O‘AHU SUBSEA CABLE TELECOMMUNICATIONS PROJECT
MANAGEMENT PLAN

PREPARED FOR:

Humuhumu Services, LLC and Starfish Infrastructure, Inc.

PREPARED BY:

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1.0 Introduction

Humuhumu Services, LLC and Starfish Infrastructure, Inc. (Applicants) are requesting a non-exclusive easement and immediate construction right-of-entry for the purpose of constructing a new telecommunication facility on State submerged lands. The Project is proposed within the Resource Subzone of the State Conservation District and is an identified land use pursuant to Hawaiʻi Administrative Rules (HAR), §13-5-22, P-14 TELECOMMUNICATIONS (D-1) *New telecommunications facility*. Proposed uses identified as P-14 TELECOMMUNICATIONS (D-1) *New telecommunications facility* require that a Management Plan be approved simultaneously with the Conservation District Use Permit (CDUP). This Management Plan was prepared to support the Conservation District Use Application (CDUA) in accordance with the content requirements outlined in HAR § 13-5, Exhibit 3.

2.0 Proposed Use

Project infrastructure proposed on State submerged lands would occupy an estimated 35,488 square feet. This includes the area needed for the installation of:

- Six landing pipes utilizing horizontal directional drilling (HDD) methods between the shoreline and exit points on State submerged lands, and
- Three subsea cables that would be laid on the seafloor between the seaward limit of State of Hawaiʻi marine waters and the end of the landing pipe and then each cable would be pulled though a landing pipe to connect to a beach manhole onshore.

3.0 Project Location

The proposed use of State submerged lands is located seaward of Barbers Point Beach Park (Tax Map Key [TMK] [1] 9-1-026:027), ʻEwa District, Island of Oʻahu, Hawaiʻi. An overview of proposed locations for landing pipes and subsea cable installation on State submerged lands is included as **Figure 1** and an HDD Plan and Profile Drawing for the six landing pipes is included as **Figure 2**.

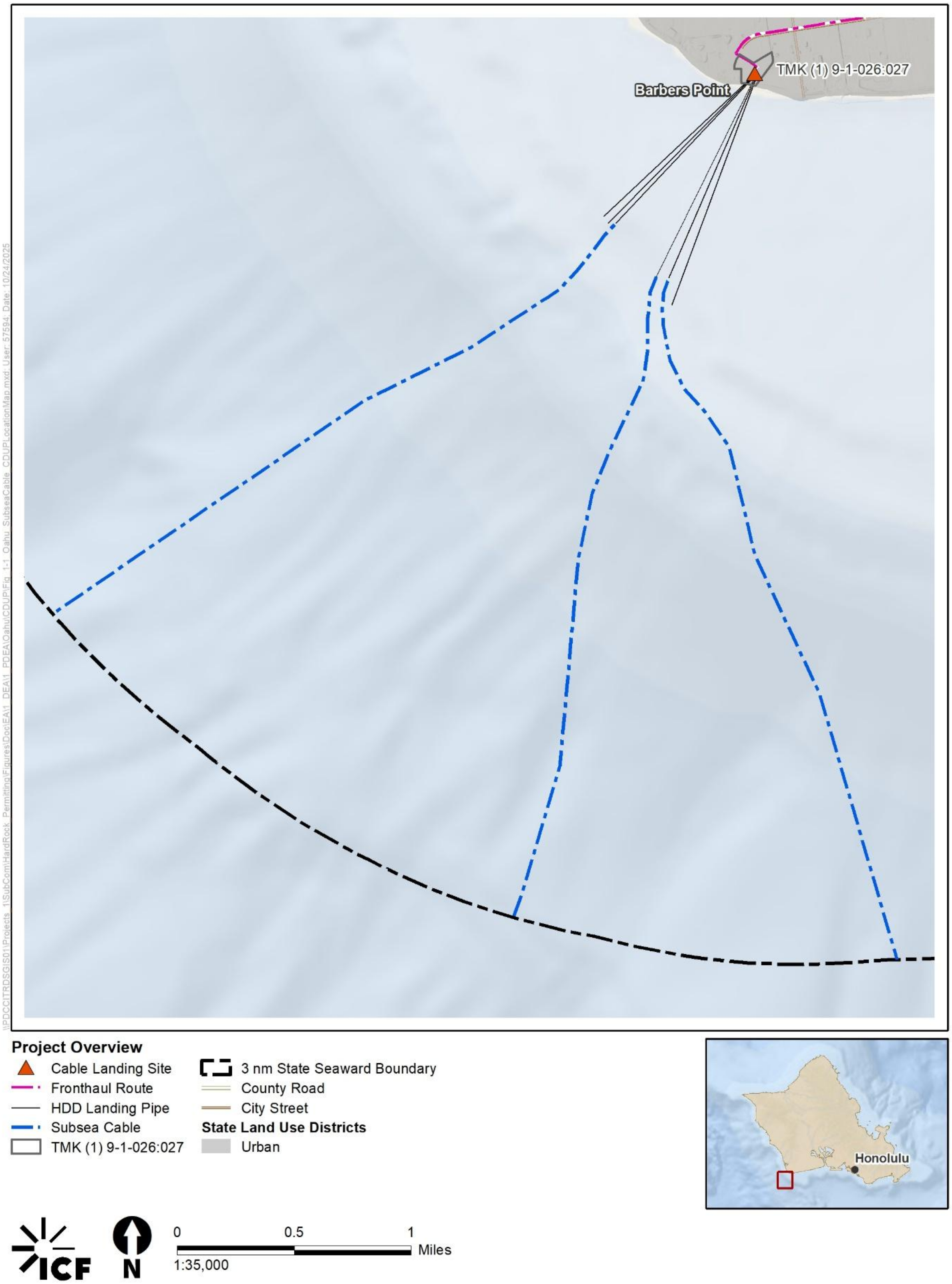

Figure 1. Project Location Map

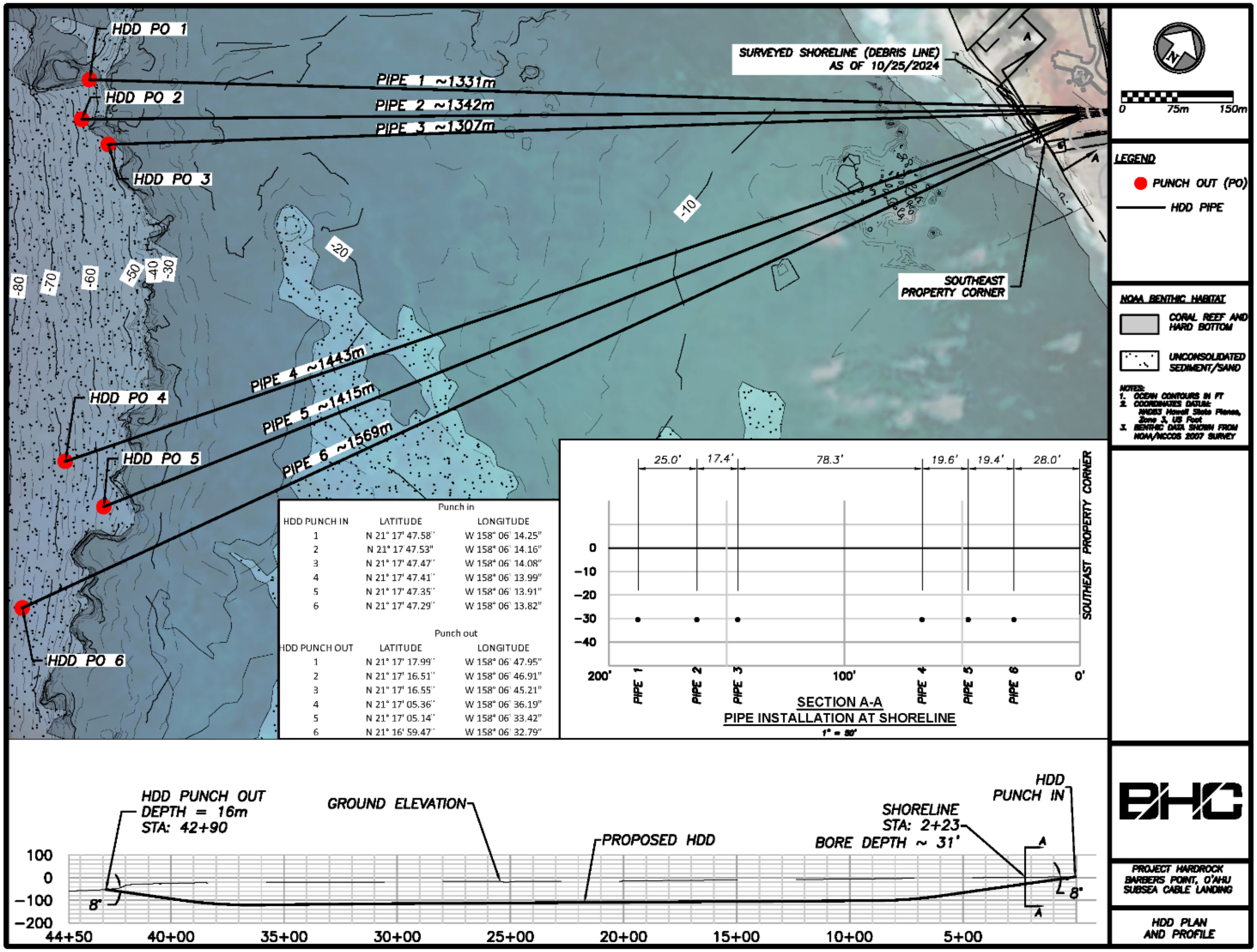

Figure 2. HDD Plan and Profile Drawing

4.0 Natural Resource Assessment

Nearshore and Marine Biological Resources and Habitat

Biological resources occupying State submerged lands and State marine waters within the Conservation District include marine and nearshore habitats, essential fish habitat (for pelagic species, bottomfish and seamount groundfish, crustacean, and coral reef ecosystems), and federal and state threatened or endangered species including six endangered species of whale, five species of threatened or endangered sea turtles, the endangered the Hawaiian monk seal (*Monachus schauinslandi),* the Giant Manta Ray (*Mobula birostris)*, and the Oceanic Whitetip Shark (*Carcharhinus longimanus*).

The nearshore benthic habitat between the shoreline and the proposed HDD exit points consists of alternating areas of flat limestone pavement and sand channels with no dense aggregation of corals. The overall physical structure in the vicinity of the HDD exit points consists of a nearly flat fossil limestone reef surface that terminates in a steep sloping face. The seaward terminus of the sloping reef face consists of a juncture with flat plains consisting of white calcareous sand. Sand plains are populated by patches of seagrass (*Halophila sp.*) interspersed with expanses of *Avrainvillea lacerate*, commonly referred to as “mudweed”.

Dive surveys completed in March 2025 found that three of the six HDD exit points had benthic substrate comprised of uniform beds of sand that avoid coral and seagrass within a 49-foot (15 m) radius of the exit point. Three of the six HDD exit points are located on hard bottom consisting of limestone fossil reef that is colonized by turf algae, macroalgae, and small scattered corals. One of the HDD exit points on hard bottom avoided coral and two of the HDD exit points had small and sparsely distributed coral colonies comprised of cauliflower coral (*Pocillopara meandrina*) and lobe coral (*Porites lobata*) (MRC 2025).

Coastal Scenic and Recreational Resources

The cable landing site for the Project is located at Barbers Point Beach Park (TMK [1] 9-1-026:027). While swimming is typically not recommended due to strong currents, dangerous shorebreak, and the presence of rocks and reef, surfing and day use of the picnic area and recreational fishing from the shoreline is common at the beach park. Existing scenic resources at or near the cable landing site include the shoreline at Barbers Point Beach Park and the Barbers Point Lighthouse, from which there are unobstructed views of the ocean. Because Project infrastructure would be installed below ground and would not alter use of the shoreline or scenic views once installed, no additional management actions to conserve scenic and recreational resources are recommended.

Historic and Cultural Resources

Cable route surveys conducted for the Project did not identify potential submerged cultural resources (i.e., wrecks) within the Project area to the limits of the State of Hawaiʻi marine waters (3 nautical miles from shore). A records search with the Bureau of Ocean Energy Management, the State Historic Preservation Division (SHPD), and SHPD’s Hawaiʻi Cultural Resource Information System (HICRIS) identified three potential submerged resources offshore Barbers Point: the *Arthur*, a British brig belonging to Captain Barber which was reported lost near Barbers Point in 1796; the *Liliu*, a schooner reported lost in 1877; and an “unknown” potential submerged cultural resource identified during the Pearl Harbor Deepwater Maritime Heritage Resources Survey in 2005. The *Arthur*, the *Liliu*, and the unknown potential submerged resource are located at distances of 420 meters, 789 meters, and 1,026 meters from the subsea cable centerline, respectively, and are well outside the Area of Potential Effect (APE) for the Project.

Biocultural resources that were identified seaward of Barbers Point Beach Park (TMK [1] 9-1-026:027) through consultation for the Cultural Impact Assessment and Ka Paʻakai Analysis (Pacific Legacy 2025) include fisheries, *limu*, coral, and marine ecosystems generally.

5.0 Natural Hazard Assessment

The coastal environment at the shoreline and seaward of the cable landing site at Barbers Point Beach Park (TMK [1] 9-1-026:027) is subject to coastal hazards such as flooding, sea level rise, coastal erosion and storm waves arising from hurricanes, tropical storms, or more rarely tsunami. The area immediately makai of the shoreline is located in Flood Zone VE (Coastal High Hazard District) where wave action and fast-moving water can be associated with a base flood event. This same area is also within the 1.1-foot (0.3-meter [m]) future sea level rise scenario as modeled by the Pacific Islands Ocean Observing System (PacIOOS 2018).

Because the Project is a coastal dependent development that must be located near the shoreline to facilitate the landing of subsea telecommunication cables, complete avoidance of coastal hazards is not feasible. However, the landing pipes and subsea cables proposed for installation on State submerged lands within the Conservation District are specifically built for the marine environment and are designed to be resilient to flooding and inundation by sea water. The proposed landing pipes that would house the subsea cables would be directionally drilled at an estimated depth of 31 feet (9.5 m) beneath the shoreline and would not be affected by coastal erosion processes. Because Project infrastructure is designed to be resilient to coastal hazards, no additional management actions in response to natural hazards are recommended.

6.0 Best Management Practices Used During Project Construction and Implementation

The Applicants will comply with the following terms and conditions outlined in the Nationwide Permit verification(s) issued for the Project:

a. Permittee will implement and abide by the best management practices, avoidance, and minimization measures provided with the Nationwide Permit application material, including adherence to an Inadvertent Drilling Fluid Release (IDFR) Contingency Plan (**Attachment 1**).

b. Permittee will implement and abide by the general and activity specific minimization measures in the Standard Local Operating Procedures for Endangered Species in the Central and Western Pacific Region (Pac-SLOPES) and the Essential Fish Habitat Programmatic Agreement between the U.S. Army Corps of Engineers (USACE) and National Marine Fisheries Service (NMFS).

c. Permittee will contact the U.S. Coast Guard (USCG) at least two weeks prior to beginning of in-water landing pipe installation or cable laying to request publication of a Local Notice to

Mariners. USCG may be reached at SecHonoWaterways@uscg.mil and D14-DG-PJdpw@uscg.mil.

d. Permittee will notify NOAA's National Ocean Service (NOS) upon completion of the activities authorized by the Nationwide Permit. Notification of completion must include a drawing which certifies the location and configuration of the completed activity (a certified permit drawing may be used). Notifications must be sent to NOS, either in mailed correspondence to Nautical Data Branch, Office of Coast Survey, N/CS26, 1315 East-West Highway, Silver Spring, MD 20910-3282 or by electronic mail correspondence, with the requisite documents attached, through ocs.ndb@noaa.gov.

e. Permittee will comply with the General Conditions of the Clean Water Act, Section 401 Blanket Water Quality Certification (WQC) WQC1092 issued for the Nationwide Permit by the State of Hawai'i Department of Health, Clean Water Branch.

7.0 Best Management Practices Used During the Lifetime of the Project

Subsea cable repairs are expected to be infrequent but would consist of recovering and splicing damaged cable over the life of the Project, if needed. Such incidents of cable damage are rare, with a likelihood of just one or two incidents in the State of Hawai'i marine waters over the projected 25-year life of the cables. Activities to be undertaken for subsea cable repair would utilize methods and equipment similar to subsea cable installation and the same BMPs implemented during construction would also apply to repair of cables over the life of the Project. Landing pipes are installed with directional boring beneath the seafloor and do not require ongoing maintenance.

8.0 Conservation Methods and Applications to be Used in the Short Term and Long Term

Submerged Cultural Resources

Potential submerged cultural resources have been avoided through project design (i.e., cable routing). Two shipwrecks, the *Arthur* and the *Liliu*, and an unknown potential submerged resource identified through a records search are located at distances of 420 meters, 789 meters, and 1,026 meters from the subsea cable centerline, respectively, and are well outside the Area of Potential Effect for the Project.

Biological and Biocultural Resources in the Marine Environment

Impacts on biological and biocultural resources such as fisheries, *limu*, coral, marine ecosystems, and special status marine species (i.e., threatened or endangered) were minimized through both Project design and implementation of BMPs.

Design elements include:

1. Minimizing impacts to coral and seagrass though use of dive surveys to identify locations for HDD exit points on the seafloor where coral and seagrass cover was absent or sparsely populated, and

2. Minimizing impacts to the seafloor and marine water quality by installing landing pipes with HDD and surface laying subsea cables on the seafloor without trenching or burial.

BMPs incorporated into the Project design include:

1. Implementation of an IDFR Contingency Plan during drilling operations to reduce the potential for an inadvertent release of drilling fluid in marine waters, and
2. Compliance with all the terms and conditions of the USACE Nationwide Permit, including conditions from consultations with NMFS for marine protected species and essential fish habitat, and general conditions of the blanket WQC issued with the NWP to avoid degradation of marine water quality during Project construction.

9.0 Existing Uses and Facilities

The proposed use of State submerged lands and State marine waters extends seaward from the shoreline at Barbers Point Beach Park (TMK [1] 9-1-026:027) to the limits of State marine waters (3 nautical miles from shore). Existing uses within the vicinity of the proposed Project include recreational use of the shoreline at Barbers Point Beach Park, and use of the Barbers Point single point mooring system, ongoing vessel traffic, and ocean recreation and fishing in offshore waters.

10.0 Proposed Uses and Facilities

Project infrastructure proposed on State submerged lands would occupy an estimated 35,488 square feet. This includes the area needed for the installation of:

- Six landing pipes utilizing HDD methods between the shoreline and exit points on State submerged lands, and
- Three subsea cables that would be laid on the seafloor between the seaward limit of State marine waters and the end of the landing pipe and then each cable would be pulled though a landing pipe to connect to a beach manhole onshore.

The proposed use is an identified land use in the Resource Subzone pursuant to HAR 13-5-22, P-14 Telecommunications (D-1) *New telecommunications facility*.

11.0 Activity Schedule

Project Sequencing and Schedule

Landing pipe installation is currently planned to commence as early as the third quarter (Q3) of 2026 with completion in the first quarter (Q1) of 2027. Subsea cable installation would follow installation of the landing pipes, commencing in Q1 2027. Subsea cable installation would require approximately 2 weeks for each of 3 cables (6 weeks total duration). However, each subsea cable would be installed on a separate and distinct installation schedule and could occur over one to two calendar quarters (i.e., Q1 to Q2 2027). Overall, installation of landing pipes and subsea cables are planned for completion within one calendar year from issuance of the CDUP.

Ongoing Maintenance

Once installed, the Applicants would be responsible for the operation and maintenance of the cable system. Given the durability of the system and proven cable installation methods, the need for subsea cable repairs is expected to be infrequent but would consist of recovering and splicing damaged cable. Such incidents of cable damage are rare, with a likelihood of just one or two incidents in the State of Hawaiʻi marine waters over the projected 25-year life of the cables. Landing pipes are installed with directional boring beneath the seafloor and do not require ongoing maintenance.

Natural Resource Monitoring

Natural resource monitoring that will occur during construction includes:

Inadvertent Drilling Fluid Release (IDFR) Monitoring

The monitoring plan to be implemented during HDD operations includes project site monitoring, drilling fluid pressure monitoring, and drilling fluid return monitoring to support early detection and response in the event of an inadvertent release of drilling fluid into the environment. A detailed description of the monitoring plan is included in **Attachment 1, *Inadvertent Drilling Fluid Release Contingency Plan***. The IDFR Contingency Plan also outlines procedures for containment, response, and notification in the event of an inadvertent release of drilling fluid.

Post-Installation Survey at HDD Sites 1 and 2

The Applicants will conduct a single post-installation survey at HDD Sites 1 and 2 (**Figure 2**) to document any unavoidable loss of coral caused by landing pipe installation. Dive surveys to collect photography would utilize a survey methodology comparable to the 2025 surveys conducted to characterize the baseline condition of benthic habitat at the HDD exit points. Post-installation survey results will be documented in a brief memo report that will be provided to the USACE and NMFS. The Applicants will notify USACE and NMFS if the landing pipe installation at HDD Sites 1 and 2 resulted in a loss of corals to reinitiate the consultation. Note that post-installation monitoring is only being conducted at HDD Sites 1 and 2 because coral was not detected within the survey areas for HDD Sites 3 through 6 during pre-construction dive surveys.

Protected Species Monitoring Logs

The Applicants will record all non-take interactions with listed species in monitoring logs that will be provided to USACE and NMFS within 90 calendar days of Project completion, in compliance with the Nationwide Permit. Monitoring logs will include information on total hours and dates of monitoring; identification of ESA species observed and their location; the type of in-water activity that was occurring when the observation occurred; and any additional information on the behavior of ESA-listed species or action(s) taken by the Project to avoid incidental take of listed species.

Annual Report

The estimated duration for installation of the six landing pipes and three subsea cables is up to one year. Based on this, the Applicants expect to prepare one annual report to document construction and monitoring activities completed during the construction period. If the construction duration extends beyond one year, a second annual report will be filed for the second year.

The Annual Report will include the following:

- Status of project construction and estimated or actual date of completion
- Status of compliance with any conditions of the CDUP
- Summary of monitoring activities completed during the reporting period and their outcomes (including results of the post-installation benthic survey)
- While not expected, an Incident Report will be included in the Annual Report in the event of an inadvertent release of drilling fluid during the reporting period
- A copy of the Compliance Certification provided to the USACE upon completion of the in-water activities authorized under the Nationwide Permit, if completed during the reporting period. The notification of completion will include a drawing which certifies the location and configuration of the completed activity (a certified permit drawing may be used).

The Annual Report will be submitted within 15 months of the CDUP issuance date, and again the following year if construction extends beyond one year.

12.0 Other Information or Data

For additional information about the Project, please refer to the Final Environmental Assessment and Finding of No Significant Impact (ICF 2025) enclosed with the CDUA.

13.0 References

ICF. 2025. Oʻahu Subsea Cable Telecommunications Project Final Environmental Assessment and Finding of No Significant Impact. October. Available at: https://files.hawaii.gov/dbedt/erp/Doc_Library/2025-10-08-OA-FEA-Oahu-Subsea-Cable-Telecommunications-Project.pdf

Marine Research Consultants, Inc. (MRC). 2025. *Marine Biota Survey – Subsea Cable Telecommunications Project, Barbers Point, Oʻahu, Hawaiʻi*. May.

Pacific Legacy. 2025. *Cultural Impact Assessment for the Proposed Oʻahu Subsea Cable Telecommunications Project, Honouliuli Ahupuaʻa, ʻEwa Moku, Island of Oʻahu*. Prepared by Jillian A. Swift, Ph.D. and Mara A. Mulrooney, Ph.D. Prepared for ICF International. March.

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Attachment 1

Inadvertent Drilling Fluid Release Contingency Plan

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Project Overview

The Project includes installing multiple steel casings (landing pipes) from points on land to points in the Pacific Ocean that will house the planned subsea fiber optic cables. The landing pipes would be installed by a construction method known as horizontal directional drilling (HDD). HDD allows for a bore machine to be positioned on land, bore down under the beach and surf zone, and exit at a predetermined point in the ocean. The HDD would occupy the bore entry site, drilling steel casings into the ground at an angle of approximately 12 degrees. Once the HDD reaches the desired depth, the direction would level out as the drilling continues to push the landing pipe horizontally through the ground. When the landing pipe reaches the appropriate distance offshore, the drill head would be guided to the ocean bottom at approximately 49 feet (15 m) to 71 feet (22 m) of water depth. After the borehole is completed, the bore assembly consisting of the drill bit and electronics would be removed by divers or the bore pipe would be withdrawn back to the bore site to remove the assembly before reinstalling the landing pipe into the completed borehole. This operation would be repeated for each of the landing pipes. The Project would include the installation of up to six such landing pipes that would be approximately 7 inches (17.8 centimeters [cm]) in diameter and approximately 4,400 to 5,100 feet (1,341 m to 1,555 m) from the shoreline.

Prior to the commencement of the HDD, geotechnical investigations would take place to help identify the types and densities of materials that will be encountered during the HDD process.

The HDD process utilizes an inert, nontoxic mixture of water and bentonite clay. This mixture, known as *drilling mud*, is necessary to facilitate the drilling process. Its characteristics stabilize the borehole, suspend the cuttings so they can be pumped back to the drill site, lubricate the hole, and drive the drill head. Bentonite is a non-toxic, naturally occurring clay commonly used in farming practices; however, if large volumes of bentonite are discharged to waterways, the clay can act like a concentrated silt and cause environmental degradation by smothering benthic invertebrates, aquatic plants, and fish and their eggs.

During boring operations, it is possible that fractures in the underlying rock substrate may potentially result in the inadvertent release of bentonite clay into the environment. This event is described as an Inadvertent Drilling Fluid Release (IDFR) and typically occurs in highly fractured soils or if the bore path is shallow. This plan is intended to prevent such IDFRs or to respond should one occur.

Plan Objectives

The objectives of the IDFR contingency plan are to do the following.

- Minimize the potential for IDFRs.
- Provide the timely detection of any IDFRs that could enter or otherwise compromise or affect any sensitive cultural, environmental, or biological resources, surface facilities, or features.
- Facilitate notification of all appropriate agencies immediately and ensure documentation of any incident.
- Facilitate proper response, containment, and clean-up in the event an IDFR occurs.

Responsibilities

The Contractor's responsibilities for the management of the work include the following.

- Monitor hydraulic pressures during the performance of the work.
- Minimize potential for an IDFR.
- Detect any IDFRs at ground or water surface.
- Contain any IDFRs.
- Clean up any IDFRs.
- Document any IDFR.
- Notify the permitting agencies and stakeholders of any IDFR.

Preconstruction Inadvertent Drilling Fluid Release Prevention

Experienced Crew

IDFR prevention begins well before the mobilization of the drilling equipment to the Project site. To this end, the Contractor will employ skilled, competent workers who are familiar with HDD construction, have performed many crossings of multiple complexities, and are well versed in monitoring for IDFRs and the warning signs that are often a precursor to an IDFR.

Drilling Profile Design

The profile of the drill path will be designed to gain depth as soon as possible and will then maintain a minimum depth of cover below ground or seabed level of greater than 30-feet (9.1 m), though the Contractor is likely to go deeper. Depths beyond 30-feet (9.1 m) reduce the risk of an IDFR reaching ground or water surface.

Casing Pipe at Entry

Prior to construction, a geotechnical investigation will be completed. The resulting report will provide the Contractor the information needed to determine if they need to install a steel casing at the entry points to ensure the borehole stays open and the drilling fluids have a clear path back to the bore site. This casing pipe is usually temporary and is removed after the bored landing pipes are installed. However, there are situations in which it is desirable to leave the surface casing in place.

Drilling Fluid Selection

The drilling fluids will dominantly consist of water and a high yield bentonite clay. It is not anticipated that any other additives will be necessary to safely accomplish this crossing, however if it is determined that some would be beneficial, Material Safety Data Sheets (MSDS) will be submitted prior to their use.

The basic drilling fluid properties of concern include the following.

- Viscosity
- Fluid density
- Sand (solids) content
- Mud weight

Lost Circulation Material (LCM) may be used in case of an IDFR or loss of circulation. LCM products are used to bridge fractured ground and fissures, allowing a foundation for bentonite to form a waterproof filter cake against fracture zones and stop fluid flowing into the frac out zone. Once lodged in the problem voids, LCM will swell up to 200 times its original size, thus bridging the frac out and allowing it to be sealed off with bentonite. LCM can also be spotted into caving zones to prevent collapse. MSDS for LCM will be submitted if needed.

Drilling Exit Point

The exit points of the HDDs have been selected to minimize the length of the landing pipes while also avoiding sensitive biological resources. Further, the ends of the landing pipes need to be in a position where the cable ship can approach to install the subsea fiber optic cable. As the HDD drill bit nears the exit point, the drillers will switch from the use of the bentonite clay to fresh water. This practice will reduce the potential for the silty drilling fluid to be released into the ocean and reduce turbidity upon exit.

Construction IDFR Monitoring

The Contractor will be vigilant during the construction process to reduce the possibility of an IDFR.

Project Site Monitoring

Monitoring the project site provides the primary HDD good practice necessary to minimize the potential of an IDFR. The frequency of monitoring may be increased or decreased depending on the conditions of the work and phase of the work (i.e., increased monitoring during the period of lost circulation or reduced monitoring when HDD activities have been demonstrated to consistently produce anticipated results).

Drilling Fluid Pressure Monitoring

The drilling company will maintain drilling fluid monitoring equipment on site (and crew members who are proficient in their use) to evaluate fluid properties and adjust fluid quality as necessary during drilling operations. Adjustments of the basic drilling fluid properties may be desired in certain circumstances to match actual soil types to achieve a more stable borehole, improve cuttings return, and/or to reduce the IDFR potential during difficult drilling circumstances.

Pump pressures will be monitored continuously with the use of a pressure gauge located on the driller's console. This pressure is commonly referred to as *standpipe pressure* and reflects the pressure through the mud pump(s), surface plumbing, drill pipe, and across the jet nozzle(s) in the bit. These pressures will be logged for each joint drilled, in the drillers log. The amount of standpipe pressure generated is generally determined by how much pressure is required to hydraulically erode the formation using a jetting bottom hole assembly or that is required to turn the rotor section of a mud motor.

Standpipe pressure may increase and decrease depending on the strength of the formation being drilled at any given time, but it is anticipated that mud pressures for the Project would range from 500–700 pounds per square inch (psi).

In addition, the drilling company will employ the use of an annular pressure tool to monitor the annular pressure of the fluid returns while drilling the borehole to mitigate over pressurizing weaker formations, reducing the chances for a frac-out from occurring. Annular pressures of 50–125 psi may be anticipated for this bore, with annular pressures expected to increase gradually as the length of the drill increases.

Drilling Fluid Returns Monitoring

Good HDD practices dictate monitoring fluid returns during the progression of work. In many cases, the loss of or sudden changes in fluid returns provide an early indication that down-hole conditions may be susceptible to the occurrence of an IDFR. Fluid returns are monitored on a continuous, or near continuous, basis.

Plugging of the borehole annulus or the presence of a major formation fracture can lead to partial or full loss of drilling fluid circulation. It is possible to monitor fluid loss by watching for significant differences or sudden changes between the fluid rate being pumped downhole and the rate of returns flowing into the surface containment pits. The presence of back pressure in the drill pipe when unscrewing from the down-hole work string is also a warning of a plugged annulus, which could increase the possibility of an IDFR.

In accordance with this plan, the drilling company will monitor the drilling fluid pump rate, the solids control tank level, and visually observe the rate of drilling fluid returns to the containment pits and back pressures. As drilling progresses, the driller will be kept appraised of whether back pressure is present or if high volumes of drilling fluid are being lost downhole, taking into consideration ground conditions and the volume of fluid needed to fill the new hole being drilled. Should the driller feel that fluid circulation is slowing or is about to stop, or back pressure in the string is present, the driller will immediately implement the following procedures.

1. Temporarily cease drilling operations and shut off the mud pumps.
2. Dispatch observers to inspect the area between the entry point and the bit, along the bore alignment, for evidence of drilling fluid on the surface or in the water.
3. If no drilling fluids are seen on the ground surface or in the water, the mud pumps will be started and volumes gradually increased as the drill pipe is pulled back, rotating the drill string to wipe the borehole annulus and encourage flow.

Depending on the success of this procedure, the properties of the drilling fluid may be altered to aid in restoring circulation. Observers will continuously monitor the area for IDFRs as long as the mud pumps remain on.

If circulation is re-established, drilling will proceed as usual, and monitoring for IDFRs will become more routine as long as circulation is maintained. If circulation is not re-established, monitoring will continue while the pumps are operating.

Often times, in the course of drilling the borehole, circulation may be temporarily lost as the bit is advanced through more permeable sections of the formation and fluid pressures are at a maximum. Under these circumstances, the loss of fluid circulation alone may be temporary. As the pilot bit advances beyond the zone of lost circulation, fluid pressure may return back to normal and circulation within the borehole re-established.

It is expected that at some point, circulation on each bore will be lost and not recoverable due to the length of the bore string. In such cases, monitoring will continue as the drilling proceeds to the end point.

Seabed Exit of Horizontal Directional Drill

At a suitable distance prior to the exit point (as defined by the seabed geology), the use of standard drilling mud will be curtailed. The borehole will be completed to the punch-out point using either fresh water or a biodegradable, nonsolid, biopolymer fluid, such as Xanthan Gum to minimum release of bentonite onto the seabed. Xanthan Gum is an industry standard drilling fluid for cases in which solids-free systems are a requirement. Xanthan gum is considered non-hazardous and suitable for use in environmentally sensitive locations and applications.

Inadvertent Drilling Fluid Release Response

Land-Based Release

If IDFRs are observed on the ground surface, at a location other than the bore containment pits, the following procedures will be implemented.

1. Cease drilling operations.
2. Notify all required parties.
3. Document the event with photographs.
4. Contain the drilling fluid with sand or gravel bags, straw bales and/or wattles, or a premade containment vessel made of steel so the fluid cannot migrate from the fracture location.
5. If possible, excavate a small sump pit at the fracture location and provide a means of containment of the fluid while it is returned to either the drilling site for cleaning and re-use or to an approved pump site (e.g., vac trucks, pumps, or both).
6. Clean up the affected area using a vacuum unit, brooms, shovels, etc., once release is contained. Clean-up will include removal of all visible drilling fluid located in accessible areas. Removal methods will vary based on the volume of the release and the site-specific conditions. Removal equipment may include vacuum trucks, loader and track hoe buckets, small pumps, shovels, and buckets. After removal of the released drilling fluid, the release area will be returned as close to the original condition as possible.
7. Document the cleaned-up area with photographs.
8. Adjust drilling fluid properties to inhibit flow through the fracture and wipe the hole by tripping out the drill pipe to wipe the borehole annulus.
9. Determine the suitability of placing LCM in the hole.

10. After tripping the drill string back, allow the formation to rest for a suitable period and continue drilling, while monitoring the frac-out location and transferring fluids, as necessary.
11. Forward ream the borehole up to the frac-out location to relieve annular pressures, as necessary.
12. Continue drilling with minimum fluid.
13. Consider drilling a vertical relief well over the borehole in order to relieve borehole pressures and encourage flow to a known source where it can be managed.

It should be noted that often times, drill cuttings generated as a result of the drilling process will naturally bridge, and subsequently seal, fractures or voids in the formation as drilling progresses, thus providing another means to re-establish lost circulation.

Waterbody Release

1. If an IDFR is observed offshore, the following procedures will be implemented.
2. Cease drilling operations.
3. Notify all required parties.
4. Document the event with date and time stamped photographs.
5. Remove releases by vacuum truck, if possible. In cases of inadvertent releases to open water, it is usually impractical to contain the release due to the fact that the release does not necessarily occur on the bore path, and the action of waves and ocean swell quickly disperse the IDFR. Removal by vacuum truck may be attempted at the shoreline if reachable from shore and deemed appropriate.
6. Sample turbidity levels, as appropriate. Water sampling equipment will be available for use by site inspectors to evaluate turbidity levels.
7. Once dissipated, again document the event with date and time stamped photographs.
8. Adjust drilling fluid properties to inhibit flow through the fracture and wipe the hole by tripping out drill pipe to wipe the borehole annulus.
9. Determine the suitability of placing LCM in the hole.
10. After tripping the drill string back, allow the formation to rest for a suitable period, continue drilling while monitoring the frac-out location and transferring fluids, as necessary.
11. Forward ream the borehole up to the frac-out location to relieve annular pressures, as necessary.
12. Continue drilling with minimum fluid, increasing drilling fluid gradually whilst continuously monitoring for any further IDFRs.

    It should be noted that often times drill cuttings generated as a result of the drilling process will naturally bridge, and subsequently seal, fractures or voids in the formation as drilling progresses, thus providing another means to re-establish lost circulation.

The decision to proceed with the drilling operation will be made mutually between the drilling site supervisor and the on-site Client Representative after practical methods to seal off the location of the discharge have been attempted.

Inadvertent Drilling Fluid Release Control Equipment

In accordance with good HDD practices, the following frac-out containment and clean-up equipment should be present on or near the Project site for an IDFR.

- Heavy-weight sealed plastic bags filled with sand or gravel.
- Splash board: three layers of heavy plastic.
- Several 5-gallon plastic buckets.
- One wide heavy-duty push broom.
- Flat blade shovels.
- Silt fence, T-posts, and/or straw bales.
- Straw logs (wattles): at least two 10-foot rolls.
- Portable trash pumps with a minimum of 500 feet (152.4 m) of discharge hose.
- Preconstruction seawater sample as baseline for any testing following an offshore IDFR.
- Seawater sampling kits.
- Offshore dive vessel available on call in case of an offshore IDFR.
- A minimum of one vacuum unit on site and access to a vacuum truck within 1 hour of the job site.

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