depths of 23 feet below ground surface (ft bgs) for IC9995, 18.5 ft bgs for IC10000, and 19 ft bgs for TC1010. The monitoring wells were installed to assess geology of the underlying material and provide data for potential water segregating toe drains.

All monitoring wells were designed in accordance with Colorado Office of the State Engineer Rules for Water Well Construction Rule 14, "Minimum Construction Standards for Monitoring and Observation Wells/Holes and Test Holes." A Colorado-licensed well driller was used to advance boreholes and to conduct well installation, development, and sampling.

4.5.2 Rock Dump Water Levels

Historically, the water levels in rock dump piezometers and newer monitoring wells show little fluctuation in the fall and winter months, with a temporary rise in response to the spring snowmelt or summer rain events. The extent that water levels rise each year depends on the fluctuation in snowpack and summer precipitation, and the location of the piezometers within the rock dumps. Historical piezometers were installed to monitor water levels in the deeper portions of the IRD that correspond to the former drainages that run along the original valley bottoms. The Indian Rock Dump is separated into bench levels corresponding to ground surface elevation. Water levels within the rock dump are presented in Table 2. Figures 7-9 show the historical variation of water levels at each location, and Figure 3 depicts the IRD well and piezometer locations.

"**10100-10300" Level**

- Water levels in this level are subject to the source zone treatment program; however, no areas of surficial instability have been observed from 1996 through 2020.
- Water levels in recirculation wells used for extraction (RD-01, RD-03, RD-05) fluctuated 3 to 12 ft (Figure 7). RD-02 and RD-04 are wells at the same ground surface elevation and fluctuated approximately 2-4 ft. These short-term water level variations reflect changes during injection activities and appeared to have little influence on the overall subsurface water level.
- Recirculation wells at the 10300 level are former injection wells that were not used for injection in 2020. Water levels in these wells (RD-06, RD-07, RD-08, RD-09, 10300R) decreased roughly 2-6 feet from the spring snowmelt in the spring to low-flow conditions in the fall (Figure 8).

"**10370-10400" Level**

- Monitoring well IC10370R intersects the former Indian drainage running along the valley bottom beneath the IRD and exhibits strong response to seasonal snowmelt and drainout (Figure 9). Piezometer IC10360 is also near IC10370R but does not intersect the former Indian drainage. An obstruction approximately 155 feet below the well collar has prevented water levels from being observed at this location.

"10525-10725" Level

- Piezometers IC10600 and IC10525 are used to monitor subsurface water in this area. IC10600 water levels were similar in 2020 compared to 2019 and decreased 6 feet over the season. Piezometer IC10525, which is also representative of the 10400-10600 level of the rock dump, had similar water levels to both 2018 and 2019, decreasing less than 5 feet over the high to low flow sampling events (Figure 9)

"10600-10650" Level

- Piezometers IC10630 and IC10600 monitor subsurface water in this area of the IRD. The 2020 water levels during high and low flow were similar to 2019, regardless of higher snowpack levels. Water levels only stayed consistent over the course of the high to low flow events.

"10650-10780" Level

- No piezometers are present in this area. Visual inspection of the area revealed no evidence of settling or slumping of the rock dump material. The drainage channels are functioning as designed.

"10800" Level

- No piezometers are present in this area. Visual inspection of the area in 2020 revealed no evidence of settling or slumping of the rock dump material and the drainage channels are functioning as designed. Repairs made in 2012 just above the sericite stockpile continue to minimize erosion in this area, as observed in 2020.

Tie Camp Rock Dump

The TCRD is separated into bench levels corresponding to ground surface elevation. The rock dump was regraded in 1994 and approved in TR #1. It has one piezometer at an elevation of 10,375 feet.

Piezometer TC10375 monitors subsurface water in the TCRD. Water levels varied throughout 2020 but remained generally consistent with historical water levels (Figure 9).

In 2020, the IRD and TCRD were inspected monthly in accordance with the recommended monitoring program. The inspections and monitoring conducted in 2020 indicate stable conditions for the IRD and TCRD.

4.6 Establishing the Lowest Practical Level for Uranium

Field implementation in 2020 focused on maintenance and continued operation of the systems to facilitate uranium load reduction and passivation, including the phosphate injection systems in the underground mine workings and Indian Rock Dump, the ETC biochemical reactors (BCRs), and the TRM system. Required regulatory approvals/authorizations were obtained prior to initiation of field activities.

- Chemical usage authorization from the CDPHE Water Quality Control Division (WQCD), which allowed reagents to be used that were not directly specified by the CDPS permit (No. CO0022756) (Appendix C).
- United States Environmental Protection Agency Class V Underground Injection Control "authorization by rule" (Appendix D).

- Amendment No. 19 and subsequent Amendment No. 20 to the CDPHE RML Permit No. 150-01, which focused on management and handling of licensed radiological materials (Appendix E).

Compliance with the conditions of the approvals/authorizations and CDPS permit conditions were maintained during and following the 2020 field activities. Field work is summarized in the following subsections.

4.6.1 Phosphate Injection Systems

The injection systems operated from June 2020 through October 2020 and included 1,050,000 gallons of phosphate reagent injection volume into the underground mine workings and 2,640,000 gallons of injection volume into the PMD/IRD.

Both systems successfully delivered and distributed reagents throughout the target injection zone (underground mine workings) and into saturated and unsaturated zone fill material (Pinnacle Mine Dump area of the IRD) as demonstrated by phosphate concentrations. Decreases in uranium concentrations in downgradient surface water have been observed at the Chester Fault Springs location as well as at locations on IRD (IC-10300R and RD-09). Reductions in uranium have not been observed at SW-33, which can be attributed to slow migration of the clean waterfront (i.e., migration of treated, uranium-reduced water from the injection zone) and desorption of residual uranium downgradient of phosphate injection zones.

Other work associated with the phosphate injection system included well rehabilitation of existing injection wells and maintenance of injection systems.

No phosphate injection/recirculation activities are planned for 2021.

4.6.2 Engineered Treatment Cells

In 2018, two bioreactor ETCs were constructed on the IRD to collect and treat surface water from the CFS. The bioreactors resumed operation in 2020 and treated 480,000 gallons of water. The treatment cells contain organic-based media (woodchips, manure, hay) and effectively removed 45% of the uranium load from the springs during 2020. The ETCs removed approximately 2.5 milligrams per gallon (mg/gal) reactor/day of uranium by the end of 2020 operation. Three drum-scale bioreactors were constructed in 2019 to test media amendments to inform future reactor designs. These reactors operated again in 2020 in the same configuration as 2019.

In 2020, a pilot scale ETC was constructed and operated similar to the existing ETCs. The ETC tested modified cell dimensions, post treatment processes, and a roll-off construction concept. The cell treated over 50,000 gallons and effectively removed uranium from 65-97% of the uranium load during favorable operating conditions.

4.6.3 Treatment Residuals Management System

The TRM system is located on the Indian drainage between the toe of the Indian Rock Dump and the sediment control pond (Figure 3). The system is used to mitigate and residual phosphate that may remain in surface water downgradient of injection activities. The system is designed to dose iron and aluminum (ferric chloride and sodium aluminate) and polymer flocculant (Mineral Master MM-2480). Bench testing was conducted in early 2017 to determine optimal field dosing rates and to verify enhanced iron/aluminum precipitate removal with flocculant. Phosphate and secondary treatment byproducts were successfully controlled during load reduction field activities in 2015 through 2020; therefore, field implementation of the TRM system was not necessary in 2020 or in previous years.

4.6.4 Surface Water Management

In 2020, surface water management focused on advancing water segregation approaches and the associated implications. As part of this effort, continued monitoring of North Pit Lake stratification and potential turnover was conducted, including continual monitoring of temperature and conductivity via data loggers placed on a mooring line anchored to the lake bottom.

4.7 Colorado Discharge Permit System Monitoring

Monthly discharge monitoring reports (DMRs), pursuant to CDPS Permit No. CO-0022756, were submitted to the CDPHE WQCD throughout 2020. Analytical tests conducted for the DMRs at SW-33 consist of flow, dissolved radium 226, total radium 226/228, total uranium, pH, total suspended solids, total dissolved solids, oil and grease (visual only), potentially dissolved zinc, and whole effluent toxicity (WET). During 2020, analytical results were below the CDPS permit 30-day average or daily maximum limitations, and WET tests passed consistent with historical results. The 2020 DMRs are on file with the WQCD.

4.8 Radioactive Materials License

The RTP building, foundation, and sediments excavated from the upper portion of Indian drainage below the former RTP area were placed in the Tie Camp Disposal Cell in 2001. Final grading and revegetation of the former RTP area was completed in 2003. With the removal of the RTP, radioactive source material and the associated treatment capacity were removed. HMC is authorized by the RML and associated license amendments to manage the Tie Camp Low-Grade Stockpile and Disposal Cell, and the sediment upstream of the sediment control pond embankment within the applicable guidelines. HMC is also authorized to possess, handle and store natural uranium in water treatment media and residuals collected through the phosphate injection system, engineered treatment cell, and TRM system. The current license was renewed in 2013 and amended (No. 20) by the CDPHE Hazardous Materials and Waste Management Division in July 2020. The 2020 Annual RML Letter Report will be submitted to CDPHE by May 31, 2021 in accordance with RML License Condition 15.F. A copy of this report will be provided to DRMS upon request.

5. INSPECTIONS

DRMS representative Dustin Czapla conducted the annual inspection on October 22, 2020. No violations were noted during this inspection. The 2020 DRMS inspection report is included in Appendix F. In addition to observations noted in previous sections, specific observations included:

- General Inspection Topics were inspected and given a categorical evaluation:
    - Records
    - General Mine Plan Compliance
    - Signs and Markers
    - Backfill and Grading
    - Erosion/Sedimentation
    - Roads
    - Reclamation Plan/Compliance
- South Pit: Inspection was completed when grading work was nearly complete and appears to be in accordance with the approved reclamation plan.
- Sediment Control Pond: Inspection was completed after completion of the work and appeared to be in accordance with the approved reclamation plan.

6. SURETY

HMC maintains a reclamation surety performance bond for the Pitch Reclamation Project in the form of a financial guarantee bond with Liberty Mutual Insurance Company. The financial guarantee bond was re-evaluated as part of the mine reclamation plan amendment and increased in 2019 to $24,451,940. A copy of the notification and surety form to DRMS is provided as Appendix G.

7. MONITORING AND RECLAMATION ACTIVITIES PLANNED FOR 2021

HMC submitted a 112d-3 amendment to Permit No. M-1977-004 in June 2019. The amendment package includes a comprehensive update of the mine reclamation plan and addresses the existing conditions and remaining work to be performed to adequately reclaim and close the site. The reclamation plan amendment was approved by DRMS on January 6, 2020.

During 2021, the following monitoring and reclamation activities are tentatively scheduled or planned, but will be dependent upon site access:

Slope Stability

- Conduct annual surveys of the slope monitoring monuments and inclinometers.
- Continue to monitor the drainage channels on the east and south walls of the North Pit, the east wall of the South Mine area, and other areas throughout the property, and make improvements as necessary.
- Reseed areas graded during 2020 that were completed after seeding efforts could effectively be implemented.

Tie Camp Disposal Cell

- Monitor the Tie Camp Disposal Cell for depressions where water could pond and manage the drainage off and around the cell.
- Monitor revegetation and reseed and/or fertilize as necessary.

Sediment Control Pond

- Clean sediment traps in the Indian and Tie Camp drainages above the sediment control pond.
- Inspect and monitor the sediment control pond embankment, including surveying the monuments, inspecting for seepage, removing tree seedlings on the upstream and downstream face of the embankment, monitoring the outlet pipe and cleaning the debris trap above the outlet pipe, and repairing rill erosion as need.
- Monitor the sediment control pond embankment piezometers monthly, or more often if it is necessary to store water above the clay blanket located on the upstream side of the sediment control pond embankment.
- Inspect the piezometers for silt buildup and pressure flush the piezometers as necessary to eliminate buildup of debris and silt.

Sand Filter Plant Demolition

Demolish the former sand filter plant and dispose of demolition debris either offsite or in the Tie Camp Disposal Cell, pending CDPHE-RMD approval.

Tie Camp Rock Dump Diversion Channel

Establish a diversion ditch around the TCRD. Water will also be rerouted from the IRD culvert and combine with the TCRD diversion. The ditch will be lined with a GCL liner to minimize infiltration and seepage along its alignment.

Rock Dumps

- Inspect drainage and erosion repairs on the upper benches of the TCRD and the groin area on the western side of the IRD.

- Monitor IRD inclinometers to confirm slope stability. No phosphate injection/recirculation activities are planned for 2021.

Underground Mine Workings

- Collect water level readings in the piezometers in and near the underground mine workings. No phosphate injections/recirculation activities are planned for 2021.

Revegetation and Weed Control

- Continue noxious weed control management using Milestone with Telar XP and Escort XP w/R-11 Activator.

General Maintenance and Permit Compliance Activities

- Grade roads for safe travel into and around mine.
- Conduct monthly and quarterly monitoring and reporting in accordance with the CPDS permit. Water quality monitoring will continue in 2021.
- Continue to monitor the constructed marsh area located in the drainage area near the former RTP and on the small sediment settling basins constructed upgradient from the sediment control pond, including placement of additional organic material (e.g., peat), and other enhancements to further promote sediment control.

Optimization of Source Control and Treatment BMPs

The following additional BMP advancement activities are proposed for 2021:

- Continued operation of ETCs and drum scale bioreactors.
- Continued surface water and shallow groundwater investigations.
- Operation of pilot ion exchange (IX) systems to evaluate uranium removal efficiencies and water quality compatibility.

TABLE

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Current Designation	Spring 1995	Spring 1996	Spring 1997	Spring 1998	Fall 1998	Spring 1999	Fall 1999	Spring 2000	Fall 2000	Spring 2001	Fall 2001	Spring 2002	Fall 2002	Spring 2003
TC-1	Inactive	*<1	No Flow	*<1	No Flow	*<1	No Flow	N-O	*<1	*<1	No Flow	No Flow	N-O	N-O	N-O
TC-2	Spring	*5	*5	*5	*5	*5	*1	N-O	0.6	*<1	0.8	0.3	No Flow	0.2	1.5
TC-3	Spring	*5	*5	*5	*5	*5	*1	N-O	0.5	*<1	0.8	0.5	No Flow	0.4	3.8
TC-4	Seep	*<1	No Flow	*5	No Flow	*5	No Flow	N-O	1.2	No Flow	0.4	No Flow	No Flow	No Flow	4.3
TC-5	Seep	*<1	No Flow	*5	No Flow	*5	No Flow	N-O	0.5	No Flow	0.4	No Flow	No Flow	No Flow	1.7
TC-6	Inactive	*5	No Flow	No Flow	N-O	N-O	N-O	N-O	N-O	No Flow	No Flow	No Flow	N-O	N-O	N-O
TC-7	Inactive	No Flow	*20	No Flow	No Flow	No Flow	No Flow	N-O	No Flow	No Flow	No Flow	No Flow	N-O	N-O	N-O
TC-8	Inactive	No Flow	No Flow	*<1	*<1	*<1	*<1	N-O	*<1	No Flow	No Flow	No Flow	N-O	N-O	N-O
TC-9	Seep	No Flow	No Flow	No Flow	*<1	*<1	0.1	N-O	0.2	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
TC-10	Spring	First monitored in spring 1999					*1	N-O	1.5	0.9	0.5	0.5	0.4	0.6	1.2
TC-11	Inactive	First monitored in spring 2000							*<1	No Flow	No Flow	No Flow	N-O	N-O	N-O
TC-12	Inactive	First monitored in spring 2000							No Flow	No Flow	N-O	N-O	N-O	N-O	N-O
IC-1	Inactive	*2	No Flow	No Flow	*<1	No Flow	N-O	N-O	N-O	N-O	No Flow	No Flow	N-O	N-O	N-O
IC-2	Spring/Seep	*<1	*<1	*<1	*<1	*<1	0.7	N-O	1.2	No Flow	0.5	No Flow	No Flow	No Flow	2.1
IC-3	Seep	*2	*2	*2-5	*<1	*<1	No Flow	N-O	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
IC-4	Spring/Seep	*10	*5	*20	*15	*1	*2.5	N-O	8.6	No Flow	3.8	No Flow	No Flow	No Flow	28.4
IC-5	Inactive	No Flow	No Flow	No Flow	*<1	No Flow	No Flow	N-O	*<1	*<1	No Flow	No Flow	N-O	N-O	N-O
IC-6	Seep	*5	No Flow	No Flow	*2	*<1	No Flow	N-O	1.3	No Flow	0.5	no flow	0.5	no flow or dry	0.7
IC-7	Inactive	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	N-O	*<1	*<1	No Flow	No Flow	N-O	N-O	N-O
IC-8	Inactive	3	No Flow	No Flow	*<1	No Flow	No Flow	N-O	*<1	No Flow	No Flow	No Flow	N-O	N-O	N-O

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Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Current Designation	Spring 1995	Spring 1996	Spring 1997	Spring 1998	Fall 1998	Spring 1999	Fall 1999	Spring 2000	Fall 2000	Spring 2001	Fall 2001	Spring 2002	Fall 2002	Spring 2003
IC-9	Inactive	No Flow	*<1	*<1	*<1	No Flow	No Flow	N-O	*<1	No Flow	No Flow	No Flow	N-O	N-O	N-O
IC-10	Spring	First monitored in spring 2003													16.8
IC-11	Inactive	First monitored in spring 2003													5.2
IC-12	Seep	First monitored in spring 2008													
CF-1	Re-named as CFS and CFS-2	N-O	Variable	Variable	No Flow	*<1	Re-named as CFS and CFS-2								
CF-2		N-O	Variable	Variable	No Flow	*<1	Re-named as CFS and CFS-2								
NP-1	Inactive	First monitored in fall 1998				*<1	No Flow	N-O	No Flow	No Flow	No Flow	No Flow	N-O	N-O	N-O
CFS	Spring	First monitored in fall 1999						1.8	2.6	N-O	2.3	N-O	0.6	0.5	N-O
CFS-2	Spring	First monitored in fall 2002												0.4	N-O
RD-SEEP	Spring	First monitored in spring 2019													
TC-13	Spring	First monitored in spring 2019													
EWS-01	Spring	First monitored in spring 2019													

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Fall 2003	Spring 2004	Fall 2004	Spring 2005	Fall 2005	Spring 2006	Fall 2006	Spring 2007	Fall 2007	Spring 2008	Fall 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010
TC-1	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-2	0.3	0.6	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow
TC-3	0.4	0.9	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow
TC-4	No Flow	0.4	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow
TC-5	No Flow	No Flow	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow
TC-6	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-7	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-8	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-9	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow
TC-10	0.6	1.7	0.6	0.9	0.5	0.7	0.5	0.9	0.5	1	0.5	0.9	0.4	0.8	0.5
TC-11	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-12	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-1	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-2	0.3	0.9	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow
IC-3	No Flow	No Flow	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	no flow or dry	Flow observed	No Flow
IC-4	No Flow	1.9	No Flow	20.9	No Flow	15.4	No Flow	37.2	0.4	44.8	0.6	25	0.2	20.3	No Flow
IC-5	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-6	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
IC-7	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-8	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O

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Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Fall 2003	Spring 2004	Fall 2004	Spring 2005	Fall 2005	Spring 2006	Fall 2006	Spring 2007	Fall 2007	Spring 2008	Fall 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010
IC-9	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-10	4.2	13.4	4.9	14.5	4.1	11.9	5.6	15.3	5.7	18.2	4.4	13.6	5.1	13.2	4.6
IC-11	No Flow	No Flow	No Flow	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-12	First monitored in spring 2008									33.3	0.4	14.3	0.3	6.4	No Flow
CF-1	Re-named as CFS and CFS-2														
CF-2	Re-named as CFS and CFS-2														
NP-1	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
CFS	1.5	3.1	1.7	4.6	1.6	3.4	1.8	2.8	2.5	7.2	3.1	5.7	1.9	5.4	2
CFS-2	0.7	1.1	0.6	2.1	0.6	1.2	0.9	0.4	0.7	4.4	1.6	2.8	1.3	1.6	0.7
RD-SEEP	First monitored in spring 2019														
TC-13	First monitored in spring 2019														
EWS-01	First monitored in spring 2019														

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Spring 2011	Fall 2011	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Spring 2018
TC-1	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-2	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	Flow observed	N-O	N-O	N-O
TC-3	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	Flow observed	N-O	N-O	N-O
TC-4	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	N-O	N-O	N-O
TC-5	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	N-O	N-O	N-O
TC-6	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-7	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-8	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-9	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	Flow observed	No Flow	N-O	N-O	N-O
TC-10	0.9	0.4	0.6	0.5	0.5	0.6	1	0.5	1.1	0.4	0.5	0.4	0.7	0.3	0.9
TC-11	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
TC-12	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-1	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-2	Flow observed		Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	0.6	N-O	N-O	N-O
IC-3	Flow observed		Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	Flow observed	N-O	N-O	N-O
IC-4	40	No Flow	No Flow	No Flow	3.3	No Flow	37.5	No Flow	30	No Flow	20	0.7	18.5	0.6	2.31
IC-5	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-6	No Flow	No Flow	No Flow	No Flow	0.7	No Flow	1.4	No Flow	No Flow	No Flow	No Flow	No Flow	N-O	N-O	N-O
IC-7	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-8	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Spring 2011	Fall 2011	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014	Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Spring 2018
IC-9	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-10	17.4	5.5	6.3	3.2	10	5	14	5.5	37.5	5	12.5	4.6	5.5	5	5
IC-11	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
IC-12	17.6	0.4	No Flow	No Flow	4	No Flow	33.3	No Flow	14	No Flow	42.3	1.4	12.9	1.2	1.67
CF-1	Re-named as CFS and CFS-2														
CF-2	Re-named as CFS and CFS-2														
NP-1	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O	N-O
CFS	5.7	0.1	1.9	1.2	3	1.2	3.1	1.7	5	1.6	4.8	1.2	3.6	1.3	0.64
CFS-2	2.7	0.8	0.8	0.5	2	0.8	3.9	0.9	3	1.1	5.2	Flow observed	3.9	1.5	0.94
RD-SEEP	First monitored in spring 2019														
TC-13	First monitored in spring 2019														
EWS-01	First monitored in spring 2019														

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Fall 2018	Spring 2019	Fall 2019	Spring 2020	Fall 2020
TC-1	N-O	N-O	N-O	No Flow	N-O
TC-2	N-O	N-O	N-O	Flow observed	N-O
TC-3	N-O	N-O	N-O	Flow observed	N-O
TC-4	N-O	N-O	N-O	No Flow	N-O
TC-5	N-O	Flow observed	N-O	Flow observed	N-O
TC-6	N-O	N-O	N-O	No Flow	N-O
TC-7	N-O	N-O	N-O	No Flow	N-O
TC-8	N-O	N-O	N-O	No Flow	N-O
TC-9	N-O	Flow observed	N-O	Flow observed	N-O
TC-10	0.48	1	N-O	0.5	0.21
TC-11	N-O	N-O	N-O	No Flow	N-O
TC-12	N-O	N-O	N-O	No Flow	N-O
IC-1	N-O	N-O	N-O	Flow observed	N-O
IC-2	N-O	Flow observed	N-O	Flow observed	N-O
IC-3	N-O	N-O	N-O	Flow observed	N-O
IC-4	No Flow	3	N-O	Flow observed	N-O
IC-5	N-O	N-O	N-O	No Flow	N-O
IC-6	N-O	Flow observed	N-O	No Flow	N-O
IC-7	N-O	N-O	N-O	No Flow	N-O
IC-8	N-O	N-O	N-O	No Flow	N-O

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Station	Fall 2018	Spring 2019	Fall 2019	Spring 2020	Fall 2020
IC-9	N-O	N-O	N-O	Flow observed	N-O
IC-10	3.18	10	2	10.8	4.58
IC-11	N-O	N-O	N-O	No Flow	N-O
IC-12	Flow observed	7.69	Flow observed	8.25	0.125
CF-1	Re-named as CFS and CFS-2				
CF-2	Re-named as CFS and CFS-2				
NP-1	N-O	N-O	N-O	N-O	N-O
CFS	2.27	N-O	1.5	2.7	1.44
CFS-2	1.15	N-O	3.4	1.4	2.53
RD-SEEP	First monitored in 2019	Flow observed	No flow	No Flow	No Flow
TC-13		Flow observed	N-O	No Flow	N-O
EWS-01		N-O	Flow observed	Flow observed	N-O

Table 1
Springs and Seeps Summary of Activity 1995-2020
Pitch Reclamation Project
Colorado Mined Land Reclamation Board - 2020 Annual Reclamation Report

Notes:

Flow presented in gallons per minute

* = flows visually estimated

Flow observed = below measurable quantity or not accesible for measurement

No flow = feature observed with no flow

CF/CFS = feature located at south wall of North Pit Lake within the Chester Fault Zone

IC = feature located in Indian Creek drainage

N-O = not observed

NP = feature located at wouth wall of North Pit Lake

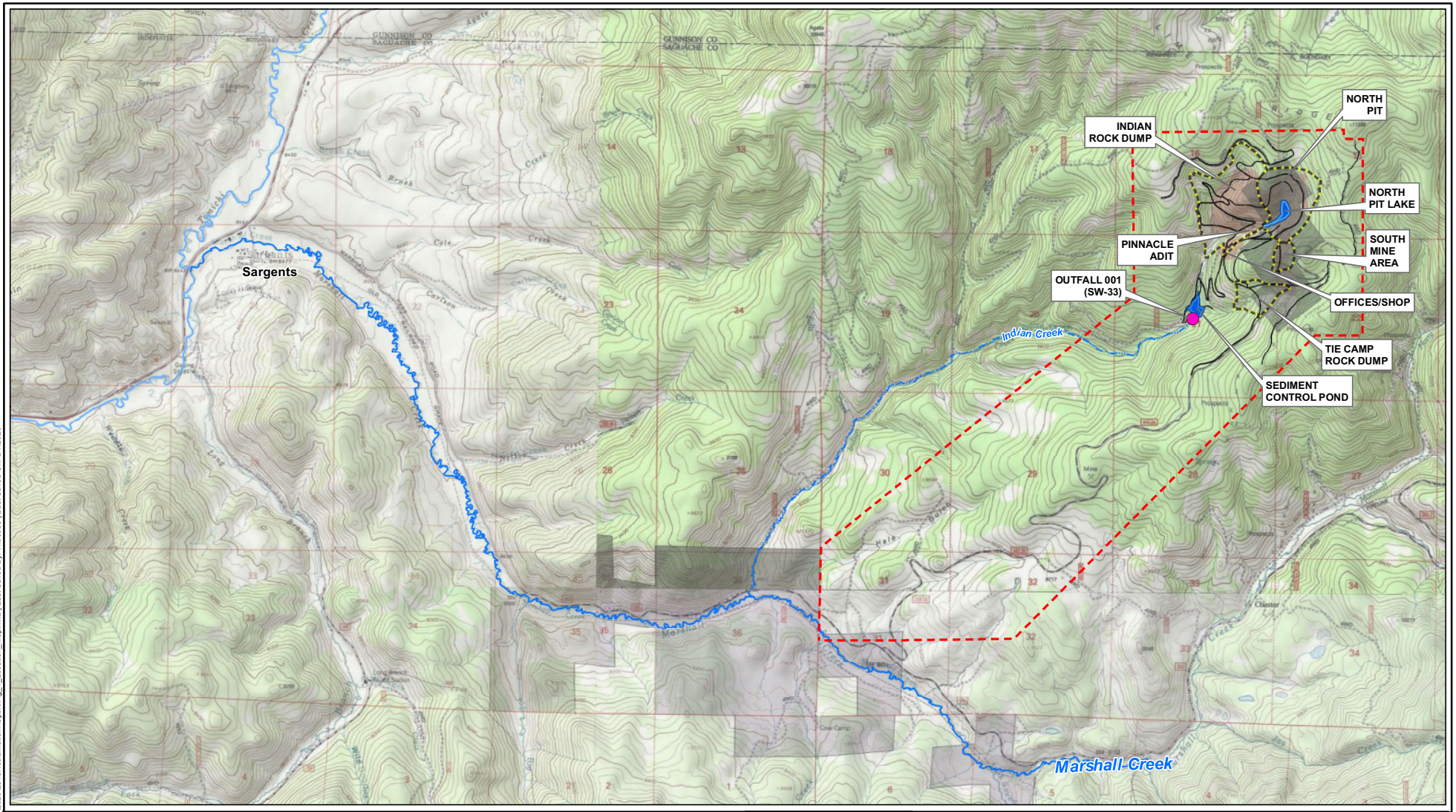
TC = feature located in the Tie Camp Creek drainage

Table 2
Seasonal Water Level Readings in Rock Dump Piezometers
Pitch Reclamation Site
Saguache County, CO

Ground Surface Elevation (ft amsl)	10631.50	10603.80	10523.60	10379.95	10373.40	10304.72	10305.55	10305.39	10304.64	10304.09	10043.60	10043.40	10043.29	10040.85	10044.42	10373.00
Location	10630	10600 [a]	10525 [a]	10370R	10360 [a]	10300R	RD-06	RD-07	RD-08	RD-09	RD-01	RD-02	RD-03	RD-04	RD-05	TC10375 [a]
Piezometer Type	M	M	M	M	M	I/M [c]	I/M [c]	I/M [c]	I/M [c]	I/M [c]	E	E	E	M	E	M
High Flow 2017	10436.5	10363.8	10301.2	10185.7	10156.2	10125.0	*10114.2*	*10115.0*	*10115.7*	*10100.1*	10028.3	10027.3	10028.7	10025.2	*10025.8*	10210.1
Low Flow 2017	10431.1	10356.7	10297.6	10184.1	10154.9	10116.4	10110.4	10117.2	10119.8	10116.5	10024.5	10027.3	10024.7	10021.4	10027.9	10206.6
High Flow 2018	10451.5	10357.3	10303.2	10183.7	[b]	10117.7	10114.6	10113.6	10118.6	10117.5	10030.0	10024.6	10025.1	10022.5	10025.6	10207.3
Low Flow 2018	10432.7	10355.7	10296.6	10177.6	[b]	10116.0	10119.7	10113.7	10158.0	10115.5	10022.0	10022.7	10022.0	10020.5	10026.7	10205.2
High Flow 2019	10431.9	10357.4	10304.2	10184.2	[b]	10120.8	10124.2	10123.5	10122.3	10118.7	10038.7	10027.9	10029.3	10024.9	10040.4	10210.7
Low Flow 2019	10430.5	10355.3	10300.8	10183.6	[b]	10117.2	--	10112.4	10116.2	10115.5	10028.1	10024.5	10024.6	10022.5	10029.3	10211.2
High Flow 2020	10430.8	10359.4	10305.9	10194.6	[b]	10119.8	10120.7	10119.9	10118.6	10115.0	10027.7	10026.2	10028.2	10023.0	10038.1	10207.6
Low Flow 2020	10431.6	10353.0	10298.3	10180.5	[b]	10119.4	10115.0	10113.2	10116.2	10117.5	10024.1	10024.0	10024.1	10022.6	10022.8	10204.5

Notes:
ft amsl = feet above mean sealevel
Piezometer Type:
M = Monitoring
I = Injection
E = Extraction
High-flow monitoring typically occurs in late May of each year
Low-flow monitoring typically occurs in early October of each year
Injection wells were monitored outside of typical high-flow monitoring period
(a) - Estimated casing height of piezometer used due to lack of survey data
(b) - Water level not taken due to obstruction in the piezometer
(c) - Operated as injection well from 2017-2018 and a monitoring well from 2019-2020

FIGURES

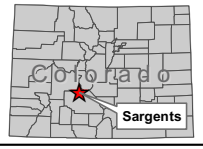


Legend

- Sample Points
- Colorado Division of Reclamation, Mining, and Safety Permit Boundary
- Facility Areas
- Marshall Creek
- Indian Creek
- Tomichi Creek

Notes:

Source: USGS 7.5' Quadrangles of Sargents, Chester, Sargents Peak, and Paholone Peak, Colorado



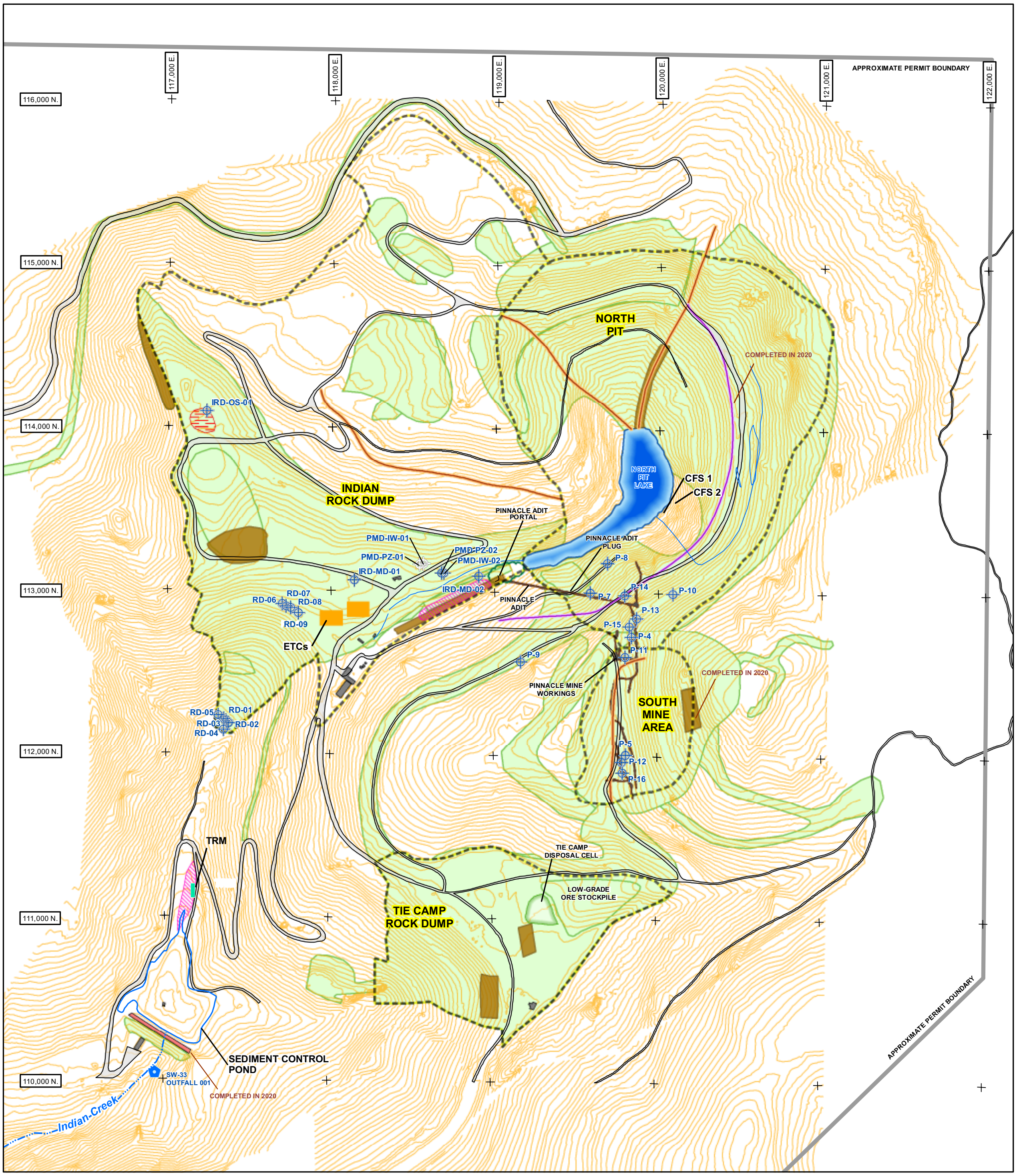
0 3,000 6,000 Feet

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

LOCATION MAP

ARCADIS | FIGURE 1

Path: D:\Share\Pitch\GIS\MXD\2020\2019ReclamationReport\Fig_1_Location_Map.mxd | Last Saved By: vn80988 | Last Saved On: 6/1/2020



Legend

- Piezometers
- Colorado Discharge Permit System Compliance Point
- Facility Areas
- Buildings
- Clay-Fabric-Rock Lined Channel
- Riprap Lined Channel
- Approximate Permit Boundary
- Areas of Earth Structure Repair
- Areas Revegetated
- Engineered Treatment Cell Area
- Marsh Area
- Clay Stockpile
- Drainage Improvement
- Underground Workings
- Sediment Pond Embankment
- Disposal Cell Tie Camp
- Road
- Treatment Residuals Management Area
- Completed in 2020

Colorado
Sargents

Notes:

1. Base topography provided by Homestake Mining Company established in 1994.
2. Revegetated areas prior to 1998 provided by Golder Associates.
3. For illustrative purposes.

HOMESTAKE
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

2020 RECLAMATION AREAS

ARCADIS

FIGURE 2

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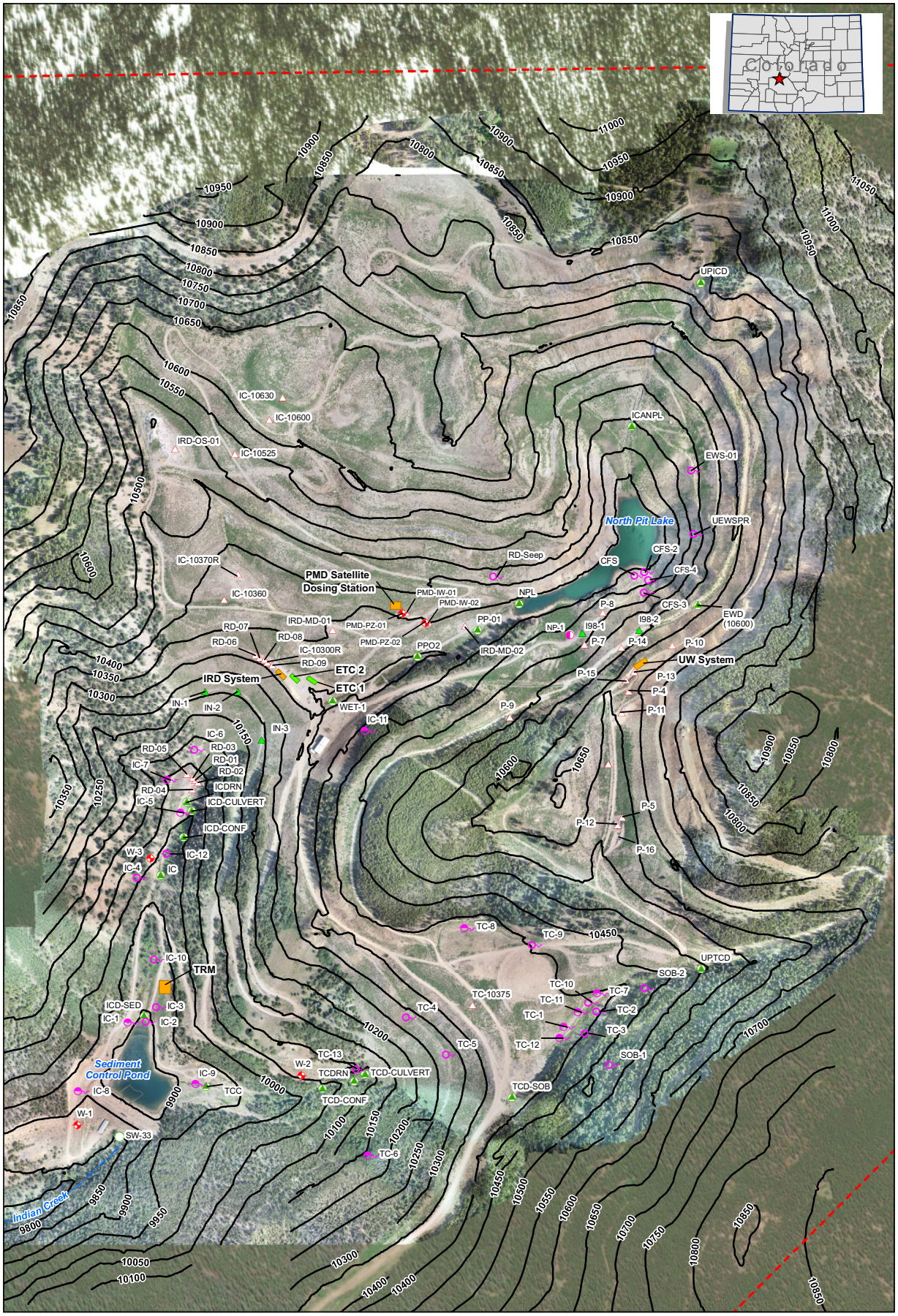


Legend

- Monitoring Well
- Inclinometer
- Piezometer
- Surface Water Sampling Point
- Active Seep/Spring
- Inactive Seep/Spring
- Colorado Discharge Permit System Compliance Point
- Colorado Discharge Permit System Boundary
- Contours = 50 feet

TRM = Treatment Residuals Management
IRD = Indian Rock Dump
ETC = Engineered Treatment Cell
UW = Underground Workings
PMD = Pinnacle Mine Dump

N

0 260 520 Feet

HOMESTAKE

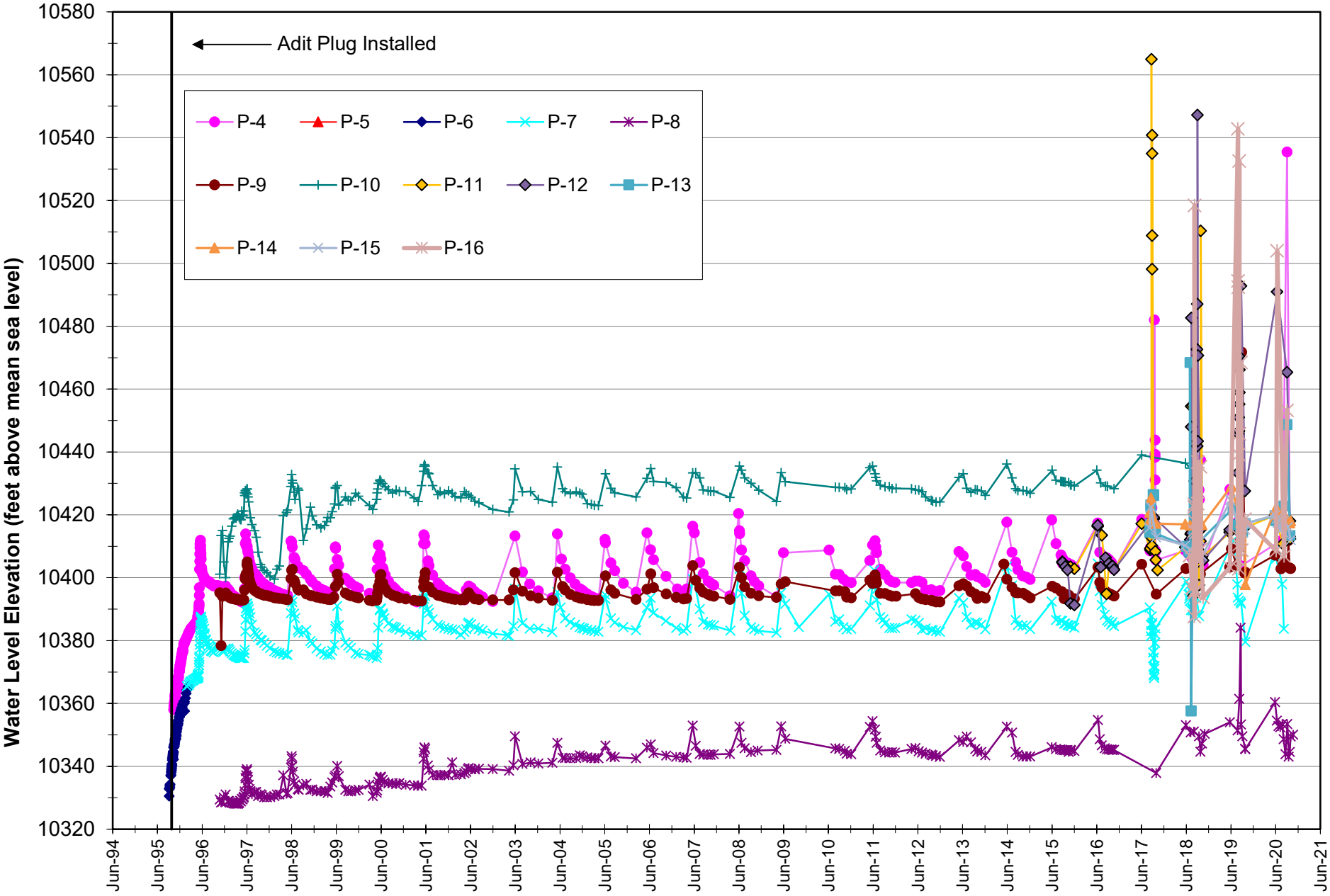
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SYSTEMS AND MONITORING LOCATIONS

ARCADIS

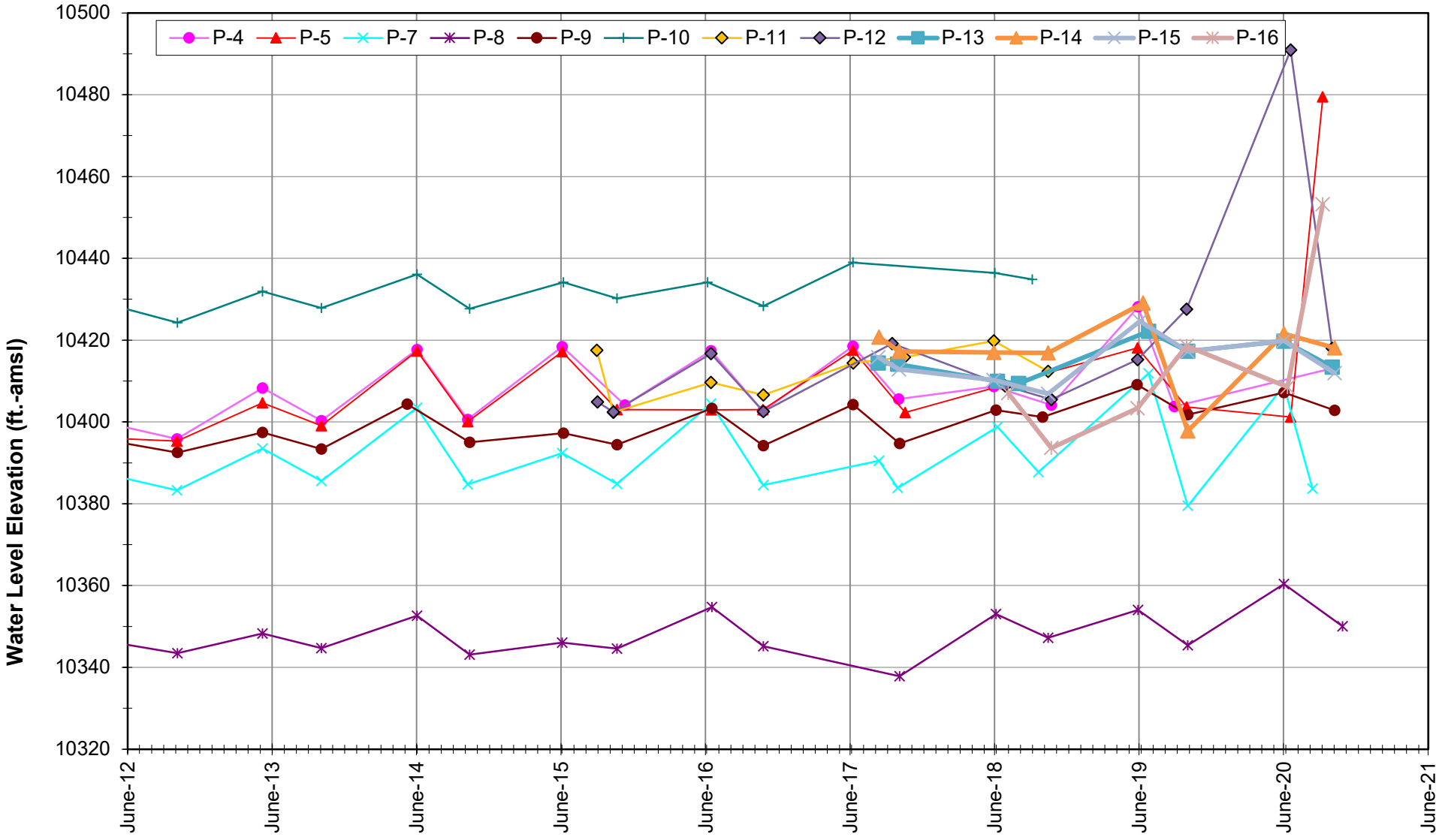
FIGURE
3

Path: T:_ENVAOO\000102_PitchGIS\MXD\2020\2020-09\Figure 3-2 Monitoring Locations.mxd Date Saved: 12/9/2020 12:40:32 PM



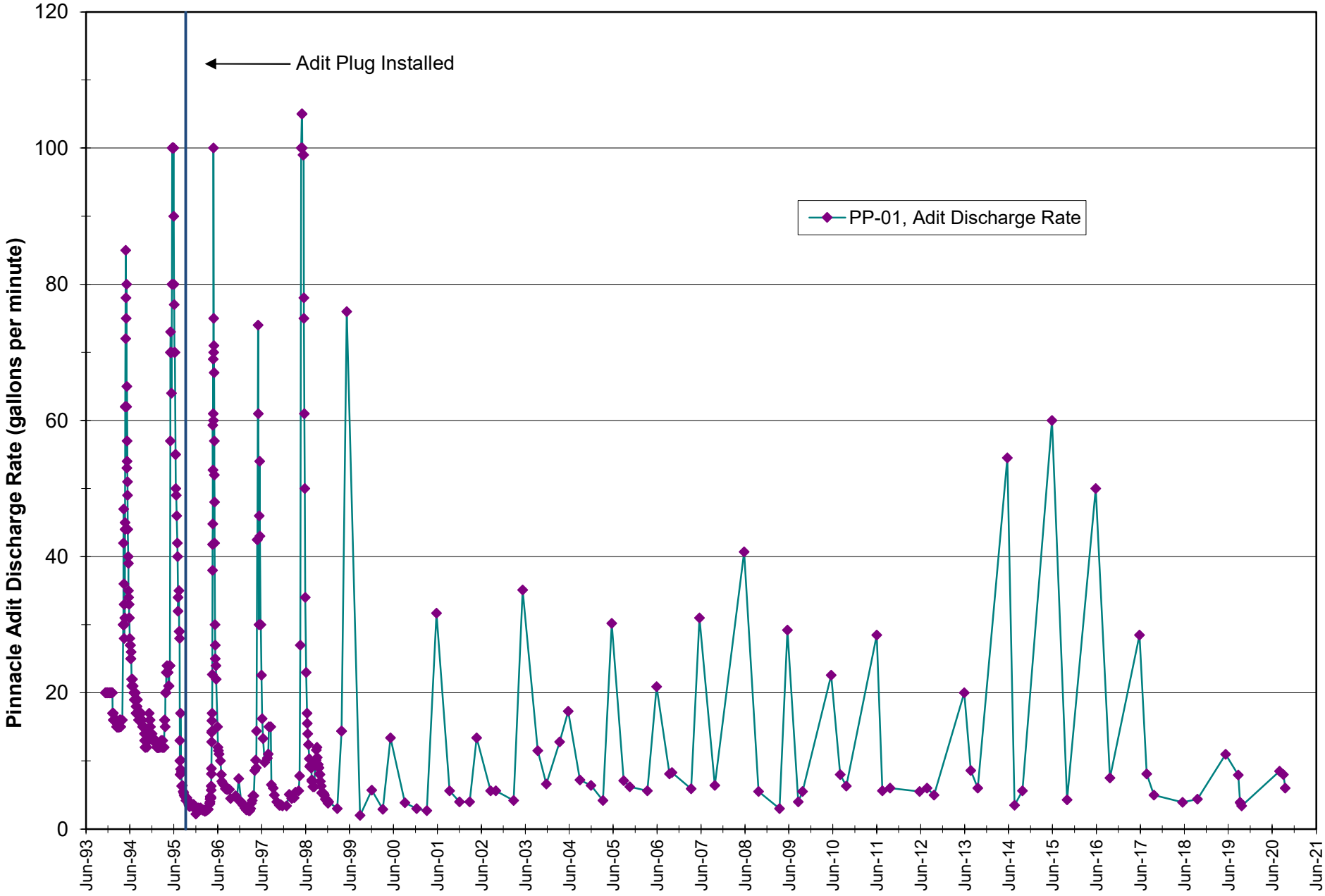
PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
2020 Annual Reclamation Report

Figure 4a: Water Level Elevation Data in P - Wells 1995-2020



PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
2020 Annual Reclamation Report

Figure 4b: Water Level Elevation Data in P-Wells 2012-2020



PITCH RECLAMATION PROJECT
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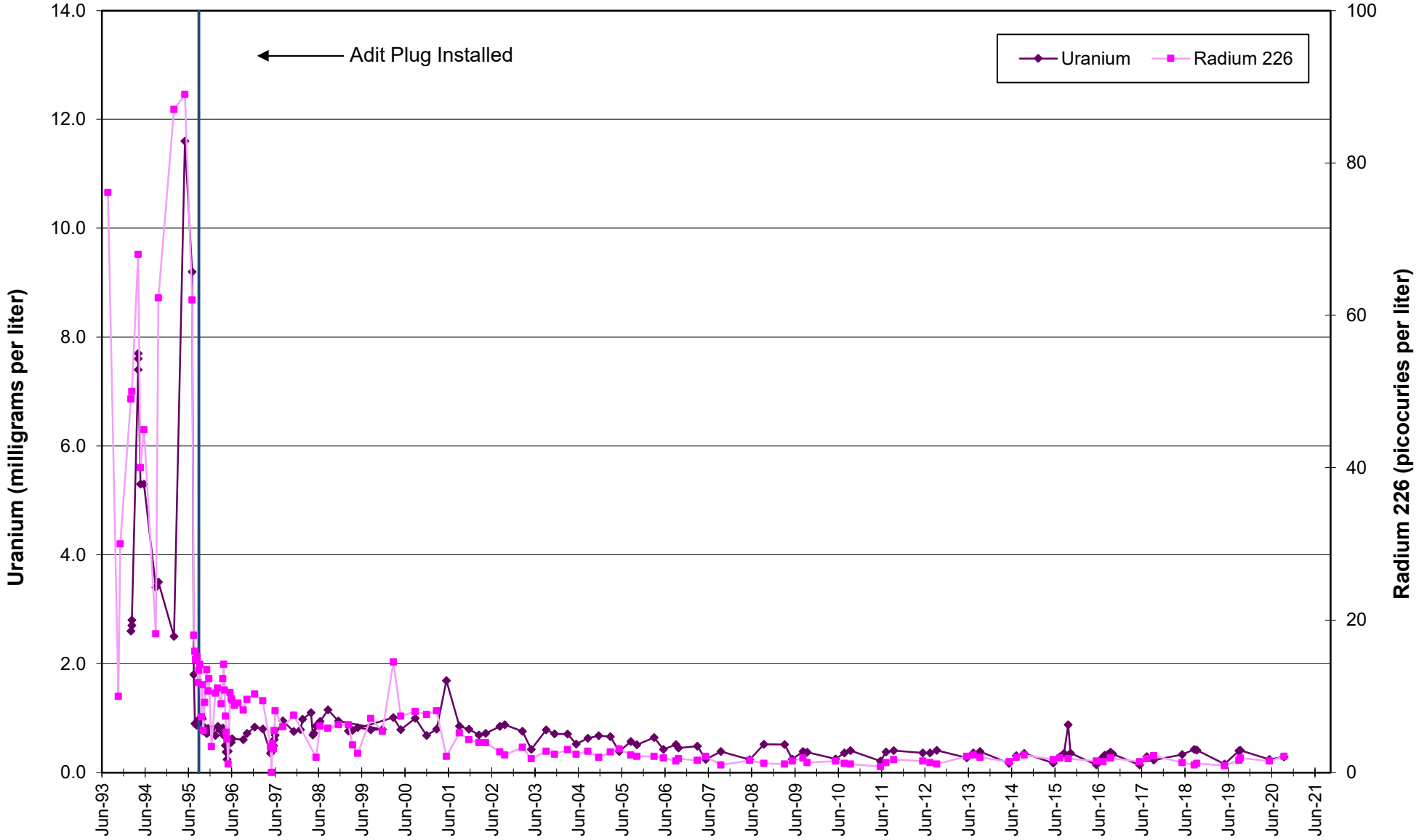
Figure 5: Hydrograph of Pinnacle Adit Discharge



PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
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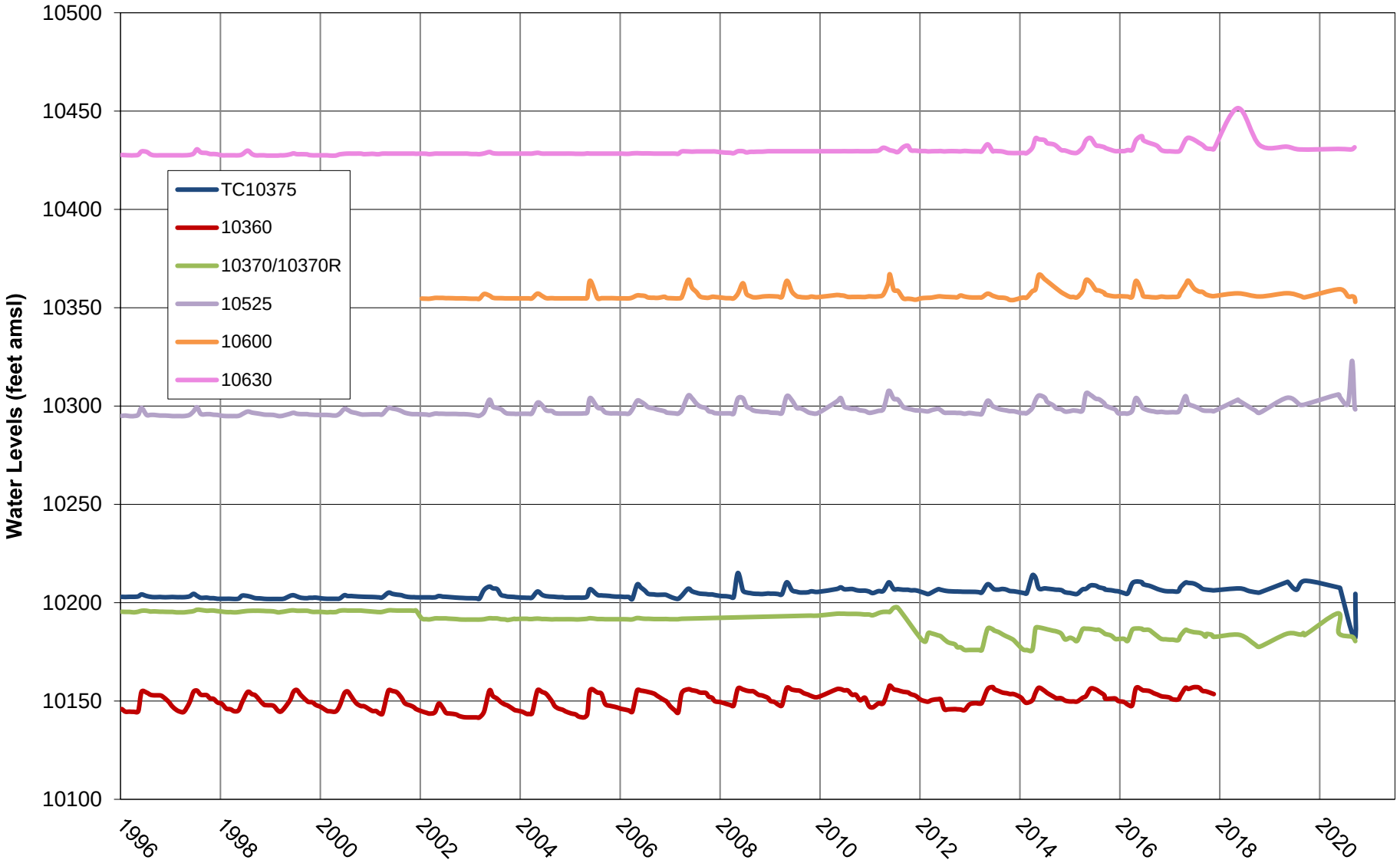
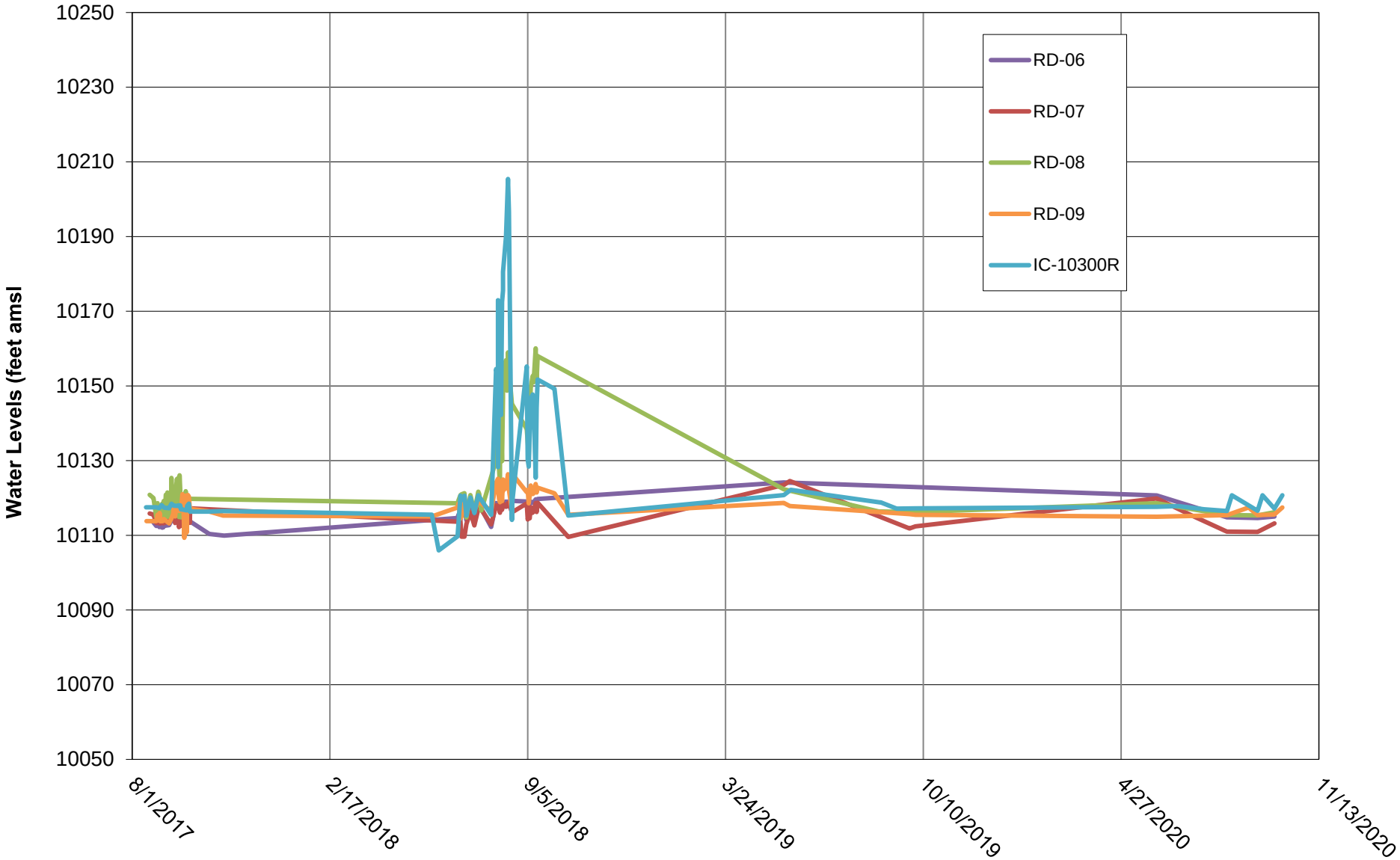
Figure 6: Pinnacle Adit Discharge, Uranium and Radium Concentrations

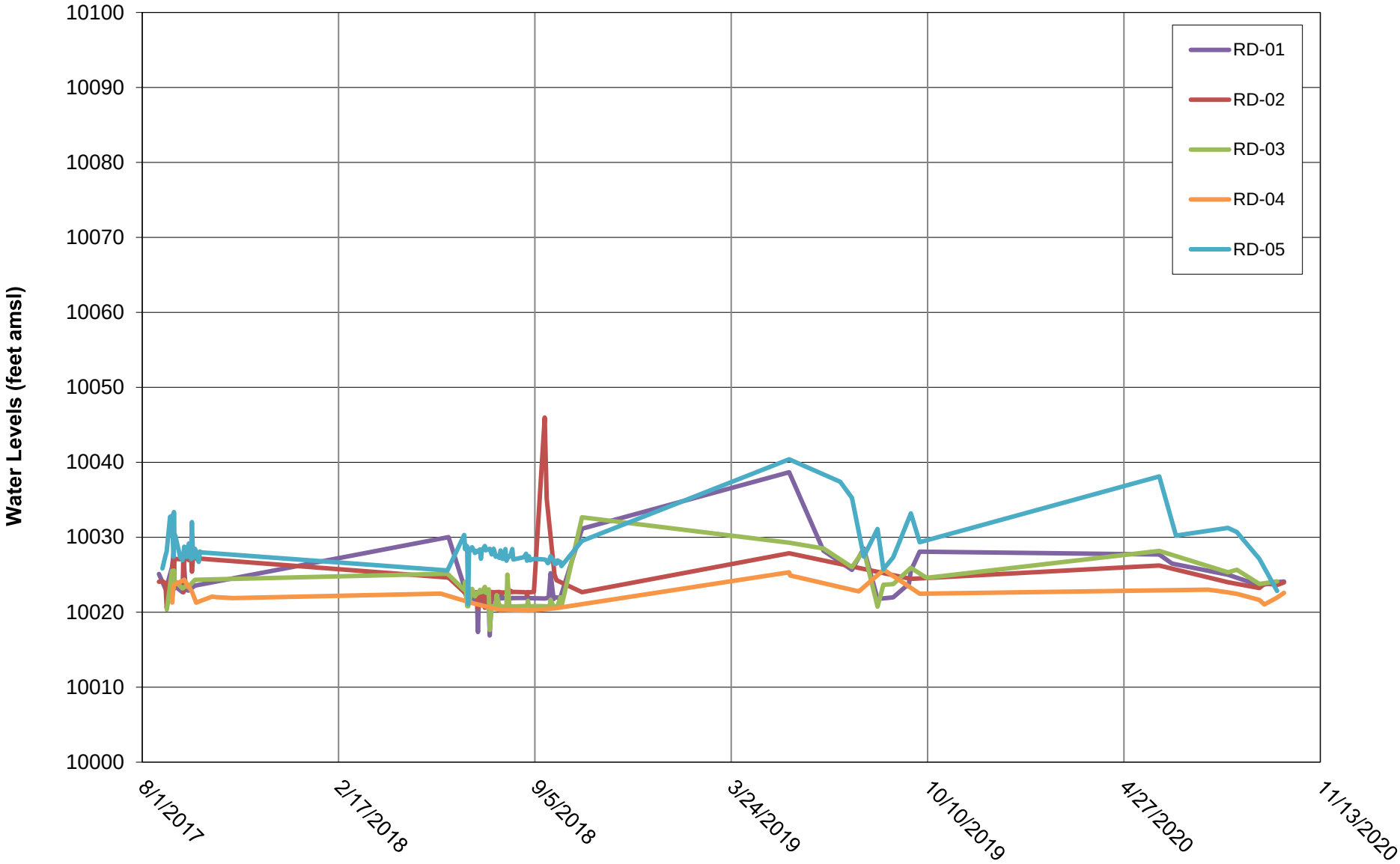


PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
2020 Annual Reclamation Report

Figure 7: Historical Water Levels in Piezometers at Indian Rock Dump and Tie Camp Rock Dump



HOMESTAKE	**PITCH RECLAMATION PROJECT** **HOMESTAKE MINING COMPANY** **2020 Annual Reclamation Report**	**Figure 8: Historical Water Levels in Piezometers at the 10300 Level of Indian Rock Dump**



HOMESTAKE	**PITCH RECLAMATION PROJECT** **HOMESTAKE MINING COMPANY** **2020 Annual Reclamation Report**	**Figure 9: Historical Water Levels in Piezometers at the Toe of Indian Rock Dump**

APPENDICES

APPENDIX A

2019 Reclamation Plan Amendment Approval

January 6, 2020

David Wykoff
Homestake Mining Company
P.O. Box 40
Sargents, CO 81248

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

RE: Pitch Project, Permit # M-1977-004, Approval of 112d-3 Amendment Application (AM-01)

Mr. Wykoff:

The Division of Reclamation, Mining and Safety (Division) has approved your amendment application (AM-01). The terms of AM-01 approved by the Division are hereby incorporated into Permit No. M-1977-004. All other conditions and requirements of the permit remain in full force and effect.

The estimated reclamation cost of *$24,451,940* exceeds the *$2,291,000* financial warranty currently held for this site. **Please submit the additional financial warranty in the amount of *$22,160,940*.** The revision will not be finalized until the financial warranty is received and accepted by the Division.

Please make arrangements with Gabriel Benvenuti at the Division of Reclamation, Mining and Safety Denver Office, phone no. 303.866.3567, ext. 8148 for submittal of the financial warranty. Any questions regarding completion, execution and/or submittal of financial and/or performance warranty forms should also be directed to Mr. Benvenuti.

If you require additional information, or have questions or concerns, please contact me.

Sincerely,

Dustin Czapla
Environmental Protection Specialist
Division of Reclamation, Mining and Safety
Phone: (303) 866-3567, ext. 8188

APPENDIX B

2020 Annual Inclinometer and Survey Monitoring Report

BGC ENGINEERING USA INC.
AN APPLIED EARTH SCIENCES COMPANY

HOMESTAKE MINING COMPANY

PITCH MINE

2020 ANNUAL INCLINOMETER AND SURVEY MONITORING REPORT

FINAL

PROJECT NO.: 0011284-01 DATE: January 7, 2021

BGC ENGINEERING USA INC.
AN APPLIED EARTH SCIENCES COMPANY
447 E. Main Street
Montrose, CO USA 81401
Telephone (970) 615-8056

January 7, 2021
Project No.: 0011284-01

Dave Wykoff, Site Manager
Homestake Mining Company
112 Marshall Street
PO Box 40
Sargents, Colorado 81248

Dear Mr. Wykoff,

Re: 2020 Annual Inclinometer and Survey Monitoring Report

Please find attached the 2020 Annual Inclinometer and Survey Monitoring report associated with the Pitch Reclamation Project for your review and comment.

We trust this meets your current requirements.

Yours sincerely,

BGC ENGINEERING INC.
per:

Michael Henderson, PE, P.Eng.
Project Manager

EXECUTIVE SUMMARY

This 2020 annual inclinometer and survey monitoring report is a component of the continuing Engineer of Record (EOR) role established for BGC Engineering Inc. (BGC). During the year, reclamation and closure activities occurred around the Pitch Mine property. This included the construction of a diversion channel in the North Pit, slope remediation and construction of a diversion channel in the South Pit, and improvements to the Sediment Pond and Dam. The general locations of these activities can be seen on Drawing 1. Many of the survey monitoring points were in the remediated South Pit area, requiring removal as part of the construction activities.

In June and October 2020, six inclinometer casings (I98-1, I98-2, I98-3, IN-1, IN-2, and IN-3) were surveyed using an inclinometer probe to measure subsurface movement at their locations. Inclinometer data for I98-1, I98-3, IN-1, IN-2, and IN-3 did not indicate movement for the 2020 inclinometer monitoring cycle (i.e., measured incremental displacement between 2019 and 2020 annual monitoring periods did not exceed the estimated instrument error range). Data for inclinometer I98-2 were found to have errors and were not used.

In October 2020, North Star Surveying Inc. (North Star) surveyed surface monitoring points throughout the site. There were 52 monitoring points surveyed in 2020 of which all 52 had survey data from 2019 to compare against and determine annual displacement values. For 2020, 7 of the 52 (13%) monitoring points had displacement values greater than the associated potential survey error range as compared to 42 of 49 (47%) in 2019. Of the 52 monitoring points, zero had movements greater than the established movement threshold of 0.5 ft/year. Within the North Pit, 5 of the 45 (11%) monitoring points had displacement values above their associated potential survey error range for 2020 and none were above the established movement threshold. Within the South Pit, 2 of the 7 (29%) monitoring points had displacement values above their associated potential survey error for 2019 and none were above the established movement threshold. Due to construction in the areas with active slope movement, areas where monitoring points have previously shown movement greater than the threshold were removed due to the necessary earthworks. In addition, monitoring points that had previously shown no movements were not surveyed due to time constraints.

BGC recommends continuing the annual monitoring of inclinometer casings I98-1, I98-2, I98-3, IN-1, IN-2, and IN-3 at the Pitch Mine to monitor and document movement rates. Supplemental inclinometer surveys of the six casings noted above should be considered for site conditions that may cause increased movement such as pump or injection tests, ground disturbance, and anomalous rainfall events or wetter than average winter snow conditions. Inclinometer surveys in subsequent years should be compared with the installation borehole logs to identify potential discrete geologic structures and geologic material types that may be contributing to movement to aid in informing future monitoring data evaluations.

BGC also recommends continuing the current survey methodology for the surface monitoring points, as well as: 1) Evaluating enhanced monitoring techniques including increasing the accuracy of the ground-based survey and satellite-based lidar surveys for the North Pit and South Pit zones; 2) Applying monitoring point data and ground observations from the 2019 survey program to ongoing detailed review and mitigation design for the North Pit partial backfill; and 3) Assembling and analyzing survey data collected prior to 2012.

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LIMITATIONS

BGC Engineering Inc. (BGC) prepared this document for the account of Homestake Mining Company (HMC). The material in it reflects the judgment of BGC staff in light of the information available to BGC at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

As a mutual protection to our client, the public, and ourselves, all documents and drawings are submitted for the confidential information of our client for a specific project. BGC hereby authorizes HMC, Arcadis Environmental Consultant (Arcadis), and the State of Colorado to use this document for purposes related to this project. Authorization for any use and/or publication of this document or any data, statements, conclusions or abstracts from or regarding our documents and drawings, through any form of print or electronic media, including without limitation, posting or reproduction of same on any website, is reserved pending BGC's written approval for agencies and companies not explicitly mentioned above. A record copy of this document is on file at BGC. That copy takes precedence over any other copy or reproduction of this document.

1.0 INTRODUCTION

BGC developed the 2020 Annual Inclinometer and Survey Monitoring Report (previously written as two separate reports) to summarize the results of annual inclinometer and surface survey monitoring. Details on the background of the site and purpose for this report are described in previous monitoring reports by BGC (BGC, 2020a and BGC, 2020b).

1.1. Inclinometers

There are six inclinometer casings installed at the Pitch Mine that are actively being surveyed (Drawing 1). The three oldest of these inclinometer casings were installed in 1998 to monitor deformations in the east and south walls of the North Pit, initiated by a previously documented slope movement event (Knight Piésold, 2017).

- I98-1 is positioned on the lower bench of the south wall
- I98-2 is positioned on the upper bench of the south wall
- I98-3 is positioned behind the head scarp above the east wall.

Three additional inclinometer casings were installed in 2017 in the Indian Rock Dump (IRD) to monitor potential movement induced by field-demonstration tests in the IRD performed by Arcadis in 2017.

- IN-1 is positioned on the western side of the IRD
- IN-2 is positioned in the middle of the IRD
- IN-3 is positioned on the eastern side of the IRD.

1.2. Survey Monitoring Points

The earliest monitoring points were installed at the North Pit in 1994. Additional survey monitoring points were added in subsequent years to cover more of the mine site and replace monitoring points that became obsolete or damaged due to re-grading and other factors. Annual data compilation and review of this data has been performed by various consulting parties since the initial installations.

BGC assumed the role of EOR following the 2017 survey program and has been the reviewing party for ongoing survey data collection. BGC obtained pre-2017 data for the number of monitoring points replaced, decommissioned, and added shown in Table 1-1 from the report “Pitch Reclamation Project Evaluation of Surface Slope Displacement During the 2015-2016 Monitoring Period, Rev C. document” (Knight Piésold, 2016).

Survey data that were found in reports and emails from 1998-2020 were provided in two formats. The first format type was common for data from 1998 through 2012 and is provided in azimuth (degrees), inclination (degrees), and displacement (inches). The second format type was common for data from 2012-2020 and is provided as northing (ft), easting (ft), and elevation (ft). Due to difficulty converting measurements between the two formats, only data since 2012 has been analyzed for this report. Table 1-1 provides the number of monitoring points read since 2012 as well as how many have been added or removed each year. Drawing 1 shows the location of the

monitoring points in 2020 and 2019. Monitoring points surveyed in 2020 are shown in blue in the drawing to show where monitoring points have been decommissioned since 2019.

Table 1-1. Number of monitoring points read annually.

Survey Year	Total Number of Monitoring Points Read	Number of Monitoring Points Decommissioned from Previous Year	Number of Monitoring Points Installed from Previous Year
2012	87	0	0
2013	87	0	0
2014	88	1	0
2015	91	3	0
2016	94	4	1
2017	94	2	2
2018	107	15	2
2019	91	2	18
2020	52	39	0

2.0 2020 CONSTRUCTION ACTIVITIES ON SITE

In 2020, construction activities occurred at the site with the primary goal of moving towards closure. One intent of closure is to reduce the potential for slope instabilities and reduce maintenance costs primarily in the North and South Pit. Many monitoring points were in these areas and had to be removed to allow for construction. The earthworks included (1) reconstructing the diversion channel at the 10,500 foot level in the North Pit to reduce infiltration into the slope, (2) remove and reconstruct a small landslide in the South Pit, and (3) reconstruct and replace aging outlet works at the sediment control pond. The locations of these activities can be seen on Drawing 1.

3.0 DATA COLLECTION

3.1. Inclinometers

Site-wide construction occurred at Pitch Mine in 2020. Therefore, inclinometer readings were taken before construction began to have a baseline to compare pre- and post-construction. The pre-construction readings occurred on June 9, 2020. Readings were then taken on October 6, 2020 to align with the annual readings and end of the construction season. At the time of the readings, the majority of the construction work had been completed; however, some construction work was still being completed for the year.

3.2. Survey Monitoring Point Error

There were 52 monitoring points surveyed in 2020 in the North Pit and South Pit zones (Appendix A). Every monitoring point surveyed in 2020 had data from 2019 to compare with and

determine annual displacement values. From 2019 to 2020, 39 monitoring points were discontinued because they were either removed during construction or because movements measured in past years were less than the survey equipment error.

Potential survey error, the error from measurements using a total station to survey, is estimated by North Star to be 0.1 ft for every 1,000 ft of distance from the control point to the monitoring point. The potential survey error for all the monitoring points varies from 0.0 to 0.3 ft, with a median value of 0.11 ft. The calculated survey error for each monitoring point, which varies, is shown on Plots 1, 2, and 3 in Appendix B. The calculated maximum survey error (0.3 ft) for all of the monitoring points is shown on Plots 4, 5, and 6 in Appendix B.

The threshold for the annual rate of local or global slope movement has been set at 0.5 ft per year (BGC, 2019a). Slope movements below this amount are considered typical of ongoing landform deformation in the area. Slope movements greater than this amount should be evaluated, and corrective actions taken as necessary. The rate of slope movement will be evaluated using annual inclinometer surveys in the translation zones (areas showing distinct shear zones of movement), and surveying of surface monuments.

The 2020 survey program indicates that 7 of the 52 (13%) monitoring points had annual displacement magnitudes greater than the potential survey error and 0 of 52 greater than the established movement threshold. In contrast, the 2019 survey program indicated that 42 of the 89 (47%) monitoring points had annual displacement magnitudes greater than the potential survey error and 7 of 89 (8%) greater than the established movement threshold. This difference in the two years shows a decrease in the number of monitoring points with displacements above their associated survey error and above the established movement threshold. The amount of monitoring points with displacements above their associated error is similar to 2012-2013 and 2017-2018. Due to construction in the areas with active slope movement, areas where monitoring points have previously shown movement greater than the threshold were removed due to necessary earthworks. In addition, some monitoring points that had shown no historical movement were not surveyed due to time constraints. The large number of decommissioned monitoring points makes year to year comparison less reliable since the data set has changed and is not reliable to infer general patterns of ground movement for the site for this year compared to previous years.

Table 3-1 shows the number of monitoring points surveyed each year, number of monitoring points with both data for the current year and previous year, number of monitoring points with movement above their associated potential survey error, number above the established movement threshold, and the percentage breakdown. Appendix A shows the coordinates and elevation of each monitoring point from 2012 to 2020, their associated potential survey error, estimated displacement for each year, and estimated direction of movement.

Table 3-1. Number and Percentage of monitoring points with movement above their associated survey error and established movement threshold.

Year	Number of Monitoring Points Surveyed	Number of Monitoring Points Surveyed that also has Data from the Previous Year as well	Number of Monitoring Points with Movement Above their Associated Survey Error	Percentage	Number of Monitoring Points with Movement Above the Established Movement Threshold (0.5 ft/year)	Percentage	Annual Precipitation for Sargents, CO (inches) (Colorado Climate Center, 2020)
2012[1]	87	-	-	-	-	-	8.9
2013	87	87	11	13%	0	0%	15.3
2014	87	87	30	34%	4	5%	17.9
2015	91	88	38	43%	8	9%	16.5
2016	94	90	28	31%	8	9%	15.1
2017	94	92	31	34%	7	8%	15.9
2018	92	92	17	18%	0	0%	12.8
2019	91	89	42	47%	7	8%	17.8
2020	52	52	7	13%	0	0%	8.9

Note:

1. 2012 is the first year of data analyzed for this report and serves as the baseline for movement. Therefore, movement and a percentage cannot be calculated until a second year of data are available.

4.0 ANALYSIS

4.1. Inclinometers

Validation of the data from readings of inclinometer casings I98-1, I98-2, I98-3, IN-1, IN-2, and IN-3 were calculated from surveys taken on June 9 and October 6 in 2020 (Table 4-1). Details on the validation process is described in previous monitoring reports (BGC, 2020a). The 2020 validation values were at or below manufacturer-prescribed for all inclinometer readings except I98-2. Due to the very large errors in the survey for 198-2 the data were considered unreliable. This error was identified to occur around 210 ft below ground surface (bgs) where the probe wheels may have come temporarily out of the grooved track. This potential error also occurred in 2019 and may be from a change in the casing at a specific point. This error is likely also amplified by the geometry of the hole as described in the next section.

4.1.1. Data Error and Corrections

Potential sources of error associated with the Digitilt Classic Inclinometer system include limitations in the performance of equipment (requiring frequent calibration), anomalous installation characteristics, movement alterations to the installation characteristics, casing spiraling, and varied measurement techniques (DGSI, 2013). The combination of errors within datasets can alter associated data plots and create exaggerated displacements and false directions of movement. Specifically, recalibration and anomalous installation characteristics are suspected of causing error in inclinometer readings for I98-1, I98-2, and I98-3, as discussed below.

Inclinometers I98-2 and I98-3 show profiles indicating anomalous installation characteristics. The profile of each inclinometer is provided in Appendix C. The profile of Inclinometer I98-2 shows it was drilled with approximately 100 inches of deviation from vertical in the B axis (perpendicular to the downslope direction). It is normal for boreholes to deviate, but this level of deviation appears to correspond to erroneous data in the profile change plot (also in Appendix C). The profile of Inclinometer I98-3 shows signs of casing compression during installation. This is especially evident in the A axis where the profile shows a general curve and then smaller undulations most notably around 65 ft and 95 ft bgs. These undulations appear to correspond to the recent movement shown in the profile change plots in the last year. This error has likely become more prevalent in recent years due to the lack of frequent calibrations of the probe itself. The probe is being sent to the manufacturer to be calibrated before future readings and has the potential to reduce the amount of error (although it is not likely to reduce all of the error).

To improve the analysis of the inclinometer plots, some corrections can be made after the readings have been taken. A bias-shift error was identified as a potential component in the I98-1 and I98-2 inclinometer plots. To correct for this, a bias shift correction was made for each year by manually increasing the correction factor until the lower portions of the plot were near vertical.

4.1.2. Inclinometer Analysis

Inclinometer data is plotted in the A-axis and B-axis. Because movement typically does not occur directly in line with these axes, the resultant of the two is used to determine the full magnitude of movement and direction.

Inclinometer readings for IN-1, IN-2, IN-3, and I98-3 did not indicate real movement for the 2020 inclinometer monitoring cycle (i.e., zones of measured incremental displacement did not exceed the estimated error range shown in Table 3-1). Surficial survey monitoring data for I98-3 has indicated movement in the opposite direction of anticipated movement (uphill) in previous years. This data is suspected of reading error and was not taken into consideration for movement. The I98-2 inclinometer plots were not analyzed due to the error in the recording for 2020 as explained in Section 4.2.

In Appendix C, inclinometer plots indicate movement along zones observed in previous years for I98-1. The movement has increased in the 2020 annual monitoring cycle with respect to recent years, suggesting slope movement. Rates of annual displacements at depths both directly above and below the movement zones were used to calculate rates of movement in the resultant direction (Figure 4-1 and Table 4-1).

The following section discusses the movements for I98-1 as no actual movement (greater than instrument error) was measured for IN-1, IN-2, IN-3, and I98-3, and I98-2 had unreliable data for 2020.

4.1.3. Inclinometer I98-1

Inclinometer data for I98-1 indicate three zones of ground movement around 14.5-22.5 ft, 42.5-50.5 ft, and 68.5-82.5 ft bgs with the most movement in the upper zone. The rate of change (inches per year) of incremental displacement for these three zones in 2020 show less change as compared to the previous year (2019). The entire inclinometer (10-152 ft) shows a decrease in the rate of movement (see Figure 4-1 and Table 4-1). Ground movement trends within I98-1 indicate slope creep is the primary form of ground movement.

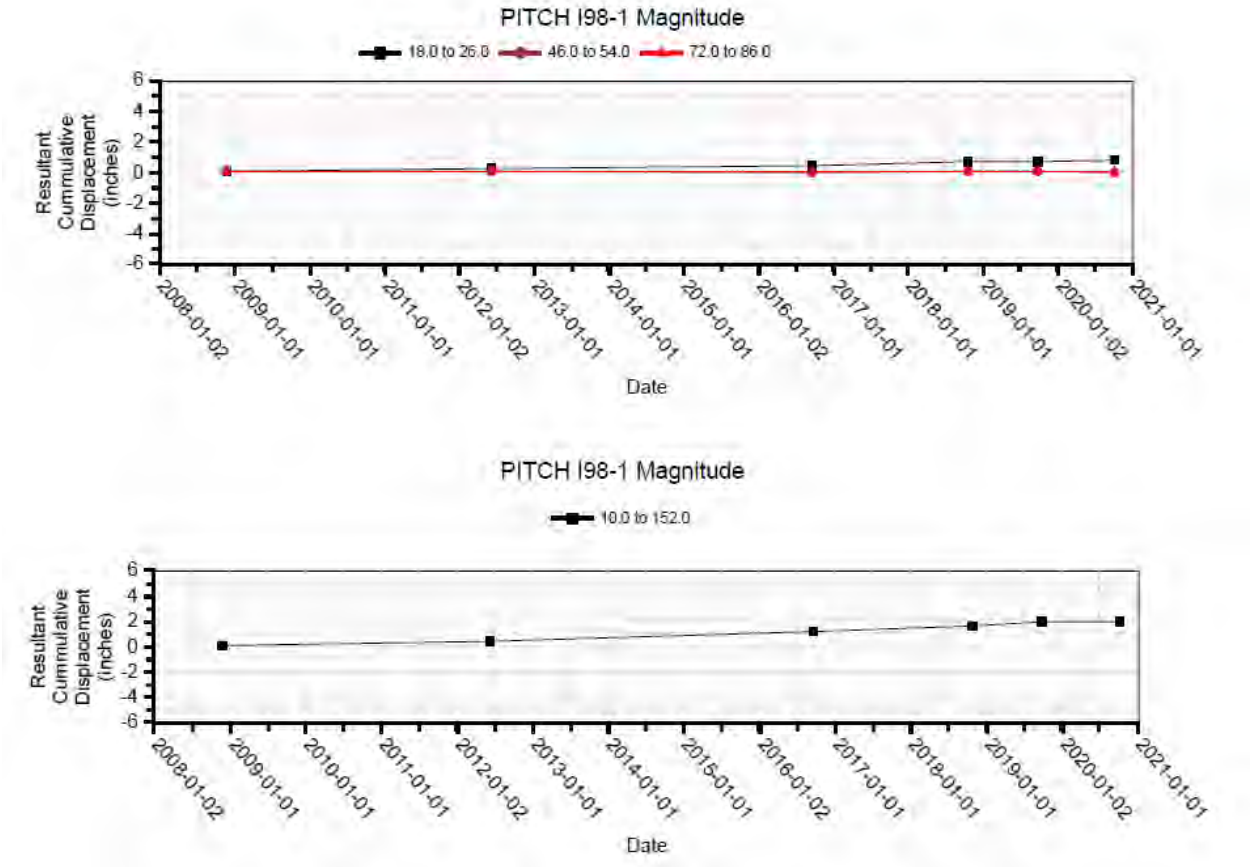

Figure 4-1. Magnitude plots of inclinometer I98-1 for various ground movement zones over time.

Table 4-1. Rates of movement (inches per year) for inclinometer I98-1 associated with Figure 4-1.

	Rate of Movement (inches per year)			
Year	**Ground Movement Zone 18'-26'**	**Ground Movement Zone 46'-54'**	**Ground Movement Zone 72'-86'**	**Ground Movement Zone 10'-152'**
2008-2012	0.05	0.02	0.02	0.11
2012-2016	0.05	-0.02	-0.01	0.18
2016-2018	0.11	0.01	0.01	0.21
2018-2019	0.05	0.01	0.00	0.33
2019-2020	0.05	-0.06	-0.01	0.03

4.2. Survey Analysis

BGC analyzed the survey data provided by North Star from 2012-2020 within the Microsoft Excel 2016 software (Appendix A and B). Specifically, annual rates of movement, cumulative movement, direction of movement, and movement correlations to precipitation were evaluated.

Annual rates of movement were calculated as the change in movement between survey dates. As these surveys did not occur on the same date each year, the corresponding timeframe

between surveys does not equal exactly one calendar year. Data have not been extrapolated or interpolated based on variances in survey dates as these would be inferred movement, not recorded movement. Previous reports have provided drawings for each year showing the magnitude and direction of movement for each monitoring point. No movement above the established threshold (0.5 ft/yr) was recorded and therefore the new set of drawings would not provide any new information.

Plots 1 to 6 in Appendix B show the annual incremental displacement and cumulative movement since installation (or as far back as 2012) for all monitoring points. A survey error line (red dashed line) is included to show the associated potential survey error of each monitoring point. Plot 7 shows the annual precipitation (rainfall plus the snowfall's rainfall equivalent) versus the average annual displacement of all monitoring points. The average annual incremental displacement of all monitoring points is less than in 2019. The large number of decommissioned monitoring points makes year to year comparisons less reliable since the data set has changed and is not reliable to infer general patterns of ground movement for the site for this year compared to previous years.

4.2.1. North Pit

The North Pit contains the majority of monitoring points at the site (45 of 52). For the 2020 monitoring cycle, 5 monitoring points in the North Pit had displacement values greater than their associated potential survey error. Plot 2 shows the incremental displacement in the North Pit from 2012 to 2020. Throughout the years, displacements remain at a scale comparable to the associated potential survey error. Plot 5 shows the cumulative movement in the North Pit from 2012 to 2020 does not exceed the established movement threshold (0.5 ft/year) for any monitoring points. The general movement from monitoring points in the North Pit, therefore, indicates overall slope creep.

4.2.2. South Pit

The South Pit contained the majority of monitoring points that showed movement greater than the threshold. However, most of the monitoring points were removed this year due to earth works. For the 2020 monitoring cycle, two of the seven (29%) monitoring points in the South Pit have displacement values greater than their associated potential survey error. Zero monitoring points have movement greater than the established movement threshold (0.5 ft/year). Plot 3 shows the annual rate of movement in the South Pit from 2012 to 2020. Throughout the years, displacements on the order of several feet has occurred for several of the monitoring points however, all of these were decommissioned this year. Plot 6 shows the cumulative movement in the South Pit from 2012 to 2020 for several monitoring points with up to 23 ft of cumulative movement. The general movement from the monitoring points in the South Pit, therefore, indicates a discrete landslide that is actively creeping (discussed in further detail in BGC, 2019b). One monitoring point of interest, MP17-95(VERN), had a unique change in movement. It was installed in 2017 and showed very little movement in 2018 (0.33 ft). However, in 2019 it showed a displacement of 22.5 feet from the previous year. This monitoring point was not surveyed in 2020 and was likely in the area of earth works.

5.0 CONCLUSIONS

5.1. Inclinometers

Inclinometer readings for IN-1, IN-2, IN-3, and I98-3 did not indicate real movement during the annual monitoring cycle. Inclinometer I98-2 showed erroneous data and was not useful. The I98-2 inclinometer will be attempted to be read in 2021 to determine if the error is a repeating event or if a reading can be obtained without the same type of error. If the error continues, then a decision will be made based on these findings to determine the appropriate course of action in relation to this inclinometer location. The inclinometer reading for I98-1 indicates similar incremental displacement observed in 2019 which is generally lower than the overall rate since 2008.

5.2. Survey Monitoring Points

The total number of monitoring points with displacements above their associated potential survey error and the established movement threshold in the Pitch Mine has decreased. However, it is not reliable to compare ground movements to previous years in the south pit landslide area since all of the monitoring points on the active landslide were removed for construction. This area and others with mitigation completed this year will require future monitoring to determine if the previous ground movement observed have been reduced to an acceptable level.

6.0 RECOMMENDATIONS

6.1. Inclinometer

BGC recommends continued monitoring of inclinometers I98-1, I98-2, I98-3, IN-1, IN-2, and IN-3 on at least an annual basis. The probe and cable have been sent to the manufacturer for calibration; this should be carried out bi-annually. Annual inclinometer surveys should be collected within approximately the same timeframe each subsequent year using the field methods established in the 2017 annual inclinometer monitoring cycle. Supplemental inclinometer surveys should be considered for inclinometers when conditions of heightened potential for movement occur. The decision to perform supplemental inclinometer surveys should be made through cooperative review of site conditions by HMC and BGC. Conditions for supplemental inclinometer surveys may include pump tests, ground disturbance, and anomalous rainfall events.

Additionally, inclinometer borehole logs should be obtained from the installation report from 1998 and compared with inclinometer surveys to identify potential discrete geologic structures and geologic material types that may be contributing to or influencing movements. Strain rates associated with geologic material types should be considered during subsequent reviews of inclinometer data.

6.2. Survey Monitoring Points

BGC recommends the following courses of action based on the conclusions from the 2020 survey program.

- Adding Monitoring Points
    - Areas that were disturbed from construction this year should have monitoring points replaced to monitor ground movement post-construction. Specifically, the South pit should continue to be monitored due to the history of high annual displacements in this area.
- Continued Monitoring:
    - Maintain the current survey and observation methodology by using ground observations and monitoring point data review to check for changes in potential ground movement. Options to reduce the amount of potential survey error should be evaluated to allow for more precise monitoring and analysis.
- Enhanced Monitoring:
    - Supplementing the current program with additional enhanced monitoring techniques and reviewing on an annual basis should be considered where ground movement is suspected and observed. Enhanced monitoring techniques may include ground-based photogrammetry, aerial photogrammetry and lidar (Light Detection and Ranging). Ground-based photogrammetry and lidar can be considered for areas with good vantage points and easier access.
- Detailed Site Investigation and Mitigation:
    - South Pit - Monitoring point data and ground observations from the 2020 survey program should be applied to ongoing detailed review of South pit ground movements. The application of this information, in combination with the ongoing investigative efforts, can help provide information about potential driving force mechanisms and better define the extent of ground movement in this zone. Understanding these ground movement characteristics may contribute to a mitigation design.
- Better Understand the Impacts of Precipitation on Slope Movement:
    - Continue to evaluate relationship of precipitation versus movement of monitoring points to better understand the relation of precipitation and slope movement and mechanisms contributing to its acceleration and deceleration.
- Analyze Pre-2012 Survey Data:
    - Find additional pre-2012 monitoring point survey data and convert into the same coordinate-based format used for 2012-2020 data (northing, easting, and elevation) to identify longer-duration trends.

7.0 CLOSURE

We trust the above satisfies your requirements at this time. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC ENGINEERING INC.
per:

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APPENDIX A
MONITORING POINTS

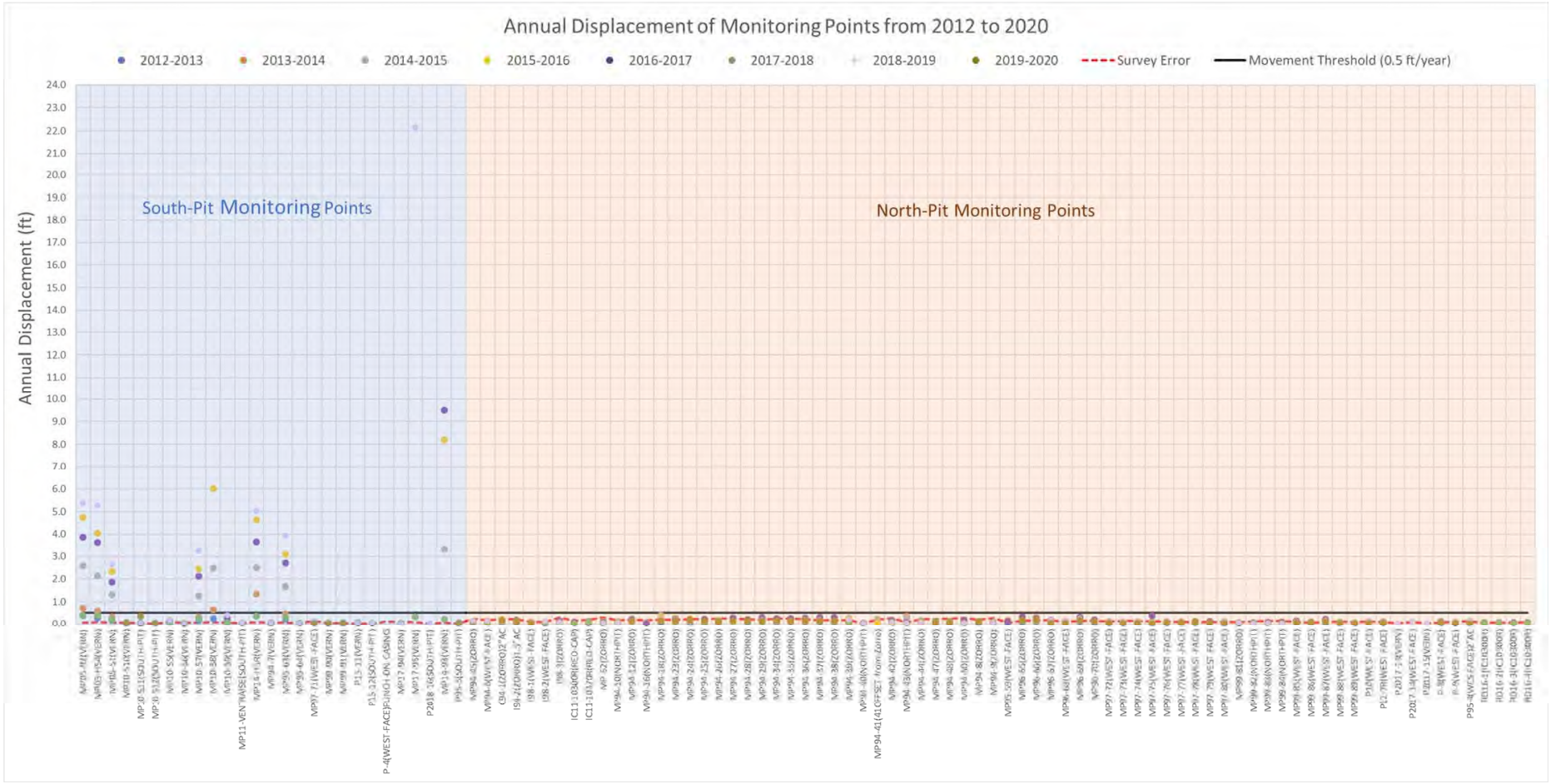
Table A-1. Survey monitoring point data with location, discplacement values, and direction of movement by year.

Monitoring Point Name	2012			2013			2014			2015			2016			2017		
	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation
C94-1(ZORRO)2"AC	114581.06	121251.64	10943.08	114581.09	121251.58	10943.04	114581.03	121251.50	10942.96	114581.00	121251.35	10942.83	114580.95	121251.14	10942.77	114580.89	121251.07	10942.64
I94-2(ZORRO)1.5"AC	114513.18	121254.82	10941.60	114513.14	121254.76	10941.57	114513.07	121254.68	10941.53	114513.05	121254.53	10941.43	114513.00	121254.38	10941.31	114512.95	121254.28	10941.18
I98-1(WEST-FACE)	113051.05	119576.23	10423.86	113051.07	119576.18	10423.87	113051.10	119576.10	10423.87	113051.14	119576.05	10423.92	113051.15	119575.98	10423.90	113051.18	119575.92	10423.93
I98-2(WEST-FACE)	113069.25	119901.86	10537.40	113069.26	119901.85	10537.40	113069.27	119901.75	10537.39	113069.29	119901.64	10537.38	113069.32	119901.59	10537.36	113069.37	119901.54	10537.33
I98-3(ZORRO)	114673.73	121872.12	11082.17	114673.72	121872.09	11082.21	114673.78	121872.13	11082.16	114673.82	121872.11	11082.19	114673.81	121872.03	11082.24	114673.73	121872.12	11082.15
IC11-10300R(RED-CAP)	112872.07	117768.65	10297.73	112872.00	117768.65	10297.77	112872.02	117768.66	10297.71	112872.01	117768.67	10297.74	112872.00	117768.70	10297.79	112872.02	117768.62	10297.76
IC11-10370R(RED-CAP)	113375.33	117596.64	10373.01	113375.23	117596.60	10373.07	113375.24	117596.61	10373.03	113375.22	117596.60	10373.02	113375.19	117596.65	10373.04	113375.20	117596.64	10372.99
MP05-92(VERN)	112116.01	120306.37	10763.75	112115.77	120306.10	10763.65	112115.37	120305.52	10763.53	112113.85	120303.52	10762.93	112111.00	120299.87	10761.85	112108.67	120296.94	10760.93
MP05-HS4(VERN)	112077.83	120362.61	10775.92	112077.64	120362.43	10775.81	112077.27	120362.00	10775.64	112075.93	120360.52	10774.91	112073.29	120357.77	10773.51	112070.96	120355.21	10772.38
MP05-S1(VERN)	112092.36	120199.40	10730.13	112092.32	120199.22	10730.13	112092.24	120198.89	10730.11	112092.00	120197.60	10730.03	112091.52	120195.33	10729.89	112091.18	120193.50	10729.81
MP10-S10(VERN)	111934.32	120014.56	10647.38	111934.30	120014.60	10647.39	111934.31	120014.54	10647.37	111934.30	120014.54	10647.39	111934.29	120014.55	10647.39	111934.30	120014.56	10647.38
MP10-S11(SOUTH-PIT)	111871.09	119875.91	10583.67	111871.14	119875.92	10583.66	111871.11	119875.89	10583.65	111871.12	119875.87	10583.65	111871.12	119875.87	10583.66	111871.11	119875.85	10583.64
MP10-S12(SOUTH-PIT)	111839.47	119798.43	10561.60	111839.50	119798.42	10561.59	111839.49	119798.40	10561.58	111839.50	119798.39	10561.58	111839.49	119798.40	10561.58	111839.49	119798.38	10561.56
MP10-S5(VERN)	112206.20	120416.60	10826.36	112206.21	120416.63	10826.35	112206.17	120416.55	10826.32	112206.08	120416.47	10826.28	112205.96	120416.39	10826.19	112205.85	120416.30	10826.13
MP10-S6(VERN)	112167.56	120160.15	10723.25	112167.56	120160.15	10723.25	112167.57	120160.14	10723.26	112167.56	120160.12	10723.26	112167.53	120160.14	10723.27	112167.54	120160.13	10723.27
MP10-S7(VERN)	112038.63	120171.60	10710.47	112038.58	120171.44	10710.44	112038.51	120171.12	10710.40	112038.20	120169.92	10710.28	112037.44	120167.62	10710.03	112036.85	120165.59	10709.87
MP10-S8(VERN)	111964.68	120265.22	10733.88	111964.52	120265.05	10733.76	111964.13	120264.57	10733.59	111962.60	120262.80	10732.80	111958.48	120258.78	10731.11	---	---	---
MP10-S9(VERN)	111998.23	120112.55	10687.60	111998.19	120112.57	10687.63	111998.17	120112.51	10687.63	111998.09	120112.36	10687.71	111997.90	120112.09	10687.86	111997.79	120111.89	10687.97
MP11-VENTRAISE(SOUTH-PIT)	111733.40	119839.22	10564.57	111733.42	119839.22	10564.56	111733.40	119839.19	10564.56	111733.41	119839.19	10564.55	111733.41	119839.19	10564.55	111733.41	119839.17	10564.53
MP14-93(VERN)	---	---	---	---	---	---	111962.70	120222.62	10720.90	111960.76	120220.12	10719.91	111956.04	120213.95	10717.26	111950.90	120206.78	10713.75
MP14-H5R(VERN)	112134.84	120348.50	10785.93	112134.66	120348.22	10785.83	112134.18	120347.71	10784.68	112132.72	120345.78	10784.05	112129.93	120342.27	10782.83	112127.73	120339.53	10781.85
MP17-94(VERN)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	111956.65	120307.14	10745.43
MP17-95(VERN)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	111952.41	120245.79	10725.92
MP-52(ZORRO)	114966.37	121854.37	11094.66	114966.38	121854.38	11094.67	114966.45	121854.38	11094.64	114966.42	121854.37	11094.66	114966.40	121854.38	11094.78	114966.38	121854.37	11094.68
MP94-10(NORTHPIT)	113504.02	119597.81	10384.90	113504.04	119597.84	10384.85	113504.01	119597.81	10384.86	113504.01	119597.84	10384.85	113504.12	119597.83	10384.85	113504.05	119597.79	10384.87
MP94-12(ZORRO)	114008.29	120977.59	10799.91	114008.39	120977.55	10799.87	114008.32	120977.43	10799.83	114008.14	120977.26	10799.77	114008.18	120977.11	10799.67	114008.09	120976.94	10799.60
MP94-16(NORTHPIT)	113599.89	119756.97	10346.40	113599.91	119757.01	10346.35	113599.89	119757.00	10346.35	113599.94	119757.01	10346.31	113599.93	119757.01	10346.34	113599.93	119756.99	10346.34
MP94-18(ZORRO)	114477.54	120901.51	10874.67	114477.57	120901.48	10874.63	114477.46	120901.31	10874.56	114477.35	120900.97	10874.37	114477.23	120900.70	10874.31	114477.13	120900.53	10874.24
MP94-23(ZORRO)	114637.82	120813.34	10861.34	114637.90	120813.26	10861.27	114637.75	120813.12	10861.24	114637.71	120812.89	10861.18	114637.61	120812.63	10861.14	114637.49	120812.46	10861.08
MP94-24(ZORRO)	114223.77	121071.95	10874.90	114223.80	121071.91	10874.90	114223.77	121071.75	10874.80	114223.71	121071.63	10874.70	114223.59	121071.42	10874.87	114223.48	121071.29	10874.58
MP94-25(ZORRO)	114211.86	121261.17	10913.30	114211.85	121261.15	10913.27	114211.79	121261.05	10913.18	114211.76	121260.91	10913.11	114211.73	121260.72	10913.11	114211.66	121260.63	10912.91
MP94-26(ZORRO)	114200.48	121420.97	10942.18	114200.46	121420.93	10942.14	114200.41	121420.86	10942.11	114200.41	121420.76	10942.02	114200.39	121420.60	10941.97	114200.38	121420.55	10941.87
MP94-27(ZORRO)	114651.53	121390.91	10966.94	114651.64	121390.84	10966.90	114651.54	121390.74	10966.82	114651.49	121390.58	10966.73	114651.50	121390.38	10966.70	114651.41	121390.29	10966.46
MP94-28(ZORRO)	114628.79	121205.84	10937.51	114628.80	121205.77	10937.51	114628.73	121205.68	10937.44	114628.74	121205.52	10937.31	114628.66	121205.32	10937.25	114628.62	121205.22	10937.08
MP94-29(ZORRO)	114988.85	120780.37	10882.37	114988.89	120780.27	10882.32	114988.84	120780.21	10882.26	114988.76	120779.97	10882.22	114988.67	120779.80	10882.17	114988.50	120779.57	10882.11
MP94-34(ZORRO)	115186.55	121417.18	11025.71	115186.54	121417.12	11025.73	115186.50	121417.05	11025.62	115186.40	121416.94	11025.43	115186.40	121416.80	11025.41	115186.25	121416.65	11025.26
MP94-35(ZORRO)	115126.61	121211.45	10999.83	115126.65	121211.36	10999.80	115126.60	121211.26	10999.73	115126.53	121211.08	10999.61	115126.45	121210.91	10999.51	115126.33	121210.71	10999.46
MP94-36(ZORRO)	115069.35	121010.49	10949.02	115069.34	121010.40	10948.99	115069.34	121010.31	10948.90	115069.28	121010.11	10948.81	115069.21	121009.94	10948.73	115069.08	121009.74	10948.60
MP94-37(ZORRO)	115142.22	120531.14	10856.60	115142.24	120531.05	10856.61	115142.15	120530.94	10856.58	115142.03	120530.72	10856.54	115141.94	120530.52	10856.47	115141.73	120530.30	10856.49
MP94-38(ZORRO)	115028.51	120420.82	10811.89	115028.53	120420.75	10811.90	115028.39	120420.67	10811.86	115028.24	120420.49	10811.90	115028.10	120420.34	10811.90	115027.85	120420.15	10811.90
MP94-39(ZORRO)	115385.12	120456.49	10851.78	115385.12	120456.54	10851.83	115385.15	120456.58	10851.78	115385.10	120456.54	10852.06	115385.12	120456.48	10851.84	115385.10	120456.55	10851.80
MP94-40(NORTHPIT)	115680.05	120368.18	10877.67	115680.03	120368.17	10877.68	115680.02	120368.17	10877.68	115680.01	120368.15	10877.68	115680.01	120368.15	10877.68	115680.04	120368.15	10877.67
MP94-41(41OFFSET-from-Zorro)	115690.41	120569.35	10906.85	115690.51	120569.33	10906.90	115690.38	120569.49	10906.83	115690.36	120569.37	10906.94	115690.38	120569.36	10906.97	---	---	---
MP94-42(ZORRO)	114149.30	121779.71	11045.53	114149.29	121779.73	11045.55	114149.34	121779.74	11045.56	114149.34	121779.73	11045.58	114149.33	121779.73	11045.63	114149.33	121779.73	11045.47
MP94-43(NORTHPIT)	115873.42	120444.39	10909.45	115873.41	120444.48	10909.48	115873.58	120444.18	10909.45	115873.41	120444.41	10909.49	115873.44	120444.40	10909.44	115873.41	120444.45	10909.47
MP94-44(ZORRO)	113381.50	121068.37	10835.02	113381.50	121068.31	10835.09	113381.53	121068.28	10835.02	113381.40	121068.19	10834.94	113381.52	121068.15	10834.99	113381.45	121068.16	10834.89
MP94-45(ZORRO)	112416.88	120583.74	10908.25	112416.86	120583.73	10908.28	112416.92	120583.81	10908.30	112416.89	120583.75	10908.31	112416.99	120583.75	10908.29	112416.87	120583.71	10908.27
MP94-47(ZORRO)	113193.54	120683.95	10719.03	113193.51	120683.95	10718.98	113193.54	120683.93	10719.03	113193.50	120683.88	10718.99	113193.59	120683.86	10719.00	113193.62	120683.88	10719.02
MP94-48(ZORRO)	113021.18	120928.99	10795.30	113021.20	120928.99	10795.37	113021.22	120929.02	10795.36	113021.24	120929.01	10795.29	113021.31	120928.99	10795.40	113021.26	120929.00	10795.38
MP94-50(ZORRO)	112863.67	121152.80	10826.93	112863.69	121152.82	10826.94	112863.69	121152.86	10826.91	112863.74	121152.85	10826.95	112863.83	121152.86	10826.96	112863.67	121152.80	10826.94
MP94-6(WEST-FACE)	112598.43	120481.47	10839.98	112598.46	120481.49	10839.89	112598.39	120481.36	10839.93	112598.38	120481.31	10839.95	112598.39	120481.33	10839.97	112598.43	120481.29	10839.95
MP94-7(VERN)	112264.70	120351.42	10822.09	112264.74	120351.45	10822.05	112264.71	120351.40	10822.06	112264.70	120351.38	10822.05	112264.67	120351.39	10822.01	112264.67	120351.39	10822.03
MP94-8(ZORRO)	113716.51	120790.37	10730.84	113716.56	120790.36	10730.84	113716.48	120790.26	10730.84	113716.48	120790.17	10730.78	113716.46	120790.05	10730.72	113716.43	120789.94	10730.73
MP94-9(ZORRO)	115271.77	121674.12	11102.50	115271.80	121674.09	11102.55	115271.81	121674.13	11102.46	115271.77	121674.11	11102.54	115271.82	121674.13	11102.61	115271.84	121674.11	11102.52
MP95-59(WEST-FACE)	113262.80	119677.87	10385.28	113262.81	119677.83	10385.27	113262.87	119677.68	10385.24	113262.94	119677.53	10385.26	113263.02	119677.43	10385.21	113263.10	119677.34	10385.22
MP95-63(VERN)	112040.57	120194.54	10718.16	112040.54	120194.33	10718.15	112040.45	120193.88	10718.16	112040.12	120192.26	10718.01	112039.45	120189.24	10717.76	112038.99	120186.58	10717.50
MP95-64(VERN)	112389.67	120109.68	10731.65	112389.68	120109.70	10731.64	112389.66	120109.67	10731.66	112389.67	120109.66	10731.66	112389.66	120109.65	10731.65	112389.65	120109.67	10731.66
MP96-65(ZORRO)	114593.29	120431.05	10662.66	114593.35	120431.00	10662.68	114593.14	120430.84	10662.68	114592.96	120430.65	10662.69	114592.77	120430.45	10662.73	114592.53	120430.24	10662.72
MP96-66(ZORRO)	114246.56	120530.50	10627.99	114246.61	120530.44	10628.04	114246.53	120530.23	10628.08	114246.44	120529.98	10628.13	114246.31	120529.70	10628.17	114246.25	120529.44	10628.24
MP96-67(ZORRO)	113828.09	120541.24	10605.43	113828.15	120541.21	10605.43	113828.08	120541.11	10605.37	113828.02	120540.96	10605.32	113827.98	120540.83	10605.28	113827.92	120540.68	10605.20
MP96-68(WEST-FACE)	113099.33	119914.22	10539.19	113099.32	119914.19	10539.18	113099.37	119914.10	10539.17	113099.39	119913.96	10539.15	113099.46	119913.95	10539.10	113099.52	119913.88	10539.08
MP96-69(ZORRO)	114206.90	120310.06	10543.63	114206.95	120310.00	10543.66	114206.84	120309.80	10543.69	114206.71	120309.54	10543.68	114206.62	120309.28	10543.70	114206.50	120309.01	10543.73
MP96-70(ZORRO)	113856.96	120351.59	10539.86	113856.99	120351.58	10539.89	113856.94	120351.44	10539.89	113856.94	120351.27	10539.88	113856.93	120351.12	10539.88	113856.86	120350.94	10539.90
MP97-71(WEST-FACE)	112575.14	120225.77	10793.17	112575.11	120225.74	10793.15	112575.12	120225.64	10793.16	112575.09	120225.54	10793.18	112575.10	120225.53	10793.20	112575.11	120225.54	10793.10
MP97-72(WEST-FACE)	112790.18	120124.80	10711.68	112790.17	120124.77	10711.68	112790.17	120124.66	10711.63	112790.16	120124.54	10711.62	112790.22	120124.55	10711.60	112790.28	120124.52	10711.60
MP97-73(WEST-FACE)	112826.44	120212.51	10721.73	112826.45	120212.49	10721.73	112826.45	120212.40	10721.69	112826.46	120212.27	10721.69	112826.52	120212.29	10721.67	112826.55	120212.22	10721.66
MP97-74(WEST-FACE)	112871.43	120285.11	10725.98	112871.42	120285.08	10725.98	112871.41	120284.96	10725.96	112871.41	120284.84	10725.94	112871.50	120284.83	10725.91	112871.51	120284.80	10725.88
MP97-75(WEST-FACE)	112890.92	119916.08	10611.36	112890.95	119916.09	10611.34	112890.94	119915.97	10611.34	112890.96	119915.88	10611.36	112890.99	119915.87	10611.33	112891.26	119916.13	10611.30
MP97-76(WEST-FACE)	113085.39	120258.95	10630.56	113085.41	120258.95	10630.55	113085.39	120258.84	10630.51	113085.43	120258.75	10630.51	113085.46	120258.68	10630.49	113085.51	120258.61	10630.45
MP97-77(WEST-FACE)	112887.31	119648.42	10518.71	112887.31	119648.42	10518.70	112887.31	119648.34	10518.70	112887.33	119648.23	10518.75	112887.34	119648.22	10518.76	112887.38	119648.19	10518.73
MP97-78(WEST-FACE)	112976.05	119755.46	10530.21	112976.08	119755.44	10530.19	112976.10	119755.34	10530.20	112976.10	119755.23	10530.21	112976.14	119755.23	10530.18	112976.17	119755.18	10530.17
MP97-79(WEST-FACE)	113159.32	120058.28	10552.74	113159.33	120058.26	10552.71	113159.30	120058.15	10552.69	113159.32	120058.04	10552.66	113159.38	120058.00	10552.59	113159.42	120057.90	10552.55
MP97-80(WEST-FACE)	113234.70	120202.26	10569.77	113234.70	120202.24	10569.75	113234.69	120202.15	10569.76	113234.76	120202.06	10569.73	113234.76	120201.96	10569.69	113234.78	120201.87	10569.67
MP99-81(ZORRO)	114252.16	119909.57	10449.60	114252.22	119909.55	10449.59	114252.23	119909.54	10449.57	114252.17	119909.52	10449.56	114252.18	119909.50	10449.55	114252.16	119909.49	10449.54
MP99-82(NORTHPIT)	113967.37	119866.48	10358.41	113967.38	119866.49	10358.36	113967.36	119866.45	10358.35	113967.37	119866.41	10358.36	113967.34	119866.40	10358.38	113967.34	119866.37	10358.32
MP99-83(NORTHPIT)	113803.02	119942.77	10360.11	113803.03	119942.82	10360.08	113803.03	119942.74	10360.04	113803.03	119942.70	10360.02	113803.00	119942.68	10360.07	113802.98	119942.66	10360.02
MP99-84(NORTHPIT)	113651.17	120032.30	10340.04	113651.20	120032.32	10340.02	113651.21	120032.23	10340.00	113651.22	120032.23	10339.95	113651.21	120032.20	10340.01	113651.21	120032.12	10339.97
MP99-85(WEST-FACE)	113853.97	120212.86	10488.53	113853.97	120212.82	10488.51	113853.93	120212.69	10488.50	113853.88	120212.57	10488.49	113853.83	120212.44	10488.48	113853.80	120212.29	10488.47
MP99-86(WEST-FACE)	114108.85	120100.82	10470.97	114108.86	120100.78	10470.94	114108.78	120100.72	10470.94	114108.74	120100.65	10470.99	114108.70	120100.57	10470.96	114108.68	120100.47	10470.98
MP99-87(WEST-FACE)	114381.65	120151.45	10531.22	114381.62	120151.41	10531.22	114381.51	120151.28	10531.22	114381.37	120151.15	10531.24	114381.35	120150.94	10531.22	114381.28	120150.74	10531.22
MP99-88(WEST-FACE)	114795.19	120137.48	10644.86	114795.18	120137.53	10644.84	114795.16	120137.49	10644.87	114795.11	120137.54	10644.88	114795.16	120137.51	10644.83	114795.09	120137.54	10644.86
MP99-89(WEST-FACE)	114515.41	119990.03	10527.03	114515.39	119990.04	10527.05	114515.34	119990.04	10527.07	114515.30	119990.04	10527.06	114515.31	119990.00	10527.09	114515.28	119989.99	10527.08
MP99-90(VERN)	112123.80	119928.60	10629.16	112123.80	119928.64	10629.17	112123.79	119928.59	10629.16	112123.80	119928.57	10629.17	112123.79	119928.58	10629.18	112123.77	119928.58	10629.17
MP99-91(VERN)	112567.56	119941.62	10656.42	112567.61	119941.59	10656.42	112567.56	119941.58	10656.40	112567.56	119941.56	10656.39	112567.55	119941.56	10656.41	112567.53	119941.54	10656.39
P10(WEST-FACE)	112987.46	120087.84	10621.80	112987.49	120087.79	10621.83	112987.52	120087.73	10621.78	112987.46	120087.63	10621.76	112987.53	120087.62	10621.78	112987.54	120087.54	10621.68
P12-7R(WEST-FACE)	112991.06	119583.12	10443.39	112991.07	119583.10	10443.38	112991.11	119582.98	10443.37	112991.12	119582.88	10443.42	112991.15	119582.86	10443.39	112991.17	119582.82	10443.43
P15-11(VERN)	---	---	---	---	---	---	---	---	---	112600.37	119799.27	10604.21	112600.36	119799.28	10604.22	112600.35	119799.28	10604.20
P15-12(SOUTH-PIT)	---	---	---	---	---	---	---	---	---	111957.55	119782.66	10554.40	111957.53	119782.67	10554.40	111957.52	119782.65	10554.38
P2017-13(VERN)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P2017-14(WEST-FACE)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P2017-15(VERN)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P2018-16(SOUTH-PIT)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P-4(WEST-FACE)PUNCH-ON-CASING	---	---	---	---	---	---	---	---	---	112723.00	119837.42	10620.68	---	---	---	---	---	---
P-8(WEST-FACE)	113173.18	119687.38	10434.23	113173.18	119687.35	10434.23	113173.23	119687.23	10434.21	113173.27	119687.10	10434.21	113173.30	119687.03	10434.17	113173.37	119686.95	10434.16
P-9(WEST-FACE)	112569.08	119159.99	10482.76	112569.06	119160.03	10482.72	112569.10	119159.94	10482.70	112569.14	119159.85	10482.74	112569.12	119159.83	10482.74	112569.13	119159.83	10482.76
P95-4(WES-FACE)2"AC	112723.22	119837.42	10616.29	112723.25	119837.42	10616.31	112723.21	119837.36	10616.26	112723.20	119837.22	10616.30	112723.21	119837.27	10616.31	112723.24	119837.27	10616.29
P95-5(SOUTH-PIT)	112000.78	119806.96	10561.02	112000.77	119806.97	10561.01	112000.76	119806.96	10561.01	112000.81	119806.90	10560.99	112000.79	119806.92	10560.99	112000.76	119806.96	10560.98
RD16-1(IC10300R)	---	---	---	---	---	---	---	---	---	---	---	---	112195.22	117362.14	10036.58	112195.23	117362.11	10036.53
RD16-2(IC10300R)	---	---	---	---	---	---	---	---	---	---	---	---	112181.13	117377.44	10036.43	112181.14	117377.41	10036.36
RD16-3(IC10300R)	---	---	---	---	---	---	---	---	---	---	---	---	112207.47	117348.42	10036.30	112207.48	117348.39	10036.25
RD16-4(IC10300R)	---	---	---	---	---	---	---	---	---	---	---	---	112139.98	117346.25	10033.83	112139.99	117346.20	10033.79
RD2017-5(IC10300R)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-6(RED-CAP)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-7(RED-CAP)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-8(RED-CAP)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-9(RED-CAP)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IN2017-1(GPS-ZORRO)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IN2017-2(GPS-ZORRO)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IN2017-3(GPS-ZORRO)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IRD-MD-2018-1(GPS-ZORRO)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IRD-MD-2018-2(GPS-ZORRO)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IRD-OS-2018-01(RED-CAP)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

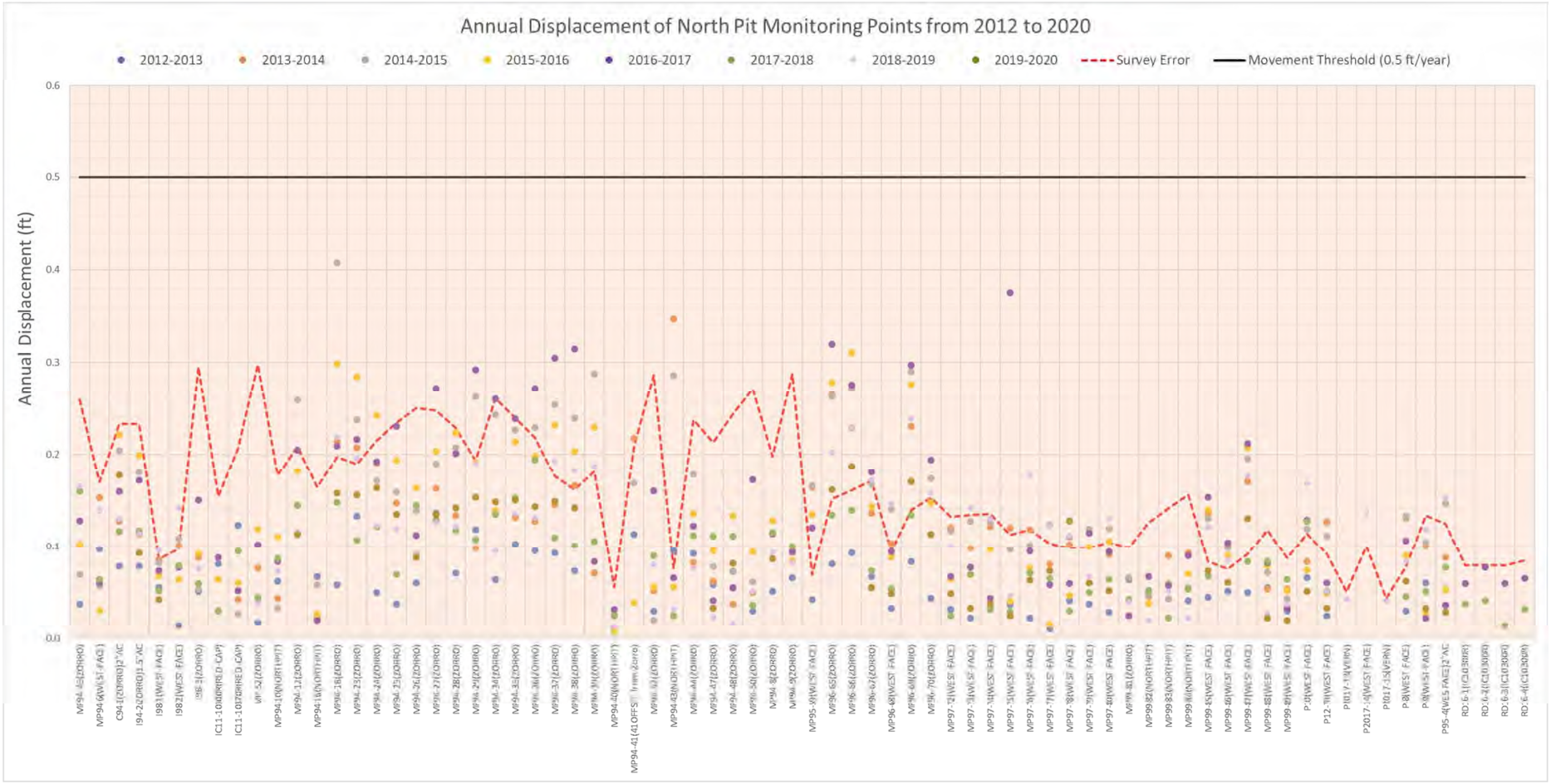
Monitoring Point Name	2018 (Old Coordinates)			2018 (New Coordinates)			2019 (New Coordinates)			2020 (New Coordinates)		
	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation
C94-1(ZORRO)2"AC	114580.79	121251.01	10942.64	114580.82	121251.01	10942.64	114580.85	121250.92	10942.55	114580.70	121250.83	########
I94-2(ZORRO)1.5"AC	114512.88	121254.23	10941.10	114512.91	121254.23	10941.10	114512.87	121254.13	10941.06	114512.86	121254.04	########
I98-1(WEST-FACE)	113051.21	119575.95	10423.96	113051.07	119576.18	10423.79	113051.06	119576.09	10423.82	113051.07	119576.05	########
I98-2(WEST-FACE)	113069.43	119901.59	10537.34	113069.30	119901.82	10537.17	113069.27	119901.68	10537.19	---	---	---
I98-3(ZORRO)	114673.78	121872.15	11082.16	114673.82	121872.14	11082.17	114673.75	121872.15	11082.18	---	---	---
IC11-10300R(RED-CAP)	112872.03	117768.60	10297.78	1 12871.96	117768.69	10297.95	---	---	---	---	---	---
IC11-10370R(RED-CAP)	113375.16	117596.57	10373.04	1 13,375.09	117596.66	10373.22	---	---	---	---	---	---
MP05-92(VERN)	112108.43	120296.63	10760.90	112108.46	120296.37	10761.00	112105.22	120292.33	10759.59	---	---	---
MP05-HS4(VERN)	112070.70	120354.94	10772.26	112070.73	120354.67	10772.36	112067.17	120351.28	10770.52	---	---	---
MP05-S1(VERN)	112091.12	120193.30	10729.82	112091.17	120193.03	10729.92	112090.70	120190.43	10729.77	---	---	---
MP10-S10(VERN)	111934.29	120014.53	10647.44	111934.35	120014.24	10647.54	111934.33	120014.27	10647.52	111934.29	120014.26	########
MP10-S11(SOUTH-PIT)	111871.13	119875.83	10583.66	111871.15	119875.83	10583.81	111871.12	119875.84	10583.78	111870.94	119876.11	########
MP10-S12(SOUTH-PIT)	111839.52	119798.37	10561.58	111839.53	119798.37	10561.73	111839.49	119798.38	10561.70	111839.50	119798.38	########
MP10-S5(VERN)	112205.82	120416.25	10826.15	112205.85	120415.99	10826.25	112205.72	120415.92	10826.15	---	---	---
MP10-S6(VERN)	112167.53	120160.11	10723.29	112167.58	120159.85	10723.39	112167.57	120159.87	10723.40	---	---	---
MP10-S7(VERN)	112036.79	120165.35	10709.89	112036.83	120165.08	10709.99	112035.76	120162.03	10709.69	---	---	---
MP10-S8(VERN)	---	---	---	---	---	---	---	---	---	---	---	---
MP10-S9(VERN)	111997.76	120111.84	10688.02	111997.81	120111.56	10688.12	111997.61	120111.26	10688.29	---	---	---
MP11-VENTRAISE(SOUTH-PIT)	111733.43	119839.17	10564.55	111733.45	119839.17	10564.70	111733.41	119839.17	10564.66	---	---	---
MP14-93(VERN)	111950.79	120206.58	10713.72	111950.83	120206.30	10713.82	---	---	---	---	---	---
MP14-H5R(VERN)	112127.51	120339.25	10781.81	112127.54	120338.99	10781.91	112124.54	120335.22	10780.46	---	---	---
MP17-94(VERN)	111956.64	120307.12	10745.47	111956.68	120306.84	10745.57	111956.67	120306.86	10745.57	---	---	---
MP17-95(VERN)	111952.23	120245.52	10725.85	111952.27	120245.24	10725.95	111938.84	120229.55	10717.90	---	---	---
MP-52(ZORRO)	114966.38	121854.35	11094.64	114966.42	121854.35	11094.64	114966.42	121854.38	11094.65	---	---	---
MP94-10(NORTHPIT)	113503.98	119597.84	10384.88	113503.91	119597.75	10385.21	113503.98	119597.73	10385.21	---	---	---
MP94-12(ZORRO)	114007.97	120976.86	10799.59	114008.00	120976.86	10799.59	114007.97	120976.75	10799.58	114007.93	120976.67	########
MP94-16(NORTHPIT)	---	---	---	---	---	---	113599.85	119756.91	10346.74	---	---	---
MP94-18(ZORRO)	114477.09	120900.44	10874.13	114477.11	120900.44	10874.13	114476.97	120900.28	10874.18	114476.93	120900.14	########
MP94-23(ZORRO)	114637.44	120812.37	10861.11	114637.46	120812.37	10861.11	114637.37	120812.21	10861.03	114637.30	120812.08	########
MP94-24(ZORRO)	114223.41	121071.23	10874.50	114223.44	121071.24	10874.50	114223.40	121071.12	10874.52	114223.32	121071.03	########
MP94-25(ZORRO)	114211.62	121260.59	10912.87	114211.66	121260.59	10912.87	114211.62	121260.48	10912.86	114211.57	121260.42	########
MP94-26(ZORRO)	114200.26	121420.51	10941.80	114200.29	121420.51	10941.81	114200.33	121420.43	10941.83	114200.29	121420.38	########
MP94-27(ZORRO)	114651.31	121390.22	10966.42	114651.35	121390.22	10966.42	114651.39	121390.14	10966.33	114651.33	121390.03	########
MP94-28(ZORRO)	114628.53	121205.15	10937.11	114628.56	121205.15	10937.11	114628.49	121205.06	10937.07	114628.49	121204.95	########
MP94-29(ZORRO)	114988.52	120779.49	10882.04	114988.54	120779.49	10882.04	114988.45	120779.34	10881.96	114988.39	120779.20	########
MP94-34(ZORRO)	115186.19	121416.60	11025.15	115186.22	121416.59	11025.15	115186.18	121416.51	11025.17	115186.11	121416.44	########
MP94-35(ZORRO)	115126.28	121210.63	10999.34	115126.31	121210.62	10999.34	115126.26	121210.51	10999.27	115126.16	121210.41	########
MP94-36(ZORRO)	115069.06	121009.67	10948.42	115069.09	121009.66	10948.42	115069.06	121009.53	10948.44	115068.99	121009.42	########
MP94-37(ZORRO)	115141.73	120530.19	10856.49	115141.75	120530.18	10856.49	115141.62	120530.04	10856.45	115141.55	120529.91	########
MP94-38(ZORRO)	115027.78	120420.08	10811.88	115027.80	120420.07	10811.88	115027.66	120419.96	10811.85	115027.65	120419.82	########
MP94-39(ZORRO)	115385.14	120456.51	10851.89	115385.16	120456.50	10851.89	115385.12	120456.56	10851.72	---	---	---
MP94-40(NORTHPIT)	115680.03	120368.17	10877.66	115679.97	120368.04	10877.99	115679.97	120368.04	10878.00	---	---	---
MP94-41(41OFFSET-from-Zorro)	---	---	---	---	---	---	---	---	---	---	---	---
MP94-42(ZORRO)	114149.33	121779.69	11045.55	114149.38	121779.70	11045.55	114149.32	121779.73	11045.50	---	---	---
MP94-43(NORTHPIT)	115873.42	120444.43	10909.48	115873.36	120444.30	10909.81	115873.36	120444.29	10909.78	---	---	---
MP94-44(ZORRO)	113381.43	121068.15	10835.00	113381.46	121068.16	10835.00	113381.41	121068.11	10834.99	---	---	---
MP94-45(ZORRO)	112416.94	120583.74	10908.41	112416.96	120583.77	10908.41	112416.86	120583.70	10908.30	---	---	---
MP94-47(ZORRO)	113193.52	120683.83	10719.02	113193.54	120683.85	10719.02	113193.56	120683.84	10719.03	113193.55	120683.81	########
MP94-48(ZORRO)	113021.16	120928.96	10795.35	113021.19	120928.98	10795.35	113021.20	120928.97	10795.36	113021.25	120929.01	########
MP94-50(ZORRO)	112863.67	121152.82	10826.97	112863.70	121152.85	10826.97	112863.66	121152.82	10826.98	---	---	---
MP94-6(WEST-FACE)	112598.37	120481.31	10839.94	112598.27	120481.56	10839.77	112598.20	120481.44	10839.77	---	---	---
MP94-7(VERN)	112264.68	120351.37	10822.07	112264.71	120351.12	10822.17	112264.67	120351.11	10822.13	---	---	---
MP94-8(ZORRO)	113716.34	120789.88	10730.69	113716.37	120789.89	10730.69	113716.34	120789.81	10730.72	113716.33	120789.76	########
MP94-9(ZORRO)	115271.78	121674.10	11102.44	115271.82	121674.09	11102.45	115271.79	121674.13	11102.51	---	---	---
MP95-59(WEST-FACE)	---	---	---	---	---	---	113263.03	119677.38	10385.06	---	---	---
MP95-63(VERN)	112038.96	120186.28	10717.50	112039.00	120186.01	10717.60	112038.28	120182.16	10717.04	---	---	---
MP95-64(VERN)	112389.63	120109.64	10731.70	112389.68	120109.41	10731.80	112389.68	120109.42	10731.78	---	---	---
MP96-65(ZORRO)	114592.47	120430.16	10662.81	114592.49	120430.16	10662.81	114592.33	120430.04	10662.76	114592.23	120429.92	########
MP96-66(ZORRO)	114246.22	120529.33	10628.32	114246.24	120529.33	10628.32	114246.10	120529.16	10628.27	114246.09	120528.98	########
MP96-67(ZORRO)	113827.87	120540.63	10605.22	113827.89	120540.64	10605.22	113827.82	120540.49	10605.16	113827.84	120540.44	########
MP96-68(WEST-FACE)	113099.57	119913.90	10539.08	113099.44	119914.12	10538.91	113099.42	119913.98	10538.92	113099.46	119914.00	########
MP96-69(ZORRO)	114206.44	120308.92	10543.81	114206.46	120308.92	10543.81	114206.33	120308.72	10543.78	114206.25	120308.57	########
MP96-70(ZORRO)	113856.82	120350.86	10539.97	113856.84	120350.86	10539.97	113856.78	120350.74	10539.89	113856.80	120350.64	########
MP97-71(WEST-FACE)	112575.10	120225.51	10793.09	112574.99	120225.77	10792.93	112574.97	120225.70	10793.02	112574.99	120225.70	########
MP97-72(WEST-FACE)	112790.27	120124.51	10711.58	112790.15	120124.76	10711.42	112790.15	120124.66	10711.41	112790.19	120124.64	########
MP97-73(WEST-FACE)	112826.59	120212.26	10721.62	112826.48	120212.50	10721.46	112826.46	120212.36	10721.47	112826.49	120212.35	########
MP97-74(WEST-FACE)	112871.54	120284.80	10725.89	112871.42	120285.04	10725.73	112871.41	120284.92	10725.68	112871.42	120284.89	########
MP97-75(WEST-FACE)	112891.28	119916.14	10611.28	112891.15	119916.38	10611.12	112891.14	119916.34	10611.14	112891.15	119916.32	########
MP97-76(WEST-FACE)	113085.58	120258.62	10630.45	113085.47	120258.85	10630.28	113085.40	120258.69	10630.28	113085.46	120258.71	########
MP97-77(WEST-FACE)	112887.42	119648.24	10518.74	112887.27	119648.48	10518.58	112887.25	119648.36	10518.60	112887.27	119648.29	########
MP97-78(WEST-FACE)	112976.19	119755.20	10530.18	112976.05	119755.43	10530.01	112976.04	119755.32	10530.03	112976.12	119755.22	########
MP97-79(WEST-FACE)	113159.45	120057.86	10552.55	113159.33	120058.09	10552.38	113159.33	120058.02	10552.37	113159.35	120057.98	########
MP97-80(WEST-FACE)	113234.84	120201.88	10569.69	113234.73	120202.10	10569.52	113234.70	120201.97	10569.51	113234.71	120201.92	########
MP99-81(ZORRO)	114252.15	119909.50	10449.58	114252.16	119909.51	10449.58	114252.13	119909.48	10449.57	---	---	---
MP99-82(NORTHPIT)	113967.33	119866.32	10358.32	113967.27	119866.22	10358.65	113967.27	119866.22	10358.67	---	---	---
MP99-83(NORTHPIT)	113802.97	119942.64	10360.02	113802.90	119942.54	10360.34	113802.94	119942.51	10360.35	---	---	---
MP99-84(NORTHPIT)	113651.19	120032.09	10340.01	113651.13	120031.99	10340.33	113651.15	120031.99	10340.32	---	---	---
MP99-85(WEST-FACE)	113853.83	120212.23	10488.48	113853.72	120212.41	10488.31	113853.64	120212.32	10488.33	113853.66	120212.25	########
MP99-86(WEST-FACE)	114108.69	120100.41	10470.98	114108.57	120100.59	10470.82	114108.51	120100.53	10470.84	114108.50	120100.47	########
MP99-87(WEST-FACE)	114381.26	120150.66	10531.23	114381.14	120150.82	10531.07	114381.08	120150.66	10531.06	114381.03	120150.54	########
MP99-88(WEST-FACE)	114795.13	120137.47	10644.88	114795.01	120137.61	10644.71	114795.00	120137.63	10644.72	114795.00	120137.64	########
MP99-89(WEST-FACE)	114515.32	119989.95	10527.11	114515.20	119990.11	10526.95	114515.16	119990.10	10526.95	114515.14	119990.10	########
MP99-90(VERN)	112123.78	119928.55	10629.22	112123.85	119928.28	10629.32	112123.82	119928.32	10629.29	112123.83	119928.33	########
MP99-91(VERN)	112567.52	119941.53	10656.42	112567.59	119941.31	10656.52	112567.58	119941.31	10656.50	112567.60	119941.32	########
P10(WEST-FACE)	112987.65	120087.58	10621.73	112987.53	120087.81	10621.56	112987.48	120087.65	10621.57	112987.52	120087.68	########
P12-7R(WEST-FACE)	112991.20	119582.78	10443.44	112991.05	119583.01	10443.28	112991.05	119582.96	10443.29	112991.06	119582.93	########
P15-11(VERN)	112600.30	119799.25	10604.22	112600.38	119799.03	10604.32	112600.41	119799.05	10604.30	---	---	---
P15-12(SOUTH-PIT)	111957.54	119782.64	10554.42	111957.55	119782.64	10554.57	111957.53	119782.66	10554.54	---	---	---
P2017-13(VERN)	112835.04	119869.79	10608.58	112835.12	119869.59	10608.68	112835.13	119869.60	10608.64	---	---	---
P2017-14(WEST-FACE)	112975.52	119793.37	10528.59	112975.38	119793.61	10528.43	112975.36	119793.47	10528.44	---	---	---
P2017-15(VERN)	112787.03	119823.98	10607.18	112787.11	119823.78	10607.28	112787.12	119823.78	10607.24	---	---	---
P2018-16(SOUTH-PIT)	111885.22	119800.72	10558.42	111885.23	119800.71	10558.57	111885.21	119800.73	10558.53	---	---	---
P-4(WEST-FACE)PUNCH-ON-CASING	---	---	---	---	---	---	---	---	---	---	---	---
P-8(WEST-FACE)	113173.39	119686.94	10434.20	113173.25	119687.17	10434.03	113173.27	119687.09	10434.02	113173.30	119687.04	########
P-9(WEST-FACE)	112569.10	119159.87	10482.77	112568.93	119160.12	10482.61	112568.97	119160.01	10482.63	112568.96	119160.04	########
P95-4(WES-FACE)2"AC	112723.31	119837.30	10616.30	112723.17	119837.55	10616.13	112723.10	119837.42	10616.16	112723.10	119837.44	########
P95-5(SOUTH-PIT)	112000.77	119806.97	10561.01	112000.78	119806.96	10561.16	112000.79	119806.94	10561.11	112000.78	119806.94	########
RD16-1(IC10300R)	112195.21	117362.10	10036.56	112195.18	117362.23	10036.78	---	---	---	---	---	---
RD16-2(IC10300R)	112181.12	117377.43	10036.39	112181.09	117377.55	10036.61	---	---	---	---	---	---
RD16-3(IC10300R)	112207.49	117348.38	10036.25	112207.46	117348.50	10036.47	---	---	---	---	---	---
RD16-4(IC10300R)	112139.98	117346.23	10033.79	112139.95	117346.35	10034.01	---	---	---	---	---	---
RD2017-5(IC10300R)	112228.70	117314.10	10037.42	112228.67	117314.23	10037.64	---	---	---	---	---	---
RD2017-6(RED-CAP)	112911.33	117699.15	10298.62	112911.27	117699.24	10298.79	---	---	---	---	---	---
RD2017-7(RED-CAP)	112898.51	117723.22	10298.46	112898.44	117723.32	10298.64	---	---	---	---	---	---
RD2017-8(RED-CAP)	112888.15	117751.17	10297.76	112888.08	117751.26	10297.93	---	---	---	---	---	---
RD2017-9(RED-CAP)	112855.35	117799.39	10297.18	112855.28	117799.49	10297.36	---	---	---	---	---	---
IN2017-1(GPS-ZORRO)	112700.49	117414.29	10200.49	112700.49	117414.29	10200.49	---	---	---	---	---	---
IN2017-2(GPS-ZORRO)	112702.74	117600.35	10200.39	112702.74	117600.35	10200.39	---	---	---	---	---	---
IN2017-3(GPS-ZORRO)	112426.20	117740.55	10186.04	112426.20	117740.55	10186.04	---	---	---	---	---	---
IRD-MD-2018-1(GPS-ZORRO)	113060.69	118139.38	10340.16	113060.69	118139.38	10340.16	---	---	---	---	---	---
IRD-MD-2018-2(GPS-ZORRO)	113090.82	118900.31	10310.87	113090.82	118900.31	10310.87	---	---	---	---	---	---
IRD-OS-2018-01(RED-CAP)	114066.93	117242.39	10461.78	114066.85	117242.46	10461.96	---	---	---	---	---	---

Monitoring Point Name	Survey Error (ft)	Cumulative Displacement from Baseline (ft)								Annual Direction of Movement from North in Degrees (cells colored from red [zero degrees] to green [360 degrees]). *Cells contain "-" if movement is below survey error]*							
		2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
C94-1(ZORRO)2"AC	0.23	0.08	0.19	0.39	0.60	0.74	0.81	0.94	1.12	---	---	---	---	---	---	---	---
I94-2(ZORRO)1.5"AC	0.23	0.08	0.19	0.36	0.56	0.72	0.83	0.94	1.04	---	---	---	---	---	---	---	---
I98-1(WEST-FACE)	0.09	0.05	0.14	0.21	0.27	0.34	0.34	0.43	0.48	---	---	---	---	---	---	264	---
I98-2(WEST-FACE)	0.10	0.01	0.11	0.22	0.28	0.35	0.33	0.47	---	---	276	280	---	---	---	259	---
I98-3(ZORRO)	0.30	0.05	0.05	0.09	0.14	0.02	0.06	0.14	---	---	---	---	---	---	---	---	---
IC11-10300R(RED-CAP)	0.15	0.08	0.05	0.07	0.10	0.07	0.08	---	---	---	---	---	---	---	---	---	---
IC11-10370R(RED-CAP)	0.21	0.12	0.10	0.12	0.14	0.13	0.19	---	---	---	---	---	---	---	---	---	---
MP05-92(VERN)	0.08	0.37	1.09	3.67	8.42	12.28	12.67	18.03	---	---	235	233	232	232	232	231	---
MP05-HS4(VERN)	0.09	0.28	0.87	3.00	7.06	10.70	11.09	16.34	---	---	229	228	226	228	226	224	---
MP05-S1(VERN)	0.07	0.18	0.52	1.84	4.16	6.03	6.23	8.88	---	---	256	259	258	259	253	260	---
MP10-S10(VERN)	0.07	0.05	0.02	0.03	0.03	0.02	0.07	0.11	0.16	---	---	---	---	---	---	---	---
MP10-S11(SOUTH-PIT)	0.03	0.05	0.03	0.06	0.05	0.07	0.09	0.13	0.50	---	---	---	---	---	---	162	124
MP10-S12(SOUTH-PIT)	0.03	0.03	0.04	0.06	0.04	0.07	0.08	0.13	0.15	---	---	---	---	---	---	166	---
MP10-S5(VERN)	0.09	0.03	0.07	0.20	0.36	0.52	0.56	0.74	---	---	---	221	214	219	---	208	---
MP10-S6(VERN)	0.07	0.00	0.02	0.03	0.04	0.03	0.06	0.09	---	---	---	---	---	---	---	---	---
MP10-S7(VERN)	0.07	0.17	0.50	1.75	4.18	6.30	6.54	9.79	---	---	258	255	252	254	256	251	---
MP10-S8(VERN)	0.08	0.26	0.90	3.37	9.36	---	---	---	---	---	231	229	224	---	---	---	---
MP10-S9(VERN)	0.07	0.05	0.08	0.26	0.62	0.88	0.95	1.35	---	---	---	242	235	241	239	236	---
MP11-VENTRAISE(SOUTH-PIT)	0.04	0.02	0.03	0.04	0.04	0.06	0.06	0.12	---	---	---	---	---	---	---	180	---
MP14-93(VERN)	0.08	---	---	3.32	11.52	21.01	21.23	---	---	---	---	---	233	234	241	---	---
MP14-H5R(VERN)	0.08	0.35	1.62	3.93	8.52	12.15	12.50	17.53	---	---	227	233	232	231	232	231	---
MP17-94(VERN)	0.09	---	---	---	---	---	0.05	0.07	---	---	---	---	---	---	---	---	---
MP17-95(VERN)	0.08	---	---	---	---	---	0.33	22.50	---	---	---	---	---	---	---	229	---
MP-52(ZORRO)	0.30	0.02	0.08	0.05	0.12	0.02	0.03	0.07	---	---	---	---	---	---	---	---	---
MP94-10(NORTHPIT)	0.18	0.06	0.04	0.06	0.11	0.05	0.05	0.13	---	---	---	---	---	---	---	---	---
MP94-12(ZORRO)	0.21	0.11	0.18	0.39	0.55	0.75	0.86	0.98	1.09	---	---	224	---	---	---	---	---
MP94-16(NORTHPIT)	0.16	0.07	0.06	0.10	0.08	0.07	---	---	---	---	---	---	---	---	---	---	---
MP94-18(ZORRO)	0.20	0.06	0.24	0.65	0.94	1.15	1.28	1.50	1.66	---	---	251	247	240	---	228	---
MP94-23(ZORRO)	0.19	0.13	0.25	0.49	0.77	0.98	1.07	1.26	1.42	---	---	259	250	235	---	240	---
MP94-24(ZORRO)	0.21	0.05	0.22	0.38	0.61	0.79	0.90	1.02	1.18	---	---	---	241	---	---	---	---
MP94-25(ZORRO)	0.23	0.04	0.18	0.34	0.51	0.70	0.76	0.88	1.02	---	---	---	---	---	---	---	---
MP94-26(ZORRO)	0.25	0.06	0.15	0.28	0.43	0.53	0.64	0.73	0.81	---	---	---	---	---	---	---	---
MP94-27(ZORRO)	0.25	0.14	0.21	0.39	0.58	0.79	0.89	1.02	1.15	---	---	---	---	---	---	---	---
MP94-28(ZORRO)	0.23	0.07	0.18	0.38	0.60	0.77	0.84	0.96	1.10	---	---	---	---	---	---	---	---
MP94-29(ZORRO)	0.19	0.12	0.19	0.44	0.63	0.91	1.00	1.19	1.34	---	---	251	---	234	---	---	---
MP94-34(ZORRO)	0.26	0.06	0.17	0.40	0.51	0.76	0.88	0.98	1.13	---	---	---	---	---	---	---	---
MP94-35(ZORRO)	0.24	0.10	0.21	0.44	0.65	0.87	1.01	1.15	1.30	---	---	---	---	---	---	---	---
MP94-36(ZORRO)	0.22	0.10	0.22	0.44	0.64	0.90	1.06	1.19	1.33	---	---	253	---	237	---	---	---
MP94-37(ZORRO)	0.18	0.09	0.21	0.46	0.69	0.98	1.07	1.27	1.42	---	---	240	247	226	---	228	---
MP94-38(ZORRO)	0.16	0.07	0.19	0.43	0.63	0.94	1.04	1.22	1.36	---	---	230	227	217	---	218	---
MP94-39(ZORRO)	0.18	0.07	0.09	0.29	0.06	0.07	0.11	0.30	---	---	---	218	---	---	---	121	---
MP94-40(NORTHPIT)	0.06	0.02	0.03	0.05	0.05	0.03	0.02	0.04	---	---	---	---	---	---	---	---	---
MP94-41(41OFFSET-from-Zorro)	0.21	0.11	0.14	0.11	0.12	---	---	---	---	---	---	---	---	---	---	---	---
MP94-42(ZORRO)	0.29	0.03	0.06	0.06	0.11	0.07	0.04	0.12	---	---	---	---	---	---	---	---	---
MP94-43(NORTHPIT)	0.08	0.10	0.26	0.04	0.02	0.06	0.05	0.08	---	---	300	---	---	---	---	---	---
MP94-44(ZORRO)	0.24	0.09	0.09	0.22	0.22	0.25	0.23	0.31	---	---	---	---	---	---	---	---	---
MP94-45(ZORRO)	0.26	0.04	0.09	0.06	0.12	0.04	0.17	0.34	---	---	---	---	---	---	---	---	---
MP94-47(ZORRO)	0.21	0.06	0.02	0.09	0.11	0.11	0.12	0.15	0.18	---	---	---	---	---	---	---	---
MP94-48(ZORRO)	0.24	0.07	0.08	0.06	0.16	0.11	0.06	0.08	0.16	---	---	---	---	---	---	---	---
MP94-50(ZORRO)	0.27	0.03	0.07	0.08	0.17	0.01	0.04	0.10	---	---	---	---	---	---	---	---	---
MP94-6(WEST-FACE)	0.17	0.10	0.13	0.17	0.15	0.18	0.18	0.31	---	---	---	---	---	---	---	---	---
MP94-7(VERN)	0.08	0.06	0.04	0.06	0.09	0.07	0.06	0.11	---	---	---	---	---	---	---	---	---
MP94-8(ZORRO)	0.20	0.05	0.11	0.22	0.35	0.45	0.54	0.63	0.72	---	---	---	---	---	---	---	---
MP94-9(ZORRO)	0.29	0.07	0.06	0.04	0.12	0.07	0.06	0.15	---	---	---	---	---	---	---	---	---
MP95-59(WEST-FACE)	0.07	0.04	0.21	0.37	0.50	0.61	---	---	---	---	292	297	307	312	---	---	---
MP95-63(VERN)	0.07	0.21	0.67	2.33	5.43	8.14	8.44	12.40	---	---	259	259	257	260	264	259	---
MP95-64(VERN)	0.05	0.02	0.02	0.03	0.03	0.02	0.08	0.10	---	---	---	---	---	---	---	---	---
MP96-65(ZORRO)	0.15	0.08	0.26	0.52	0.80	1.11	1.22	1.42	1.58	---	217	226	227	221	---	217	230
MP96-66(ZORRO)	0.16	0.09	0.29	0.55	0.86	1.13	1.26	1.49	1.68	---	249	251	244	257	---	231	267
MP96-67(ZORRO)	0.17	0.07	0.14	0.31	0.45	0.63	0.68	0.85	0.91	---	---	---	---	248	---	244	---
MP96-68(WEST-FACE)	0.10	0.03	0.13	0.27	0.31	0.40	0.41	0.56	0.61	---	---	277	---	---	---	262	---
MP96-69(ZORRO)	0.14	0.08	0.27	0.56	0.83	1.13	1.24	1.48	1.65	---	241	243	251	246	---	237	242
MP96-70(ZORRO)	0.15	0.04	0.15	0.32	0.47	0.66	0.75	0.91	1.02	---	---	269	---	249	---	244	---
MP97-71(WEST-FACE)	0.16	0.05	0.13	0.23	0.25	0.24	0.27	0.39	0.42	---	---	---	---	---	---	---	---
MP97-72(WEST-FACE)	0.13	0.03	0.15	0.26	0.27	0.31	0.32	0.42	0.47	---	---	---	---	---	---	---	---
MP97-73(WEST-FACE)	0.13	0.02	0.12	0.24	0.24	0.32	0.31	0.45	0.49	---	---	---	---	---	---	262	---
MP97-74(WEST-FACE)	0.14	0.03	0.15	0.28	0.30	0.34	0.34	0.47	0.51	---	---	---	---	---	---	---	---
MP97-75(WEST-FACE)	0.11	0.04	0.11	0.21	0.22	0.35	0.37	0.42	0.45	---	---	---	---	44	---	---	---
MP97-76(WEST-FACE)	0.12	0.02	0.12	0.21	0.29	0.38	0.40	0.57	0.64	---	---	---	---	---	---	246	---
MP97-77(WEST-FACE)	0.10	0.01	0.08	0.20	0.21	0.24	0.21	0.34	0.41	---	---	282	---	---	---	260	---
MP97-78(WEST-FACE)	0.10	0.04	0.13	0.24	0.25	0.31	0.30	0.41	0.54	---	---	272	---	---	---	264	309
MP97-79(WEST-FACE)	0.10	0.04	0.14	0.26	0.32	0.44	0.48	0.55	0.61	---	255	280	---	292	---	---	---
MP97-80(WEST-FACE)	0.10	0.03	0.11	0.21	0.32	0.41	0.41	0.54	0.60	---	---	---	---	---	---	258	---
MP99-81(ZORRO)	0.10	0.06	0.08	0.06	0.09	0.10	0.07	0.11	---	---	---	---	---	---	---	---	---
MP99-82(NORTHPIT)	0.13	0.05	0.07	0.09	0.09	0.15	0.19	0.21	---	---	---	---	---	---	---	---	---
MP99-83(NORTHPIT)	0.14	0.06	0.08	0.11	0.10	0.15	0.17	0.22	---	---	---	---	---	---	---	---	---
MP99-84(NORTHPIT)	0.16	0.04	0.09	0.13	0.11	0.20	0.21	0.24	---	---	---	---	---	---	---	---	---
MP99-85(WEST-FACE)	0.08	0.04	0.18	0.31	0.45	0.60	0.65	0.77	0.84	---	253	249	248	259	---	231	---
MP99-86(WEST-FACE)	0.08	0.05	0.13	0.21	0.29	0.39	0.44	0.53	0.59	---	---	240	244	259	---	222	---
MP99-87(WEST-FACE)	0.09	0.05	0.22	0.41	0.59	0.80	0.88	1.06	1.19	---	230	224	265	251	---	249	247
MP99-88(WEST-FACE)	0.12	0.05	0.03	0.10	0.05	0.12	0.06	0.09	0.11	---	---	---	---	---	---	---	---
MP99-89(WEST-FACE)	0.09	0.03	0.08	0.11	0.12	0.14	0.14	0.18	0.20	---	---	---	---	---	---	---	---
MP99-90(VERN)	0.05	0.04	0.01	0.03	0.03	0.04	0.08	0.14	0.16	---	---	---	---	---	---	127	---
MP99-91(VERN)	0.04	0.06	0.04	0.07	0.06	0.09	0.10	0.12	0.14	---	---	---	---	---	---	---	---
P10(WEST-FACE)	0.11	0.07	0.13	0.21	0.23	0.33	0.33	0.50	0.55	---	---	---	---	---	---	254	---
P12-7R(WEST-FACE)	0.09	0.02	0.15	0.25	0.28	0.32	0.37	0.42	0.46	---	288	273	---	---	---	---	---
P15-11(VERN)	0.03	---	---	---	0.02	0.03	0.07	0.11	---	---	---	---	---	---	211	34	---
P15-12(SOUTH-PIT)	0.02	---	---	---	0.02	0.03	0.03	0.07	---	---	---	---	---	---	---	135	---
P2017-13(VERN)	0.05	---	---	---	---	---	---	0.04	---	---	---	---	---	---	---	---	---
P2017-14(WEST-FACE)	0.10	---	---	---	---	---	---	0.14	---	---	---	---	---	---	---	---	---
P2017-15(VERN)	0.04	---	---	---	---	---	---	0.04	---	---	---	---	---	---	---	---	---
P2018-16(SOUTH-PIT)	0.02	---	---	---	---	---	---	0.05	---	---	---	---	---	---	---	---	---
P-4(WEST-FACE)PUNCH-ON-CASING	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P-8(WEST-FACE)	0.08	0.03	0.16	0.29	0.37	0.48	0.49	0.57	0.63	---	293	289	290	311	---	284	---
P-9(WEST-FACE)	0.13	0.06	0.08	0.15	0.17	0.17	0.12	0.24	0.27	---	---	---	---	---	---	---	---
P95-4(WES-FACE)2"AC	0.12	0.04	0.07	0.20	0.15	0.15	0.15	0.30	0.33	---	---	264	---	---	---	240	---
P95-5(SOUTH-PIT)	0.02	0.02	0.02	0.07	0.05	0.04	0.02	0.07	0.09	---	---	311	---	---	---	297	180
RD16-1(IC10300R)	0.08	---	---	---	---	0.06	0.04	---	---	---	---	---	---	---	---	---	---
RD16-2(IC10300R)	0.08	---	---	---	---	0.08	0.04	---	---	---	---	---	---	---	---	---	---
RD16-3(IC10300R)	0.08	---	---	---	---	0.06	0.01	---	---	---	---	---	---	---	---	---	---
RD16-4(IC10300R)	0.08	---	---	---	---	0.06	0.03	---	---	---	---	---	---	---	---	---	---
RD2017-5(IC10300R)	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-6(RED-CAP)	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-7(RED-CAP)	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-8(RED-CAP)	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
RD2017-9(RED-CAP)	0.15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IN2017-1(GPS-ZORRO)	0.23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IN2017-2(GPS-ZORRO)	0.22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IN2017-3(GPS-ZORRO)	0.23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IRD-MD-2018-1(GPS-ZORRO)	0.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IRD-MD-2018-2(GPS-ZORRO)	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
IRD-OS-2018-01(RED-CAP)	0.28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

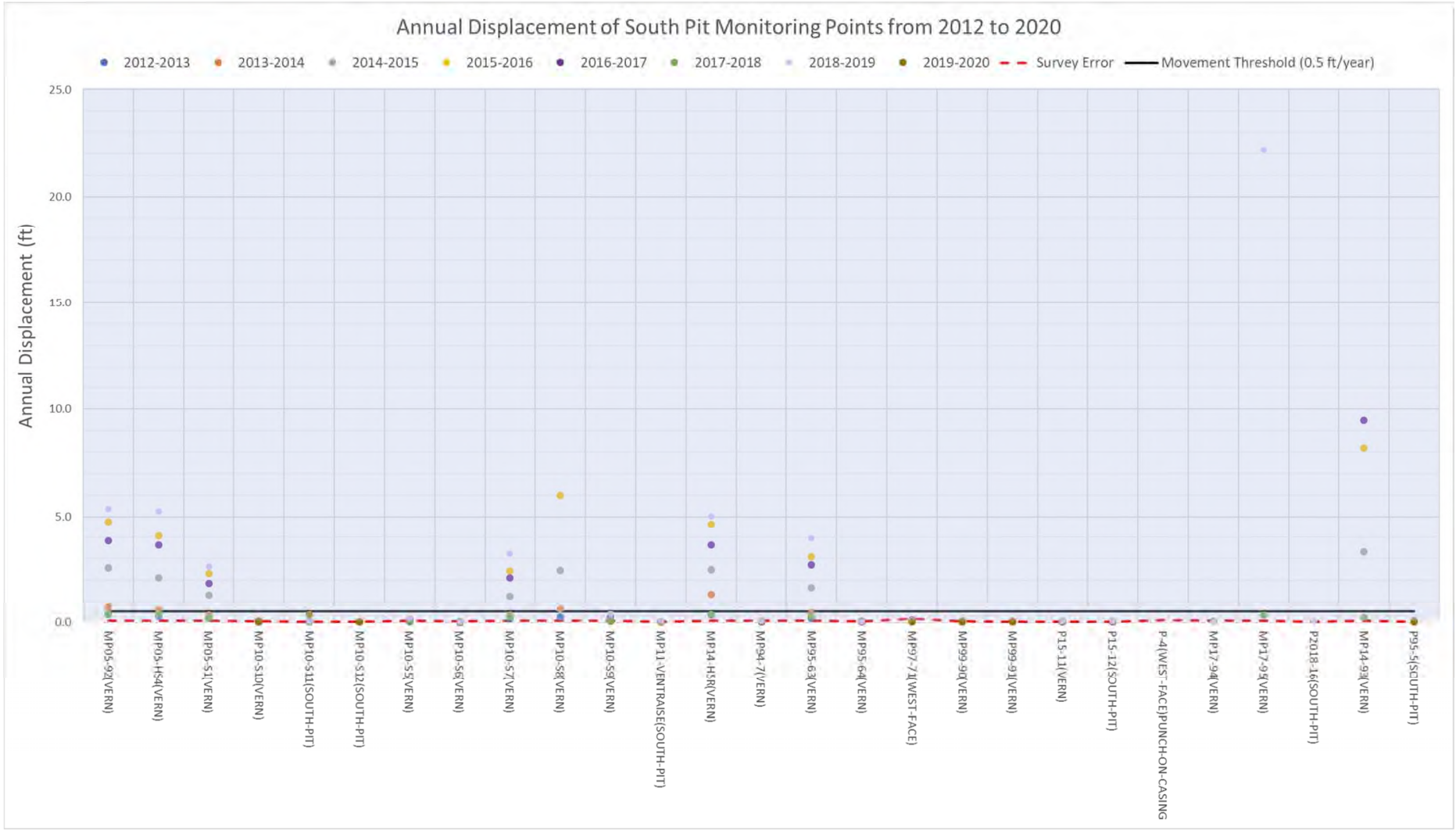
APPENDIX B
PLOTS OF MONITORING POINT DISPLACEMENTS


Annual Displacement of Monitoring Points from 2012 to 2020
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019
2019-2020
Survey Error
Movement Threshold (0.5 ft/year)
Annual Displacement (ft)
South-Pit Monitoring Points
North-Pit Monitoring Points

Plot 1

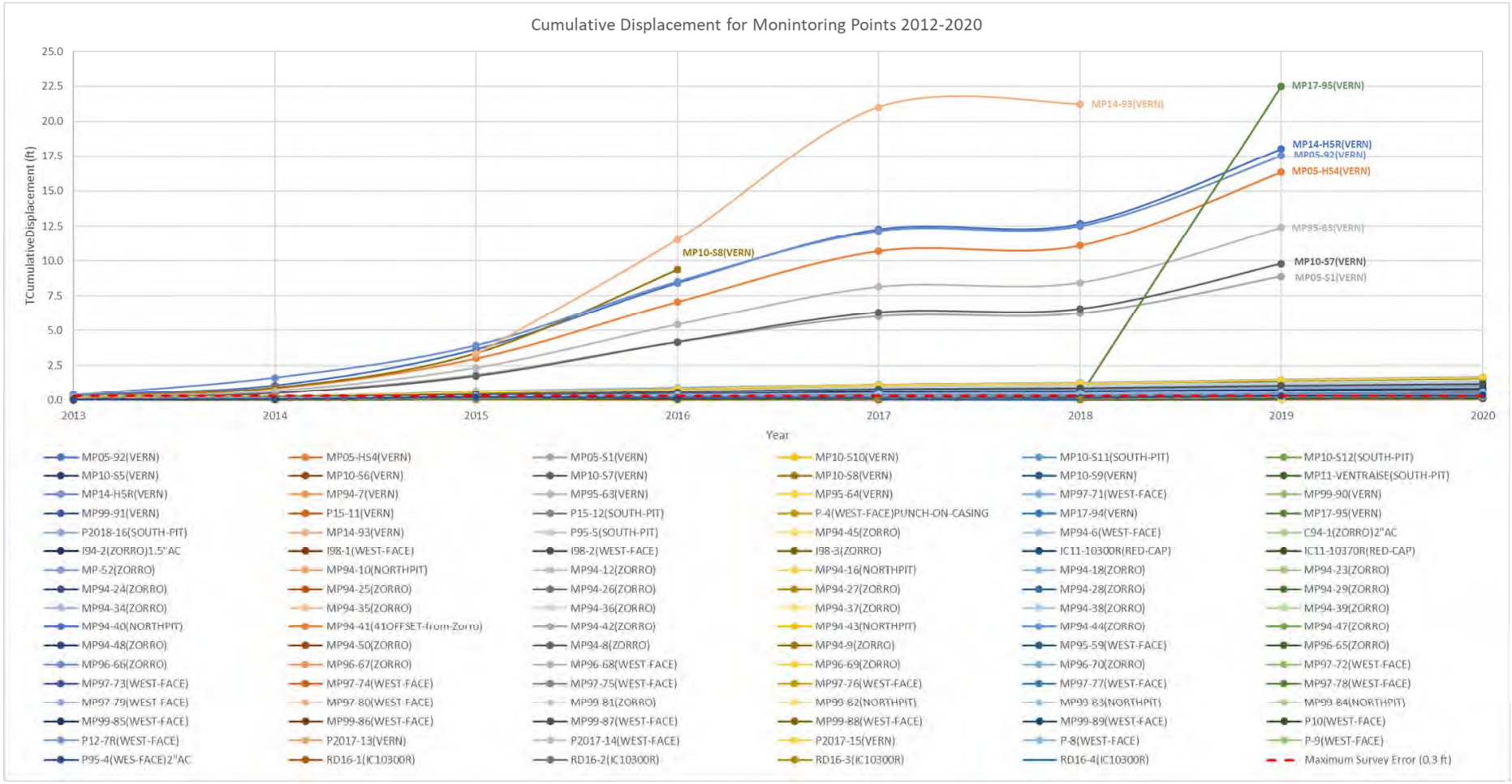

Annual Displacement of North Pit Monitoring Points from 2012 to 2020
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019
2019-2020
Survey Error
Movement Threshold (0.5 ft/year)
Annual Displacement (ft)
0.6
0.5
0.4
0.3
0.2
0.1
0.0

Plot 2

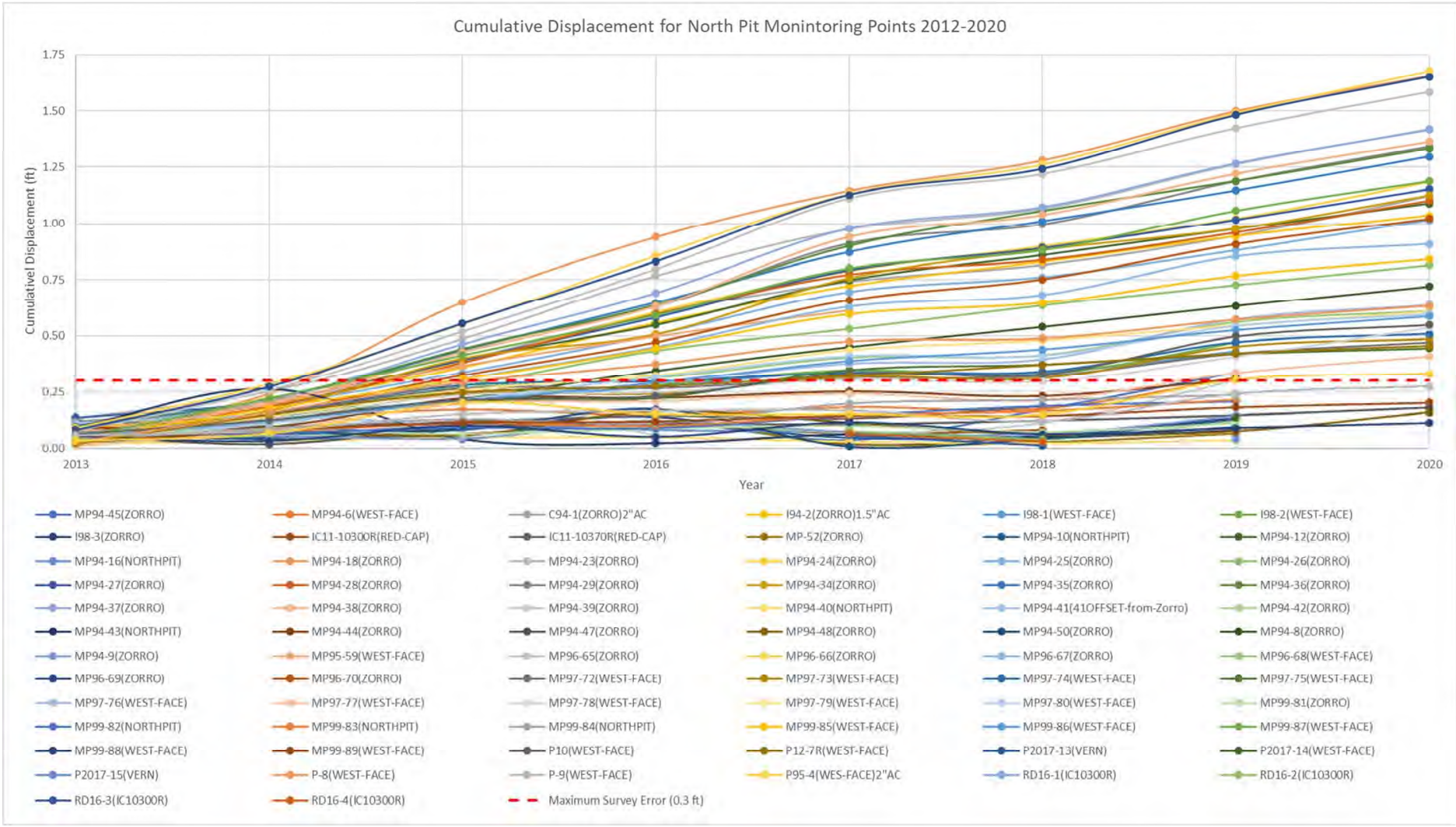


Plot 3

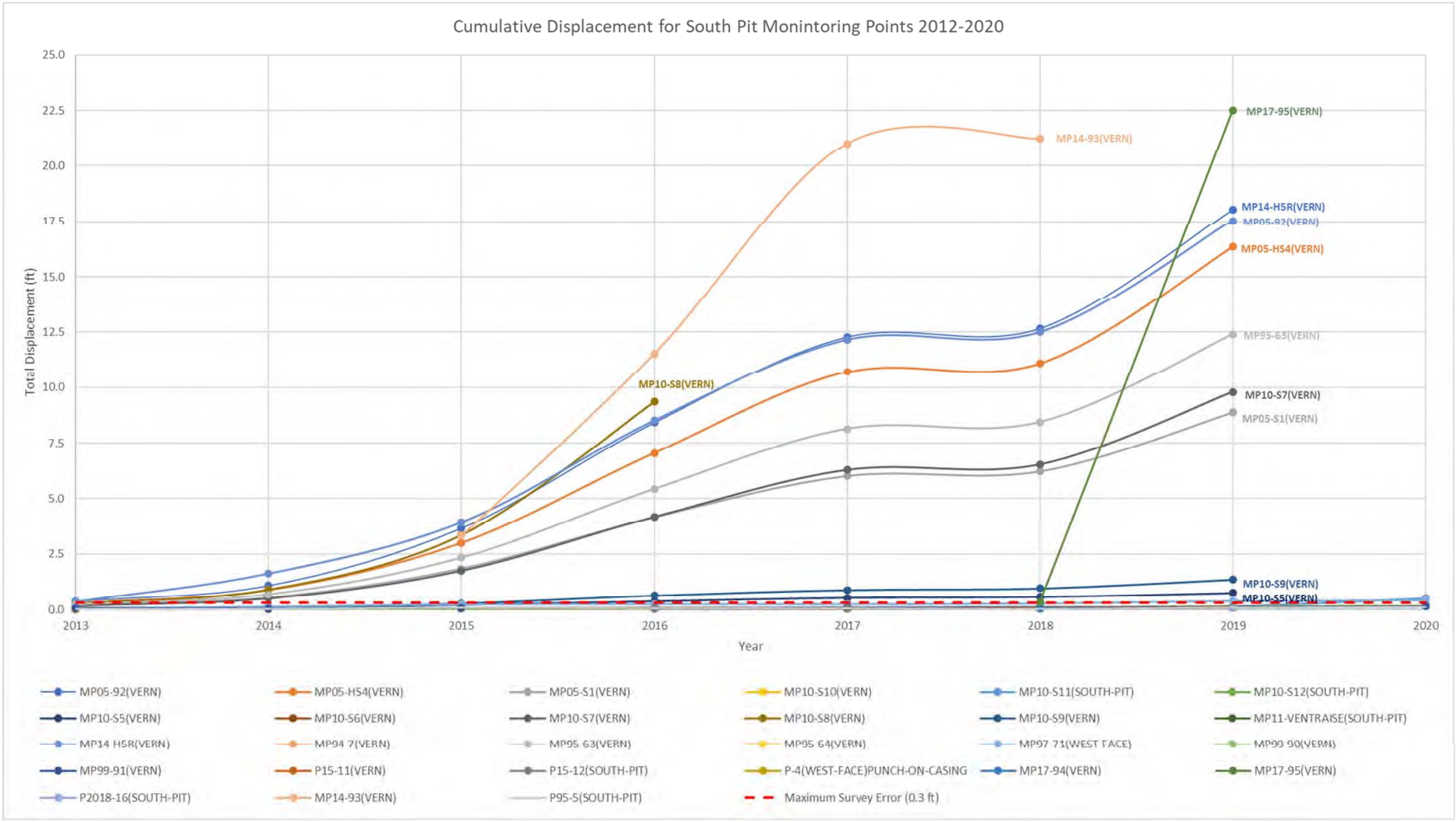
Appendix B Plots of Monitoring Point Displacement


Cumulative Displacement for Monintoring Points 2012-2020
TCumulativeDisplacement (ft)
Year
MP17-95(VERN)
MP14-93(VERN)
MP14-H5R(VERN)
MP05-92(VERN)
MP05-HS4(VERN)
MP95-63(VERN)
MP10-S8(VERN)
MP10-S7(VERN)
MP05-S1(VERN)
MP05-92(VERN)
MP05-HS4(VERN)
MP05-S1(VERN)
MP10-S10(VERN)
MP10-S11(SOUTH-PIT)
MP10-S12(SOUTH-PIT)
MP10-S5(VERN)
MP10-S6(VERN)
MP10-S7(VERN)
MP10-S8(VERN)
MP10-S9(VERN)
MP11-VENTRAISE(SOUTH-PIT)
MP14-H5R(VERN)
MP94-7(VERN)
MP95-63(VERN)
MP95-64(VERN)
MP97-71(WEST-FACE)
MP99-90(VERN)
MP99-91(VERN)
P15-11(VERN)
P15-12(SOUTH-PIT)
P-4(WEST-FACE)PUNCH-ON-CASING
MP17-94(VERN)
MP17-95(VERN)
P2018-16(SOUTH-PIT)
MP14-93(VERN)
P95-5(SOUTH-PIT)
MP94-45(ZORRO)
MP94-6(WEST-FACE)
C94-1(ZORRO)2"AC
I94-2(ZORRO)1.5"AC
I98-1(WEST-FACE)
I98-2(WEST-FACE)
I98-3(ZORRO)
IC11-10300R(RED-CAP)
IC11-10370R(RED-CAP)
MP-52(ZORRO)
MP94-10(NORTHPIT)
MP94-12(ZORRO)
MP94-16(NORTHPIT)
MP94-18(ZORRO)
MP94-23(ZORRO)
MP94-24(ZORRO)
MP94-25(ZORRO)
MP94-26(ZORRO)
MP94-27(ZORRO)
MP94-28(ZORRO)
MP94-29(ZORRO)
MP94-34(ZORRO)
MP94-35(ZORRO)
MP94-36(ZORRO)
MP94-37(ZORRO)
MP94-38(ZORRO)
MP94-39(ZORRO)
MP94-40(NORTHPIT)
MP94-41(41OFFSET-from-Zorro)
MP94-42(ZORRO)
MP94-43(NORTHPIT)
MP94-44(ZORRO)
MP94-47(ZORRO)
MP94-48(ZORRO)
MP94-50(ZORRO)
MP94-8(ZORRO)
MP94-9(ZORRO)
MP95-59(WEST-FACE)
MP96-65(ZORRO)
MP96-66(ZORRO)
MP96-67(ZORRO)
MP96-68(WEST-FACE)
MP96-69(ZORRO)
MP96-70(ZORRO)
MP97-72(WEST-FACE)
MP97-73(WEST-FACE)
MP97-74(WEST-FACE)
MP97-75(WEST-FACE)
MP97-76(WEST-FACE)
MP97-77(WEST-FACE)
MP97-78(WEST-FACE)
MP97-79(WEST-FACE)
MP97-80(WEST-FACE)
MP99-81(ZORRO)
MP99-82(NORTHPIT)
MP99-83(NORTHPIT)
MP99-84(NORTHPIT)
MP99-85(WEST-FACE)
MP99-86(WEST-FACE)
MP99-87(WEST-FACE)
MP99-88(WEST-FACE)
MP99-89(WEST-FACE)
P10(WEST-FACE)
P12-7R(WEST-FACE)
P2017-13(VERN)
P2017-14(WEST-FACE)
P2017-15(VERN)
P-8(WEST-FACE)
P-9(WEST-FACE)
P95-4(WES-FACE)2"AC
RD16-1(IC10300R)
RD16-2(IC10300R)
RD16-3(IC10300R)
RD16-4(IC10300R)
Maximum Survey Error (0.3 ft)

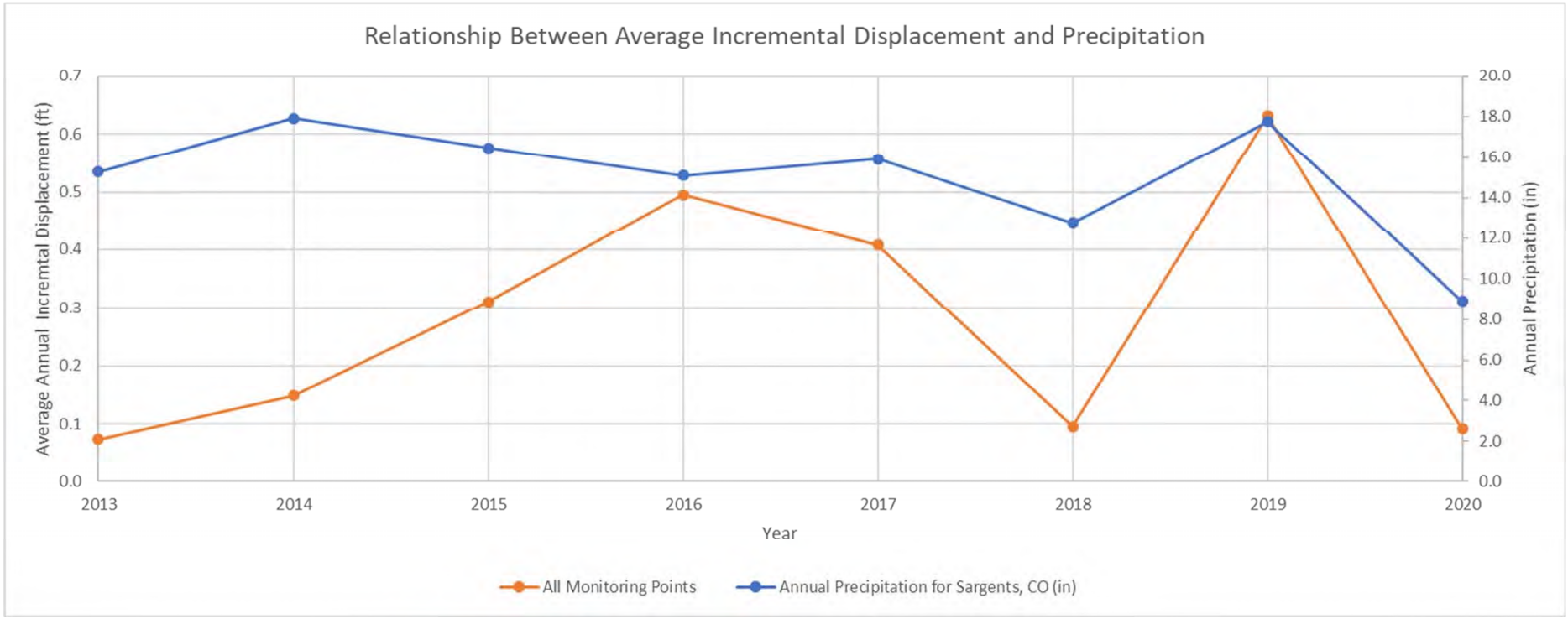
Plot 4


Cumulative Displacement for North Pit Monintoring Points 2012-2020
Cumulativel Displacement (ft)
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
2013
2014
2015
2016
2017
2018
2019
2020
Year
MP94-45(ZORRO)
MP94-6(WEST-FACE)
C94-1(ZORRO)2"AC
I94-2(ZORRO)1.5"AC
I98-1(WEST-FACE)
I98-2(WEST-FACE)
I98-3(ZORRO)
IC11-10300R(RED-CAP)
IC11-10370R(RED-CAP)
MP-52(ZORRO)
MP94-10(NORTHPIT)
MP94-12(ZORRO)
MP94-16(NORTHPIT)
MP94-18(ZORRO)
MP94-23(ZORRO)
MP94-24(ZORRO)
MP94-25(ZORRO)
MP94-26(ZORRO)
MP94-27(ZORRO)
MP94-28(ZORRO)
MP94-29(ZORRO)
MP94-34(ZORRO)
MP94-35(ZORRO)
MP94-36(ZORRO)
MP94-37(ZORRO)
MP94-38(ZORRO)
MP94-39(ZORRO)
MP94-40(NORTHPIT)
MP94-41(41OFFSET-from-Zorro)
MP94-42(ZORRO)
MP94-43(NORTHPIT)
MP94-44(ZORRO)
MP94-47(ZORRO)
MP94-48(ZORRO)
MP94-50(ZORRO)
MP94-8(ZORRO)
MP94-9(ZORRO)
MP95-59(WEST-FACE)
MP96-65(ZORRO)
MP96-66(ZORRO)
MP96-67(ZORRO)
MP96-68(WEST-FACE)
MP96-69(ZORRO)
MP96-70(ZORRO)
MP97-72(WEST-FACE)
MP97-73(WEST-FACE)
MP97-74(WEST-FACE)
MP97-75(WEST-FACE)
MP97-76(WEST-FACE)
MP97-77(WEST-FACE)
MP97-78(WEST-FACE)
MP97-79(WEST-FACE)
MP97-80(WEST-FACE)
MP99-81(ZORRO)
MP99-82(NORTHPIT)
MP99-83(NORTHPIT)
MP99-84(NORTHPIT)
MP99-85(WEST-FACE)
MP99-86(WEST-FACE)
MP99-87(WEST-FACE)
MP99-88(WEST-FACE)
MP99-89(WEST-FACE)
P10(WEST-FACE)
P12-7R(WEST-FACE)
P2017-13(VERN)
P2017-14(WEST-FACE)
P2017-15(VERN)
P-8(WEST-FACE)
P-9(WEST-FACE)
P95-4(WES-FACE)2"AC
RD16-1(IC10300R)
RD16-2(IC10300R)
RD16-3(IC10300R)
RD16-4(IC10300R)
Maximum Survey Error (0.3 ft)

Plot 5

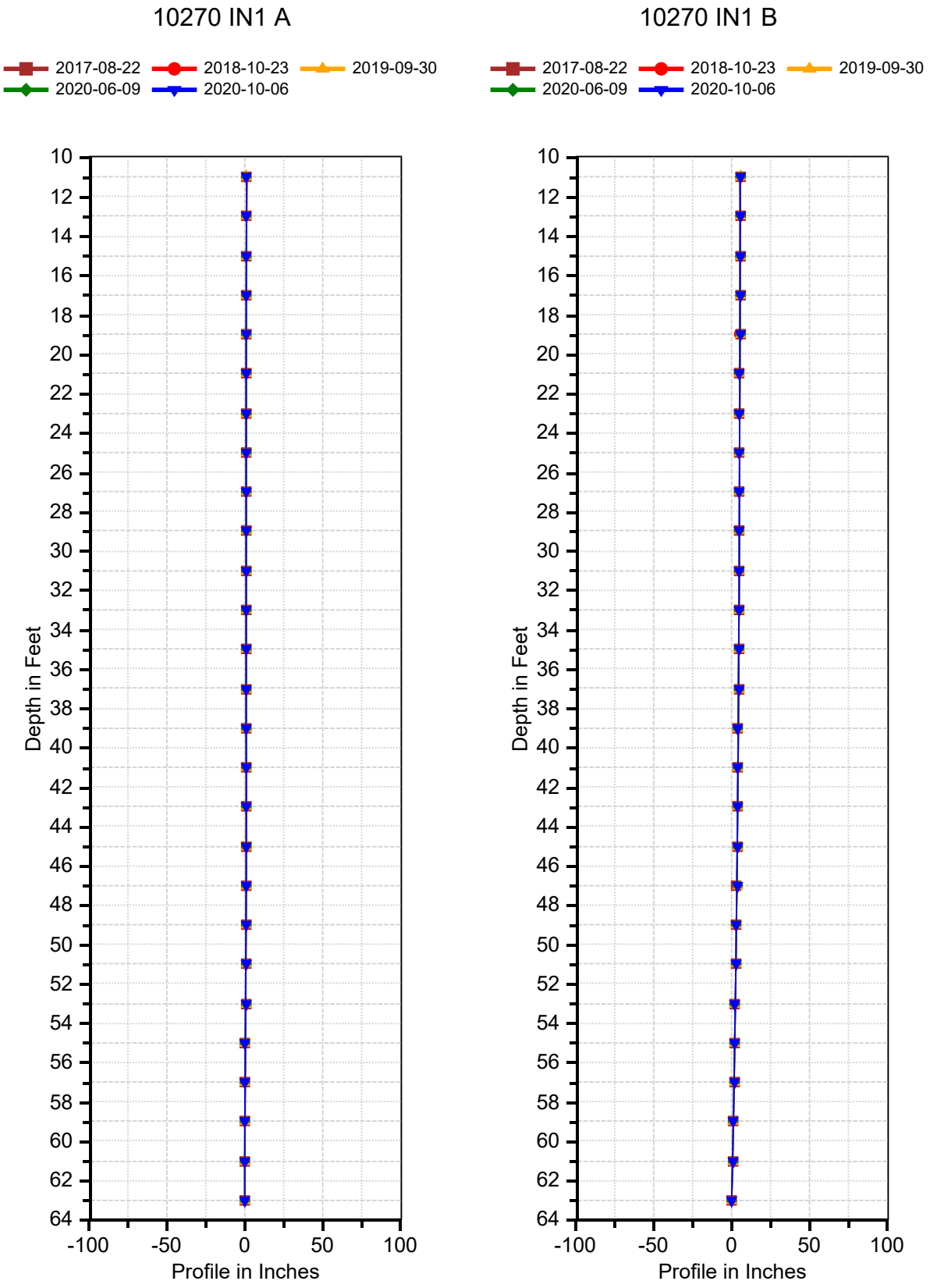

Cumulative Displacement for South Pit Monintoring Points 2012-2020
Total Displacement (ft)
Year
25.0
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
2013
2014
2015
2016
2017
2018
2019
2020
MP17-95(VERN)
MP14-93(VERN)
MP14-H5R(VERN)
MP05-92(VERN)
MP05-HS4(VERN)
MP95-63(VERN)
MP10-S8(VERN)
MP10-S7(VERN)
MP05-S1(VERN)
MP10-S9(VERN)
MP10-S5(VERN)
MP05-92(VERN)
MP05-HS4(VERN)
MP05-S1(VERN)
MP10-S10(VERN)
MP10-S11(SOUTH-PIT)
MP10-S12(SOUTH-PIT)
MP10-S5(VERN)
MP10-S6(VERN)
MP10-S7(VERN)
MP10-S8(VERN)
MP10-S9(VERN)
MP11-VENTRAISE(SOUTH-PIT)
MP14-H5R(VERN)
MP94-7(VERN)
MP95-63(VERN)
MP95-64(VERN)
MP97-71(WEST FACE)
MP99-90(VERN)
MP99-91(VERN)
P15-11(VERN)
P15-12(SOUTH-PIT)
P-4(WEST-FACE)PUNCH-ON-CASING
MP17-94(VERN)
MP17-95(VERN)
P2018-16(SOUTH-PIT)
MP14-93(VERN)
P95-5(SOUTH-PIT)
Maximum Survey Error (0.3 ft)

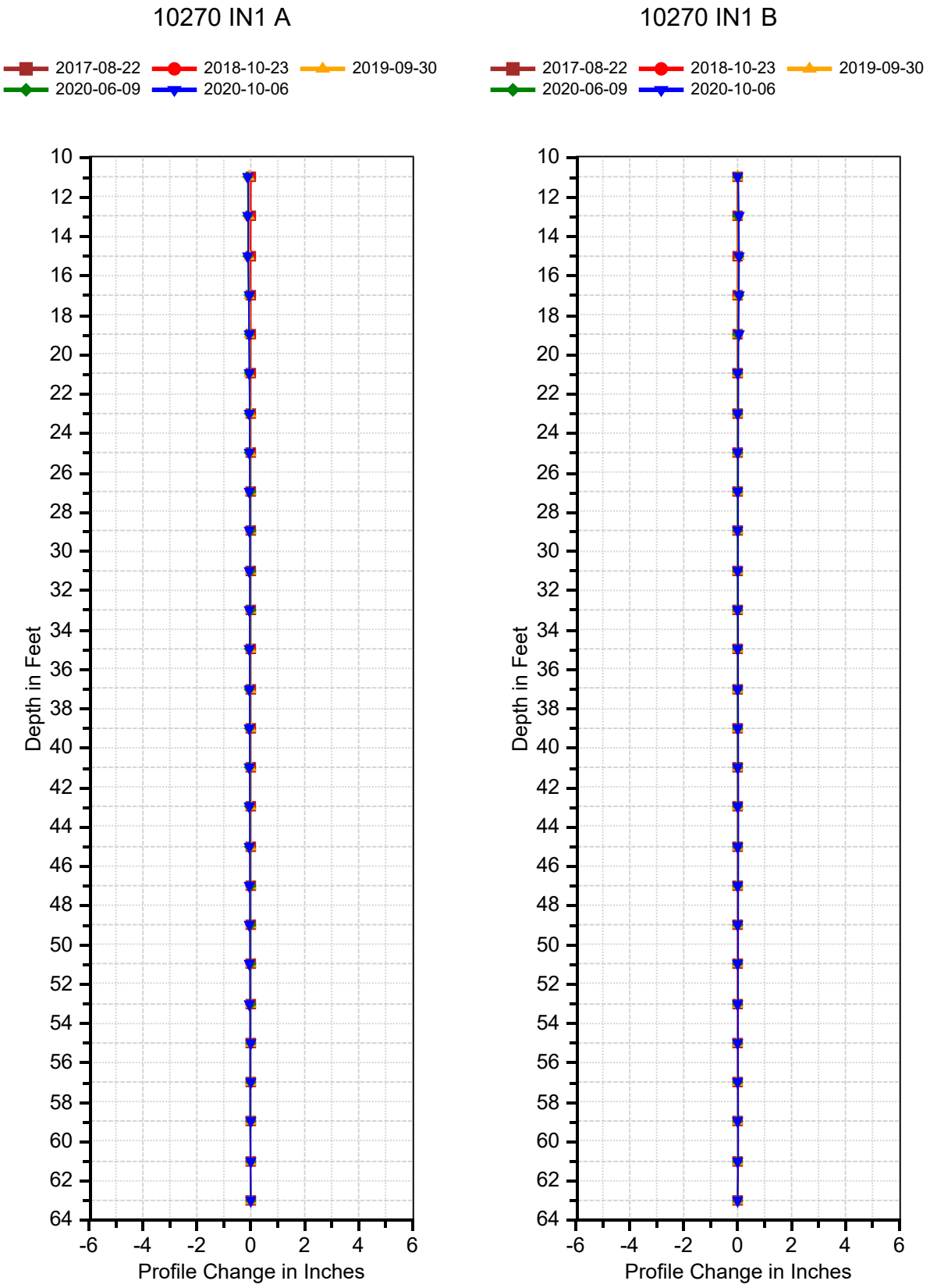
Plot 6

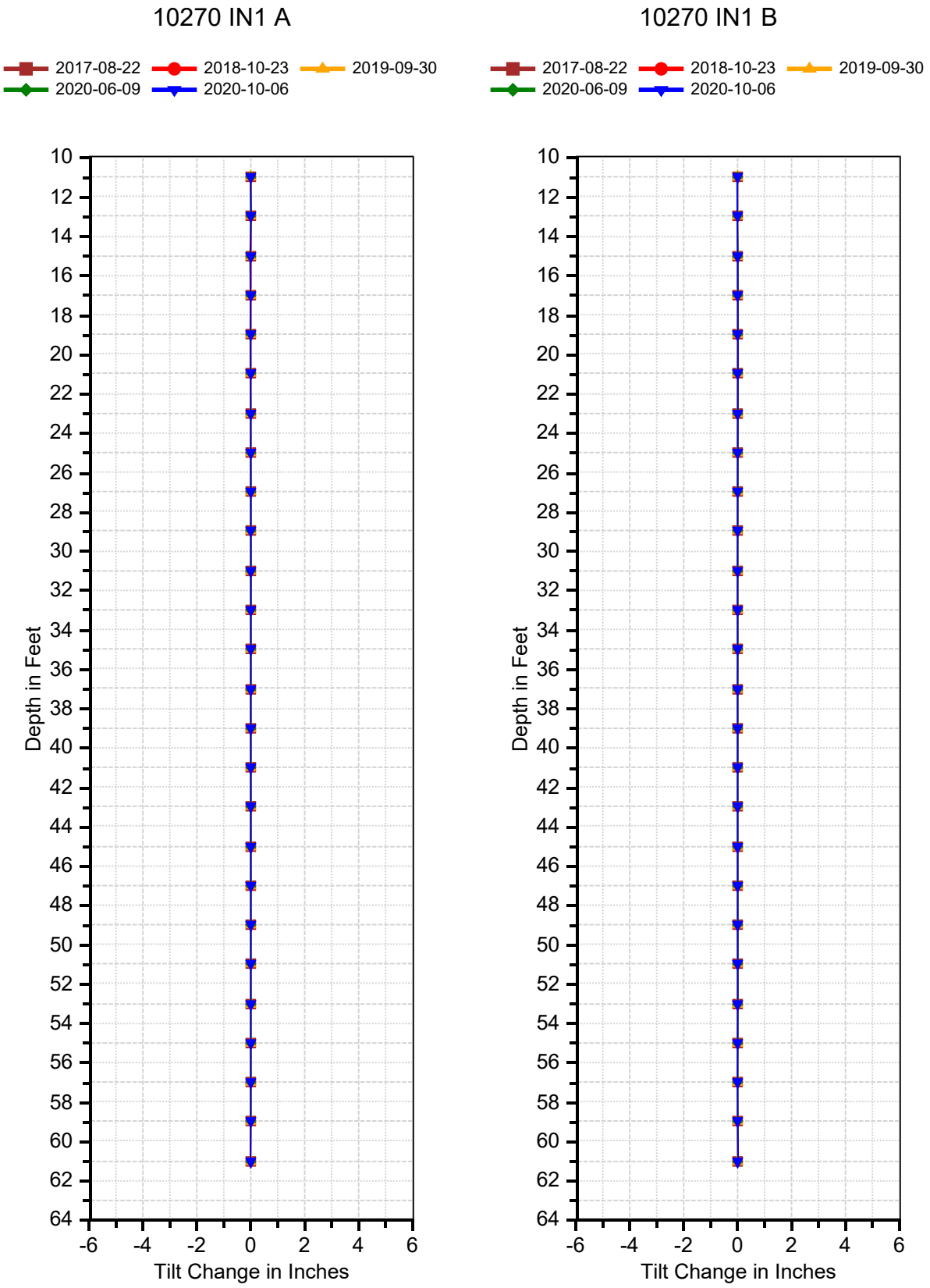

Relationship Between Average Incremental Displacement and Precipitation
Average Annual Incremtal Displacement (ft)
Annual Precipitation (in)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
2013
2014
2015
2016
2017
2018
2019
2020
Year
All Monitoring Points
Annual Precipitation for Sargents, CO (in)

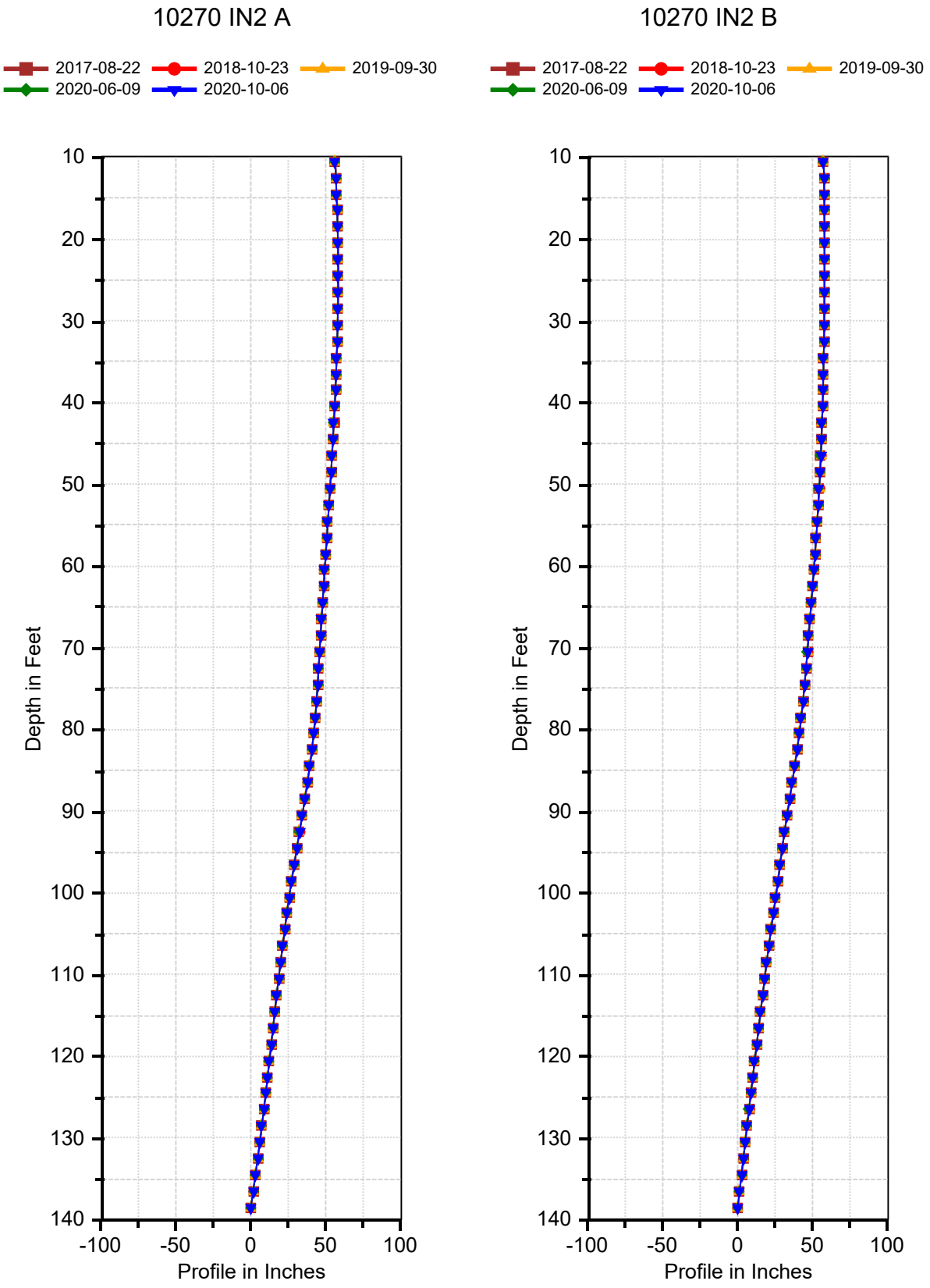
Plot 7

APPENDIX C
INCLINOMETERS PLOTS


10270 IN1 A
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile in Inches
10270 IN1 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile in Inches


10270 IN1 A
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile Change in Inches
10270 IN1 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile Change in Inches


10270 IN1 A
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Tilt Change in Inches
10270 IN1 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Tilt Change in Inches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2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile in Inches
10
20
30
40
50
60
70
80
90
100
110
120
130
140
-100
-50
0
50
100
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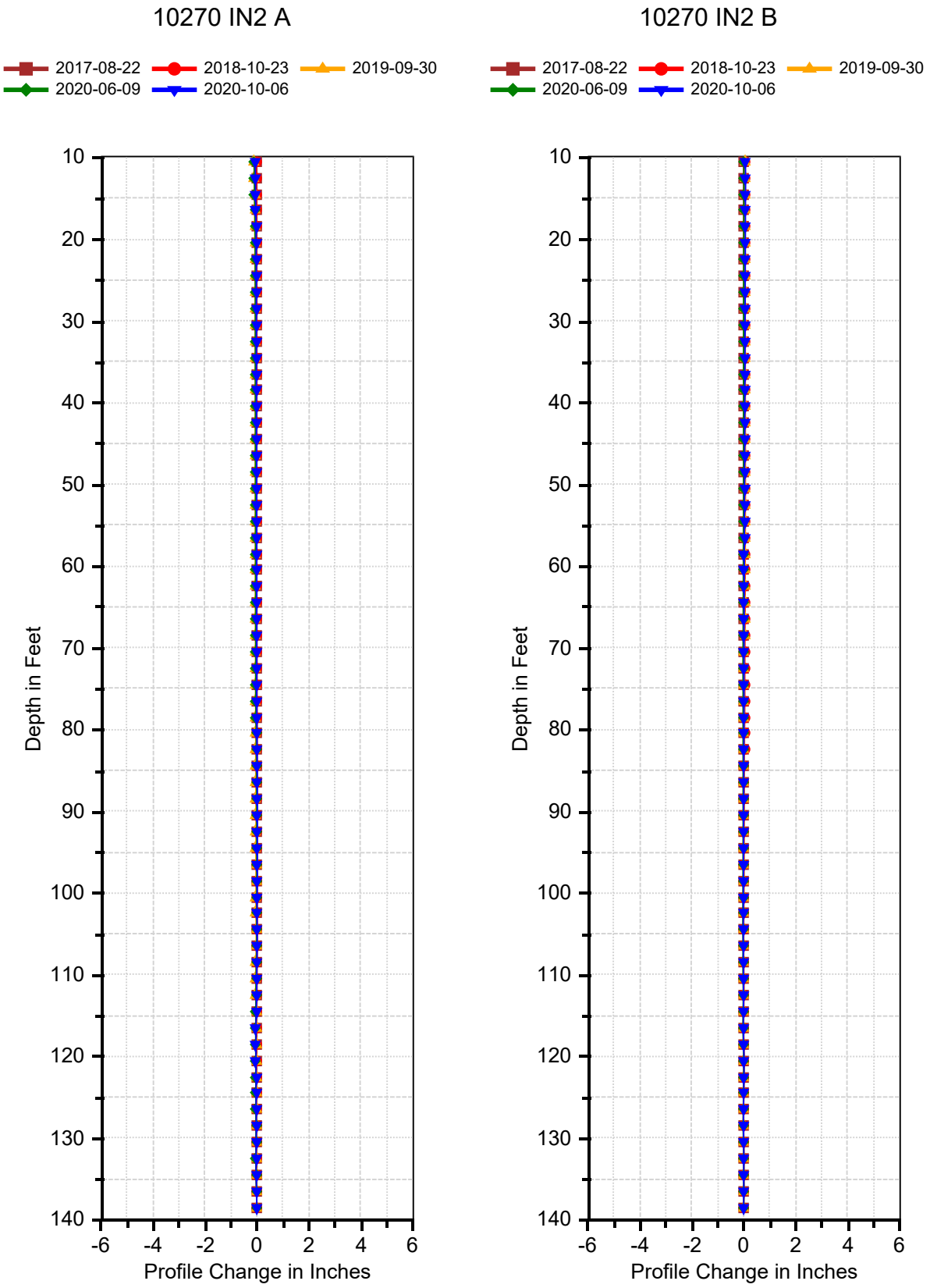
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile in Inches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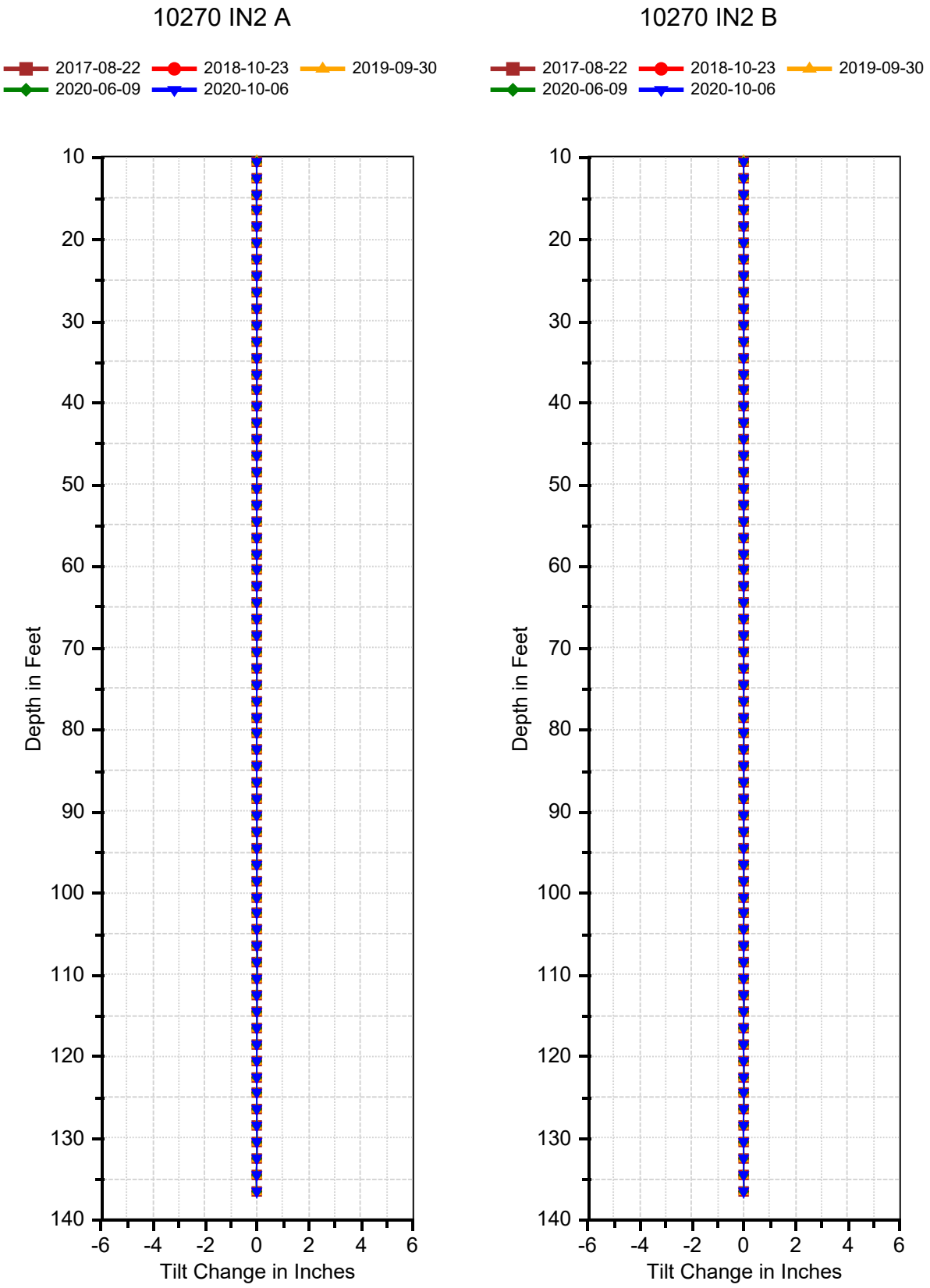
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
10
20
30
40
50
60
70
80
90
100
110
120
130
140
-6
-4
-2
0
2
4
6
Profile Change in Inches
10270 IN2 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile Change in Inches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2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
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70
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90
100
110
120
130
140
-6
-4
-2
0
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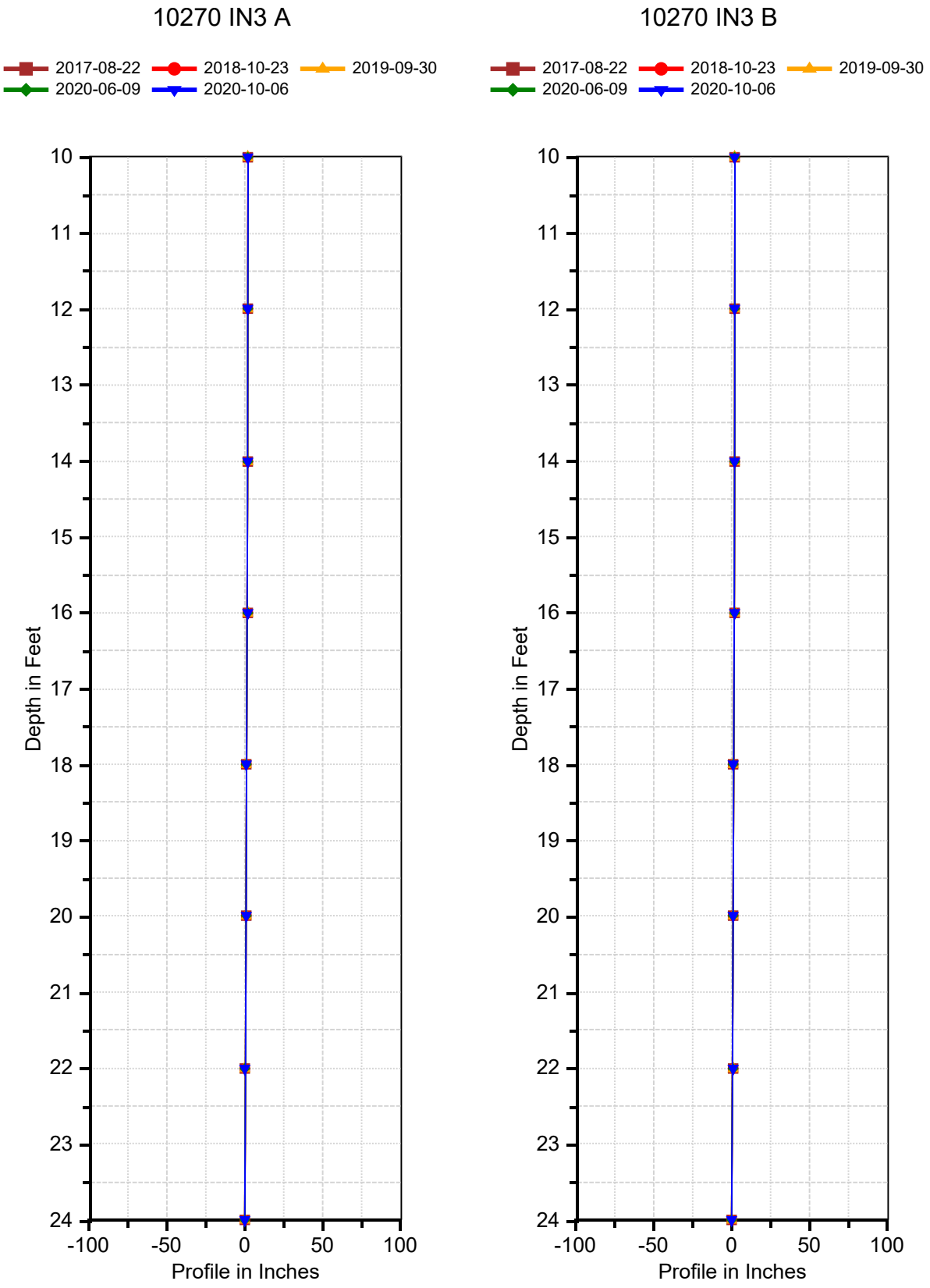
4
6
Tilt Change in Inches
10270 IN2 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Tilt Change in Inches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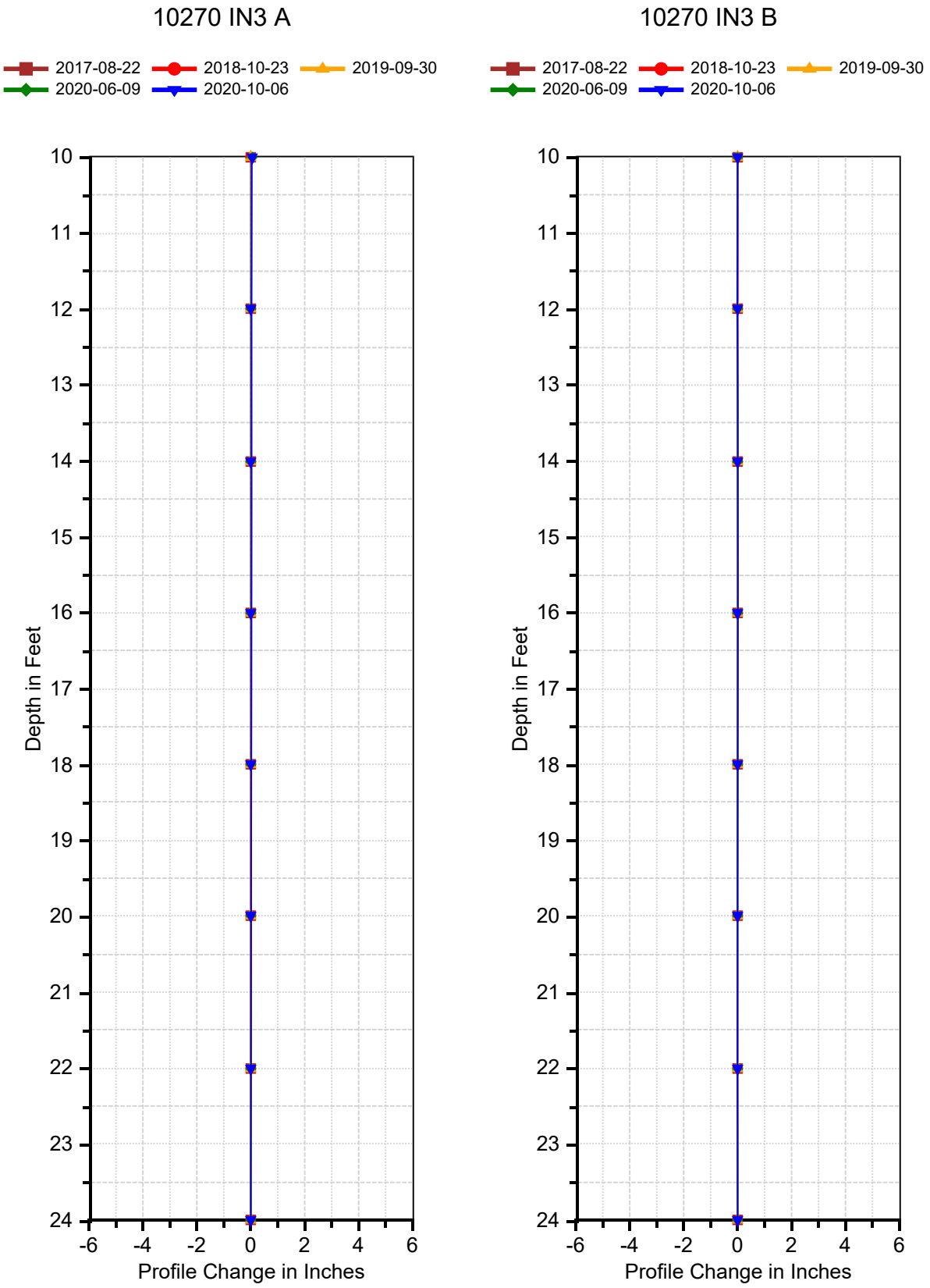
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile in Inches
10270 IN3 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile in Inches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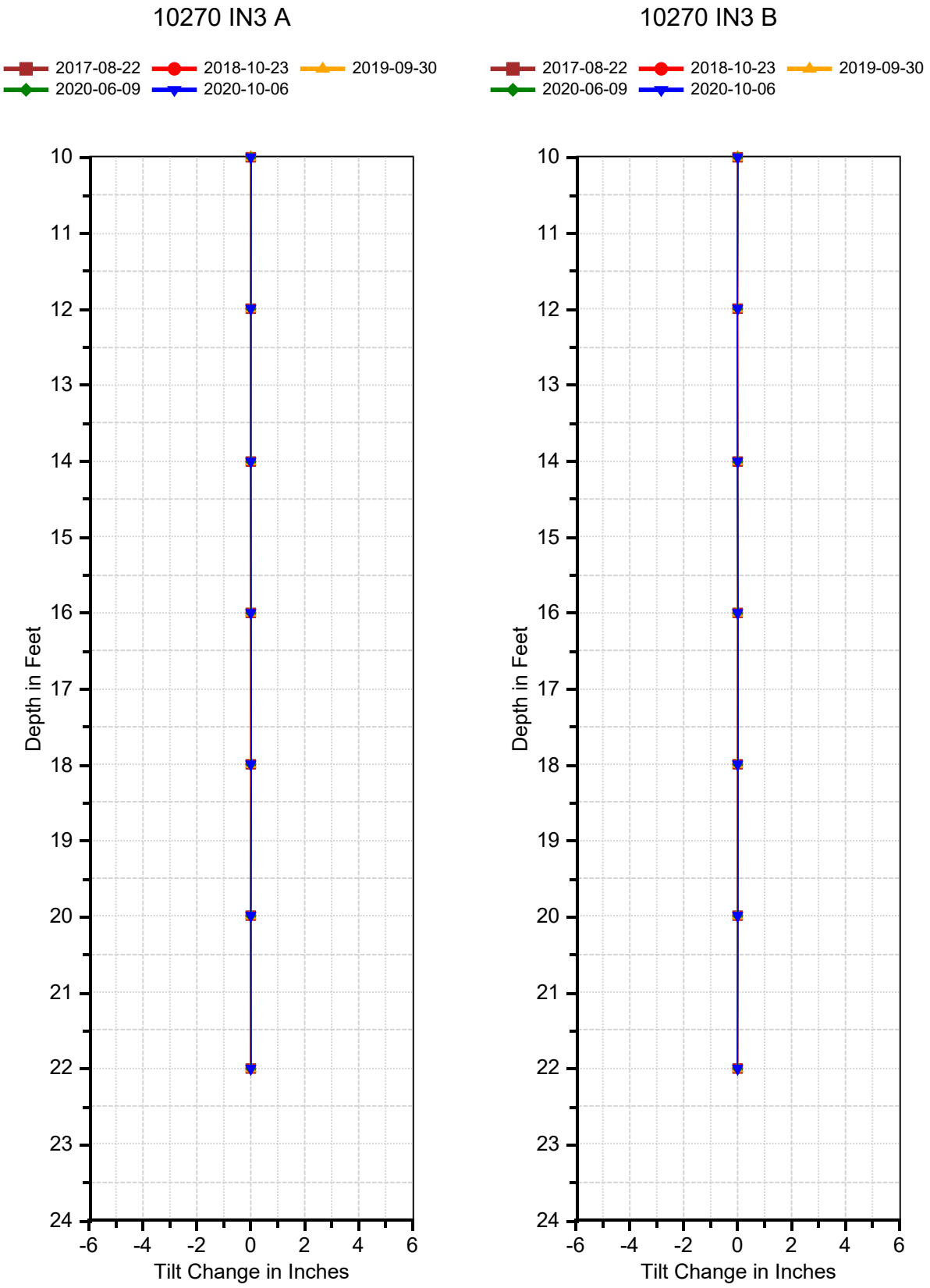
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile Change in Inches
10270 IN3 B
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Profile Change in Inches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2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
-6
-4
-2
0
2
4
6
Tilt Change in Inches
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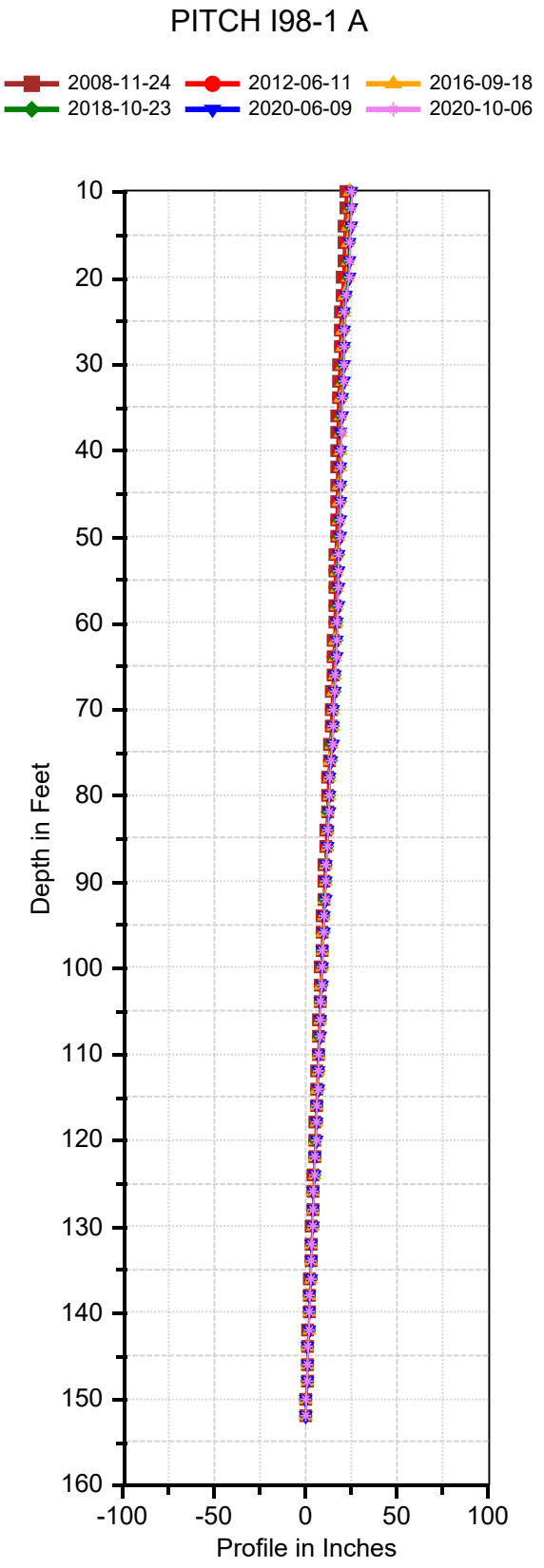
2017-08-22
2018-10-23
2019-09-30
2020-06-09
2020-10-06
Depth in Feet
Tilt Change in Inches


PITCH I98-1 A
2008-11-24
2012-06-11
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
10
20
30
40
50
60
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80
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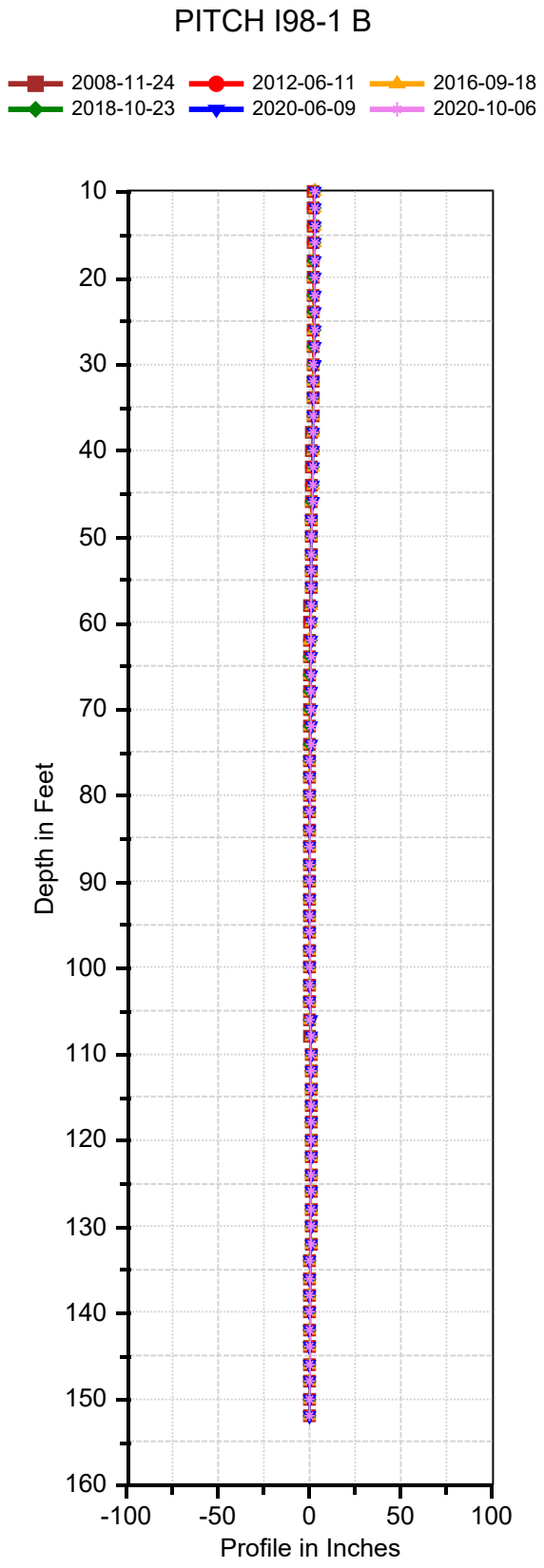
140
150
160
-100
-50
0
50
100
Profile in Inches


PITCH I98-1 B
2008-11-24
2012-06-11
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
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-100
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50
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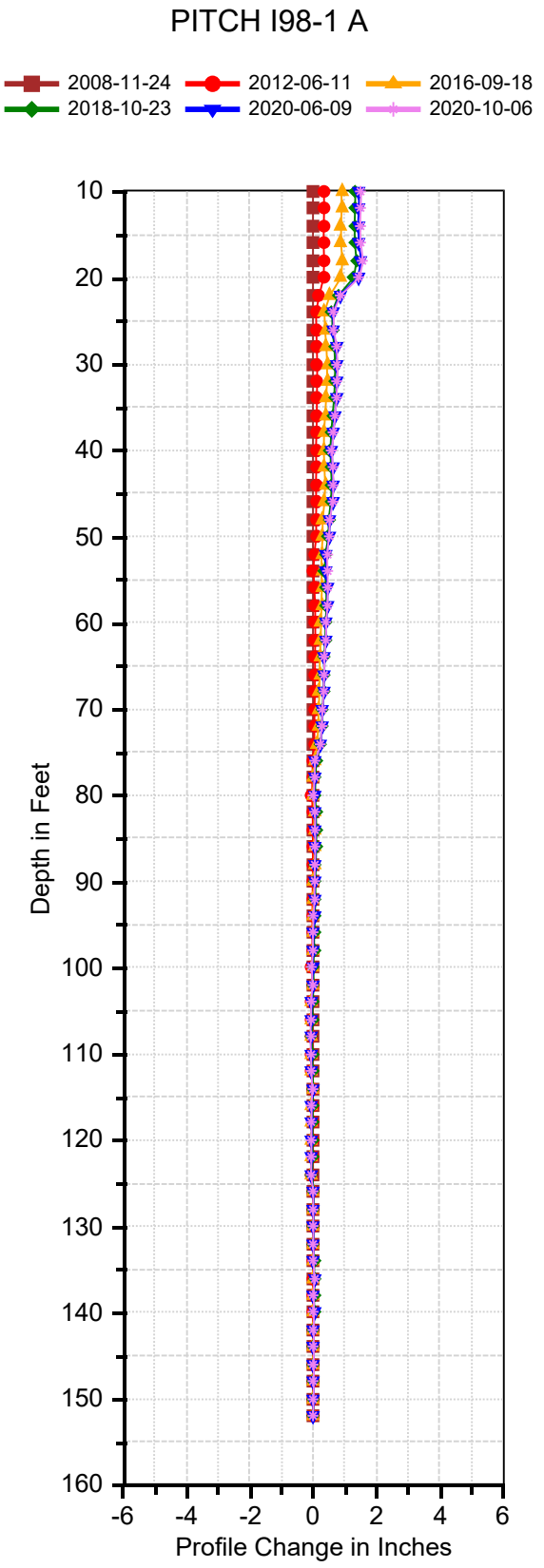
Profile in Inches


PITCH I98-1 A
2008-11-24
2012-06-11
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
10
20
30
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150
160
-6
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-2
0
2
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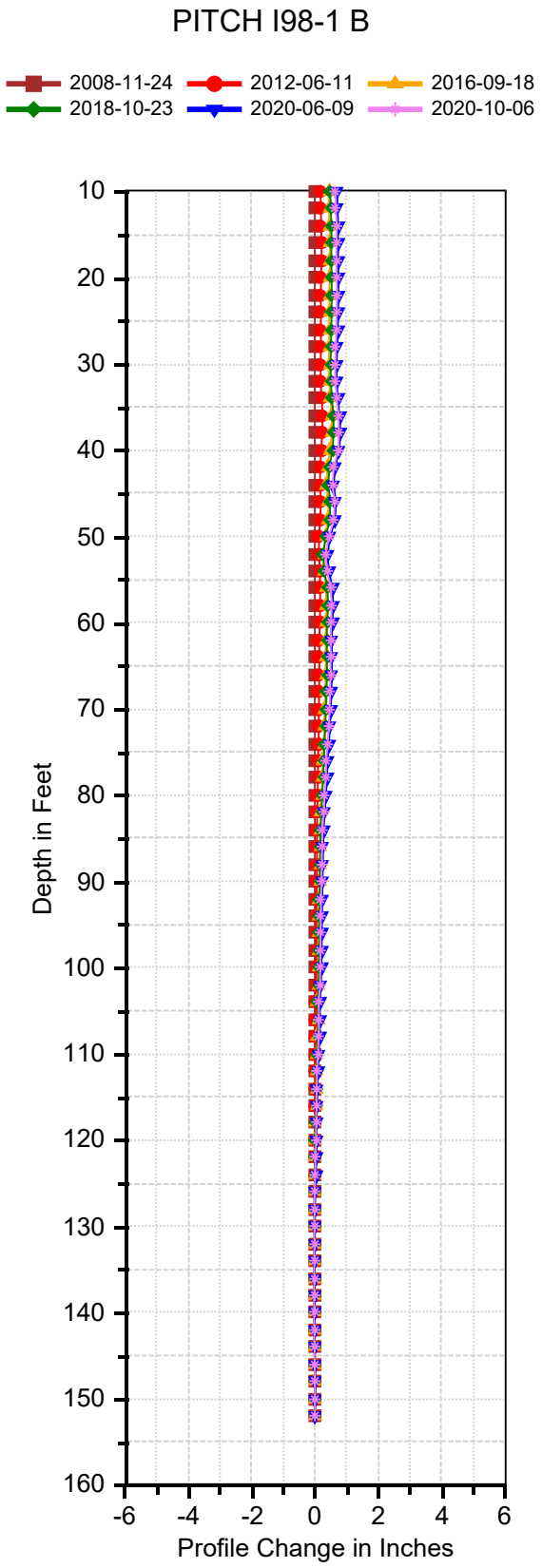
6
Profile Change in Inches


PITCH I98-1 B
2008-11-24
2012-06-11
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
10
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150
160
-6
-4
-2
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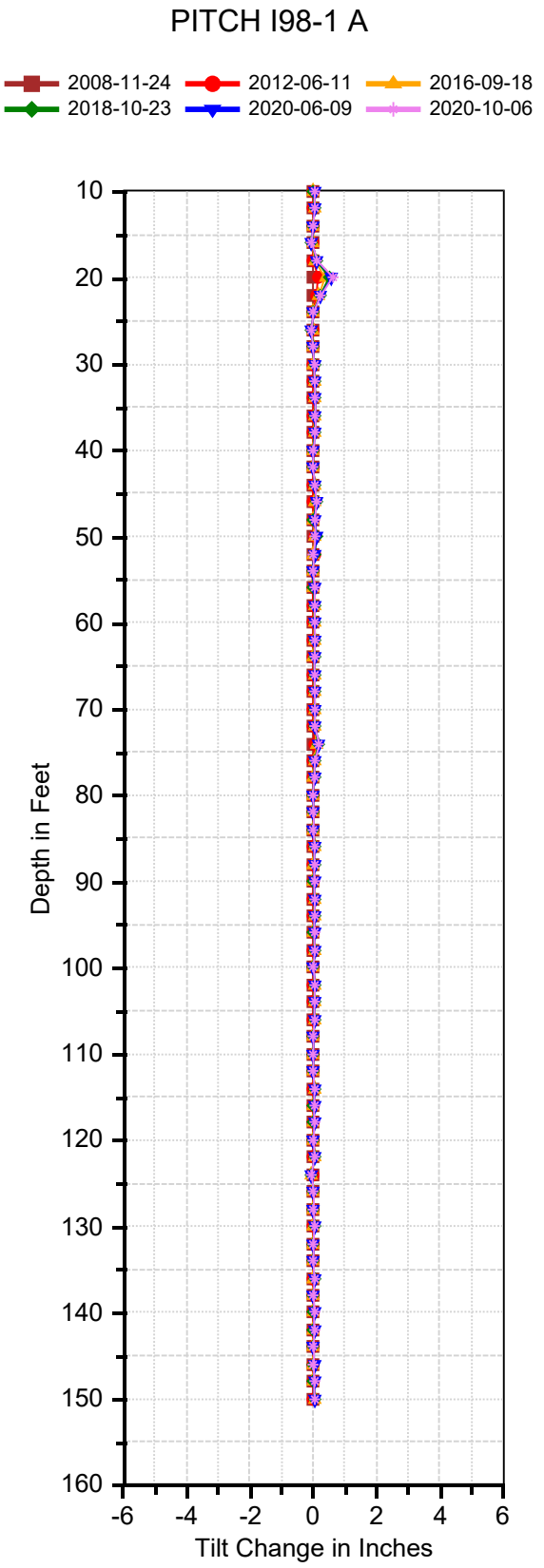
Profile Change in Inches


PITCH I98-1 A
2008-11-24
2012-06-11
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
10
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60
70
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-6
-4
-2
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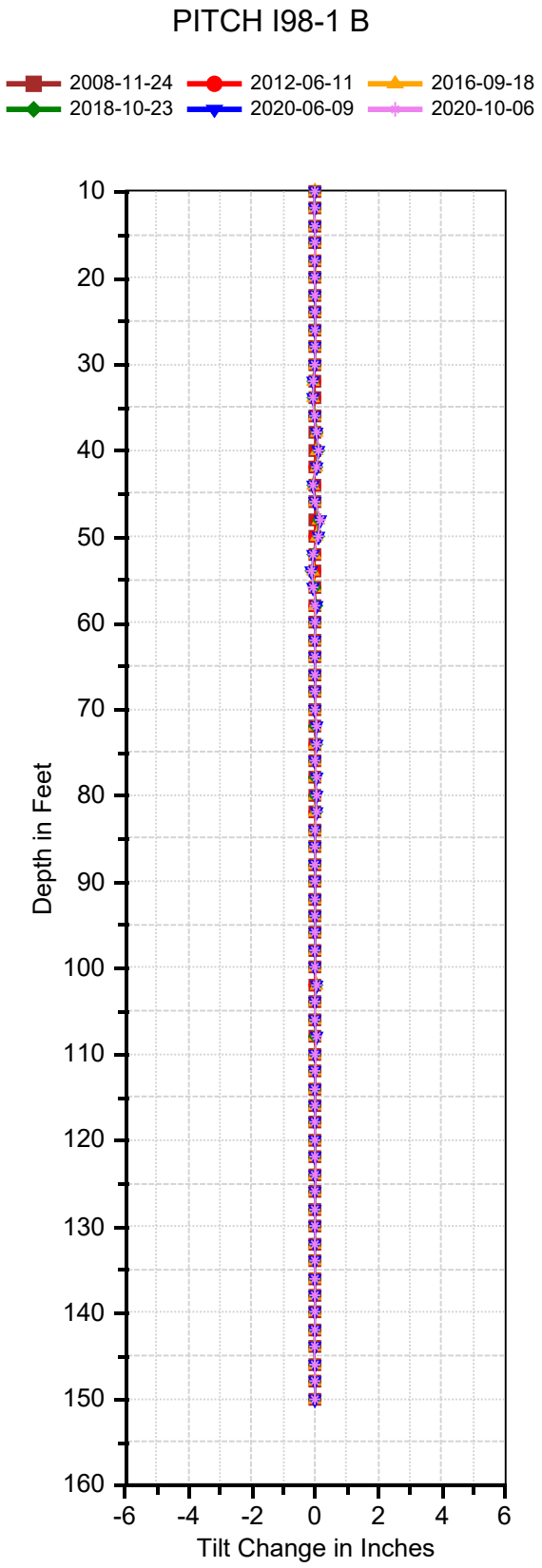
6
Tilt Change in Inches


PITCH I98-1 B
2008-11-24
2012-06-11
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
10
20
30
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-6
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-2
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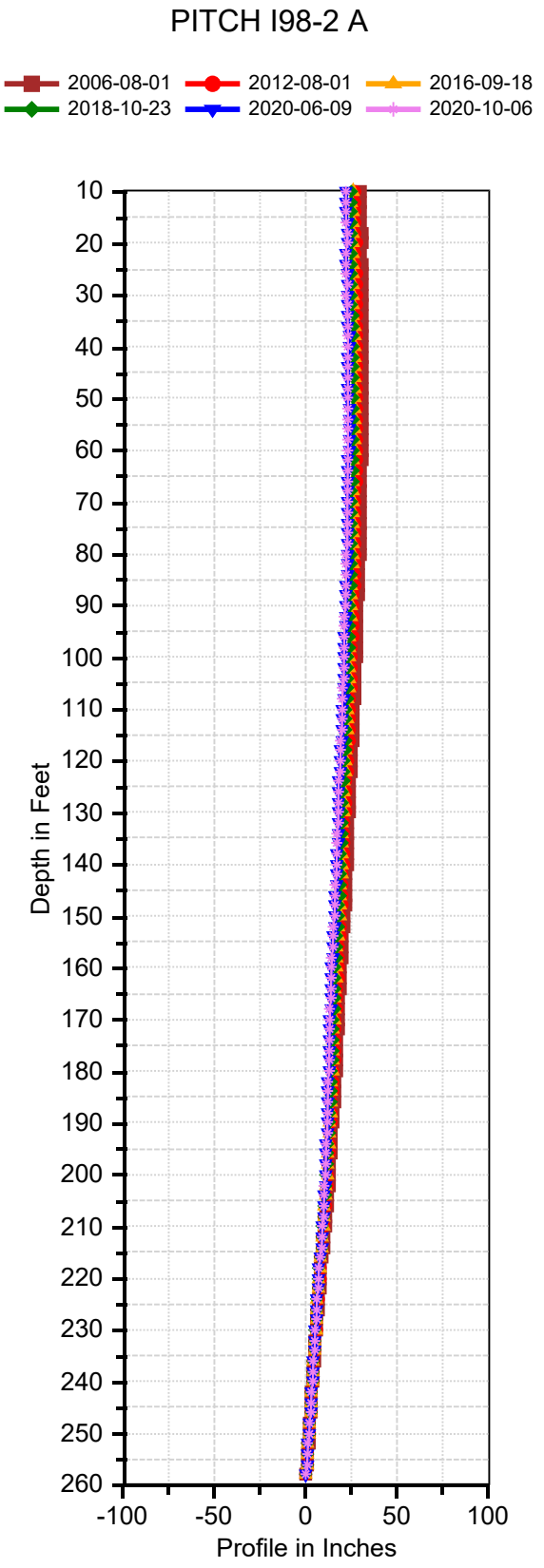
6
Tilt Change in Inches


PITCH I98-2 A
2006-08-01
2012-08-01
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
10
20
30
40
50
60
70
80
90
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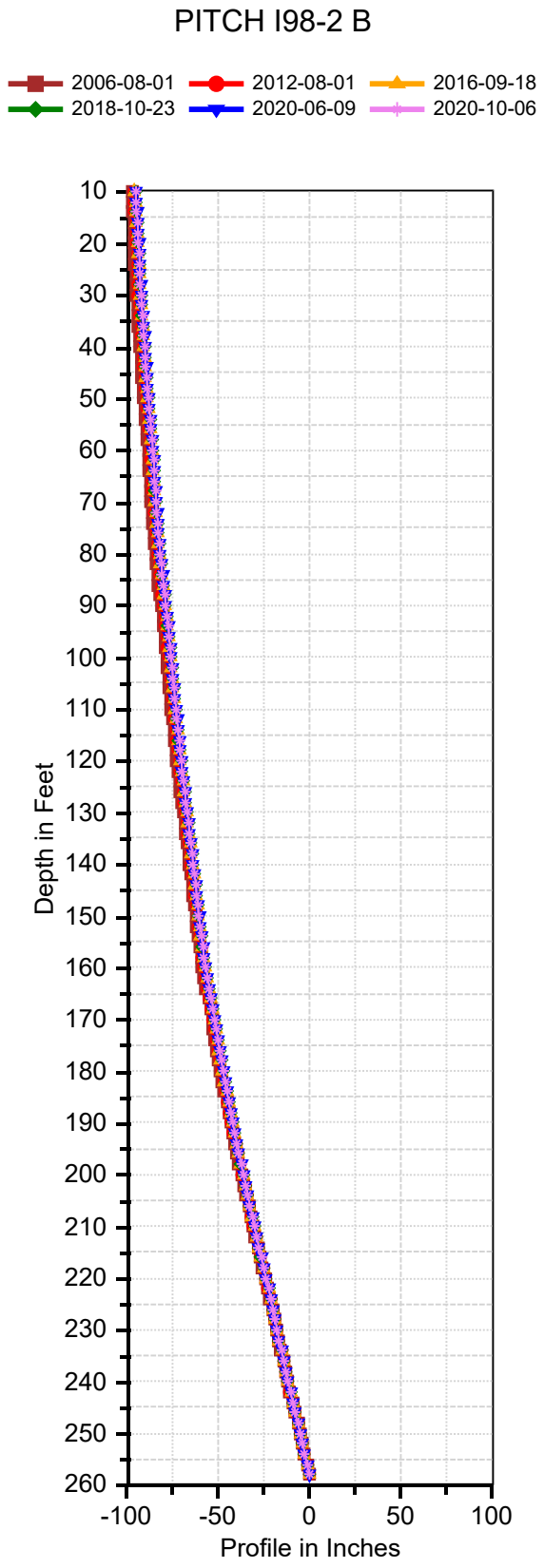
160
170
180
190
200
210
220
230
240
250
260
-100
-50
0
50
100
Profile in Inches


PITCH I98-2 B
2006-08-01
2012-08-01
2016-09-18
2018-10-23
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2020-10-06
Depth in Feet
10
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120
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140
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160
170
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190
200
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230
240
250
260
-100
-50
0
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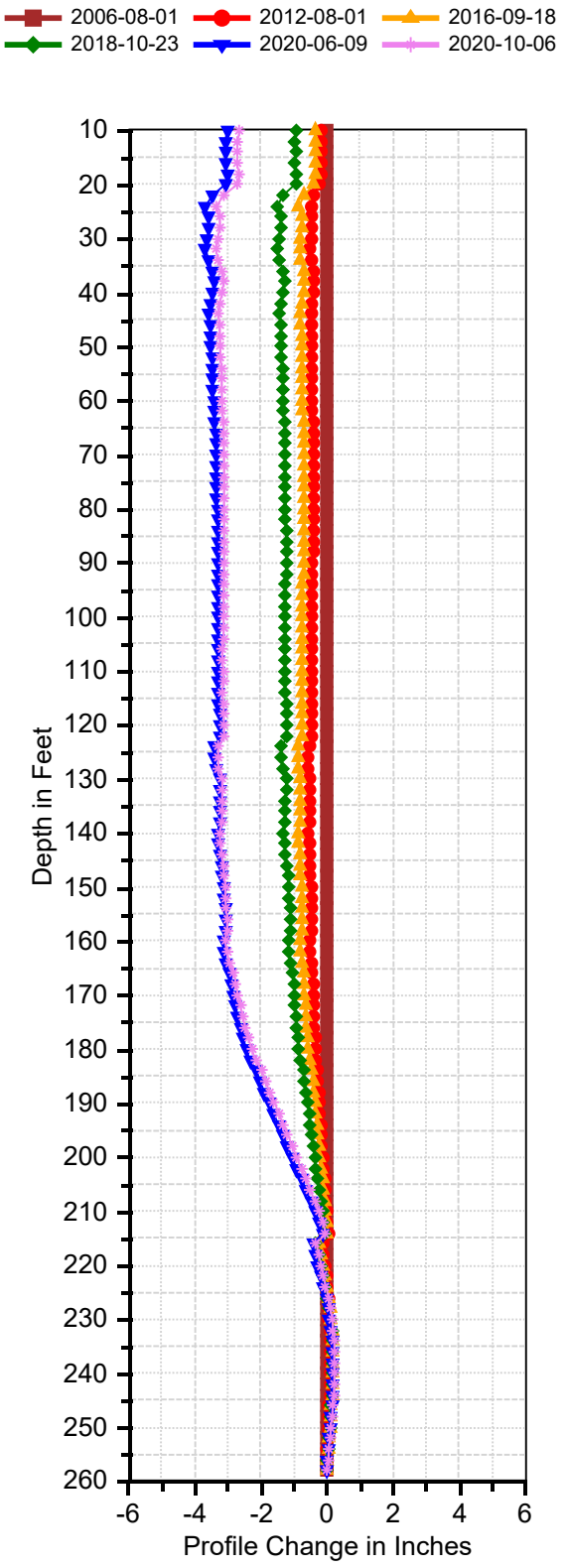
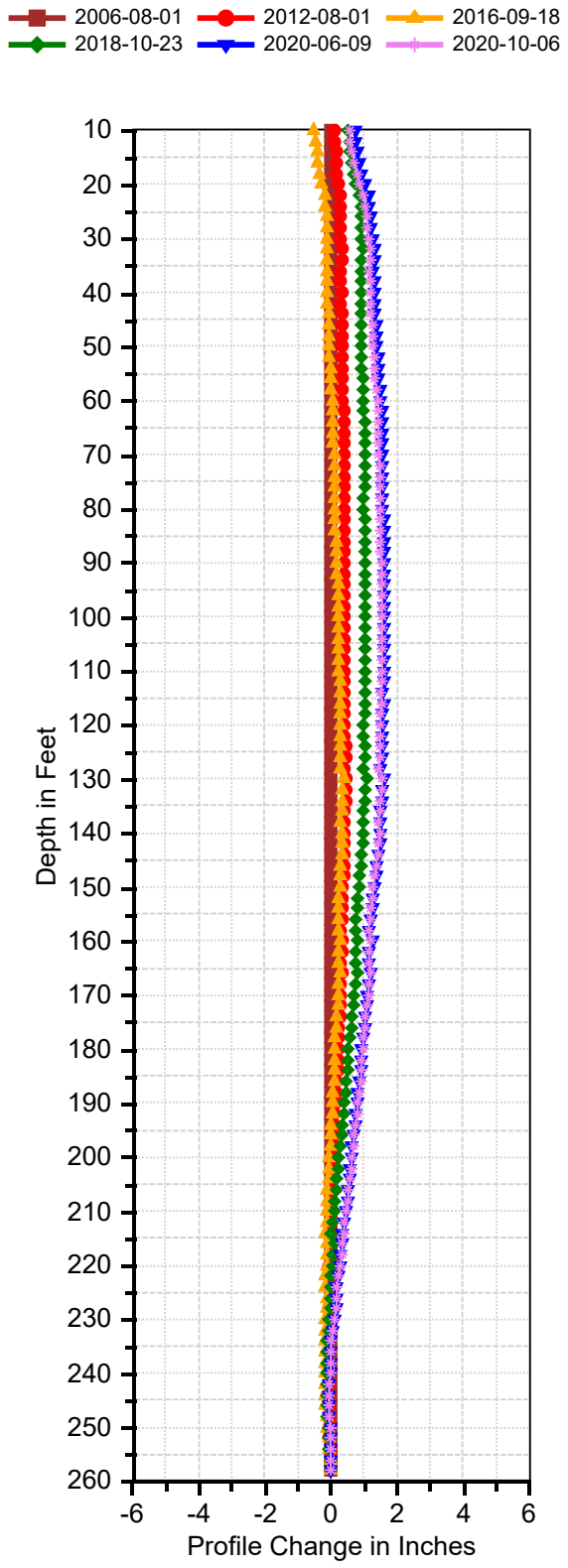
100
Profile in Inches

PITCH I98-2 A



PITCH I98-2 B



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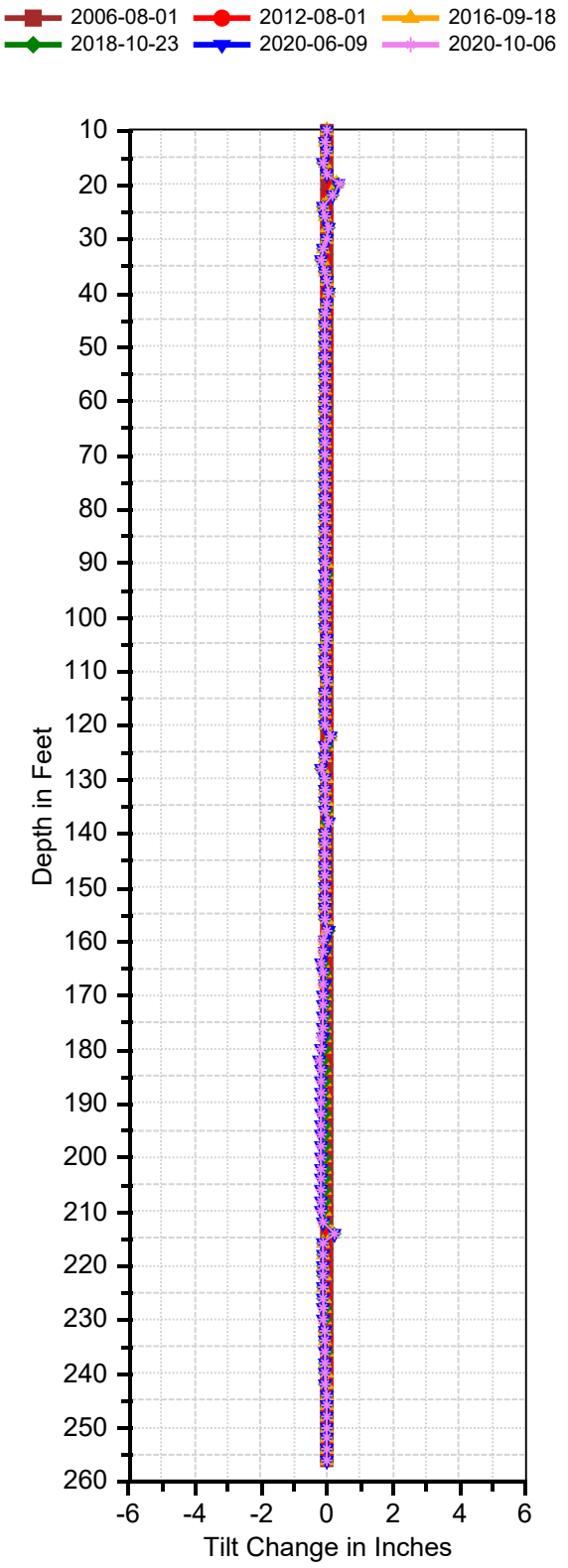
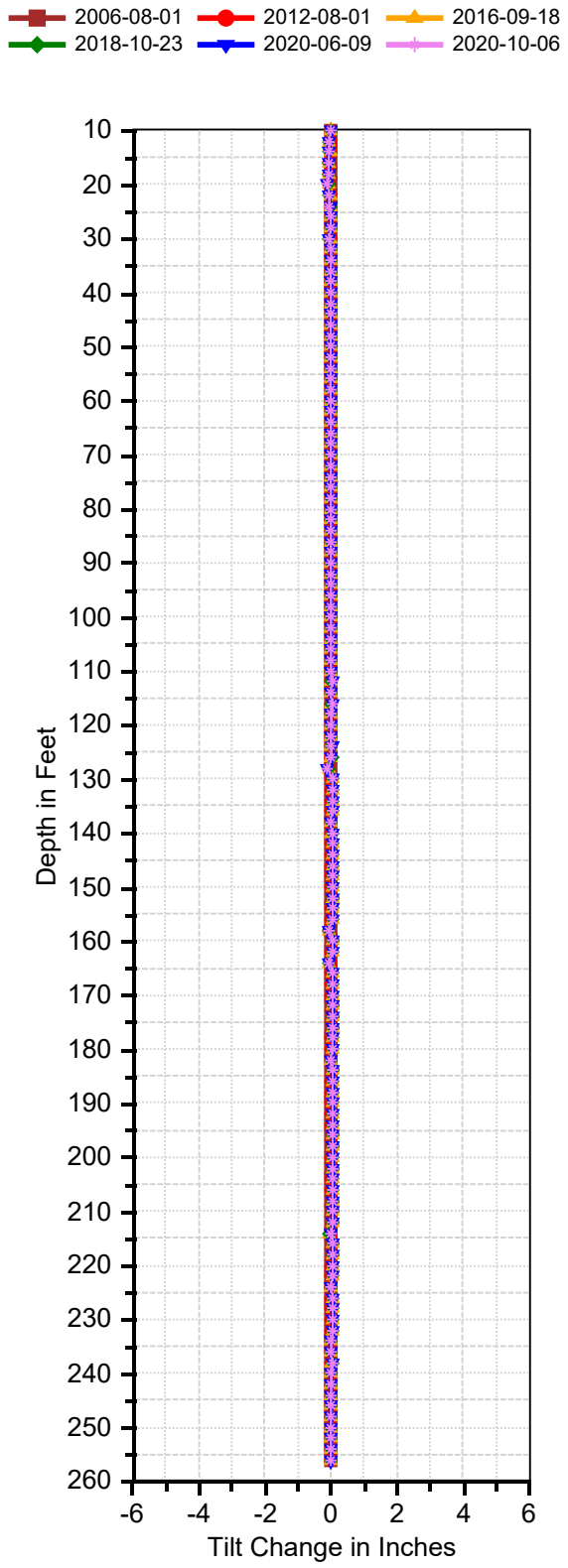
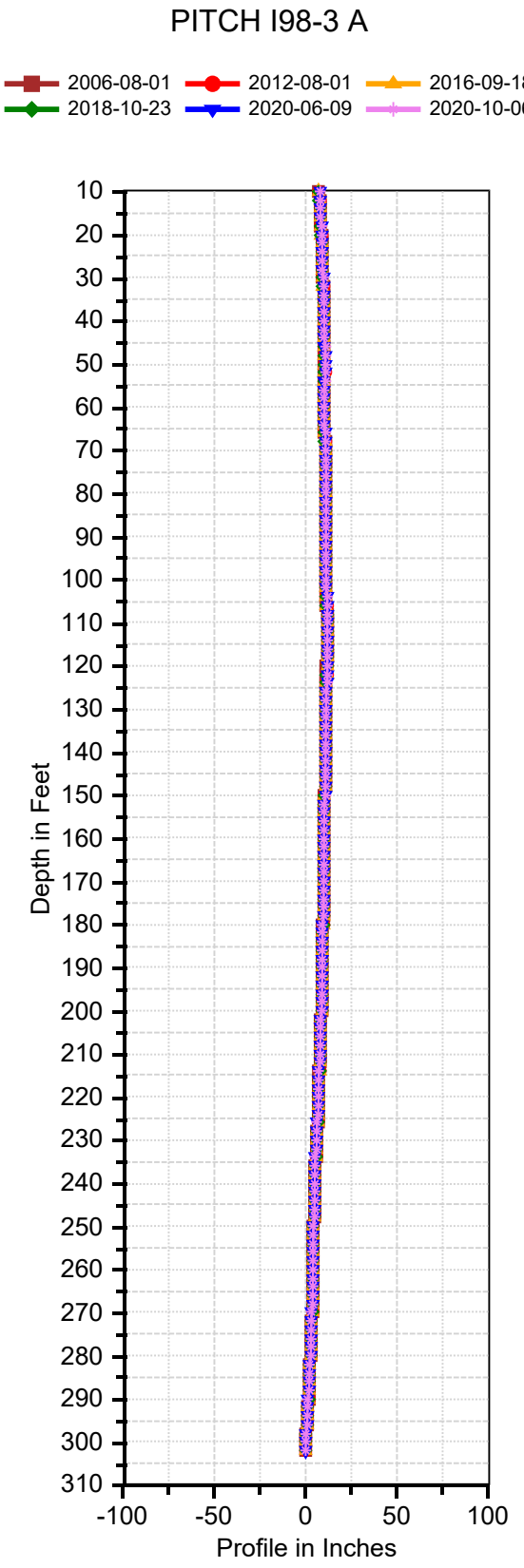


PITCH I98-2 B




PITCH I98-3 A
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2020-06-09
2020-10-06
Depth in Feet
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30
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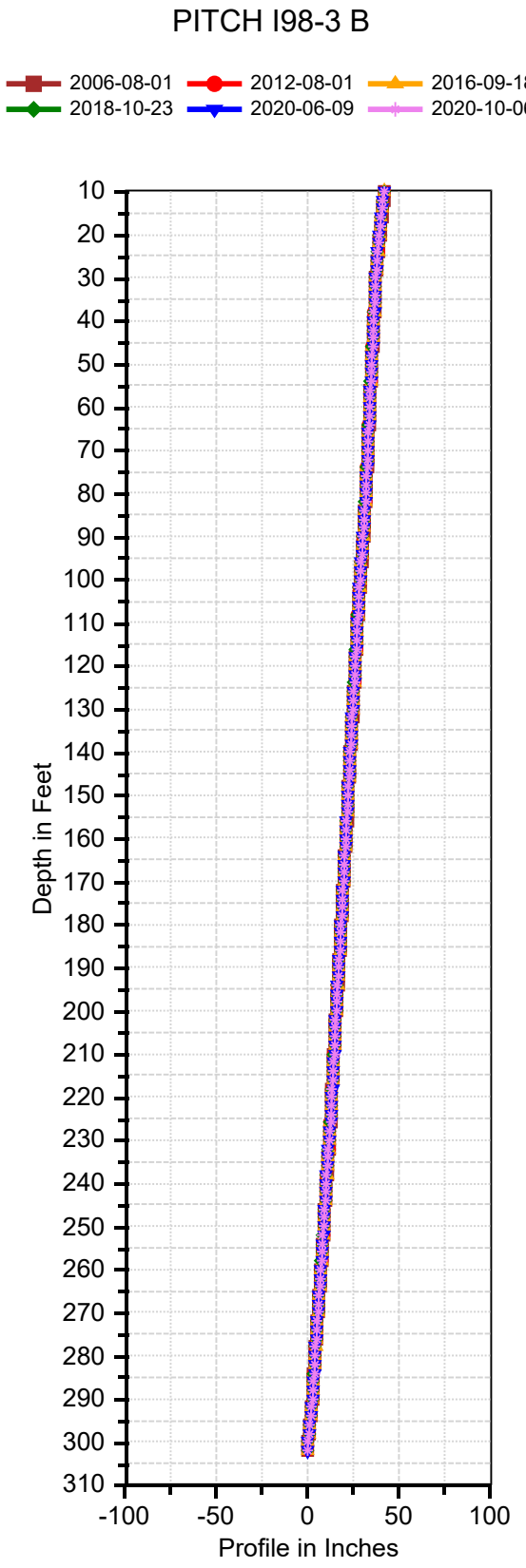
100
Profile in Inches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2020-10-06
Depth in Feet
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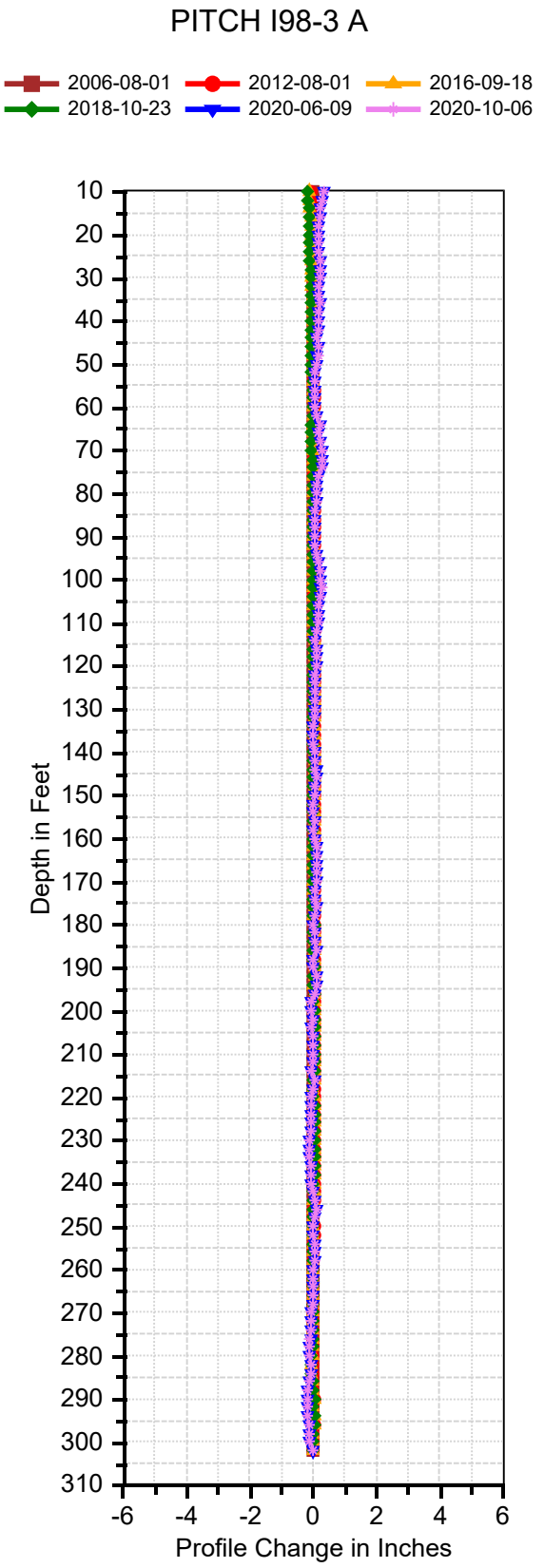
Profile in Inches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2020-10-06
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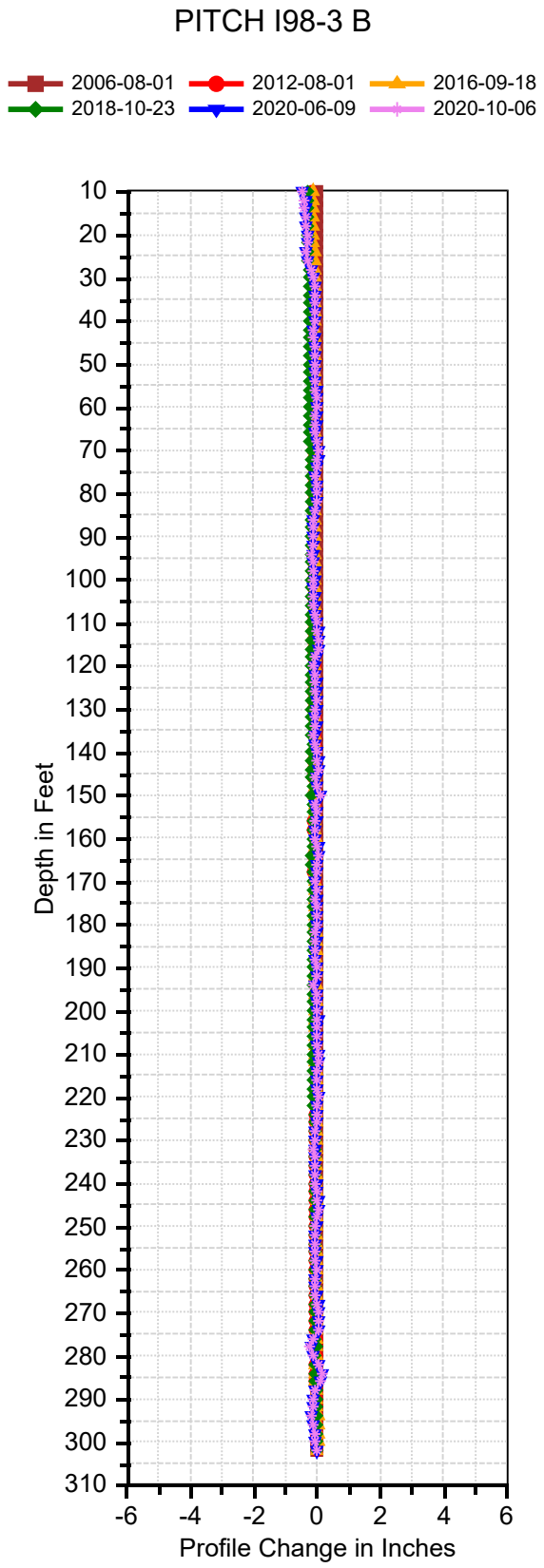
4
6
Profile Change in Inches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2020-10-06
Depth in Feet
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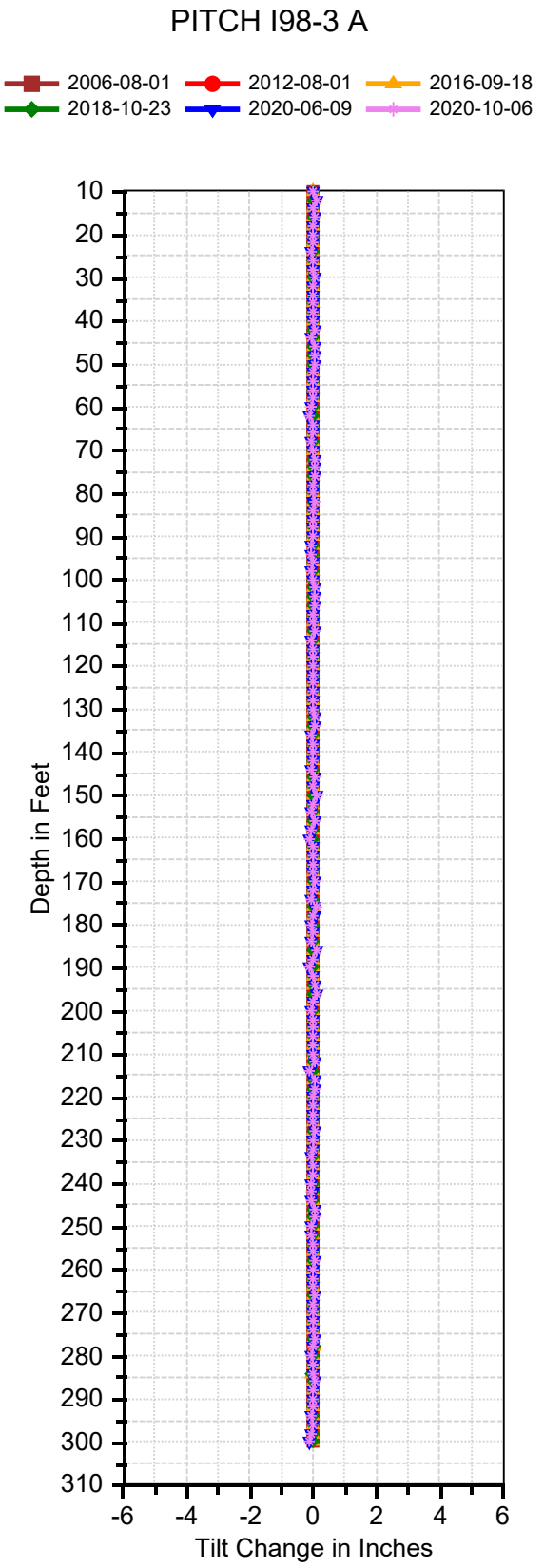
Profile Change in Inches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2018-10-23
2020-06-09
2020-10-06
Depth in Feet
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160
170
180
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210
220
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240
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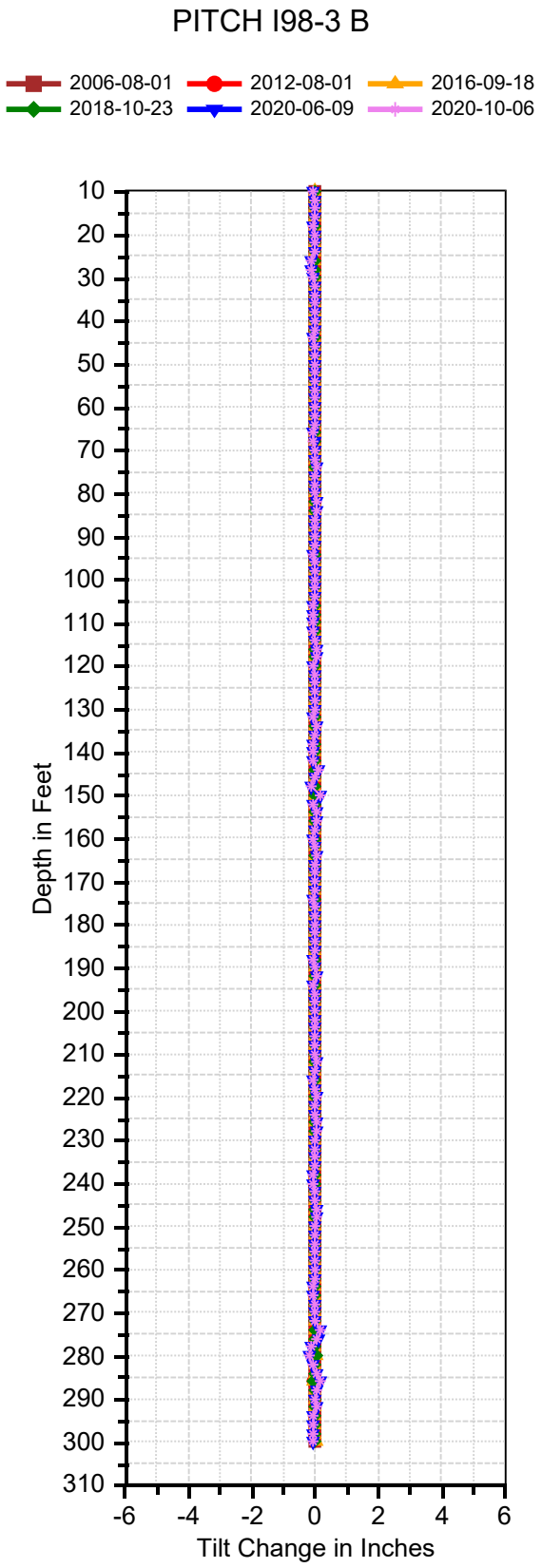
260
270
280
290
300
310
-6
-4
-2
0
2
4
6
Tilt Change in Inches


PITCH I98-3 B
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2012-08-01
2016-09-18
2018-10-23
2020-06-09
2020-10-06
Depth in Feet
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30
40
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180
190
200
210
220
230
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300
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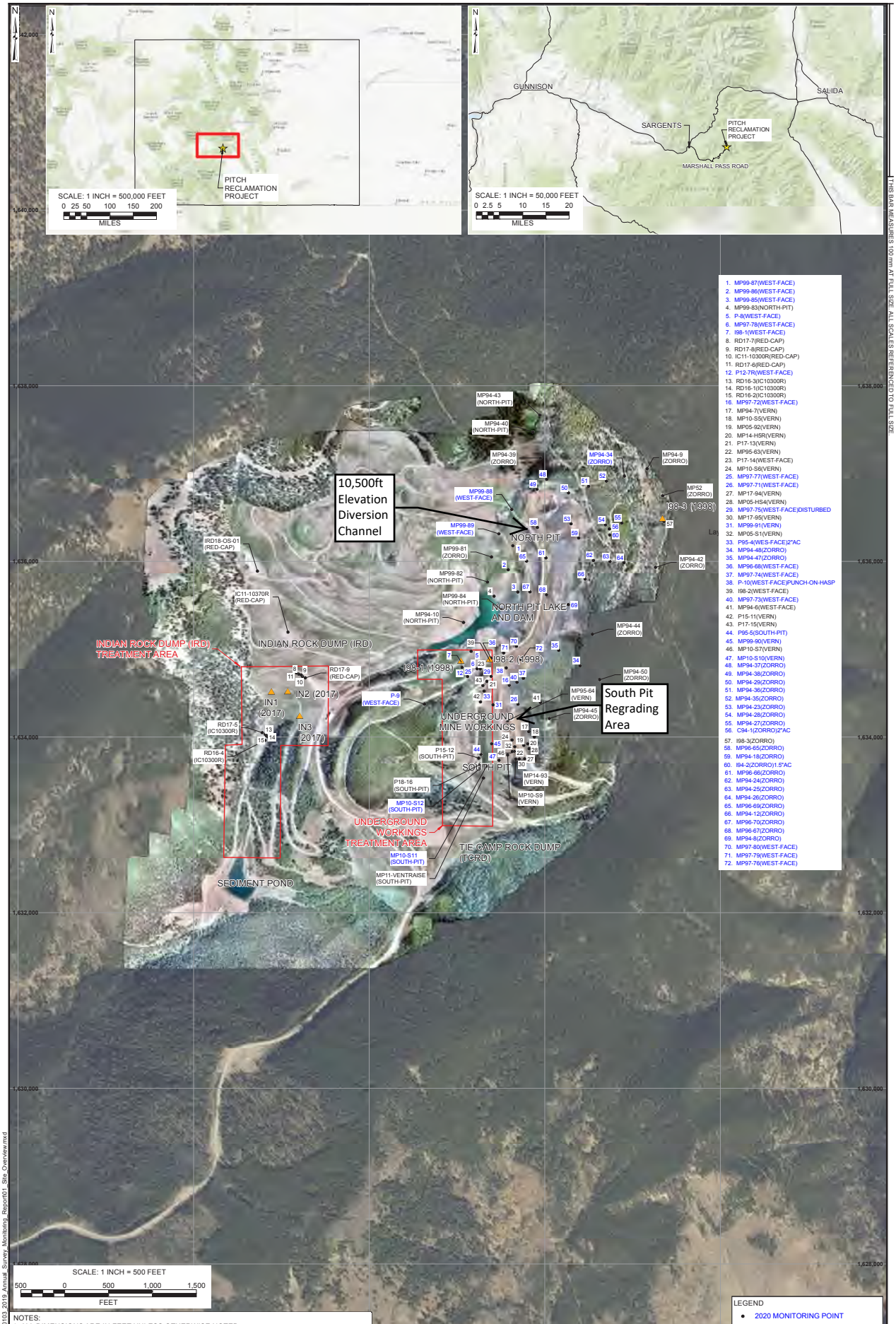
-6
-4
-2
0
2
4
6
Tilt Change in Inches

DRAWINGS



THIS BAR MEASURES 100 mm AT FULL SIZE. ALL SCALES REFERENCED TO FULL SIZE.

NOTES:
1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.
2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "2020 ANNUAL INCLINOMETER AND SURVEY MONITORING REPORT", AND DATED JANUARY 2021.
3. BASE IMAGERY BASED ON DRONE MOSAICKED IMAGERY PROVIDED BY NORTH STAR SURVEYING INC. DATED 2018, AND NAIP IMAGERY PROVIDED BY WORLD IMAGERY FROM ESRI, DATED OCTOBER 13, 2017.
4. PROJECTION IS NAD 1983 STATEPLANE COLORADO SOUTH FIPS 0503 FEET. VERTICAL DATUM IS NAVD88 (GEOID12B).
5. UNLESS BGC AGREES OTHERWISE IN WRITING, THIS DRAWING SHALL NOT BE MODIFIED OR USED FOR ANY PURPOSE OTHER THAN THE PURPOSE FOR WHICH BGC GENERATED IT. BGC SHALL HAVE NO LIABILITY FOR ANY DAMAGES OR LOSS ARISING IN ANY WAY FROM ANY USE OR MODIFICATION OF THIS DOCUMENT NOT AUTHORIZED BY BGC. ANY USE OF OR RELIANCE UPON THIS DOCUMENT OR ITS CONTENT BY THIRD PARTIES SHALL BE AT SUCH THIRD PARTIES' SOLE RISK.

SCALE:	1 "=500 '
DATE:	JAN 2021
DRAWN:	AG
CHECKED:	EJF
APPROVED:	MH

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: HOMESTAKE MINING COMPANY

PROJECT: 2020 ANNUAL INCLINOMETER AND SURVEY MONITORING REPORT

TITLE: SITE OVERVIEW

PROJECT No.: 0011284-01

DWG No.: 01

X:\Projects\0011\GIS_Pitch\Production\20200103_2019 Annual_Survey_Monitoring_Report\01_Site_Overview.mxd

APPENDIX C

2020 Approved Chemical Approval

COLORADO
Department of Public Health & Environment

Patrick Malone, President
Homestake Mining Company
2270 Corporate Cir, Ste 100
Henderson, NV 89074
pmalone@Barrick.com

Dave Wykoff, Supervisor
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Pitch Reclamation Project
PO Box 40
Sargents, CO 81248
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MEMORANDUM

TO: Pitch Reclamation Project, Homestake Mining Company

FROM: Kathy Rosow, Permit Writer 303-692-3521

DATE: 5/28/2020

RE: **Chemical Evaluation – 2020 Field Season**
Pitch Reclamation Project
Permit No: CO0022756

A. SCOPE OF CHEMICAL EVALUATION/SUMMARY

Homestake Mining Company (Homestake) is developing and implementing a field program to reduce uranium loading from the Pitch Reclamation Project to the discharge point for CDPS permit C00022756, and to establish the Lowest Practical Level (LPL) for uranium. The program includes chemical treatment to achieve these goals. To that end, Homestake submitted a chemical evaluation request to the Water Quality Control Division on February 18, 2020 and supplemental information on May 5 and 18, 2020 (collectively, the 'request'), for the chemicals proposed for use at the Pitch Reclamation Project in the 2020 field season.

In this request, Homestake proposed to use the chemicals identified in Table 1 (below) in the 2020 field program, which builds on previous field programs (2015 through 2019). Homestake proposed two new chemicals for use in 2020 field program, as identified in the table. With the exception of the two new chemicals, Homestake does not propose to increase the quantities for any of these chemicals for the 2020 season above what was requested and evaluated by the division in 2019. However, due to the nature of the site, and the yearly change in chemicals and/or chemical concentrations, chemical evaluations for this site are conducted holistically, and for an entire field season. Note that in 2019, Homestake provided additional information for the cationic water soluble polymer MM-2480 to indicate that the compound does not contain any metals.

The division's evaluation of the request involved determining whether the proposed chemicals may be used as described for the 2020 field season without a modification of CDPS permit CO0022756; the permit is currently administratively extended, which means that the permit effective on 1/1/2010 continues in force to the effective date of the new permit.

Consistent with the administratively extended permit, the authorized discharge point for the Pitch Reclamation Project is 'Outfall 001A, following disinfection and prior to mixing with the receiving stream' (i.e., Indian Creek). Outfall 001A is the only discharge point to surface water authorized in the administratively extended permit; discharges to Indian Creek other than from Outfall 001A are not authorized in CDPS permit CO0022756.

The division evaluated the proposed chemical constituents relative to their calculated and/or measured concentrations at Outfall 001A.

Further, as provided in the memorandum forwarded to Homestake for the 2019 field season (dated June 17, 2019), the division does not have jurisdiction over discharges to groundwater. The implementing agency for discharges to groundwater at mines is the Division of Reclamation Mining and Safety. In a similar way, the division is not the implementing agency for injection wells regulated under the Underground Injection Control (UIC) Program (U.S. Environmental Protection Agency (EPA) Region 8 authority). Therefore, the division did not consider the chemicals **Mudnox, Hydrochloric acid, and Calcium hydroxide/slaked lime** as part of the injection well rehabilitation in the 2020 chemical evaluation. Note that **Hydrochloric acid, and Calcium hydroxide/slaked lime** are used in other applications at the facility, and so this chemical evaluation does evaluate them in that context.

Proposed 2020 activities include expanded field demonstration-scale testing to advance uranium load reduction alternatives, as follows:

- Phosphate Injection Remedy Testing (underground mine workings and in the Indian Rock Dump) – used to reduce uranium load reductions in downgradient surface water.
- Tracers for subsurface injection – used with phosphate injections to document subsurface water flow and behavior of injected solutes (underground mine workings, the Indian Rock Dump, and Engineered Treatment Cells).
- Oxygen Scavenger for Underground Workings Source Water – used to consume anticipated dissolved oxygen in new source water (i.e., North Pit Lake water) for injections prior to dosing and reinjection.
- Injection Well Rehabilitation – **Not considered in 2020 chemical evaluation** (see discussion above).
- Engineered Treatment Cell Testing – intercepts surface water from the Chester Fault Seep to remove uranium.
- Treatment Residuals Management Program – a control measure for use in removing residual dissolved phosphate (using iron and/or aluminum reagents), if surface water concentrations approach compliance limits. This management program has not been used since inception.

Table 1 – Proposed chemicals.

	Chemical Name	Purpose
1	Sodium monobasic phosphate	Phosphate injection program to precipitate aqueous uranium for source control in the underground mine workings and in the Indian Rock Dump
2	Phosphoric acid	
3	Fluorescein	Tracer for subsurface injection - underground mine workings
4	Eosine	
5	Rhodamine WT	
6	Potassium chloride	Tracer for subsurface injection – single well testing
7	Iron (ferric) chloride	Treatment Residuals Management Program - reaction with phosphate to limit soluble concentrations
8	Sodium aluminate	
9	Cationic water soluble polymer (MM-2480)	Treatment Residuals Management Program - flocculent to remove iron and aluminum precipitates
10	Sodium carbonate	Treatment Residuals Management Program - pH buffer for use with iron chloride
11	Sodium bicarbonate	
12	Calcium hydroxide (fine, slaked)	Treatment Residuals Management Program - reaction with phosphate to limit soluble concentrations; reduce bicarbonate alkalinity
13	Hydrochloric acid, 32%	Engineered Treatment Cell (Drum/field scale) – passive flow-through treatment of aqueous uranium - Chester Fault Spring water
14	*	*
15	Sodium lactate	Engineered Treatment Cell (Drum/field scale) – passive flow-through treatment of aqueous uranium - Chester Fault Spring water
16	Lactic acid	
17	Diammonium phosphate	
18	Iron additive (Yellow iron oxide)	

19	Sodium Sulfite	Oxygen Scavenger for Underground Workings Source Water
20	Potassium Sulfite	
21	Natural organic carbon sources (alfalfa hay, mulch, compost/manure, and wood chips/sawdust)	Engineered Treatment Cell (Drum/field scale) – passive flow-through treatment of aqueous uranium - Chester Fault Spring water

* Mudnox was not evaluated for in 2020 field program – see discussion regarding discharges to groundwater/UICs in Section A.

B. DIVISION ANALYSIS

1. Summary and performance

In July 2015 and annually thereafter, the division evaluated and approved chemicals proposed for use at the Pitch Reclamation Project to: 1) reduce uranium loading to surface water from the facility, and 2) establish the LPL for uranium (in work coordinated with the Standards Unit at the division). Homestake indicates that the pilot and field testing to date were effective in demonstrating uranium removal within and immediately downgradient of injection zones.

Homestake documented that during and following the field testing programs, compliance with the CDPS permit effluent limitations was maintained at SW-33 (Outfall 001), which the division verified through a review of DMR data. In addition, analytical results for the sampling associated with the 2015 – 2019 chemical evaluations indicates that the concentrations of the various parameters did not exceed the associated standards/WQBEL at Outfall 001A, as summarized in Table 2.

Table 2 - Summary analytical results – 2015 through 2019 field seasons.

Parameter	Year sampling initiated	Required sampling frequency	Maximum value at Outfall 001A: 2019 field season	Standard/WQBEL	Sample results range: 2015-2019 field programs
Phosphorus	2015	Weekly	0.024 mg/l	0.11 mg/l	<0.005 - 0.071 mg/l
Iron	2016	Weekly	770 ug/l	1000 ug/l	20 – 770 ug/l
Aluminum	2017	Weekly	120 ug/l	1438 ug/l	7 – 120 ug/l
EC	2017	Quarterly	1.21 dS/m	2.9 dS/m	0.804 – 1.3 dS/m
SAR	2017	Quarterly	<0.1	The lesser of 9, or calculated limit	<0.1
Chloride	2019	2x per month	1 mg/l	250 mg/l	<1 – 1 mg/l
Ammonia	2019	2x per month	<0.05 mg/l	Estimated at 0.35 mg/l	<0.05 mg/l

2. Pollutants of concern

The division reviewed the MSDS documents associated with the proposed chemical additives listed in Table 1, and determined the potential pollutants of concern for each chemical (see Table 3).

Table 3 - Pollutants of Concern per Chemical.

Chemical Name		Pollutants of Concern
1	Sodium monobasic phosphate	Phosphate (phosphorus), EC/SAR, TDS
2	Phosphoric acid	Phosphate (phosphorus), pH, TDS
3	Fluorescein	pH, EC/SAR, Aquatic Toxicity, TDS
4	Eosine	pH, EC/SAR, Aquatic Toxicity, TDS
5	Rhodamine WT	pH, EC/SAR, Aquatic Toxicity, TDS
6	Potassium chloride	EC/SAR, Chloride, TDS

	Chemical Name	Pollutants of Concern
7	Iron (ferric) chloride	Iron, Chloride, EC/SAR, TDS
8	Sodium aluminate	pH, EC/SAR, Aluminum, TDS
9	MM-2480 Polymer	pH, Aquatic Toxicity
10	Sodium carbonate	pH, EC/SAR, TDS
11	Sodium bicarbonate	pH, EC/SAR, TDS
12	Calcium hydroxide (fine, slaked)	pH, EC/SAR, TDS
13	Hydrochloric acid, 32%	pH, Chloride
14	*	*
15	Sodium lactate	pH, EC/SAR, TDS
16	Lactic acid	pH, TDS
17	Diammonium phosphate	Ammonia, Phosphate
18	Iron additive (Yellow iron oxide)	Iron, nickel, cadmium, mercury, lead, and arsenic
19	Sodium sulfite	Sulfate, EC/SAR, TDS, dissolved oxygen
20	Potassium sulfite	Sulfate, EC/SAR, TDS, dissolved oxygen
21	Natural organic carbon sources (alfalfa hay, mulch, compost/manure, and wood chips/sawdust)	BOD_5

* Mudnox was not evaluated for in 2020 field program – see discussion regarding discharges to groundwater/UICs in Section A.

3. Parameter Evaluation

The division evaluated each identified pollutant of concern, as follows:

Phosphorus – Consistent with the 2017 -2019 chemical approvals, Homestake plans to inject a maximum phosphate mass of 13,000 kg as PO_4 (4,240 kg as P) in 2020 (including contributions from diammonium phosphate), which yields a maximum calculated phosphorus concentration of 7.7 mg/l at Outfall 001A without implementing the control measures discussed below to maintain total phosphorus concentrations at SW-33 below 0.11 mg/l. The actual amount of phosphate reagent injected in 2019 was approximately 2650 kg.

Homestake documented on the chemical evaluation form that phosphorus concentrations at Outfall 001A will be less than 0.11 mg/l. To maintain phosphorus concentrations below the applicable water quality standard, and to further mitigate the quantity of injected phosphate mass beyond natural attenuation mechanisms (including adsorption, precipitation, and dilution), Homestake has committed to implementing both operational procedures and a treatment residuals management program (controls measures), as needed to maintain phosphorus concentrations below the water quality standard at Outfall 001A. The control measures are consistent with 2019 field activities, and include:

- Operational Controls:
    - Phosphate injections will be operated in a "back-recirculation" injection approach at the Indian Rock Dump, wherein water will be extracted from downgradient monitoring wells and reinjected in upgradient monitoring wells relative to the predominant groundwater flow direction, upstream of discharge to surface water. Monitoring of the extracted groundwater (which will intercept upgradient injected water before it migrates downgradient and seeps into surface water) will provide an early warning for elevated phosphate.
    - If phosphate is detected in extracted groundwater or in surface water during the monitoring program

(described below) at concentrations that indicate the potential for non-compliance at Outfall 001A, the injection program will be modified (i.e., reduced or ceased).

- Treatment Residuals Management Program:

  - If upstream total phosphorus concentrations are observed at concentrations that indicate the phosphorus standard at Outfall 001A could be exceeded, operation of the treatment residuals management program will commence (which is intended to remove dissolved phosphate through the addition of iron and aluminum based reagents, and slaked lime if necessary). This management program has not been used since inception.

The water quality standard for phosphorus for Indian Creek is 0.11 mg/l (annual median). Concentrations of phosphorus in samples taken at Outfall 001A for the 2019 field demonstration, using a phosphate mass of 2650 kg as PO_4, were measured at **0.024 mg/l or less**, or less than 50% of the standard. The highest single phosphorus concentration recorded at Outfall 001A since the initial 2015 field season was 0.071 mg/l.

These analytical results, paired with the control measures (operational and treatment controls) and Homestake's commitment to cease injection of phosphate to avoid exceeding the water quality standard for phosphorus, demonstrate that the requested injected phosphate mass for the 2020 field season will not result in an exceedance of the chronic water quality standard. However, based on the mass proposed for use during the field season, weekly phosphorus monitoring is required. Homestake documented that weekly monitoring will be conducted in Table 2 of the February 18, 2020 chemical evaluation request.

Iron and Aluminum – Homestake proposes to use an iron additive (Engineered Treatment Cell), and ferric chloride and sodium aluminate reagents (Treatment Residuals Management) consistent with the 2019 field program, i.e., using a maximum total applied mass of 2600 kg iron, and 2100 kg aluminum in the 2020 field season.

Referencing previous chemical evaluation requests (2017-2019), Homestake states that the anticipated concentrations of iron and aluminum at Outfall 001 are not dependent on the total mass of the reagents applied upstream, but rather on the solubility of iron and aluminum at near-neutral pH, and that dissolved iron and aluminum concentrations will be limited by precipitation as metal oxyhydroxides, while total recoverable concentrations will be limited by settling of precipitated solids in the Sediment Pond.

Aluminum - Homestake documented on the chemical evaluation form that total recoverable aluminum concentrations at Outfall 001A will be less than 1438 ug/l, and calculated that following precipitation and flocculation, actual total recoverable aluminum concentrations at Outfall 001A will be **less than 300 ug/l**, which it confirmed with bench testing and subsequent field data.

While there is not an aluminum standard specified for Indian Creek, Regulation 31 specifies a chronic aluminum standard equal to e(1.3695[ln(hardness)]-0.1158) when the pH downstream of the outfall is greater than 7.0. The pH of the discharge at Outfall 001 is equal to the pH of the receiving stream, which Homestake estimated to remain at approximately 8.3. At a hardness of 243 mg/l as $CaCO_3$ (as provided in the WQA for the administratively extended permit; capped at 220 mg/l), the chronic aluminum standard for the receiving stream is equal to 1438 ug/l.

Concentrations of total recoverable aluminum in samples taken at Outfall 001A for the 2019 field demonstration were measured at **120 ug/l** (one result) **or less** (the remaining 2019 results were reported at 50 ug/l or less). The highest total recoverable aluminum concentration recorded at Outfall 001A since the initial 2015 field season was 120 ug/l. All reported values less than 50% of the standard.

These analytical results demonstrate that the requested aluminum mass for the 2020 field season will not result in an exceedance of the chronic water quality standard. However, based on the mass proposed for use during the field season, and the dependency of the final total recoverable aluminum concentrations at Outfall 001 on both pH and settling control measures, weekly total recoverable aluminum monitoring is required. Homestake documented that weekly monitoring will be conducted in Table 2 of the February 18, 2020 chemical evaluation request.

Iron – Homestake documented on the chemical evaluation form that total recoverable iron concentrations at Outfall 001A will be less than 1000 ug/l, and calculated that following precipitation and flocculation, actual total recoverable iron concentrations at Outfall 001A will be less than 300 ug/l, which it confirmed with bench testing and subsequent field data.

The water quality standard for total recoverable iron (30 day average) for Indian Creek is 1000 ug/l. Concentrations of total recoverable iron in samples taken at Outfall 001A for the 2019 field demonstration were measured at **770 ug/l or less**. The highest total recoverable iron concentration recorded at Outfall 001A since the initial 2015 field season was 770 ug/l (in the 8/24/2019 sampling event). The weekly sampling results immediately before and after this result were both reported as 40 ug/l, resulting in a 30-day average value of **283 ug/l** (based on 3 weekly samples- the 4th sample was the wrong analytical form). While the individual result reported for the 8/24/2019 sampling event is greater than 50% of the standard, the calculated 30-day average value remains less than 50% of the standard.

These analytical results demonstrate that the requested iron mass for the 2020 field season will not result in an exceedance of the chronic water quality standard. However, based on the mass proposed for use during the field season, and the dependency of the final total recoverable iron concentrations at Outfall 001 on both pH and settling control measures, weekly total recoverable iron monitoring is required. Homestake documented that weekly monitoring will be conducted in Table 2 of the February 18, 2020 chemical evaluation request.

Electrical conductivity (EC), Sodium Adsorption Ratio (SAR), and TDS – Many of the proposed chemicals may contribute to an increase in the EC/SAR and TDS levels of the discharge.

EC/SAR

In the information submitted to the division as part of the 2020 request, Homestake calculated that the maximum anticipated sodium concentration at outfall 01A would be less than 105 mg/l based on the average flow rate at Outfall 001A (including contributions from use of the sodium sulfite salt proposed for use in 2020), and calculated EC at the outfall as **0.96 dS/m.**

Recent communication (5/2020) with the local Water Commissioner indicates that there are no diversions of Indian Creek used for regular crop irrigation. Therefore, the division used the EC WQBEL calculated in the draft 2014 WQA (2.9 dS/m) in this evaluation. EC values in samples taken at Outfall 001A for the 2019 field demonstration, were measured at **1.21 dS/m or less**, above Homestake's 2019 estimated value (0.89 dS/m), but less than 50% of the calculated WQBEL. The highest EC value recorded at Outfall 001A since the initial sampling began (2017 field season) was 1.3 dS/m.

Homestake calculated SAR at Outfall 001, including the sodium contributed from the treatment reagents, at 1.27, compared to a calculated WQBEL of 4.31 (using an EC of 0.96 dS/m). The highest SAR value reported at Outfall 001A since the initial sampling began (2017 field season) was <0.1.

These analytical results demonstrate that the mass of chemicals for the 2020 field season will not result in an exceedance of the EC and SAR WQBELs. However, based on the mass proposed for use during the field season, quarterly EC and SAR monitoring is required. Homestake documented that quarterly monitoring will be conducted in Table 2 of the February 18, 2020 chemical evaluation request.

TDS

The permit requires TDS monitoring and quarterly reporting. This requirement continues to be applicable under the new chemical approval.

pH – The permit requires pH monitoring, and establishes a limit of 6.5-9.0 s.u. This requirement and limit continue to be applicable under the new chemical approval.

Aquatic Toxicity (WET) - Many of the proposed chemicals have the possibility to contribute to aquatic toxicity, and are being used in large quantities. Therefore, the division requires that Homestake conduct the required quarterly whole effluent toxicity tests for the 2nd (unless the 2nd quarter sample has already been collected), 3rd

and 4th quarters of 2020 during the time the field activities occur at the facility. Note that the automatic compliance response as required in the permit is applicable to 'report only' requirements for WET testing.

Chloride – Consistent with the 2017 - 2019 chemical approvals, Homestake proposes to apply a maximum total mass of 5000 kg of chloride in 2020. Given the dilution available, Homestake calculated a maximum chloride concentration of 64 mg/l at Outfall 001A.

Homestake documented on the chemical evaluation form that chloride concentrations at Outfall 001A will be maintained below 50% of the chronic standard of 250 mg/l for Marshall Creek. Concentrations of chloride in samples taken at Outfall 001A for the 2019 field demonstration were measured at **1 mg/l or less**. These analytical results demonstrate that the requested chloride mass for the 2020 field season will not result in an exceedance of the chronic water quality standard. However, based on the mass proposed for use during the field season, and because the division has just one season of data, monthly sampling for chloride is required (reduced from 2 times per month monitoring in 2019).

Ammonia – Homestake proposes to use the chemical diammonium phosphate in the ETC. As provided in correspondence dated May 30, 2019, Homestake predicted the maximum ammonia concentration at Outfall 001A will be 0.0074 mg/l as N. This calculated effluent concentration of 0.0074 mg/l is several orders of magnitude below a conservative estimate of the associated WQBEL for Indian Creek (i.e., 0.35 mg/l, using the highest stream temperature standard and effluent pH), and is below the PQL of 0.2 mg/l.

Concentrations of ammonia in samples taken at Outfall 001A for the 2019 field demonstration were measured at **<0.05 mg/l**. These analytical results demonstrate that the requested ammonia mass for the 2020 field season will not result in an exceedance of the chronic water quality standard. However, based on the mass proposed for use during the field season, and because the division has just one season of data, monthly sampling for ammonia is required (reduced from 2 times per month monitoring in 2019).

Nickel, cadmium, mercury, lead, arsenic - Homestake proposes to use 112 kg of yellow iron oxide in the Engineered Treatment Cell (ETC). As provided in supplemental information dated 5/18/2020 and the associated MSDS, Homestake indicates that the yellow iron oxide reagent can contain up to 2% of various other metals. Homestake calculated the concentrations of each of these trace metals at Outfall 001A utilizing the effluent flow rates and iron concentrations obtained during the 2019 operation of the ETC (assumes proportionality of the trace metal concentrations with iron). Homestake states that the calculated effluent concentrations for the trace metals are conservative in that the concentrations listed in the MSDS represent maximum quantities, but are likely lower than those numbers in the actual material assay; that the trace metals are also removed from solution as the iron precipitates in the ETC; and that the effluent iron concentration used in the estimate (from 2019 operation of the ETC) is likely conservative for 2020 estimations, as the observed concentration decreased with continued operation of the ETC.

This information and the associated water quality standards for Indian Creek are provided in Table 4, below. The division used a hardness of 243 mg/l as CaCO3 (as provided in the WQA for the administratively extended permit) for the TVS metals.

Table 4 - Estimated trace metal concentration at Outfall 001A and associated water quality standards.

Constituent	Maximum concentration in yellow iron oxide reagent (MSDS)	Maximum concentration at Outfall 001A (ug/l) (calculated)	Indian Creek water quality standards (chronic)
Nickel	200 mg/kg	0.0024 ug/l	110 ug/l
Cadmium	10 mg/kg	0.00012 ug/l	0.83 ug/l
Mercury	10 mg/kg	0.00012 ug/l	0.01 ug/l
Lead	50 mg/kg	0.0006 ug/l	6.5 ug/l
Arsenic	50 mg/kg	0.0006 ug/l	7.6 ug/l

All calculated concentrations for the trace metals are below 50% of the associated water quality standards. In all cases, the water quality standard is more than two orders of magnitude above the calculated

concentrations. Therefore, monitoring for nickel, cadmium, mercury, lead, and arsenic as part of this chemical evaluation is not required at this time.

Sulfate - Homestake proposes to use two new chemicals (sodium and potassium sulfite) to consume dissolved oxygen in extracted North Pit Lake water, prior to injection into the northern underground mine workings. Homestake proposes to apply a maximum quantity of 910 kg as SO_3 in 2020, and indicates that both reagents react fully with dissolved oxygen, reducing 0_2 to H_20 and oxidizing sulfite to sulfate, releasing sodium or potassium ions. Homestake states that the sulfite addition at the proposed maximum would increase the sulfate concentration in North Pit Lake water from 212 mg/l to 284 mg/l, but that the injection water is not anticipated to increase the sulfate concentration in groundwater in the injection zone (e.g., 232 mg/l to 443 mg/l), which ultimately expresses to surface water.

The water quality standard for sulfate for Marshall Creek is 250 mg/l (the less restrictive of existing quality as of January 1, 2000, or 250 mg/l), and the division calculated the WQBEL as 528 mg/l (based on the draft 2014 WQA). As Marshall Creek contributes to drinking water wells located in the alluvium downstream of the discharge, the water supply standards apply to this segment.

While Homestake does not anticipate the added chemicals will influence the total estimated sulfate concentration at Outfall 001, because Homestake is contributing sulfate to surface water, 2 times per month sampling for sulfate is required to demonstrate that concentrations are less than 50% of the chronic standard of 528 mg/l for Marshall Creek.

Dissolved oxygen - Homestake proposes to use two new chemicals (sodium and potassium sulfite) to consume dissolved oxygen in extracted North Pit Lake water, prior to injection into the northern underground mine workings. Homestake proposes to apply a maximum quantity of 910 kg as SO_3 in 2020, and indicates that both reagents react fully with dissolved oxygen, reducing 0_2 to H_20 and oxidizing sulfite to sulfate, releasing sodium or potassium ions.

The water quality standard for dissolved oxygen (chronic) for Indian Creek is 6.0 mg/l (7.0 mg/l spawning). The purpose of the sodium and potassium sulfite chemical addition is to remove oxygen and Homestake has indicated that the groundwater in the injection zone ultimately expresses to surface water. Therefore, 2 times per month sampling for dissolved oxygen is required to demonstrate that concentrations remain above the standard for Indian Creek.

BOD_5 - Homestake proposes to construct an additional pilot-scale ETC for operation during the 2020 field season. Solid phase media in the ETC will include a mixture of natural organic carbon sources (including alfalfa hay, mulch, compost/manure, and wood chips/sawdust or similar) in varying proportions. The 2020 ETC will operate in-parallel with two other ETC systems, contains approximately 700 to 800 cubic feet of the solid phase media, and will operate throughout the field season and into the winter at a flow rate of approximately 1 gpm.

The potential for biochemical oxygen demand is associated with runoff/leachate from these types of organic carbon sources. Regulation 62 includes the following BOD_5 effluent limitations that apply to all discharges of wastewater, except stormwater, to State waters: 30 mg/l (30-day average); 45 mg/l (7-day average). The division does not expect that BOD_5 concentrations will exceed these limitations based on the other POCs associated with operation of the ETC (e.g., iron and ammonia) and their dosed concentrations vs measured concentrations at Outfall 001A. However, 2 times per month sampling for BOD_5 is required to demonstrate that concentrations remain below the Regulation 62 BOD_5 effluent limitations.

C. CONCLUSION

Based on the analysis of the information provided by Homestake in this request, the division approves the use of the chemicals identified in Table 1 of this correspondence, consistent with the provisions identified in this memorandum and the chemical evaluation request for the 2020 field season. The division determined that the use of these chemicals does not require a modification to the monitoring requirements and/or discharge limitations provided in CDPS permit CO0022756 at this time. Chemicals not listed in Table 1 are not approved

for the 2020 field program. Consistent with CDPS permit CO0022756, all monitoring associated with this chemical evaluation must be performed using 40 C.F.R. Part 136 methods.

Note that all chemicals used in the treatment process that may be discharged to waters of the State must be used in accordance with all state and federal regulations, and in strict accordance with the manufacturer's instructions.

APPENDIX D

2020 Approved UIC

PITCH RECLAMATION PROJECT

April 8, 2020

Mr. Omar Sierra-Lopez
U.S. EPA Region 8
Mail Code 8WP-SUI
1595 Wynkoop Street
Denver, CO 80202-1129
sierra-lopez.omar@epa.gov
Phone: (303) 312-7045

RE: Request for Class V Rule Authorization related to Uranium Mass Load Reduction Field Testing, Pitch Reclamation Project, Saguache County, Colorado

Dear Mr. Sierra-Lopez:

Homestake Mining Company (HMC) hereby requests a Rule Authorization regarding the proposed use of Class V aquifer remediation injection wells at the Pitch Reclamation Project located 6 miles east of Sargents, Colorado. We propose to continue advancing phosphate reagent and non-reactive tracer injections associated with the continued development and evaluation of source control/treatment field activities to reduce uranium load to the Colorado Discharge Permit System (CDPS) permit (No. CO0022756) compliance point Outfall 001A (also known as SW-33) and establish the Lowest Practical Level (LPL) for uranium. Building upon successful pilot and field demonstration tests from 2015 through 2019, the continued field demonstration-scale testing proposed in 2020 will continue to advance uranium load reduction alternatives.

Pilot and field demonstration-scale testing from 2015-2019 were performed under the following United States Environmental Protection Agency (UESPA) Rule Authorizations:

- USEPA File #CO50000-10920 dated May 26, 2015;
- USEPA File #CO50000-11148 dated May 5, 2016;
- USEPA File #CO50000-11147 dated May 8, 2017;
- USEPA File #CO50000-10920 dated July 19, 2018 (verbal approval granted in June 2018); and
- USEPA File #CO50000-10920 dated May 15, 2019. A follow up request to reinject decant water into injection wells following pH-neutralization and settling/filtration was submitted on June 18, 2019 and approved by EPA on July 3, 2019.

Field testing in 2015 and 2016 involving the injection of a mixture of phosphate and non-reactive tracer into the historic Pinnacle Mine underground workings (underground mine workings) and the Indian Rock Dump have been successful at treating uranium by precipitation as low-solubility phosphate-based minerals. Field demonstration-scale testing from 2017 through 2019 included expanded phosphate injection programs in the underground mine workings and the Indian Rock Dump (specifically, the Pinnacle Mine Dump area in 2019), installation and implementation of a pilot-scale engineered treatment cell (ETC), and a treatment residuals management program.

A continuation of the expanded phosphate injection program from 2019 is proposed for 2020. Operations in 2020 will be similar to the 2017 through 2019 programs approved under USEPA Rule Authorizations, but with the following two additional items:

1) At the underground mine workings, HMC plans to modify the existing extraction/injection/recirculation process (discussed below) to include extraction of surface water from the North Pit Lake for reinjection with phosphate in injection wells. Previously, water sourced for phosphate injection was collected from extraction wells P-7 and P-13.
2) Up to three additional injection wells will be installed in the Pinnacle Mine Dump area adjacent to existing injection wells PMD-IW-01 and PMD-IW-02.

This letter request provides specific details related to planned injection activities to support the “authorization by rule” in accordance with Title 40 Code of Federal Regulations (40 CFR) Sections 144.24 and 144.84(a).

Overview

Property Owner:	Homestake Mining Company
Point of Contact:	Clark Burton – Director of Closure Operations Homestake Mining Company 2270 Corporate Circle Suite 100 Henderson, Nevada 89074 Phone: +1(702) 522-6938
Property Operator:	Dave Wykoff – Pitch Site Manager Homestake Mining Company P.O. Box 40 Sargents, Colorado 81248 Phone: (970) 641-4541
Property Location:	The Pitch Reclamation Project is located 6 miles east of Sargents, Saguache County, Colorado 81248, Latitude:

	38°24'24 N, Longitude: 106°17'50 W. Sections 29, 30, 31, 32, Township 48 North, Range 6 East, New Mexico Prime Meridian (**Figure 1**).
Constituents of Interest:	Uranium
Equipment:	Up to 3 new recirculation/monitoring wells and 25 existing recirculation/monitoring wells within the underground mine workings and the Indian Rock Dump (specifically, the Pinnacle Mine Dump) will be used to deliver, recirculate, and/or monitor phosphate-based reagents and non-reactive tracer(s) (**Figure 2**). Injection equipment will consist of tanks, totes, flow meters, pumps, and conveyance piping necessary to transport the injection fluid to the recirculation/monitoring wells.

2015 - 2019 Field Program Overview

Phosphate injection pilot testing conducted in 2019 was deemed successful based on the following metrics:

- Both systems successfully delivered and distributed reagents throughout the target injection zone (underground mine workings) and into the saturated and the unsaturated-zone fill material with elevated uranium concentrations (specifically, the Pinnacle Mine Dump) as demonstrated by phosphate and tracer dye concentrations.
- Containment of injected reagents and treatment residuals was successful as demonstrated by the low concentrations of phosphate and lack of observed secondary effects (such as arsenic desorption/mobilization or decreased pH) downgradient/downstream of the injection zones.
- Effective treatment at the underground mine workings can be seen in the evaluation of uranium concentrations in water sampled from the Chester Fault Springs (CFSs) and monitoring well P-8. The CFSs have shown statistically significant reductions in uranium compared to pre-injection concentrations and have historically contributed up to 15 percent (%) of the overall uranium load at SW-33.
- Following phosphate injection, phosphate concentrations in the injection zone decreased over time relative to tracer concentrations, indicating that phosphate is

naturally attenuated via adsorption and precipitation reactions near the injection zone (particularly, attenuation beyond dilution).

- During and following phosphate injections from 2015-2019, compliance with the CDPS permit conditions and terms of the chemical approvals was maintained at SW-33, with phosphorus concentrations not observed above 0.1 milligrams per liter (mg/L). Specifically, phosphorus detections in surface water across the site between 2017 and 2019 (i.e., during field-scale injection implementation) were below 0.071 mg/L.

- Bench-scale and pilot testing demonstrated the effectiveness and feasibility of iron and aluminum reagent addition for removal of residual dissolved phosphate as part of a "treatment residuals management program", should it become necessary if injected phosphate expresses to surface water at concentrations approaching compliance limits. This system was not required in 2019 or previous years.

Additional details on the 2015-2019 work, including the results of ETC solid phase media field-scale testing, have been summarized in LPL updates submitted to the Colorado Water Quality Control Division (WQCD), which can be provided to the USEPA upon request. Details on the Pitch Reclamation Project background, geology/hydrology, operational history, and land ownership can be found in the Request for Class V Rule Authorization submitted to the USEPA on May 4, 2015 (approved as Rule Authorization, USEPA File #CO50000-10920, dated May 26, 2015).

Proposed 2020 Injection Activities

The main modification proposed in 2020 for the underground mine workings injection system is the extraction of surface water from the North Pit Lake to facilitate injections at the underground mine workings. This modification is being proposed to maximize injection rates into the available well network while reducing injection well fouling. Although this change is anticipated to result in greater volumes injected in the underground mine workings over previous years, the overall injection volumes are not larger than the approved maximum volumes outlined in previous agency approvals.

Because the North Pit Lake water contains dissolved oxygen above concentrations present in groundwater, an oxygen scavenging reagent will be dosed along with phosphate. Reagent stock solution (monosodium phosphate or phosphoric acid) and an oxygen scavenger (potassium sulfite or sodium sulfite) will be added to the extracted water, which will then be piped to existing injection wells. Bench tests with site-specific water demonstrates that the added sulfite quickly reacts with dissolved oxygen (within minutes to hours), oxidizing to sulfate and resulting in total sulfate concentrations in the injection water that are consistent with sulfate concentrations already present in groundwater at the site. Additional details on these and other field activities planned for 2020 (phosphate and oxygen scavenger injection, ETC testing, BCR drum-scale testing,

treatment residuals management, and injection well rehabilitation/reinjection) and the associated chemical usage, chemical safety data sheets, fate and transport of injected reagents, control measures, and monitoring are presented in the Chemical Approval Request for CDPS Permit Number CO0022756 (**Attachment 1**), submitted to the WQCD on January 29, 2020.

To incorporate North Pit Lake as a supply source to the current underground workings injection system, a pump will be placed near the surface of the lake and a pipeline will be installed from the lake up to an extraction well (P-7) to convey water to the existing extraction infrastructure. The North Pit Lake extraction point is shown on **Figure 2**. The pipeline will be constructed using SDR9 HDPE and will be anchored to the ground at adequate intervals. The appropriate safety controls will be implemented.

A Request for Technical Revision (TR-10) to the Pitch Reclamation Project reclamation permit No. M-77-004HR was submitted to the Colorado Division of Reclamation, Mining and Safety (DRMS) on May 22, 2019 (**Attachment 2)**. TR-10 included surface disturbances associated with drilling and reclamation for anticipated 2020 field activities and was approved by DRMS on June 13, 2019.

Well Construction Details

The proposed new recirculation/monitoring wells within the Former Pinnacle Mine Dump of the IRD (PMD-IW-03, PMD-IW-04, and PMD-IW-05) will be constructed in accordance with Colorado Office of the State Engineer guidelines. The wells will be completed at an anticipated depth no greater than 140 ft below ground surface.

Boreholes for the three wells will be advanced to total depth with a diameter of approximately 10-inches. The wells will consist of Schedule 80 PVC flush thread 6-inch casing with approximately 20 ft. of 0.020-inch continuous slotted stainless-steel well screen. An 8/12 sized sand filter pack will be placed to a depth of approximately 5-feet above the screened interval. A 5-foot bentonite chip annular seal will be placed above the sand filter pack, followed by backfilling the well annulus with a Portland/bentonite grout mix. The surface stick-up well completion for all wells will consist of an 8- to 10-inch steel vault and locking lid. The inner casing will be sealed with a locking cap. The well vaults will be surrounded by an approximate 2-foot diameter concrete apron sloped to facilitate proper drainage.

Summary

An integral component to establishing a practical, technically achievable and sustainable LPL is the implementation of source control and treatment technologies to reduce uranium load at this high elevation mine site with limited year-round access. Pilot and field implementation testing from 2015 through 2019 in the underground mine workings and near the toe of the Indian Rock Dump was successful at treating uranium in groundwater, including desired attenuation of the injected phosphate. One of the primary

goals of the 2020 field activities is to continue operation of the phosphate injection systems to realize measurable uranium load reduction in downgradient surface water. Continued phosphate injection/recirculation within the underground mine workings and the Indian Rock Dump (specifically within the former Pinnacle Mine Dump) is proposed, with a treatment residuals management program in place to actively control residual phosphate concentrations prior to discharge at SW-33 if needed. This request for Rule Authorization to continue to perform uranium mass load reduction at the Pitch Reclamation Project includes the general plans for the associated injections as summarized above and detailed in **Attachment 1**.

If you have any questions or require further information regarding this update, please contact me at +1 (505) 252-9615.

Sincerely,

David Wykoff

Dave Wykoff, on behalf of
Clark Burton
Homestake Mining Company
Director of Closure Operations

CC: Dave Wykoff – Homestake Mining Company, Site Manager
Anna Hagemeister – Arcadis, U.S., Inc.

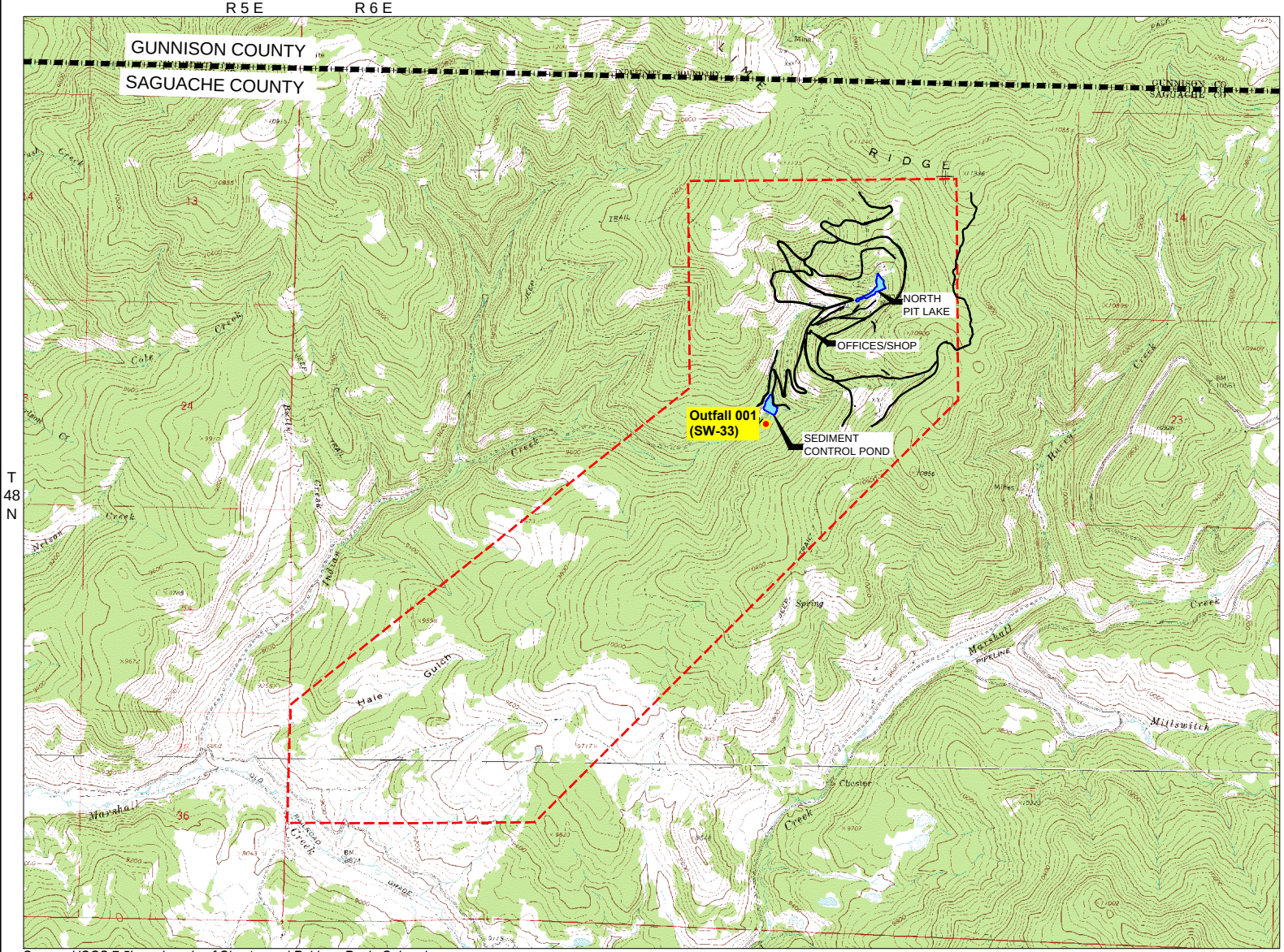
Figures

Figure 1 – Location Map
Figure 2 – Monitoring Locations

Attachments

1. HMC. 2020. Chemical Approval Request for CDPS Permit (Number CO0022756) for the Pitch Reclamation Project, Saguache County, Colorado. March.
2. HMC. 2019. Technical Revision Request: Field Activities to Support Reclamation and Establishment of the Lowest Practical Level for Uranium, Pitch Reclamation Project, Colorado Division of Reclamation, Mining and Safety Reclamation Permit Number M-1977-004. May.

Figures



Source: USGS 7.5' quadrangle of Chester and Pahlone Peak, Colorado.

Legend

- Colorado Discharge Permit System (CDPS) Compliance Point
- Colorado Division of Reclamation, Mining, and Safety (DRMS) Permit Boundary
- Roads

N

0 2,000 4,000 6,000 Feet

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SITE LOCATION

ARCADIS

FIGURE 1

Z:\GIS\A0000102_Pitch\ACAD\Reclamation FI 03-01-16.dwg

Legend

- Proposed Recirculation/Monitoring Well (Tentative)
- Existing Recirculation/Monitoring Well
- Existing Surface Water Monitoring Location
- Colorado Discharge Permit System Compliance Point
- Colorado Discharge Permit System Boundary
- Contours - 50 feet

N

0 260 520 Feet

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

MONITORING LOCATIONS

ARCADIS

FIGURE
2

Path: Z:\GISProjects_ENVAC000102_Pitch\GIS\MXD\2020\2020-02\Fig_2_Monitoring_Locations_redlinesv0.mxd Date Saved: 4/6/2020 10:53:41 PM

Attachment 1

COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

COLORADO WATER QUALITY CONTROL DIVISION - REQUEST FOR CHEMICAL EVALUATION

Please print or type all information. All items must be filled out completely and correctly.

MAIL ORIGINAL FORM WITH INK SIGNATURES TO THE FOLLOWING ADDRESS:

Colorado Dept. of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Dr. South WQCD-P-B2
Denver, CO 80246-1530

FAXED or EMAILED FORMS WILL NOT BE ACCEPTED.

PURPOSES OF FORM.

- The information required by this form will be used by the division to determine whether a permit modification is needed when a permittee seeks to use different chemicals from those listed in its permit or fact sheet. If a permit modification is needed, these new chemicals may not be added prior to the effective date of the permit modification.
- A permittee may also directly apply for a permit modification without completing this form.
- The information required by this form may also be used by the division to supplement a pending permit application or renewal.
- Completion of this form (or a permit modification application) may be required for compliance with Regulation 61.8(5), 5 CCR 1002-61, or similar permit conditions, which require that a permittee notify the division of anything that will significantly change the nature or increase the quantity of pollutants discharged or that may result in noncompliance with permit requirements. Completion of this form (or a permit modification application) may also be required prior to approvals under Regulation 22, 5 CCR 1002-22.
- If the division determines that a permit modification is necessary and if the permittee signs Part F below, this form may also serve as an application to modify the permit. If Part F is not signed and the division informs the permittee that a permit modification is necessary, the permittee must submit a permit modification application to the division in order to move forward with the chemical addition. Until a permit modification is effective, the use of the chemical is not authorized by the permit.

PART A. IDENTIFICATION OF PERMIT Please identify the permit number

PERMIT NUMBER CO0022756

PART B. PERMITTEE INFORMATION (application must be signed by the legal contact* listed here)

Company Name Homestake Mining Company

Mailing Address _____

City _____ State _____ Zipcode _____

Legal Contact Name* Patrick Malone Phone Number _____

Title President, Homestake Mining Company Email _____

PART C. FACILITY/PROJECT INFORMATION

Facility/Project Name	Pitch Reclamation Project		
Location (address)	112 Marshall Street		
City	Sargents	County	Saguache
Local Contact Name	Dave Wykoff	Phone Number	970-641-4541
Title	Site Manager	Email	dwykoff@barrick.com

PART D. REQUIRED INFORMATION FOR CHEMICAL REQUEST:

****** This part must be complete (i.e., you must provide ALL required information) for the division to process the chemical evaluation request ******

For **EACH** chemical requested, provide the following information – **use additional pages if necessary.**

1. Is an MSDS attached for **EACH** chemical product requested? ■ Yes □ No

2. List name of each chemical product requested, the wastestream and outfall, and dosing rate

Chemical	**Wastestream and outfall**	**Dosing rate (in influent or pond) -- in mg/L or ug/L --**
Chemical 1: See attachments 1 and 2		
Chemical 2:		

3. List each **active component** as a percentage of the chemical product.

   If the active component is not 100% of the chemical product, list all other ingredients (e.g., non-active ingredients, carriers, proprietary ingredients, etc.) as a percentage of the mixture.

   Chemical 1:

Active component	**Percent of mixture**	**Other component**	**Percent of mixture**
See attachments 1 and 2			

4. Does the chemical product contain proprietary ingredients? ■ Yes □ No
   ** The division may require additional information from the manufacturer to identify the presence or absence of specific parameters in the proprietary component of the mixture.*

5. Provide the concentration of each active/other component in the effluent, and the method used to derive the concentration.

Chemical 1:

Active component	**Conc. In Effluent (in mg/L or ug/L)**	**Method used**
See attachments 1 and 2		
Other component	**Conc. In Effluent (in mg/L or ug/L)**	**Method used**
See attachments 1 and 2		

6. Provide the aquatic toxicity of the chemical, as documented in the MSDS.

See attachments 1 and 2

a. The aquatic toxicity provided above represents: □ active component only ■ mixture

7. Did you evaluate using a less toxic chemical for treatment? ■ Yes □ No

Additional Information

- The requested chemical addition may trigger certified operator requirements, pursuant to Section 100.5.2 of the Water and Wastewater Facility Operator Certification Requirements.

- The requested chemical addition may result in additional limitations and/or monitoring requirements in the certification/permit (e.g., Whole Effluent Toxicity (WET), metals, organics, etc.)

PART E. CERTIFICATION Required Signature

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment."

Signature of **Legal Contact*** Date Signed

Dave Wykoff, on behalf of Patrick Malone President, Homestake Mining Company

Name (printed) Title

PART F. CERTIFICATION Signature for Permit Modification Application

If you desire this document to also be used as a permit modification application if the division determines that a permit modification is necessary, please also sign below. If this section is not signed, and a permit modification is deemed necessary by the division, the permittee must submit a permit modification application to the division if the permittee wishes to move forward with the chemical addition. Until a permit modification is effective, the use of the chemical is not authorized by the permit.

I understand that submittal of this application is for coverage under the State of Colorado Discharge Permit System until such time as the application is amended or the certification is transferred, inactivated, or expired.

Signature of **Legally Responsible Party*** Date Signed

Name (printed) Title

*This modification application shall be signed, dated, and certified for accuracy by the permittee. In all cases, it shall be signed as follows:

1. In the case of a corporation, by a principal executive officer of at least the level of vice-president, or his or her duly authorized representative, if such representative is responsible for the overall operation of the operation from which the discharge described herein originates;
2. In the case of a partnership, by a general partner;
3. In the case of a sole proprietorship, by the proprietor;
4. In the case of a municipal, state, or other public operation, by either a principal executive officer, ranking elected official, or other duly authorized employee.

Attachment 1

2. List name of each chemical product requested, the wastestream and outfall, and dosing rate

	Chemical	Wastestream and outfall [1]	Dosing rate in influent stream [2]	Dosing rate basis
1	Sodium Monobasic Phosphate [3]	Recirculated pore water in underground mine workings and Indian Rock Dump injection systems	0-550 mg/L as PO_4	Concentration in water reinjected into wells
2	Phosphoric Acid [3]	Recirculated pore water in underground mine workings and Indian Rock Dump injection systems	0-550 mg/L as PO_4	Concentration in water reinjected into wells
3	Fluorescein	Chester Fault Spring water entering Engineered Treatment Cells	10 mg/L	Concentration in Engineered Treatment Cell influent water
4	Eosine	Recirculated pore water in underground mine workings injection system	10 mg/L	Concentration in water reinjected into wells
5	Rhodamine WT	Recirculated pore water in Indian Rock Dump injection system	10 mg/L	Concentration in water reinjected into wells
6	Potassium Chloride	Well casing of an individual monitoring well	1,000 mg/L	Concentration within well screen interval
7	Ferric Chloride	Indian drainage upstream of Sediment Pond	50 mg/L as Fe	Concentration in Indian drainage before precipitation
8	Sodium Aluminate	Indian drainage upstream of Sediment Pond	40 mg/L as Al	Concentration in Indian drainage before precipitation
9	MM-2480 Polymer	Indian drainage upstream of Sediment Pond	1 mg/L	Concentration in Indian drainage before flocculation
10	Sodium Carbonate	Indian drainage upstream of Sediment Pond	25 mg/L	Concentration in Indian drainage at dosing point
11	Sodium Bicarbonate	Indian drainage upstream of Sediment Pond	40 mg/L	Concentration in Indian drainage at dosing point
12a	Calcium Hydroxide (fine, slaked)	North Pit Lake	185 mg/L	Concentration following mixing in North Pit Lake
12b	Calcium Hydroxide (fine, slaked)	Added to spent well rehabiliation water for pH neutralization; reinjected into Indian Rock Dump injection well following neutralization and solids removal	90 kg	Total mass used in pH-neutralization of well rehabilitation solution (up to 20 events)
13	Hydrochloric Acid, 32%	Well casing of an individual injection well; re-extracted from well, pH-neutralized, and reinjected into Indian Rock Dump injection well following solids removal	160 gallons	Total maximum volume used for well rehabilitation (up to 8 gallons per event, up to 20 events)
14	Mudnox ®	Well casing of an individual injection well; re-extracted from well, pH-neutralized, and reinjected into Indian Rock Dump injection well following solids removal	10 gallons	Total maximum volume used for well rehabilitation (0.5 gallons per event, up to 20 events)
15	Sodium Lactate[4]	Chester Fault Spring water entering drum-scale bioreactor	615 mg/L	Concentration in water advanced through drum-scale bioreactor
16	Lactic Acid	Chester Fault Spring water entering drum-scale bioreactor	500 mg/L	Concentration in water advanced through drum-scale bioreactor
17	Diammonium Phosphate	Chester Fault Spring water entering drum-scale bioreactor	60 mg/L	Concentration in water advanced through drum-scale bioreactors
18	Yellow Iron Oxide	Solid reagent used in 55-gallon drum-scale bioreactor constructed in 2019. This bioreactor will continue to operate in 2020.	112 kg	Total mass emplaced in drum-scale bioreactor constructed in 2019.
New:2020				
19	Sodium Sulfite	Recirculated North Pit Lake water in underground mine workings injection system	60 mg/L as SO_3	Concentration in water reinjected into wells
20	Potassium Sulfite	Recirculated North Pit Lake water in underground mine workings injection system	60 mg/L as SO_3	Concentration in water reinjected into wells

Notes:
See Attachment 2 for more details

[1] The "wastestream" descriptions provided include water to which chemical is added. The outfall in each case corresponds to the project outfall: Monitoring point SW-33 (see Attachment 2)

[2] Column header differs from Item 2 in Request Form. Units (concentration or total mass basis) are specified for each chemical, and the basis for the dosing rate is provided in the subsequent column.

[3] Sum of phosphoric acid and sodium monobasic phosphate will not exceed an average of 550 mg/L as PO_4 over course of operational season.

[4] Sum of lactic acid and sodium lactate will not exceed an average of 615 mg/L over course of operational season.

[5] Sum of sodium sulfite and potassium sulfite will not exceed an average of 60 mg/L as sulfite (SO_3) over course of operational season.

Note: Blue text indicates modifications from 2019 Chemical Approval Request.

3. List each active component as a percentage of the chemical product.

Chemical		Active Component	Percent of Mixture	Other Component	Percent of Mixture
1	Sodium monobasic phosphate	Phosphate: $H_2PO_4^-$	81%	Sodium	19%
2	Phosphoric acid	Phosphate: $H_2PO_4^-$	82%	Acid (H^+)	3%
				Water	15%
3	Fluorescein	Fluorescein Anion	88%	Sodium	12%
4	Eosine	Eosine Anion	93%	Sodium	7%
5	Rhodamine WT	Rhodamine Anion	92%	Sodium	8%
6	Potassium Chloride	Potassium Chloride	100%		
7	Ferric Chloride	Iron	14%	Chloride	26%
				Water	60%
8	Sodium Aluminate	Aluminum (as hydroxide following reaction with water)	22-32%	Sodium	9-13%
				Sodium Hydroxide	3-9%
				Water	52-66%
9	MM-2480 Polymer	MM-2480 Polymer	100%	N/A[2]	
10	Sodium carbonate	Carbonate	57%	Sodium	43%
11	Sodium bicarbonate	Bicarbonate	73%	Sodium	27%
12a/b	Calcium Hydroxide (fine, slaked)	Calcium Hydroxide	100%		
13	Hydrochloric Acid, 32%	Acid (H^+)	1%	Chloride	31%
				Water	68%
14	Mudnox ®	Alkyloxypolyethyleneoxyethanol	5-20%	N/A[1]	
15	Sodium lactate	Lactate	48%	Sodium	12%
				Water	40%
16	Lactic Acid	Lactate	79%	Acid (H+)	6%
				Water	15%
17	Diammonium Phosphate	Diammonium Phosphate	100%		
18	Yellow Iron Oxide	Yellow iron oxide	98%	Other Components (trace metals)	sum of trace metals 2%
New:2020					
19	Sodium Sulfite	Sulfite: SO3-	63%	Sodium	37%
20	Potassium Sulfite	Sulfite: SO3-	23%	Potassium	22%
				Water	65%

4. Does the chemical product contain proprietary ingredients?

9	MM-2480 Polymer
14	Mudnox ®

Notes

[1] Per email requests with the manufacturer of Mudnox, the components remain proprietary. The manufacturer provides the assurance that Mudnox does not contain any substances regulated as hazardous substances under the CERCLA or Superfund Acts, nor any chemicals which are subject to reporting requirements of CFR Title 40 Part 372, nor any substances regulated as pollutants pursuant to the Clean Water Act, nor any chemicals listed as Proposition 65.

[2] The proprietary components of this polymer do not contain any metals. The organic carbon-based reagent is used in water treatment applications and has previously been approved and covered by a 2017 Request for Additional Information.

5. Provide the concentration of each active/other component in the effluent and the method used to derive the concentration.

Active Components	Concentration in Effluent: Project Outfall SW-33 [1]	Method Used [2]
Phosphate	< 0.11 mg/L (annual median basis)	Calculated from mixing/attenuation and following treatment residuals management as necessary
Fluorescein	< 0.5 mg/L	Estimated from anticipated mixing/attenuation and based on 2017-2019 monitoring results
Eosine	< 0.5 mg/L	Estimated from anticipated mixing/attenuation and based on 2017-2019 monitoring results
Rhodamine WT	< 0.5 mg/L	Estimated from anticipated mixing/attenuation and based on 2017 -2019 monitoring results
Potassium Chloride	Negligible	Negligible/non-detectible increase at SW-33 following dilution in Sediment Pond based on limited maximum quantity used (2 kg)
Iron	< 1 mg/L total recoverable (anticipate < 0.3 mg/L total and dissolved)	Following precipitation and flocculation, confirmed with bench testing
Aluminum	< 1.438 mg/L total recoverable, 30-day average (anticipate < 0.3 mg/L total and dissolved)	Following precipitation and flocculation, confirmed with bench testing
MM-2480 Polymer	< 0.05 mg/L	Estimated assuming 95% removal efficiency following flocculation with iron and aluminum
Carbonate/Bicarbonate	Negligible	Used in combination with iron to neutralize acidity. No net increase in water alkalinity; accordingly, no anticipated change in bicarbonate concentration
Calcium Hydroxide	Negligible	Used in lime softening application; minor decrease in downgradient calcium concentration
Hydrochloric Acid, 32%	Negligible	Acid component will be neutralized using lime; chloride component at SW-33 would be negligible following surface discharge, transport through vadose zone, and dilution in Sediment Pond
Mudnox ®	Negligible	Negligible/non-detectable increase at SW-33 following bio/photodegradation, transport through vadose zone, and dilution subsequent to surface discharge based on limited maximum quantity (10 gallons)
Sodium lactate	Negligible	Estimated based on anticipated design flow rate for drum reactors (2 gallons per hour) and SW-33 flow rate (>240 gallons per minute); actual dosing rate will also be optimized to ensure consumption of lactate in the bioreactor
Lactic Acid	Negligible	Estimated based on anticipated design flow rate for drum reactors (2 gallons per hour) and SW-33 flow rate (>240 gallons per minute); actual dosing rate will also be optimized to ensure consumption of lactate in the bioreactor
Diammonium Phosphate	Negligible	Estimated based on anticipated design flow rate for drum reactors (2 gallons per hour) and SW-33 flow rate (> 240 gallons per minute).
Yellow Iron Oxide	Negligible	Low solubility solid-phase reagent used; dissolved iron released from material will oxidize, reprecipitate, and settle from solution (see "Iron" entry above)
New:2020		
Sodium sulfite	Negligible	Sulfite rapidly oxidizes to sulfate following oxygen scavenging reaction, confirmed with bench testing. Sulfate in injection water similar to concentrations already present in groundwater.
Potassium sulfite	Negligible	Sulfite rapidly oxidizes to sulfate following oxygen scavenging reaction, confirmed with bench testing. Sulfate in injection water similar to concentrations already present in groundwater.

Other Components	Concentration in Effluent: Project Outfall SW-33 [1]	Method Used [2]
Sodium	< 105 mg/L increase; sodium adsorption ratio (SAR) maintained below 3.81	Calculated based on anticipated mixing with downstream flows, assuming maximum monosodium phosphate dosing.
Chloride[3]	< 64 mg/L increase	Calculated based on anticipated mixing with downstream flows
Acid (H+)	Negligible	Does not contribute to acidity at SW-33 following reaction with soil minerals (e.g., calcite)
Hydroxide (OH-)	Negligible	Does not contribute to alkalinity at SW-33 following reaction with co-added ferric chloride
Potassium	Negligible	Calculated based on anticipated mixing with downstream flows

Notes

[1] Estimated concentrations are provided for the project outfall, SW-33.

[2] Methods for estimating concentrations are provided in Attachment 2.

[3] Chloride contribution due to well redevelopment chemicals not included as contribution to aquifer is expected to be negligible.

Note: Blue text indicates modifications from 2019 Chemical Approval Request.

6. Provide the aquatic toxicity of the chemical, as documented in the SDS

Chemical		Aquatic Toxicity (SDS Information)	Comments
1	Sodium monobasic phosphate	No information/not fully investigated Ecotoxicity: Do not empty into drains	Not anticipated to be toxic at anticipated downstream surface water concentrations, since concentration at outfall will be maintained below water quality limits. Applies to active and other components.
2	Phosphoric acid	This material is an acid. The primary effects and toxicity of this material are due to its corrosive nature. Fish: Mosquitofish, 138 mg/L, 96 hours, LC_{50}	
3	Fluorescein	LC_{50}: Catfish: 2,267,000 ug/L Rainbow Trout: 1,372,000 ug/L Bluegill: 3,433,000 ug/L	Not anticipated to be toxic at anticipated downstream surface water concentrations (< 0.5 mg/L at SW-33, below casual visual detection limit)
4	Eosine	Ecological Information: NA Toxicological: Oral (Animal): > 2000 mg/kg (Rat)	
5	Rhodamine WT	Ecological: Not determined Toxicological: No data available	
6	Potassium Chloride	Toxicity to fish: LC_{50} - Fathead minnow - 880 mg/L - 96 h Mortality NOEC - Fathead minnow - 500 mg/L - 7 d Mortality LOEC - Fathead minnow - 1,000 mg/L - 7 d Toxicity to daphnia and other aquatic invertebrates: EC_{50} - Daphnia magna - >440 mg/L 48h (OECD Test Guideline 202)	
7	Ferric Chloride	EC_{50} Daphnia 1: 9.6 mg/L LC_{50} fish 2: 75.6 mg/L	Toxicity information not believed to be applicable following pH neutralization and precipitation of metals in surface water
8	Sodium Aluminate	LC_{50} (96 hours): 11.1 mg/L (Western Mosquitofish) NR-ZERO (9 days): 5.0 - 40.0 mg/L (Chinook Salmon) NR-ZERO (1-4 days): 5.0 - 40.0 mg/L (Daphnia magna)	
9	MM-2480 Polymer	Toxicity to fish (dono rerio, rainbow trout, fathead minnow): LC_{50}/96 hours = 5-10 mg/L Toxicity to daphnia: EC50, 48 hours = 20-50 mg/L Toxicity to algae: Algal inhibition tests are not appropriate. The flocculation characteristics of the product interfere directly in the test medium preventing homogeneous distribut8ion which invalidates the test.	
10	Sodium Carbonate	Acute toxicity fishes: LC_{50}, 300 mg/L, 96 h, Lemomis macrochirus Acute toxicity invertebrates: EC_{50}, 200-227 mg/L, 48 h, Ceriodaphnia sp. Toxicity algae and other aquatic plants: EC_{50}, 242 mg/L, 5 days, Algae	Product will be used to neutralize acid generated by ferric chloride. Toxicity information not believed to be applicable at neutral pH of surface water.
11	Sodium Bicarbonate	LC_{50} Fish 1: 7100 mg/L Bluegill LC_{50} Fish 1: 8250 - 9000 mg/L (96 h, Lepomis macrochirus) EC_{50} Daphnia 1: 4100 mg/L; 2350 mg/L (48 h, Daphnia Magna) LC_{50} Fish 2: 7700 mg/L Rainbow Trout	
12	Calcium Hydroxide (fine, slaked)	Toxicity to fish: LC_{50} - Clarias gariepinus - 33.884 mg/L - 96 hours Toxicity to daphnia and other aquatic invertebrates: EC50 - Daphnia magna - 49.1 mg/L - 48 h Toxicity to algae: EC_{50} - Green algae - 184.6 mg/L - 72 h	Product will be used in a lime softening application with co-removal of phosphate or as neutralizing agent in well redevelopment. Toxicity information not believed to be applicable following precipitation of calcium carbonate in surface water.
13	Hydrochloric Acid	LC50 Fish 1: 100% pH lowered to 3.6 mg/L Bluegill LC50 Fish 2: 282 mg/L (mosquito fish)	Product will be applied in injection wells and removed after a short period in order to remove mineral scaling; solution will be pH-neutralized before discharge to surface and toxicity information not believed to be applicable.
14	Mudnox ®	Alkyloxypolyethyleneoxyethanol LC_{50} Fish 1: 3.2 mg/L 96 h Pimephales promelas EC_{50} Crustacea: 3.2 mg/L 48 h water flea Polyethylene glycol LC_{50} Fish 2: 5000 mg/L 24 h Carassius auratus	Product will be applied in injection wells and removed after a short period in order to remove mineral scaling; product anticipated to attenuate, biodegrade, and dilute before reaching surface water
15	Sodium lactate	Toxicity to fish: Oncorhynchus mykiss (rainbow trout) - 130 mg/L - 96 h Toxicity to daphnia and other aquatic invertebrates: Daphnia magna (water flea) - 130 mg/L - 48 h	Product will be consumed within bioreactor prior to discharge to Indian drainage; further dilution and microbial consumpion in drainage
16	Lactic Acid	EC_{50} Daphnia = 240 mg/L - 48 h LC_{50} fish = 320 mg/L - 48 h EC_{50} Algae = 3500 mg/L	
17	Diammonium phosphate	Toxicity to fish Cirrhinus mrigala: LC_{50}/96 hours = 1,700 mg/L Pimephales promelas LC50/96 hr = 155 mg/L Toxicity to daphnia: LC50, 96 hours = 1,790mg/L LC50	Product will be dosed well below toxicity thresholds; majority of product will be consumed within bioreactor prior to discharge to Indian drainage; additional dilution in Indian drainage
18	Yellow Iron Oxide	Toxicity to fish LC50, 96Hrs, Fish mg/L: >1000 (48 h) Idus Idus dorata	Product will not be present in surface water at indicated concentrations
New: 2020			
19	Sodium Sulfite	LC50 fish 1: 220-460 mg/l	Sulfite will oxidize to sulfate in groundwater before potential discharge to surface water
20	Potassium Sulfite	Toxicity to fish-Golden orfe-215-464 mg/l 96 h	

Note: Blue text indicates modifications from 2019 Chemical Approval Request.

Attachment 2

PITCH RECLAMATION PROJECT

January 29, 2020

Ms. Jennifer Charles
Environmental Protection Specialist
Permits Section Unit 3
State of Colorado, Water Quality Control Division
Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246
Phone: (303) 692-6430
jennifer.charles@state.co.us

RE: Chemical Approval Request for CDPS Permit (Number CO0022756) for the Pitch Reclamation Project, Saguache County, Colorado

Dear Ms. Charles:

Homestake Mining Company is continuing to advance alternatives that can be implemented at the Pitch Reclamation Project (Figure 1) to reduce uranium load to the Colorado Discharge Permit System (CDPS) permit (Number CO0022756) compliance point Outfall 001A (also known as SW-33) and establish the Lowest Practical Level (LPL) for uranium. Alternatives currently being evaluated include introduction of phosphate reagents at strategic locations to precipitate aqueous uranium and achieve source control, addition of iron- and aluminum-based reagents for removal of potential surface water phosphate residuals, and emplacement of solid-phase media to achieve passive flow-through treatment of aqueous uranium. The CDPS permit does not specify any chemicals for use (Part IV.A.3); therefore, these reagents must be approved by the Water Quality Control Division (WQCD) prior to use.

Building upon successful pilot tests and expanded field demonstration from 2015 through 2019, plans are being developed to conduct additional field demonstration testing in 2020 to continue to advance uranium load reduction alternatives. Specific details regarding planned chemical usage as part of the 2020 field program, a description of the fate and transport of injected reagents, and control measures to be taken to maintain compliance with the CDPS permit and terms of the chemical approval are described below. This 2020 Chemical Approval Request is similar to the 2019 Chemical Approval Request with the following addition:

- Addition of an oxygen scavenger (sodium sulfite or potassium sulfite) to lower the dissolved oxygen content of pit lake water to be extracted, dosed with phosphate reagents, and reinjected.

Beyond the addition noted above, the maximum quantities of chemicals proposed for use in 2020 do not exceed the amounts proposed and approved for use in 2019; we therefore request approval for usage of these chemicals according to the previous approval basis. The sulfite reagent included above will fully react and convert to sulfate following injection, resulting in minimal influence on water chemistry at Outfall 001A.

Background

Initial chemical approval for uranium load reduction alternatives evaluation was granted by the WQCD on July 10, 2015 for "proof of concept" pilot testing using phosphate reagents and conservative tracer. Additional chemical approval was granted as follows:

- June 3, 2016 for expanded pilot testing using larger quantities of phosphate reagents and tracers, iron- and aluminum-based reagents in management of phosphate residuals, and solid-phase reagents (fish bone apatite and zero-valent iron [ZVI]) in flow-through pilot test-scale ETCs.
- June 1, 2017 for expanded field demonstration phosphate injections, treatment residuals management, and ETC testing using ZVI reactive media.
- May 31, 2018 for use of chemicals to continue 2017 field testing through the 2018 field season.
- June 17, 2019 for use of chemicals to continue field testing through the 2019 field season, as well as well redevelopment activities and new media amendments investigated in a biochemical reactor pilot test that operated during the 2019 field season.

Phosphate injection tests conducted from 2015 to 2019 were effective in demonstrating uranium removal within and immediately downgradient of injection zones. The specific results of the 2015 through 2018 LPL programs are described in more detail in the LPL updates provided to the WQCD:

- 2015 LPL Update dated April 4, 2016
- 2016 LPL Update dated December 6, 2016
- 2017 LPL Update dated July 11, 2018; also provided to the Water Quality Control Commission in advance of the Temporary Modifications Rulemaking Hearing for Regulations 32-38, December 10, 2018
- 2018 LPL Update dated June 25, 2019

The 2019 LPL update will be provided to the WQCD Standards Unit in early 2020.

In 2019, a total phosphate reagent quantity of 13,000 kilograms (kg) as phosphate (4,240 kg as P) was approved for injection. The actual amount of phosphate reagent injected in 2019 was approximately 2,650 kg, injected as follows:

- A total mass of 1,150 kg of phosphate was dosed into 650,000 gallons of groundwater extracted and reinjected in the underground mine workings
- A total mass of 1,500 kg of phosphate was dosed into 1.75 million gallons of groundwater extracted and reinjected in the Indian Rock Dump

During and following phosphate injections from 2015 through 2019, compliance with the CDPS permit conditions and terms of the chemical approvals was maintained at SW-33, with phosphorus concentrations not observed above 0.11 milligrams per liter (mg/L), and no indication that values would approach this level on a running annual median basis. Total phosphorus detections in surface water at SW-33 in 2019 were all below 0.024 mg/L, compared to the 0.11 mg/L water quality standard. Values were also below the standard at upstream points across the site, with the highest value of 0.053 mg/L observed local to the Indian Rock Dump and occurring only during a brief period in the summer. In addition, bench-scale and pilot testing demonstrated the effectiveness and feasibility of iron and aluminum reagent addition for removal of residual dissolved phosphate as part of a "treatment residuals management program", should it become necessary if injected phosphate expresses to surface water at concentrations approaching compliance limits.

Proposed 2020 Activities

Additional expanded field demonstration-scale testing is planned for 2020 to continue to advance uranium load reduction alternatives. Specific activities known to require chemical approval are described below.

Continued Phosphate Injection Remedy Testing

A continuation of the phosphate injection program implemented in 2017 through 2019 is proposed for 2020. Separate phosphate injections will be conducted in the underground mine workings and in the Indian Rock Dump using a combination of wells and infrastructure installed from 2015 through 2019.

At the Indian Rock Dump, groundwater will be extracted from one set of monitoring wells and piped to another set of monitoring wells for reinjection in the Former Pinnacle Mine Dump (Figure 2). Reagent stock solutions will be added through a tee directly into the recirculating water as it is piped from extraction to injection wells.

At the underground mine workings, HMC plans to modify the existing extraction/injection/recirculation process to include extraction of surface water from the North Pit Lake. Reagent stock solution and an oxygen scavenger (discussed below) will be added to the extracted water, which will then be piped to existing injection wells. The water recirculation and dosing program will involve extraction and reinjection of several million gallons of groundwater in each area. Specifically, the current goal of the phosphate injection program is to maintain operations at the annual recirculation and phosphate dosing rates approved in previous years until a sufficient quantity of phosphate has been deposited to yield observable uranium load reductions in downgradient surface water drainages. Based on this goal, the maximum phosphate chemical usage for 2020 is

proposed as the 2019 approved value of 13,000 kg as phosphate (described below). Non-reactive tracers will again be used in 2020 in quantities similar to what was approved for use in 2019. Tracers will be used at the underground mine workings, the Indian Rock Dump, and at the ETCs.

Based on rationale presented below, it is anticipated that surface water phosphate values will remain below the water quality standard of 0.11 mg/L (particularly on a running-annual median basis), despite continued use of reagent. The rationale is similar to the basis presented in the 2017 through 2019 chemical approval requests and responses to comments and has been further confirmed by observations during the previous three years of field implementation. The same control measures put in place in 2017 through 2019 will continue to be implemented in 2020. The basis for the proposed phosphate mass and associated control measures are described in the "Usage Basis and Anticipated Fate and Transport" section of this request.

Oxygen Scavenger for Underground Workings Source Water

From 2015 to 2019, water was extracted in the northern end of the underground mine workings and reinjected in the southern end. The 2020 modification of extracting water from the North Pit Lake is anticipated to provide an opportunity to achieve higher solution injection volumes than under the current configuration. Currently, injections into the northern underground mine workings are limited by the preferential flow path or "short-circuit" that develops between extraction well P-7 and the northern injection wells (P-4 and P-11), resulting in undesirable re-extraction of injected water. By extracting from the North Pit Lake instead, this short circuit is eliminated, and injections into the northern underground mine workings can be conducted throughout the season rather than only at the end of the season. The change in source water will require addition of an oxygen scavenging reagent to consume anticipated dissolved oxygen prior to dosing and reinjection. Specifically:

- Surface water will be pumped from the pit lake directly to the existing system for reinjection.
- Reagent stock solutions will be added through dosing pumps directly into the recirculating water.

Injection Well Rehabilitation

A continuation of the injection well rehabilitation program implemented in 2019 is proposed for 2020. An addition to the LPL program in 2019 included the use of well rehabilitation chemicals to remove well screen precipitates that formed during ongoing injection. The approved chemical reagents in 2019 include hydrochloric acid, slaked lime (calcium hydroxide; $Ca(OH)_2$), and Mudnox® (active ingredients alkyloxypolyethyleneoxyethanol and polyethylene glycol). The well rehabilitation procedure proposed for 2020 will be similar to 2019. A mixture of hydrochloric acid and Mudnox® will be added to each injection well to dissolve precipitates. Following a brief shut-in period, the reagent will be subsequently pumped out of the well into a storage tank and pH-neutralized using calcium hydroxide. Following settling to remove solids, HMC

will reinject the pH-neutralized decant water into an Indian Rock Dump injection well, consistent with the 2019 procedure. The solids generated will be disposed separately following appropriate disposal procedures.

Engineered Treatment Cell Testing

In 2019, three drum-scale ETCs were installed to investigate optimization of ETC reagent media mixtures. Solid-phase media and liquid reagents used in the tests, including yellow iron oxide, lactic acid, sodium lactate, hydrochloric acid, and diammonium phosphate, were approved for use in 2019. These reactors will continue to be operated in 2020 as installed. No additional yellow iron will be added to the drum, and the liquid reagents will be used in the same approved quantities as 2019. In addition to the drum scale ETCs, two field demonstration scale ETCs were operated in 2018 and 2019. These treated re-routed surface water from the Chester Fault Springs (CFS) locations. These cells will continue to be operated in 2020 as installed.

Treatment Residuals Management Program

A system for management of treatment residuals in surface water (particularly phosphate) was constructed adjacent to Indian drainage in 2016. In the event that phosphorus is observed at key surface water monitoring points at concentrations that would risk exceeding the water quality standard at SW-33, iron and/or aluminum reagents will be added directly to surface water to remove dissolved phosphate, as described below. In addition, a system for addition of calcium hydroxide into surface water at the North Pit Lake may also be used as a means of reducing phosphate concentrations, if necessary. The management program has not been required since inception; however, phosphate monitoring will continue as in previous years to evaluate the potential for exceedances to water quality standards.

Chemical Usage

To advance the evaluation of uranium load reduction alternatives, we request approval to use the chemical additives provided in Table 1, with the understanding that concentrations of reagents used will remain below water quality standards at SW-33. Specifically:

- The annual-median total phosphorus concentration will be maintained below 0.11 mg/L, as established in Regulations 31 (the Basic Standards and Methodologies for Surface Water) and 35 (Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins) and effective January 31, 2018.
- Fluorescent tracers will be maintained below 0.5 mg/L, the point at which a casual observer might notice a change in coloration of the water.
- pH will be maintained within the permit limitations of 6.5 to 9.
- Total recoverable iron will be maintained below the 1.0 mg/L standard for Indian Creek, consistent with anticipated maximum total recoverable and dissolved iron concentrations of 0.3 mg/L (described below).

- The 30-day average total recoverable aluminum concentration will be maintained below the receiving water chronic aluminum standard of 1.438 mg/L (calculated hardness-based standard for an assumed pH of 8.3 and hardness capped at 220 mg/L as $CaCO_3$, per Regulation 31), consistent with anticipated maximum total recoverable and dissolved aluminum concentrations of 0.3 mg/L (described below).
- The contributions to electrical conductivity (EC) and Sodium Adsorption Ratio (SAR) will be maintained well below the CDPS permit Water Quality-Based Effluent Limitations (WQBEL) limits. Specifically, the EC will be maintained below 1.3 deciSiemens per meter (dS/m) per the CDPS permit, and the SAR will be maintained below the EC-dependent calculated value of 9 or lower.
- Chloride concentrations will be maintained below 50% of the chronic standard of 250 mg/L for Marshall Creek.
- Ammonia concentrations will remain below detection levels, in accordance with the WQCD requirement outlined in the Approved Chemical Usage – 2019 Field Season Memorandum dated June 17, 2019.

The maximum anticipated quantities of reagent to be used in 2020 are also provided in Table 1, and the Safety Data Sheets (SDSs) for these reagents are provided in Attachment A. The Usage Basis and Anticipated Fate and Transport section below provides the calculation results and rationale for estimated SW-33 concentrations based on proposed reagent quantities and site-specific flow rates. In cases where reagent quantities were the same as last year, these calculations have not changed from previous chemical approvals. Although the previous calculations are based on older historical Site drainage flow averages, a comparison of SW-33 flow rates over the past ten years confirms that the date ranges specified below are still applicable.

Usage Basis and Anticipated Fate and Transport

Monitoring results collected during field activities from 2015 through 2019 have provided important information on subsurface water flow and behavior of injected solutes that can be used to inform additional field implementation. Specifically:

- Dye tracers indicate that pore water in the underground mine workings is migrating primarily from south to north toward the North Pit Lake. Tracers injected into monitoring wells P-4 and P-11 are observable at downgradient Chester Fault Springs (approximately 700 feet away) within approximately 1 month.
- Tracer results further suggest that solute transport is influenced by a substantial degree of mixing and dispersion. Tracer concentrations at downgradient monitoring points do not arrive as a discrete concentrated mass or “slug” as it was injected, but rather as a continual, low-level tail, suggesting substantial dispersion of the injected plume as it radiates outward from the injection zone. Low, uniform concentrations observed in CFS, CFS-2, and P-8 (Figure 2) suggest a high degree of mixing across a large aqueous volume and slow advection out of the underground mine workings. This provides evidence that residual soluble phosphate is likely migrating in the same way in the underground mine workings area; in other words, the injected phosphate mass is not traveling as a discrete

plume, but is exhibiting substantial dispersion (in addition to attenuation) as water flows downgradient.

- Results from the Indian Rock Dump injections also suggest that migration of residual phosphate (following adsorption and precipitation) is largely controlled by spreading and dispersion of residual dissolved reagent, rather than migrating as a discrete plume. For example, during 2016 pilot testing, downgradient monitoring-well RD-04 exhibited phosphate concentrations that quickly (within days of injection) increased to a maximum concentration of 10 mg/L (over 30 times lower than injection strength), remaining steady before slowly decreasing.

2019 and proposed 2020 phosphate injections are focusing on a localized source zone area of the Indian Rock Dump referred to as the Pinnacle Mine Dump (Figure 2). This injection location is further upgradient within the rock dump than the 2017 and 2018 injection location on the 10300 level of the dump. This modification provides additional distance within the dump over which phosphate can attenuate and disperse. Attenuation of phosphate injected in 2019 was confirmed by minimal phosphate levels observed in downgradient monitoring well IRD-MD-01.These results provide the basis for keeping the assigned maximum injection quantities of additional reagents in 2020 at the levels approved for use in 2017 through 2019, with the goal of realizing significant uranium reduction observable in surface water while continuing to achieve regulatory compliance in surface water at SW-33.

Non-Reactive Tracers

For the fluorescent dye tracers, it is assumed that the primary control on SW-33 concentrations is dilution. For this reason, the overall mass of tracer used will be limited to what is reasonably expected with dilution across the site to maintain compliance. Previous tracer usage from 2015 through 2019 demonstrated that tracers injected into the subsurface do eventually express to surface water with maximum concentrations of tracer dye at SW-33 of approximately 0.7 µg/L detected after four months of phosphate injections in 2018, three orders of magnitude lower than the 0.5 mg/L visual limit. During the 2019 field season, none of the three tracers were observed at detectable limits at SW-33.

For 2019, the proposed maximum combined dye usage is 50 kg, applied as fluorescein, rhodamine WT, and/or eosine. This 50 kg quantity is the same as the approved quantity in 2019. Based on dilution estimations provided in previous chemical approval requests as well as two years of surface water analytical results with similar tracer loading, dye concentrations are anticipated to remain well below the casually-observable visible limit of 0.5 mg/L at SW-33.

In addition to the dye tracers that will be included in the phosphate injections, potassium chloride (KCl) salt may be used in single-well tracer tests. These tests were performed in select wells in 2016 to confirm groundwater velocity near wells used for injection/extraction and monitoring. While these tests were not performed in 2017 through 2019, they may be performed again in 2020 in newly-installed wells and/or wells not tested in 2016 through 2019. The tests involve replacement of the water within the well

screen with a solution of higher conductivity than the water in the surrounding aquifer. Because the tests require addition of a volume equivalent to the volume within the well screen the reagent volumes are very small (approximately 20 gallons for a 20-foot, 5-inch inner-diameter well screen). The mass of KCl to be used in 2020 (maximum of 2 kg) will not pose risk at SW-33.

Phosphate

Data collected over five years of phosphate injections (2015 through 2019) continue to demonstrate that total phosphorus concentrations downgradient of injection zones are limited by sorption and precipitation reactions, in addition to dilution. In 2019, a total phosphate reagent quantity of 13,000 kg was approved for injection. The actual amount of phosphate reagent injected in 2019 was approximately 2,650 kg. Following 2019 injections, total phosphorus was not observed above 0.024 mg/L at SW-33, determined using EPA Method 365.1 (reporting limit of 0.005 mg/L). (The dissolved phosphorus concentration during the same sampling event was 0.008 mg/L, indicating that the sample may have been influenced by particulate matter.) These results suggest that larger quantities can continue to be injected while maintaining concentrations below the 0.11 mg/L annual-median limit, likely without the need for treatment residuals management. A maximum phosphate chemical usage quantity of 13,000 kg as phosphate (4,240 kg as P, consistent with the 2019-approved quantity) is proposed for use in 2020, to be applied as a combination of phosphoric acid and sodium monophosphate.

The expected maximum concentration for total phosphorus at SW-33 can be estimated according to the rationale provided in previous chemical approval requests. This rationale is reproduced below, and still applies based on observations to-date:

- The expected maximum concentration for total phosphorus at SW-33 can be calculated by accounting for phosphorus dilution and attenuation via adsorption and precipitation. Based on the assumptions outlined below, a maximum concentration of 7.7 mg/L P was estimated at SW-33. However, this estimate does not include the operational procedures and treatment residuals management program put into place to maintain total phosphorus concentrations at SW-33 below 0.11 mg/L P.

- The calculated maximum total phosphorus concentration of 7.7 mg/L P includes the following two components:

    - Maximum SW-33 concentration resulting from underground mine workings injections: 2.1 mg/L P

    - Maximum SW-33 concentration resulting from Indian Rock Dump injections: 5.7 mg/L P

- These components were based on the following assumptions:
    - Based on the residence times of surface water bodies across the site, the concentration was estimated using the maximum injection mass over the

first 24 days of operation (first four weeks assuming 6 days per week operation, 24 hours per day). This is based on the rationale that, given the phosphorus injection rates, potential SW-33 compliance issues would be realized before the total approved reagent mass could be injected. This assumption corresponds to total reagent masses of 1,180 kg phosphate as phosphorus in each of the underground mine workings and Indian Rock Dump (2,360 kg as P total).

- Underground mine workings injected phosphorus is assumed to be diluted in the North Pit Lake, Indian drainage, and Sediment Pond, while Indian Rock Dump injected phosphorus is assumed to be diluted in the Sediment Pond only.
- In the 2016 chemical approval request, an in-situ phosphorus attenuation rate of 50% was assumed for calculations. Based on 2016 through 2019 observations, the actual attenuation was greater than 90%.
- Accordingly, the assumed phosphorus attenuation rate was increased to 85%, which is still conservative relative to the actual level of phosphorus attenuation observed over the past four years of injections.

Based on the assumptions outlined above, a maximum concentration of 7.7 mg/L P was estimated at SW-33; however, this assumption is still conservative given the actual observed concentrations ranging from below detection at 0.005 mg/L to a maximum concentration of 0.024 mg/L at SW-33 in 2019. In addition, this estimate does not include the operational procedures and treatment residuals management program (each described further below) which will be put into place to maintain annual-median total phosphorus concentrations at SW-33 below 0.11 mg/L as P.

Oxygen Scavenger Reagents

Reagents used for oxygen scavenging of surface water are proposed for use at the underground mine workings. Two reagent options are proposed for use; sodium sulfite and potassium sulfite. Both reagents react fully with dissolved oxygen, reducing O_2 to H_2O and oxidizing sulfite to sulfate, releasing sodium or potassium ions.

A bench test conducted in 2019 demonstrated that sodium sulfite dosed into surface water collected from North Pit Lake was fully consumed, generating dissolved sulfate. The reagent fully reacts, resulting in below detectable sulfite concentrations in the samples (below a 2 mg/L laboratory reporting limit). In these tests, sodium sulfite was dosed at 40 mg/L as sulfite, the stoichiometric equivalent required to remove 8 mg/L of dissolved oxygen. As an added contingency, a maximum concentration of 60 mg/L as sulfite, dosed as either the sodium or potassium salt, is proposed for use in 2020, with a total maximum reagent quantity of 910 kg as SO_3 proposed for use in 2020. This concentration would result in a sulfate concentration of 72 mg/L following sulfite oxidation to sulfate.

The anticipated concentration of sulfate in the injection water, governed by ambient sulfate concentrations in North Pit Lake water plus sulfate added with sulfite reagent addition, would be similar to sulfate concentrations in the formation. The sulfate

concentration in North Pit Lake water (2012-2019 average) is 212 mg/L; addition of sulfite at the proposed maximum would increase this to 284 mg/L For comparison, the historical average sulfate concentrations at underground mine workings injection wells P-4 and P-5 is 232 mg/L and 443 mg/L, respectively. Accordingly, the injection water is not anticipated to increase the sulfate concentration in groundwater in the injection zone which ultimately expresses to surface water.

EC/SAR may also be affected by increased sodium in the groundwater with use of the sodium sulfite salt. This effect is accounted for in the EC/SAR calculation for 2020 and is described in the SAR section below. The downstream effect of additional sodium is not expected to raise the EC and SAR above the allowable levels of 1.3 dS/m and 9, respectively.

Well Rehabilitation Reagents

Well rehabilitation chemicals are planned for use in 2020 to remove silt and chemical precipitates from injection well screens to maintain maximum injectability. Chemical reagents proposed for use include hydrochloric acid and Mudnox®, with calcium hydroxide used for neutralization of spent rehabilitation solution.

The same quantities approved for use in 2019 are proposed again in 2020. This includes 160 gallons of 32% hydrochloric acid and 10 gallons of Mudnox, based on an assumed 20 rehabilitation events. After rehabilitation, the water will be removed until extracted water exhibits near-neutral pH and low turbidity. The extracted water will then be neutralized with slaked lime. The neutralization will result in reprecipitation of dissolved solids and settling of precipitates in the water collection tank, which will be separated. The decant solution, primarily composed of groundwater containing residual chloride, Mudnox, and phosphate, will be reinjected at an Indian Rock Dump injection well.

Engineered Treatment Cell Reagents

Drum scale tests installed in 2019 and field scale tests installed in 2018 will be operated in the 2020 field season. The liquid reagents approved in 2019, including a mixture of lactic acid/sodium lactate, hydrochloric acid, and diammonium phosphate, will be used at the same concentrations in 2020 as described in Attachment 1.

Based on the limited volume of the reagents, consumption within the ETCs, low solubility of solid-phase media, and high dilution factor (3 orders of magnitude), the concentration of dissolved constituents released from the ETCs (sodium, phosphorus, residual unreacted lactate and/or ammonium) will be negligible at SW-33. Specifically, dissolved organic carbon, ammonium, and phosphate dosed into the ETC will be consumed in the reactors and dosed at concentrations to limit residual unreacted reagent. Iron oxide dissolved in the ETC drums will either precipitate as iron sulfide within the drums or will reoxidize and reprecipitate in surface water downgradient of the cells. Any residual reagents will be substantially diluted with discharge to the Indian Drainage. The maximum flow through each drum-scale test is anticipated to be no more than 2 gallons per hour. The Indian Drainage flow rate is approximately 160 gallons per minute, which reflects a

three-order of magnitude dilution. The effect of sodium lactate usage on SAR are considered negligible.

Treatment Residuals Management Reagents

Iron and Aluminum

As described in the 2017 through 2019 chemical approval requests, dissolved iron and aluminum concentrations will be limited by precipitation as metal oxyhydroxides, while total recoverable concentrations will be limited by settling of precipitated solids in the Sediment Pond. Bench testing conducted in 2016 demonstrated that iron and aluminum dosed into water collected from SW-33 rapidly precipitated and settled to less than 1 mg/L (less than 0.3 mg/L on a dissolved basis) at the concentrations tested (up to 100 mg/L). Additional bench testing conducted in 2017 with artificial surface water having a similar composition as SW-33 demonstrated near complete removal of phosphorus (total and dissolved) using iron- and aluminum-based reagents in combination with polymer flocculant. Initial phosphorus concentrations of up to 5 mg/L were reduced to less than the reporting limit of 0.1 mg/L, for both total and dissolved phosphorus, through precipitation and flocculation of iron-and aluminum-phosphate precipitates. Non-detect dissolved iron and aluminum results as well as reductions in total iron and aluminum concentrations by over an order of magnitude (less than 0.75 mg/L) demonstrate that residual iron and aluminum are particulate and can be controlled to below permit requirements. Precipitation and settling of these metals is more effective at greater dosed concentrations, since larger particles are formed which settle more easily. Accordingly, the anticipated total recoverable concentrations at SW-33 are not anticipated to be dependent on the total quantity used. The more robust silt curtain installed in 2017 will also aid in the settling of iron and aluminum precipitates in the Sediment Pond upstream of SW-33.

For the purposes of determining maximum reagent quantities for use in 2020, the following assumptions on dosing concentrations and operation timeframe were made. These operational assumptions are identical to those assumed for 2017 through 2019 operations.

- Ferric chloride dosed concentration: 50 mg/L iron, 95 mg/L chloride
- Sodium aluminate dosed concentration: 40 mg/L aluminum

Iron and aluminum concentrations at SW-33 will be substantially lower than the dosed concentrations due to precipitation reactions, as described above.

For determining maximum reagent masses, the treatment residuals management program is assumed to be in operation for a maximum period of 60 days. Using an average Indian drainage flow rate of 160 gpm (August flow rates from 2009 through 2014; confirmed to be similar to current flow rates), the maximum total masses are as follows:

- Ferric Chloride: 2,600 kg iron, 5,000 kg chloride
- Sodium Aluminate: 2,100 kg aluminum

Lime

In addition to iron and aluminum reagents, addition of slaked lime (calcium hydroxide) into surface water may be used as a means of reducing phosphate concentrations, if necessary. Calcium hydroxide addition can result in an increase in pH; however, the following guidelines and principles will apply to maintain pH below 9.0 at SW-33:

- Addition of lime will result in the removal of calcium, magnesium, and bicarbonate through precipitation of carbonate minerals (e.g., calcite). This "lime softening" process substantially reduces the bicarbonate alkalinity of the water.
- As higher pH lime-dosed water re-equilibrates with air in the turbulent flow of the drainages, the dissolution of CO_2 will result in reacidification to below pH 9.
- The maximum lime quantity to be used in 2020 is 10,000 kg as $Ca(OH)_2$ (identical to the approved quantity in 2019, which was not used), calculated as the mass required to completely lime soften the volume of the North Pit Lake (approximately 13.3 million gallons).

Flocculant

While not implemented in 2019, use of a commercial organic polymer flocculant is again being considered in 2020 in combination with iron and aluminum dosing as a means of enhancing the agglomeration and settling of iron/aluminum precipitates as part of the treatment residuals management program. The flocculant will aid in the coagulation of iron and aluminum precipitates, as demonstrated in the 2017 bench scale testing. The program would involve dosing of polymer flocculant MM-2480 (Mineral Masters), which was approved for use in 2017 through 2019. Flocculant will be added to the Indian drainage at the point where it discharges to the Sediment Pond. The maximum mass of flocculant requested for approval in 2020 is 52 kg, corresponding to the 60-day use assumption discussed above (for sodium aluminate and ferric chloride), with a dosed concentration of 1 mg/L. This is identical to the approved quantity in 2017 through 2019. The basis for use is similar to that provided in the 2019 chemical approval request:

- Because the flocculant is removed from solution, the concentration at SW-33 will not be a simple function of the maximum mass added. Specifically, it is anticipated that a minimum 95% removal efficiency of the flocculant will be realized, which would yield a maximum flocculant concentration of 0.05 mg/L at SW-33. It should be noted that this estimate does not include dilution in the Sediment Pond, which would further lower the flocculant concentration at SW-33.
- Based on the SDS information on ecological toxicity for the flocculant MM-2480, this maximum dosing is below ecotoxicological limits. Specifically, LC-50 values for fish are 5 to 10 mg/L, while EC-50 values for daphnia are 20 to 50 mg/L. Further, the SDS for this compound indicates that its toxicity is substantially reduced in the environment due to adsorption to organic matter and degradation by hydrolysis in natural waters.

As documented in the 2019 Chemical Approval Request, acrylamide is noted on the SDS for MM-2480. However, acrylamide is not present as a degradation product of the polymer; rather it is present as a chemical residual in the polymer manufacturing process. According to the polymer vendor (Mineral Masters), the acrylamide residual present in the product constitutes less than 1 mg/kg. Based on a maximum 1 mg/L dosing concentration of the flocculant, the dissolved acrylamide concentration in water would be near 1 part per trillion or less. No mitigation measures for dissolved acrylamide are planned.

Sodium Carbonate/Bicarbonate

Acidity generated by the addition of ferric chloride will not exceed the pH buffering capacity provided by the natural alkalinity in the water of approximately 200 mg/L as calcium carbonate. The use of sodium aluminate in combination with ferric chloride will also act to neutralize iron acidity. Regardless, a combination of sodium carbonate and sodium bicarbonate may also be used along with iron and aluminum reagents. Use of these reagents does not pose risk at SW-33 other than the addition of sodium and potential increased pH with sodium carbonate. The concentrations of these reagents will be limited so as not to exceed the SAR (described below) or a pH of 9 at the dosing point, which will ensure compliance downstream at SW-33.

Sodium Adsorption Ratio (SAR)

Calculation of the SAR follows the same rationale provided in the 2019 chemical approval request, reproduced below, but with numbers adjusted to reflect anticipated 2020 usage and average August flows at SW-33 (2013-2019). Sodium-containing reagents which will contribute to the SAR at SW-33 include the following:

	Reagent concentration (mg/L)	Sodium concentration (mg/L Na)	Flow rate (gpm)	Effective SW-33 Contribution (mg/L)
Underground Workings Injections:				
Monosodium phosphate	421.0	80.7	60	17.7
Eosine	10	0.66	60	0.1
Indian Rock Dump Injections:				
Monosodium phosphate	0.0	0.0	50	0.0
Rhodamine WT	10	0.81	50	0.1
Treatment Residuals Management (Dosing in Indian Drainage):				
Sodium aluminate	40	34.1	160	20.0
Sodium carbonate/bicarbonate	80	21.9	160	12.8
Engineered Treatment Cells and Drum-scale Tests:				
Sodium Lactate	613.6	125.9	0.03	0.02
Fluorescein	10	1.22	0.03	0.0001
Oxygen Scavenger:				
Sodium Sulfite	94.5	34.5	60	7.58

*Calculation assumes all phosphate from injection systems derived from monosodium phosphate in order to calculate maximum possible SAR. During operations, phosphoric acid: monosodium phosphate dosing ratio is closer to 3:1 and would result in significantly lower sodium contribution.
**Calculation assumes all sulfite reagent dosed as sodium sulfite in order to calculate maximum possible SAR. The use of potassium sulfite will result in lower sodium concentrations and a lower SAR.

The table above includes maximum concentrations of sodium for each reagent based on flow streams. These flows will be diluted with other surface water streams above SW-33. Based on an average August flow rates at SW-33 (from 2013-2019) of 273 gpm, the sodium concentration increase would be a maximum of 4.5 mg/L. Using this sodium concentration, the SAR can be estimated using the following average SW-33 ion concentrations over the same period:

- Calcium: 142 mg/L
- Magnesium: 82 mg/L
- Bicarbonate alkalinity: 298 mg/L
- Ca(x) (modified calcium concentration based on ratio to bicarbonate) = 50 mg/L
- Electrical Conductivity (EC) = 0.96 dS/m

This yields a maximum calculated SAR at SW-33 of 1.27, well below the maximum allowable SAR of 4.31 based on an EC of 0.95 dS/cm. This estimate does not include dilution in the Sediment Pond, which would further lower the calculated SAR at SW-33.

Active Control Measures and Monitoring

As described above, chemical concentrations will be maintained below applicable limits at SW-33. Chemical concentrations will remain low via natural attenuation mechanisms (including adsorption, precipitation, and dilution), as well as active control measures where necessary. The following control measures will be implemented to maintain low surface water concentrations of added chemical reagents:

- Consistent with 2019 activities, phosphate injections will be operated in a “back-recirculation” injection approach at the Indian Rock Dump, wherein water will be extracted from downgradient monitoring wells and reinjected in upgradient monitoring wells relative to the predominant groundwater flow direction, upstream of discharge to surface water. Monitoring of the extracted groundwater (which will intercept upgradient injected water before it migrates downgradient and seeps into surface water) will provide an early warning for elevated phosphate.
- If phosphate is detected in extracted groundwater or in surface water during the monitoring program (described below) at concentrations that indicate the potential for non-compliance at SW-33, the injection program will be modified (i.e., reduced or ceased).
- If phosphate is still observed in surface water at levels that indicate concentrations will approach limitations at SW-33, operation of the treatment residuals management program will commence.

- A more robust silt curtain was installed in the Sediment Pond in 2017 to enhance the settling and removal of suspended iron and aluminum particulates deriving from treatment residuals management.

Performance monitoring will be conducted through the 2020 field season to evaluate the effectiveness of the field program and demonstrate compliance with the CDPS permit and associated chemical approval conditions. The program includes monitoring groundwater within the underground mine workings and Indian Rock Dump, downgradient surface water locations across the mine site, and SW-33 (Table 2, Figure 2). At a minimum, performance monitoring will be conducted weekly upon injection system startup through October 2020 (weather-permitting) and will include (Table 2):

- Field measurements: pH, electrical and specific conductivity, temperature, dissolved oxygen
- Laboratory analyses:
    - SW-33: Total recoverable and dissolved uranium, phosphorus, iron, and aluminum; total fluorescent tracer dye, chloride, and ammonium.
    - Other Locations (Table 2): Dissolved uranium, phosphorus, iron, and aluminum (occasional/less frequent total recoverable analysis for comparison); total fluorescent tracer dye. Iron and aluminum will only be collected downstream of potential dosing points, and with the exception of SW-33, may only be collected if iron/aluminum dosing systems are operating.

In addition, laboratory EC and SAR will be reported quarterly for SW-33, and real-time monitoring of phosphate will be performed using field test kits to confirm that surface water concentrations are within the limits summarized above. Quarterly whole effluent toxicity (WET) testing required by the CDPS permit is tentatively scheduled to occur in August, 2020 (3rd quarter) and October, 2020 (4th quarter), which should account for the timing that the chemicals would reach the outfall. In addition, monthly compliance monitoring at SW-33 will continue to provide long-term performance monitoring data beyond the timeframe shown in Table 2.

Summary

Advancement of uranium load reduction strategies will be continued at the Pitch Reclamation Project in 2020,. Operations will be similar to the program implemented in 2019, with exceptions noted above (including use of North Pit Lake water for injections and use of an oxygen scavenging reagent). This work will build upon the successes achieved and knowledge gained in the previous four years of field programs. The maximum chemical quantities proposed for 2020 are based upon fate and transport estimations (informed from the 2015 and 2016 pilot tests and 2017 through 2019 expanded field implementation) such that compliance at SW-33 will be maintained. Active control measures will also be employed if warranted to aid in achieving compliance at SW-33. The activities conducted in 2020 will provide for the continuation of establishing the LPL for uranium through implementation of practical strategies to reduce uranium mass loading.

If you have any questions or require further information regarding this chemical approval request, please contact me at (505) 252-9615.

Sincerely,

Dave Wykoff, on behalf of
Patrick Malone
President, Homestake Mining Company

CC: Blake Beyea – WQCD – Standards
Stephanie Baker – WQCD – Standards
Dave Wykoff – Homestake Mining Company, Site Manager
Mike Hay – Arcadis, U.S., Inc.

Tables

Table 1 – Proposed 2020 Chemical Usage
Table 2 – Performance Monitoring Schedule

Figures

Figure 1 – Location Map
Figure 2 – Monitoring Locations

Attachments

Attachment A – Safety Data Sheets

Tables

Table 1
Proposed 2020 Chemical Usage
Pitch Reclamation Project, Sargents, CO

Chemical Name	Usage	Maximum 2020 Quantity
Phosphates		
Sodium monobasic phosphate	Used in combination to yield solution > pH 4.5 for injection in underground mine workings and Indian Rock Dump	Combined chemical mass of 13,000 kg as PO_4
Phosphoric acid		
Non-Reactive Tracers		
Sodium fluorescein	Non-reactive tracer in underground mine workings, Indian Rock Dump injections, and Engineered Treatment Cells. Tracer combinations to be determined at time of injection.	Combined chemical mass of 50 kg
Rhodamine WT		
Eosine		
Potassium Chloride	Non-reactive tracer in single-well tracer tests	2 kg
Treatment Residuals Management		
Ferric Chloride	Dosing into surface water for treatment of phosphate residuals, if necessary	2,600 kg as Fe (5,000 kg Cl) Maximum concentration to maintain Cl < 95 mg/L at SW-33
Sodium Aluminate	Dosing into surface water for treatment of phosphate residuals, if necessary	2,100 kg as Al Maximum concentration to maintain SAR < 4.31 at SW-33 (total Na < 105 mg/L)
Cationic water-soluble polymer (MM-2480)	Potentially used as a flocculant for enhanced removal of iron and aluminum precipitates	52 kg
Calcium hydroxide (fine, slaked)	Dosing into surface water for treatment of phosphate residuals, if necessary	10,000 kg as $Ca(OH)_2$ Dosing concentration/rate limited to maintain downstream pH < 9.0
Sodium carbonate	Potentially used as pH/alkalinity buffer for ferric chloride	1,300 kg
Sodium bicarbonate	Potentially used as pH/alkalinity buffer for ferric chloride	2,100 kg
Well Redevelopment		
Chemicals for well redevelopment will be injected and subsequently extracted, neutralized and discharged to surface.		
Calcium hydroxide (fine, slaked)	Used to neutralize extracted well redevelopment water	90 kg
Mudnox®	Dispersant, injected and subsequently extracted during well redevelopment activities	0.5 gallons per event, 20 events
Hydrochloric Acid	Acid, mixed and injected with Mudnox® during well redevelopment activities	8 gallons per event, 20 events
Drum-Scale Tests		
Organic Acid	Carbon source for packed-bed reactor, sodium lactate/lactic acid combination	10 kg
Diammonium phosphate	Nitrogen and phosphate source for packed-bed reactor	2 kg
Iron additive	Iron source for drum-scale bioreactor	112 kg emplaced in 2019 cell that will continue to operate in 2020
Oxygen Scavenger		
Sodium Sulfite	Dosing into surface water for reduction of dissolved oxygen prior to phosphate dosing	Combined chemical mass of 910 kg as SO_3
Potassium Sulfite		

Note: Blue text indicates modifications from 2019 Chemical Approval.

Table 2
Performance Monitoring Schedule
Pitch Reclamation Project, Sargents, CO

Week of:	8-Jun	15-Jun	22-Jun	29-Jun	6-Jul	13-Jul	20-Jul	27-Jul	3-Aug	10-Aug	17-Aug	24-Aug	31-Aug	7-Sep	14-Sep	21-Sep	28-Sep	5-Oct	12-Oct	19-Oct	26-Oct	2-Nov	9-Nov
Operation Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Monitoring Location:																							
RD well*	X		X		X		X		X		X		X		X		X		X				
UW well*	X		X		X		X		X		X		X		X		X		X				
NPL	X	X			X		X		X		X		X		X		X		X		O		O
IC	X	X		X	X		X		X		X		X		X		X		X		O		O
TCC	X					X				X				X					X				O
Compliance Monitoring:																							
SW-33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	O

Analytes

Field parameters: pH, temperature, dissolved oxygen, conductivity

Monitoring Location Laboratory Analyses: Dissolved Uranium, Dissolved Phosphorus as P, Fluorescent Tracers (Fluorescein, Rhodamine WT, and Eosine; when dosing occurs)

Compliance Monitoring Laboratory Analyses:

- Monthly: pH, TSS, Total Radium-226 & 228
- Quarterly: Oil and Grease (visual), TDS, Total Recoverable Uranium, Potentially Dissolved Zinc, Dissolved Radium-226, WET, SAR/EC
- Weekly: Total Phosphorus, Total Recoverable Iron, Total Recoverable Aluminum
- Biweekly: Chloride, Ammonium

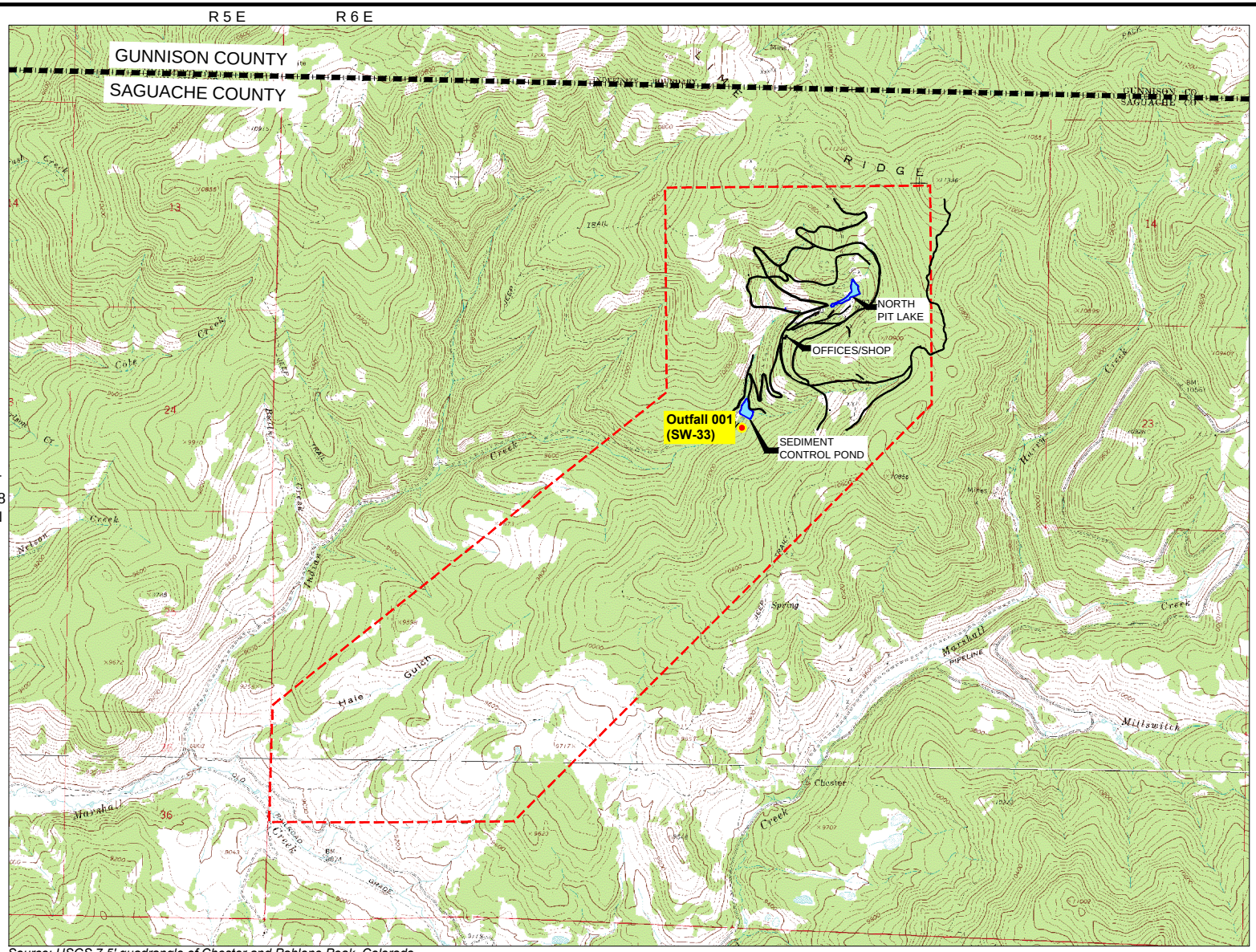
Notes

X - Tentatively scheduled sampling event. Monitoring schedule may be uniformly shifted +/- 2 week depending on weather/snowmelt conditions.

O - Provisional sampling event. May not be conducted depending on weather conditions.

* RD and UW well sample will be collected from RD-01, RD-02, RD-03, or RD-05 in the Rock Dump (RD), and P-13 or P-7 at the underground workings (UW), depending on system operations.

Figures



Source: USGS 7.5' quadrangle of Chester and Pahlone Peak, Colorado.

Legend

- Colorado Discharge Permit System (CDPS) Compliance Point
- Colorado Division of Reclamation, Mining, and Safety (DRMS) Permit Boundary
- Roads

N

0 2,000 4,000 6,000 Feet

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

SITE LOCATION

ARCADIS

FIGURE 1

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LEGEND:

- Monitoring Well
- Existing Recirculation/Monitoring Well
- Existing Surface Water Monitoring Location
- CDPS Permit Compliance Point
- Engineered Treatment Cell (ETC) System
- Former Surface Water Drainages
- Existing Treatment Residuals Management Staging Location
- Former Leach Pad Area

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

MONITORING LOCATIONS

ARCADIS

FIGURE 2

Last Saved By: MAI00749
Z:\GISProjects_ENV\AO000102_Pitch\GIS\MXD\2020\2020-01\Fig2 DRAFT Monitoring_Locations Attachment 2.mxd 1/22/2020 6:07:29 AM

Attachment A
Safety Data Sheets

SAFETY DATA SHEET

Creation Date 08-Sep-2006 **Revision Date** 23-Jul-2014 **Revision Number** 1

1. Identification

Product Name **Sodium phosphate, monobasic**

Cat No. : **AC389870000; AC389870010; AC389870025; AC389870100; AC389872500**

Synonyms Sodium dihydrogen phosphate, anhydrous; Dihydrogen sodium phosphate, anhydrous

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Based on available data, the classification criteria are not met

Label Elements
None required

Hazards not otherwise classified (HNOC)
None identified

3. Composition / information on ingredients

Component	CAS-No	Weight %
Sodium phosphate, monobasic	7558-80-7	>95

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention if symptoms occur.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention if symptoms occur.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Get medical attention if symptoms occur.

Ingestion Do not induce vomiting. Get medical attention if symptoms occur.

Most important symptoms/effects No information available.
Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature Not applicable
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.

Hazardous Combustion Products
Oxides of phosphorus Sodium oxides
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
1	0	1	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid dust formation. Avoid contact with skin, eyes and clothing.
Environmental Precautions Avoid release to the environment. See Section 12 for additional ecological information.

Methods for Containment and Clean Up Sweep up or vacuum up spillage and collect in suitable container for disposal. Avoid dust formation.

7. Handling and storage

Handling Wear personal protective equipment. Ensure adequate ventilation. Avoid dust formation. Avoid contact with skin, eyes and clothing. Avoid ingestion and inhalation.

Storage Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	White
Odor	No information available
Odor Threshold	No information available
pH	4.1 - 4.7 (5 % Solution)
Melting Point/Range	No data available
Boiling Point/Range	No information available
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Relative Density	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition temperature	> 170°C
Viscosity	Not applicable
Molecular Formula	H2 Na P O4
Molecular Weight	119.98

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions. Hygroscopic.
Conditions to Avoid	Avoid dust formation. Incompatible products. Excess heat. Exposure to moisture.
Incompatible Materials	Strong acids, Strong bases
Hazardous Decomposition Products	Oxides of phosphorus, Sodium oxides
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information	No acute toxicity information is available for this product
Component Information	
Toxicologically Synergistic Products	No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	No information available
Sensitization	No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Sodium phosphate, monobasic	7558-80-7	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity
Do not empty into drains.

Persistence and Degradability Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT Not regulated
TDG Not regulated
IATA Not regulated
IMDG/IMO Not regulated

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Sodium phosphate, monobasic	X	X	-	231-449-2	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313 Not applicable

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act Not applicable

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals

State Right-to-Know Not applicable

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Sodium phosphate, monobasic	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class Non-controlled

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 08-Sep-2006
Revision Date 23-Jul-2014
Print Date 23-Jul-2014

Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

Univar USA Inc Safety Data Sheet

SDS No:

Version No:

Order No:

3075 Highland Pkwy, Ste 200, Downers Grove, IL 60515
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

Univar
3075 Highland Pkwy STE 200
Downers Grove, IL 60515
425-889-3400

SAFETY DATA SHEET

1. Identification

Product identifier: PHOSPHORIC ACID SOLUTION

Other means of identification

SDS number: 000100000143

Recommended use and restriction on use

Recommended use: Reserved for industrial and professional use.

Restrictions on use: Not known.

Manufacturer/Importer/Supplier/Distributor Information

Univar

3075 Highland Pkwy STE 200

Downers Grove, IL 60515

425-889-3400

Emergency telephone number:For emergency assistance Involving chemicals

call CHEMTREC day or night at: 1-800-424-9300. CHEMTREC INTERNATIONAL Tel# 703-527-3887

2. Hazard(s) identification

Hazard Classification

Health Hazards

Acute toxicity (Oral)	Category 4
Skin Corrosion/Irritation	Category 1A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Hazard Symbol

Signal Word	Danger
Hazard Statement	Harmful if swallowed. Harmful if inhaled. Causes severe skin burns and eye damage. May be corrosive to metals.
Precautionary Statements	
Prevention	Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Do not breathe dust or mists. Wear protective gloves/protective clothing/eye protection/face protection.
Response	IF INHALED: Remove person to fresh air and keep comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower]. IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth. Do NOT induce vomiting. Immediately call a POISON CENTER/doctor. Wash contaminated clothing before reuse.
Storage	Keep container tightly closed. Store in a well-ventilated place. Store in a dry place. Protect from sunlight. Store locked up.

Disposal	Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.
Other hazards which do not result in GHS classification	None.

3. Composition/information on ingredients

Substances

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
Phosphoric Acid		7664-38-2	>=5 - <=95%
Water		7732-18-5	>=5 - <=95%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

Composition Comments: The components are not hazardous or are below required disclosure limits.

4. First-aid measures

General information: Get immediate medical advice/attention.

Ingestion: Call a physician or poison control center immediately. Never give liquid to an unconscious person. Do NOT induce vomiting.

Inhalation: Call a physician or poison control center immediately. If breathing stops, provide artificial respiration. Move to fresh air. If breathing is difficult, give oxygen.

Skin Contact: Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Eye contact: If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

Most important symptoms/effects, acute and delayed

Symptoms: No data available.

Indication of immediate medical attention and special treatment needed

Treatment: No data available.

5. Fire-fighting measures

General Fire Hazards: No unusual fire or explosion hazards noted.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Use fire-extinguishing media appropriate for surrounding materials.

Unsuitable extinguishing media: No data available.

Specific hazards arising from the chemical: During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters

Special fire fighting procedures: No unusual fire or explosion hazards noted.

Special protective equipment for fire-fighters: Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep unauthorized personnel away.

Methods and material for containment and cleaning up: Absorb spillage with non-combustible, absorbent material. Prevent runoff from entering drains, sewers, or streams.

Environmental Precautions: Do not contaminate water sources or sewer.

7. Handling and storage

Precautions for safe handling: Do not taste or swallow. Wash hands thoroughly after handling. Do not get in eyes. Do not get in eyes, on skin, on clothing.

Conditions for safe storage, including any incompatibilities: Store locked up.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values	Source
Phosphoric Acid	TWA	1 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	STEL	3 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	ST ESL	10 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
	AN ESL	1 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
	TWA PEL	1 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	STEL	3 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	STEL	3 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	STEL	3 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (03 2016)
	STEL	3 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	1 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
Chemical Identity	**Type**	**Exposure Limit Values**	**Source**

Phosphoric Acid	TWA	1 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	STEL	3 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	ST ESL	10 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
	AN ESL	1 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
	TWA PEL	1 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	STEL	3 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	STEL	3 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	STEL	3 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (03 2016)
	STEL	3 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	1 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
Chemical Identity	**Type**	**Exposure Limit Values**	**Source**
Phosphoric Acid	TWA	1 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	STEL	3 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	ST ESL	10 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental

			Quality) (02 2013)
	AN ESL	1 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
	TWA PEL	1 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	STEL	3 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	STEL	3 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	STEL	3 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (03 2016)
	STEL	3 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	1 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)

Appropriate Engineering Controls Provide adequate ventilation.

Individual protection measures, such as personal protective equipment

General information: Provide easy access to water supply and eye wash facilities. Use personal protective equipment as required. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned.

Eye/face protection: Wear a full-face respirator, if needed. Wear safety glasses with side shields (or goggles) and a face shield.

Skin Protection

Hand Protection: Chemical resistant gloves

Other: Chemical resistant clothing

Respiratory Protection:	In case of inadequate ventilation use suitable respirator.
Hygiene measures:	Do not eat, drink or smoke when using the product. Wash hands after handling. Do not get in eyes. Observe good industrial hygiene practices. Wash contaminated clothing before reuse. Do not get this material in contact with skin. Wash hands before breaks and immediately after handling the product.

9. Physical and chemical properties

Physical state:	liquid
Form:	Liquid
Color:	Clear colorless
Odor:	Odorless
Odor threshold:	No data available.
pH:	1.6 (25 °C)
Melting point/freezing point:	No data available.
Initial boiling point and boiling range:	> 135 °C
Flash Point:	> 121 °C
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	0.038 hPa
Vapor density:	No data available.
Relative density:	1.13
Solubility(ies)	
Solubility in water:	Completely Soluble
Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.

Viscosity: No data available.

10. Stability and reactivity

Reactivity: No data available.
Chemical Stability: Material is stable under normal conditions.
Possibility of hazardous reactions: Stable
Conditions to avoid: Avoid heat or contamination.
Incompatible Materials: Strong bases. Corrosive to metals
Hazardous Decomposition Products: May attack light-alloy metals and liberate hydrogen gas. Thermal decomposition or combustion may liberate carbon oxides and other toxic gases or vapors.

11. Toxicological information

Symptoms related to the physical, chemical and toxicological characteristics

Ingestion: No data available.
Inhalation: No data available.
Skin Contact: No data available.
Eye contact: No data available.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral

Product: ATEmix (): 1,578.947368 mg/kg
ATEmix (): 1,578.947368 mg/kg
ATEmix (): 1,530 mg/kg

Dermal

Product: ATEmix (): 3,326.31579 mg/kg
ATEmix (): 3,326.31579 mg/kg
ATEmix (): 2,740 mg/kg

Inhalation

Product: No data available.

Repeated dose toxicity

Product: No data available.

Skin Corrosion/Irritation

Product: No data available.

Serious Eye Damage/Eye Irritation

Product: No data available.

Respiratory or Skin Sensitization

Product: No data available.

Carcinogenicity

Product: No data available.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

No carcinogenic components identified

US. National Toxicology Program (NTP) Report on Carcinogens:

No carcinogenic components identified

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):

No carcinogenic components identified

Germ Cell Mutagenicity

In vitro

Product: No data available.

In vivo

Product: No data available.

Reproductive toxicity

Product: No data available.

Specific Target Organ Toxicity - Single Exposure

Product: No data available.

Specific Target Organ Toxicity - Repeated Exposure

Product: No data available.

Aspiration Hazard

Product: No data available.

Other effects: No data available.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product: No data available.

Aquatic Invertebrates

Product: No data available.

Chronic hazards to the aquatic environment:

Fish

Product: No data available.

Aquatic Invertebrates

Product: No data available.

Toxicity to Aquatic Plants

Product: No data available.

Persistence and Degradability

Biodegradation

Product: No data available.

BOD/COD Ratio

Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)

Product: No data available.

Partition Coefficient n-octanol / water (log Kow)

Product: No data available.

Mobility in soil: No data available.

Known or predicted distribution to environmental compartments

Phosphoric Acid No data available.
Water No data available.

Known or predicted distribution to environmental compartments

Water No data available.

Known or predicted distribution to environmental compartments

Phosphoric Acid No data available.
Water No data available.

Known or predicted distribution to environmental compartments

Water No data available.

Known or predicted distribution to environmental compartments

Phosphoric Acid No data available.
Water No data available.

13. Disposal considerations

Disposal instructions: Discharge, treatment, or disposal may be subject to national, state, or local laws.

Contaminated Packaging: Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN Number:	UN 1805
UN Proper Shipping Name:	Phosphoric acid solution(- Phosphoric Acid)
Transport Hazard Class(es)	
Class:	8
Label(s):	8
Packing Group:	III
Marine Pollutant:	Not regulated.
Special precautions for user:	–

IATA

UN Number:	UN 1805
Proper Shipping Name:	Phosphoric acid, solution(- Phosphoric Acid)
Transport Hazard Class(es):	
Class:	8
Label(s):	8
Packing Group:	III
Environmental Hazards	Not regulated.
Special precautions for user:	–
Other information	
Passenger and cargo aircraft:	Allowed.
Cargo aircraft only:	Allowed.

15. Regulatory information

Version: 1.1
Revision Date: 05/10/2019

US Federal RegulationsUS. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

Phosphoric Acid Reportable quantity: 5000 lbs.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

☐ Acute (Immediate) ☐ Chronic (Delayed) ☐ Fire ☐ Reactive ☐ Pressure Generating

SARA 302 Extremely Hazardous Substance

None present or none present in regulated quantities.

SARA 304 Emergency Release Notification

Chemical Identity	RQ
Phosphoric Acid	5000 lbs.

SARA 311/312 Hazardous Chemical

Chemical Identity	Threshold Planning Quantity
Chemical Identity	**Threshold Planning Quantity**
Chemical Identity	**Threshold Planning Quantity**
Phosphoric Acid	500 lbs

SARA 313 (TRI Reporting)

None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

Phosphoric Acid Reportable quantity: 5000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

US State Regulations

US. California Proposition 65

No ingredient regulated by CA Prop 65 present.

US. New Jersey Worker and Community Right-to-Know Act

No ingredient regulated by NJ Right-to-Know Law present.

US. Massachusetts RTK - Substance List

No ingredient regulated by MA Right-to-Know Law present.

US. Pennsylvania RTK - Hazardous Substances

No ingredient regulated by PA Right-to-Know Law present.

US. Rhode Island RTK

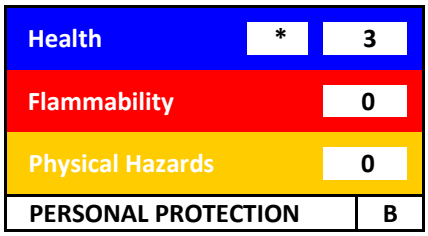
No ingredient regulated by RI Right-to-Know Law present.

Version: 1.1
Revision Date: 05/10/2019

Inventory Status: Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EINECS, ELINCS or NLP:	On or in compliance with the inventory
Japan (ENCS) List:	On or in compliance with the inventory
China Inv. Existing Chemical Substances:	On or in compliance with the inventory
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.
Mexico INSQ:	On or in compliance with the inventory
Ontario Inventory:	Not in compliance with the inventory.
Taiwan Chemical Substance Inventory:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

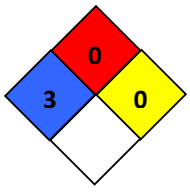
HMIS Hazard ID

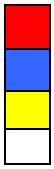


B - Safety Glasses & Gloves

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible; *Chronic health effect

NFPA Hazard ID





Flammability
Health
Reactivity
Special hazard.

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible

Issue Date:	05/10/2019
Revision Date:	No data available.
Version #:	1.1
Further Information:	No data available.

Version: 1.1
Revision Date: 05/10/2019

Univar USA Inc Safety Data Sheet

For Additional Information contact SDS Coordinator during business hours, Pacific time: (425) 889-3400

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Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from your local Univar sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein.

This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Safety Data Sheet

Section 1: Identification of the Substance/Mixture and of the Company/Undertaking

1.1 Product identifier

Product Name • **Phosphoric Acid 85% FCC**

Synonyms • Orthophosphoric Acid

CAS Number • 7664-38-2

SDS Number/Grade • 3f

EC Number • 231-633-2

EU Index Number • 015-011-00-6

REACH Registration Number • 01-2119485924-24-0037

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified use(s) • Polymerization of propylene; alkylating catalyst. Control of bacteria growth in selected processed foods. Flocculation agent for clarification of sugar juices after liming process. Various other uses in food products. Chemical – Strengthening or fortifying weak phosphoric acid solutions. Polymerization of propylene; alkylating catalyst

1.3 Details of the supplier of the safety data sheet

Manufacturer • Innophos

259 Prospect Plains Rd. Bldg A
Cranbury, NJ 08512-3706
United States

Telephone (Technical) • 609-495-2495

Responsible Party - EU • LSR Associates Ltd

Woolley Road
Alconbury, Cambridgeshire PE28 4HS
United Kingdom

info@lsr-associates.com

Telephone (General) • +44 (0) 1954 212132

1.4 Emergency telephone number

Manufacturer • 800-424-9300 - Chemtrec - within USA and Canada

Manufacturer • +1 703-527-3887 - Chemtrec - outside USA and Canada (collect calls accepted)

Manufacturer • 615-386-7816 - Innophos Emergency Communication Team (ECT)

Section 2: Hazards Identification

EU/EEC

According to Regulation (EC) No 1272/2008 (CLP)/REACH 1907/2006 [amended by 453/2010]
According to EU Directive 67/548/EEC (DSD) or 1999/45/EC (DPD)

2.1 Classification of the substance or mixture

CLP

- Corrosive to Metals 1 - H290
  Skin Corrosion 1B - H314

DSD/DPD

- Corrosive (C)

  R34

2.2 Label Elements

CLP

DANGER

Hazard statements

- H290 - May be corrosive to metals
  H314 - Causes severe skin burns and eye damage.

Precautionary statements

Prevention

- P234 - Keep only in original container.
  P260 - Do not breathe mist/vapours/spray.
  P264 - Wash thoroughly after handling.
  P280 - Wear protective gloves/protective clothing/eye protection/face protection.

Response

- P390 - Absorb spillage to prevent material damage.
  P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
  P301+P330+P331 - IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
  P363 - Wash contaminated clothing before reuse.
  P304+P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
  P310 - Immediately call a POISON CENTER or doctor/physician.
  P321 - Specific treatment (see supplemental first aid instructions on this label).
  P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Storage/Disposal

- P406 - Store in corrosive resistant/ container with a resistant inner liner.
  P405 - Store locked up.
  P501 - Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

DSD/DPD

Risk phrases

- R34 - Causes burns.

Safety phrases

- S36 - Wear suitable protective clothing.
  S37 - Wear suitable gloves.
  S39 - Wear eye/face protection.
  S45 - In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

2.3 Other Hazards

CLP

- According to Regulation (EC) No. 1272/2008 (CLP) this material is considered hazardous.

DSD/DPD

- This product is considered dangerous according to the European Directive 67/548/EEC.

United States (US)

According to OSHA 29 CFR 1910.1200 HCS

2.1 Classification of the substance or mixture

OSHA HCS 2012

- Corrosive to Metals 1 - H290
  Skin Corrosion 1B - H314

2.2 Label elements

OSHA HCS 2012

DANGER

Hazard statements

- May be corrosive to metals - H290
  Causes severe skin burns and eye damage. - H314

Precautionary statements

Prevention

- Keep only in original container. - P234
  Do not breathe mist/vapours/spray. - P260
  Wash thoroughly after handling. - P264
  Wear protective gloves/protective clothing/eye protection/face protection. - P280

Response

- Absorb spillage to prevent material damage. - P390
  IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. - P303+P361+P353
  IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. - P301+P330+P331
  Wash contaminated clothing before reuse. - P363
  IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. - P304+P340
  Immediately call a POISON CENTER or doctor/physician. - P310
  Specific treatment, see supplemental first aid information. - P321
  IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. - P305+P351+P338

Storage/Disposal

- Store in corrosive resistant/ container with a resistant inner liner. - P406
  Store locked up. - P405
  Dispose of content and/or container in accordance with local, regional, national, and/or international regulations. - P501

2.3 Other hazards

OSHA HCS 2012

- Under United States Regulations (29 CFR 1910.1200 - Hazard Communication Standard), this product is considered hazardous.

Canada

According to WHMIS

2.1 Classification of the substance or mixture

WHMIS

- Corrosive - E

2.2 Label elements

WHMIS

- Corrosive - E

2.3 Other hazards

WHMIS

- In Canada, the product mentioned above is considered hazardous under the Workplace Hazardous Materials Information System (WHMIS).

Section 3 - Composition/Information on Ingredients

3.1 Substances

Composition					
Chemical Name	**Identifiers**	**%**	**LD50/LC50**	**Classifications According to Regulation/Directive**	**Comments**
Phosphoric acid	**CAS:**7664-38-2 **EC Number:**231-633-2	36% TO 95%	Ingestion/Oral-Rat LD50 • 1.25 g/kg Inhalation-Rat LC50 • 25.5 mg/m³	**EU DSD/DPD:** Annex I: C; R34 **EU CLP:** Annex VI: Skin Corr. 1B, H314, Corr. to Metals 1, H290 **OSHA HCS 2012:** Skin Corr. 1B, H314, Corr. to Metals 1, H290	NDA

3.2 Mixtures

- Material does not meet the criteria of a mixture in accordance with Regulation (EC) No 1272/2008.

Section 4 - First Aid Measures

4.1 Description of first aid measures

Inhalation

- Administer oxygen if breathing is difficult. Do not use mouth-to-mouth method if victim inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Give artificial respiration if victim is not breathing. Move victim to fresh air.

Skin

- For minor skin contact, avoid spreading material on unaffected skin. In case of contact with substance, immediately flush skin with running water for at least 20 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes. Wash contaminated clothing before reuse.

Eye

- In case of contact with substance, immediately flush eyes with running water for at least 15 minutes. Seek immediate medical attention, preferably with an ophthalmologist. If the physician is not immediately available, eye irrigation should be continued for an additional 15 minutes. If it is necessary to transport the patient to a physician and the eye needs to be bandaged, use a dry sterile cloth pad and cover both eyes.

Ingestion

- If swallowed give 2-3 glasses of water if victim is conscious and alert. Do not give anything by mouth to an unconscious person. Do NOT induce vomiting. Obtain medical attention immediately if ingested. Do not use mouth-to-mouth method if victim ingested the substance. Do not leave victim unattended. To prevent aspiration of swallowed product, lay victim on side with head lower than waist. Persons attending the victim should avoid direct contact with heavily contaminated clothing and vomitus. Wear impervious gloves while decontaminating skin and hair.

4.2 Most important symptoms and effects, both acute and delayed

- Refer to Section 11 - Toxicological Information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to Physician

- All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

4.4 Other information

- Call 911 or emergency medical service. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Section 5 - Firefighting Measures

5.1 Extinguishing media

Suitable Extinguishing Media
- Not combustible. Use extinguishing media suitable for surrounding fire.

Unsuitable Extinguishing Media
- None known.

5.2 Special hazards arising from the substance or mixture

Unusual Fire and Explosion Hazards
- Not combustible.
Under fire conditions, toxic, corrosive fumes are emitted.

Hazardous Combustion Products
- Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.
Oxides of phosphorus.

5.3 Advice for firefighters

- Wear positive pressure self-contained breathing apparatus (SCBA).
Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection.
Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Keep unauthorized personnel away.
Evacuate residents who are downwind of fire.
Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.
Persons who may have been exposed to contaminated smoke should be immediately examined by a physician and checked for symptoms of poisoning. The symptoms should not be mistaken for heat exhaustion or smoke inhalation.

Section 6 - Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal Precautions
- Ventilate enclosed areas. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.

Emergency Procedures
- Keep unauthorized personnel away. Dike spill using absorbent or impervious materials such as earth, sand or clay. Dike or retain dilution water or water from firefighting for later disposal.

6.2 Environmental precautions

- Prevent entry into waterways, sewers, basements or confined areas. Runoff from fire control or dilution water may cause pollution.

6.3 Methods and material for containment and cleaning up

Containment/Clean-up Measures
- Exercise caution during neutralization as considerable heat may be generated. Neutralize spill area with soda ash, sodium bicarbonate or lime. Flush neutralized spill with copious amounts of water.

6.4 Reference to other sections

- Refer to Section 8 - Exposure Controls/Personal Protection and Section 13 - Disposal Considerations.

Section 7 - Handling and Storage

7.1 Precautions for safe handling

Handling
- Do not get on skin or in eyes. Avoid breathing vapors and mists. Do not ingest. Handle and open container with care. Use only with adequate ventilation. Use caution when combining with water; DO NOT add water to corrosive liquid, ALWAYS add corrosive liquid to water while stirring to prevent release of heat, steam and fumes. This product reacts violently with bases liberating heat and causing spattering.

7.2 Conditions for safe storage, including any incompatibilities

Storage

- Store in a dry, well-ventilated place. Store locked up. Keep away from incompatible materials. Ventilate enclosed areas.

7.3 Specific end use(s)

- Refer to Section 1.2 - Relevant identified uses.

Section 8 - Exposure Controls/Personal Protection

8.1 Control parameters

Exposure Limits/Guidelines						
	Result	**ACGIH**	**Argentina**	**Australia**	**Austria**	**Belgium**
Phosphoric acid (7664-38-2)	STELs	3 mg/m3 STEL	3 mg/m3 STEL [CMP-CPT]	3 mg/m3 STEL	2 mg/m3 STEL [KZW] (4 X 15 min)	2 mg/m3 STEL
	TWAs	1 mg/m3 TWA	1 mg/m3 TWA [CMP]	1 mg/m3 TWA	Not established	1 mg/m3 TWA
	MAKs	Not established	Not established	Not established	1 mg/m3 TWA [TMW]	Not established

Exposure Limits/Guidelines (Con't.)						
	Result	**China**	**Czech Republic**	**Denmark**	**Egypt**	**Finland**
Phosphoric acid (7664-38-2)	STELs	3 mg/m3 STEL	Not established	Not established	3 mg/m3 STEL	2 mg/m3 STEL
	TWAs	1 mg/m3 TWA	1 mg/m3 TWA	1 mg/m3 TWA	Not established	1 mg/m3 TWA
	Ceilings	Not established	2 mg/m3 Ceiling	Not established	Not established	Not established

Exposure Limits/Guidelines (Con't.)						
	Result	**France**	**Germany DFG**	**Germany TRGS**	**Greece**	**Hong Kong**
Phosphoric acid (7664-38-2)	STELs	0.5 ppm STEL [VLCT] (indicative limit); 2 mg/m3 STEL [VLCT] (indicative limit)	Not established	Not established	3 mg/m3 STEL	3 mg/m3 STEL
	TWAs	0.2 ppm TWA [VME] (indicative limit); 1 mg/m3 TWA [VME] (indicative limit)	Not established	2 mg/m3 TWA AGW (The risk of damage to the embryo or fetus can be excluded when AGW and BGW values are observed, inhalable fraction, exposure factor 2)	1 mg/m3 TWA	Not established
	Ceilings	Not established	4 mg/m3 Peak (inhalable fraction)	Not established	Not established	Not established
	MAKs	Not established	2 mg/m3 TWA MAK (inhalable fraction)	Not established	Not established	Not established

Exposure Limits/Guidelines (Con't.)						
	Result	**Hungary**	**India**	**Indonesia**	**Ireland**	**Israel**
Phosphoric acid (7664-38-2)	TWAs	1 mg/m3 TWA [AK]	1 mg/m3 TWA	1 mg/m3 TWA	1 mg/m3 TWA	1 mg/m3 TWA
	STELs	2 mg/m3 STEL [CK]	3 mg/m3 STEL	Not established	2 mg/m3 STEL	3 mg/m3 STEL

Exposure Limits/Guidelines (Con't.)						
	Result	**Italy**	**Japan**	**Korea**	**Malaysia**	**Mexico**
Phosphoric acid	TWAs	1 mg/m3 TWA	1 mg/m3 OEL	1 mg/m3 TWA (Serial No. 459)	1 mg/m3 TWA	1 mg/m3 TWA LMPE-PPT

(7664-38-2)	STELs	2 mg/m3 STEL	Not established	3 mg/m3 STEL (Serial No. 465)	Not established	3 mg/m3 STEL [LMPE-CT]

Exposure Limits/Guidelines (Con't.)						
	Result	**Netherlands**	**New Zealand**	**NIOSH**	**Norway**	**OSHA**
Phosphoric acid (7664-38-2)	TWAs	1 mg/m3 TWA	1 mg/m3 TWA	1 mg/m3 TWA	1 mg/m3 TWA	1 mg/m3 TWA
	STELs	2 mg/m3 STEL	Not established	3 mg/m3 STEL	Not established	Not established

Exposure Limits/Guidelines (Con't.)						
	Result	**Philippines**	**Poland**	**Portugal**	**Singapore**	**South Africa**
Phosphoric acid (7664-38-2)	STELs	Not established	2 mg/m3 STEL [NDSCh]	3 mg/m3 STEL [VLE-CD	3 mg/m3 STEL	3 mg/m3 STEL
	TWAs	1 mg/m3 TWA	1 mg/m3 TWA [NDS]	1 mg/m3 TWA [VLE-MP]	1 mg/m3 PEL	1 mg/m3 TWA

Exposure Limits/Guidelines (Con't.)						
	Result	**Spain**	**Sweden**	**Switzerland**	**Taiwan**	**United Kingdom**
Phosphoric acid (7664-38-2)	MAKs	Not established	Not established	1 mg/m3 TWA [MAK]	Not established	Not established
	STELs	2 mg/m3 STEL [VLA-EC]	3 mg/m3 STV	2 mg/m3 STEL [KZW] (4 X 15)	Not established	2 mg/m3 STEL
	TWAs	1 mg/m3 TWA [VLA-ED] (indicative limit value; it is prohibited the partial or complete commercialization or use of this substance as a phytosanitary or biocide compound)	1 mg/m3 LLV	Not established	1 mg/m3 TWA	1 mg/m3 TWA

Exposure Limits/Guidelines (Con't.)		
	Result	**Venezuela**
Phosphoric acid (7664-38-2)	STELs	3 mg/m3 STEL [LEB
	TWAs	1 mg/m3 TWA [CAP

8.2 Exposure controls

Engineering Measures/Controls

- Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Personal Protective Equipment

Respiratory

- Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or symptoms are experienced.

Eye/Face

- Wear face shield and eye protection. An emergency eye wash must be readily accessible to the work area. Ensure safety shower is available near all areas of bulk storage, delivery and use.

Hands

- Wear protective gloves selected with regard to both durability as well as permeation resistance.

Skin/Body

- Wear protective clothing

General Industrial Hygiene Considerations

- Do not get in eyes or on skin or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, or using tobacco. Handle in accordance with good industrial hygiene and safety practice.

Environmental Exposure Controls

- Follow best practice for site management and disposal of waste.

Key to abbreviations

ACGIH = American Conference of Governmental Industrial Hygiene
MAK = Maximale Arbeitsplatz Konzentration is the maximum permissible concentration
MSHA = Mine Safety and Health Administration
NIOSH = National Institute of Occupational Safety and Health
OEL = Occupational Exposure Limit(s)
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level determined by the Occupational Safety and Health Administration (OSHA)
STEL = Short Term Exposure Limits are based on 15-minute exposures
STEV = Short Term Exposure Value
NAB = Threshold Values (Indonesia)
TWAEV = Time-Weighted Average Exposure Value
TWA = Time-Weighted Averages are based on 8h/day, 40h/week exposures

Section 9 - Physical and Chemical Properties

9.1 Information on Physical and Chemical Properties

Material Description			
Physical Form	Liquid	Appearance/Description	Colorless viscous liquid with no odor.
Color	Colorless	Odor	Odorless
Odor Threshold	Data lacking		
General Properties			
Boiling Point	100 to 200 C(212 to 392 F)	Melting Point	Refer to Product data sheet for specific information.
Decomposition Temperature	Data lacking	pH	< 1
Specific Gravity/Relative Density	1.22 to 1.81 Water=1 @ 25 C(77 F)	Water Solubility	Miscible
Viscosity	Data lacking	Explosive Properties	Not relevant.
Oxidizing Properties:	Not relevant.		
Volatility			
Vapor Pressure	< 2 mmHg (torr) @ 20 C(68 F)	Vapor Density	Data lacking
Evaporation Rate	Data lacking		
Flammability			
Flash Point	Not relevant	UEL	Not relevant
LEL	Not relevant	Autoignition	Not relevant
Flammability (solid, gas)	Not relevant.		
Environmental			
Octanol/Water Partition coefficient	Data lacking		

9.2 Other Information

- No additional physical and chemical parameters noted.

Section 10: Stability and Reactivity

10.1 Reactivity

- No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

- Stable

10.3 Possibility of hazardous reactions

- Hazardous polymerization will not occur.

10.4 Conditions to avoid

- Incompatible materials.

10.5 Incompatible materials

- Strong oxidizing agents, strong reducing agents, bases and certain metals

10.6 Hazardous decomposition products

- Oxides of phosphorus.

Section 11 - Toxicological Information

11.1 Information on toxicological effects

Other Material Information

- This material is an acid. The primary effects and toxicity of this material are due to its corrosive nature.

	CAS	
PHOS ACID 85% FCC	7664-38-2	**Acute Toxicity:** Ingestion/Oral-Rat LD50 • 1530 mg/kg • Comments: Data for phosphoric acid; Skin-Rabbit LD50 • 2740 mg/kg; **Irritation:** Eye-Rabbit • 119 mg/kg • Severe irritation, irreversible, burns (corrosive) • Comments: Data for phosphoric acid; Skin-Rabbit • 595 mg/kg 24 Hour(s) • Severe irritation, irreversible, burns (corrosive)

GHS Properties	Classification
Acute toxicity	**EU/CLP** • Acute Toxicity - Dermal - Data lacking; Acute Toxicity - Inhalation - Data lacking; Acute Toxicity - Oral - Data lacking **OSHA HCS 2012** • Acute Toxicity - Dermal - Inconclusive data; Acute Toxicity - Inhalation - Inconclusive data; Acute Toxicity - Oral - Data lacking
Aspiration Hazard	**EU/CLP** • Data lacking **OSHA HCS 2012** • Not relevant
Carcinogenicity	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Germ Cell Mutagenicity	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Skin corrosion/Irritation	**EU/CLP** • Skin Corrosion 1B **OSHA HCS 2012** • Skin Corrosion 1B
Skin sensitization	**EU/CLP** • Data lacking **OSHA HCS 2012** • Data lacking
STOT-RE	**EU/CLP** • Data lacking **OSHA HCS 2012** • Data lacking
STOT-SE	**EU/CLP** • Data lacking **OSHA HCS 2012** • Data lacking
Toxicity for Reproduction	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Respiratory sensitization	**EU/CLP** • Data lacking **OSHA HCS 2012** • Data lacking
Serious eye damage/Irritation	**EU/CLP** • Data lacking **OSHA HCS 2012** • Classification criteria not met

Route(s) of entry/exposure

- Inhalation, Skin, Eye, Ingestion

Potential Health Effects

Inhalation

Acute (Immediate)

- Under normal conditions of use, no health effects are expected.

Chronic (Delayed)
- Repeated or prolonged exposure to corrosive fumes may cause bronchial irritation with chronic cough.

Skin

Acute (Immediate)
- Causes severe skin burns and eye damage.

Chronic (Delayed)
- Repeated or prolonged exposure to corrosive materials will cause dermatitis.

Eye

Acute (Immediate)
- Corrosive. Can cause permanent damage to the cornea, blindness.

Chronic (Delayed)
- Repeated or prolonged exposure to corrosive materials or fumes may cause conjunctivitis.

Ingestion

Acute (Immediate)
- Causes corrosion, burns to mouth and esophagus, abdominal pain, chest pain, nausea, vomiting, diarrhea, seizures. Aspiration of the swallowed or vomited product can cause severe pulmonary complications.

Chronic (Delayed)
- Repeated or prolonged exposure to corrosive materials or fumes may cause gastrointestinal distrubances.

Carcinogenic Effects
- This product does not contain any ingredient designated by IARC, NTP, ACGIH or OSHA as probable or suspected human carcinogens.

Key to abbreviations
LD = Lethal Dose
TC = Toxic Concentration

Section 12 - Ecological Information

12.1 Toxicity

PHOS ACID 85% FCC			7664-38-2		
Dosage	**Species**	**Duration**	**Results**	**Exposure Conditions**	**Comments**
138 mg/L	**Fish:** Mosquitofish	96 Hour(s)	LC50	NDA	NDA

12.2 Persistence and degradability
- No data found for product.

12.3 Bioaccumulative potential
- No data found for product.

12.4 Mobility in Soil
- No data found for product.

12.5 Results of PBT and vPvB assessment
- PBT and vPvB assessment has not been carried out.

12.6 Other adverse effects

Ecological Fate
- No data found for product.

12.7 Other Information
- No specific biodegradation test data located. While acidity of this material is readily reduced in natural waters, the resulting phosphate may persist indefinitely or incorporate into biological systems.

Section 13 - Disposal Considerations

13.1 Waste treatment methods

Product waste
- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations. This material is considered an EPA hazardous waste. EPA "RCRA" Hazardous Waste Code: "C" Corrosive.

Packaging waste
- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Section 14 - Transport Information

	14.1 UN number	14.2 UN proper shipping name	14.3 Transport hazard class(es)	14.4 Packing group	14.5 Environmental hazards
DOT	UN1805	Phosphoric acid solution	8	III	NDA
TDG	UN1805	PHOSPHORIC ACID, LIQUID	8	III	NDA
IMO/IMDG	UN1805	PHOSPHORIC ACID SOLUTION	8	III	NDA
IATA/ICAO	UN1805	Phosphoric Acid, Solution	8	III	NDA

14.6 Special precautions for user
- None known.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
- Not relevant.

14.8 Other information
- The listed Transportation Classification does not address regulatory variations due to changes in package size, mode of shipment or other regulatory descriptors.

DOT
- Phosphoric acid has a reportable quantity of 5000 lbs (2270 kg) as listed in Appendix A to 49 CFR 172.101.

Section 15 - Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

SARA Hazard Classifications
- Acute

Inventory						
Component	**CAS**	**Canada DSL**	**Canada NDSL**	**China**	**EU EINECS**	**EU ELNICS**
Phosphoric acid	7664-38-2	Yes	No	Yes	Yes	No

Inventory (Con't.)				
Component	**CAS**	**New Zealand**	**Philippines PICCS**	**TSCA**
Phosphoric acid	7664-38-2	Yes	Yes	Yes

Canada

Labor

Canada - List of Prohibited and Restricted Cosmetic Ingredients (The Cosmetic Ingredient Hotlist)

• Phosphoric acid	7664-38-2	Not Listed

Canada - WHMIS - Classifications of Substances

• Phosphoric acid	7664-38-2	E (including <=85%)

Canada - WHMIS - Ingredient Disclosure List

• Phosphoric acid	7664-38-2	1 %

Environment

Canada - 2004 NPRI (National Pollutant Release Inventory)

• Phosphoric acid	7664-38-2	Not Listed

Canada - 2005 NPRI (National Pollutant Release Inventory)

• Phosphoric acid	7664-38-2	Not Listed

Canada - CEPA - Greenhouse Gases Subject to Mandatory Reporting

• Phosphoric acid	7664-38-2	Not Listed

Canada - CEPA - Priority Substances List

• Phosphoric acid	7664-38-2	Not Listed

Canada - DWQ (Drinking Water Quality) - IMACs

• Phosphoric acid	7664-38-2	Not Listed

Other

Canada - Accelerated Reduction/Elimination of Toxics (ARET)

• Phosphoric acid	7664-38-2	Not Listed

Canada New Brunswick

Environment

Canada - New Brunswick - Ozone Depleting Substances - Schedule A

• Phosphoric acid	7664-38-2	Not Listed

Canada - New Brunswick - Ozone Depleting Substances - Schedule B

• Phosphoric acid	7664-38-2	Not Listed

Germany

Environment

Germany - TA Luft - Types and Classes

• Phosphoric acid	7664-38-2	Not Listed

Germany - Water Classification (VwVwS) - Annex 1

• Phosphoric acid	7664-38-2	Not Listed

Germany - Water Classification (VwVwS) - Annex 2 - Water Hazard Classes

• Phosphoric acid	7664-38-2	ID Number 392, hazard class 1 - low hazard to waters

Germany - Water Classification (VwVwS) - Annex 3

• Phosphoric acid	7664-38-2	Not Listed

Philippines

Other

Philippines - Priority Chemical List

• Phosphoric acid	7664-38-2	Not Listed

Singapore

Other

Singapore - Corrosive and Explosive Substances - Corrosive Substances

• Phosphoric acid	7664-38-2	Not Listed

Thailand

Environment

Thailand - Quantities of Chemicals

• Phosphoric acid	7664-38-2	1 mg/m3 Quantities of Chemicals

Thailand - Water Quality Criteria - Maximum Concentration Allowance

• Phosphoric acid	7664-38-2	Not Listed

United States

Labor

U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals

• Phosphoric acid	7664-38-2	Not Listed

U.S. - OSHA - Specifically Regulated Chemicals

• Phosphoric acid	7664-38-2	Not Listed

Environment

U.S. - CAA (Clean Air Act) - 1990 Hazardous Air Pollutants

• Phosphoric acid	7664-38-2	Not Listed

U.S. - CAA (Clean Air Act) - Class II Ozone Depletors

• Phosphoric acid	7664-38-2	Not Listed

U.S. - CERCLA/SARA - Hazardous Substances and their Reportable Quantities

• Phosphoric acid	7664-38-2	5000 lb final RQ; 2270 kg final RQ

U.S. - CERCLA/SARA - Radionuclides and Their Reportable Quantities

• Phosphoric acid	7664-38-2	Not Listed

U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances EPCRA RQs

• Phosphoric acid	7664-38-2	Not Listed

U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances TPQs

• Phosphoric acid	7664-38-2	Not Listed

U.S. - CERCLA/SARA - Section 313 - Emission Reporting

• Phosphoric acid	7664-38-2	Not Listed

U.S. - CERCLA/SARA - Section 313 - PBT Chemical Listing

• Phosphoric acid	7664-38-2	Not Listed

Other

U.S. - FDA - Direct Food Additives

• Phosphoric acid	7664-38-2	Not Listed

U.S. - FDA - Food Additives Generally Recognized as Safe (GRAS)

• Phosphoric acid	7664-38-2	21 CFR 182.1073

U.S. - FDA - Total Food Additives List Sourced from EAFUS

		133.123, 133.124, 133.129, 133.169, 133.173, 133.178,

• Phosphoric acid	7664-38-2	133.179, 163.110, 163.111, 163.112, 175.300, 177.2260, 178.1010, 178.3520, 182.1073, 73.275, 73.85

U.S. - USDA - National Organic Program - Substances Allowed as Ingredients in or on Organic Processed Products

• Phosphoric acid	7664-38-2	(cleaning of food-contact surfaces and equipment only)

United States - California

Environment

U.S. - California - Proposition 65 - Carcinogens List

• Phosphoric acid	7664-38-2	Not Listed

U.S. - California - Proposition 65 - Developmental Toxicity

• Phosphoric acid	7664-38-2	Not Listed

U.S. - California - Proposition 65 - Maximum Allowable Dose Levels (MADL)

• Phosphoric acid	7664-38-2	Not Listed

U.S. - California - Proposition 65 - No Significant Risk Levels (NSRL)

• Phosphoric acid	7664-38-2	Not Listed

U.S. - California - Proposition 65 - Reproductive Toxicity - Female

• Phosphoric acid	7664-38-2	Not Listed

U.S. - California - Proposition 65 - Reproductive Toxicity - Male

• Phosphoric acid	7664-38-2	Not Listed

15.2 Chemical Safety Assessment

- No Chemical Safety Assessment has been carried out.

Section 16 - Other Information

Last Revision Date
- 14/October/2015

Preparation Date
- 14/October/2014

Disclaimer/Statement of Liability
- The information herein is given in good faith but no warranty, expressed or implied, is made.

Key to abbreviations

NDA = No Data Available

SAFETY DATA SHEET (SDS)
REVISION DATE: 03/03/2016

HUE CORPORATION

Color your everything, may your Hue come true

SECTION I. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

PRODUCT IDENTIFIER:

PRODUCT NAME ..... **HUE URANINE CONC** (Also known as Fluorescein)
PRODUCT NUMBER 1-C8-073PC
COLOR INDEX NAME ..... ACID YELLOW 073
COLOR INDEX NO 45350
C. A. S. # 518-47-8
CHEMICAL FAMILY..... XANTHENE

INTENDED USE OF THE PRODUCT:

FELT TIP, MARKER INKS, WATER BASED COATINGS AND LEAK DETECTION

NAME, ADDRESS AND TELEPHONE OF RESPONSIBLE PARTY:

HUE CORPORATION	TELEPHONE	714-389-3130
P.O. BOX 509	FAX	714-389-9731
TUSTIN, CA 92781	EMAIL	SUPPORT@HUECORPORATION.COM

EMERGENCY TELEPHONE NUMBER:

CHEMTREC (USA)	1-800-424-9300
CHEMTREC (OUTSIDE USA)	1-703-527-3887

SECTION 2. HAZARD(S) IDENTIFICATION

CLASSIFICATION OF THE SUBSTANCE OR MIXTURE:

GHS-US
ACUTE TOX. - INHALATION (CATEGORY 5)
EYE DAM./IRRITATION (CATEGORY 2B)
SKIN CORR./IRRITATION (CATEGORY 3)

GHS LABELING:

HAZARD PICTOGRAMS (GHS-US):	NO SYMBOL
SIGNAL WORD	WARNING
HAZARD STATEMENT(S)	H333 - MAY BE HARMFUL IF INHALED H320 - CAUSES EYE IRRITATION H316 - CAUSES MILD SKIN IRRITATION
PRECAUTIONARY STATEMENTS	P305 + 351 + P338 - IF IN EYES: RINSE CAUTIOUSLY WITH WATER FOR SEVERAL MINUTES. REMOVE CONTACT LENSES IF PRESENT AND EASY

TO DO. CONTINUE RINSING.
P337 + P313 - IF EYE IRRITATION OCCURS/PERSISTS:
GET MEDICAL ADVICE AND ATTENTION.
P261 - AVOID BREATHING DUST/FUMES/GAS/MIST/VAPORS/SPRAY
P264 - WASH FACE THOROUGHLY AFTER HANDLING.
P322 + P313 - IF SKIN IRRITATION OCCURS: GET MEDICAL ADVICE/ ATTENTION.
P304 + 312 - IF INHALED: CALL A POISON CENTER/DOCTOR/PHYSICIAN IF YOU FEEL UNWELL

OTHER HAZARDS NO DATA AVAILABLE
UNKNOWN ACUTE TOXICITY NO DATA AVAILABLE

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

DESCRIPTION OF MIXTURE: PROPRIETARY MIXTURE OF DYES.

SUBSTANCE:

NAME	C.A.S.#	WEIGHT 100%	GHS-US CLASSIFICATION
ACID YELLOW 073	518-47-8	100%	ACUTE TOX. - INHALATION (CATEGORY 5) EYE DAM./IRRITATION (CATEGORY 2B) SKIN CORR./IRRITATION (CATEGORY 3)

SECTION 4. FIRST AID MEASURES

FIRST AID MEASURES GENERAL:

INHALATION: REMOVE TO FRESH AIR. IF BREATHING IS DIFFICULT, GIVE OXYGEN AND GET IMMEDIATE MEDICAL ATTENTION.

SKIN: WASH WITH MILD SOAP AND WATER. IF IRRITATION OCCURS GET MEDICAL ATTENTION. IF CLOTHING IS CONTAMINATED, RE-MOVE AND WASH BEFORE REUSE.

EYES: FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES, HOLDING EYELIDS APART FOR THOROUGH IRRIGATION. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION: INDUCE VOMITING - SEEK IMMEDIATE MEDICAL ATTENTION.

MOST IMPORTANT SYMPTOMS AND EFFECTS, ACUTE AND DELAYED:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY HAZARDOUS COMMUNICATION STANDARD. HOWEVER, AS WITH ALL CHEMICAL; HANDLE WITH CARE, AVOID EYE AND SKIN CONTACT, AVOID INHALATION OF DUSTS OR VAPORS. WASH THOROUGHLY AFTER HANDLING. KEEP CONTAINERS CLOSED.

SECTION 5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA:

WATER, DRY CHEMICAL, CARBON DIOXIDE, FOAM.

SPECIAL HAZARDS ARISING FROM SUBSTANCE OR MEDIA:

FIREFIGHTERS SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS TO GUARD AGAINST POTENTIALLY TOXIC AND IRRITATING FUMES. AVOID DUSTING. DUST CAN FORM EXPLOSIVE MIXTURES WITH AIR.

PROTECTION/ADVICE FOR FIREFIGHTER(S):

BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING.

SECTION 6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

REMOVE PERSONS FROM DANGER AREA.

ENVIROMENTAL PRECAUTIONS:

AVOID ANY UNCONTROLLED RELEASE OF MATERIAL. DO NOT EMPTY INTO DRAINS OR THE AQUATIC ENVIRONMENT.

EMERGENCY PROCEDURES:

NO ADDITIONAL INFORMATION

METHODS AND MATERIALS FOR CONTAMINENT AND CLEANING UP:

WHERE SPILLS ARE POSSIBLE, A COMPREHENSIVE SPILL RESPONSE PLAN SHOULD BE DEVELOPED AND IMPLEMENTED. AVOID ANY UNCONTROLLED RELEASE OF MATERIAL.

UTILIZE RECOMMENDED PROTECTIVE CLOTHING AND EQUIPMENT (SEE SECTION 8).
SPILLS SHOULD BE SWEPT UP USING AN ABSORBENT DUST CONTROL PRODUCT AND PLACED IN CONTAINERS. SPILL AREA CAN BE WASHED WITH WATER. COLLECT WATER FOR APPROVED DISPOSAL.
IN THE EVENT OF UNCONTROLLED RELEASE OF THIS MATERIAL, THE USER SHOULD DETERMINE IF THE RELEASE IS REPORTABLE UNDER APPLICABLE LAWS AND REGULATIONS.

SECTION 7. HANDLING AND STORAGE

PRECAUTIONS FOR SAFE HANDLING:

HANDLE WITH CARE. AVOID OVER EXPOSURE. USE NIOSH/OSHA APPROVED RESPIRATOR, WORK GLOVES, AND CLOTHING. WASH AFTER HANDLING. SENSITIVE INDIVIDUALS MAY EXPERIENCE RESPIRATORY ALLERGIES. MAY CAUSE SKIN IRRITATION. USE WITH LOCAL VENTILATION.

CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES:

USE PROCESS ENCLOSURES, LOCAL EXHAUST VENTILATION OR OTHER ENGINEERING CONTROLS TO KEEP AIRBORNE LEVELS BELOW RECOMMENDED EXPOSURE LIMITS.

KEEP AWAY FROM HEAT. KEEP AWAY FROM SOURCES OF IGNITION.

KEEP AWAY FROM STRONG OXIDIZING AND REDUSING AGENTS.

SPECIFIC END USES:

FELT TIP, MARKER INKS, WATER BASED COATINGS AND LEAK DETECTION

SECTION 8. EXPOSURE CONTROLS /PERSONAL PROTECTION

CONTROL PARAMETERS:

INGREDIENTS WITH LIMIT VALUES THAT REQUIRE MONITORING AT THE WORKPLACE - NOT REQUIRED

EXPOSURE CONTROLS:

APPROPRIATE ENGINEERING CONTROLS - THE USUAL PRECAUTIONARY MEASURES ARE TO BE ADHERED TO WHEN HANDLING CHEMICALS.

PERSONAL PROTECTIVE EQUIPMENT:

HAND PROTECTION	WEAR IMPERMEABLE RUBBER OR PLASTIC GLOVES
EYE PROTECTION	TIGHTLY SEALED SAFETY GOGGLES OR FULL FACE SIDE SHIELDS.
SKIN AND BODY	APRON, COVERALLS AND NON-LEATHER SOLED WORK SHOES. WASH DYE CONTAMINATED CLOTHES AND SKIN WITH MILD SOAP AND DETERGENTS.
RESPIRATORY	WEAR OSHA/NIOSH APPROVED DUST MASK/RESPIRATOR
HYGIENE MEASURES	HANDLE IN ACCORDANCE WITH GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES. WASH HANDS AFTER HANDLING MATERIAL.
OTHER PROTECTION	DELUGE SAFETY SHOWER AND EYE WASH STATION SHOULD BE LOCATED NEAR WORK AREA.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES :

APPEARANCE, COLOR, ODOR	YELLOW POWDER, NO ODOR
pH	8.0 - 9.0
MELTING POINT/FREEZING POINT	ND
INITIAL BOILING POINT/BOILING RANGE	0.00
FLASHPOINT	NORMALLY STABLE, NOT COMBUSTIBLE NOR FLAMMABLE
EVAPORATION RATE	NO DATA
FLAMMABILITY (SOLID,GAS)	NORMALLY STABLE, NOT COMBUSTIBLE NOR FLAMMABLE
UPPER EXPLOSIVE LIMITS	NA
LOWER EXPLOSIVE LIMITS	NA
VAPOR PRESSURE	NA
VAPOR DENSITY	NA
RELATIVE DENSITY	NA
SOLUBILITY IN WATER	SOLUBLE
PARTITION COEFFICIENT N-OCTANOL/WATER	NO DATA

AUTO-IGNITION TEMPERATURE	NO DATA
DECOMPOSITION TEMPERATURE	NO DATA
VISCOSITY, DYNAMIC	NO DATA
VISCOSITY, CINEMATIC	NO DATA
EXPLOSIVE PROPERTIES	N/A
OXIDIZING PROPERTIES	NA
OTHER INFORMATION	NA

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY	STABLE UNDER NORMAL STORAGE AND HANDLING CONDITIONS.
CONDITIONS TO AVOID	OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.
INCOMPATIBLE MATERIALS	OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.

HAZARDOUS DECOMPOSITION PRODUCTS - CO, CO2, OXIDES OF NITROGEN AND OTHER POTENTIALLY TOXIC FUMES.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL EFFECTS :

ORAL (ANIMAL	GREATER THAN 7,000 MG/KG - RAT
DERMAL (ANIMAL)	NA
EFFECTS TO EYES (ANIMAL)	EYES - RABBIT, NOT IRRITATING
SKIN IRRITATION (ANIMAL)	SKIN - RABBIT, SLIGHT IRRITANT

SKIN CORROSION/IRRITATION	NOT CLASSIFIED
SERIOUS EYE DAMAGE/IRRITATION	CAUSES EYE IRRITATION
RESPIRATORY OR SKIN SENSITIZATION	NOT CLASSIFIED
GERM CELL MUTAGENICITY	NOT CLASSIFIED
CARCINOGENICITY	NOT CLASSIFIED
REPRODUCTIVE TOXICITY	NOT CLASSIFIED
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE)	MAY CAUSE DROWSINESS OR DIZZINESS.
ASPIRATION HAZARD	NOT CLASSIFIED
INHALATION	MAY CAUSE DROWSINESS OR DIZZINESS.
EYE CONTACT	CAUSES SERIOUS EYE IRRITATION.
INGESTION	INGESTION MAY CAUSE NAUSEA, VOMITING AND DIARRHEA

SECTION 12. ECOLOGICAL INFORMATION

TOXICITY	NA
PERSISTENCE AND DEGRADABILITY	NA
BIOACCUMULATIVE POTENTIAL	NA
MOBILITY IN SOIL	LC-50 (LETHAL CONCENTRATION) UG = MICROGRAMS/LITER CHANNEL CATFISH - 2,267,000 UG/LITER RAINBOW TROUT - 1,372,000 UG/LITER BLUEGILL - 3,433,000 UG/LITER
OTHER ADVERSE EFFECTS	NA

SECTION 13. DISPOSAL CONSIDERATION

WASTE DISPOSAL RECOMMENDATION :

EMPTY BAGS THOROUGHLY. CARRY OUT THE PROPER RECYLING, REUSAGE OR DISPOSAL.
PLEASE REFER TO THE RELEVANT EU REGULATIONS, IN PARTICULAR THE GUIDELINES/DECISIONS OF THE COUNCIL REGARDING HANDLING OF WASTES (E.G. 75/442/EEC, 91/689/EEC, 94/67/EC, 94/904/EC) AS IMPLEMENTED IN NATIONAL REGULATIONS.

REGIONAL RECOMMENDATION :

BURY OR INCINERATE ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

CONTAINERS SHOULD NOT BE REUSED WITHOUT PROFESSIONAL CLEANING AND RECONDITIONING.
OBSERVE ALL LABELED SAFEGUARDS UNTIL CLEANED, RECONDITIONED OR DESTROYED.

PLEASE REFER TO SECTION 8 (EXPOSURE CONTROLS /PERSONAL PROTECTION) OF THIS SDS.

SECTION 14. TRANSPORTATION INFORMATION

UN NUMBER	NONE
UN PROPER SHIPPING NAME	NONE

DEPARTMENT OF TRANSPORTATION (DOT) : NOT HAZARDOUS FOR TRANSPORTATION

TRANSPORT HAZARD CLASS(ES)

HAZARD LABLES (DOT) :

PACKING GROUP (DOT)	NA
DOT SPECIAL PROVISIONS	NA

ADDITIONAL INFORMATION:

OVERLAND TRANSPORT	NONE
TRANSPORT BY SEA	NONE
AIR TRANSPORT	NONE
DOT QUANTITY LIMITATIONS PASSENGER AIRCRAFT	NA
DOT QUANTITY LIMITATIONS CARGO AIRCRAFT	NA

SECTION 15. REGULATORY INFORMATION

US FEDERAL REGULATIONS:

THE SUBSTANCES IS LISTED ON UNITED STATES TSCA (TOXIC SUBSTANCE CONTROL ACT) INVENTORY.

US STATE REGULATIONS:

NONE

CHEMICAL IDENTITY:

518-47-8	TSCA	DSL	NDSL	EINECS	ELINCS	ENCS	CHINA	KECL	PICCS	AICS
	X	-	-	-	-	-	-	-	-	-

TSCA STATUS	IN COMPLIANCE
E C CLASSIFICATION	(67/548/EEC - 88/379/EEC) N/A
EINECS NUMBER	
REACH CLASSIFICATION	
R PHRASES	
ADDITIONAL REGULATORY INFORMATION	

SECTION 16. OTHER INFORMATION

INDICATION OF CHANGES:

NA

OTHER INFORMATION:

NA

GHS FULL TEXT PHRASES:

MAY BE HARMFUL IF INHALED	H333
CAUSES EYE IRRITATION	H320
CASUES MILD SKIN IRRITATION	H316

	HEALTH	FLAMMABILITY	REACTIVITY	PERSONAL PROT
H. M. I. S. CLASSIFICATION:	1	0	0	D

HMIS CODE: **4** - SEVERE HAZARD, **3** - SERIOUS HAZARD, **2** - MODERATE HAZARD, **1** - SLIGHT HAZARD, **0** - MINIMAL HAZARD

SAFETY DATA SHEET (SDS)
REVISION DATE: 03/03/2016

Safety Data Sheet

INTRACID RHODAMINE WT LIQUID

Safety Data Sheet dated: 5/13/2015 - version 1

Date of first edition: 5/13/2015

1. IDENTIFICATION

Product identifier

Mixture identification:

Trade name: INTRACID RHODAMINE WT LIQUID

Other means of identification:

Trade code: A45171566

Recommended use of the chemical and restrictions on use

Recommended use: Industrial color additive

Restrictions on use: Not Determined

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

Sensient Colors LLC

2515 N. Jefferson

63106 St. Louis, MO (USA)

Phone: 1 800-325-8110

Emergency Number(CHEMTREC): 1-800-424-9300

2. HAZARD(S) IDENTIFICATION

The identity of the individual components of this product is proprietary information and is considered a trade secret pursuant to 29 CFR 1910.1200

Hazardous components as defined in the OSHA Hazard Communication Standard: components with a HEALTH hazard (carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, etc..) and/or a PHYSICAL hazard (a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive, etc.)

Classification of the chemical

Skin Irrit. 2	Causes skin irritation.
Eye Irrit. 2B	Causes eye irritation

Label elements

Symbols:

Warning

Code	Description
H315	Causes skin irritation.
H320	Causes eye irritation

Code	Description
P264	Wash ... Thoroughly after handling.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352	IF ON SKIN: Wash with plenty of water/…
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321	Specific treatment (see ... On this label).
P332+P313	If skin irritation occurs: Get medical advice/attention.
P337+P313	If eye irritation persists: Get medical advice/attention.

P362+P364 Take off contaminated clothing and wash it before reuse.

Ingredient(s) with unknown acute toxicity:

None

Hazards not otherwise classified identified during the classification process:

None

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances

Not Determined

Mixtures

Hazardous components within the meaning of 29 CFR 1910.1200 and related classification:

List of components

Qty	Name	Ident. Numb.	Classification	Registration Number
10-12.5 %	RHODAMINE LIQUID	CAS:65392-81-6 EC:265-730-6	Skin Irrit. 2, H315; Eye Irrit. 2B, H320	
10-12.5 %	RHODAMINE LIQUID	CAS:75701-30-3 EC:278-292-6	Skin Irrit. 2, H315; Eye Irrit. 2B, H320	
1-3 %	TRIMELLITIC ACID	CAS:528-44-9 EC:208-432-3	Skin Irrit. 2, H315; Eye Irrit. 2A, H319; STOT SE 3, H335	

4. FIRST AID MEASURES

Description of first aid measures

In case of skin contact:

Immediately take off all contaminated clothing and shoes.

Immediately remove any contaminated clothing, shoes or stockings.

After contact with skin, wash immediately with soap and plenty of water.

In case of eye contact:

Wash immediately and thoroughly with running water, keeping eyelids regularly raised, for at least 15 minutes. Cold water may be used. Check for and remove any contact lenses at once. OBTAIN A MEDICAL EXAMINATION.

Protect the eyes with a sterile gauze or a clean, dry handkerchief.

In case of ingestion:

Do not induce vomiting, get medical attention showing the MSDS and label hazardous.

In case of inhalation:

Remove casualty to fresh air and keep warm and at rest.

Most important symptoms/effects, acute and delayed

Eye irritation

Eye damages

Skin Irritation

Erythema

Indication of any immediate medical attention and special treatment needed

In case of accident or unwellness, seek medical advice immediately (show directions for use or safety data sheet if possible).

5. FIRE-FIGHTING MEASURES

Extinguishing media

Suitable extinguishing media:

Water, CO2, foam, chemical powders, according to the materials involved in the fire.

In case of fire, use foam, dry chemical, CO2.

Unsuitable extinguishing media:

None in particular.

Specific hazards arising from the chemical

Do not inhale explosion and combustion gases.

Burning produces heavy smoke.

Hazardous combustion products: Not Determined

Explosive properties: Not Determined

Oxidising properties: Not Determined

Special protective equipment and precautions for fire-fighters

Use suitable breathing apparatus .

Collect contaminated fire extinguishing water separately. This must not be discharged into drains.

Move undamaged containers from immediate hazard area if it can be done safely.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Wear personal protection equipment.

Remove persons to safety.

See protective measures under point 7 and 8.

Methods and material for containment and cleaning up

Suitable material for taking up: dry and inert absorbing material (e.g. vermiculite, sand, earth).

Wash with plenty of water.

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes, inhalation of vapours and mists.

Don't use empty container before they have been cleaned.

Before making transfer operations, assure that there aren't any incompatible material residuals in the containers.

Contamined clothing should be changed before entering eating areas.

Do not eat or drink while working.

See also section 8 for recommended protective equipment.

Conditions for safe storage, including any incompatibilities

Storage temperature: Not Determined

Incompatible materials:

None in particular.

Instructions as regards storage premises:

Adequately ventilated premises.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

No Data Available

Appropriate engineering controls: Not Determined

Individual protection measures

Eye/face protection:

Use close fitting safety goggles, don't use eye lens.

Skin protection:

Use clothing that provides comprehensive protection to the skin, e.g. cotton, rubber, PVC or viton.

Hand protection:

Use protective gloves that provide comprehensive protection, e.g. P.V.C., neoprene or rubber.

Respiratory protection:

Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State Liquid

Appearance: Liquid,

Odour: Not Determined

Odour threshold: Not Determined

pH: 10.50

Melting point/ range: Not Determined

Boiling point/ range: Not Determined

Flash point: > 100°C / 212°F

Evaporation rate: Not Determined

Upper/lower flammability or explosive limits: Not Determined

Vapour density: Not Determined

Vapour pressure: Not Determined

Density: Not Determined

Water solubility: Not Determined

Lipid solubility: Not Determined

Partition coefficient (n-octanol/water): Not Determined

Auto-ignition temperature: Not Determined

Decomposition temperature: Not Determined

Viscosity: Not Determined

Explosive properties: Not Determined

Oxidising properties: Not Determined

Flammability (Solid, Gas): Not Determined

Other information

Substance group relevant properties: Not Determined
Miscibility: Not Determined
Fat Solubility: Not Determined
Conductivity: Not Determined

10. STABILITY AND REACTIVITY

Reactivity

Stable under normal conditions.

Chemical stability

Data not Available.

Possibility of hazardous reactions

Burning produces carbon monoxide and/or carbon dioxide.

Conditions to avoid

Stable under normal conditions of temperature and pressure.

Incompatible materials

Avoid strong oxidizing agents, peroxides, acids, alkali metals.

Hazardous decomposition products

Burning produces carbon monoxide and/or carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on toxicological effects

Toxicological information of the product: No Data Available

Substance(s) listed on the IARC Monographs:

None

Substance(s) listed as OSHA Carcinogen(s):

None

Substance(s) listed as NIOSH Carcinogen(s):

None

Substance(s) listed on the NTP report on Carcinogens:

None

12. ECOLOGICAL INFORMATION

Toxicity

Adopt good working practices, so that the product is not released into the environment.
Eco-toxicity:

List of Eco-Toxicological properties of the product

No Data Available

Persistence and degradability

Not Determined

Bioaccumulative potential

Not Determined

Mobility in soil

Not Determined

Other adverse effects

Not Determined

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Recover if possible. In so doing, comply with the local and national regulations currently in force.

14. TRANSPORT INFORMATION

UN number

ADR-UN number: N/A
DOT-UN Number: N/A
IATA-Un number: N/A
IMDG-Un number: N/A

UN proper shipping name

ADR-Shipping Name: N/A
DOT Proper Shipping Name: N/A
IATA-Technical name: N/A
IMDG-Technical name: N/A

Transport hazard class(es)

ADR-Class: N/A
DOT Hazard Class: N/A
IATA-Class: N/A
IMDG-Class: N/A

Packing group

ADR-Packing Group: N/A
Exempted for ADR: N/A
IATA-Packing group: N/A
IMDG-Packing group: N/A

Environmental hazards

Marine pollutant: No
Environmental Pollutant: Not Determined

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

Not Determined

Special precautions

Department of Transportation (DOT):

DOT-Special Provision(s): N/A
DOT Label(s): N/A
DOT Symbol: N/A
DOT Cargo Aircraft: N/A
DOT Passenger Aircraft: N/A
DOT/TDG Bulk: N/A
DOT Non-Bulk: N/A

Road and Rail (ADR-RID):

ADR-Label: N/A
ADR-Upper number: N/A
ADR Tunnel Restriction Code: N/A

Air (IATA):

IATA-Passenger Aircraft: N/A
IATA-Cargo Aircraft: N/A
IATA-Label: N/A
IATA-Sub Risk: N/A
IATA-Erg: N/A
IATA-Special Provisioning: N/A

Sea (IMDG):

IMDG-Stowage Code: N/A
IMDG-Stowage Note: N/A
IMDG-Sub Risk: N/A
IMDG-Special Provisioning: N/A
IMDG-Page: N/A
IMDG-Label: N/A
IMDG-EMS: N/A
IMDG-MFAG: N/A

15. REGULATORY INFORMATION

USA - Federal regulations

TSCA - Toxic Substances Control Act

TSCA inventory:

All the components are listed on the TSCA inventory

TSCA listed substances:

RHODAMINE LIQUID	is listed in TSCA	Section 8b
RHODAMINE LIQUID	is listed in TSCA	Section 8b
TRIMELLITIC ACID	is listed in TSCA	Section 8b, Section 5

SARA - Superfund Amendments and Reauthorization Act

Section 302 - Extremely Hazardous Substances:

no substances listed

Section 304 - Hazardous substances:

no substances listed

Section 313 - Toxic chemical list:

no substances listed

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

Substance(s) listed under CERCLA:

no substances listed

CAA - Clean Air Act

CAA listed substances:

no substances listed

CWA - Clean Water Act

CWA listed substances:

no substances listed

USA - State specific regulations

California Proposition 65

Substance(s) listed under California Proposition 65:

no substances listed

Massachusetts Right to know

Substance(s) listed under Massachusetts Right to know:

no substances listed

Pennsylvania Right to know

Substance(s) listed under Pennsylvania Right to know:

no substances listed

New Jersey Right to know

Substance(s) listed under New Jersey Right to know:

no substances listed

16. OTHER INFORMATION

Code	Description
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H320	Causes eye irritation
H335	May cause respiratory irritation.

Safety Data Sheet dated: 5/13/2015 - version 1

The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality. The information relates only to the specific material and may not be valid for such material used in combination with any other material or in any process.

This document was prepared by a competent person who has received appropriate training.

It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended.

This MSDS cancels and replaces any preceding release.

Legend to abbreviations and acronyms used in the safety data sheet:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.

RID: Regulation Concerning the International Transport of Dangerous Goods by Rail

IMDG: International Maritime Code for Dangerous Goods

IATA: International Air Transport Association

IATA-DGR: Dangerous Goods Regulation by the "International Air Transport Association" (IATA)

ICAO: International Civil Aviation Organization

ICAO-TI: Technical Instructions by the "International Civil Aviation Organization" (ICAO)

GHS: Globally Harmonized System of Classification and Labeling of Chemicals
CLP: Classification, Labeling, Packaging
EINECS: European Inventory of Existing Commercial Chemical Substances
INCI: International Nomenclature of Cosmetic Ingredients
CAS: Chemical Abstracts Service (division of the American Chemical Society)
GefStoffVO: Ordnance on Hazardous Substances, Germany
LC50: Lethal concentration, for 50 percent of test population
LD50: Lethal dose, for 50 percent of test population
DNEL: Derived No Effect Level
PNEC: Predicted No Effect Concentration
TLV: Threshold Limiting Value
TWATLV: Threshold Limiting Value for the Time Weighted Average 8 hour day.(ACGIH Standard)
STEL: Short Term Exposure limit
STOT: Specific Target Organ Toxicity
WGK: German Water Hazard Class
KSt: Explosion coefficient
y for the damage.

SAFETY DATA SHEET (SDS)
REVISION DATE: 03/03/2016

HUE CORPORATION

Color your everything, may your Hue come true

SECTION I. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

PRODUCT IDENTIFIER:

PRODUCT NAME ..... **HUE EOSINE EX CONC**
PRODUCT NUMBER 1-C6-087-XPC
COLOR INDEX NAME ..... ACID RED 087
COLOR INDEX NO 45380
C. A. S. # 17372-87-1
CHEMICAL FAMILY..... XANTHENE DYE

INTENDED USE OF THE PRODUCT:

FELT TIP, MARKER INKS, WATER BASED COATINGS AND SPECIALTY INKS, PRINTING ON NYLON, SILK AND WOOL.

NAME, ADDRESS AND TELEPHONE OF RESPONSIBLE PARTY:

HUE CORPORATION	TELEPHONE	714-389-3130
P.O. BOX 509	FAX	714-389-9731
TUSTIN, CA 92781	EMAIL	SUPPORT@HUECORPORATION.COM

EMERGENCY TELEPHONE NUMBER:

CHEMTREC (USA)	1-800-424-9300
CHEMTREC (OUTSIDE USA)	1-703-527-3887

SECTION 2. HAZARD(S) IDENTIFICATION

CLASSIFICATION OF THE SUBSTANCE OR MIXTURE:

GHS-US
ACUTE TOX. - INHALATION (CATEGORY 5)
EYE DAM./IRRITATION (CATEGORY 2B)
SKIN CORR./IRRITATION (CATEGORY 3)

GHS LABELING:

HAZARD PICTOGRAMS (GHS-US):	NO SYMBOL
SIGNAL WORD	WARNING
HAZARD STATEMENT(S)	H333 - MAY BE HARMFUL IF INHALED H320 - CAUSES EYE IRRITATION H316 - CAUSES MILD SKIN IRRITATION
PRECAUTIONARY STATEMENTS	P305 + 351 + P338 - IF IN EYES: RINSE CAUTIOUSLY WITH WATER FOR

SEVERAL MINUTES. REMOVE CONTACT LENSES IF PRESENT AND EASY TO DO. CONTINUE RINSING.
P337 + P313 - IF EYE IRRITATION OCCURS/PERSISTS: GET MEDICAL ADVICE AND ATTENTION.
P261 - AVOID BREATHING DUST/FUMES/GAS/MIST/VAPORS/SPRAY
P264 - WASH FACE THOROUGHLY AFTER HANDLING.
P322 + P313 - IF SKIN IRRITATION OCCURS: GET MEDICAL ADVICE/ ATTENTION.
P304 + 312 - IF INHALED: CALL A POISON CENTER/DOCTOR/PHYSICIAN IF YOU FEEL UNWELL
P501 - DISPOSE OF CONTENTS/ CONTAINER IN ACCORDANCE WITH LOCAL/ REGIONAL/ NATIONAL INTERNATIONAL REGULATIONS.

OTHER HAZARDS NO DATA AVAILABLE
UNKNOWN ACUTE TOXICITY NO DATA AVAILABLE

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

DESCRIPTION OF MIXTURE: PROPRIETARY MIXTURE OF DYES.

SUBSTANCE:

NAME	C.A.S.#	WEIGHT 100%	GHS-US CLASSIFICATION
ACID RED 087	17372-87-1	100%	ACUTE TOX. - INHALATION (CATEGORY 5) EYE DAM./IRRITATION (CATEGORY 2B) SKIN CORR./IRRITATION (CATEGORY 3)

SECTION 4. FIRST AID MEASURES

FIRST AID MEASURES GENERAL:

INHALATION: REMOVE TO FRESH AIR. IF BREATHING IS DIFFICULT, GIVE OXYGEN AND GET IMMEDIATE MEDICAL ATTENTION.

SKIN: WASH WITH MILD SOAP AND WATER. IF IRRITATION OCCURS GET MEDICAL ATTENTION. IF CLOTHING IS CONTAMINATED, RE-MOVE AND WASH BEFORE REUSE.

EYES: FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES, HOLDING EYELIDS APART FOR THOROUGH IRRIGATION. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION: INDUCE VOMITING - SEEK IMMEDIATE MEDICAL ATTENTION.

MOST IMPORTANT SYMPTOMS AND EFFECTS, ACUTE AND DELAYED:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY HAZARDOUS COMMUNICATION STANDARD. HOWEVER, AS WITH ALL CHEMICAL; HANDLE WITH CARE, AVOID EYE AND SKIN CONTACT, AVOID INHALATION OF DUSTS OR VAPORS. WASH THOROUGHLY AFTER HANDLING. KEEP CONTAINERS CLOSED.

SECTION 5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA:

WATER, DRY CHEMICAL, CARBON DIOXIDE, FOAM.

SPECIAL HAZARDS ARISING FROM SUBSTANCE OR MEDIA:

FIREFIGHTERS SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS TO GUARD AGAINST POTENTIALLY TOXIC AND IRRITATING FUMES. AVOID DUSTING. DUST CAN FORM EXPLOSIVE MIXTURES WITH AIR.

PROTECTION/ADVICE FOR FIREFIGHTER(S):

BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING.

SECTION 6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

REMOVE PERSONS FROM DANGER AREA.

ENVIROMENTAL PRECAUTIONS:

AVOID ANY UNCONTROLLED RELEASE OF MATERIAL. DO NOT EMPTY INTO DRAINS OR THE AQUATIC ENVIRONMENT.

EMERGENCY PROCEDURES:

NO ADDITIONAL INFORMATION

METHODS AND MATERIALS FOR CONTAMINENT AND CLEANING UP:

WHERE SPILLS ARE POSSIBLE, A COMPREHENSIVE SPILL RESPONSE PLAN SHOULD BE DEVELOPED AND IMPLEMENTED. AVOID ANY UNCONTROLLED RELEASE OF MATERIAL.

UTILIZE RECOMMENDED PROTECTIVE CLOTHING AND EQUIPMENT (SEE SECTION 8).
SPILLS SHOULD BE SWEPT UP USING AN ABSORBENT DUST CONTROL PRODUCT AND PLACED IN CONTAINERS. SPILL AREA CAN BE WASHED WITH WATER. COLLECT WATER FOR APPROVED DISPOSAL.
IN THE EVENT OF UNCONTROLLED RELEASE OF THIS MATERIAL, THE USER SHOULD DETERMINE IF THE RELEASE IS REPORTABLE UNDER APPLICABLE LAWS AND REGULATIONS.

SECTION 7. HANDLING AND STORAGE

PRECAUTIONS FOR SAFE HANDLING:

HANDLE WITH CARE. AVOID OVER EXPOSURE. USE NIOSH/OSHA APPROVED RESPIRATOR, WORK GLOVES, AND CLOTHING. WASH AFTER HANDLING. SENSITIVE INDIVIDUALS MAY EXPERIENCE RESPIRATORY ALLERGIES. MAY CAUSE SKIN IRRITATION. USE WITH LOCAL VENTILATION.

CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES:

USE PROCESS ENCLOSURES, LOCAL EXHAUST VENTILATION OR OTHER ENGINEERING CONTROLS TO KEEP AIRBORNE LEVELS BELOW RECOMMENDED EXPOSURE LIMITS.

KEEP AWAY FROM HEAT. KEEP AWAY FROM SOURCES OF IGNITION.

KEEP AWAY FROM STRONG OXIDIZING AND REDUSING AGENTS.

SPECIFIC END USES:

FELT TIP, MARKER INKS, WATER BASED COATINGS AND SPECIALTY INKS, PRINTING ON NYLON, SILK AND WOOL.

SECTION 8. EXPOSURE CONTROLS /PERSONAL PROTECTION

CONTROL PARAMETERS:

INGREDIENTS WITH LIMIT VALUES THAT REQUIRE MONITORING AT THE WORKPLACE - NOT REQUIRED

EXPOSURE CONTROLS:

APPROPRIATE ENGINEERING CONTROLS - THE USUAL PRECAUTIONARY MEASURES ARE TO BE ADHERED TO WHEN HANDLING CHEMICALS.

PERSONAL PROTECTIVE EQUIPMENT:

HAND PROTECTION	WEAR IMPERMEABLE RUBBER OR PLASTIC GLOVES
EYE PROTECTION	TIGHTLY SEALED SAFETY GOGGLES OR FULL FACE SIDE SHIELDS.
SKIN AND BODY	APRON, COVERALLS AND NON-LEATHER SOLED WORK SHOES. WASH DYE CONTAMINATED CLOTHES AND SKIN WITH MILD SOAP AND DETERGENTS.
RESPIRATORY	WEAR OSHA/NIOSH APPROVED DUST MASK/RESPIRATOR
HYGIENE MEASURES	HANDLE IN ACCORDANCE WITH GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES. WASH HANDS AFTER HANDLING MATERIAL.
OTHER PROTECTION	DELUGE SAFETY SHOWER AND EYE WASH STATION SHOULD BE LOCATED NEAR WORK AREA.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES :

APPEARANCE, COLOR, ODOR	POWDER, NO ODOR
pH	7.0 - 8.5
MELTING POINT/FREEZING POINT	ND
INITIAL BOILING POINT/BOILING RANGE	0.00
FLASHPOINT	NOT APPLICABLE
EVAPORATION RATE	NO DATA
FLAMMABILITY (SOLID,GAS)	NORMALLY STABLE, NOT COMBUSTIBLE NOR FLAMMABLE
UPPER EXPLOSIVE LIMITS	NA
LOWER EXPLOSIVE LIMITS	NA
VAPOR PRESSURE	NA
VAPOR DENSITY	NA
RELATIVE DENSITY	NA

SOLUBILITY IN WATER	SOLUBLE
PARTITION COEFFICIENT N-OCTANOL/WATER	NO DATA
AUTO-IGNITION TEMPERATURE	NO DATA
DECOMPOSITION TEMPERATURE	NO DATA
VISCOSITY, DYNAMIC	NO DATA
VISCOSITY, CINEMATIC	NO DATA
EXPLOSIVE PROPERTIES	N/A
OXIDIZING PROPERTIES	NA
OTHER INFORMATION	NA

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY	STABLE UNDER NORMAL STORAGE AND HANDLING CONDITIONS.
CONDITIONS TO AVOID	OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.
INCOMPATIBLE MATERIALS	OXIDIZING & REDUCING AGENTS MAY DESTROY COLOR.
HAZARDOUS DECOMPOSITION	PRODUCTS - CO, CO2, OXIDES OF NITROGEN AND OTHER POTENTIALLY TOXIC FUMES.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL EFFECTS :

ORAL (ANIMAL	GREATER THAN 2000 MG/KG - RAT
DERMAL (ANIMAL)	NO DATA AVAILABLE
EFFECTS TO EYES (ANIMAL)	NO DATA AVAILABLE
SKIN IRRITATION (ANIMAL)	NO DATA AVAILABLE

SKIN CORROSION/IRRITATION	NOT CLASSIFIED
SERIOUS EYE DAMAGE/IRRITATION	CAUSES SERIOUS EYE IRRITATION
RESPIRATORY OR SKIN SENSITIZATION	NOT CLASSIFIED
GERM CELL MUTAGENICITY	NOT CLASSIFIED
CARCINOGENICITY	NOT CLASSIFIED
REPRODUCTIVE TOXICITY	NOT CLASSIFIED
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE)	MAY CAUSE DROWSINESS OR DIZZINESS.
ASPIRATION HAZARD	NOT CLASSIFIED
INHALATION	MAY CAUSE DROWSINESS OR DIZZINESS.
EYE CONTACT	CAUSES SERIOUS EYE IRRITATION.
INGESTION	INGESTION MAY CAUSE NAUSEA, VOMITING AND DIARRHEA

SECTION 12. ECOLOGICAL INFORMATION

TOXICITY	NA
PERSISTENCE AND DEGRADABILITY	NA
BIOACCUMULATIVE POTENTIAL	NA
MOBILITY IN SOIL	NA
OTHER ADVERSE EFFECTS	NA

SECTION 13. DISPOSAL CONSIDERATION

WASTE DISPOSAL RECOMMENDATION :

EMPTY BAGS THOROUGHLY. CARRY OUT THE PROPER RECYLING, REUSAGE OR DISPOSAL.
PLEASE REFER TO THE RELEVANT EU REGULATIONS, IN PARTICULAR THE GUIDELINES/DECISIONS OF THE COUNCIL REGARDING HANDLING OF WASTES (E.G. 75/442/EEC, 91/689/EEC, 94/67/EC, 94/904/EC) AS IMPLEMENTED IN NATIONAL REGULATIONS.

REGIONAL RECOMMENDATION :

BURY OR INCINERATE ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

CONTAINERS SHOULD NOT BE REUSED WITHOUT PROFESSIONAL CLEANING AND RECONDITIONING.
OBSERVE ALL LABELED SAFEGUARDS UNTIL CLEANED, RECONDITIONED OR DESTROYED.

PLEASE REFER TO SECTION 8 (EXPOSURE CONTROLS /PERSONAL PROTECTION) OF THIS SDS.

SECTION 14. TRANSPORTATION INFORMATION

UN NUMBER	NONE
UN PROPER SHIPPING NAME	NONE

DEPARTMENT OF TRANSPORTATION (DOT) : NOT HAZARDOUS FOR TRANSPORTATION

TRANSPORT HAZARD CLASS(ES)

HAZARD LABLES (DOT) :

PACKING GROUP (DOT)	NA
DOT SPECIAL PROVISIONS	NA

ADDITIONAL INFORMATION:

OVERLAND TRANSPORT	NONE
TRANSPORT BY SEA	NONE
AIR TRANSPORT	NONE
DOT QUANTITY LIMITATIONS PASSENGER AIRCRAFT	NA
DOT QUANTITY LIMITATIONS CARGO AIRCRAFT	NA

SECTION 15. REGULATORY INFORMATION

US FEDERAL REGULATIONS:

THIS SUBSTANCE IS LISTED ON UNITED STATES TSCA (TOXIC SUBSTANCE CONTROL ACT) INVENTORY.

US STATE REGULATIONS:

NONE

CHEMICAL IDENTITY:

	TSCA	DSL	NDSL	EINECS	ELINCS	ENCS	CHINA	KECL	PICCS	AICS
17372-87-1	X	-	-	-	-	-	-	-	-	-

TSCA STATUS	IN COMPLIANCE
E C CLASSIFICATION	(67/548/EEC - 88/379/EEC) N/A
EINECS NUMBER	
REACH CLASSIFICATION	
R PHRASES	
ADDITIONAL REGULATORY INFORMATION	CONTAINS: <11PPM BENZENE, (CAS#71-43-2) <11PPM TOLUENE, (CAS#108-88-3) <11PPM XYLENES, (CAS#1330-20-7)

SECTION 16. OTHER INFORMATION

INDICATION OF CHANGES:

NA

OTHER INFORMATION:

NA

GHS FULL TEXT PHRASES:

MAY BE HARMFUL IF INHALED	H333
CAUSES EYE IRRITATION	H320
CASUES MILD SKIN IRRITATION	H316

	HEALTH	FLAMMABILITY	REACTIVITY	PERSONAL PROT
H. M. I. S. CLASSIFICATION:	1	0	0	D

HMIS CODE: **4** - SEVERE HAZARD, **3** - SERIOUS HAZARD, **2** - MODERATE HAZARD, **1** - SLIGHT HAZARD, **0** - MINIMAL HAZARD

SAFETY DATA SHEET (SDS)
REVISION DATE: 03/03/2016

SAFETY DATA SHEET

Version 6.5
Revision Date 01/15/2020
Print Date 01/18/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Potassium chloride

Product Number : P9333
Brand : Sigma-Aldrich
CAS-No. : 7447-40-7

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements

Not a hazardous substance or mixture.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula : KCl
Molecular weight : 74.55 g/mol
CAS-No. : 7447-40-7
EC-No. : 231-211-8

No components need to be disclosed according to the applicable regulations.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Hydrogen chloride gas, Potassium oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

hygroscopic Keep in a dry place.
Storage class (TRGS 510): 13: Non Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber

Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: crystalline, powder Colour: white
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	7
e)	Melting point/freezing point	Melting point/range: 770 °C (1418 °F)
f)	Initial boiling point and boiling range	1,500 °C 2,732 °F
g)	Flash point	()No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	1.98 g/mL at 25 °C (77 °F)

n)	Water solubility	soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
Exposure to moisture

10.5 Incompatible materials
Strong acids, Strong oxidizing agents

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas, Potassium oxides
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - female - 3,020 mg/kg
Remarks: (ECHA)
Inhalation: No data available
Dermal: No data available
No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
Ames test
Salmonella typhimurium
Result: negative
In vitro mammalian cell gene mutation test
mouse lymphoma cells
Result: negative
Mutagenicity (mammal cell test): chromosome aberration.
Chinese hamster lung cells
Result: positive

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information

Repeated dose toxicity - Rat - male - Oral - 2 yr - No observed adverse effect level - 1,820 mg/kg - Lowest observed adverse effect level - 110 mg/kg
(ECHA)
RTECS: TS8050000

hyperkalemia, Nausea, Vomiting, Abdominal pain, Diarrhoea, Constipation., Paresthesia., Thirst, Dizziness, Rash, pruritus, Weakness, muscle cramps, minor psychiatric changes, minor visual changes
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Pimephales promelas (fathead minnow) - 880 mg/l - 96 h

	(OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - 440 - 880 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	static test ErC50 - Desmodesmus subspicatus (green algae) - > 100 mg/l - 72 h (OECD Test Guideline 201)
Toxicity to bacteria	static test EC50 - activated sludge - > 1,000 mg/l - 3 h (OECD Test Guideline 209)

12.2 Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

SECTION 15: Regulatory information

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
No SARA Hazards

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

Potassium chloride	CAS-No. 7447-40-7	Revision Date

New Jersey Right To Know Components

Potassium chloride	CAS-No. 7447-40-7	Revision Date

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

SECTION 16: Other information

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.5 Revision Date: 01/15/2020 Print Date: 01/18/2020

Ferric Chloride Solution

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 12/12/2013 Revision date: 01/17/2017 Supersedes: 01/17/2017 Version: 1.1

SECTION 1: Identification

1.1. Identification

Product form : Mixtures

Product name : Ferric Chloride Solution

Product code : LC14380

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : For laboratory and manufacturing use only.

Restrictions on use : Not for food, drug or household use

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Skin corrosion/irritation Category 1C	H314
Serious eye damage/eye irritation Category 1	H318
Hazardous to the aquatic environment - Acute Hazard Category 2	H401

Full text of H statements : see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS05

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) : H314 - Causes severe skin burns and eye damage
H401 - Toxic to aquatic life

Precautionary statements (GHS-US) : P260 - Do not breathe mist, vapors, spray
P264 - Wash exposed skin thoroughly after handling
P273 - Avoid release to the environment
P280 - Wear protective gloves, eye protection
P301+P330+P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting
P303+P361+P353 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a poison center or doctor/physician
P363 - Wash contaminated clothing before reuse
P405 - Store locked up
P501 - Dispose of contents/container to comply with local, state and federal regulations
If inhaled: Remove person to fresh air and keep comfortable for breathing

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	GHS-US classification
Ferric Chloride, Hexahydrate	(CAS No) 10025-77-1	71	Acute Tox. 4 (Oral), H302 Skin Corr. 1C, H314 Eye Dam. 1, H318 Aquatic Acute 2, H401
Water	(CAS No) 7732-18-5	29	Not classified

Full text of hazard classes and H-statements : see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

First-aid measures after inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a poison center or doctor/physician.

First-aid measures after skin contact : Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Immediately call a poison center or doctor/physician.

First-aid measures after eye contact : Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center or doctor/physician.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Immediately call a poison center or doctor/physician.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : Causes severe skin burns and eye damage.

Symptoms/injuries after eye contact : Causes serious eye damage.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Reactivity : Thermal decomposition generates : Corrosive vapors.

5.3. Advice for firefighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment : Safety glasses. Gloves. Protective clothing.

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters. Avoid release to the environment.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor. Do not breathe mist, vapors, spray.

Hygiene measures : Wash exposed skin thoroughly after handling. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Comply with applicable regulations.

Storage conditions : Keep only in the original container in a cool, well ventilated place away from : incompatible materials. Keep container closed when not in use.

Incompatible products : Strong bases. metals.

Incompatible materials : Sources of ignition. Direct sunlight.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Ferric Chloride, Hexahydrate (10025-77-1)		
NIOSH	NIOSH REL (TWA) (mg/m³)	1 mg/m³

Water (7732-18-5)
Not applicable

8.2. Exposure controls

Appropriate engineering controls : Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Provide adequate general and local exhaust ventilation.

Personal protective equipment : Avoid all unnecessary exposure. Face shield. Gloves. Protective clothing. Safety glasses.

Hand protection : Wear protective gloves.

Eye protection : Chemical goggles or face shield.

Skin and body protection : Wear suitable protective clothing.

Respiratory protection : Wear appropriate mask.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Color : amber

Odor : None.

Odor threshold : No data available

pH : No data available

Melting point : No data available

Freezing point : No data available

Boiling point : No data available

Flash point : No data available

Relative evaporation rate (butyl acetate=1) : No data available

Flammability (solid, gas) : Non flammable.

Vapor pressure : No data available

Relative vapor density at 20 °C : No data available

Relative density	:	No data available
Solubility	:	Soluble in water.
Log Pow	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	No data available
Explosive properties	:	No data available
Oxidizing properties	:	No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Thermal decomposition generates : Corrosive vapors.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

metals. Strong bases.

10.6. Hazardous decomposition products

Hydrogen chloride. iron oxide. Thermal decomposition generates : Corrosive vapors.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure	:	Skin and eye contact
Acute toxicity	:	Not classified

Ferric Chloride, Hexahydrate (10025-77-1)	
LD50 oral rat	1872 mg/kg (Rat)
ATE US (oral)	1872.000 mg/kg body weight

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg
ATE US (oral)	90000.000 mg/kg body weight

Skin corrosion/irritation	:	Causes severe skin burns and eye damage.
Serious eye damage/irritation	:	Causes serious eye damage.
Respiratory or skin sensitization	:	Not classified
Germ cell mutagenicity	:	Not classified
Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified
Specific target organ toxicity – single exposure	:	Not classified
Specific target organ toxicity – repeated exposure	:	Not classified
Aspiration hazard	:	Not classified
Potential Adverse human health effects and symptoms	:	Based on available data, the classification criteria are not met.

Symptoms/injuries after eye contact : Causes serious eye damage.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - water : Harmful to aquatic life.

Ferric Chloride Solution	
LC50 fish 1	<

Ferric Chloride, Hexahydrate (10025-77-1)	
EC50 Daphnia 1	9.6 mg/l (EC50; 48 h; Daphnia magna)
LC50 fish 2	75.6 mg/l (LC50; 96 h; Gambusia affinis)

12.2. Persistence and degradability

Ferric Chloride Solution	
Persistence and degradability	Not established.

Ferric Chloride, Hexahydrate (10025-77-1)	
Persistence and degradability	Biodegradability: not applicable. Biodegradability in soil: not applicable. No test data on mobility of the substance available.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable

Water (7732-18-5)	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

Ferric Chloride Solution	
Bioaccumulative potential	Not established.

Ferric Chloride, Hexahydrate (10025-77-1)	
BCF fish 1	<= 100 (BCF)
Bioaccumulative potential	No bioaccumulation data available.

Water (7732-18-5)	
Bioaccumulative potential	Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on the global warming : No known effects from this product.

GWPmix comment : No known effects from this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations. Dispose of contents/container to comply with local, state and federal regulations.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN2582 Ferric chloride, solution, 8, III

UN-No.(DOT) : UN2582

Proper Shipping Name (DOT) : Ferric chloride, solution

Transport hazard class(es) (DOT)	:	8 - Class 8 - Corrosive material 49 CFR 173.136
Packing group (DOT)	:	III - Minor Danger
Hazard labels (DOT)	:	8 - Corrosive

DOT Packaging Non Bulk (49 CFR 173.xxx)	:	203
DOT Packaging Bulk (49 CFR 173.xxx)	:	241
DOT Special Provisions (49 CFR 172.102)	:	B15 - Packaging must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance. IB3 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1 and 31HA2, 31HB2, 31HN2, 31HD2 and 31HH2). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized, except for UN2672 (also see Special Provision IP8 in Table 2 for UN2672). T4 - 2.65 178.274(d)(2) Normal..... 178.275(d)(3) TP1 - The maximum degree of filling must not exceed the degree of filling determined by the following: Degree of filling = 97 / 1 + a (tr - tf) Where: tr is the maximum mean bulk temperature during transport, and tf is the temperature in degrees celsius of the liquid during filling.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	154
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	5 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	60 L
DOT Vessel Stowage Location	:	A - The material may be stowed ‘‘on deck’’ or ‘‘under deck’’ on a cargo vessel and on a passenger vessel.
Other information	:	No supplementary information available.

SECTION 15: Regulatory information

15.1. US Federal regulations

Ferric Chloride Solution	
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory except for:

Ferric Chloride, Hexahydrate	CAS No 10025-77-1	71%

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Ferric Chloride, Hexahydrate (10025-77-1)	
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

15.2. International regulations

CANADA

Ferric Chloride Solution	
WHMIS Classification	Class E - Corrosive Material

Ferric Chloride, Hexahydrate (10025-77-1)	
WHMIS Classification	Class E - Corrosive Material

Water (7732-18-5)	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

EU-Regulations

No additional information available

National regulations
No additional information available

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

SECTION 16: Other information

Revision date : 01/17/2017

Other information : None.

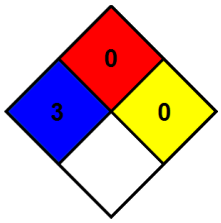
Full text of H-phrases: see section 16:

H302	Harmful if swallowed
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H401	Toxic to aquatic life

NFPA health hazard : 3 - Materials that, under emergency conditions, can cause serious or permanent injury.

NFPA fire hazard : 0 - Materials that will not burn under typical dire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand.

NFPA reactivity : 0 - Material that in themselves are normally stable, even under fire conditions.



HMIS III Rating

Health : 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given

Flammability : 0 Minimal Hazard - Materials that will not burn

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

Personal protection : H

H - Splash goggles, Gloves, Synthetic apron, Vapor respirator

SDS US LabChem

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

SAFETY DATA SHEET

Revision date 2015-03-12 **Revision number** 1

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier

Product name WS-128

Other means of identification

Product code 3213M
Synonyms Liquid sodium aluminate

Recommended use of the chemical and restrictions on use

Recommended use [RU] No information available
Uses advised against No information available

Details of the supplier of the safety data sheet

Supplier Anderson Chemical Company
325 South Davis Ave.
Litchfield, MN 55355
320-693-2477
Hours: Monday-Friday 8:00-5:00 CST (Central Standard Time)

Emergency telephone number

24 Hour Emergency Phone Number CHEMTREC: (800) 424-9300

Contact Point accomn.com

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Skin corrosion/irritation	Category 1 Sub-category A
Serious eye damage/eye irritation	Category 1

GHS Label elements, including precautionary statements

EMERGENCY OVERVIEW

Physical state	**Color**	**Appearance**	**Odor**
liquid	amber	clear to slightly hazy	no appreciable odor

DANGER

Hazard statements
Causes severe skin burns and eye damage

Precautionary Statements - Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection

Precautionary Statements - Response
Immediately call a POISON CENTER or doctor/physician
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting

Precautionary Statements - Storage
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other information
• Not applicable

Unknown acute toxicity
• 32% of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No	weight-%	TRADE SECRET
Sodium aluminum oxide	1302-42-7	32%	--
Sodium Hydroxide	1310-73-2	8%	--
Water	7732-18-5	60%	--

*The exact percentage (concentration) of composition has been withheld as a trade secret

Alternate CAS Number(s)
An alternate CAS number for 1302-42-7 (Sodium aluminum oxide) is 11138-49-1 (Sodium Aluminate).

4. FIRST AID MEASURES

First Aid Measures

Eye contact
Remove contact lenses, if worn. Immediately flush with plenty of water for at least 15 minutes, holding eyelids apart to ensure flushing of the entire surface. Washing within one minute is essential to achieve maximum effectiveness. Seek medical advice immediately.

Skin contact
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention.

Ingestion
Do not induce vomiting. Give large amounts of water followed by milk if available. If vomiting should occur spontaneously, keep airway clear. Seek medical advice immediately. Never give anything by mouth to an unconscious person.

Inhalation
Remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Most important symptoms and effects, both acute and delayed

Acute effects
Inhalation of corrosive substances may cause irritation of the respiratory tract with coughing, choking, pain and possible burns of the mucus membrane. In some cases pulmonary edema may develop, either immediately or more often within a period of 5-72 hours. The symptoms may include tightness in the chest, frothy sputum cyanosis, and dizziness. Physical findings may include low blood pressure and high pulse. Severe cases may be fatal. Eye and skin contact may cause severe irritation, pain and burns. Ingestion may cause immediate pain and severe burns of the mucous membrane. There may be discoloration of the tissues. Swallowing and speech may be difficult at first and then almost impossible. The effects on the esophagus and gastrointestinal tract may range from irritation to severe corrosion. Edema of the epiglottis and shock may occur.

Chronic effects
Depending on the concentration, repeated ingestion may cause effects as with acute exposure. Effects depend on concentration and duration of exposure. Repeated or prolonged skin contact may result in dermatitis or effects similar to acute exposure. Repeated exposure by inhalation may cause inflammatory ulcerative changes to the mouth and possibly bronchial and gastrointestinal disturbances. Repeated or prolonged eye contact may result in conjunctivitis or effects similar to acute exposure. .

Aggravated Medical Conditions
Existing skin, eye and lung conditions. Persons with kidney disorders have an increased risk from exposure based on general information found on aluminum salts.

Indication of any immediate medical attention and special treatment needed

Note to physicians
Aluminum soluble salts may cause gastroenteritis if ingested. Treatment includes the use of demulcents. Note: Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

5. FIRE-FIGHTING MEASURES

Extinguishing media

Suitable extinguishing media
Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons
No information available

Special hazards arising from the substance or mixture

Special Hazard
May produce hazardous fumes or hazardous decomposition products.

Advice for firefighters

Firefighting measures
Product is a water solution and nonflammable. In a fire, this product may build up pressure and rupture a sealed container; cool exposed containers with water spray. Use self-contained breathing apparatus in confined areas; avoid breathing mist or spray.

Special protective equipment for firefighters
Full protective clothing and approved self-contained breathing apparatus required for firefighting personnel.

Explosion data

Sensitivity to Mechanical Impact
None.

Sensitivity to Static Discharge
None.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions
Wear suitable protective clothing and gloves.

Environmental precautions

Environmental precautions
Do not allow liquid to enter streams or waterways.

Methods and material for containment and cleaning up

Methods for containment
Prevent further leakage or spillage if safe to do so. Build dikes as necessary to contain flow of large spills.

Methods for cleaning up
Clear spills immediately. For small spills, neutralize with weak acidic material such as vinegar, an inert material to absorb, or wash product to a chemical sewer. Place contaminated materials into containers and store in a safe place to await proper disposal.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling
Keep container closed when not in use
Keep away from open flames, hot surfaces and sources of ignition.
Avoid contact with eyes, skin and clothing
Wear chemical splash goggles, gloves, and protective clothing when handling.
Wash thoroughly after handling
Do not breathe mist or spray.
Use with adequate ventilation and employ respiratory protection where mist or spray may be generated.
Do not take internally
FOR INDUSTRIAL USE ONLY.

Conditions for safe storage, including any incompatibilities

Technical measures and storage conditions
Keep container tightly closed when not in use.
Store in a cool, dry place away from direct heat.

Incompatible products
Strong acids.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Component	weight-%	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sodium Hydroxide 1310-73-2	8%	2 mg/m^3 Ceiling	2 mg/m^3 TWA	10 mg/m^3 IDLH

Appropriate engineering controls

Engineering controls
Local exhaust ventilation as necessary to maintain exposures to within applicable limits. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details. If there are no applicable or established exposure limit requirements or guidelines, general ventilation should be sufficient.

Individual protection measures, such as personal protective equipment

Eye/face Protection
Wear chemical splash goggles and face shield (when eye and face contact is possible due to splashing or spraying of material).

Hand Protection
Appropriate chemical resistant gloves should be worn.

Skin and body protection
Standard work clothing and work shoes.

Respiratory protection
If exposures exceed the PEL or TLV, use NIOSH/MSHA approved respirator in accordance with OSHA Respiratory Protection Requirements under 29 CFR 1910.134. If there are no applicable or established exposure limit requirements or guidelines, general ventilation should be sufficient.

Other personal protection data
Eyewash fountains and safety showers must be easily accessible.

Hygiene measures
Take off contaminated clothing and wash before reuse.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid
Color	amber
Appearance	clear to slightly hazy
Odor	no appreciable odor
Odor threshold	No information available

Property	Values	Remarks / Method
pH	~ 14	No information available

Melting / freezing point	< -32.2 °C / < -26 °F	No information available
Boiling point / boiling range	116 °C / 241 °F	No information available
Flash point	Not applicable	No information available
Evaporation rate	No information available	No information available
Flammability (solid, gas)	Not applicable	No information available
Flammability Limit in Air		
Upper flammability limit	Not applicable	No information available
Lower flammability limit	Not applicable	No information available
Vapor pressure	No information available	No information available
Vapor density	No information available	No information available
Specific gravity	1.4 - 1.6	No information available
Solubility (water)	Complete	No information available
Solubility in other solvents	No information available	No information available
Partition coefficient: n-octanol/water	No information available	No information available
Autoignition temperature	Not applicable	No information available
Decomposition temperature	No information available	No information available
Kinematic viscosity	No information available	No information available
Dynamic viscosity	200 - 400 cps @ 25 °C	No information available

Other information

Density	11.6 - 13.3 lb/gal - @ 25 °C
Bulk Density	No information available
Explosive properties	No information available.
Oxidizing properties	No information available
Softening point	No information available
Molecular weight	No information available
Volatile organic compounds (VOCs) content	No information available
Percent Volatile, wt.%	No information available

10. STABILITY AND REACTIVITY

Reactivity

Reactivity
No data available.

Chemical stability

Chemical stability
Stable under normal conditions of handling, use and transportation.

Possibility of hazardous reactions

Possibility of hazardous reactions
None under normal processing.

Hazardous polymerization
Not anticipated under normal or recommended handling and storage conditions.

Conditions to avoid

Conditions to avoid
None known

Incompatible materials

Materials to avoid
Strong acids.

Hazardous decomposition products

Hazardous decomposition products
Thermal decomposition may release toxic and/or hazardous gases.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Eye contact
Direct contact may cause severe irritation, pain and burns, possibly severe. May result in permanent blindness. The degree of injury depends on the concentration and duration of contact. The full extent of the injury may not be immediately apparent.

Skin contact
Corrosive to skin. Direct contact may cause severe irritation, pain and possibly burns.

Ingestion
Causes burns of the mouth, throat and stomach. Will cause burns of mucous membreanes of gastrointestinal tract, with nausea, vomiting and diarrhea.

Inhalation
Inhalation of mist or spray may irritate respiratory tract and may cause burns and difficulty breathing.

Acute toxicity - Product Information

Oral LD50 No information available

Dermal LD50 No information available

Inhalation LC50 No information available

Acute toxicity - Component Information

Component	weight-%	Oral LD50	Dermal LD50	Inhalation LC50
Sodium Hydroxide 1310-73-2	8%	--	= 1350 mg/kg (Rabbit)	--

Information on toxicological effects

Symptoms
No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation
Causes burns

Serious eye damage/eye irritation
Risk of serious damage to eyes

Sensitization
No information available

Germ cell mutagenicity
No information available

Carcinogenicity
This product does not contain any components in concentrations greater than or equal to 0.1% that are listed as known or suspected carcinogens by NTP, IARC, ACGIH, or OSHA.

Reproductive toxicity
No information available

Specific target organ toxicity - Single exposure
No information available.

Specific target organ toxicity - Repeated exposure
No information available

Aspiration hazard
No information available.

Numerical measures of toxicity - Product Information

• 32% of the mixture consists of ingredient(s) of unknown toxicity

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (dermal)	11475 mg/kg

Other information
Conclusions are drawn from sources other than direct testing.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Acute aquatic toxicity - Product Information

Fish	LC50 (96h, static, fresh water) = 11.1 mg/L (*Gambusia affinis* / Western Mosquitofish) [1] NR-ZERO (9 days, static, fresh water) = 5.0 - 40.0 mg/L (*Oncorhynchus tshawytscha* / Chinook Salmon) [2]
Crustacea	NR-ZERO (1 - 4 days, static, fresh water) = 5.0 - 40.0 mg/L (*Daphnia magna* / Water Flea) [2]
Algae/aquatic plants	No information available

Acute aquatic toxicity - Component Information

Component	weight-%	Algae/aquatic plants	Fish	Toxicity to daphnia and other aquatic invertebrates
Sodium Hydroxide 1310-73-2	8%	--	LC50 (96 h static) = 45.4 mg/L (Oncorhynchus mykiss)	--

Persistence and degradability

Persistence and degradability
No information available

Bioaccumulative potential

Bioaccumulative potential
No information available.

Mobility

Mobility
No information available

Results of PBT and vPvB assessment

PBT and vPvB assessment
No information available

Other adverse effects

Other information
LC50 = Lethal concentration to 50% of test organisms
NR-ZERO = 0% mortality or 100% survival of organisms

[1] Author(s): Wallen,I.E., W.C. Greer, and R. Lasater, Publication Year: 1957, Title: Toxicity to Gambusia affinis of Certain Pure Chemicals in Turbid Waters, Source: Sewage Ind. Wastes29(6): 695-711
[2] Author(s): Peterson,S.A., W.D. Sanville, F.S. Stay, and C.F. Powers, Publication Year: 1974, Title: Nutrient Inactivation as a Lake Restoration Procedure. Laboratory Investigations, Source: EPA-660/3-74-032, U.S.EPA, Corvallis, OR:118 p.
See ECOTOX: Ecotoxicological Database at http://www.epa.gov/ecotox and search CAS# 1302-42-7 and CAS# 11138-49-1.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes
Disposal should be made in accordance with federal, state and local regulations.

Contaminated packaging
Since empty containers retain product residue, follow label warnings even after container is emptied.

RCRA

Is the unused product a RCRA hazardous waste if discarded? (Yes/No) Yes
If yes, the EPA Hazardous Waste Code is: D002 (corrosivity)

14. TRANSPORT INFORMATION

DOT Regulated

DOT UN/NA Number UN1819

Proper shipping name	Sodium Aluminate Solution
Hazard class	8
Packing group	II
ERG Number	154

ICAO/IATA Regulated

UN number	UN1819
Proper shipping name	Sodium Aluminate Solution
Hazard class	8
Packing group	II
ERG Code	8L

IMDG Regulated

UN number	UN1819
Proper shipping name	Sodium Aluminate Solution
Hazard class	8
Packing group	II
EmS	F-A; S-B

Harmonized Tariff Number 2841.90

15. REGULATORY INFORMATION

International Inventories

TSCA (United States)
All ingredients are on the inventory or exempt from listing

Australia (AICS)
All ingredients are on the inventory or exempt from listing

Canada (DSL)
All ingredients are on the inventory or exempt from listing

Canada (NDSL)
None of the ingredients are on the inventory.

China (IECSC)
All ingredients are on the inventory or exempt from listing

EINECS (European Inventory of Existing Chemical Substances)
All ingredients are on the inventory or exempt from listing

ELINCS (European List of Notified Chemical Substances)
None of the ingredients are on the inventory.

ENCS (Japan)
All ingredients are on the inventory or exempt from listing

South Korea (KECL)
All ingredients are on the inventory or exempt from listing

Philippines (PICCS)
All ingredients are on the inventory or exempt from listing

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
AICS - Australian Inventory of Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
IECSC - China Inventory of Existing Chemical Substances
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances

U.S. Federal Regulations

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302).

Component	CERCLA/SARA Hazardous Substance RQ	CERCLA/SARA - Section 302 Extremely Hazardous Substances TPQs	Calculated Product RQ
Sodium Hydroxide 1310-73-2	1000 lb final RQ; 454 kg final RQ	--	--

CWA (Clean Water Act)

This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Priority Pollutants	CWA - Toxic Pollutants
Sodium Hydroxide 1310-73-2	Present	1000 lb RQ	--	--

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic health hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive hazard	No

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

U.S. State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Sodium Hydroxide 1310-73-2	
Massachusetts Right to Know Law	Present
Minnesota Hazardous Substance List	Present
New Jersey Right to Know List	sn 1706
Pennsylvania Right to Know List	Environmental hazard

16. OTHER INFORMATION

NFPA Rating Health - 3 Flammability - 0 Instability - 0 Special Hazard -

HMIS Rating	Health - 3		Flammability - 0		Physical hazard - 0		Personal protection - X

Product code	3213M
Revision date	2015-03-12
Revision number	1

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

ISO 9001:2008 Certified

MINERAL MASTERS

130 W GRAND LAKE BLVD., WEST CHICAGO, IL 60185

FOR CHEMICAL EMERGENCY. SPILL, LEAK, EXPOSURE, OR ACCIDENT, CALL CHEMTREC, 1-800-424-9300

MATERIAL SAFETY DATA SHEET

Revised 8-11-10

1. IDENTIFICATION OF THE PRODUCT

MM-2480

2. HAZARDS IDENTIFICATION

Appearance and Odor

Form : Granular solid
Color : White
Odor : None

Emergency Overview :
Aqueous solutions or powders that become wet render surfaces extremely slippery.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Identification : Cationic water-soluble polymer.

Regulated Components
None.

4. FIRST AID MEASURES

Inhalation : No hazards which require special first aid measures.
Skin contact : No hazards which require special first aid measures. Wash with water and soap as a precaution. Call a physician if irritation persists.

Eye contact : Rinse thoroughly with plenty of water, also under the eyelids. In case of persistent eye irritation, consult a physician.

Ingestion : No hazards which require special first aid measures. The product is not considered toxic based on studies on laboratory animals.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : Water. Water spray. Foam. Carbon dioxide (CO2). Dry powder.

Precautions : Aqueous solutions or powders that become wet render surfaces extremely slippery.

Special protective equipment for firefighters : No special protective equipment required.

Flash point : Not applicable
Autoignition temperature : Not applicable

6. ACCIDENTAL RELEASE MEASURES

Personal precautions : No special precautions required.

Environmental precautions : As with all chemical products, do not flush into surface water.

Methods for cleaning up : Do not flush with water Clean up promptly by sweeping or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

Handling
Safe handling advice : Avoid contact with skin and eyes. Avoid dust formation. Do not breathe dust. Wash hands before breaks and at the end of workday.

Storage

Keep in a dry, cool place (0 - 35 °C).

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures
Use local exhaust if dusting occurs. Natural ventilation is adequate in absence of dusts.

Personal protective equipment
Respiratory protection : Dust safety masks are recommended where concentration of total dust is more than 10 mg/m3.

Hand protection : Rubber gloves.

Eye protection : Safety glasses with side-shields. Do not wear contact lenses where this product is used.

Skin and body protection : Chemical resistant apron or protective suit if spashing or repeated contact with solution is likely.

Hygiene measures
Wash hands before breaks and at the end of workday. Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form : Granular solid
Color : White Odor : None

pH : 2.5 - 4.5 @ 5 g/l

Melting point/range : Not applicable Flash point : Not applicable

Autoignition temperature : Not applicable

Approx. bulk density : 0.62 Water solubility : See Technical Bulletin

LogPow : 0

10. STABILITY AND REACTIVITY

Stability : Stable. Hazardous polymerisation does not occur.

Materials to avoid : Oxidizing agents may cause exothermic reactions.

Hazardous decomposition products : Burning of the dried material can produce: hydrogen chloride gas, nitrogen oxides (NOx), carbon oxides.

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Skin : The results of testing on rabbits showed this material to be non-toxic even at high dose levels.

Oral : LD50/oral/rat = 5000 mg/kg.

Inhalation : The product is not expected to be toxic by inhalation.

Irritation

Skin : The results of testing on rabbits showed this material to be non-irritating to the skin.

Eyes : Testing conducted according to the Draize technique showed the material produces no corneal or iridial effects and only slight transitory conjuctival effects similar to those which all granular materials have on conjuctivae.

Sensitization : The results of testing on guinea pigs showed this material to be non-sensitizing.

Chronic toxicity : A one-year feeding study on rats did not reveal adverse health effects. A one-year feeding study on dogs did not reveal adverse health effects.

12. ECOLOGICAL INFORMATION

Aquatic toxicity

Toxicity to fish (dano rerio, rainbow trout, fathead minnow): LC50/96 hours = 5 - 10 mg/L.

Toxicity to daphnia : EC50/48 hours = 20 - 50 mg/L.

Toxicity to algae : Algal inhibition tests are not appropriate. The flocculation characteristics of the product interfere directly in the test medium preventing homogenous distribution which invalidates the test.

Environmental fate

Hydrolysis : At natural pHs (>6) the polymer degrades due to hydrolysis to more than 70% in 28 days. The hydrolysis products are not harmfull to aquatic organisms.

LogPow : 0

Bioaccumulation : Does not bioaccumulate.

Other ecological information :
The effects of this product on aquatic organisms are rapidly and significantly mitigated by the presence of dissolved organic carbon in the aquatic environment.

13. DISPOSAL CONSIDERATIONS

Disposal : In accordance with local, state and federal regulations.

Container : Rinse empty containers with water and use the rinse water to prepare the working solution. Can be landfilled or incinerated, when in compliance with local, state and federal regulations.

14. TRANSPORT INFORMATION

DOT

Remarks : Not classified as dangerous in the meaning of DOT regulations.

IMDG/IMO
Remarks : Not classified as dangerous in the meaning of IMO/IMDG regulations.
ICAO/IATA
Remarks : Not classified as dangerous in the meaning of ICAO/IATA regulations.

15. REGULATORY INFORMATION

US SARA Reporting Requirements

SARA Title III Sections
Sara (311, 312) hazard class : Not concerned

State Regulations

The following statement is made in order to comply with the California Safe Drinking Water and Toxic Enforcement Act of 1986. This product contains the following substance (s) known to the State of California to cause cancer : Acrylamide.

International Inventories

European Union (EINECS/ELINCS) : All components of this product are either listed on the inventory or are exempt from listing.

USA (TSCA) : All components of this product are either listed on the inventory or are exempt from listing.

Canada (DSL) : All components of this product are either listed on the inventory or are exempt from listing.

Australia (AICS) : All components of this product are either listed on the inventory or are exempt from listing.

China (IECSC) : All components of this product are either listed on the inventory or are exempt from listing.

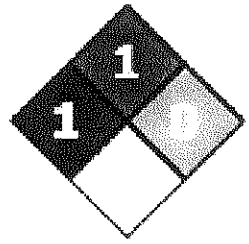
Japan (ENCS) : All components of this product are either listed on the inventory or are exempt from listing.

Korea (ECL) : All components of this product are either listed on the inventory or are exempt from listing.

Philippines (PICCS) : All components of this product are either listed on the inventory or are exempt from listing.

16. OTHER INFORMATION

NFPA and HMIS Ratings :



NFPA :

Health : 1
Flammability : 1
Instability : 0

HMIS :

Health : 1
Flammability : 1
Physical Hazard : 0

PREPARED BY MINERAL MASTERS THIS INFORMATION IS OFFERED IN GOOD FAITH AS TYPICAL VALUES AND NOT AS A PRODUCT SPECIFICATION. NO WARRANTY, EXPRESSED OR IMPLIED IS HEREBY MADE. THE RECOMMENDED INDUSTRIAL HYGIENE AND SAFE HANDLING PROCEDURES ARE BELIEVED TO BE GENERALLY APPLICABLE. HOWEVER,E ACH USER SHOULD REVIEW THESE RECOMMENDATIONS IN THE SPECIFIC CONTEXT OF THE INTENDED USE AND DETERMINE WHETHER THEY ARE APPROPRIATE.

SAFETY DATA SHEET

Version 4.8
Revision Date 02/28/2015
Print Date 02/07/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Calcium hydroxide

Product Number : 239232
Brand : Sigma-Aldrich

CAS-No. : 1305-62-0

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin irritation (Category 2), H315
Serious eye damage (Category 1), H318
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
Acute aquatic toxicity (Category 3), H402

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H315 Causes skin irritation.
H318 Causes serious eye damage.
H335 May cause respiratory irritation.
H402 Harmful to aquatic life.

Precautionary statement(s)
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P273 Avoid release to the environment.
P280 Wear eye protection/ face protection.
P280 Wear protective gloves.

P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	H_2CaO_2
Molecular weight	:	74.09 g/mol
CAS-No.	:	1305-62-0
EC-No.	:	215-137-3

Hazardous components

Component	Classification	Concentration
Calcium dihydroxide		
	Skin Irrit. 2; Eye Dam. 1; STOT SE 3; Aquatic Acute 3; H315, H318, H335, H402	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Calcium oxide

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.
Storage class (TRGS 510): Non Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Calcium dihydroxide	1305-62-0	TWA	5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Eye irritation Skin irritation		
		TWA	5.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation Skin irritation		

		TWA	15.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Colour: beige
b)	Odour	No data available

c)	Odour Threshold	No data available
d)	pH	12.4 - 12.6 at 20 °C (68 °F)
e)	Melting point/freezing point	>= 450 °C (>= 842 °F)
f)	Initial boiling point and boiling range	No data available
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	The product is not flammable.
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	2.24 g/mL at 25 °C (77 °F)
n)	Water solubility	0.99 g/l at 20 °C (68 °F)
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	The substance or mixture is not classified as oxidizing.

9.2 Other safety information

Bulk density	200 - 800 kg/m3

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong acids

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 7,340 mg/kg

Inhalation: No data available

No data available

Skin corrosion/irritation
Skin - Rabbit
Result: Irritating to skin.
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Severe eye irritation
(OECD Test Guideline 405)

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
Inhalation - May cause respiratory irritation.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: EW2800000

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Clarias gariepinus - 33.884 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 49.1 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	EC50 - Pseudokirchneriella subcapitata (green algae) - 184.6 mg/l - 72 h (OECD Test Guideline 201)

12.2 Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential
Does not bioaccumulate.

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Harmful to aquatic life.

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Calcium dihydroxide	1305-62-0	1994-04-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Calcium dihydroxide	1305-62-0	1994-04-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Calcium dihydroxide	1305-62-0	1994-04-01

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Eye Dam.	Serious eye damage
H315	Causes skin irritation.

H318	Causes serious eye damage.
H335	May cause respiratory irritation.
H402	Harmful to aquatic life.
Skin Irrit.	Skin irritation
STOT SE	Specific target organ toxicity - single exposure

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.8 Revision Date: 02/28/2015 Print Date: 02/07/2016

SAFETY DATA SHEET

Based upon Regulation (EC) No. 1907/2006, as amended by Regulation (EC) No. 453/2010

sodium carbonate

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier:

Product name : sodium carbonate

Synonyms : carbonic acid disodium salt; carbonic acid sodium salt; CASWELL NO. 752; chrystol carbonate; crystol carbonate (=sodium carbonate); disodium carbonate; natural ash; Na-X; snowlite 1; soda ash; soda, crystals; soda (=sodium carbonate); anhydrous soda; ash; bisodium carbonate; calcined soda(=sodium carbonate); sodium carbonate, anhydrous; sodium carbonate, anhydrous ASTM D458; sodium carbonate, anhydrous GE materials D4D5; sodium carbonate, anhydrous powder; sodium carbonate, crude; sodium carbonate, granular; Solvay soda; synthetic ash; washing soda (= sodiumcarbonate)

Registration number REACH : 01-2119485498-19-0011

Product type REACH : Substance/mono-constituent

CAS number : 497-19-8

EC index number : 011-005-00-2

EC number : 207-838-8

RTECS number : VZ4050000

Molecular mass : 105.99 g/mol

Formula : Na2CO3

1.2 Relevant identified uses of the substance or mixture and uses advised against:

1.2.1 Relevant identified uses

Chemical raw material

Glass production: raw material

Detergent: component

Acidity regulator

Paper production: auxiliary substance

1.2.2 Uses advised against

No uses advised against known

1.3 Details of the supplier of the safety data sheet:

Supplier of the safety data sheet

OCI Chemical Corporation
Five Concourse Parkway - Suite 2500
USA GA 30328-6111 Atlanta

Manufacturer of the product

OCI Wyoming L.P.
254 County Road 4-6
USA - WY 82935 Green River

1.4 Emergency telephone number:

24h/24h:

CHEMTREC : +1 703 527 38 87

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

2.1.1 Classification according to Regulation EC No 1272/2008

Classified as dangerous according to the criteria of Regulation (EC) No 1272/2008

Class	Category	Hazard statements
Eye Irrit.	category 2	H319: Causes serious eye irritation.

2.1.2 Classification according to Directive 67/548/EEC-1999/45/EC

Classified as dangerous in accordance with the criteria of Directives 67/548/EEC and 1999/45/EC

Xi; R36 - Irritating to eyes.

2.2 Label elements:

Labelling according to Regulation EC No 1272/2008 (CLP)

Signal word	Warning
H-statements	
H319	Causes serious eye irritation.
P-statements	
P280	Wear eye protection/face protection.
P264	Wash hands thoroughly after handling.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/attention.

2.3 Other hazards:

SECTION 3: Composition/information on ingredients

3.1 Substances:

Name (REACH Registration No)	CAS No EC No	Conc. (C)	Classification according to DSD/DPD	Classification according to CLP	Note	Remark
sodium carbonate (01-2119485498-19)	497-19-8 207-838-8	C>99 %	Xi; R36	Eye Irrit. 2; H319	(1)	Mono-constituent

(1) For R-phrases and H-statements in full: see heading 16

3.2 Mixtures:

Not applicable

SECTION 4: First aid measures

4.1 Description of first aid measures:

General:

Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

After inhalation:

Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact:

Rinse with water. Soap may be used. Do not apply (chemical) neutralizing agents. Take victim to a doctor if irritation persists.

After eye contact:

Rinse immediately with plenty of water. Do not apply neutralizing agents. Take victim to an ophthalmologist if irritation persists.

After ingestion:

Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Consult a doctor/medical service if you feel unwell.

4.2 Most important symptoms and effects, both acute and delayed:

4.2.1 Acute symptoms

After inhalation:

AFTER INHALATION OF DUST: Dry/sore throat. Coughing. Slight irritation. EXPOSURE TO HIGH CONCENTRATIONS: Irritation of the respiratory tract. Irritation of the nasal mucous membranes. Respiratory difficulties.

After skin contact:

Not irritating.

After eye contact:

Irritation of the eye tissue. Lacrimation.

After ingestion:

AFTER ABSORPTION OF HIGH QUANTITIES: Nausea. Abdominal pain. Irritation of the gastric/intestinal mucosa.

4.2.2 Delayed symptoms

No effects known.

4.3 Indication of any immediate medical attention and special treatment needed:

If applicable and available it will be listed below.

SECTION 5: Firefighting measures

5.1 Extinguishing media:

5.1.1 Suitable extinguishing media:

Adapt extinguishing media to the environment.

5.1.2 Unsuitable extinguishing media:

No unsuitable extinguishing media known.

5.2 Special hazards arising from the substance or mixture:

Upon combustion: CO and CO2 are formed. Reacts on exposure to water (moisture) with (some) metals.

5.3 Advice for firefighters:

5.3.1 Instructions:

No specific fire-fighting instructions required.

5.3.2 Special protective equipment for fire-fighters:

Gloves. Safety glasses. Protective clothing. Dust cloud production: compressed air/oxygen apparatus. Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Prevent dust cloud formation, e.g. by wetting. No naked flames.

6.1.1 Protective equipment for non-emergency personnel

See heading 8.2

6.1.2 Protective equipment for emergency responders

Gloves. Safety glasses. Protective clothing. Dust cloud production: compressed air/oxygen apparatus.

Suitable protective clothing

See heading 8.2

6.2 Environmental precautions:

Contain released substance, pump into suitable containers. Plug the leak, cut off the supply. Knock down/dilute dust cloud with water spray. Violent exothermic reaction with (some) acids: release of harmful gases/vapours (carbon dioxide). Carbon dioxide is heavier than air and will collect in ducts, drains and low lying areas.

6.3 Methods and material for containment and cleaning up:

Prevent dust cloud formation. Scoop solid spill into closing containers. Clean contaminated surfaces with an excess of water. Wash clothing and equipment after handling.

6.4 Reference to other sections:

See heading 13.

SECTION 7: Handling and storage

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

7.1 Precautions for safe handling:

Avoid raising dust. Keep away from naked flames/heat. Observe normal hygiene standards. Keep container tightly closed.

7.2 Conditions for safe storage, including any incompatibilities:

7.2.1 Safe storage requirements:

Store in a cool area. Store in a dry area. Keep container in a well-ventilated place. Keep out of direct sunlight. Meet the legal requirements.

7.2.2 Keep away from:

Heat sources, (strong) acids, metals, water/moisture.

7.2.3 Suitable packaging material:

No data available

7.2.4 Non suitable packaging material:

Aluminium, zinc.

7.3 Specific end use(s):

If applicable and available, exposure scenarios are attached in annex. See information supplied by the manufacturer.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

8.1.1 Occupational exposure

a) Occupational exposure limit values

If limit values are applicable and available these will be listed below.

b) National biological limit values

If limit values are applicable and available these will be listed below.

8.1.2 Sampling methods

Product name	Test	Number
No data available		

8.1.3 Applicable limit values when using the substance or mixture as intended

If limit values are applicable and available these will be listed below.

8.1.4 DNEL/PNEC values

DNEL - Workers

sodium carbonate

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term local effects inhalation	10 mg/m³	

DNEL - General population

sodium carbonate

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Acute local effects inhalation	10 mg/m³	

8.1.5 Control banding

If applicable and available it will be listed below.

8.2 Exposure controls:

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

8.2.1 Appropriate engineering controls

Avoid raising dust. Keep away from naked flames/heat. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.

8.2.2 Individual protection measures, such as personal protective equipment

Observe normal hygiene standards. Keep container tightly closed. Do not eat, drink or smoke during work.

a) Respiratory protection:

Dust production: dust mask with filter type P1.

b) Hand protection:

Gloves.

- materials for protective clothing (good resistance)

Butyl rubber, PVC.

c) Eye protection:

Safety glasses. In case of dust production: protective goggles.

d) Skin protection:

Protective clothing.

8.2.3 Environmental exposure controls:

See headings 6.2, 6.3 and 13

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Physical form	Crystalline solid
	Crystalline powder
	Grains
	Lumps
Odour	Odourless
Odour threshold	Not applicable
Colour	Colourless to white
Particle size	694 µm
Explosion limits	Not applicable
Flammability	Non combustible
Log Kow	-6.19 ; Estimated value
Dynamic viscosity	Data not required
Kinematic viscosity	Data not required
Melting point	851 °C
Boiling point	Data not required
Flash point	Not required: exemption according to REACH
Evaporation rate	Not applicable
Vapour pressure	Not required: exemption according to REACH

Relative vapour density	Not applicable
Solubility	water ; 212.5 g/l ; 20 °C
Relative density	2.52-253 ; 20 °C
Decomposition temperature	1600 °C
Auto-ignition temperature	>400 °C
Explosive properties	No chemical group associated with explosive properties
Oxidising properties	No chemical group associated with oxidising properties
pH	11.6 ; 5.0 %

Physical hazards

No physical hazard class

9.2 Other information:

Absolute density	2530 kg/m³

SECTION 10: Stability and reactivity

10.1 Reactivity:

Substance has basic reaction.

10.2 Chemical stability:

Hygroscopic.

10.3 Possibility of hazardous reactions:

Reacts on exposure to water (moisture) with (some) metals. Violent exothermic reaction with (some) metals. Reacts with (strong) oxidizers.

10.4 Conditions to avoid:

Avoid raising dust. Keep away from naked flames/heat.

10.5 Incompatible materials:

(strong) acids, metals, water/moisture, aluminium, zinc.

10.6 Hazardous decomposition products:

Violent exothermic reaction with (some) acids: release of harmful gases/vapours (carbon dioxide). Upon combustion: CO and CO2 are formed.

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

11.1.1 Test results

- Toxicokinetics: summary

Toxicokinetics (absorption, metabolism, distribution and elimination)
The toxicokinetics of sodium carbonate are well understood. When sodium carbonate comes into contact with body fluids it will dissociate into carbonate and sodium. The carbonate could potentially increase the pH of the blood.

The major extracellular buffer in the blood and the interstitial fluid of vertebrates is the bicarbonate buffer system, described by the following equation:
H2O + CO2 _ H2CO3 _ H+ + HCO3
Carbon dioxide from the tissues diffuses rapidly into red blood cells, where it is hydrated with water to form carbonic acid. This reaction is accelerated by carbonic anhydrase, an enzyme present in high concentrations in red blood cells. The carbonic acid formed dissociates into bicarbonate and hydrogen ions. Most of the bicarbonate ions diffuse into the plasma. Since the ratio of H2CO3 to dissolved CO2 is constant at equilibrium, pH may be expressed in terms of bicarbonate ion concentration and partial pressure of CO2 by means of the Henderson-Hasselbach equation:
pH = pk + log [HCO3-]/aPCO2

The blood plasma of man normally has a pH of 7.40. Should the pH fall below 7.0 or rise above 7.8, irreversible damage may occur. Compensatory mechanisms for acid-base disturbances function to alter the ratio of HCO3 to PCO2, returning the pH of the blood to normal. Thus, metabolic acidosis may be compensated for by hyperventilation and increased renal absorption of HCO3. Metabolic alkalosis may be compensated for by hypoventilation and the excess of HCO3- in the urine (Johnson and Swanson, 1987). Renal mechanisms are usually sufficient to restore the acid-base balance (McEvoy, 1994). The uptake of sodium, via exposure to sodium carbonate, is much less than the uptake of sodium via food. Therefore, sodium carbonate is not expected to be systemically available in the body. Furthermore it should be realised that an oral uptake of sodium carbonate will result in a neutralisation in the stomach due to the gastric acid.

Acute toxicity

sodium carbonate

Route of exposure	Parameter	Method	Value	Exposure time	Species	Gender	Value determination
Oral	LD50		2800 mg/kg		Rat	Male/female	Experimental value
Dermal	LD50		>2000 mg/kg		Rabbit		Experimental value
Inhalation	LC50		2.30 mg/l	2 h	Rat	Male	Experimental value

Conclusion

Low acute toxicity by the oral route

Low acute toxicity by the dermal route

Low acute toxicity by the inhalation route

Corrosion/irritation

sodium carbonate

Route of exposure	Result	Method	Exposure time	Time point	Species	Value determination
Eye	Irritating	EPA 16 CFR 1500.42		1; 2; 3; 4; 7; 10; 14 days	Rabbit	Experimental value
Eye	Highly irritating	Equivalent to OECD 405		1; 24; 48; 72; 168 hours	Rabbit	Experimental value
Dermal	Not irritating	OECD 404		24; 48; 72 hours	Rabbit	Experimental value
Inhalation (aerosol)	Slightly irritating					Literature

Conclusion

Causes serious eye irritation.

Not classified as irritating to the skin

Not classified as irritating to the respiratory system

Respiratory or skin sensitisation

sodium carbonate

Route of exposure	Result	Method	Exposure time	Observation time point	Species	Gender	Value determination
Skin							Not determined, exemption according to REACH
Inhalation							Not determined, exemption according to REACH

Conclusion

Not classified as sensitizing for skin

Not classified as sensitizing for inhalation

Specific target organ toxicity

sodium carbonate

Route of exposure	Parameter	Method	Value	Organ	Effect	Exposure time	Species	Gender	Value determination
Oral									No relevant data available
Dermal									No data available
Inhalation									No data available

Conclusion

Supplementary classification for repeated dose toxicity was not considered necessary

Mutagenicity (in vitro)

sodium carbonate

Result	Method	Test substrate	Effect	Value determination
Negative	Other	Escherichia coli		Experimental value
Ambiguous	OECD 471	Bacteria (S.typhimurium)		Read-across

Mutagenicity (in vivo)

sodium carbonate

Result	Method	Exposure time	Test substrate	Gender	Organ	Value determination
						No data available

Carcinogenicity

sodium carbonate

Route of exposure	Parameter	Method	Value	Exposure time	Species	Gender	Value determination	Organ	Effect
Inhalation							No data available		
Dermal							No data available		
Oral							No data available		

Reproductive toxicity

sodium carbonate

	Parameter	Method	Value	Exposure time	Species	Gender	Effect	Organ	Value determination
Developmental toxicity	NOAEL	Other	≥ 245 mg/kg		Rat		No effect		Experimental value
Effects on fertility									Not determined, exemption according to REACH

Conclusion CMR

Not classified for carcinogenicity

Not classified for mutagenic or genotoxic toxicity

Not classified for reprotoxic or developmental toxicity

Toxicity other effects

sodium carbonate

No (test)data available

Chronic effects from short and long-term exposure

sodium carbonate

ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Dry skin. Tingling/irritation of the skin. Affection of the nasal septum.

SECTION 12: Ecological information

12.1 Toxicity:

sodium carbonate

	Parameter	Method	Value	Duration	Species	Test design	Fresh/salt water	Value determination
Acute toxicity fishes	LC50	Other	300 mg/l	96 h	Lepomis macrochirus	Static system	Fresh water	Experimental value
Acute toxicity invertebrates	EC50	Other	200 - 227 mg/l	48 h	Ceriodaphnia sp.	Semi-static	Fresh water	Experimental value
Toxicity algae and other aquatic plants	EC50		242 mg/l	5 day(s)	Algae			Experimental value

Conclusion

Slightly harmful to fishes (LC50(96h) 100-1000 mg/l)

Practically non-toxic to algae (EC50 >100 mg/l)

Slightly harmful to invertebrates (EC50 (48h): 100 - 1000 mg/l)

pH shift

Not classified as dangerous for the environment according to the criteria of Directive 67/548/EEC

Not classified as dangerous for the environment according to the criteria of Regulation (EC) No 1272/2008

12.2 Persistence and degradability:

Biodegradability: not applicable

12.3 Bioaccumulative potential:

sodium carbonate

Log Kow

Method	Remark	Value	Temperature	Value determination
		-6.19		Estimated value

Conclusion

Low potential for bioaccumulation (Log Kow < 4)

12.4 Mobility in soil:

Low potential for adsorption in soil

12.5 Results of PBT and vPvB assessment:

The criteria of PBT and vPvB as listed in Annex XIII of Regulation (EC) No 1907/2006 do not apply to inorganic substances.

12.6 Other adverse effects:

sodium carbonate

Global warming potential (GWP)

Not included in the list of substances which may contribute to the greenhouse effect (Regulation (EC) No 842/2006)

Ozone-depleting potential (ODP)

Not classified as dangerous for the ozone layer (Regulation (EC) No 1005/2009)

SECTION 13: Disposal considerations

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

13.1 Waste treatment methods:

13.1.1 Provisions relating to waste

Waste material code (Directive 2008/98/EC, Decision 2000/0532/EC).
16 05 07* (discarded inorganic chemicals consisting of or containing dangerous substances). Depending on branch of industry and production process, also other waste codes may be applicable. Hazardous waste according to Directive 2008/98/EC.

13.1.2 Disposal methods

Precipitate/make insoluble. Remove to an authorized dump (Class I). Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. May be discharged to wastewater treatment installation. Do not discharge into drains or the environment.

13.1.3 Packaging/Container

Waste material code packaging (Directive 2008/98/EC).
15 01 10* (packaging containing residues of or contaminated by dangerous substances).

SECTION 14: Transport information

Road (ADR)

14.1 UN number:

Transport	Not subject

14.2 UN proper shipping name:

14.3 Transport hazard class(es):

Hazard identification number	
Class	
Classification code	

14.4 Packing group:

Packing group	
Labels	

14.5 Environmental hazards:

Environmentally hazardous substance mark	no

14.6 Special precautions for user:

Special provisions	
Limited quantities	

Rail (RID)

14.1 UN number:

Transport	Not subject

14.2 UN proper shipping name:

14.3 Transport hazard class(es):

Hazard identification number	
Class	
Classification code	

14.4 Packing group:

Packing group	
Labels	

14.5 Environmental hazards:

Environmentally hazardous substance mark	no

14.6 Special precautions for user:

Special provisions	
Limited quantities	

Inland waterways (ADN)

14.1 UN number:

Transport	Not subject

14.2 UN proper shipping name:

14.3 Transport hazard class(es):

Class	
Classification code	

14.4 Packing group:

Packing group	
Labels	

14.5 Environmental hazards:

Environmentally hazardous substance mark	no

14.6 Special precautions for user:

Special provisions	
Limited quantities	

Sea (IMDG/IMSBC)

14.1 UN number:

Transport	Not subject

14.2 UN proper shipping name:

14.3 Transport hazard class(es):

Class	

14.4 Packing group:

Packing group	
Labels	

14.5 Environmental hazards:

Marine pollutant	-
Environmentally hazardous substance mark	no

14.6 Special precautions for user:

Special provisions	
Limited quantities	

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code:

Annex II of MARPOL 73/78	

Air (ICAO-TI/IATA-DGR)

14.1 UN number:

Transport	Not subject

14.2 UN proper shipping name:

14.3 Transport hazard class(es):

Class	

14.4 Packing group:

Packing group	
Labels	

14.5 Environmental hazards:

Environmentally hazardous substance mark	no

14.6 Special precautions for user:

Special provisions	
Passenger and cargo transport: limited quantities: maximum net quantity per packaging	

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

European legislation:

European drinking water standards

Maximum concentration in drinking water: 200 mg/l (sodium) (Directive 98/83/EC)

Volatile organic compounds (VOC)

Not applicable (inorganic)

National legislation The Netherlands

Waste identification (the Netherlands)	LWCA (the Netherlands): KGA category 05
Waterbezwaarlijkheid	11

National legislation Germany

TA-Luft	TA-Luft Klasse 5.2.1
WGK	1; Classification water polluting in compliance with Verwaltungsvorschrift wassergefährdender Stoffe (VwVwS) of 27 July 2005 (Anhang 2)

National legislation France

No data available

National legislation Belgium

No data available

15.2 Chemical safety assessment:

A chemical safety assessment has been performed.

SECTION 16: Other information

Information based on classification according to CLP

Labelling according to Directive 67/548/EEC-1999/45/EC (DSD/DPD)

Enumerated in substance list Annex I of Directive 67/548/EEC et sequens

Labels

Irritant

R-phrases

36	Irritating to eyes

S-phrases

(02)	(Keep out of the reach of children)
22	Do not breathe dust
26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice

Full text of any R-phrases referred to under headings 2 and 3:

R36 Irritating to eyes

Full text of any H-statements referred to under headings 2 and 3:

H319 Causes serious eye irritation.

(*) = INTERNAL CLASSIFICATION BY BIG

PBT-substances = persistent, bioaccumulative and toxic substances

DSD	Dangerous Substance Directive
DPD	Dangerous Preparation Directive
CLP (EU-GHS)	Classification, labelling and packaging (Globally Harmonised System in Europe)

The information in this safety data sheet is based on data and samples provided to BIG. The sheet was written to the best of our ability and according to the state of knowledge at that time. The safety data sheet only constitutes a guideline for the safe handling, use, consumption, storage, transport and disposal of the substances/preparations/mixtures mentioned under point 1. New safety data sheets are written from time to time. Only the most recent versions may be used. Old versions must be destroyed. Unless indicated otherwise word for word on the safety data sheet, the information does not apply to substances/preparations/mixtures in purer form, mixed with other substances or in processes. The safety data sheet offers no quality specification for the substances/preparations/mixtures in question. Compliance with the instructions in this safety data sheet does not release the user from the obligation to take all measures dictated by common sense, regulations and recommendations or which are necessary and/or useful based on the real applicable circumstances. BIG does not guarantee the accuracy or exhaustiveness of the information provided and cannot be held liable for any changes by third parties. This safety data sheet is only to be used within the European Union, Switzerland, Iceland, Norway and Liechtenstein. Any use outside of this area is at your own risk. Use of this safety data sheet is subject to the licence and liability limiting conditions as stated in your BIG licence agreement or when this is failing the general conditions of BIG. All intellectual property rights to this sheet are the property of BIG and its distribution and reproduction are limited. Consult the mentioned agreement/conditions for details.

Safety Data Sheet

Mud Nox

Issue Date: 03-Oct-2007 **Revision Date:** July 5, 2018

1. IDENTIFICATION

Product Identifier

Product Name Mud-Nox

Other means of identification

SDS # CCH-006

Recommended use of the chemical and restrictions on use

Recommended Use Cleaning agent.

Details of the supplier of the safety data sheet

Supplier Address
Cotey Chemical Corporation
4410 M.L.K. Blvd.
Lubbock, TX 79408

Emergency Telephone Number

Company Phone Number 806-747-2096
Emergency Telephone (24 hr) INFOTRAC 1-352-323-3500 (International)
1-800-535-5053 (North America)

2. HAZARDS IDENTIFICATION

Appearance Clear colorless liquid **Physical State** Liquid **Odor** Characteristic

Classification

This chemical does not meet the hazardous criteria set forth by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200). However, this Safety Data Sheet (SDS) contains valuable information critical to the safe handling and proper use of this product. This SDS should be retained and available for employees and other users of this product.

Other Hazards
Harmful to aquatic life with long lasting effects

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No	Weight-%
Alkyloxypolyethyleneoxyethanol	84133-50-6	5-20

If Chemical Name/CAS No is "proprietary" and/or Weight-% is listed as a range, the specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. FIRST-AID MEASURES

First Aid Measures

General Advice Provide this SDS to medical personnel for treatment.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact Wash off immediately with soap and plenty of water. If skin irritation occurs: Get medical advice/ attention.

Inhalation Remove to fresh air. Get medical attention if you feel unwell.

Ingestion Clean mouth with water and drink afterwards plenty of water. Get medical attention if you feel unwell.

Most important symptoms and effects

Symptoms None known.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Carbon dioxide (CO2). Water spray or fog. Dry chemical. Foam.

Unsuitable Extinguishing Media Not determined.

Specific Hazards Arising from the Chemical
Keep containers cool with water spray to prevent container rupture due to steam buildup.

Hazardous Combustion Products Smoke, fumes or vapors, and oxides of carbon.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions Use personal protective equipment as required.

Environmental Precautions See Section 12 for additional Ecological Information.

Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Clean-Up Wash small spills to sanitary sewer. For large spills - confine spill, soak up with approved absorbent, shovel product into approved container for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on Safe Handling Handle in accordance with good industrial hygiene and safety practice. Do not eat, drink or smoke when using this product. Wash contaminated clothing before reuse.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible Materials Strong oxidizers. Strong acids.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies

Appropriate engineering controls

Engineering Controls Apply technical measures to comply with the occupational exposure limits. Showers. Eyewash stations. Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/Face Protection Avoid contact with eyes.

Skin and Body Protection Wear suitable protective clothing.

Respiratory Protection Ensure adequate ventilation, especially in confined areas.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice. Do not eat, drink or smoke when using this product. Wash contaminated clothing before reuse.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid		
Appearance	Clear colorless liquid	**Odor**	Characteristic
Color	Colorless	**Odor Threshold**	Not determined

Property	**Values**	**Remarks • Method**
pH	7	
Melting Point/Freezing Point	Not determined	
Boiling Point/Boiling Range	37 °C / 100 °F	
Flash Point	Not determined	
Evaporation Rate	<1	(Water = 1)
Flammability (Solid, Gas)	Liquid- Not Applicable	
Upper Flammability Limits	Not determined	

Lower Flammability Limit	Not determined	
Vapor Pressure	17 mmHg	@ 20°C (68°F)
Vapor Density	<1	(Air=1)
Specific Gravity	1.000	(Water = 1)
Water Solubility	Completely soluble	
Solubility in other solvents	Not determined	
Partition Coefficient	Not determined	
Auto-ignition Temperature	Not determined	
Property	**Values**	**Remarks • Method**
Decomposition Temperature	Not determined	
Kinematic Viscosity	Not determined	
Dynamic Viscosity	Not determined	
Explosive Properties	Not determined	
Oxidizing Properties	Not determined	
Additional Information	Volatile by volume 88%	

10. STABILITY AND REACTIVITY

Reactivity
Not reactive under normal conditions.

Chemical Stability
Stable.

Possibility of Hazardous Reactions
None under normal processing.

Hazardous Polymerization Hazardous polymerization does not occur.

Conditions to Avoid
Extreme temperatures. Keep from freezing.

Incompatible Materials
Strong oxidizers. Strong acids.

Hazardous Decomposition Products
Decomposition will not occur if handled and stored properly. In case of fire, oxides of carbon, hydrocarbons, fumes or vapors, and smoke may be produced.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Eye Contact Avoid contact with eyes.

Skin Contact Avoid contact with skin.

Inhalation Do not inhale.

Ingestion Do not ingest.

Component Information

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Polyethylene glycol 25322-68-3	= 28 g/kg (Rat)	> 20 g/kg (Rabbit)	-

Information on physical, chemical and toxicological effects

Symptoms Please see section 4 of this SDS for symptoms.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Carcinogenicity Based on the information provided, this product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC or NTP.

Numerical measures of toxicity
Not determined

12. ECOLOGICAL INFORMATION

Ecotoxicity
Harmful to aquatic life with long lasting effects.

Component Information

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Alkyloxypolyethyleneoxyethanol 84133-50-6		3.2: 96 h Pimephales promelas mg/L LC50		3.2: 48 h water flea mg/L EC50
Polyethylene glycol 25322-68-3		5000: 24 h Carassius auratus mg/L LC50		

Persistence/Degradability
Not determined.

Bioaccumulation
Not determined.

Mobility
Not determined

Other Adverse Effects
Not determined

13. DISPOSAL CONSIDERATIONS

Waste Treatment Methods

Disposal of Wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated Packaging Disposal should be in accordance with applicable regional, national and local laws and regulations.

14. TRANSPORT INFORMATION

Note Please see current shipping paper for most up to date shipping information, including exemptions and special circumstances.

DOT Not regulated

IATA Not regulated

IMDG Not regulated

15. REGULATORY INFORMATION

International Inventories

Chemical Name	TSCA	DSL	NDSL	EINECS	ELINCS	ENCS	IECSC	KECL	PICCS	AICS
Alkyloxypolyethyleneoxyethanol	Present	X				Present	X	Present	X	X

Legend:

TSCA *- United States Toxic Substances Control Act Section 8(b) Inventory*

DSL/NDSL *- Canadian Domestic Substances List/Non-Domestic Substances List*

EINECS/ELINCS *- European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances*

ENCS *- Japan Existing and New Chemical Substances*

IECSC *- China Inventory of Existing Chemical Substances*

KECL *- Korean Existing and Evaluated Chemical Substances*

PICCS *- Philippines Inventory of Chemicals and Chemical Substances*

AICS *- Australian Inventory of Chemical Substances*

US Federal Regulations

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355).

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

CWA (Clean Water Act)

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

This product does not contain any substances regulated under applicable state right-to-know regulations

16. OTHER INFORMATION

NFPA	**Health Hazards**	**Flammability**	**Instability**	**Special Hazards**
	Not determined	Not determined	Not determined	Not determined
HMIS	**Health Hazards**	**Flammability**	**Physical Hazards**	**Personal Protection**
	0	0	0	Not determined

Issue Date: 03-Oct-2007
Revision Date: July 15, 2015
Revision Note: New format

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

SAFETY DATA SHEET

Creation Date 24-Aug-2009 **Revision Date** 18-Jan-2018 **Revision Number** 5

1. Identification

Product Name **Hydrochloric acid**

Cat No. : **A481-212; A481-212LC; S71942SC; S71943; S71943ND; S80036; S80038; SA49**

Synonyms Muriatic acid; Hydrogen chloride; HCl (Technical/Certified ACS Plus/Optima/NF/FCC)

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 B
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation

Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Water	7732-18-5	62-65
Hydrochloric acid	7647-01-0	35-38

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Corrosive Material. Causes burns by all exposure routes. Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous Combustion Products
Hydrogen chloride gas
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Do not get in eyes, on skin, or on clothing.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Do not ingest.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Hydrochloric acid	Ceiling: 2 ppm	Ceiling: 5 ppm Ceiling: 7 mg/m^3 (Vacated) Ceiling: 5 ppm (Vacated) Ceiling: 7 mg/m^3	IDLH: 50 ppm Ceiling: 5 ppm Ceiling: 7 mg/m^3	Ceiling: 5 ppm Ceiling: 7 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	pungent
Odor Threshold	No information available
pH	< 1
Melting Point/Range	-35 °C / -31 °F
Boiling Point/Range	57 °C / 135 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	125 mbar @ 20 °C
Vapor Density	1.27
Specific Gravity	1.18
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	1.8 mPa.s @ 15°C
Molecular Formula	HCl.H2O
Molecular Weight	55.55

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat.

Incompatible Materials Metals, Strong oxidizing agents, Bases, sodium hypochlorite, Amines, Fluorine, Cyanides, Alkaline

Hazardous Decomposition Products Hydrogen chloride gas

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions Contact with metals may evolve flammable hydrogen gas.

11. Toxicological information

Acute Toxicity

Product Information
Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	-	Not listed	Not listed
Hydrochloric acid	238 - 277 mg/kg (Rat)	> 5010 mg/kg (Rabbit)	1.68 mg/L (Rat) 1 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed
Hydrochloric acid	7647-01-0	Not listed	Not listed	Not listed	Not listed	Not listed

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Hydrochloric acid	-	282 mg/L LC50 96 h Gambusia affinis mg/L LC50 48 h Leucscus idus	-	56mg/L EC50 72h Daphnia

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN1789
Proper Shipping Name HYDROCHLORIC ACID
Hazard Class 8
Packing Group II

TDG

UN-No UN1789
Proper Shipping Name HYDROCHLORIC ACID
Hazard Class 8
Packing Group II

IATA

UN-No UN1789
Proper Shipping Name Hydrochloric acid
Hazard Class 8
Packing Group II

IMDG/IMO

UN-No UN1789
Proper Shipping Name Hydrochloric acid
Hazard Class 8
Packing Group II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Water	X	X	-	231-791-2	-		X	-	X	X	X
Hydrochloric acid	X	X	-	231-595-7	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Hydrochloric acid	7647-01-0	35-38	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Hydrochloric acid	X	5000 lb	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Hydrochloric acid	X		-

OSHA Occupational Safety and Health Administration
Not applicable

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Hydrochloric acid	-	TQ: 5000 lb

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Hydrochloric acid	5000 lb	5000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Water	-	-	X	-	-
Hydrochloric acid	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Hydrochloric acid	0 lb STQ (anhydrous); 11250 lb STQ (37% concentration or greater)

Other International Regulations

Mexico - Grade	No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	24-Aug-2009
Revision Date	18-Jan-2018
Print Date	18-Jan-2018
Revision Summary	SDS sections updated. 2. 3. 11.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Version 5.5
Revision Date 01/13/2015
Print Date 11/10/2018

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Lactic acid

Product Number : W261106
Brand : Aldrich

CAS-No. : 50-21-5

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin irritation (Category 2), H315
Serious eye damage (Category 1), H318

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statement(s)
P264 Wash skin thoroughly after handling.
P280 Wear eye protection/ face protection.
P280 Wear protective gloves.
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338 + P310 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Synonyms : DL-Lactic acid
2-Hydroxypropionic acid

Formula : $C_3H_6O_3$

Molecular weight : 90.08 g/mol

Hazardous components

Component		Classification	Concentration
Lactic acid			
CAS-No. EC-No.	50-21-5 200-018-0	Skin Irrit. 2; Eye Dam. 1; H315, H318	>= 90 - <= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Storage class (TRGS 510): Combustible liquids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: viscous Colour: colourless
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/freezing point: < -80 °C (< -112 °F) at ca.1,013 hPa (760 mmHg)
f)	Initial boiling point and boiling range	122 °C (252 °F) at 20 hPa (15 mmHg) - lit.
g)	Flash point	113 °C (235 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	1.209 g/cm3 at 25 °C (77 °F)
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	400 °C (752 °F) at 1,011.4 - 1,018.9 hPa (758.6 - 764.2 mmHg)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Surface tension	70.7 mN/m at 20 °C (68 °F)

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
Avoid moisture.

10.5 Incompatible materials
Bases, Oxidizing agents, Reducing agentsStrong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: OD2800000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Acute Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lactic acid	50-21-5	
Water	7732-18-5	

New Jersey Right To Know Components

	CAS-No.	Revision Date
Lactic acid	50-21-5	

Water	7732-18-5

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Eye Dam.	Serious eye damage
H315	Causes skin irritation.
H318	Causes serious eye damage.
Skin Irrit.	Skin irritation

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	
Flammability:	1
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	1
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.5 Revision Date: 01/13/2015 Print Date: 11/10/2018

Diammonium Phosphate, Technical Grade

SAFETY DATA SHEET

SDS#: 1177

Review/Revision Date: 10/17/16

SECTION 1 - General Information And Chemical Product Identification

Trade Name: Diammonium Phosphate, Technical Grade **CAS #:** 7783-28-0

Chemical Name: Ammonium Phosphate, Dibasic **Product Code:** DAPGSAC

Application/Uses/ Fertilizer / fire retardant

Restrictions None lilsted

Distributor Information LidoChem, Inc. 20 Village Court, Hazlet, NJ 07730, Phone: (732) 888 8000
Fax: (732) 264 2751 * email: info@lidochem.com

Emergency phone #: CHEMTREC - Day or Night - at 800 424 9300

SECTION 2 - Hazard(s) Identification

Classification of the substance or mixture (GHS-US)

Skin irritation (Category 2)
Eye irritation (Category 2A)
Specific target organ toxicity - single exposure (Category 3)
Acute aquatic toxicity (Category 3)

Physical Hazards
None

Hazard Statement
H315: Causes skin irritation
H319: Causes serious eye irritation
H335: May cause respiratory irritation
H402: Harmful to aquatic life

OSHA Defined Hazards
This product does NOT contain any products considered hazardous under the Federal OSHA HazCom. Standard 29 CFR 1910.1200.

HNOC - Hazards Not Otherwise Classified
No other hazards classified

Irritant

Signal Word

Warning

GHS Pecautionary Statements - Prevention, Response, Storage, Disposal

P261: Avoid breathing dust/fume/gas/mist/vapours/spray
P271: Use only outdoors or in a well-ventilated area

P264: Wash thoroughly after handling
P281: Use personal protective equipment as required

P273: Avoid release to the environment

P302+352: IF ON SKIN: Wash with soap and water

P332+313: If skin irritation occurs: Get medical advice/attention

P362: Take off contaminated clothing and wash before reuse
P363: Wash contaminated clothing before reuse

P304+340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

P305+351+338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing

P403+233: Store in a well-ventilated place. Keep container tightly closed
P405: Store locked up

P501: Dispose of contents/container to local, state and federal regulations

SECTION 3 Composition/information On Ingredients

Molecular Weight: 132.06 **Chemical FORMULA:** $(NH4)_2\ H\ PO_4$

CAS#:	Common Name/Synonyms:	% by Wt.
7783-28-0	Ammonium Phosphate, Dibasic	100%

SECTION 4 - First Aid Information

Description of first aid measures

General Advice:

Treat symptomatically. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

If Inhaled:

Remove victim from immediate source of exposure and assure that the victim is breathing. If breathing is difficult, administer oxygen, if available. If victim is not breathing, administer CPR (cardiopulmonary resuscitation). Seek medical attention. Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. **NOTE: See Section 16 - Other Information**

In Case Of Skin Contact:

Product may irritate the skin. In case of contact, immediately wash with plenty of soap and water for at least 5 minutes. Seek medical attention if irritation develops or persists. Remove contaminated clothing and shoes. Clean contaminated clothing and shoes before reuse. Skin contact may aggravate existing skin disease.

In Case Of Eye Contact:

Flush eyes with large quantities of running water for a minimum of 15 minutes. If present and easy to do, remove contact lenses. Hold eyelids apart during the flushing to ensure rinsing of entire surface of the eye and lids with water. DO NOT let victim rub eye(s). Do not attempt to neutralize with chemical agents. Oils/ointments should not used at this time. Get medical attention if eye irritation occurs.

If Swallowed:

If product is ingested, irritation and nausea may occur. Give several glasses of water. **Never give anything to eat or drink to someone who is unconscious, having convulsions, or unable to swallow.** If vomiting occurs, keep head below hips to reduce risk of aspiration. Give fluids again. Seek medical attention if health effects occur. Do not induce vomiting.

Most important symptoms and effects, both acute and delayed:

Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. Skin contact may aggravate existing skin disease.

Indication of any immediate medical attention and special treatment needed:

Treat symptomatically.

SECTION 5 - Fire And Explosion Data

Suitable Extinguishing Media:

Use extinguishing method suitable for surrounding fire. Water. Foam. Dry chemical powder. Carbon dioxide (CO_2).
Not considered to be a fire hazard.

UnSuitable Extinguishing Media:

None known

Specific Hazards arising from the chemical:

None. Not combustible. Under conditions of fire this material may produce: Ammonia.
Oxides of nitrogen, oxides of phosphorus.

Special protective equipment and precautions for fire-fighters:

Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing. Move containers from fire area if you can do it without risk.

Fire-fighting equipment/instructions

Keep unnecessary people away, isolate hazard area and deny entry. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.

Specific Methods

In the event of fire, cool tanks with water spray. Move containers from fire area if you can do so without risk.

Section 6 - Accidental Release Measures

Personal precautions, protective equipment and emergency procedures:

No action shall be taken involving any personal risk or without suitable training. Keep unnecessary and unprotected personnel from entering. Put on appropriate personal protective equipment as recommended in Section 8. Wear appropriate protective gear for the situation. Ventilate area of leak or spill.

Environmental Precautions:

Dike or retain dilution water or water from fire fighting for later disposal. Prevent material from entering public sewer system or any waterways. Runoff from fire control or dilution water may cause pollution.

Methods and Materials for Containment and Clean Up:

Sweep or vacuum up and place in an appropriate closed container. DO NOT RETURN MATERIAL TO ITS ORIGINAL CONTAINER. Clean up residual material by washing area with water and detergent. Prevent material from entering public sewer system or any waterways. If not contaminated, recover and reuse product.

Section 7- Handling and Storage

Precautions for safe handling:

Avoid direct or prolonged contact with skin and eyes. Avoid generating dust.

Conditions for safe storage:

Store in tightly closed containers. This product is hygroscopic and tends to cake in storage. Store in an area that is cool, dry with a stable temperature away from heat source. Local and general ventilation: Use only with adequate ventilation.

Incompatibilites:

Strong bases, sodium hypo chlorite, combustible materials, reducing agents, acids, alkalis, chlorates, chlorides, chromates, nitrates, perinanganates metallic powder, substances containing copper, nickel, cobalt, zinc and their alloys.

Section 8 - Exposure Control and Personal Protection

Occupational Exposure Limits:

Chemical Identity:	CAS #:	Exposure Limit Values		SOURCE	OSHA/PPM
		TWA	STEL		PEL
Ammonium Phosphate, Dibasic	7783-28-0	3mg/m3	10mg/m3	ACGIH Threshold Limit Values	None
				ACGIH Threshold Limit Values	
				ACGIH Threshold Limit Values	

Exposure Limits and Appropriate Engineering Controls:

Exposure limits represent regulated or recommended worker breathing zone concentrations measured by validated sampling and analytical methods meeting OSHA requirements. The following limits (ACGIH, OSHA and other) apply to this material, where, if indicated, S=skin and C=ceiling limit:
ACGH TLV/TWA PARTICULATES NOT OTHERWISE CLASSIFIED : 10mg/cubic meter(INHALABLES)
ACGH TLV/TWA PARTICULATES NOT OTHERWISE CLASSIFIED: 3mg/cubic meter (RESPIRABLE)

Individual Protection Measures, (Personal Protective Equipment):

Eye Protection

Wear Safety Glasses. Eye and face protection requirements will vary dependent upon work environment conditions and material handling practices. Appropriate ANSI Z87 approved equipment should be selected for the particular use intended for this material. It is generally regarded as good practice to wear a minimum of safety glasses with side shields when working in industrial environments.

Skin Protection

Skin contact should be minimized through use of gloves and suitable long-sleeved clothing (i.e. shirts and pants). Consideration must be given to both to durability as well as permeation resistance.

Other Protection:

Where engineering controls are indicated by use conditions or a potential for excessive exposure exists, the above listed and following traditional exposure control techniques may be used to effectively minimize employee exposures.

Respiratory Protection

(NIOSH Approved): For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive- pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen- deficient atmospheres.

Ventilation Limits:

Provide Natural or Mechanical ventilation to minimize exposure. If practical, use local mechanical exhaust ventilation at sources of air contamination such as open process equipment.

Hygienic Practices:

All food / smoking materials should be kept in a separate area away from the storage/use location. Eating, drinking and smoking should be prohibited in areas where there is a potential for significant exposure to this material. Before eating, drinking or smoking, hands and face should be thoroughly washed. Facilities storing or using this material should be equipped with an eyewash and safety shower.

Section 9 - Physical and Chemical Properties

Appearance And Odor: White solid powder or granules with ammonia-like odor

pH: 7.8 - 8.2

Melting Point:	May decompose before melting	**Flammable Limits:**	No data available
Freezing Point:	No data available	**UEL:**	No data available
Boiling Point:	225° F	**LEL:**	No data available
Flash Point:	No data available	**Vapor Pressure(mm/hg):**	No data available
Evaporation Rate:	No data available	**Vapor Density(air=1):**	No data available
Solubilities:	57wt/wt% at 10° C	**Autoignition Temp:**	No data available
Specific Gravity:	No data available	**Decomposition Temp:**	No data available
Bulk Density:	1.619 g/cm3	**Reactivity In Water:**	No data available
Other Information:	No data available	**Viscosity:**	No data available

Section 10 - Stability and Reactivity

Chemical Stability and Reactivity:

This material is stable under normal handling and storage conditions.

Possible Hazardous Reactions:

Will not occur under normal processing conditions.

Conditions to Avoid:

Extreme heat, rain, dusting conditions, extreme humidity.

Incompatible Materials:

Strong bases, sodium hypo chlorite, combustible materials, reducing agents, acids, alkalis, chlorates, chlorides, chromates, nitrates, permanganates, metallic powder, substances containing copper, nickel, cobalt, zinc and their alloys.

Hazardous Decomposition Products:

Water vapor and toxic gases such as nitrogen oxides, ammonia, chlorine, and hydrogen chlorine, phosphoric acid may be given off.
Hazardous polymerization does not occur.

Section 11- Toxicological Information

Information On The Likely Routes Of Exposure: Inhalation, Ingestion and Dermal.

Symptoms Related To The Physical, Chemical And Toxicological Effects:

Inhalation Effects:

> 5000 mg/m3, 4 hours

Skin Effects:

> 7940 mg/kg Sprague-Dawley Rabbit

Dermal Toxicity:

> 5000 mg/kg Sprague-Dawley Rat

Eye Effects:

Slightly irritating (Rabbit, 2.2/110.0, 24 hour exp)
Symptoms can include irritation, redness, scratching of the cornea, and tearing.

Ingestion Effects:

Practically Nontoxic (Rat dosage LD50 > 5750 mg/kg)

Sensitization:

No information available.

Carcinogenicity/Mutagenicity:

This product does not contain any ingredients designated by IARC, NTP, ACGIH or OSHA as a probable or suspected human carcinogen. Mutagenicity lymphocyte result:: negative

Reproductive Effects:

Contains no ingredient listed as toxic to reproduction.

Neurotoxicity:

No data found for this product.

Target Organs:

No data found for this product.
Frequent inhalation of fume/dust over a long period of time increases the risk of developing lung diseases.

Additional Toxicological Information:

None

Section 12- Ecological Information

Ecotoxicity: Daphnia LC50 1790 mg/l, 96 hours; Carp, hawk fish (Cirrhinus mrigala 1700 mg/l, 96 hours

Degradability: There are no data on the degradability of this product

Bioaccumulative potential: No data available

Mobility in the Soil: The product is water soluble and may spread in water systems

Additional Adverse effect on environment:

LC50 - lethal concentration 50% of test species, 155 mg/l/96 hr, fish: Pimephales promelas.

SECTION 13 - Disposal Considerations

Disposal Instructions and Regulations:

Chemical additions, processing or otherwise altering material may make the waste management information presented in MSDS incomplete, inaccurate or otherwise inappropriate. Be advised that state/local requirements for waste disposal may be more restrictive or otherwise different from federal laws and regulations. Consult state/local regulations regarding proper disposal of this material.

Hazardous Waste Code: Not considered a hazardous waste.

Container Disposal Information:

Be advised that state/local requirements for container disposal may be more restrictive or otherwise different from federal laws and regulations. Consult state/local regulations regarding proper disposal of container.

Section 14 - Transport Information

US DOT, IATA, IMO, ADR:

Proper Shipping Name:	Ammonium Phosphate, Dibasic		
D. O. T. Hazard Class:	Not regulated by D.O.T.	**UN #:**	N/A
Label Requirement:	None	**RQ:**	N/A
Placard:	None	**CAS:**	7783-28-0
Packing Group:	N/A	**ERG Book Information:**	171
Environment Hazards:	N/Ap	**Marine Pollutant:**	N/Ap
Special Precautions:	N/Ap	**IATA:**	Not regulated as dangerous goods

Section 15 - Regulatory Information

US Federal - OSHA Status:

This product does NOT contain any products considered hazardous under the Federal OSHA HazCom. Standard 29 CFR 1910.1200.

TSCA Status:

Listed/Reportable

U.S. SARA Reporting Requirements:

SARA Title III Hazard Classes Section 302 - EXTREMELY HAZARDOUS SUBSTANCES:

This product does NOT contain ingredients listed in Appendix A and B as Extremely Hazardous substances.

SARA Title III Hazard Classes Sections 311/312:

Immediate (acute) health hazard

SARA Section 313 Toxic Chemicals:

This product contains the following toxic chemical subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right to Know Act:

CAS#	Chemical Name:
	This material does not contain any chemical components with known CAS numbers that exceed the threshold reporting levels.

SARA Superfund Section 110:

This product does not contain ingredients listed as hazardous substances on the Priority List of CERCLA Hazardous substances.

CERCLA, 40 CFR 117, 302:

This product does NOT contain ingredients specified in the List of Extremely Hazardous Substances.

CERCLA listed substances are:

none

Other Federal Reporting Requirements:

CAA: This product does NOT contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act

CWA: NO chemicals in product are listed a Hazardous Substances, Priority Pollutants or Toxic Pollutants under the CWA.

RCRA: NOT considered a hazardous waste.

State Reporting Requirements:

State Right to Know Laws:

CAS#	State RTK	Chemical Name
		None

CALIFORNIA PROPOSITION 65:

This product does NOT contain a chemical or chemicals subject to California Proposition 65.

Michigan Critical Materials:

This product does NOT contain ingredients listed on the Michigan Critical Materials Register.

Global Lists/International Inventories:

Canada CEPA: All intentional ingredients are listed on the DSL

Canada WHMIS: Not controlled.

SECTION 16 - Other Information

Medical Conditions Possibly Aggravated by Exposure:

All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred. **Notes to Physician:**

Ingestion of large quantities of phosphate salts (over 1.0 grams for an adult) may cause an osmotic catharsis resulting in diarrhea and probable abdominal cramps. Larger doses such as 4-8 grams will almost certainly cause these effects in everyone. In healthy individuals most of the ingested salt will be excreted in the feces with the diarrhea and, thus, not cause any systemic toxicity. Doses greater than 10 grams hypothetically may cause systemic toxicity. Treatment should take into consideration both anionic and cation portion of the molecule. The following treatments should be considered for the specific group(s) of phosphate salts found in this product

All phosphate salts, except calcium salts, have a hypothetical risk of hypocalcemia, so calcium levels should be monitored.

Ammonium salts have a hypothetical risk of ammonia toxicity. In addition to calcium levels, ammonia and phosphate levels should be monitored.

Potassium salts have a hypothetical risk of hyperkalemia which can cause cardiac arrhythmia. In addition to calcium levels, potassium and phosphate levels should be monitored. Also consider continuous EKG monitoring to detect hyperkalemia

Sodium salts have a hypothetical risk of hypernatremia. In addition to calcium levels, sodium and phosphate levels should be monitored.

4-15-15 SDS reviewed - updated to GHS requirements. This replaces all previous MSDS's

10-17-16 - All sections reviewed for final GHS Classification

Date of last revision:

10-17-2016

NOTICE: OSHA STANDARD 29 CFR 1910.1200 requires that information be provided to employees regarding the hazards of chemicals by means of a Hazard Communication Program including training, labeling, Material Safety Data Sheets, and access to written records. We request that you, and it is your legal duty, make all information in this Material Safety Data Sheet available to your employees.

Key Legend Information:

N/Ap:	Not Applicable		
N/R:	Not Rated	ND:	Not Determined
ACGI	American Conference of Govr'ntal Industrial Hygienists	NDA:	No Data Available
OSHA:	Occupational Safety and Health Administration	TLV:	Threshold Limit Value
PEL:	Permissible Exposure Limit	TWA:	Time Weighted Average
STEL:	Short Term Exposure Limit	NTP:	National Toxicology Program
IARC:	International Agency for Research on Cancer	TSCA:	Toxic Substance Control Act
SARA Title III:	Superfund Amendments and Reauthorization Act	CERCLA:	Comprehensive Response, Compensation and Liability Act
CAA:	Clean Air Act	CWA:	Clean Water Act
RCRA:	Resource Conservation Recovery Act		
IATA:	International Air Transport Association Shipping Info.	IMO:	International Maritime Organization Shipping Info.
DSL:	Domestic Substance List (Canada)	WHMIS:	Workplace Hazardous Materials Information System

SAFETY DATA SHEET

Version 6.4
Revision Date 01/10/2020
Print Date 01/18/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Iron(III) oxide

Product Number : 529311
Brand : Aldrich
CAS-No. : 1309-37-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements

Not a hazardous substance or mixture.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : Ferric oxide

Formula : Fe_2O_3
Molecular weight : 159.69 g/mol
CAS-No. : 1309-37-1

EC-No. : 215-168-2

Component	Classification	Concentration
Diiron trioxide		
		<= 100 %

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact
Wash off with soap and plenty of water.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Iron oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas.
For personal protection see section 8.

6.2 Environmental precautions
No special environmental precautions required.

6.3 Methods and materials for containment and cleaning up
Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.
Storage class (TRGS 510): 11: Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Diiron trioxide	1309-37-1	TWA	5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Pneumoconiosis Not classifiable as a human carcinogen		
		TWA	5 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix D - Substances with No Established RELs		

		TWA	10 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	15 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		PEL	10 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		PEL	5 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		The concentration and percentage of the particulate used for this limit are determined from the fraction passing a size selector with the following characteristics: Aerodynamic Diameter in Micrometers (unit density sphere)..... Percent Passing Selector 0 ..... 100 1 ..... 97 2 ..... 91 3 ..... 74 4 ..... 50 5 ..... 30 6 ..... 17 7 ..... 9 8 ..... 5 10 1		
		PEL	5 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

8.2 Exposure controls

Appropriate engineering controls
General industrial hygiene practice.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
No special environmental precautions required.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 1,538 °C (2,800 °F)
f)	Initial boiling point and boiling range	No data available
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower	No data available

	flammability or explosive limits	
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	5.15 g/cm3
n)	Water solubility	insoluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Chloroformates, Peroxides, Strong acids, Strong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - No data available
Hazardous decomposition products formed under fire conditions. - Iron oxides
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - male and female - > 5,000 mg/kg
(OECD Test Guideline 420)
LC50 Inhalation - Rat - male and female - 4 h - > 5.05 mg/l
(OECD Test Guideline 403)

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation - 4 h
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation
(OECD Test Guideline 405)

Respiratory or skin sensitisation
Maurer optimisation test - Guinea pig
Result: negative

Germ cell mutagenicity
Ames test
Result: negative
(Lit.)

Rat - female - Bone marrow
Result: negative
(ECHA)

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity

Specific target organ toxicity - single exposure

Specific target organ toxicity - repeated exposure

Aspiration hazard

Additional Information
RTECS: NO7400000

Long term inhalation exposure to iron (oxide fume or dust) can cause siderosis. Siderosis is considered to be a benign pneumoconiosis and does not normally cause significant physiologic impairment. Siderosis can be observed on x-rays with the lungs having a mottled appearance., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

After uptake of large quantities:

CNS disorders, shock
Other information
Inhalation of the dusts should be avoided as even inert dusts may impair respiratory organ functions.
Handle in accordance with good industrial hygiene and safety practice.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Danio rerio (zebra fish) - > 10,000 mg/l - 96 h Remarks: (ECHA)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - > 100 mg/l - 48 h (OECD Test Guideline 202)

12.2 Persistence and degradability
The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

12.4 Mobility in soil

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Contact a licensed professional waste disposal service to dispose of this material. Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

SECTION 15: Regulatory information

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Acute Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Diiron trioxide	1309-37-1	2007-03-01

SECTION 16: Other information

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.4 Revision Date: 01/10/2020 Print Date: 01/18/2020

Univar USA Inc Safety Data Sheet

SDS No:	
Version No:	008 2018-02-07
Order No:	

3075 Highland Pkwy, Ste 200, Downers Grove, IL 60515
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

SAFETY DATA SHEET

SDS NUMBER: EUSA-150
CURRENT ISSUE DATE:
April, 2017

SODIUM SULFITE

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sodium Sulfite

OTHER/GENERIC NAMES: Sodium Sulfite

PRODUCT USE AND RESTRICTIONS ON USE: Paper manufacture, food additive, water treatment, waste treatment, other industrial processes.

SUPPLIER:
Esseco USA LLC
4 Gatehall Drive
Parsippany, NJ 07054

FOR MORE INFORMATION CALL: 973-267-3330
(Monday-Friday, 9:00am-4:30pm)
FOR EMERGENCY IN USA, CALL CHEMTREC: 800-424-9300
(24 Hours/Day, 7 Days/Week)

2. HAZARDS IDENTIFICATION

GHS Classification

Not Classified as Hazardous

Label Elements:

None Required

3. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
Sodium sulfite	7757-83-7	≥97

Trace impurities and additional material names not listed above may appear in Section 15 of this SDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons. The exact concentrations are a trade secret.

4. FIRST AID MEASURES

SKIN: Immediately wash skin with plenty of soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if irritation persists.

EYES: Flush eyes with water for several minutes. Remove contact lenses if present if you can do so easily and continue flushing. Get medical attention if irritation occurs and persists.

INHALATION: Remove to fresh air. Get immediate medical attention if signs of suffocation, irritation or other symptoms develop.

INGESTION:	Rinse mouth with water and give 1 glass of water to drink. Do not induce vomiting unless directed to do so be medical personnel. Get medical attention if symptoms develop.
MOST IMPORTANT SYMPTOMS/EFFECTS, ACUTE AND DELAYED:	May irritate the skin. May cause irritation to the eyes. Harmful if swallowed or inhaled. May cause severe and possibly fatal allergic reactions if inhaled or swallowed by some asthmatics and other 'sulfite-sensitive' individuals. Reacts with acids to form toxic and irritating sulfur dioxide gas.
INDICATION OF IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT, IF NEEDED:	Immediate medical attention is required for allergic respiratory reaction. Treat symptomatically. Note potential for anaphylactic shock with allergic individuals.

5. FIRE FIGHTING MEASURES

SUITABLE (AND UNSUITABLE) EXTINGUISHING MEDIA:
Material is not flammable. Use extinguishing media appropriate for material in surrounding fire.

SPECIFIC HAZARDS ARISING FROM THE CHEMICAL:
Releases toxic and irritating sulfur dioxide at fire temperatures.

SPECIAL PROTECTIVE EQUIPMENT AND PRECAUTIONS FOR FIRE-FIGHTING:
Wear NIOSH-approved self-contained breathing apparatus. Use water-spray to keep containers cool, and to knock down vapors or gases.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT, AND EMERGENCY PROCEDURES: Provide ventilation to clear sulfur dioxide fumes which may be generated by contact with water. Wear appropriate personal protective equipment.

ENVIRONMENTAL PRECAUTIONS: Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

METHODS AND MATERIALS FOR CONTAINMENT AND CLEANING UP: Promptly sweep up material with minimum dusting and shovel into an empty container with a cover. Rinse spill area with plenty of water.

7. HANDLING AND STORAGE

PRECAUTIONS FOR SAFE HANDLING: (See section 8 for recommended personal protective equipment.)
Avoid contact with skin, eyes and clothing. Do not breathe dust. Do not eat or drink in the work area. Use normal personal hygiene and housekeeping. Keep away from acids and oxidizing agents.

CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES:
Store in a cool, dry, well-ventilated area away from acids and oxidizing agents.

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SODIUM SULFITE

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES

INGREDIENT NAME	ACGIH TLV	OSHA PEL	OTHER LIMIT
Sodium sulfite	None	None	None

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:
Sulfur dioxide: OSHA TWA = 5 ppm
ACGIH STEL = 0.25 ppm

APPROPRIATE ENGINEERING CONTROLS:
Local exhaust if dusty conditions exist or if there is a release of sulfur dioxide gas. Do not use in unventilated spaces, e.g., the holds of fishing boats, walk-in coolers or confined spaces.

INDIVIDUAL PROTECTION MEASURES, SUCH AS PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION: For handling dry material, wear rubber gloves and full work clothing, including long-sleeved shirt and trousers. When handling solutions and there is prolonged or repeated contact, wear impervious gloves, clothing and boots.

EYE PROTECTION: Wear chemical safety goggles.

RESPIRATORY PROTECTION: Where required, use a NIOSH-approved respirator for dust, mist and/or sulfur dioxide gas, as conditions indicate. Some exposures may require a NIOSH-approved self-contained breathing apparatus or supplied-air respirator. Equipment selection depends on contaminant type and concentration. Select in accordance with 29 CFR 1910.134 and good industrial hygiene practice.

ADDITIONAL RECOMMENDATIONS: Eyewash and safety shower are recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	White to pale yellow crystals or powder.		
PHYSICAL STATE:	Solid.		
ODOR:	Odorless.		
ODOR THRESOLD:	Not determined.		
MOLECULAR WEIGHT:	126.04		
CHEMICAL FORMULA:	Na_2SO_3		
RELATIVE DENSITY (water = 1.0):	2.63		
SOLUBILITY IN WATER (weight %):	17% at 10°C (50°F); 28% at 33.3°C (91.94°F)		
pH:	5% solution - 9.8		
INITIAL BOILING POINT/RANGE:	Not applicable.		
MELTING/FREEZING POINT:	Decomposes at 900°C (1652°F)		
VAPOR PRESSURE:	Not applicable.		
VAPOR DENSITY (air = 1.0):	Not applicable.		
EVAPORATION RATE:	Not applicable.	**COMPARED TO:**	Not applicable.
% VOLATILES:	Not applicable.		

PARTITION COEFFICIENT (N-OCTANOL/WATER):	Not determined.
VISCOSITY:	Not applicable.
FLASH POINT:	Not flammable.
FLASH POINT METHOD:	Not applicable.
AUTOIGNITION TEMPERATURE:	Not applicable.
UPPER FLAME LIMIT (volume % in air):	Not applicable.
LOWER FLAME LIMIT (volume % in air):	Not applicable.
DECOMPOSITION TEMPERATURE:	Not determined.
FLAMMABILITY (SOLID, GAS)	Not flammable.
OSHA FLAMMABILITY CLASS:	Not applicable.

10. STABILITY AND REACTIVITY

REACTIVITY:
Not normally reactive

CHEMICAL STABILITY:
Normally stable.

POSSIBILITY OF HAZARDOUS REACTIONS:
Reacts with acids to form toxic and irritating sulfur dioxide gas.

CONDITIONS TO AVOID:
Avoid elevated temperatures. Temperatures above 900°C (1652°F) cause the rapid evolution of toxic and corrosive sulfur dioxide gas and hazardous residue.

INCOMPATIBILITIES:
Oxidizers: may cause strong exothermic reactions.
Acids: releases sulfur dioxide gas.

HAZARDOUS DECOMPOSITION PRODUCTS:
Sulfur dioxide and sodium sulfide residue. Sodium sulfide is flammable, a dangerous fire risk, a strong irritant to skin and tissue, and is incompatible with acids.

11. TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH HAZARDS

ACUTE EFFECTS OF EXPOSURE:

SKIN:	Repeated or prolonged contact with dust may cause irritation. Contact with solutions will cause skin irritation.
EYES:	Dust or mist may irritate the eyes. Solutions will irritate or burn.
INHALATION:	Inhalation of dust or mist can irritate the respiratory tract. May cause severe or deadly allergic reactions in some asthmatics and sulfite sensitive individuals. Possible signs and symptoms of allergic reactions include bronchoconstriction, sweating, flushing, hives, rapid heart rate, decreased blood pressure, and anaphylaxis. Contact with acids releases sulfur dioxide gas which may be harmful or deadly if inhaled.

INGESTION: May irritate the gastrointestinal tract. May cause severe or deadly allergic reactions in some asthmatics and sulfite sensitive individuals. Large doses may cause violent colic and diarrhea, circulatory disturbances, central nervous system depression, and even death.

CHRONIC EFFECTS: None known.

Ingredients found on one of the three OSHA designated carcinogen lists are listed below.

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST
No ingredients listed in this section.	----	----	----

NUMERICAL MEASURES OF TOXICITY:

Immediate (Acute) Effects:
Sodium sulfite -LD_{50} (oral, rat) = 2610-6400 mg/kg; LC_{50} (inhalation, rat) >5.5 mg/L/4 hr.; LC_{50} (inhalation, rat) >22 mg/L/1 hr.

Delayed (Subchronic and Chronic) Effects:
Sodium sulfite has been demonstrated to be mutagenic in microbial systems; however, it is not mutagenic in studies involving insects and is not considered to present a mutagenic threat to multi-cell organisms.

Other Data:
None

12. ECOLOGICAL INFORMATION

ECOTOXICITY:
The following ecotoxicity data is available for Sodium sulfite:

Daphnia magna LC50 48 hrs	440 mg/L
Western Mosquitofish 96hrs LC50	460 mg/L
Biological Oxygen Demand (BOD)	0.12 lb/lb, instantaneous

PERSISTENCE AND DEGRADBILITY:
No data available

BIOACCUMULATIVE POTENTIAL:
No data available

MOBILITY IN SOIL:
No data available

OTHER ADVERSE EFFECTS:
No data available.

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? No

If yes, the RCRA ID number is: Not applicable.

SODIUM SULFITE

OTHER DISPOSAL CONSIDERATIONS:
Dispose of in accordance with applicable Federal, State and Local regulations.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT HAZARD CLASS:	Not regulated.
US DOT ID NUMBER:	Not applicable.
PROPER SHIPPING NAME:	Not applicable.

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS:	All components are listed on TSCA Inventory of Chemical Substances.
OTHER TSCA ISSUES:	None.

SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

INGREDIENT NAME	SARA/CERCLA RQ (lb)	SARA EHS TPQ (lb)
No ingredients listed in this section.	----	----

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee. Many states have more stringent regulations. Report all spills in accordance with local, state and federal regulations.

SECTION 311 HAZARD CLASS: See OSHA Hazard Classification in Section 2.

SARA 313 TOXIC CHEMICALS:
The following ingredients are SARA 313 "Toxic Chemicals" and may be subject to annual reporting requirements. CAS numbers and weight percents are found in Section 2.

INGREDIENT NAME	COMMENT
No ingredients listed in this section.	----

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

INGREDIENT NAME	WEIGHT %	COMMENT
No ingredients listed in this section.	----	----

SAFETY DATA SHEET

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SODIUM SULFITE

CALIFORNIA PROPOSITION 65

This product does not contain any ingredients known to the State of California to cause cancer and/or reproductive harm.

ADDITIONAL REGULATORY INFORMATION:

None

FOREIGN CHEMICAL CONTROL INVENTORY STATUS:

Listed on Canadian DSL, Australian AICS, Philippines PICCS, Chinese IECSC, Japanese MITI, Korean KECL, and EU EINECS.

16. OTHER INFORMATION

CURRENT ISSUE DATE:	April, 2017
PREVIOUS ISSUE DATE:	December, 2013

CHANGES TO SDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:
Removed old WHMIS classification system.

OTHER INFORMATION: This product is not for drug use. Only Food Grade material is for use as a food additive.

Univar USA Inc Safety Data Sheet

For Additional Information contact SDS Coordinator during business hours, Pacific time: (425) 889-3400

Notice

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Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from your local Univar sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein.

This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Univar USA Inc Safety Data Sheet

SDS No:	
Version No:	001 2016-05-11
Order No:	

3075 Highland Pkwy, Ste 200, Downers Grove, IL 60515
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

Univar
3075 Highland Pkwy STE 200
Downers Grove, IL 60515
425-889-3400

SAFETY DATA SHEET

1. Identification

Product identifier: POTASSIUM SULFITE SOLUTION

Other means of identification

SDS number: 000100001346

Recommended use and restriction on use

Recommended use: Reserved for industrial and professional use.

Restrictions on use: Not known.

Emergency telephone number:For emergency assistance Involving chemicals

call CHEMTREC day or night at: 1-800-424-9300. CHEMTREC INTERNATIONAL Tel# 703-527-3887

2. Hazard(s) identification

Hazard classification

Not classified

Label elements

Hazard symbol	No symbol
Signal word	No signal word.
Hazard statement	Not applicable
Precautionary statement	Not applicable

Other hazards which do not result in GHS classification None.

3. Composition/information on ingredients

Substances

Chemical identity	Common name and synonyms	CAS number	Content in percent (%)*
Sulfurous acid, potassium salt (1:2)		10117-38-1	45 - 47%
Water		7732-18-5	53 - 55%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

Composition comments: The components are not hazardous or are below required disclosure limits.

4. First-aid measures

Ingestion: Call a physician or poison control center immediately. Only induce vomiting at the instruction of medical personnel. Never give anything by mouth to an unconscious person.

Inhalation: Move to fresh air. If breathing is difficult, give oxygen. Perform artificial respiration if breathing has stopped.

Skin contact: Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Eye contact: If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

Most important symptoms/effects, acute and delayed

Symptoms: No data available.

Indication of immediate medical attention and special treatment needed

Treatment: No data available.

5. Fire-fighting measures

General fire hazards: No data available.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Use fire-extinguishing media appropriate for surrounding materials.

Unsuitable extinguishing media: No data available.

Specific hazards arising from the chemical: No data available.

Special protective equipment and precautions for firefighters

Special fire fighting procedures:	No data available.
Special protective equipment for fire-fighters:	No data available.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:	No data available.
Methods and material for containment and cleaning up:	Absorb spillage with non-combustible, absorbent material. Dike for later disposal.

7. Handling and storage

Precautions for safe handling:	Avoid contact with eyes, skin, and clothing. Use only with adequate ventilation.
Conditions for safe storage, including any incompatibilities:	No data available.

8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None of the components have assigned exposure limits.

Appropriate engineering controls	No data available.

Individual protection measures, such as personal protective equipment

General information:	Use personal protective equipment as required. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned.
Eye/face protection:	Wear goggles/face shield.
Skin protection	
Hand protection:	No data available.
Other:	No data available.
Respiratory protection:	In case of inadequate ventilation use suitable respirator.
Hygiene measures:	When using do not eat, drink or smoke. Wash thoroughly after handling.

9. Physical and chemical properties

Physical state:	Liquid
Form:	No data available.
Color:	No data available.
Odor:	No data available.
Odor threshold:	No data available.
pH:	9 - 10
Melting point/freezing point:	No data available.
Initial boiling point and boiling range:	> 100 °C
Flash Point:	No data available.
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	No data available.
Vapor density:	No data available.
Relative density:	No data available.
Solubility(ies)	
Solubility in water:	No data available.
Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.
Viscosity:	No data available.

10. Stability and reactivity

Reactivity: No data available.

Chemical stability:	Material is stable under normal conditions.
Possibility of hazardous reactions:	No data available.
Conditions to avoid:	No data available.
Incompatible materials:	No data available.
Hazardous decomposition products:	No data available.

11. Toxicological information

Symptoms related to the physical, chemical and toxicological characteristics

Ingestion:	No data available.
Inhalation:	No data available.
Skin contact:	No data available.
Eye contact:	No data available.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral

Product: ATEmix (): 2,150 mg/kg

Dermal

Product: ATEmix (): 2,000 mg/kg

Inhalation

Product: No data available.

Specified substance(s):

Sulfurous acid, potassium salt (1:2)	LC 50 (Rat,): > 5.5 mg/l (, No) 2 = reliable with restrictions LC 50 (Rat,): > 5.5 mg/l (, No) 2 = reliable with restrictions LC 50 (Rat,): > 5.5 mg/l (, No) 2 = reliable with restrictions

Repeated dose toxicity

Product: No data available.

Skin corrosion/irritation

Product: No data available.

Serious eye damage/eye irritation

Product: No data available.

Respiratory or skin sensitization

Product: No data available.

Carcinogenicity

Product: No data available.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogenic components identified

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogenic components identified
US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ cell mutagenicity
In vitro
Product: No data available.
In vivo
Product: No data available.

Reproductive toxicity
Product: No data available.

Specific target organ toxicity - single exposure
Product: No data available.

Specific target organ toxicity - repeated exposure
Product: No data available.

Aspiration hazard
Product: No data available.

Other effects: No data available.

12. Ecological information

Ecotoxicity:
Acute hazards to the aquatic environment:
Fish
Product: No data available.
Aquatic invertebrates
Product: No data available.
Chronic hazards to the aquatic environment:
Fish
Product: No data available.
Aquatic invertebrates
Product: No data available.
Toxicity to Aquatic Plants
Product: No data available.

Persistence and degradability
Biodegradation
Product: No data available.

BOD/COD ratio

Product: No data available.

Bioaccumulative potential

Bioconcentration factor (BCF)

Product: No data available.

Partition coefficient n-octanol / water (log Kow)

Product: No data available.

Mobility in soil: No data available.

Known or predicted distribution to environmental compartments

Potassium sulphite No data available.

Water No data available.

Known or predicted distribution to environmental compartments

Water No data available.

Potassium sulphite No data available.

13. Disposal considerations

Disposal instructions: Dispose of waste at an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Contaminated packaging: No data available.

14. Transport information

Not regulated for US domestic ground transportation.

15. Regulatory information

US federal regulationsUS. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

None present or none present in regulated quantities.

Superfund amendments and reauthorization act of 1986 (SARA)

Hazard categories

Not listed.

SARA 302 Extremely hazardous substance

None present or none present in regulated quantities.

SARA 304 Emergency release notification

None present or none present in regulated quantities.

SARA 311/312 Hazardous chemical

Chemical identity	Threshold Planning Quantity

SARA 313 (TRI reporting)

None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

None present or none present in regulated quantities.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

US state regulations

US. California Proposition 65

No ingredient regulated by CA Prop 65 present.

US. New Jersey Worker and Community Right-to-Know Act

No ingredient regulated by NJ Right-to-Know Law present.

US. Massachusetts RTK - Substance List

No ingredient regulated by MA Right-to-Know Law present.

US. Pennsylvania RTK - Hazardous Substances

No ingredient regulated by PA Right-to-Know Law present.

US. Rhode Island RTK

No ingredient regulated by RI Right-to-Know Law present.

Version: 1.2
Revision date: 05/11/2016

Inventory Status: Australia AICS:	Not in compliance with the inventory.
Canada DSL Inventory List:	Not in compliance with the inventory.
EU EINECS List:	Not in compliance with the inventory.
EU ELINCS List:	Not in compliance with the inventory.
Japan (ENCS) List:	Not in compliance with the inventory.
EU No Longer Polymers List:	Not in compliance with the inventory.
China Inv. Existing Chemical Substances:	Not in compliance with the inventory.
Korea Existing Chemicals Inv. (KECI):	Not in compliance with the inventory.
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	Not in compliance with the inventory.
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	Not in compliance with the inventory.
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

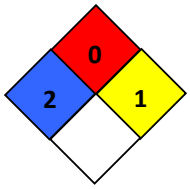
HMIS Hazard ID

Health		2
Flammability		0
Physical hazards		1
PERSONAL PROTECTION		B

B - Safety Glasses & Gloves

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; *Chronic health effect

NFPA Hazard ID



Flammability
Health
Reactivity
Special hazard.

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

Issue date:	05/11/2016
Revision date:	No data available.
Version #:	1.2
Further information:	No data available.

Version: 1.2
Revision date: 05/11/2016

Univar USA Inc Safety Data Sheet

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This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Attachment 2

COLORADO DIVISION OF RECLAMATION, MINING AND SAFETY
1313 Sherman Street, Room 215, Denver, Colorado 80203 ph(303) 866-3567

REQUEST FOR TECHNICAL REVISION (TR) COVER SHEET

File No.: M- 1977-004 Site Name: Pitch Reclamation Project

County Saguache TR# *(DRMS Use only)*

Permittee: Homestake Mining Company

Operator (If Other than Permittee):

Permittee Representative: Clark Burton - Head of Operations, Asset Development

Please provide a brief description of the proposed revision:

Installation of up to 25 boreholes/piezometers in the former Pinnacle Mine Dump for characterization of source zones and expansion of phosphate-based injections. Continued field-demonstration scale testing of phosphate-based injections and engineered treatment cell (ETC) operation. Remove and re-establish sections of the North Pit and South Pit diversion ditches, remove and replace a portion of the South Pit, perform improvements to the Sediment Control Pond, and demolish the Sand Filtration (Water Treatment) plant.

As defined by the Minerals Rules, a Technical Revision (TR) is: "a change in the permit or application which does not have more than a minor effect upon the approved or proposed Reclamation or Environmental Protection Plan." The Division is charged with determining if the revision as submitted meets this definition. If the Division determines that the proposed revision is beyond the scope of a TR, the Division may require the submittal of a permit amendment to make the required or desired changes to the permit.

The request for a TR is not considered "filed for review" until the appropriate fee is received by the Division (as listed below by permit type). Please submit the appropriate fee with your request to expedite the review process. After the TR is submitted with the appropriate fee, the Division will determine if it is approvable within 30 days. If the Division requires additional information to approve a TR, you will be notified of specific deficiencies that will need to be addressed. If at the end of the 30 day review period there are still outstanding deficiencies, the Division must deny the TR unless the permittee requests additional time, in writing, to provide the required information.

There is no pre-defined format for the submittal of a TR; however, it is up to the permittee to provide sufficient information to the Division to approve the TR request, including updated mining and reclamation plan maps that accurately depict the changes proposed in the requested TR.

Required Fees for Technical Revision by Permit Type - Please mark the correct fee and submit it with your request for a Technical Revision.

Permit Type	**Required TR Fee**	**Submitted** (mark only one)
110c, 111, 112 construction materials, and 112 quarries	$216	☐
112 hard rock (not DMO)	$175	☐
110d, 112d(1, 2 or 3)	$1006	☑

PITCH RECLAMATION PROJECT

May 22, 2019

Mr. Dustin Czapla
Environment Protection Specialist
Colorado Division of Reclamation, Mining and Safety
101 South 3rd, Suite 301
Grand Junction, Colorado 81501
Phone: (970) 243-6299
dustin.czapla@state.co.us

RE: Technical Revision Request: Field Activities to Support Reclamation and Establishment of the Lowest Practical Level for Uranium, Pitch Reclamation Project, Colorado Division of Reclamation, Mining and Safety Reclamation Permit Number M-1977-004

Dear Mr. Czapla:

Homestake Mining Company (HMC) hereby requests a Technical Revision to the Pitch Reclamation Project reclamation permit No. M-77-004HR for additional work associated with site reclamation and advancement of the Lowest Practical Level (LPL) evaluation at the Pitch Reclamation Site (Site). A site location map is provided as Figure 1, and a map of site monitoring locations is provided as Figure 2.

Site Reclamation Work

HMC initiated preparation of a 112d-3 amendment to Permit No. M-1977-004HR in 2018. The amendment package includes a comprehensive update of the mine reclamation plan and addresses the existing conditions and remaining work to be performed to adequately reclaim and close the site. The amended reclamation plan is anticipated to be submitted to Colorado Division of Reclamation, Mining and Safety (DRMS) for review in late May.

Reclamation work is proposed in 2019 as documented within the amended mine reclamation plan; however, given the anticipated review time required for the updated reclamation plan, proposed 2019 work is summarized herein to facilitate approval from DRMS. Current reclamation activities for 2019 include:

South Pit

- Remove and replace a portion of the east slope on the South Pit area that has been moving over the past few years. The upper diversion ditch will be re-established and lined with a Geosynthetic Clay Liner (GCL) to minimize infiltration along its alignment and divert water across the slope.

North Pit

- Re-establish the east diversion ditch of the north pit to convey runoff into the existing diversion ditch further south. The ditch will be regraded and lined with a GCL to minimize infiltration along its alignment and divert water across the slope. A short section of the North Pit diversion ditch will be moved into the slope to improve safe access along the maintenance road.

Sediment Control Pond Improvements

- Improvements to the sediment control pond, which include lowering the water level, replacing the sediment pond valves and risers, and lining the upstream face of the sediment control dam to limit seepage into the embankment.

Sand Filtration (Water Treatment) Plant Demolition

- The sand filtration (water treatment) plant located near the toe of the sediment control pond embankment will be demolished and disposed of, placing recovered material in approved storage areas, and plugging the pipes from the sediment dam. Approaches to demolish and remove plant will be made and reviewed by the Engineer of Record, due to pipe penetration associated with the embankment.

LPL Advancement

HMC is continuing to advance the evaluation of alternatives that can be implemented at the Pitch Reclamation Project (**Figure 1** and **Figure 2**) to reduce uranium load to the Colorado Discharge Permit System (CDPS) permit (No. CO0022756) compliance point Outfall 001A (also known as SW-33) and establish the Lowest Practical Level (LPL) for uranium. Field testing from 2015 through 2018 involved the injection of a mixture of phosphate and conservative tracer into the historical Pinnacle underground mine workings and the Indian Rock Dump. This program was successful at treating uranium by precipitation as low-solubility phosphate-based minerals. In addition, an intermediate-scale field implementation engineered treatment cell (ETC) was installed in 2018 to intercept surface water routed from the Chester Fault Springs (**Figure 2**).

The phosphate injection program and ETC installation were completed using existing and recently completed injection/monitoring wells and limited surface disturbances as approved in previous technical revisions (TR-6, TR-7, TR-8, and TR-9) to the DRMS reclamation permit No. M-1977-004HR.

Building on the success of the 2015 through 2018 pilot and field tests, and in the interest of continued evaluation of potential alternatives to address the other uranium source loads, the following field activities are planned:

- Advancement of 25 characterization boreholes and reagent injection/monitoring wells within the former Pinnacle Mine Dump boundary (Figure 3) in a phased approach between 2019 and 2021. Elevated uranium concentrations were identified in this area during 2018 characterization activities.
    - In 2019, up to five characterization boreholes will be advanced. Up to three of the boreholes may be converted into injection/recirculation/monitoring wells.
    - In subsequent years (tentatively planned for 2020 and 2021), additional drilling will be conducted in this area, including installation of up to 20 characterization boreholes and conversion of up to 12 of the boreholes into injection/recirculation/monitoring wells.
- Expanded phosphate-based injections into the Indian Rock Dump. Associated activities will include the installation of piping to connect the newly installed Pinnacle Mine Dump wells to the treatment systems installed in 2017.
- Continued operation of the phosphate injection system at the underground mine workings and the engineered treatment cells constructed in 2018 to treat water emanating from the Chester Fault springs (Figure 3).
- Implementation of active management strategies, should they become necessary, to control “treatment residuals” (i.e., residual dissolved constituents present in water resulting from reagent usage) in surface water upstream of the CDPS permit outfall (SW-33). In particular, residual phosphate in surface water resulting from phosphate injections will be managed if needed.

The following sections provide the proposed work to be conducted to support alternatives advancement and design, and information on reclamation of disturbed areas following LPL implementation. Additional details associated with prior field work is provided in the 2016 Alternatives Analysis Report, submitted to the Water Quality Control Division, the U.S. Environmental Protection Agency, and DRMS on December 6, 2016 (Arcadis 2016).

In advance of the uranium load reduction field work, approvals will also be requested from the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division as required by the CDPS permit, the CDPHE Radiation Management Program (RMP) as required by the site Radioactive Materials License (RML), and the United States Environmental Protection Agency for Class V aquifer remediation injection well “authorization by rule” in accordance with Title 40 Code of Federal Regulations (40 CFR) Sections 144.24 and 144.84(a).

Monitoring Well Construction and Borehole Advancement

Advancement of up to 25 characterization boreholes are proposed at the Pitch Reclamation Project in a 3-phased approach starting in 2019. The purpose of the boreholes is to characterize solid materials and assess the area for of the potential for subsurface water. Based on the screening results, boreholes may be converted to wells for use in the injection, recirculation, and/or monitoring of phosphate-based reagents and conservative tracer(s) at the Site.

The recirculation/monitoring wells will be completed near the former Pinnacle Mine Dump (**Figure 3**). The wells will be constructed in relatively flat areas adjacent to existing access roads. The 2019 wells are anticipated to be completed in July 2019. To accommodate drilling and well installation, surface grading will be performed on the Pinnacle Mine Dump area. The area will be graded to shed snowmelt and stormwater without ponding.

Boreholes which are selected to be completed as wells are anticipated to be at depths of up to 140 feet. Boreholes which are not completed as wells would be plugged and abandoned following drilling and sample collection.

Boreholes will be advanced and wells will be constructed in accordance with Colorado Office of the State Engineer guidelines. Wells will be completed to anticipated depths up to 140 ft below ground surface and will be constructed with 5-inch schedule 80 PVC 6-inch casing. Well screens will have a slot size of 0.020 inches and screen lengths will be up to 50 feet. An 8/12 sized sand filter pack or similar sand will be used as screen filter packs. The annulus of each well will be sealed using a hydrated bentonite seal above the screen interval and a cement and bentonite mixture grout from the bentonite to near the ground surface. The surface stick-up well completion will consist of an 8- to 10-inch steel vault and locking lid cemented in place with concrete. The production PVC casing will be sealed with a locking cap. The well vault will be surrounded by an approximate 2-foot diameter concrete apron sloped to facilitate proper drainage away from the well. Equipment used for the well installation includes drilling equipment and support vehicles. Drill cuttings will be handled as described below.

Surface Disturbance

Drilling and Monitoring Well Completion

A total of up to 1.1 acres of previously-disturbed or reclaimed ground within the Pinnacle Mine Dump will be used during drilling and completion of recirculation/monitoring wells (**Figure 3**), which includes grading of the former Pinnacle Mine Dump and placement of impacted drill cuttings in the Tie Camp disposal cell (**Figure 3)**. The disturbed areas will be reclaimed once the piezometers/wells are no longer being used as part of reagent injections and long-term monitoring associated with uranium load reduction system implementation and/or site characterization, as described below. Boreholes not completed as wells will be plugged/abandoned and reclaimed after drilling and sampling has been completed.

Drill cuttings will be screened using a hand-held Geiger-Mueller (GM) meter and segregated at the surface. Material that exhibits elevated counts per minute (cpm) relative to local background will be isolated for disposal in the low-grade ore disposal cell adjacent to Tie Camp drainage (**Figure 3).** Approval for placement of drill cuttings will be requested from the RMP, and work will be performed in accordance with the terms of the RML. Drill cuttings that do not exhibit elevated cpm readings relative to background will be spread and incorporated into the surface at the drilling locations.

Fencing and Reagent Injection/Recirculation Infrastructure

To facilitate larger scale water recirculation and phosphate injection activities, additional conveyance piping will be installed connecting existing Indian Rock Dump injection wells to the newly installed wells in the Pinnacle Mine Dump. In addition, fencing will be installed in select locations. These activities, which are anticipated to result in negligible disturbance of reclaimed areas, are as follows:

- Installation of fencing around engineered treatment cell (ETC) infrastructure (**Figure 3**).
- High-density polyethylene (HDPE) plastic piping associated with water conveyance and electrical conduits at the Indian Rock Dump phosphate injection system will be extended to run to wells installed within the Pinnacle Mine Dump. Installation will be performed in a manner consistent with pipe installation conducted in 2017 and 2018. Specifically:
    - Piping running along access roads and on steep grades will be maintained aboveground, secured to the ground using stakes and wire harness.
    - Piping will be buried at locations where piping crosses existing access roads.
    - Piping running parallel to access roads and/or drainage ditches will either be secured adjacent to the roads/ditches or placed into the drainage and away from roadways for safety purposes.
    - Piping will be HDPE welded, flanged, or a combination.

Reclamation of LPL Disturbed Areas

Surface disturbances and infrastructure installed as part of this proposed work and requiring eventual reclamation will include drilling disturbances, recirculation/monitoring wells that will require eventual plugging and abandonment, and infrastructure associated with LPL work. Reclamation of disturbed areas will include the following:

- Disturbances associated with drilling will be temporary. These areas will be restored to pre-drilling conditions immediately following drilling with the exception of access roads and drill pads that will be used to facilitate well/piezometer maintenance (Figure 3).
- The proposed wells/piezometers will be used as part of the long-term monitoring program associated with uranium load reduction system. When warranted, the wells will be abandoned in accordance with Rule 16 of the Colorado Water Well Construction Rules.
- Injection platforms and conveyance piping installed in 2017 and 2018 will be maintained across multiple seasons to support LPL activities. Reclamation of disturbed areas following the completion of injection activities will include removal of piping and engineered structures.
- Disturbed ground in each area will be re-contoured and revegetated, with grading for drainage, scarifying/harrowing, and fertilizing to be conducted as necessary for proper reclamation.

Summary

The primary site reclamation efforts for 2019 will consist of rehabilitation of a small landslide near the South Pit and reconstruction of a lined channel; lining and regrading the upper diversion ditch in the North Pit; maintenance work on the outlet riser pipe and outlet valves on the Sediment pond; and removal and restoration of the water treatment plant and ancillary structures. This work is consistent and integrated with the 2019 Amended Reclamation Plan.

An integral component to establishing a practical, technically achievable, and sustainable LPL is the development of alternatives for uranium load reduction at this high elevation mine site with limited year-round access. Pilot testing and system implementation ongoing since 2015 was successful at treating uranium in the underground mine workings and near the toe of the Indian Rock Dump, including desired attenuation of the injected phosphate. The success of these tests was based on observed uranium removal and phosphate attenuation within injection zones and immediately downgradient. Achieving meaningful load reductions in surface water will require further understanding and quantification of uranium loading to the North Pit Lake, ongoing phosphate injection system operation and optimizations, and continued expansion of other LPL-based strategies, such as use of ETCs. Based on this goal, additional LPL activities include the expansion of the phosphate injection system at the Indian Rock Dump, continued operation of the phosphate injection systems at the underground mine workings and Indian Rock Dump (with a surface water treatment residuals management program in place), and continued operation of the ETCs. Anticipated surface disturbances associated with these activities are conservatively estimated at approximately 1.1 acres.

If you have any questions or require further information regarding this submittal, please contact me at (505) 252-9615.

Sincerely,

Dave Wykoff, on behalf of
Clark Burton
Homestake Mining Company
Head of Operations, Asset Development

CC: Walter Baumann – Homestake Mining Company, Project Evaluation Manager
Dave Wykoff – Homestake Mining Company, Site Manager
Mike Hay – Arcadis, U.S., Inc.

References

Arcadis. 2016. Draft Alternatives Analysis and Lowest Practical Level Update. Prepared for Homestake Mining Company. December.

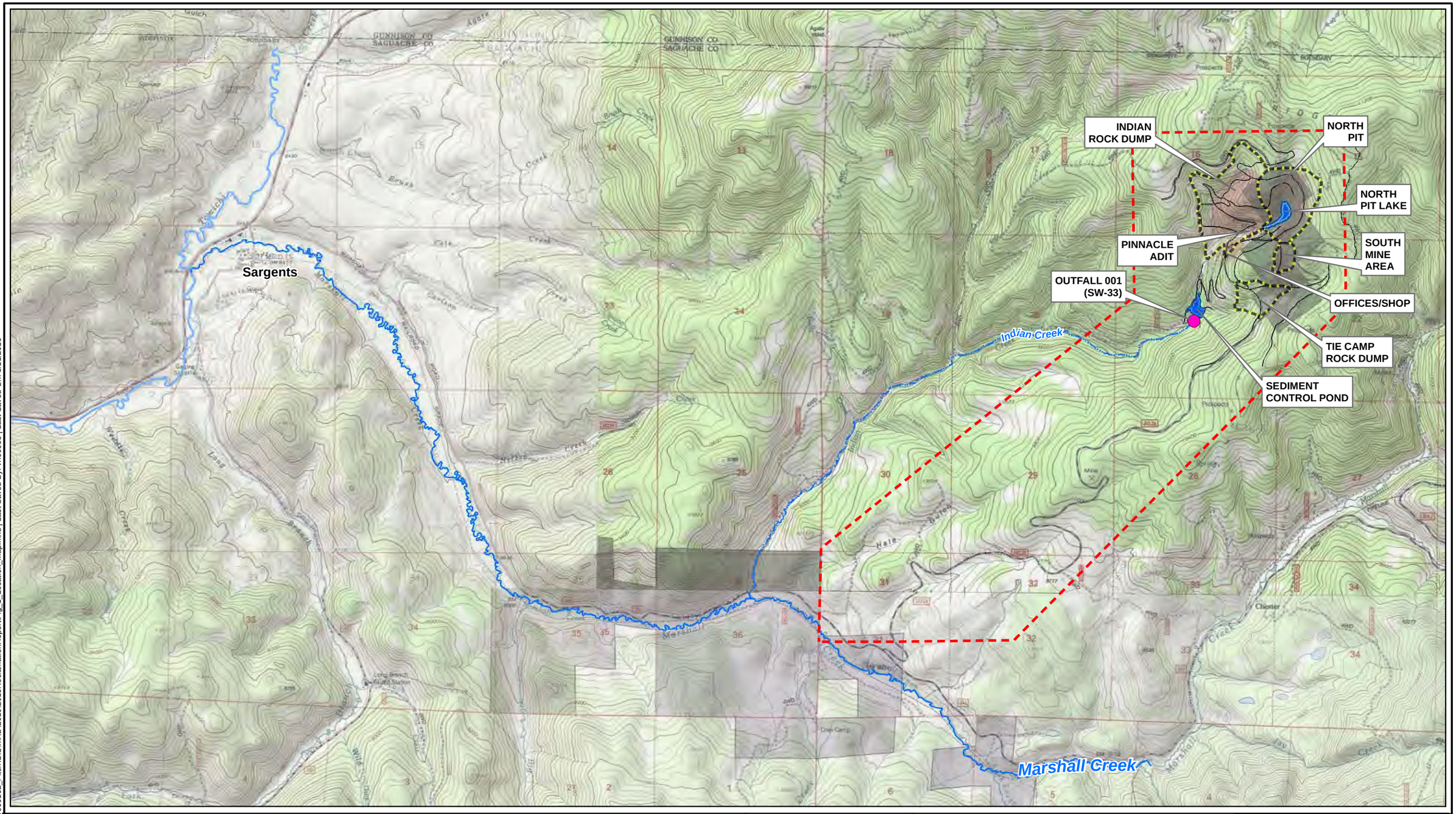
Figures

Figure 1 – Location Map

Figure 2 – Monitoring Locations

Figure 3 –Surface Disturbance Areas

Figures

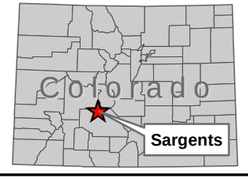


Legend

- Sample Points
- Colorado Division of Reclamation, Mining, and Safety Permit Boundary
- Facility Areas
- Marshall Creek
- Indian Creek
- Tomichi Creek

Notes:

Source: USGS 7.5' Quadrangles of Sargents, Chester, Sargents Peak, and Paholone Peak, Colorado



N

0 3,000 6,000 Feet

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

LOCATION MAP

ARCADIS

FIGURE 1

Path: Z:\GISProjects_ENVVAO000102_Pitch\GIS\MXD\2019\2019ReclamationReport\Fig_1_Location_Map.mxd | Last Saved By: vri00988 | Last Saved On: 3/11/2019

Legend

- Monitoring Well
- Inclinometer
- Piezometer
- Surface Water Sampling Point
- Active Seep/Spring
- Inactive Seep/Spring
- Colorado Discharge Permit System Compliance Point
- Colorado Discharge Permit System Boundary
- Roads
- 10,300 Level Underground Mine

N

0 260 520 Feet

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

MONITORING LOCATIONS

ARCADIS

FIGURE
2

Path: Z:\GIS\Projects_ENV\AO000102_Pitch\GIS\MXD\2019\2019-04\Fig_2_Monitoring_Features.mxd Date Saved: 4/17/2019 2:10:03 AM

Legend

- Colorado Discharge Permit System Compliance Point
- Colorado Discharge Permit System Boundary
- Proposed Fence Boundary
- 10,300 Level Underground Mine
- Roads
- Surface Disturbance Area
- Existing Treatment Residuals Management Staging Location
- Proposed Treatment Residuals Management Staging Location

N

0 260 520 Feet

HOMESTAKE

PITCH RECLAMATION PROJECT
HOMESTAKE MINING COMPANY
SARGENTS, COLORADO

2019 Surface Disturbance Areas

ARCADIS

FIGURE **3**

Path: Z:\GISProjects_ENVAQ000102_Pitch\GIS\MXD\2019\2019-04\Fig_3_Surface_Disturbance_Areas1.mxd Date Saved: 5/21/2019 10:11:22 PM

June 13, 2019

David Wykoff
Homestake Mining Company
P.O. Box 40
Sargents, CO 81248

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

RE: Pitch Project, Permit # M-1977-004, Technical Revision (TR-10) Approval

Mr. Wykoff:

The Division of Reclamation, Mining and Safety (Division) has approved your Technical Revision request (TR-10), addressing the following:

1. Repair and stabilization of the east slope in the South Pit area;
2. Improvements to the east diversion ditch of the North Pit;
3. Improvements to the sediment control pond;
4. Demolition and disposal of the sand filtration plant; and
5. Advancement of the LPL project.

The terms of TR-10 approved by the Division are hereby incorporated into Permit No. M-1977-004. All other conditions and requirements of the permit remain in full force and effect.

If you require additional information, or have questions or concerns, please contact me.

Sincerely,

Dustin Czapla
Environmental Protection Specialist
Division of Reclamation, Mining and Safety
Phone: (303) 866-3567, ext. 8188

APPENDIX E

Radioactive Materials License #150-01 Amendment 20

COLORADO
Department of Public Health & Environment

RADIOACTIVE MATERIALS LICENSE

Pursuant to the Colorado Radiation Control Act, Title 25, Article 11, Colorado Revised Statutes, and the State of Colorado Rules and Regulations Pertaining to Radiation Control (the Regulations) and in reliance on statements and representations heretofore made by the licensee designated below; a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material(s) designated below; and to use such radioactive material(s) for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders now or hereafter in effect of the Colorado Department of Public Health and Environment and to any conditions specified below.

1. Licensee: Homestake Mining Company of California

2. Mailing address: P.O. Box 40, Sargents, CO 81248

3. License number: CO 150-01, Amendment Number 20

4. Expiration date: April 30, 2023

5. Authorized Storage/Use Location: approximately 10 miles east of Sargents, Colorado in portions of Sections 29, 30, 31, and 32, T48N, R6E, New Mexico Principal Meridian. 112 Marshall St., Sargents, CO 81248. Specifically, in the clay-lined and bermed low-grade ore stockpiles situated on the Indian Creek and Tie Camp waste rock-disposal sites and in a storage cell at the toe of the Indian Creek waste rock disposal site; the sediment collection pond and associated embankment; and the water treatment facilities and storage locations on site.

6. Designated Radiation Safety Officer: Randy Whicker

7. Radiation Safety Officer contact number: (970) 556-1174

8. Fee category: 3.Q, 2.C

9. Reference number: SUA-940 (Pinnacle Exploration Company)

Conditions

10. Authorized radioactive material and uses:

A. The licensee is authorized to possess any amount of naturally occurring uranium-series radionuclides, in particular radium-226 in any naturally-occurring form contained in soils, sediments, and water. The licensee is authorized to maintain the sediment collection capabilities and, as required by final project closure, properly dispose of sediment in the sediment collection pond or in an on-site disposal cell.

B. The licensee is authorized to possess, handle, and store natural uranium and radium-226 bound to water treatment absorptive media collected through the Phosphate Injection System, Engineered Treatment Cell, or Phosphate Residuals Management System as described in the license amendment request dated April 30, 2019; the correspondence dated May 20 and 26, 2019; and in the modification requests dated January 22, 2020 and July 22, 2020; not to exceed either:

i. 0.14 Ci (5.2 GBq) total activity or 116,000 pCi (4.3 kBq) of natural uranium per gram of media; or
ii. 0.1 Ci (3.7 GBq) total activity or 6,300 pCi (0.23 KBq) of radium-226 per gram of media.

The total volume of such water treatment wastes stored at any one time on site shall not exceed 11,000 cubic feet. Final disposition of such wastes shall be conducted in accordance with Item 15.C.

11. Authorized radioactive material users:

A. Radioactive material shall be handled by the Radiation Safety Officer (RSO), or by individuals, including contract workers, who have successfully completed the training course as provided on May 20, 2019, and have been designated as authorized users by the RSO.

B. The licensee shall maintain a list of all individuals currently authorized to use radioactive materials. This list and documentation of each authorized user's training shall be available for review by the department.

C. The licensee shall maintain at least one authorized user, which shall include the RSO, until termination of the license.

D. An authorized user shall be at the facility or immediately available at all times during licensed related activities.

E. Prior to designating an individual as RSO, the licensee shall provide the department with documentation of the individual's training and experience.

F. Refresher training in health physics is required at least every two years for the RSO. The licensee shall maintain documentation of the date and content of the refresher training for review by the department.

12. General requirements:

A. The licensee shall comply with the provisions of the Regulations: Part 1, "General Provisions"; Part 3, "Licensing of Radioactive Material"; Part 4, "Standards for Protection Against Radiation"; Part 10, "Notices, Instructions and Reports to Workers; Inspections"; and Part 17, "Transportation of Radioactive Material".

B. Unless otherwise provided in this license, terms used herein are as defined in the Regulations.

C. The licensee shall not transfer possession and/or control of radioactive materials or items contaminated with radioactive material except: by transfer of waste to an authorized recipient; by transfer to a specifically licensed recipient; or, as provided otherwise by specific condition of this license pursuant to the requirements of Part 3, Section 3.22 of the Regulations.

D. Radioactive material authorized by Item 10 of this license shall be stored and used in a manner that will preclude possession or use by unauthorized personnel.

E. The licensee shall ensure that information listed in this license is correct and accurate. The licensee shall notify the department in writing within 10 days whenever the information contained in Items 1 through 7 above is no longer current or determined to be incorrect.

F. The licensee may transport radioactive material or deliver radioactive material to a carrier for transport in accordance with the provisions of Part 17 of the Regulations and the requirements of U.S. Department of Transportation (49 CFR), except for small quantities used to characterize site materials.

G. Within the scope of applicable statutes and lawful regulations thereunder, the licensee shall operate in full compliance with the requirements of each other division of the department. Violation of such other requirements shall not by itself constitute violation of this license, unless the department makes an independent finding of violation of the Regulations, or a condition of this license.

H. Where statements in referenced documents conflict, the most recent document shall prevail unless the department determines otherwise.

I. The licensee shall not make any false statement, representation, or certification in any application, record, report, plan, or other document regarding radiation levels, tests performed or radiation safety conditions or practices.

J. When required, department “approval”, “authorization”, or “concurrence” shall be obtained in writing from the department, unless otherwise specified.

K. If any part of this license is held invalid, the remainder shall not be affected.

13. Occupational dose monitoring:

A. Dose monitoring and evaluation shall be consistent with Item 14.B.

14. Specific radiation safety requirements:

A. Posting exemption

The licensee is hereby exempted from the requirements of Section 4.28 of the Regulations for areas within any exclusion area boundary, provided all entrances to the property are conspicuously posted with the sign:

"**Any Area or Container on this Property**
May Contain Radioactive Materials."

B. All operations involving the handling or use of radioactive materials authorized in Item 10 or items contaminated with such radioactive material shall be conducted in accordance with the Radiation Protection Program Manual approved by the department; the license amendment request dated April 30, 2019; correspondence dated May 20 and 26, 2019; the modification requests dated January 22, 2020 and July 22, 2020; or a Radiation Work Permit approved by the RSO.

C. Radiation Protection Program Manual

The licensee shall maintain a comprehensive written radiation safety program manual, approved by the department, governing licensed activities. The manual shall contain safety, monitoring, decontamination, and emergency procedures, including:

i. Administrative and operating procedures relating to radiological health and safety;

ii. Instructions and precautions to keep exposures and releases ALARA;

iii. Specific information on analytical equipment, laboratories, and procedures for each aspect of the monitoring program;

iv. All procedures manual revisions shall be submitted to the department for review and approval prior to implementation; and

v. No reduction in monitoring provisions shall be made without department approval.

D. Reports of accidents

i. Immediately upon discovery of any failure, or imminent threat of failure, in any process, diversion, or retention system which results or may result in a release of radioactive material into unrestricted areas, or unexpected contaminants or concentrations exceeding the authorization in Item 10, the licensee shall notify the department by telephone at (303) 877-9757 (24-hour, 7-day emergency number).

ii. The licensee shall document and maintain records for all incidents, accidents, spills, and emergencies. The documentation shall be available for review by the department.

E. Emergency response

The licensee shall use plans approved by the department to respond to emergencies such as radioactive material spills or treatment pond embankment failure. These plans shall include provisions for warning of personnel and for prompt retrieval of radioactive material released to uncontrolled areas.

F. Periodic gamma exposure rate measurements, contamination surveys, and radon monitoring, with frequency determined by the RSO, shall be taken near the treatment facilities and waste storage areas during the period when the water treatment activities authorized in Item 10.B are conducted. Survey records shall be maintained and available for review by the department.

G. Water treatment wastes authorized in Item 10.B shall be periodically characterized for natural uranium, radium-226, and radium-228, and in accordance with the correspondence provided by the licensee on May 20, 2019. The Phosphate Residuals Management System waste collected shall also be characterized for natural uranium, radium-226, and radium-228 at least once at the end of the field season if the system was operated during that season.

H. All personnel and equipment in contact with the licensed material authorized in Item 10.B shall be thoroughly surveyed for contamination before leaving the site. The licensee shall ensure that said personnel or equipment meet department approved unrestricted release criteria for levels of contamination prior being released. Surveys for the release of equipment shall be documented and maintained and available for review by the department.

I. The licensee shall maintain sufficient models and numbers of radiation detection instruments on site during the period when the water treatment activities authorized in Item 10.B are conducted. The licensee shall calibrate all radiation detection instruments at least annually and after repair.

15. Special license requirements:

A. The licensee shall not operate any on-site water treatment plant without department approval through a license amendment.

B. The on-site building used for storage of treatment wastes resulting from the activities authorized in Item 10.B shall be locked at all time when authorized personnel are not present.

C. All wastes or contaminated equipment resulting from the activities authorized in Item 10.B shall be disposed off-site at facilities authorized to accept such material, unless otherwise approved by the department.

D. Financial warranty:

The licensee shall maintain in effect a financial warranty acceptable to the department in accordance with the requirements of Section 3.9.5 of the Regulations:

i. The licensee shall maintain in force a surety pursuant to Part 3 of the Regulations for decommissioning, decontamination, and reclamation of the site; past and present transport routes to the sediment pond; the on-site disposal areas; the radioactivity-laden fraction of pond sediments; and disposal of water treatment wastes and contaminated equipment.

ii. The licensee shall maintain in effect a financial assurance warranty acceptable to the department, specific to the material authorized in Item 10.B, in the amount of $436,000 in 2019 dollars in accordance with the requirements of Section 3.9.5 of the Regulations.

iii. Item 16.F specifies provisions in effect, as provided by the financial warranty for Division of Reclamation, Mining, and Safety Permit M1977-004, totaling $2,263,000.

iv. Department incorporation into this license of the licensee's Financial Warranty for Permit M1977-004 relies on Section 3.9.5.4.5 of the Regulations and the Memorandum of Understanding between the department and the Division of Reclamation, Mining, and Safety of the Department of Natural Resources.

v. Any surety agreement and surety instruments required by this license shall be subject to annual review for adequacy by the department, and such other agencies as the department designates, in accordance with Section 3.9.5.7 of the Regulations. Cost estimates may be adjusted upward or downward as current circumstances (including, but not limited to, inflation, regulations, technology, and work completed) require. The licensee shall provide in writing to the department, no later than June 30th of each calendar year, an annual report demonstrating proof of the value of existing financial warranties and any proposed changes to the financial assurance warranties, including updated Decommissioning Funding Plan.

vi. The license and adequate surety shall remain in effect until final reclamation complies with applicable State and Federal regulations and final action on release is taken by the department as provided by the license and financial assurance agreements between the licensee and the State.

vii. Prior to seeking release of surety pursuant to this license, the licensee shall notify the department of the request for release. The licensee shall also notify the department of any intent to request modification, reduction or release of this surety. Upon determination by the department that reclamation has been performed in compliance with this license, the Regulations, and the State law, the licensee shall be released from the surety requirements.

E. Recordkeeping requirements

i. The results of sampling, analyses, surveys, instrument calibrations, inspections, audits, employee training, as well as any related reviews, investigations and corrective actions shall be documented and stored. The licensee shall maintain adequate safeguards against tampering and loss of records.

ii. All such documentation shall be maintained until disposition is authorized by the department. Personnel exposure records shall be preserved indefinitely.

F. The licensee shall, for the previous year ending December 31st, provide the department by May 31st of each year, a report that (i) states that no activity took place, or describing any activity that took place; (ii) evaluates the occupational and public exposures resulting from the licensed activities of the year; (iii) summarizes the survey or sampling activities; (iv) summarizes any incidents occurred; (v) provides a current storage inventory of the licensed material authorized in Item 10.B on site and the characterization results required in Item 14.G; and (vi) summarizes any water treatment wastes disposed off-site. A copy of the Reclamation Report to the Division of Reclamation, Mining, and Safety within the Colorado Department of Natural Resources shall be provided to the department annually.

G. Remedial action

i. Prior to site closure, to assess radum-226 concentrations in all Radium Treatment Plant (RTP) drainage channels, the licensee shall conduct a soil and sediment sampling program approved by the department. The risk assessment used for the removal of soils at the RTP will form the basis for cleanup levels in the sediment pond.

ii. Sediment pond solids shall be disposed of in place or within the on-site disposal cells in accordance with a design approved by the Division of Reclamation, Mining, and Safety as per Items 16.C and 16.D. If it is deemed viable to dispose of the solids within a disposal cell in the sediment pond area, an engineering design report will be prepared and submitted to the department for approval. Disposal of any soils and sediments containing radium-226 concentrations above applicable standards shall be by a program approved by the department. Any disposal on-site shall require a license amendment analogous to the action authorized by Amendment 08, which was effective August 15, 1994.

iii. These decommissioned areas shall be returned to unrestricted use by decontamination to background radiation and toxic contaminant ranges acceptable to the department, based on statistically defensible tests of contamination with depth, in accordance with applicable State and Federal regulations and policies in effect at the time.

H. Radiation Work Permits (RWPs):

i. The licensee shall have an RWP which establishes and specifies appropriate radiological and safety controls for any work, including maintenance, at any location of the licensed facility or site, which has radiation safety implications and for which no written procedure exists. The RSO shall be familiar with ongoing activities at the site, and make the determination if a RWP is required for a given task. All such RWPs shall be reviewed and approved in writing by the RSO prior to any activity that a RWP governs. All workers who will conduct the task a RWP governs shall be trained with the provisions in the RWP and the training shall be documented. A copy of all RWPs shall be retained for no less than 5 years for inspection by the department.

ii. RWPs are not to be a substitute for written procedures. Should the activities governed under a RWP become routine or frequently performed activities, the licensee shall develop these work permits into written procedures and provide copies to the department for review, approval and incorporation into the license.

I. Change of ownership

i. In furtherance of Section 3.15.2 of the Regulations, the licensee shall provide the department with ninety days advance notification of any proposed change in ownership or control of all properties used or to be used for activities authorized by this license.

ii. The licensee may not transfer ownership or vacate any portion of the licensed site(s) without prior written authorization from the department.

J. Bankruptcy

The licensee shall notify the department, in writing, immediately following the filing of a voluntary or involuntary petition for bankruptcy under any Chapter of Title 11 (Bankruptcy) of the United States Code by or against:

i. The licensee;

ii. An entity [as that term is defined in 11 U.S.C. 101 (14)] controlling the licensee or listing the licensed facility or licensee as property of the estate; or

iii. An affiliate [as that term is defined in 11 U.S.C. 101 (2)] of the licensee.

This notification must indicate the bankruptcy court in which the petition for bankruptcy was filed and the date of the filing of the petition.

16. Licensee commitments and reference documents:

The State of Colorado Rules and Regulations Pertaining to Radiation Control shall govern unless the licensee's statements, representations, and procedures contained in the application and correspondence are more restrictive than the Regulations. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Item 10 of this license in accordance with the statements, representations, and procedures contained in:

A. The license renewal application dated March 13, 2008, March 15, 2013, and March 2018, and the correspondences dated November 13, 2018, and December 14, 2018;

B. The Division of Reclamation, Mining, and Safety permit, including Homestake's original 1977 application to this Division's predecessor the Mined Land Reclamation division (MLRD), as amended by the Homestake letters of January 16, August 31, and October 19, 1984 to MLRD, and as subsequently approved by the MLRD or Division of Reclamation, Mining, and Safety;

C. The letter with attachment of May 3, 1989 from John Hardaway of Homestake to Edd Kray of the department containing revised reclamation and surety commitments;

D. The request for amendment dated May 31, 1994;

E. The letters with attachments dated June 2, 1994, and July 31, 1994, from Luke Russell of the Homestake Mining Company to Bruce Humphries and James Dillie of the Division of Minerals and Geology containing revised reclamation plans;

F. The application for renewal submitted January 8, 1998;

G. The Verification Sampling for Radium Treatment Plant Cleanup of the Pitch Reclamation Project report by Shepherd Miller dated April 2002;

H. The request for amendment dated April 1, 2004;

I. The request for RSO change dated March 28, 2017;

J. The Radiation Protection Program Manual, Pitch Reclamation Project, Revision 2, dated June 7, 2019, or subsequently approved by the department;

K. The license amendment request dated April 30, 2019, and the correspondence dated May 20, 2019, May 26, 2019, and June 11, 2019;

L. The Decommissioning Funding Plan dated May 20, 2019;

M. The modification request dated January 22, 2020; and

N. The license amendment request dated July 22, 2020.

For the Colorado Department of Public Health and Environment

Date: 09/25/2020 By: _____

APPENDIX F

DRMS Inspection Report

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

MINERALS PROGRAM INSPECTION REPORT
PHONE: (303) 866-3567

The Division of Reclamation, Mining and Safety has conducted an inspection of the mining operation noted below. This report documents observations concerning compliance with the terms of the permit and applicable rules and regulations of the Mined Land Reclamation Board.

MINE NAME: Pitch Project	**MINE/PROSPECTING ID#:** M-1977-004	**MINERAL:** Uranium	**COUNTY:** Saguache
INSPECTION TYPE: Monitoring	**INSPECTOR(S):** Dustin Czapla	**INSP. DATE:** October 22, 2020	**INSP. TIME:** 09:00
OPERATOR: Homestake Mining Company	**OPERATOR REPRESENTATIVE:** David Wykoff	**TYPE OF OPERATION:** 112d-3 - Designated Mining Operation	

REASON FOR INSPECTION: Normal I&E Program	**BOND CALCULATION TYPE:**	**BOND AMOUNT:** $24,451,940.00
DATE OF COMPLAINT: NA	**POST INSP. CONTACTS:** None	**JOINT INSP. AGENCY:** None
WEATHER: Clear	**INSPECTOR'S SIGNATURE:** 	**SIGNATURE DATE:** November 16, 2020

GENERAL INSPECTION TOPICS

This list identifies the environmental and permit parameters inspected and gives a categorical evaluation of each. No problems or possible violations were noted during the inspection. The mine operation was found to be in full compliance with Mineral Rules and Regulations of the Colorado Mined Land Reclamation Board for the Extraction of Construction Materials and/or for Hard Rock, Metal and Designated Mining Operations. Any person engaged in any mining operation shall notify the office of any failure or imminent failure, as soon as reasonably practicable after such person has knowledge of such condition or of any impoundment, embankment, or slope that poses a reasonable potential for danger to any persons or property or to the environment; or any environmental protection facility designed to contain or control chemicals or waste which are acid or toxic-forming, as identified in the permit.

(AR) RECORDS---------- Y	**(FN) FINANCIAL WARRANTY-------- N**	**(RD) ROADS---------- Y**
(HB) HYDROLOGIC BALANCE---------- N	**(BG) BACKFILL & GRADING---------- Y**	**(EX) EXPLOSIVES--------- N**
(PW) PROCESSING WASTE/TAILING---- N	**(SF) PROCESSING FACILITIES------- N**	**(TS) TOPSOIL---------- N**
(MP) GENL MINE PLAN COMPLIANCE- Y	**(FW) FISH & WILDLIFE---------- N**	**(RV) REVEGETATION---- N**
(SM) SIGNS AND MARKERS---------- Y	**(SP) STORM WATER MGT PLAN---- N**	**(RS) RECL PLAN/COMP-- Y**
(ES) OVERBURDEN/DEV. WASTE--------- N	**(SC) EROSION/SEDIMENTATION--- Y**	**(ST) STIPULATIONS------- N**
(AT) ACID OR TOXIC MATERIALS------- N	**(OD) OFF-SITE DAMAGE----------N**	

Y = Inspected / N = Not inspected / NA = Not applicable to this operation / PB = Problem cited / PV = Possible violation cited

OBSERVATIONS

This inspection was conducted as part of the Division of Reclamation, Mining and Safety's (Division) normal monitoring program. David Wykoff, representing the Operator, was present. Photographs are included with this report in order to illustrate some of the conditions observed**.**

The mine is located approximately six miles east of Sargents in Saguache County and accessed from Marshall Pass Road. The site is a 112d operation that includes a total of 3,003.4 permitted acres. The Division currently holds a financial warranty amount of $24,451,940.00 for this site.

Adequate mine identification signage was noted at the entrance to the site.

South Pit: Stabilization work on the South Pit Landslide Crest Mitigation Area has taken place this season. Grading work was nearly complete at the time of this inspection. The East Diversion ditch has been reestablished. The work observed appears to be in accordance with the approved reclamation plan.

Sediment Pond: Reclamation work at the Sediment Pond has occurred this season, including replacement of the valves and riser, and installation of a clay liner on the face of the dam. The work observed appears to be in accordance with the approved reclamation plan.

No problems or violations were noted during this inspection.

Responses to this inspection report should be directed to Dustin Czapla at the Division of Reclamation, Mining and Safety, 1313 Sherman Street Room 215, Denver, Colorado, 80203, phone number (303) 866-3567, ext. 8188.

Inspection Contact Address

David Wykoff
Homestake Mining Company
P.O. Box 40
Sargents, CO 81248

APPENDIX G

Letter Of Surety,

Permit M-1977-004

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

Effective January 9, 2020 this bond replaces Safeco Insurance Company Bond No. 6068126.

FINANCIAL WARRANTY
CORPORATE SURETY

Operator: Homestake Mining Company
Operation: Pitch Mine
Permit No.: M-1977-004 Bond No.: 070206093

Warrantor: Liberty Mutual Insurance Company
Street: 175 Berkeley Street
City: Boston
State: MA Zip Code: 02116
Area Code: 617-357-9500 Telephone: 617-574-5955

This form has been approved by the Mined Land Reclamation Board pursuant to sections 34-32-117, C.R.S., of the Mined Land Reclamation Act and 34-32.5-117, C.R.S., of the Colorado Land Reclamation Act for the Extraction of Construction Materials. Any alteration or modification of this form, without approval by the Board shall result in the financial warranty being invalid and result in the voiding of any permit issued in conjunction with such invalid financial warranty and subject the operator to cease and desist orders and civil penalties for operating without a permit pursuant to sections 34-32-123, C.R.S., of the Mined Land Reclamation Act and 34-32.5-123, C.R.S., of the Colorado Land Reclamation Act for the Extraction of Construction Materials

KNOW ALL MEN BY THESE PRESENTS, THAT:

WHEREAS, the Colorado Mined Land Reclamation Act, C.R.S. 1973, 34-32-101 et seq. (the "Act"), as amended, provides that no permit may be issued under the Act until the Mined Land Reclamation Board (the "Board") receives a Financial Warranty (or Warranties) as described in the Act.

WHEREAS, Homestake Mining Company (the "Operator"), a California corporation, has applied for a permit to conduct a mining operation known as Pitch Mine (the "Operation"), on certain lands in Saguache County, Colorado. These lands are described in the permit application, as amended and supplemented, and are referred to herein as the "Affected Lands".

WHEREAS, in the application for the permit, the Operator has agreed to be bound by all requirements of the Act and all applicable rules and regulations of the Board, as amended from time to time.

WHEREAS, in the application for the permit, the Operator has agreed with the Board to provide for reclamation of the Affected Lands that are now, or may become, subject to the permit, as required by law.

WHEREAS, the Operator and Liberty Mutual Insurance Company (the "Warrantor"), a corporation organized and existing under the laws of the State of Massachusetts and duly authorized to transact a bonding and surety business in the State of Colorado are hereby and firmly bound unto the State in the sum of Twenty Four Million Four Hundred Fifty One Thousand Nine Hundred Forty & No/100 Dollars ($24,451,940.00) for the life of mine or until such time as replacement is received, for the payment of which sum, well and truly made, we hereby bind ourselves and our personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Board has determined, in accordance with the Act, that the estimated costs of reclamation of the Affected Lands are those amounts for the stated periods of time as set forth herein. Said amount may be amended from time to time to reflect revised estimates of said costs of reclamation.

WHEREAS, the Operator and the Warrantor, in accordance with the Act, has promised and hereby promises the Board that it will be responsible for all the estimated costs of reclamation with regard to the Affected Lands.

WHEREAS, the Board has determined that this Financial Warranty by the Warrantor equals the estimated costs of reclamation, as approved by the Board, with regard to the Affected Lands.

NOW, THEREFORE, the Operator and the Warrantor are held hereby firmly unto the State of Colorado in the amount of those sums for those periods of time as set forth herein, until this Financial Warranty is amended or released in accordance with applicable law.

The Board may, for good cause shown, increase or decrease the amount and duration of this Financial Warranty. The Operator shall have sixty (60) days after the date of notice of any such adjustment to increase the surety amount, but no such increase shall bind the Warrantor unless and until it shall have consented thereto in writing by the issuance of an additional Financial Warranty or by an endorsement to this Financial Warranty.

The Operator and the Warrantor shall notify the Board immediately of any event which may impair this Financial Warranty. If the Board receives such notice, or otherwise has reason to believe that this Financial Warranty has been materially impaired, it may convene a hearing in accordance with the Act for the purpose of determining whether impairment has occurred.

The obligation of the Operator and the Warrantor shall continue until the Board has released this Financial Warranty or has ordered it forfeited in accordance with applicable provisions of the Act. It is understood that periods of years may necessarily be required before determination can be made that reclamation of the Affected Lands has been satisfactorily completed. It is also recognized that, as reclamation is accomplished, the amount of this Financial Warranty may be reduced with the approval of the Board so that it reflects the then current estimated cost of the remaining reclamation of the Affected Lands. No revision, extension, or renewal of the permit, or of the time allowed to complete reclamation, shall diminish the Operator's or Warrantor's obligation under this Financial Warranty. No misrepresentation by the Operator which may have induced the Warrantor to execute this Financial Warranty shall be any defense to demand by the State under this agreement.

In any single year during the life of the permit, the amount of the Financial Warranty shall not exceed the estimated cost of fully reclaiming all lands to be affected in said year, plus all lands affected in previous permit years and not yet fully reclaimed. Reclamation costs shall be computed with reference to current reclamation costs.

The amount of this Financial Warranty is based upon estimates as to the cost of reclamation, and does not operate to liquidate, limit, enlarge or restrict the Operator's obligations to complete reclamation and to comply in all respects with the permit and with applicable laws and regulations governing reclamation, even though the actual cost thereof may substantially exceed the amount of this Financial Warranty.

The Mined Land Reclamation Board or the Office of Mined Land Reclamation may recover the necessary costs, including attorney's fees or fees incurred in foreclosing on or realizing the collateral used in the event this Financial Warranty is forfeited. The face amount of this Financial Warranty shall be increased by five hundred dollars ($500.00) to cover these costs.

The Warrantor shall not be liable under this Financial Warranty for an amount greater than the sum designated herein, unless increased by a later amendment to this Financial Warranty. This Financial Warranty shall be reviewed by the Board from time to time, and the Board may require an increase in the principal sum of this Financial Warranty (and a corresponding increase in the surety amount) to cover increases in the estimated costs of reclamation, but no such increase shall bind the Warrantor unless and until it shall have consented thereto in writing by the issuance of an additional Financial Warranty or by an endorsement to this Financial Warranty.

The Warrantor reserves the right to cancel this Financial Warranty, effective only upon an anniversary date, and only by giving written notice to that effect, mailed by Certified Mail, at least ninety (90) days prior to such anniversary date, addressed to both the Operator at its address herein stated, and to the Board at the address herein stated. In the event of such cancellation, this Financial Warranty shall nevertheless remain in full force and effect as respects the reclamation of all areas disturbed prior to the effective date of such cancellation, unless and until the Operator shall file a substitute Financial Warranty which: (1) assumes liability for all reclamation obligations which shall have arisen at any time while this Financial Warranty is in force; and (2) is accepted in writing by the Board.

In the event of such cancellation, if the Financial Warranty is not fully released, the amount of the continuing Financial Warranty available for the reclamation of areas disturbed and unreclaimed at the date of cancellation shall be fixed by the Board at the amount it determines necessary to complete such reclamation (which amount may not exceed the sum designated herein) and the Board shall concurrently identify such areas in writing, and notify the Warrantor and the Operator thereof. Thereafter, the obligation of the Warrantor shall be limited to reclamation of the areas so identified.

The consideration for the Warrantor's execution of this agreement is the promise of the Operator to pay the premiums, but failure by the Operator to pay such premiums shall not invalidate or diminish the Warrantor's obligation hereunder.

The Board may make demand upon the Warrantor for payment hereunder if the Board determines that reclamation which ought to have been performed by the Operator, or its successors or assigns, remains unperformed, and if Financial Warranty forfeiture procedures required by law have been initiated. No other condition precedent need be fulfilled to entitle the State to receive the amount so demanded. However, if, upon completion of reclamation by the State, the amounts expended for reclamation shall be less than the amount received from the Warrantor, the excess shall be promptly refunded to the Warrantor.

If demand is made upon the Warrantor for payment of an amount due to the Board hereunder, and if the Warrantor fails to make payment of such amount within ninety (90) days after the date of receipt of such demand, or if it should thereafter be determined, by agreement of the Warrantor or by final judgment of court, that the amount demanded was properly payable, the Warrantor agrees to pay to the Board, in addition to the amount demanded, interest at the

current published Wall Street Journal Prime Rate for the period commencing at the end of such ninety-day period and ending on the date of actual payment.

If the Board shall notify the Warrantor that the Operator is in default, and if the Board shall initiate any Financial Warranty forfeiture procedures required by law or regulation, the Warrantor may, in lieu of making payment to the Board of the amount due hereunder, cause the reclamation to be timely performed in accordance with all requirements of the Act and all applicable rules and regulations. In such event, when and if the reclamation has been timely performed to the satisfaction of the Board or Division, this Financial Warranty shall be released. If the reclamation shall not be so performed to the satisfaction of the Board or Division, this Financial Warranty shall remain in full force and effect.

This Financial Warranty shall be subject to forfeiture whenever the Board determines that any one or more of the following circumstances exist:

1. A Cease and Desist Order entered pursuant to Section 34-32-124 of the Act has been violated, and the corrective action proposed in such Order has not been completed, although ample time to have done so has elapsed; or

2. The Operator is in default under its Performance Warranty, and such default has not been cured, although written notice and ample time to cure such default has been given; or

3. The Operator and/or the Warrantor has failed to maintain its Financial Warranty in good standing as required by the Act; or

4. The Warrantor no longer has the financial ability to carry out its obligations in accordance with the Act.

The description of lands herein is for convenience of reference only, and no error in such description, nor any revision of the permitted mining area, nor the disturbance by the Operator of lands outside of the permitted mining area shall alter or diminish the obligations of the Operator and/or Warrantor hereunder, which shall extend to the reclamation of all such lands disturbed.

If this Financial Warranty applies to National Forest System lands, and if this Financial Warranty is accepted by the United States Forest Service ("U.S.F.S.") as the bond required under 36 C.F.R. 228.13, then the Operator, having requested that the Board and the U.S.F.S. accept this single Financial Warranty in lieu of the separate bonds which would otherwise be required by applicable law, hereby agrees that, notwithstanding any other provision hereof, or of law, this Financial Warranty shall remain in full force and effect until U.S.F.S. has advised the Board by written notice that the Operator's obligations to U.S.F.S., for which this Warranty is executed, have been satisfied, and until the financial warranty has been released by the Board.

If this Financial Warranty applies to lands under the jurisdiction of the State Board of Land Commissioners ("Land Board"), and if this Financial Warranty, in whole or in part, is accepted by the Land Board as the bond required under its applicable law and procedures, then the Operator, having requested that the State accept this Financial Warranty in lieu of the separate bonds which would otherwise be required by the Colorado Mined Land Reclamation Board or Division of Reclamation, Mining and Safety and by the Land Board, hereby agrees that, notwithstanding any other provision hereof, or of law, this Financial Warranty shall remain in full force and effect until the Board is notified in writing by the Land Board that the Operator's obligations to the Land Board, for which this Warranty is executed, have been satisfied, and until the financial warranty has been released by the Board.

If all or any part of the Affected Lands are under the jurisdiction of the Bureau of Land Management, United States Department of the Interior (the "BLM"), and if, at the request of the Operator on this Financial Warranty, the BLM has, pursuant to 43 C.F.R. 3809.1-9, accepted this Financial Warranty in lieu of requiring a separate reclamation bond

payable to the United States, then, notwithstanding any other provision of this Financial Warranty, or of law, the Operator and Warrantor hereby agree that this Financial Warranty shall not be released until the Board is advised in writing by the BLM that the Operator's obligations to the BLM, for which this Warranty is executed, have been satisfied, and until the financial warranty has been released by the Board.

This Financial Warranty may be executed in multiple copies, each of which shall be treated as an original, but together they constitute only one agreement, the validity and interpretation of which shall be governed by the laws of the State of Colorado.

The provisions hereof shall bind and inure to the benefit of the parties hereto and their successors and assigns.

SIGNED, SEALED AND DATED this 9th day of January, 2020.

Liberty Mutual Insurance Company (SEAL)
Warrantor

By: Sandra L Ham
Sandra L. Ham, Attorney-In-Fact

Homestake Mining Company (SEAL)
Operator

By:

NOTARIZATION OF WARRANTOR'S ACKNOWLEDGEMENT

STATE OF Missouri)
) ss.
COUNTY OF St. Louis City)

The foregoing instrument was acknowledged before me this 9th day of January, 2020,
by Sandra L. Ham as Attorney-In-Fact of Liberty Mutual Insurance Company.

LEAH L JUENG
Notary Public, Notary Seal
State of Missouri
St. Louis City
Commission # 17302084
My Commission Expires 09-05-2021

NOTARY PUBLIC

My Commission expires: 09/05/2021

NOTARIZATION OF OPERATOR'S ACKNOWLEDGEMENT

PROVINCE
STATE OF ONTARIO)
CITY) ss.
COUNTY OF TORONTO)

The foregoing instrument was acknowledged before me this 14th day of January, 2020 by Leo van Wyk as Treasurer of Homestake Mining Company.

NOTARY PUBLIC

My Commission expires: never

APPROVED:

State of Colorado
Mined Land Reclamation Board
Division of Reclamation, Mining and Safety

By: _____ Date: _____
Division Director

M \mln\share\bondforms\Corporate Surety REVISED 25Jul2016

Liberty Mutual SURETY

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: 8201331

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Sandra L Ham all of the city of St. Louis, state of Missouri each individually if there be more than one named, its true and lawful attorney-in-fact, with full power and authority hereby conferred to sign, execute and acknowledge the above-referenced surety bond.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 30th day of May, 2019.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

STATE OF PENNSYLVANIA ss
COUNTY OF MONTGOMERY

On this 30th day of May, 2019, before me personally appeared David M Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at King of Prussia, Pennsylvania, on the day and year first above written.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Teresa Pastella, Notary Public
Upper Merion Twp., Montgomery County
My Commission Expires March 28, 2021
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII - Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-infact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, of Liberty Mutual Insurance Company, The Ohio Casualty Insurance Company, and West American Insurance Company do hereby certify that this power of attorney executed by said Companies is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 9th day of January, 2020.

By: _____
Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00am and 4:30pm EST on any business day.

APPENDIX H

Site Photograph Log

APPENDIX I - SITE PHOTOGRAPH LOG

Pitch Reclamation Project
Sargents, CO

	**Photograph: 1** **Description:** Drone photograph of Pitch Mine Site, facing north **Location:** Site **Date:** 4/18/2020
	**Photograph: 2** **Description:** UW injection system **Location:** UW Conex **Date:** 8/8/2020

	**Photograph: 3** **Description:** IRD injection system conex **Location:** IRD **Date:** 6/20/2020
	**Photograph: 4** **Description:** PMD satellite dosing conex **Location:** PMD **Date:** 5/18/2020

	**Photograph: 5** **Description:** TRM location with tree hazard removed throughout beaver pond area **Location:** TRM **Date:** 5/21/2020
	**Photograph: 6** **Description:** 2019 BCR testing **Location:** ETC **Date:** 6/23/2020

	**Photograph: 7** **Description:** ETC3 and post treatment tanks **Location:** ETC **Date:** 8/13/2020
	**Photograph: 8** **Description:** North Pit diversion channel with GSL line installed **Location:** North Pit **Date:** 7/8/2020

Photograph: 9

Description:

North Pit diversion channel with GSL line installed

Location:

North Pit

Date: 7/8/2020

Photograph: 10

Description:

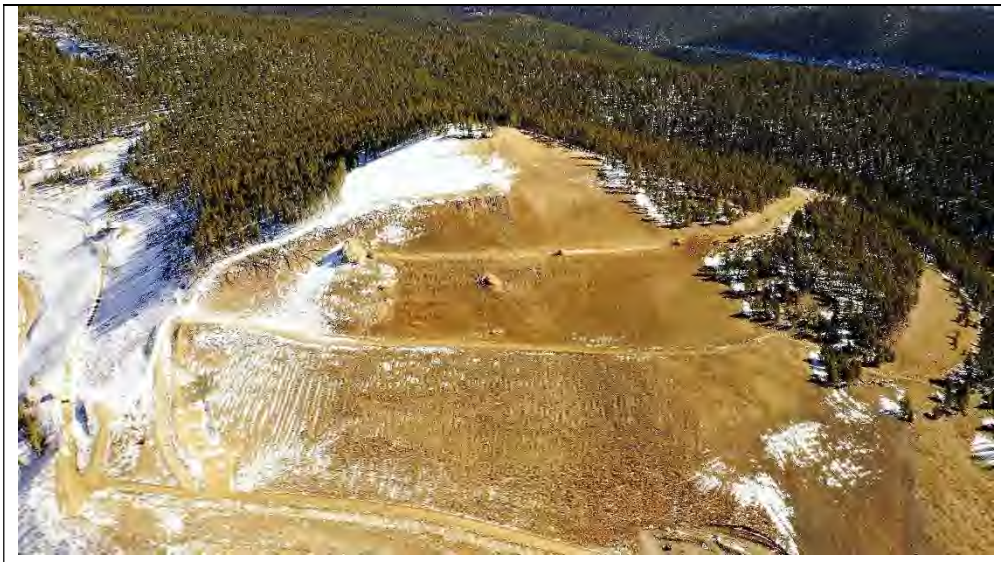
North Pit diversion channel and improved road

Location:

North Pit

Date: 8/6/2020

	**Photograph: 11** **Description:** South Pit reclamation work **Location:** South Pit **Date:** 9/20/2020
	**Photograph: 12** **Description:** South Pit reclamation work **Location:** South Pit **Date:** 9/16/2020

	**Photograph: 13** **Description:** Aerial view of South Pit finished slope **Location:** South Pit **Date:** 12/18/2020
	**Photograph: 14** **Description:** Sediment Pond drained, prior to embankment work **Location:** Sediment Pond **Date:** 8/18/2020

	**Photograph: 15** **Description:** Sediment Pond with GSL installed **Location:** Sediment Pond **Date:** 8/18/2020
	**Photograph: 16** **Description:** Placement of GSL liner and sericite on embankment of Sediment Pond **Location:** Sediment Pond **Date:** 8/26/2020

	**Photograph: 17** **Description:** Sediment Pond embankment closeup, after completion **Location:** Sediment Pond **Date:** 8/26/2020
	**Photograph: 18** **Description:** Finished Sediment Pond with new riser and silt curtain **Location:** Sediment Pond **Date:** 10/30/2020

	**Photograph: 19** **Description:** Constructed marsh area below NPL **Location:** Indian drainage **Date:** 10/30/2020
	**Photograph: 20** **Description:** Piezometer installation near Indian drainage, IC10000 **Location:** Indian drainage **Date:** 7/30/2020

	**Photograph: 21** **Description:** Piezometer installation near Indian drainage, IC9995 **Location:** Indian drainage **Date:** 7/30/2020
	**Photograph: 22** **Description:** Piezometer installation for TC10105 **Location:** Tie Camp drainage **Date:** 7/30/2020

Photograph: 23

Description:

East wall of the North Pit Lake

Location:

North Pit

Date: 6/29/2020

Photograph: 24

Description:

Tie Camp Rock Dump showing repairs done in 2012 are continuing to function

Location:

Tie Camp

Date: 5/27/2020

	**Photograph: 25** **Description:** Tie Camp disposal cell **Location:** Tie Camp **Date:** 5/27/2020
	**Photograph: 26** **Description:** Indian Rock Dump showing repairs made in 2012 are continuing to function **Location:** Indian Rock Dump **Date:** 5/27/2020