

# San Francisco Bay Conservation and Development Commission

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**TO:** Engineering Criteria Review Board (ECRB) Members

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**SUBJECT: Cargill’s Solar Sea Salt System Maintenance and Operations Project, Newark, Alameda County**  
(For Board consideration on November 16, 2022)

## Project Summary

### Project Name

Cargill’s Solar Sea Salt System Maintenance and Operations Project (BCDC Permit Application No. 2021.003.00)

### Project Representatives

Connie Lee, Senior Land Management Engineer, Cargill, Inc.

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### Project Components under Review

Berms at Cargill – Newark Plant 2, Ponds P2-12 and P2-13



## **Project Description**

On April 28, 2021, Cargill, Inc. submitted an application to the Commission for the “Solar Sea Salt System Maintenance and Operations Project” (O&M Project), BCDC Permit Application No. 2021.003.00, to continue maintenance and operational activities at Cargill’s solar salt facilities located in Newark, Fremont and Redwood City over a ten-year authorization period. This application coincided with the release for public comment of a California Environmental Quality Act (CEQA)-compliant draft Environmental Assessment, which had been under development since December 2018. The Environmental Assessment, for which BCDC is the CEQA lead agency, has not yet been finalized or certified.

The objectives of Cargill’s O&M Project include: 1) continuing to conduct various activities necessary to maintain the integrity and stability of earthen berms, water control structures, and other infrastructure to ensure continued viability of salt production activities; 2) allowing for implementation of preliminary sea level rise adaptation efforts; 3) developing and implementing alternative maintenance methods that may reduce the effects of maintenance activities on the environment, improve efficiency, and/or adapt to changing climate conditions; and 4) making discrete improvements, including making more berms all-weather (drivable) to reduce the amount of maintenance done using water-based equipment.

While the O&M Project would include a wide range of activities throughout the approximately 12,100-acre project site, the Board’s review of the O&M Project will focus specifically on the earthen berms surrounding Ponds P2-12 and P2-13 at Cargill’s Plant 2, which currently store approximately 4 to 6 million tons of Mixed Sea Salt (MSS). MSS is a layered solid matrix, with some entrained liquid bittern, comprised of precipitated salts generated during Cargill’s commercial production of NaCl and liquid bittern (concentrated MgCl<sub>2</sub> brine). More information about MSS and its relevance to the proposed O&M Project is found in the section titled “Mixed Sea Salts (MSS)” below.

## **Project Site History and Existing Conditions**

According to Section 1 of the ECRB information package included with this report and titled “Cargill Solar Sea Salt System Maintenance & Operations Project, BCDC Engineering Criteria Review Board, Presentation Package, September 2022” (Package), solar salt production in the South San Francisco Bay once involved a large network of independent solar salt producers. These operations were consolidated and integrated over time. Since 1978, Cargill has been the sole operator of these historic salt manufacturing facilities. Over the last 40 years, Cargill has reduced the footprint of its operations by 60% and transferred significant portions of its facilities (approximately 40,000 acres) to wildlife agencies and organizations for restoration and conservation.

Cargill’s current salt pond operations encompass an approximately 12,100-acre-area (Project Site) in the cities of Newark and Fremont (Alameda County), and Redwood City (San Mateo County). The Project Site is composed of the following: the three primary production plants (Newark Plant 1, Newark Plant 2, and the Redwood City Plant); Baumberg Ponds B-3C; and the

Cargill West Bay areas (brine pipeline alignment, including the Transbay section of the pipeline, and the Redwood City Maintenance Pond SF-2 Donut). Of the 12,100 acres, Cargill currently owns approximately 4,100 acres in fee title and has operating rights on approximately 8,000 acres within the Don Edwards National Wildlife Refuge (lands that Cargill transferred to the United States Fish and Wildlife Service (USFWS) for conservation purposes). In general, Cargill operates the solar salt system in the same manner as it was operated historically. The Newark Plants 1 and 2 (Figure 1-1, Figure 1-1a, 1-1b, and 1-1c of the Package) are constructed on Pescadero clay. According to Section 2.2 of the Package, both Reyes clay and Pescadero clay are very deep and poorly or very poorly drained soils that formed on basin rims in alluvium that derived from sedimentary rock.

Cargill's solar salt system is separated from the Bay, streams, and flood control channels by a system of approximately 123 linear miles of earthen berms, of which approximately 62 miles are "outboard" berms abutting the Bay, sloughs, and tidal marsh habitats. According to Cargill, these earthen berms were first constructed at various times and by various salt production companies between the 1860s and the 1950s. They were constructed of mostly native materials and completed prior to the development of modern civil engineering standards.

The portion of the O&M project subject to the Board's review relates specifically to Ponds P2-12 and P2-13 at Newark Plant 2, which store the MSS material. As shown in Figures 1-1b and 1-2 of the Package, Pond P2-12 is approximately 250 acres in size, bound by a berm of approximately 19,000 linear feet. Pond P2-13 is approximately 400 acres in size, bound by a berm of approximately 23,000 linear feet. The outboard berms are adjacent to either tidal sloughs (Newark Slough, Plummer Creek) or tidal marsh within San Francisco Bay. Based on aerial imagery identified by BCDC staff, most of the P2-12 and P2-13 berms were originally built sometime between approximately 1946 and 1956.

### **Mixed Sea Salts (MSS)**

According to Cargill, Ponds P2-12 and P2-13, store between 4 to 6 million tons of MSS. As described in Section 4.1 of the Package, MSS is generated during the commercial production of NaCl and liquid bittern (concentrated  $MgCl_2$  brine). Over 90% of the salt in Bay water is regularly recovered by Cargill as products. Other salts contained in sea water that are not recovered as products eventually precipitate during the production of liquid bittern in down-stream bittern ponds (P2-12 and P2-13). Cargill has experimented with and investigated product lines using the MSS, but only the liquid bittern (magnesium chloride brine) has proven to be commercially viable.

According to Cargill, MSS solids contain approximately 8% water and 92% dry salts, compared to liquid bittern brines (66% water and 34% dry salts) and Bay water (97% water and 3% dry salts). As a result, the material in the ponds is primarily a solid matrix, 4-5 feet thick, with approximately 20% entrained brine. After a rain event or when new liquid bittern is added to the ponds (before the salts precipitate out), there can be some liquid on top of the solid salts. According to Cargill, Ponds P2-12 and P2-13 have over two feet of freeboard that could accommodate several decades of additional MSS inventory or an influx of Bay or flood waters (this information was provided separately by Cargill and not substantiated in the Package).

Included as Appendix B to the Package is a “Final Sea Level Rise Assessment” for the Cargill site (SLR Assessment), dated April 27, 2021, and prepared by AECOM. According to the SLR Assessment, Ponds P2-12 and P-13 were identified as one of the highest risk assets at the Cargill site and a priority concern, because they have the highest salinity concentrations and are located directly adjacent to tidal marsh and tidal slough habitats of the Bay. Additionally, the SLR Assessment identified the removal of the MSS from P2-12 and P2-13 as a high priority action to reduce potential sea level rise vulnerability and ecological risk. More information about the SLR Assessment is provided in the section titled “Sea Level Rise” below.

As stated, the outboard berms that separate Ponds P2-12 and P2-13 from the Bay were originally constructed between approximately 1946 and 1956 , prior to modern engineering standards. Cargill has noted that to date there are no formal civil engineering standards in place for berms being maintained for solar sea salt production, either from the American National Standards Institute (ANSI) or the American Society of Civil Engineers (ASCE) or similar organizations. Since their construction, the berms have continued to be repaired and maintained, including extensive berm core compaction on a majority of the berms around these ponds and raising of P2-13 up to three feet above the original elevation in 1985 (see PRA 1986). Further information is provided in the section titled “Potential for Groundwater Seepage and Associated Berm Core Compaction Work” below.

Given the historic nature of the construction of these berms, the extent of geotechnical information and site-specific analysis provided by Cargill, and the ecological risk associated with potential release of the MSS material contained within P2-12 and P2-13, BCDC staff requests the ECRB’s input as to the current seismic stability of the P2-12 and P2-13 berms and how Cargill’s proposed maintenance activities may affect the berms’ integrity. Furthermore, given the information in the SLR Assessment identifying these ponds as a priority concern (as described further under the section entitled “Sea Level Rise” below), BCDC staff further requests the ECRB’s input as to how the risk of future overtopping due to sea level rise and storms could also affect the berms’ integrity.

It is important to note that, separate from the proposed O&M Project, Cargill is currently planning a project to remove the great majority of MSS material from P2-12 and P2-13, as part of the near-term and mid-term (10-30 year) adaptation planning efforts for the Project Site. If approved, the “Cargill Mixed Sea Salt Processing and Brine Discharge Project” (MSS Project) would involve constructing pipelines and associated infrastructure to harvest additional product value commercial salts from P2-12 and P2-13, dissolve residual solid MSS, and pump the dissolved MSS to the East Bay Discharger’s Authority (EBDA) effluent conveyance system for eventual dilution and safe discharge into the Bay. Cargill estimates that upon full entitlement of the MSS project, MSS removal from P2-12 and P2-13 would begin within the next three years, with the existing 4 to 6 million tons of MSS fully processed by approximately 2040. This would

significantly reduce the risks associated with a potential release of MSS. However, Cargill has indicated verbally that a residual layer (a few inches) of MSS would remain in the ponds after the initial MSS Project, as Cargill plans to continue producing and storing small amounts of the MSS material, and discharging the material for the foreseeable future.

The MSS project is currently in pre-application status (for the BCDC permit) and undergoing CEQA review, with EBDA as the lead agency.

### **Board Meeting Purpose**

As summarized by a California court, the McAteer-Petris Act “was intended to prevent further piecemeal filling of the Bay (§ 66601), and pursuant to that goal section 66605 sets out limitations of new fill. Further filling is to be authorized only when its public benefits clearly outweigh its harm, and is additionally limited to three types of uses: water-oriented uses, minor fill for improving shoreline appearance and minor fill for improving public access.” *Mein v. San Francisco Bay Conservation etc. Com.*, 218 Cal.App.3d 727, 732 (1990). Furthermore, the McAteer-Petris Act section 66605(e) specifies that “public health, safety, and welfare require that fill be constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters.”

The berms that define Cargill’s salt ponds and other salt making infrastructure were initially constructed prior to BCDC’s existence, but Cargill has periodically undertaken certain “fill” activities to maintain these berms and, upon BCDC’s creation, began seeking permits to authorize those activities. These maintenance activities include replacing fill and, occasionally, adding new fill, on top of or within the historically-existing berms. Cargill is currently seeking to renew its current permit and authorizations for such maintenance activities for another ten years.

Cargill has provided a Package which presents the solar sea salt system history, berm maintenance methods and equipment, sea level rise assessment, and geotechnical engineering elements and methods for addressing potential risk events. BCDC staff are requesting the ECRB to review these materials, focusing on the salt pond berms surrounding P2-12 and P2-13, to assess whether these berms can, structurally and seismically speaking, safely continue to serve their intended purpose and accommodate the berm maintenance activities proposed in Cargill’s permit application, in light of existing conditions and expected changes in the environment due to sea level rise.

More specifically, BCDC staff requests that the Board review the content provided and advise on the following:

1. Is there sufficient data and history to assess the functionality and stability of the P2-12 and P2-13 berms during seismic events, while providing resilience to natural wave action, and what level of seismic performance would you recommend in light of current and future sea level rise conditions?

2. Is additional assessment of the structural adequacy and integrity of the P2-12 and P2-13 berms, such as site-specific analyses, needed to assess seismic performance in the berms' current condition, as well as their ability to support future berm maintenance activities, including any berm raising to address subsidence and sea level rise?
3. Does the Board have any guidance on appropriate engineering criteria for earthen berms, accounting for the possibility and opportunity for these ponds to one day be restored to Bay habitat (although Cargill has not proposed such restoration at this time)?
4. Are the current emergency contingency plan measures sufficient to prevent and respond to a potential breach of the P2-12 and P2-13 berms, in the event of an overtopping or seismic event that could result in a release of MSS into the Bay? If not, what additional measures would the Board recommend?
5. Does the Board have any other concerns regarding safety that have not been addressed?

All questions raised above should be evaluated in context of Cargill's stated intent to continue using Ponds P2-12 and P2-13 even after full implementation of the MSS Project, but accounting for the significantly reduced amount of hypersaline solid bittern material that will remain at any given time during the operation of P2-12 and P2-13 in the foreseeable future.

### **Existing BCDC Approvals**

BCDC Permit No. 1993.004.20 (issued on March 14, 1995, as amended through December 31, 2022), authorizes Cargill to conduct ongoing operations and maintenance activities at its system of solar salt ponds in Alameda and San Mateo Counties. The full list of authorized activities is broad in scope, but the authorizations most relevant to the project portion subject to the Board's review include:

- Section I.A.2.a, "Maintain in a serviceable condition the salt pond levees<sup>1</sup> owned or controlled by the permittee by the placement of native material taken from inside salt ponds or imported material in the minimum amount necessary to repair or protect levees."
- Section I.A.2.e, "Dispose salt pond dredged material along the inside and top of salt pond levees to maintain levee configuration"; and
- Section I.A.1.d, "Place riprap in the minimum amount necessary to protect existing levees".

The existing BCDC Permit No. 1993.004.20 requires Cargill to submit annual work plans for review and approval by BCDC's staff engineer prior to commencing work each year, and to submit annual work completion reports summarizing each year's completed activities. The last substantive amendment to the permit was made on August 10, 2005 (Amendment No. Five).

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<sup>1</sup> The "levees" described in Permit 1993.004.20 refer to the same structures as the "berms" described in this staff report.

Since then, the permit has gone through 15 time extensions, without changes to the authorizations and conditions. The BCDC permit for the ten-year O&M Project (BCDC Permit Application No. 2021.003.00), if authorized, would replace Permit No. 1993.004.20 with an updated set of authorizations and conditions to reflect BCDC's current policies.

### **Phasing and Construction Timeline**

The O&M Project is currently in the application phase. A draft Environmental Assessment under CEQA was released to the public for comment in April of 2021, but it has not been finalized or certified. The Commission staff and Cargill are currently working on gathering additional information and responding to public comments/issues raised. The project will need to go before the Commission for a public hearing and vote prior to the issuance of any permit. If approved by the Commission, the permit would authorize operations and maintenance activities at the Cargill facilities for a ten-year period.

### **Engineering Elements and Analysis**

#### ***Key Topics for Consideration***

Based upon the context provided above, the following key topics for consideration were identified for the Ponds P2-12 and P-13 berms:

- **Slope and seismic stability.** For more information on this topic, see the sections titled "Geotechnical Engineering Elements," "Regional Seismicity," and "Soil Exploration Data and Information" below.
- **Subsidence.** For more information on this topic, see the section titled "Soil Exploration Data and Information" below.
- **Groundwater seepage.** For more information on this topic, see the sections titled "Potential for Groundwater Seepage and Associated Berm Core Compaction Work" and "Berm Maintenance Operations" below.
- **Sea level rise and erosion.** For more information on this topic, see the section titled "Sea Level Rise" below.

Common to all of these topics, if there were to be a breach of the berms, Cargill has also prepared an emergency contingency plan to address minor and major incidents related to problems with the berms. See the section titled "Emergency Contingency Plan" below.

Based upon these key topics of consideration, BCDC staff request that the ECRB recommend engineering criteria, methods, and additional measures of safety as deemed appropriate for the maintenance of berms at P2-12 and P2-13 based on the existing conditions and future uses.

### ***Geotechnical Engineering Elements***

Section 5 of the Package includes geotechnical engineering elements associated with the ongoing and planned maintenance and repair activities for the earthen outboard berms in the Newark and Redwood City. The section provides a narrative of observations of physical berm distress, including during seismic events, resulting from Cargill's continued berm maintenance activities. As such, key observations of geotechnical conditions are as follows:

- Numerous geotechnical investigations have been performed over the past two decades, not only at the Newark Site, but at equivalent salt pond systems around the South San Francisco Bay area. These investigations provide an understanding of the key subsurface conditions in the region, and their implications on berm performance and stability.
- The salt pond berms at Cargill and around South San Francisco Bay have demonstrated long term integrity and stability for over a century and underwent little to no damages observed during the 1989 Loma Prieta earthquake. However, included outside the Package in the references is a statement by Purcell, Rhoades & Associates (PRA 1990), dated July 12, 1990, of an interim preliminary report of a damaged bittern levee after the 1989 earthquake stating that “[t]he failure characteristics of the surface levee appear to have resulted from a ground failure within the Bay Mud which supports the levee material.” PRA further stated that “while the majority of the levee system would be considered stable during an earthquake such as the October 17, 1989 event, there must be some other component not presently considered in the model which resulted in the observed failure of a single portion of the levee...[a]n isolated pocket of loose sand located adjacent to and offshore of the levee would account for such an occurrence.”
- Cargill's maintenance activities, including placement of riprap, are done to the minimum amounts and extents needed to maintain berm protectiveness against ongoing natural erosive forces.
- Seepage of subsurface water through the berms is highly limited by the fact that water head differences and soil permeabilities are low.

Further information on seismic, liquefaction, and slope stability risk and performance description are found in sections 5.2 and 5.3 of the Package, and the slope stability expectations description is found in section 5.4.

### ***Regional Seismicity***

According to Section 2.2 of the Package, Cargill's solar salt systems are also surrounded by fault lines. The Hayward and Calaveras faults run parallel to Cargill's Newark Plants 1 and 2 eastern border and the San Andreas fault runs west and parallel to Cargill's Redwood City Plant; however, no major faults are known to cross the salt ponds or production facilities. The United States Army Corps of Engineers (USACE) has stated that “there have been no known historic records of shoreline berm failures in the Project Area due to earthquakes” (USACE 1988). In addition, Cargill has not recorded any major failures of the salt pond berms over the past 50 years. According to Cargill, the seismic activity associated with the Loma Prieta Earthquake only



resulted in minor cracking and settling of some of the salt pond berms, which were rapidly repaired and restored, and the berms have been observed for decades to demonstrate continued functionality. Cargill states that the riprap remains consistent and continuous to this day with much of the original armoring material still in place or having been replaced as needed.

### ***Soil Explorations Data and Information***

According to the available references, 1986 and 1990, Leslie Salt Co. commissioned analyses of soil explorations by Purcell Rhoades & Associates (PRA) of P2-12 and P2-13. In addition, in 2017, Cargill commissioned an analysis of soil explorations by Berlogar Stevens & Associates (BSA, 2017) of a section of P2-13 (Bittern Pond 13) for the Plummer Creek Bridge project, for which BCDC issued Permit No. M2019.009.00 to construct a 1,464-square-foot bridge. In 2006, State and Federal agencies commissioned a levee assessment report by Geomatrix Consultants (Geomatrix, 2006) as part of the South Bay Salt Pond Restoration project, that included areas of Alviso, Eden Landing and Ravenswood in the South Bay. These reference materials are included separately from the Package for review.

Appendices C1, C2, C3, C4 and C5 of the “Geotechnical Data/Sources” in the Package provide summaries of boring logs for the berms (including cone penetration tests). As such, soil explorations for Cargill’s Plummer Creek Bridge, east end of P2-13, are included in Appendix C2 (BSA, 2016). Borings for Berms P2-12 and P2-13 (BSA, 2018); P2-12 (BSA, 2007); and P2-12 and P2-13 (PRA 1986) are included in Appendix C. For adjacent sites, borings for Eden Landing, north of Plant 1, Alviso and Ravenswood in the South Bay are in Appendix C1 (Geomatrix, 2006); a separate set of borings for Eden Landing is in Appendix C4 (AECOM, 2016, 2019), and for the Coyote Intake at Plant 2 in Appendix C5 (BSA and Schaaf & Wheeler, 2020).

Cargill did not provide soil analyses for the soil explorations referenced above by BSA in 2007 and 2018, however, the boring log data was provided, as referenced above.

### ***Potential for Groundwater Seepage and Associated Berm Core Compaction Work***

Information on the potential for groundwater seepage is found in section 5.5 of the Package whereby Cargill notes that there is no evidence of prolonged seepage of fresh groundwater or saline brine in the form of rills or channels at the base of the berm, and/or undercutting of the berm face from below in a form not attributable to tidal or wave action.

Other references provided by Cargill separate from the Package indicate that in 1986, in response to a Regional Water Quality Control Board’s (RWQCB) order in May 1985, Leslie Salt Co. commissioned Purcell Rhoades & Associates to carry out soil investigations and associated borings at Ponds P2-12 and P2-13. The information is entitled “Report of Levee Integrity Bittern Storage Facilities/San Francisco Bay Area, California for Leslie Salt Co.” dated April 1, 1986 (PRA, 1986). The report indicates that approximately 7,100 feet, or 49%, of the perimeter levee system of Pond P2-12 had been cored for the purpose of repairing any previously detected seepage zones. The levee had been raised in 1959 and spot-repaired in 1984. The same document indicates that due to past seepage of bittern through portions of the levee in Pond

P2-13, 86% (approximately 17,100 feet) of the perimeter levee system had been cored for the same purpose and raised with dredged sediments by up to three feet above the original elevation during the summer of 1985. Previously, this levee had been raised in a similar manner in 1959 and 1977.

As previously mentioned, Leslie Salt Co. commissioned an interim preliminary study of a section of containment berm following the Loma Prieta earthquake (PRA 1990). A statement from PRA regarding the results of this investigation is included in the references.

In the past ten years, Cargill completed approximately four miles of berm core compaction, primarily prioritized around P-12 and P2-13 (see Figure 3-2a through Figure 3-2d of the Package). This berm core compaction involved extracting the existing berm soils and refilling and compacting the trench with imported materials.

### ***Emergency Contingency Plan***

Due to the volume of hypersaline salts adjacent to the Bay in P2-12 and P2-13 and the environmental risk posed, on August 3, 2022, BCDC requested that Cargill provide an emergency contingency plan for a berm breach scenario at P2-12 and P2-13 as part of its current permit application. Flood response planning is also part of the operational recommendations in Cargill's SLR Assessment.

The plan needed to describe Cargill's process for quickly responding to any potential berm breaches at the site. Cargill developed an Emergency Contingency Plan (Plan), which is included in Appendix D of the Package. BCDC staff's greatest concern is that a potential release of the MSS be prevented, and if a release does occur, that Cargill have sufficient response and contingency plans to stop the release, minimize the environmental damage, and restore any impacted areas.

According to the Plan, the salt pond system is comprised of the salt ponds and associated berms, which Cargill inspects visually on a routine basis seven days a week to monitor various aspects of the system. The inspections include annual aerial inspections, weekly pond level measurements, daily rounds to inspect conditions, indications of permeability, post-earthquake inspection (outer berms), and post-wave storm inspection (outer berms). The Plan includes three inspection factors to categorize any repairs as minor, potential, or critical action. Minor and potential repairs could require further evaluation and can occur over time, and, therefore, are considered not urgent. An incident is identified as "critical" when immediate action is required to prevent the situation from becoming worse. Section 4 of the Plan further explains the incident response plan for critical repair issues.

### ***Berm Maintenance Operations***

According to section 2.2 of the Package, the berms are maintained using native materials from borrow ditches adjacent to the inboard toes of the berms or clean imported material. Some of the outboard berm faces are protected against wave erosion by the placement of repurposed concrete (riprap) obtained largely from construction projects within the region or by naturally occurring tidal marsh habitat; however, Cargill reports there has been no need for rip rap to be placed on the outboard side of the berms of Pond P2-12 and P2-13 to date. The berms were built for the exclusive purpose of producing salt in shallow ponds and not for flood control purposes, although they provide some ancillary and unintended flood control benefits.

In addition, the description in section 3 of the Package indicates that Cargill's maintenance and operation of the berms includes a regular program of inspections, resurfacing of the berm top surface, replacing internal fill where necessary (berm core compaction), and adding, replacing, or rearranging protective riprap berm armoring where wind-derived waves and currents have caused localized erosion. Maintenance of berms occurs on an as-needed basis and predominantly involves placement of material (soil and riprap) on the top and side slopes of berms to restore and repair areas that are showing signs of wind or wave erosion which may occur on both internal berms and outboard berms. This is accomplished predominantly using landside equipment and clean imported material (soil and riprap) from off-site sources or from borrow ditches inside the ponds. Grading and weed management are also part of routine berm maintenance. An ongoing goal is to make any non-drivable berms drivable to facilitate more land-based maintenance work and reduce the need to breach the locks within some berms to provide access for water-based equipment to reach internal berms.

More information about berm maintenance is provided in section 3 of the Package.

### **Sea Level Rise**

On April 27, 2021, Cargill completed the above-referenced SLR Assessment of its Newark and Redwood City solar salt production facilities, which assesses potential impacts of sea level rise and identifies proactive measures to enhance the resilience of Cargill's facilities, such as raising berms. It is important to note that the SLR Assessment did not address the geotechnical stability of the berms in relation to sea level rise and overtopping. The SLR Assessment identified Ponds P2-12 and P2-13 as the highest-risk assets of the berm system, mainly due to their locations directly adjacent to the Bay and the high concentration of salts in these ponds.

The SLR Assessment identified the key vulnerabilities of the salt making system and is organized by Cargill plant and potential sea level rise scenario (i.e., timing of first exposure). The assessment applied the "likely range" (66% probability) and high emissions planning scenario SLR projections for analyzing overtopping and flooding potential for +6 inches (2030) and +12 inches (2050) of sea level rise, based on the State of California Sea-Level Rise Guidance 2018 Update by the California Ocean Protection Council (OPC Guidance), which provides guidance on how to select SLR projections based on risk aversion, adaptability, and consequence of flooding. This assessment also analyzed higher sea level rise projections but did not connect these to a specific time horizon. Cargill identified external assets exposed to temporary flooding by a 100-year storm tide as the priorities for adaptation in the near future.

Appendix A of the SLR Assessment includes maps displaying expected water levels at Ponds P2-12 and P2-13 and throughout the Cargill site for multiple storm and sea level rise scenarios. Ponds P2-12 and P2-13 are shown on Map Indices N1 and N2. The maps show expected overtopping for existing conditions under the 50-year and 100-year storm tides, along with future sea level rise of 6, 12, 24, 36, and 83". According to the maps of existing conditions, the berms isolate the salt ponds from the Bay during normal daily tides, but there are locations along P2-12 that would be subject to overtopping during extreme storm tides (100-year storm).

According to the maps, with 6 inches of sea level rise, large sections of P2-12, and small sections of P2-13, would be overtopped by a 100-year storm tide under a no-action scenario. With future sea level rise up to 36", the P2-12 and P2-13 berms would not be inundated by daily high tides but would increasingly experience overtopping during extreme storm conditions. At 83" of sea level rise, the berms would be overtopped during daily high tide action, if no actions were taken to raise the berms.

Cargill's SLR Assessment identified the MSS Ponds P2-12 and P2-13 as the highest-risk assets due to their role in enabling salt production operations, protecting other Cargill assets, and preventing mixing of concentrated brine with Bay waters. BCDC typically recommends that permit applicants consider the "1-in-200 chance" (0.5% probability, medium-high risk aversion scenario) and high emissions sea level rise projections for adaptation planning when there is sensitive infrastructure involved or limited adaptive capacity. The sea level rise projections associated with the medium-high risk aversion and high emissions planning scenario consist of sea level rise of 10 inches by 2030 and 23 inches by 2050.

The SLR Assessment includes a phased approach to adaptation planning to maintain sea level rise resilience of Cargill's facilities with a suite of physical and non-physical adaptation strategies for near-term (0-10 years), mid-term (10-30 years), and long-term (30+ years) planning horizons. The near-term approach includes targeted maintenance and raising of outboard berm segments based on identified risks, proactive initiation of the MSS Removal project, and continued refinement of operational plans among other tasks. The mid-term actions (10-30 years) include: continued maintenance and raising of outboard berm segments based on identified risk, retrofitting of critical assets located outside of the external berms (such as pumps and Bay water intakes), and completion of the MSS Project. The identified long-term actions (30+ years) include continued monitoring of sea level rise and risks of storm-tide impacts to external berms and assets, and exploring options to reduce operating footprint or decommission solar salt systems in the long-term future based on a continually improving understanding of the risks.

As part of the near-term actions, in the permit application and draft Environmental Assessment for the O&M Project, Cargill has indicated that they plan to raise certain berms up to 12 inches over the next ten years to address subsidence and the risk of overtopping. This is not explicitly described in the Package, and Cargill has not specified the exact locations throughout the Cargill site where berm raising would occur.

### **Seismic Instrumentation Plan**

Currently, Cargill has no plans to incorporate seismic instrumentation, as pursuant to the Safety of Fills Policy No. 3., into the existing berms as part of the O&M Project.

### **Staff Questions to the Board**

BCDC staff has concerns about the potential risk of a berm breach of the P2-12 and P2-13 berms in the event of an earthquake and/or flood overtopping, because the berms were not constructed to modern engineering and seismic standards, and they are considered the highest-risk assets at the Cargill site.

Staff requests that the Board review the content provided and advise on the following (these questions are identical to those posed in the section titled “Board Meeting Purpose” above):

1. Is there sufficient data and history to assess the functionality and stability of the P2-12 and P2-13 berms during seismic events, while providing resilience to natural wave action, and what level of seismic performance would you recommend in light of current and future sea level rise conditions?
2. Is additional assessment of the structural adequacy and integrity of the P2-12 and P2-13 berms, such as site-specific analyses, needed to assess seismic performance in the berms’ current condition, as well as their ability to support future berm maintenance activities, including any berm raising to address subsidence and sea level rise?
3. Does the Board have any guidance on appropriate engineering criteria/standards for earthen berms, accounting for the possibility and opportunity for these ponds to one day be restored to Bay habitat (although Cargill has not proposed such restoration at this time)?
4. Are the current emergency contingency plan measures sufficient to prevent and respond to a potential breach of the P2-12 and P2-13 berms, in the event of an overtopping or seismic event that could result in a release of MSS into the Bay? If not, what additional measures would the Board recommend?
5. Does the Board have any other concerns regarding safety that have not been addressed?

All questions raised above should be evaluated in context of Cargill’s stated intent to continue using Ponds P2-12 and P2-13 even after full implementation of the MSS Project, but accounting for the significantly reduced amount of hypersaline solid bittern material that will remain at any given time during the operation of P2-12 and P2-13 in the foreseeable future.

#### Relevant Commission Policies

##### **McAteer-Petris Act Government Code 66605(e)**

Section 66605(e) of the McAteer-Petris Act requires that fill be constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters. Given the broad scope of section 66605(e), BCDC interprets “property” to include the Baylands which front onto the outward-facing berms of ponds P2-12 and P2-13 and are held in trust by the State for the benefit of the public.

##### **Bay Plan Policies**

The project raises issues related to Bay Plan policies on topics including Safety of Fills and Climate Change. While not being directly applied to this project, the Shoreline Protection Policies (which derive their authority from Section 66605 of the McAteer-Petris Act) may be also be informative in guiding the Board’s consideration of the issues presented.

The following policies are relevant for the Board's review:

***Safety of Fills***

The policies on the Safety of Fills seek to reduce risk of life and damage to property for projects that require construction on fill in San Francisco Bay. The following policies may directly apply or provide informative guidance to the Board's consideration of the project:

1. The Commission has appointed the Engineering Criteria Review Board consisting of geologists, civil engineers specializing in geotechnical and coastal engineering, structural engineers, and architects competent to and adequately empowered to: (a) establish and revise safety criteria for Bay fills and structures thereon; (b) review all except minor projects for the adequacy of their specific safety provisions, and make recommendations concerning these provisions; (c) prescribe an inspection system to assure placement and maintenance of fill according to approved designs; ... and (f) gather, and make available performance data developed from specific projects. These activities would complement the functions of local building departments and local planning departments, none of which are presently staffed to provide soils inspections.
2. Even if the Bay Plan indicates that a fill may be permissible, no fill or building should be constructed if hazards cannot be overcome adequately for the intended use in accordance with the criteria prescribed by the Engineering Criteria Review Board.
3. To provide vitally needed information on the effects of earthquakes on all kinds of soils, installation of strong-motion seismographs should be required on all future major landfills. In addition, the Commission encourages installation of strong-motion seismographs in other developments on problem soils, and in other areas recommended by the U.S. Geological Survey, for purposes of data comparison and evaluation.
4. Adequate measures should be provided to prevent damage from sea level rise and storm activity that may occur on fill or near the shoreline over the expected life of a project. The Commission may approve fill that is needed to provide flood protection for existing projects and uses. New projects on fill or near the shoreline should either,
  - be set back from the edge of the shore so that the project will not be subject to dynamic wave energy,
  - be built so the bottom floor level of structures will be above a 100-year flood elevation that takes future sea level rise into account for the expected life of the project,
  - be specifically designed to tolerate periodic flooding, or
  - employ other effective means of addressing the impacts of future sea level rise and storm activity.

Rights-of-way for levees or other structures protecting inland areas from tidal flooding should be sufficiently wide on the upland side to allow for future levee widening to support additional levee height so that no fill for levee widening is placed in the Bay.

### ***Shoreline Protection***

The Bay Plan polices on Shoreline Protection provide guidance on the design and construction of shoreline protection projects along the Bay and the establishment of a permanent shoreline.

As previously stated, the Shoreline Protection Policies are not being directly applied to this project, though the underlying policy considerations of the Shoreline Protection Policies (which ultimately derive their authority from Section 66605 of the McAteer-Petris Act) may be also be informative in guiding the Board's consideration of the issues presented.<sup>2</sup>

1. New shoreline protection projects and the maintenance or reconstruction of existing projects and uses should be authorized if: (a) the project is necessary to provide flood or erosion protection for (i) existing development, use or infrastructure, or (ii) proposed development, use or infrastructure that is consistent with other Bay Plan policies; (b) the type of the protective structure is appropriate for the project site, the uses to be protected, and the causes and conditions of erosion and flooding at the site; (c) the project is properly engineered to provide erosion control and flood protection for the expected life of the project based on a 100-year flood event that takes future sea level rise into account; (d) the project is properly designed and constructed to prevent significant impediments to physical and visual public access; (e) the protection is integrated with current or planned adjacent shoreline protection measures; and (f) adverse impacts to adjacent or nearby areas, such as increased flooding or accelerated erosion, are avoided or minimized. If such impacts cannot be avoided or minimized, measures to compensate should be required. Professionals knowledgeable of the

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<sup>2</sup> The reason that BCDC staff does not intend to directly apply the Shoreline Protection Policies to this project is because Ponds P2-12 and P2-13 and their attendant berms should not be considered "shoreline," which connotes a fixed shore or upland landward of the "shoreline." (Reference also section 66605(f) of the McAteer-Petris Act, which states that: "fill should be authorized when the filling would, to the maximum extent feasible, establish a ***permanent shoreline***" (emphasis added).) Rather, Ponds P2-12 and P2-13 and their attendant berms should be understood as former Bay which has been diked off for the purpose of solar evaporation of Bay water in the course of salt production (i.e., "salt ponds"). (Reference section 66610(c) of the McAteer-Petris Act.) As has occurred at other former salt ponds throughout the Bay, a distinct possibility and opportunity exists to potentially one day restore the Cargill salt ponds (including Ponds P2-12 and P2-13) to a more natural habitat. Although Cargill has not made any such proposal at this time, the point is that direct and strict application of the Shoreline Protection Policies to the current project may be inimical to potential future restoration of this site if and when Cargill decides to cease saltmaking production at this site (including Ponds P2-12 and P2-13) by resulting in unnecessarily hardened shoreline armoring (which may be impractical, ecologically-destructive, or cost-prohibitive to then remove at a later time). Furthermore, salt ponds are a distinctly regulated feature under the McAteer-Petris Act. Still, while not directly applicable here, the underlying policy objectives of the Shoreline Protection Policies may be informative in guiding the Board's consideration of the issues presented here, accounting for the nature of the saltponds (as explained above), site conditions, and known, anticipated, and possible future uses of the site.

Commission's concerns, such as civil engineers experienced in coastal processes, should participate in the design.

2. Equitable and culturally-relevant community outreach and engagement should be conducted to meaningfully involve nearby communities for all shoreline protection project planning and design processes – other than maintenance and in-kind repairs to existing protection structures or small shoreline protection projects – in order to supplement technical analysis with local expertise and traditional knowledge and reduce unintended consequences. In particular, vulnerable, disadvantaged, and/or underrepresented communities should be involved. If such previous outreach and engagement did not occur, further outreach and engagement should be conducted prior to Commission action.
3. Riprap revetments, the most common shoreline protective structure, should be constructed of properly sized and placed material that meet sound engineering criteria for durability, density, and porosity. Armor materials used in the revetment should be placed according to accepted engineering practice, and be free of extraneous material, such as debris and reinforcing steel. Generally, only engineered quarry stone or concrete pieces that have either been specially cast, are free of extraneous materials from demolition debris, and are carefully selected for size, density, and durability will meet these requirements
4. Authorized protective projects should be regularly maintained according to a long-term maintenance program to assure that the shoreline will be protected from tidal erosion and flooding and that the effects of the shoreline protection project on natural resources during the life of the project will be the minimum necessary.
5. All shoreline protection projects should evaluate the use of natural and nature-based features such as marsh vegetation, levees with transitional ecotone habitat, mudflats, beaches, and oyster reefs, and should incorporate these features to the greatest extent practicable. Ecosystem benefits, including habitat and water quality improvement, should be considered in determining the amount of fill necessary for the project purpose. Suitability and sustainability of proposed shoreline protection and restoration strategies at the project site should be determined using the best available science on shoreline adaptation and restoration. Airports may be exempt from incorporating natural and nature-based features that could endanger public safety by attracting potentially hazardous wildlife.
6. Adverse impacts to natural resources and public access from new shoreline protection should be avoided. When feasible, shoreline protection projects should include components to retain safe and convenient water access, for activities such as fishing, swimming, and boating, especially in communities lacking such access. Where significant impacts cannot be avoided, mitigation or alternative public access should be provided. Shoreline protection projects that include natural and nature-based features may be self-mitigating or require less mitigation than projects that do not include any natural or nature-based features.



7. The Commission should encourage pilot and demonstration projects to research and demonstrate the benefits of incorporating natural and nature-based techniques in San Francisco Bay.
8. All contamination remediation projects in the Bay or along the Bay shoreline should integrate the best available science on sea level rise, storm surge, and associated groundwater level changes into the project design in order to protect human and ecological health by preventing the mobilization of contaminants into the environment and preventing harm to the surrounding communities.

### ***Climate Change***

The Bay Plan includes the following Climate Change policies relevant to the proposed project:

1. When planning shoreline areas or designing larger shoreline projects, a risk assessment should be prepared by a qualified engineer and should be based on the estimated 100-year flood elevation that takes into account the best estimates of future sea level rise and current flood protection and planned flood protection that will be funded and constructed when needed to provide protection for the proposed project or shoreline area. A range of sea level rise projections for mid-century and end of century based on the best scientific data available should be used in the risk assessment. Inundation maps used for the risk assessment should be prepared under the direction of a qualified engineer. The risk assessment should identify all types of potential flooding, degrees of uncertainty, consequences of defense failure, and risks to existing habitat from proposed flood protection devices.
2. To protect public safety and ecosystem services, within areas that a risk assessment determines are vulnerable to future shoreline flooding that threatens public safety, all projects—other than repairs of existing facilities, small projects that do not increase risks to public safety, interim projects and infill projects within existing urbanized areas—should be designed to be resilient to a mid-century sea level rise projection. If it is likely the project will remain in place longer than mid-century, an adaptive management plan should be developed to address the long-term impacts that will arise based on a risk assessment using the best available science-based projection for sea level rise at the end of the century.

### **References Enclosed with this Staff Report for the November 16, 2022, ECRB Meeting:**

1. Cargill Solar Sea Salt System Maintenance & Operations Project, BCDC Engineering Criteria Review Board, Presentation Package, September 2022.
2. Geomatrix Consultants, Levee Assessment Submitted to California State Coastal Conservancy, U.S. Fish & Wildlife Service and California Department of Fish and Game, October 2006.
3. Design Level Geotechnical Investigation Proposed Haul Road by BP13 and Plummer Creek Bridge Cargill Facility -7220 Central Avenue, Newark, California for Cargill, Inc., A/c Mr. Jared Frey, Carlson, Barbee& Gibson, Inc., April 11, 2017.

4. Purcell, Rhoades & Associates, Report of Levee Integrity Bittern Storage Facilities, San Francisco Bay Area, California, for Leslie Salt Co., April 1, 1986.
5. Purcell, Rhoades & Associates, Memo to Leslie Salt: Interim Preliminary Report - Damaged Bittern Levee, 295 Seaport Boulevard, Redwood City, California, July 12, 1990.
6. Phase 2 Eden Landing Draft Environmental Statement/Report, April 2018,  
<https://www.southbayrestoration.org/document/phase-2-eden-landing-draft-environmental-impact-statementreport>