Statewide Fuel Facilities Development Plan

Proposed Fuel Facilities in Hawaii's Commercial Harbors

PDF of Report in Sections

PART 2 of 2 : Sections 6.4 through 8

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Prepared for:
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Consulting Engineers

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DEPARTMENT OF TRANSPORTATION · STATE OF HAWAII ·

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SECTION SIX

FUEL FACILITIES ALTERNATIVES

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6.4 Fuel Facility Alternatives in Nawiliwili Harbor

Nawiliwili Harbor is Kauai's principal commercial harbor. Virtually all of the cargo for the island is handled there. It accommodates large cruise ships several days out of the week. It also handles a significant portion of fuel products, primarily transportation fuel such as gasoline, diesel and jet fuel. As a remnant of the sugar industry, there still do exist pipelines and storage facilities to export molasses and raw sugar.

Three conceptual design alternatives are proposed; each would upgrade fuel facilities in Nawiliwili Harbor. Two alternatives would provide new fuel facilities at a preciously undeveloped site within the harbor; the third alternative would be a minor change of existing fuel transfer facilities that would solve some operational inefficiencies. The two alternatives that provide new fuel facilities would both be preferred alternatives since they create new fuel facilities in an unused portion in the Jetty Pier area of the harbor. Both are preferred because they would also provide additional berthing capacities for the harbor. The *Kauai Commercial Harbors 2025 Master Plan* identifies this area for future expansion of harbor facilities. Consequently, the new fuel piers are designed to fit within the future harbor layout. It is anticipated that this new fuel pier would accommodate only fuel transfer until such time, when the entire Jetty Pier is developed and built as a continuous pier. At that point in time, the dedicated fuel pier would be flexible to accommodate other harbor operations. Therefore, it is recommended that the interconnecting pipelines between the fuel facility and the landside storage tanks be installed below ground in order not to impede with future cargo or other maritime operations.

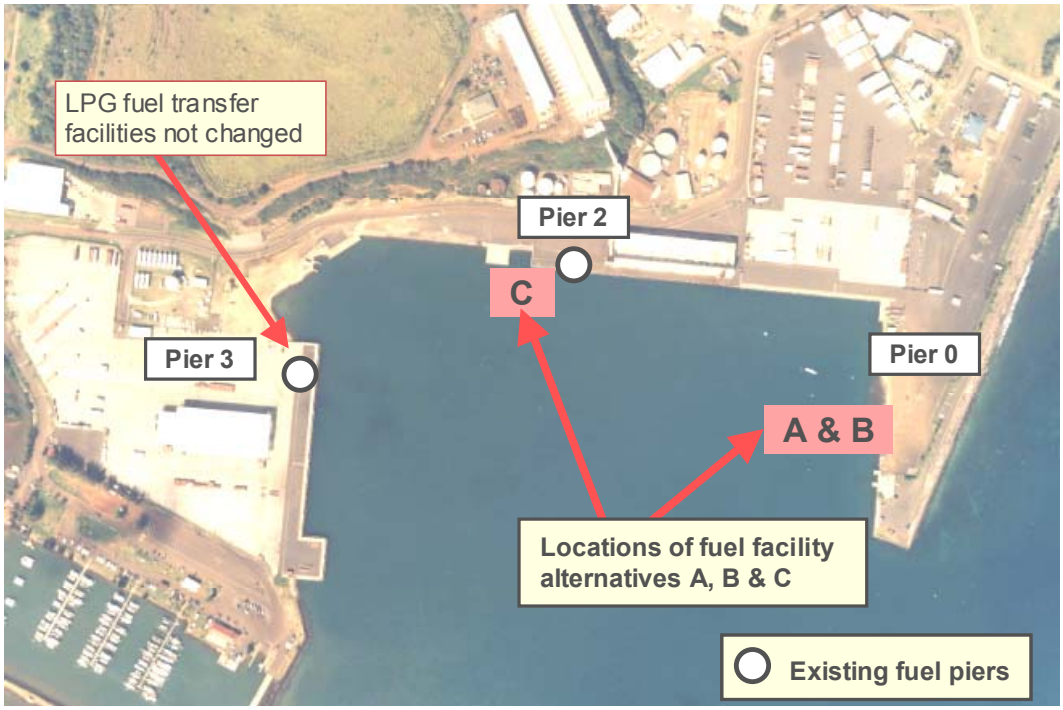

Figure 6-34: Locations of Fuel Facility Alternatives at Nawiliwili Harbor

The location of the three conceptual design alternatives is depicted in Figure 6-34. The liquid petroleum gas (LPG) fuel transfer operations remains at Pier 3.

6.4.1 Design Framework for Future Fuel Facilities

Considering the three energy design schemes as described in Section 4, Nawiliwili Harbor could support the following future fuel related functions:

1. Off-loading fuel barges that bring petroleum products.

2. Off-loading fuel barges that bring feedstock for biofuels production.

3. Loading fuel barges that transport biofuels between the islands

It is anticipated that the range of types of fuels to be handled in the future will include the following:

1. Clean petroleum products (conventional and evolving petroleum fuels).

2. Non petroleum products (ethanol, biodiesel, biofuel feedstock such as vegetable oil, molasses, etc.)

For the three fuel shipping functions the following vessel type can be accommodated at the future fuel piers:

1. Double-hull fuel barge: 400-foot long by 80-foot wide by 28-foot deep draft, capacity of approximately 80,000 barrels.

6.4.2 Conceptual Design Alternative A

Figure 6-35 shows the site plan of Alternative A. Fuel barges would moor at the new fuel pier structure located at the Jetty Pier. The new fuel pier would be constructed as a conventional sheeted bulkhead pier with a piled pier apron. Although the new pier would be intended as a dedicated fuel pier, it could also accommodate cargo vessels. However, cargo handling on the pier would not be effective due to the lack of backup areas and internal roadway connections unless developed. Interconnecting pipelines would connect the new fuel pier with the landside storage tanks.

More details of Conceptual Design Alternative A are shown in Figures 6-36 and 6-37. The new pier would have the following components:

1. A new pier structure would be built as a conventional bulkhead pier with a piled outer section. A portion of the dredged material would be used as structural fill. The pier face of the new fuel pier would coincide with the pier face of future pier extensions on the

eastern side of the harbor. The proposed new fuel pier could be regarded as the first phase of the development of the extended harbor facilities in the eastern portion of the harbor.

2. Two mooring bollards would be installed on land outside the new fuel pier. A bulk-head construction would be used for the bollards with ready access from land.

3. Marine fuel loading arms (either single-product or dual-product loading arms) would establish safe and efficient shore-to-ship fuel transfer connections. The number of loading arms would be determined by the type of fuel to be loaded and unloaded at the fuel berth.

4. Fire suppression system. Two fixed foam monitors would be installed at the new pier that would use seawater for foam generation. Different types of foam would be required for different fuel that is handled. The fixed foam monitors would be installed at suitable locations to allow good working coverage of foam spray on the fuel berth.

5. Adequate fixed lighting would be installed to illuminate all parts of the fuel pier that are critical for operating the fuel pier.

6. Bollards would be installed to protect the fuel transfer equipment against accidental impact from maintenance vehicles that operate on the fuel pier service roadway.

7. A central fuel monitoring system (fuel flow, pressures, temperatures, etc.) would inform the operator about fuel transfer progress.

8. A two-stage alarm system would alert the operator to stop pumping fuel when the unloading arms near its limits of reach or when the mooring line loads are near its limits of loading capacity.

9. An emergency shutdown system could be activated from a central point or at the pier.

10. Significant dredging would have to be carried out to establish a target depth of 35 feet at the pier face. A portion of the dredged material could be used as fill for the bulkhead pier structure.

11. Before completion of the entire Jetty Pier, the fuel pier would be accessible from the adjacent public area. A security fence and gate would separate the fuel pier from the public area.

12. New interconnecting pipelines would be installed, which would connect the fuel transfer station of the new fuel pier with the existing storage facilities located to the north of the harbor. It is anticipated that the fuel barges would have enough pumping capacity to pump the fuel to the receiving tanks. Therefore it is anticipated that no new booster pumps would have to be added.

13. Within the limits of the new fuel pier, the transmission pipelines would be installed in a shallow concrete pipeline gallery with removable covers. This form of installation is cost effective and would allow for effective maintenance of the pipelines.

14. Outside the limits of the new fuel pier, the transmission pipelines would be installed below-ground in shallow pipeline galleries. Alternatively, pipelines may be buried. Since the final construction of the entire pier at the eastern shoreline of the harbor might necessitate a rerouting of the pipelines, a more detailed design study is necessary to develop a preferred pipeline alignment.

15. Within the limits of existing Pier 1 and Pier 2, the new transmission pipelines could be installed below the piled pier structure, in order to avoid open-trench construction that would disturb harbor operations.

Issues related to fuel storage: Fuel would continue to be unloaded into existing tanks farms located within Harbors Division's boundaries. Existing tank farms hold fuel products like diesel, gasoline, ethanol and jet fuel. It may be necessary to add ethanol and/or feedstock storage facilities for the purpose of exporting ethanol from Kauai to the neighbor islands. There are a number of empty tanks available for this purpose and certain areas have room for increasing storage capacity. Their existing storage facility is currently located on another state department's property. The Gas Company has expressed an interest in space for additional storage. This issue has yet to be resolved.

6.4.3 Conceptual Design Alternative B

Figure 6-38 shows the site plan of Conceptual Design Alternative B. Fuel barges would be moored at the new protruding segmented fuel pier structure located at the Jetty Pier. The dedicated fuel pier would consist of piled breasting dolphins and a fuel transfer platform that would have connections to the shore side. Transmission pipelines would connect the new fuel pier with the existing fuel pipeline system in the harbor, which in turn would convey fuel to existing fuel storage facilities located to the north of the harbor.

More details of Conceptual Design Alternative B are shown in Figures 6-39 and 6-40. The new pier would have the same components as the Conceptual Design Alternative A, described above, except for the following:

1. A new pier would be built as a protruding segmented fuel pier. The face of the new fuel pier would match with the future pier extension at the Jetty Pier. The proposed new fuel pier could be regarded as the first phase in improvements (Figure 6-41 shows a possible integration of the piled fuel pier into the Jetty Pier). The future pier extension would use a conventional pier structure to fill the space between Pier 1 and the fuel transfer platform of the new fuel pier. This approach avoids demolishing the protruding fuel pier during construction of the Jetty Pier.

2. Four breasting dolphins would be installed, two on each side of the fuel transfer platform. Two breasting dolphins that would be adjacent to the fuel transfer platform are equipped

with a disembarkation platform to allow safe access to the fuel barge. The breasting dolphins would be interconnected with a catwalk system.

3. Two mooring bollards would be installed on land outside of the new fuel pier. A bulkhead construction would be used for the mooring dolphin with ready access from landside.

See discussion on other pier components and storage tanks in Alternative A above.

6.4.4 Conceptual Design Alternative C

Figure 6-42 shows the site plan of Conceptual Design Alternative C. Fuel barges would continue to be moored at Pier 2. The separate fuel transfer hatches used presently, would be consolidated into one fuel transfer station in order to avoid stretched out fuel transfer assets in multiple locations. Presently, there are two fuel transfer positions at Pier 2, owned and operated by two different fuel companies. Fuel barges typically carry multiple products that might be dispensed to two different tank farms. Since the fuel transfer to the two tank farms presently require access to the two fuel hatches, fuel barges have to change mooring positions when serving the two different tank farms. This causes significant inefficiency of the fuel transfer operations. Transfer of fuel from the fuel barge to one fuel hatch would avoid these inefficiencies. The present two fuel hatches are too close together to let two fuel barges moor and dispense at the same time. Therefore the rationale to retain the location of the two fuel hatches in order to operate two fuel barges at a time does not apply.

Conceptual Design Alternative C would have the same components described for Alternatives A and B, except for the following:

1. A new fuel transfer station would be installed on Pier 2. The new fuel transfer station would improve fuel transfer operation.

2. Off-loading the fuel barges is presently done with flexible fuel hoses. This operation would continue in the future. Installation of fuel loading arms would not be feasible because Pier 2 is also used for passenger and cargo operations.

3. Interconnecting pipelines would connect the new single fuel transfer station at Pier 2 with the storage facilities located to the north.

4. The transmission pipelines would be installed below ground to cross the harbor area and adjacent roadway.

See discussion on other pier components and storage tanks in Alternative A above.

6.4.5 Advantages and Disadvantages of Conceptual Design Alternatives

Table 6-2 lists advantages and disadvantages of the three conceptual design alternatives for Nawiliwili Harbor.

Figure 6-35 : CONCEPTUAL DESIGN - ALTERNATIVE A - SITE PLAN
Nawiliwili Commercial Harbor, Kauai

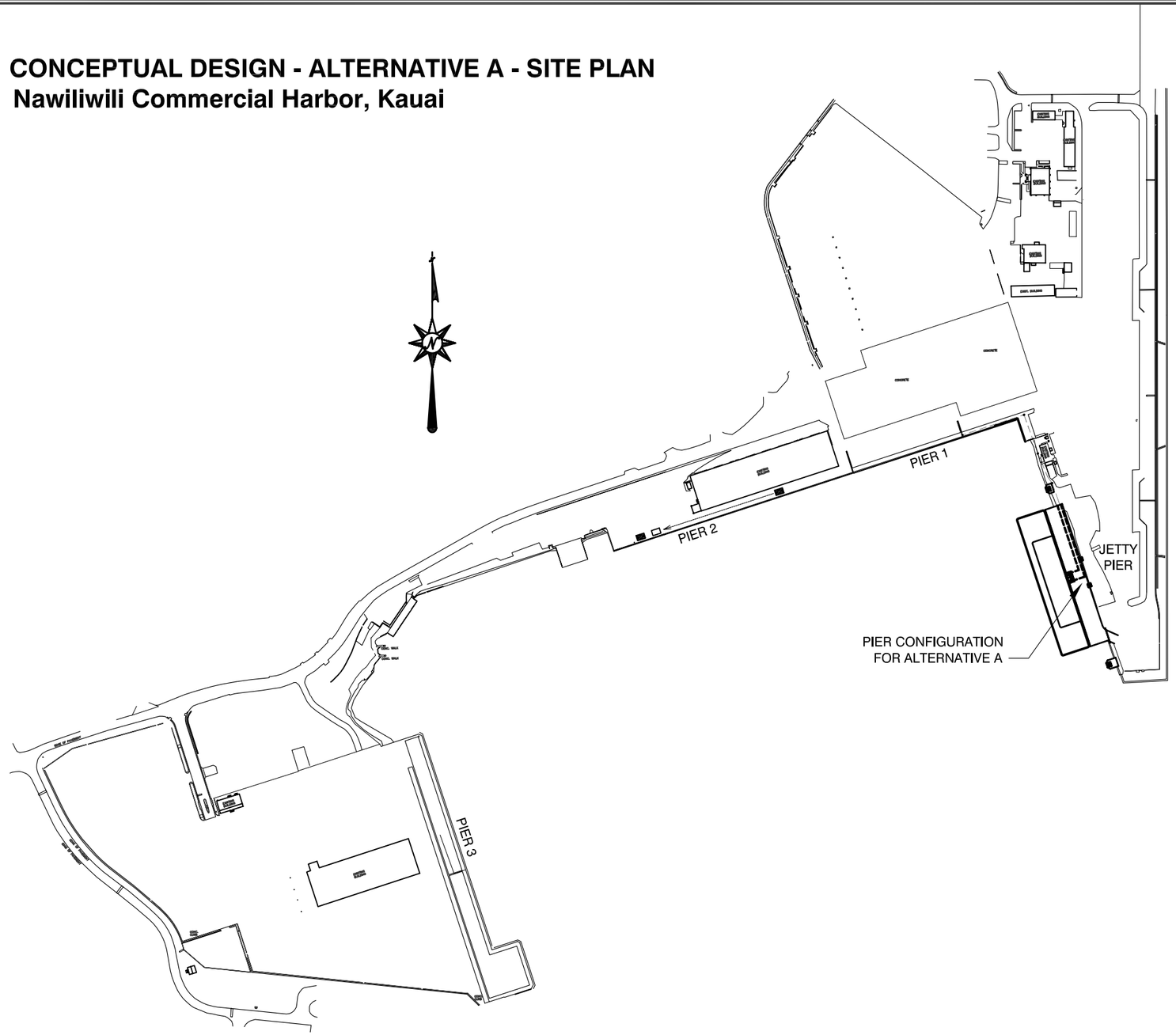

FIGURE 6-35

GRAPHIC SCALE:

300' 0 300' 300'

SCALE: 1" = 300'-0"

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DATE: May 22, 2008 3:27pm XREFS: 1244-x-TBK Nawiliwili 11x17 1244-x-Nawiliwili concept IMAGES:

Figure 6-36 : CONCEPTUAL DESIGN - ALTERNATIVE A - DETAIL PLAN
Nawiliwili Commercial Harbor, Kauai

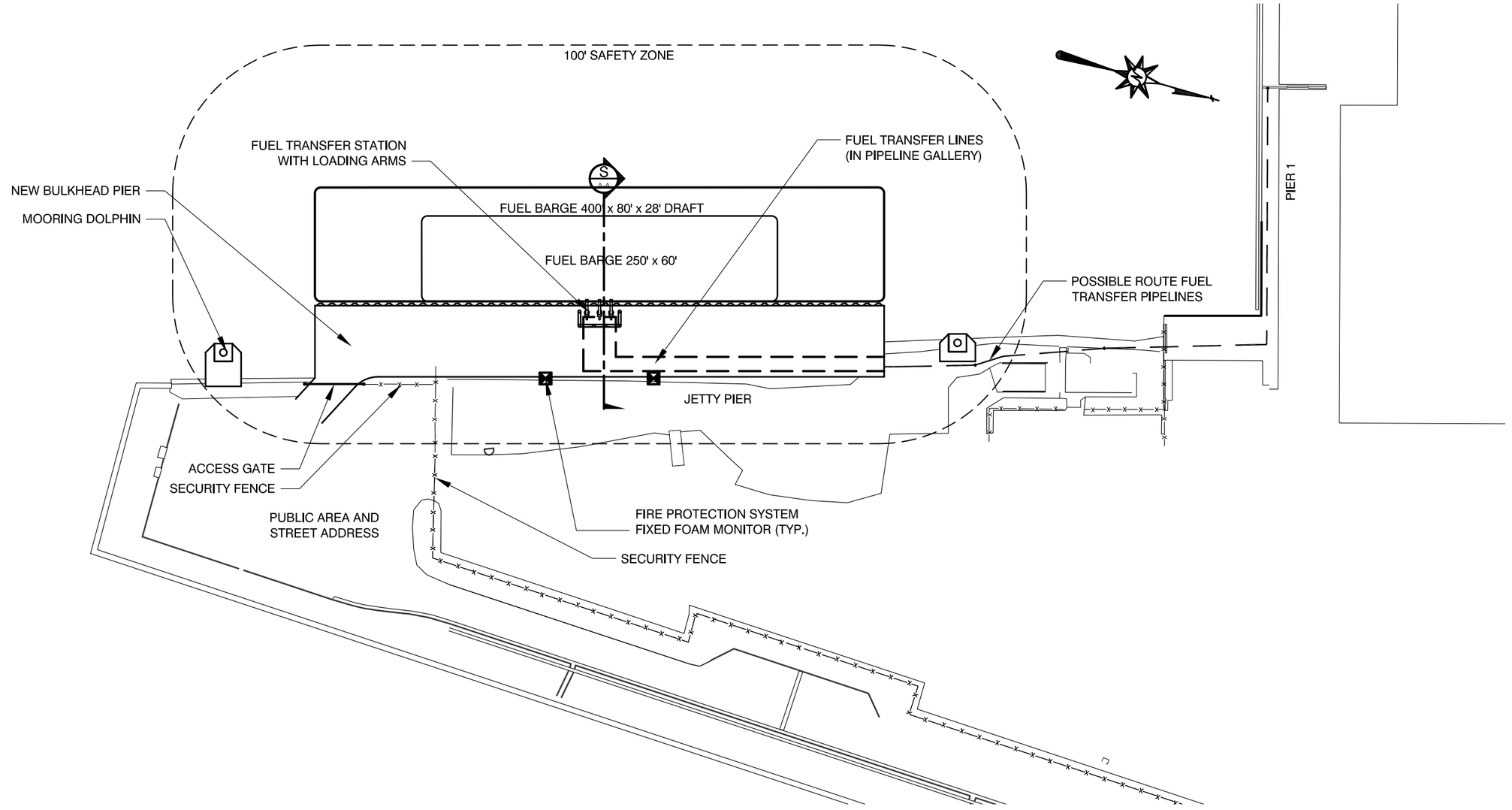

FIGURE 6-36

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GRAPHIC SCALE:

80' 0 80' 160'

SCALE: 1" = 80'-0"

Figure 6-37 : CONCEPTUAL DESIGN - ALTERNATIVE A - SECTION "A-A"
Nawiliwili Commercial Harbor, Kauai

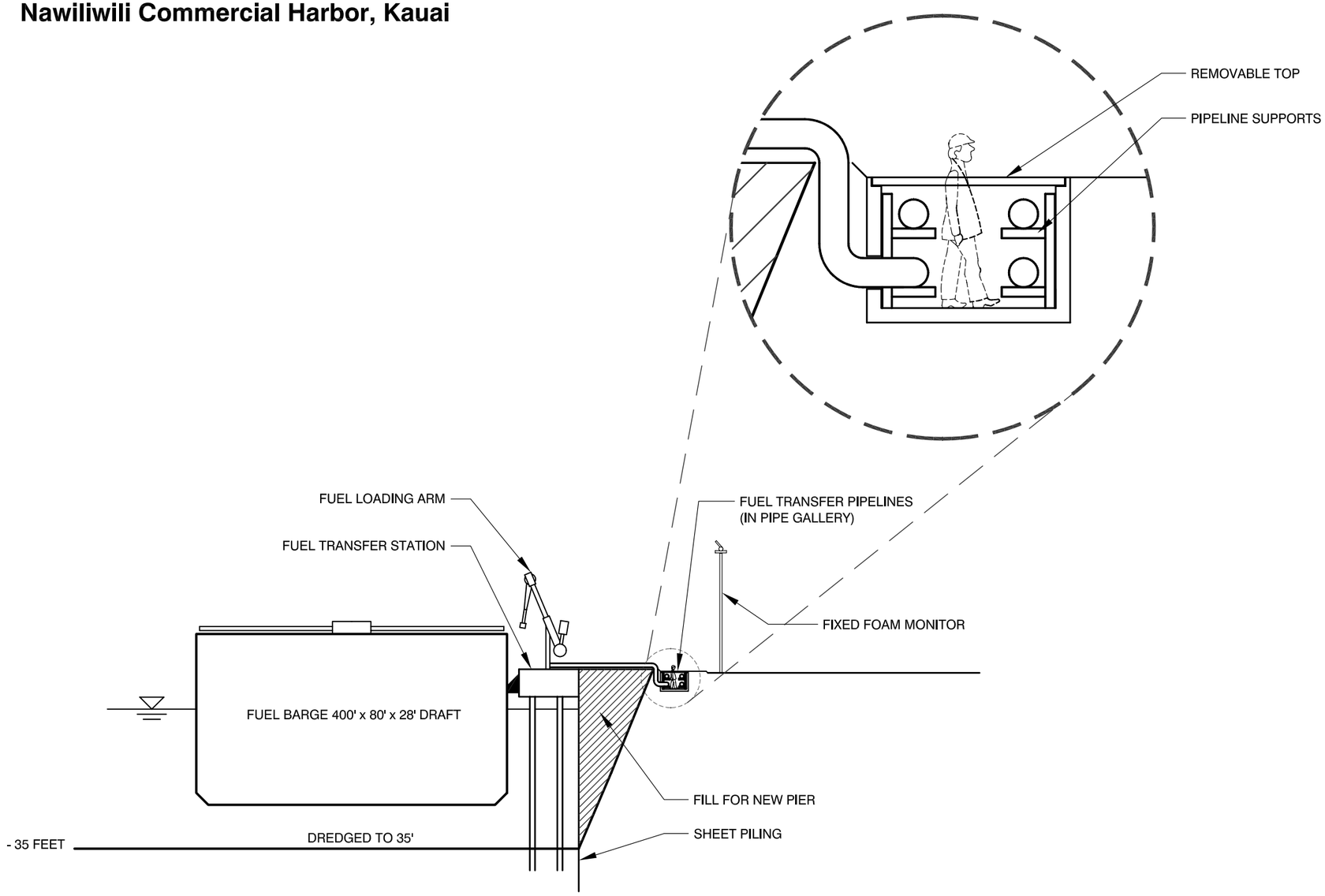

FIGURE 6-37

GRAPHIC SCALE:

30' 0 30' 60'

SCALE: 1" = 30'-0"

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Figure 6-38 : CONCEPTUAL DESIGN - ALTERNATIVE B - SITE PLAN
Nawiliwili Commercial Harbor, Kauai

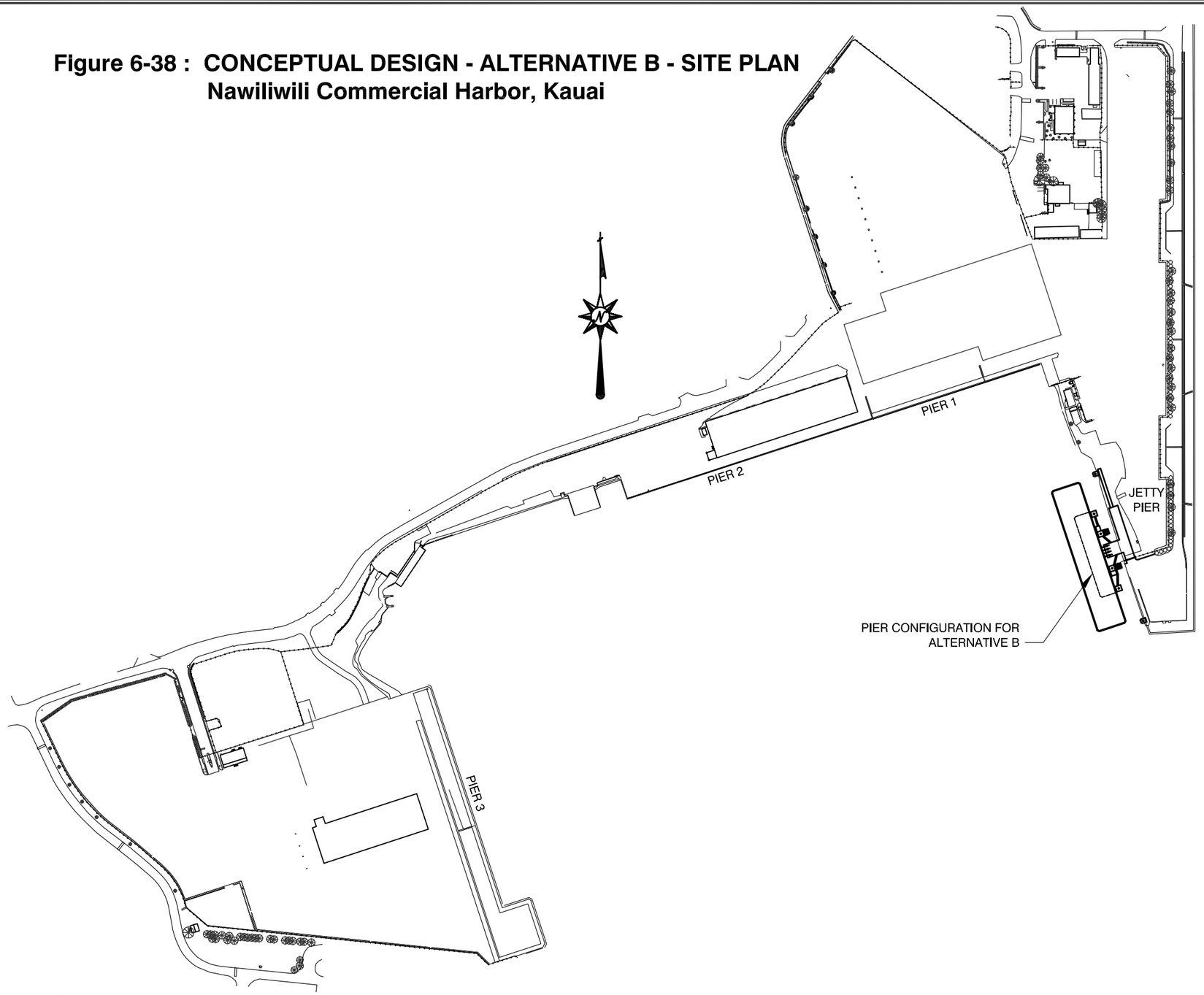

FIGURE 6-38

GRAPHIC SCALE:

300' 0 300' 300'

SCALE: 1" = 300'-0"

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Figure 6-39 : CONCEPTUAL DESIGN - ALTERNATIVE B - DETAIL PLAN
Nawiliwili Commercial Harbor, Kauai

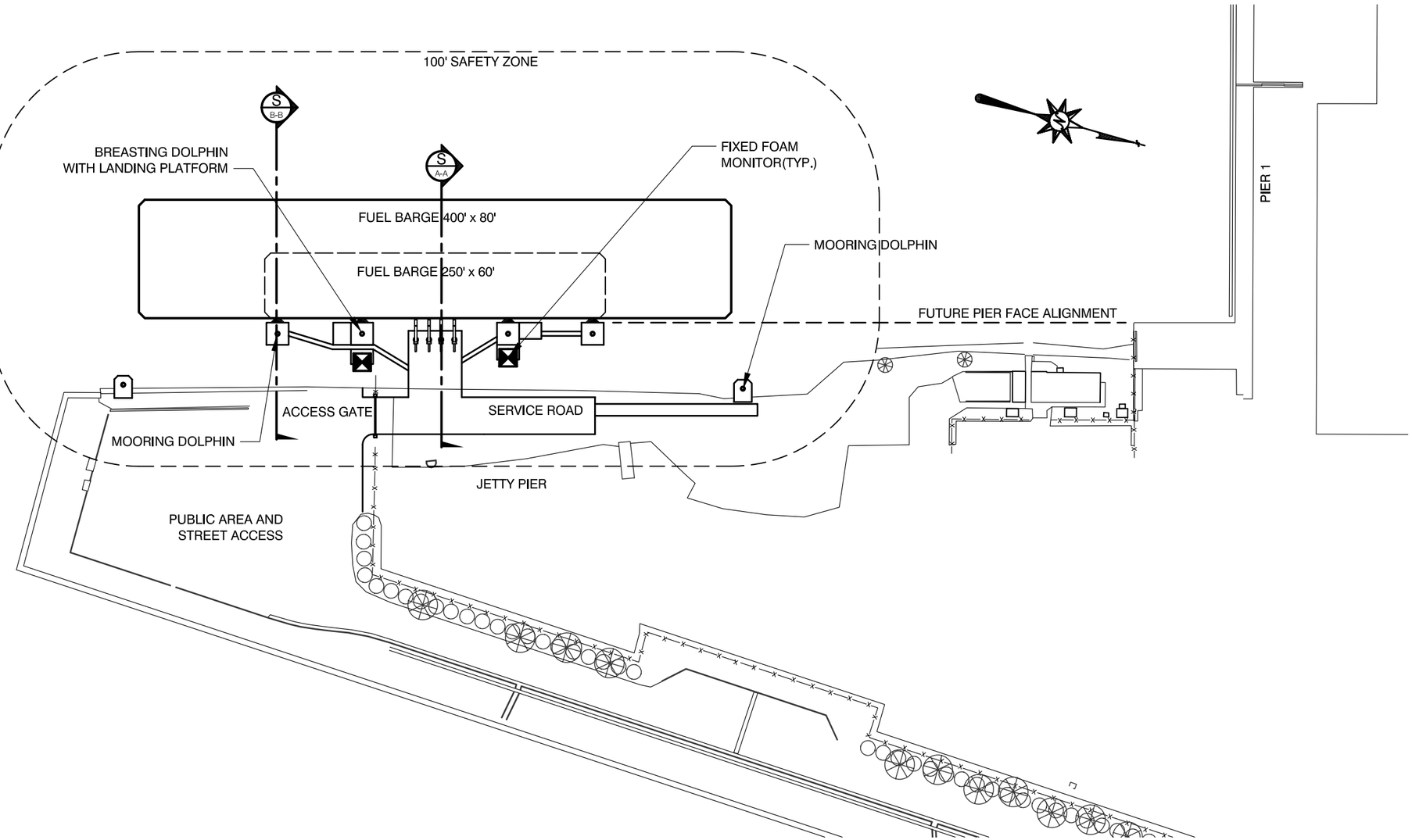

FIGURE 6-39

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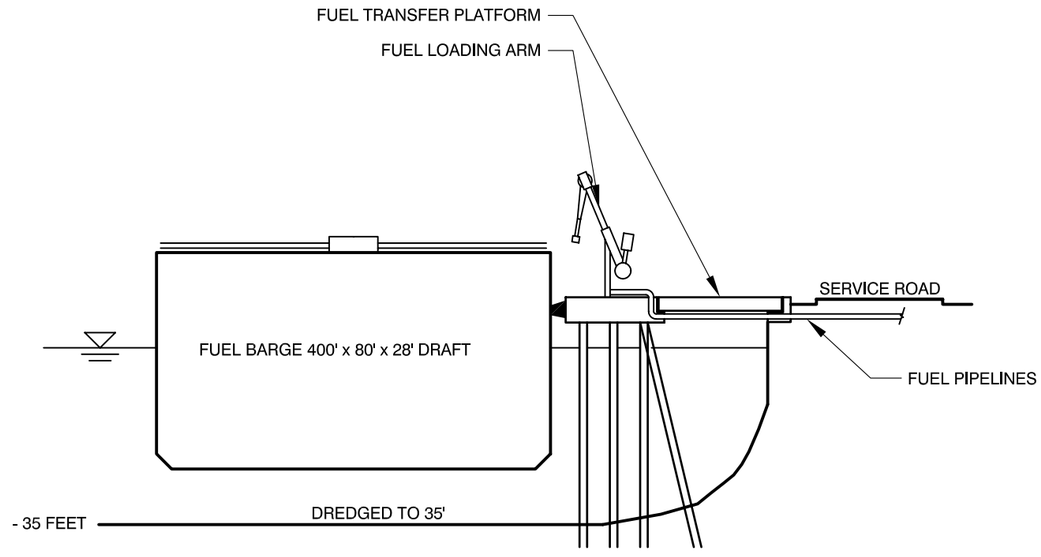
GRAPHIC SCALE:

80' 0 80' 160'

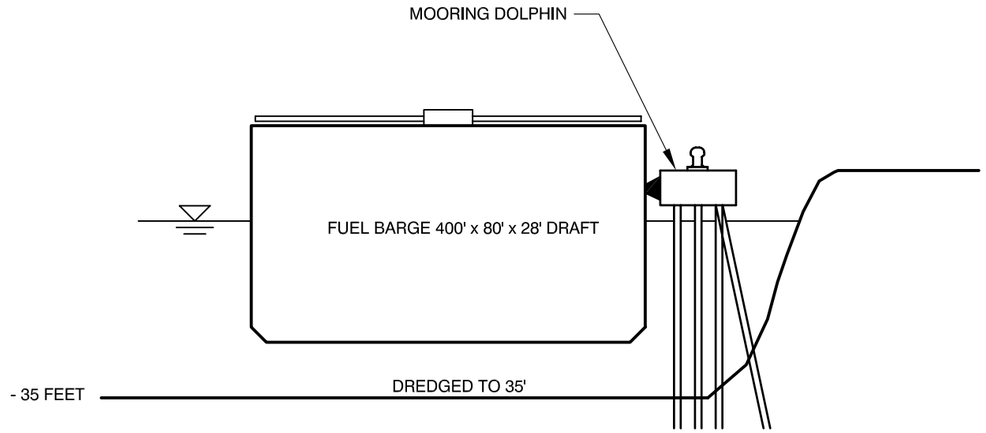
SCALE: 1" = 80'-0"

Figure 6-40 : CONCEPTUAL DESIGN - ALTERNATIVE B - DETAIL SECTIONS
Nawiliwili Commercial Harbor, Kauai



ALTERNATIVE B - SECTION "A-A"

NTS



ALTERNATIVE B - SECTION "B-B"

NTS

FIGURE 6-40

GRAPHIC SCALE:

30' 0 80' 160'

SCALE: 1" = 80'-0"

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DWG: J:\1244\dwg\Presentation-4_Revised\NAWILIWILI (12-10-07)\Figure 6-40.dwg USER: nsantos
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Figure 6-41 : CONCEPTUAL DESIGN - ALTERNATIVE B - DETAIL PLAN WITH POSSIBLE PIER 0 EXPANSION
Nawiliwili Commercial Harbor, Kauai

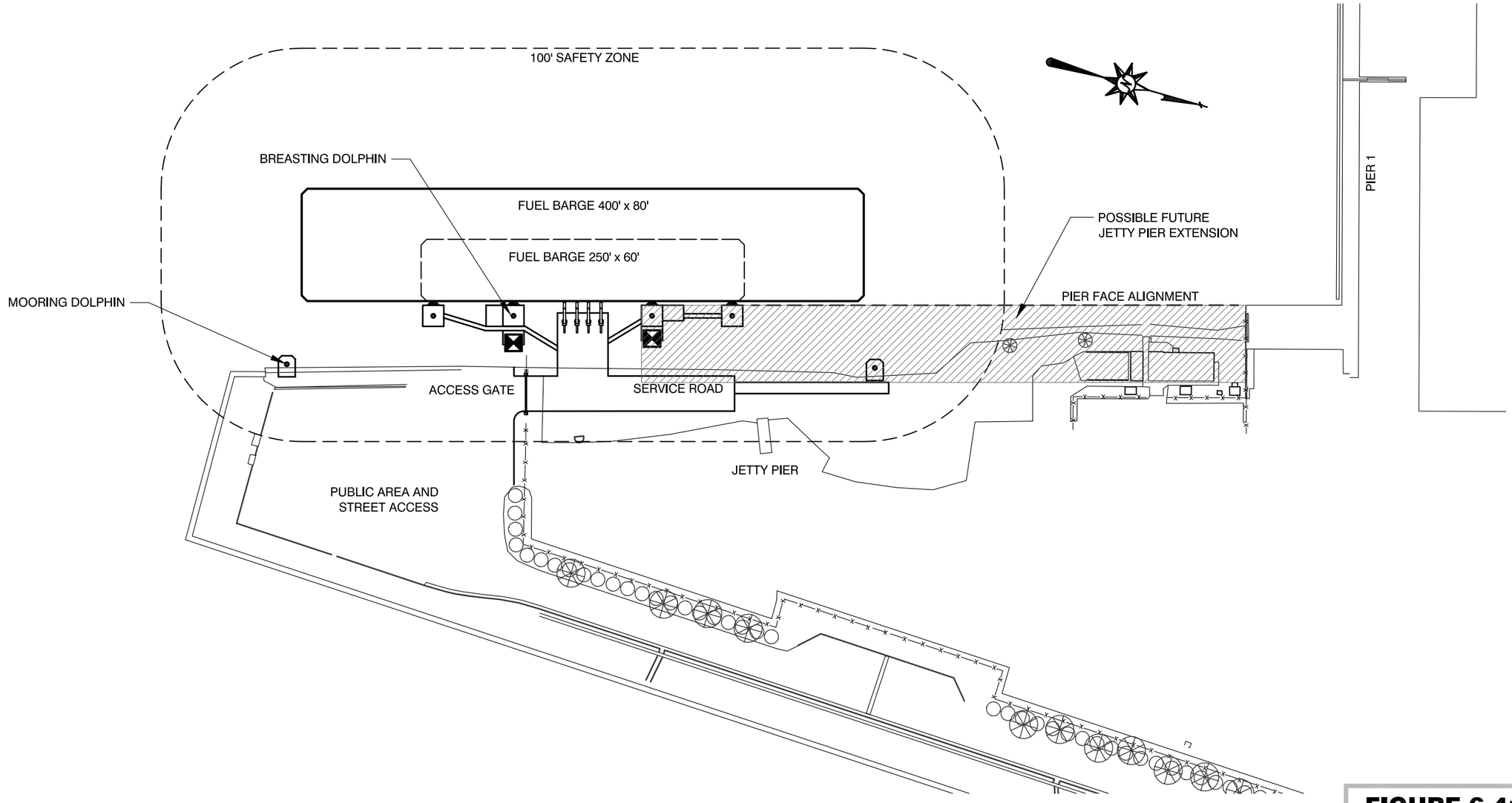

FIGURE 6-41

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GRAPHIC SCALE:
80' 0 80' 160'
SCALE: 1" = 80'-0"

DWG: J:\1244\dwg\Presentation-4_Revised\NAWILIWILI (12-10-07)\Figure 6-41.dwg USER: nsantos
DATE: May 22, 2008 3:33pm XREFS: 1244-x-TBK Nawiliwili 11x17 MZ 1244-x-Nawiliwili concept A2 IMAGES:

Figure 6-42 : CONCEPTUAL DESIGN - ALTERNATIVE C - SITE PLAN
Nawiliwili Commercial Harbor, Kauai

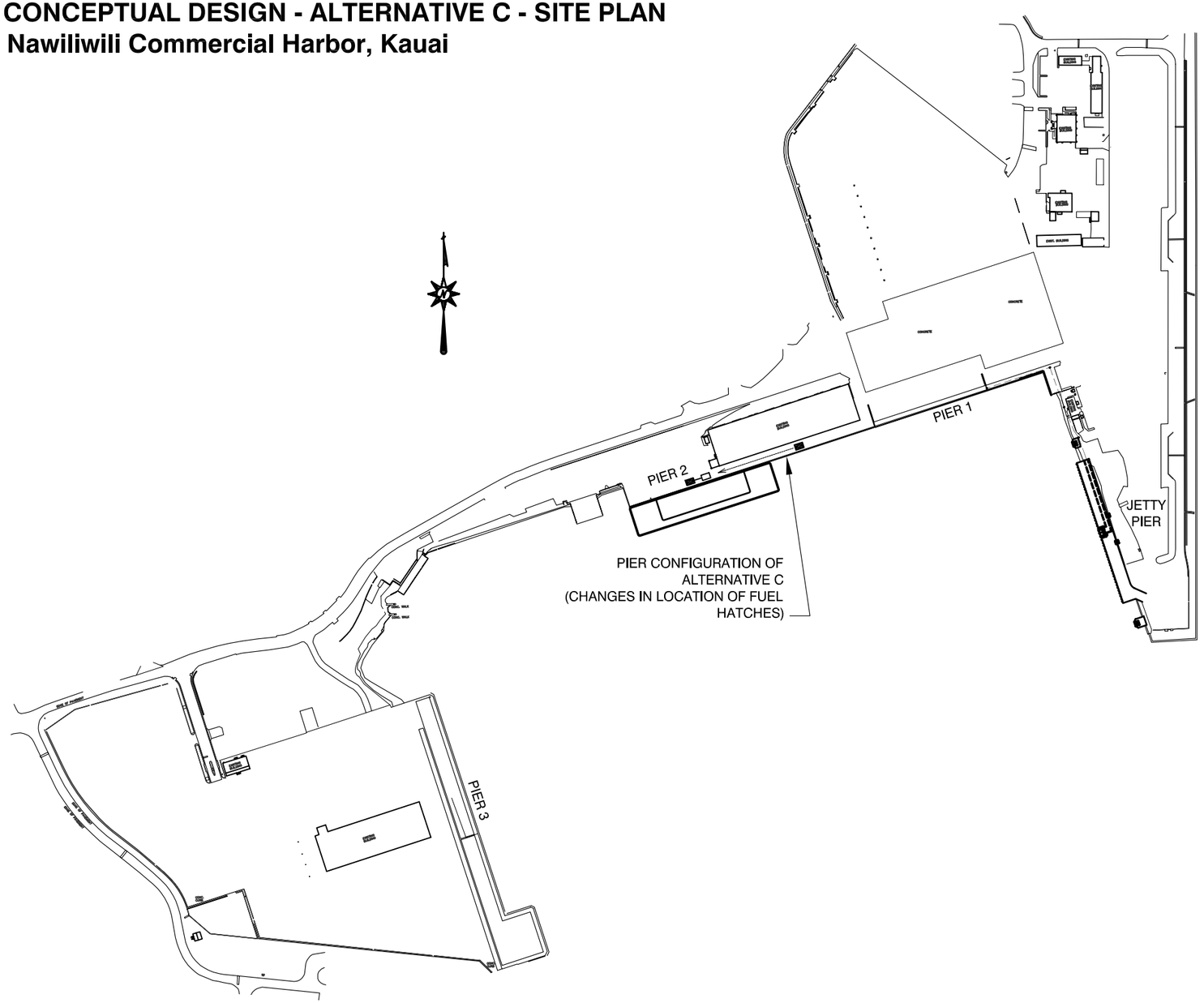

FIGURE 6-42

GRAPHIC SCALE:

300' 0 300' 300'

SCALE: 1" = 300'-0"

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Table 6-2 Nawiliwili Harbor: Advantages and Disadvantages of Conceptual Design Alternatives (Page 1 of 3)

Nawiliwili Alternative A: New fuel pier construction at Jetty Pier (conventional bulkhead pier structure)

Advantages	Disadvantages
• Until the completion of the entire Jetty Pier, the new fuel pier could be a dedicated fuel pier depending on needs. If designated as a dedicated fuel pier, this would guarantee no scheduling conflicts with cargo or passenger operations in the commercial harbor. • The impact to harbor operations during construction would be minimal, since the new fuel pier would be constructed at a location within the harbor not currently used. • Using loading arms reduces the vulnerability of fuel vessels to movements due to incident waves entering the harbor. Loading arms would provide means for safer fuel transfer and require less maintenance than flexible fuel hoses. • Dredged material could be used as structural fill for the new bulkhead pier. • The pier would be a multi-use pier and would be part of the Jetty Pier's ultimate configuration. Since the future pier structures at the Jetty Pier would be bulkhead piers (with outside piled portion of pier), the fuel pier would fit seamlessly into the future pier expansion in this area.	• The new bulkhead pier structure would require substantial investment compared to Alternative C. • The new bulkhead pier structure at the Jetty Pier would require more investment and would cause more impact during construction than Alternative B at the Jetty Pier. • Installing long transmission pipelines from the new fuel pier to the existing fuel lines in Pier 1would impact harbor users at the time of installation. This would make the installation of transmission pipelines technically challenging and costly. • The fuel pier would be located in the proximity of the planned ferry terminal. A portion of the 100-foot safety zone around the 400-foot long fuel barge would protrude into the ferry operational area.

Table 6-2 Nawiliwili Harbor: Advantages and Disadvantages of Conceptual Design Alternatives (Page 2 of 3)

Nawiliwili Alternative B: New fuel pier construction at Jetty Pier (piled fuel pier structure, protruding fuel pier)

Advantages	Disadvantages
• Until the completion of the entire Jetty Pier, the new fuel pier could be a dedicated fuel pier depending on needs. If designated as a dedicated fuel pier, this would guarantee no scheduling conflicts with cargo or passenger operations in the commercial harbor. • The impact to harbor operations during construction would be minimal, since the new fuel pier would be constructed at a location within the harbor not currently used. • Using loading arms reduces the vulnerability of fuel vessels to movements due to incident waves entering the harbor. Loading arms would provide means for safer fuel transfer and require less maintenance than flexible fuel hoses. • The piled pier structure has a lower economic and environmental impact than the bulkhead pier structure of Alternative A. Piled structures are less costly than the conventional bulkhead pier structure of Alternative A. • The piled fuel pier would be a part of the future Jetty Pier infrastructure. A proposed integration of the piled fuel pier into the Jetty Pier is depicted in Figure 6-41. The space between Pier 1 and the fuel transfer platform of the piled fuel pier could be filled with a conventional bulkhead pier structure.	• The new piled pier structure would require substantial investment compared to Alternative C. • Installing long transmission pipelines from the new fuel pier to the existing fuel lines in Pier 1 would impact harbor users at the time of installation. This would make the installation of transmission pipelines technically challenging and costly. • The fuel pier would be located in the proximity of the planned ferry terminal. A portion of the 100-foot safety zone around the 400-foot long fuel barge would protrude into the ferry operational area.

Table 6-2 Nawiliwili Harbor: Advantages and Disadvantages of Conceptual Design Alternatives (Page 3 of 3)

Nawiliwili Alternative C: Fuel facilities consolidation at Pier 2

Advantages	Disadvantages
• The consolidation of the fuel transfer facilities on Pier 2 would be a cost effective solution to improve fuel-handling operations, by avoiding fuel barges to change mooring position between dispensing fuel at two fuel hatches which are each connected to two different fuel tank farms. • Most of the existing fuel infrastructure could be easily integrated into the new fuel pier configuration. • The extent of new pier construction would be limited and there would be only limited interference on harbor operation during construction. • Increase in efficiency and in attaining current fuel facility compliance could be attained very cost effectively.	• The new fuel transfer station on Pier 2 alleviating congested harbor conditions would be limited. No new fuel facilities would be provided. • The new fuel pier configuration would not significantly increase berthing capacity, as fuel shipment schedules would still be competing with passenger operations. • Consolidation of fuel facilities to one fuel transfer station would lower the redundancy and increase vulnerability of supply interruption to Nawiliwili Harbor due to equipment failure. • As the fuel pier is only modifying existing fuel transfer facilities (e.g., the same types of fuels are handled), the fuel facility cannot attain the degree of flexibility that might be called for in a long reaching plan. The fuel transfer operations would still have conflicts in scheduling with cargo and passenger operations. • Alternative C offers such limited improvements that it cannot be compared to the benefits of the long-term solutions presented by Alternatives A and B.

6.5 Fuel Facility Alternatives in Port Allen Harbor

Port Allen is the second commercial harbor on Kauai. Port Allen Harbor is the only fuel transfer facility on Kauai that receives fuel for the electrical generating plant. Besides receiving diesel fuel and Naphtha (for electrical generation), the harbor also handles gasoline and ethanol. In its present configuration, it can only accommodate fuel barges and no tankers. Port Allen Harbor is one of two marine fuel transfer facilities on Kauai. Therefore, it serves also in a contingency function in case fuel shipments through Nawiliwili Harbor are interrupted.

Current fuel transfer operations are carried out at Port Allen Harbor's main pier, a piled pier structure that supports a concrete deck. The piled pier structure has been showing structural problems because of the specific construction method used for the pier. Specifically, the use of wooden timbers buried below the mud line to support the concrete pilings above. In addition, the pier lacks lateral stability because of the absence of lateral supports due to the use of the aforementioned construction method. The *Kauai Commercial Harbors 2025 Master Plan* recommends the demolition of the existing pier structure and the construction of new pier infrastructure. The recommended new fuel pier, designated as Pier 1 Phase 1, fits within the ultimate master plan envelope. The construction of the new Pier 1 Phase 1 can be viewed as the first construction phase of the future harbor infrastructure.

It is anticipated that future developments on Kauai will result in an increase of the quantity of petroleum fuels shipped and used. As a more recent development, it is anticipated that in addition to conventional petroleum based fuels, non-petroleum fuels such as ethanol and/or biodiesel will increase in importance. In partnership with an outside entity specializing in the production of alternative energy, the local sugar industry could be revitalized by producing biofuels from feedstock that is either grown on Kauai or imported.

The prospect of an evolving market of biofuels presents challenges and opportunities for Port Allen Harbor. Potential biofuel processing facilities on Kauai are located close to the Port Allen Harbor. If biofuel feedstock is imported to Kauai through Port Allen Harbor, the proposed fuel pier has to accommodate the quality and quantity of the feedstock shipments. Likewise if surplus biofuel is produced, this excess will have to be shipped to outside destinations. Consequently, future potential biofuel exports from Kauai might require infrastructure and operational know-how for biofuel fueling operations in Port Allen Harbor.

Only one location for future fuel transfer facilities is identified for Port Allen Harbor. This location is shown in Figure 6-43. The proposed fuel facility will serve Port Allen Harbor while the existing pier is demolished.

6.5.1. Design Framework for Future Fuel Facilities

Considering the three energy design schemes as described in Section 4, Port Allen Harbor could support the following future fuel related shipping functions:

1. Off-loading fuel barges that bring petroleum products to Kauai.

2. Off-loading fuel barges that bring biofuel feedstock for production to Kauai.

3. Loading fuel barges that export biofuels from Kauai.

4. Off-loading compressed natural gas (CNG) barges to supply natural gas to the island gas utility (CNG is an evolving technology but may be an interesting future fuel option for Kauai's power generation in the power plant).

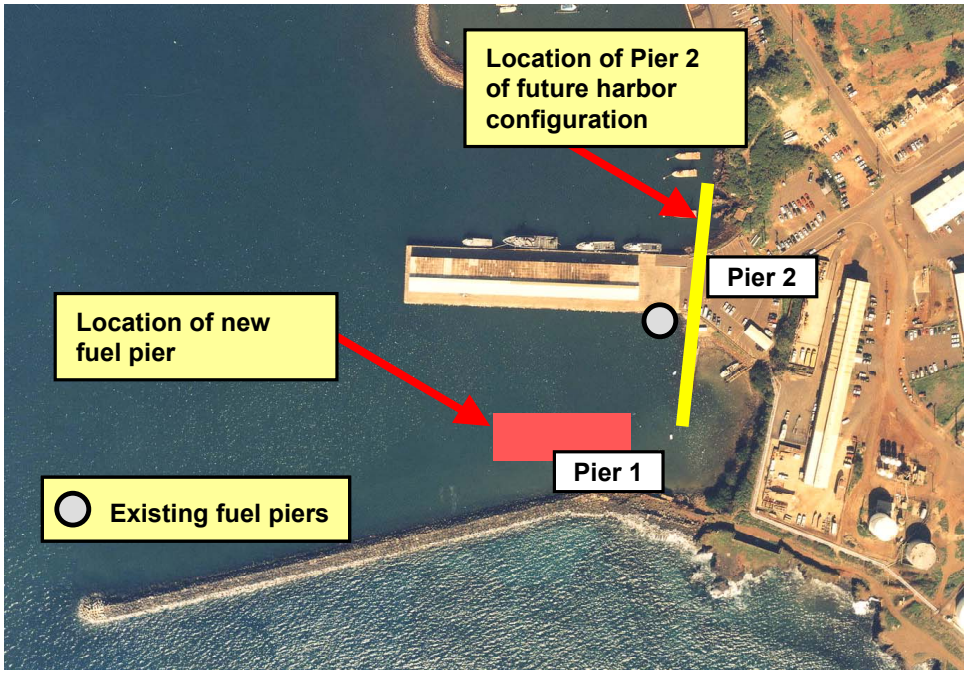

Figure 6-43 Location of Fuel Facility Alternatives for Port Allen Harbor

It is anticipated that the range of types of fuel to be handled in the future could include the following:

1. Clean petroleum products (conventional and evolving), possibly "dirty" fuels, such as residual fuels for power plants.

2. Non-petroleum products (ethanol, biodiesel, biofuel feedstock such as vegetable oil, molasses, etc.).

3. CNG as a possible future fuel option.

For the three fuel shipping functions the following vessel types could be accommodated at the future fuel pier:

1. Double-hull fuel barge: 400-foot long by 80-foot wide by 28-foot deep draft, capacity of approximately 80,000 barrels.

2. Handysize Tanker: 600-foot long by 95-foot wide by 34-foot deep draft, capacity of approximately 225,000 barrels.

3. CNG barge (evolving shipping technology) with unknown overall dimensions.

6.5.2 Conceptual Design of Fuel Facility

The conceptual design of the future fuel pier is depicted in Figures 6-44 through 6-47. The Kauai Master Plan recommends the demolition of the existing pier structure and the construction of new harbor piers. The new Pier 1 Phase 1, which is a dedicated protruding segmented fuel pier, is designed to fit within the future master plan harbor envelope. Two main features of the proposed fuel pier are the alignment of the pier face and the landside connection via a causeway.

The berthing arrangement of the design fuel vessels is shown in Figures 6-44 and 6-45. The fuel barge would be moored and unloaded/loaded at the new piled fuel pier structure, adjacent to the existing breakwater. Access to the fuel transfer platform would be provided by means of a causeway. The portion of the piled causeway that runs parallel to the breakwater (roadway in northeast direction) would form part of the future Port Allen Harbor pier facilities. A smaller causeway would run northwards and provide access to land for the larger roadway. This smaller roadway would only serve in a temporary function and would be demolished in the process of the final construction of the future Port Allen Harbor pier facilities.

The breasting line of the fuel pier, established by four piled breasting dolphins, would matche the face line of the ultimate configuration that extend to the southwest, past the fuel pier. Transmission pipelines are attached to the roadway. The transmission pipelines would connect the fuel transfer station on the fuel pier with the existing landside pipelines and fuel facilities.

The fuel pier could also accommodate a 600-foot long Handysize Tanker (Figure 6-47). In order to accommodate tankers, the harbor basin would have to be dredged deeper and expanded sufficiently than for fuel barges, as indicated in Figure 6-46.

The new Pier 1 Phase 1 would have the following components:

1. Four breasting dolphins would be installed. The two breasting dolphins that are closest to the fuel transfer platform would each be fitted with two platform extensions:

    a. A platform to allow disembarkation from the fuel barge.

    b. A platform would support the two fixed foam monitors for fire protection.

2. Two mooring dolphins would be installed at the outward positions of the new fuel pier.

3. The four breasting dolphins and the two mooring dolphins would be connected with the fuel transfer platform by means of catwalks.

4. Fuel loading arms (either single-product or dual-product loading arms) would establish safe and efficient shore-to-ship fuel transfer connections. The number of loading arms would be determined by the type of fuel to be loaded at the fuel berth.

5. A fire suppression system with two fixed foam monitors, using seawater for foam generation would be installed on the pier. Different types of foam would be required for different fuel handled. The fixed foam monitors would be installed at suitable locations to allow good working coverage of foam spray on the fuel berth.

6. Adequate fixed lighting would be installed to illuminate all parts of the fuel pier that are critical for operating the fuel pier.

7. A central fuel monitoring system (fuel flow, pressures, temperatures, etc.) would inform the operator about fuel transfer progress.

8. Two-stage alarm system that would alert the operator to stop pumping fuel when the unloading arms near its limits of reach or when the mooring line loads are near its limits of loading capacity.

9. An emergency shutdown system that could be activated from a central point or at the pier.

10. Significant dredging would have to be carried out to establish a target depth of 35 feet at the pier face. The dredging for the fuel pier will be part of the dredging for the future master plan projects.

11. The piled causeway system would connect the fuel transfer platform with the shore-side could support medium maintenance trucks. The piled causeway would run parallel to the breakwater would be integrated in the future planned harbor pier structures. The portion of the causeway that connects the wider roadway to shore-side would be a smaller roadway. It is anticipated that this smaller roadway would not be an integrated part of the future harbor structures and therefore the smaller roadway would be considered to be of temporary nature, until the future Port Allen Harbor structures are completed.

12. Transmission pipelines would connect the fuel transfer station of the new Pier 1 Phase 1 with landside storage tank farms that are located northeast of the harbor outside of the secured harbor area. It is anticipated that the fuel barges would have enough pumping capacity to pump the fuel to the receiving tanks. Therefore, no new booster pumps would be considered.

13. The transmission pipelines would be installed on pipeline supports that would be attached to the new causeway. This form of installation is cost effective, and allows for easier construction, maintenance and inspection.

14. The transmission pipelines would run from the fuel transfer station on the fuel pier to a point where they would connect into the existing fuel lines.

Fuel products such as gasoline, diesel, jet fuel and ethanol would be off-loaded into existing landside tanks farms. All of Port Allen Harbor's storage facilities are currently located on privately owned property to the northwest of the commercial harbor. The transmission pipelines from the fuel pier to the privately owned storage tank facilities run on pipeline racks outside of the harbor boundaries. The existing tank farm serves the adjacent power plant with distillate and naphtha and dispenses gasoline and road diesel to fuel truck at the fuel terminal. The storage capacity for the power plant fuels conforms to the State's required 30 day minimum storage capacity.

It is contemplated by biofuel companies to install tanks for finished biofuels products and for biofuel feedstock in the area where the existing petroleum tank farm is located. Definite plans for the future site of such tanks have not been developed at this time. Because of the finite availability of harbor area and the need of such property for cargo use, there are no plans to install any additional storage facilities within Harbors Division's boundaries.

Figure 6-44 : CONCEPTUAL DESIGN - FUTURE FUEL FACILITY - SITE PLAN
Port Allen Commercial Harbor, Kauai

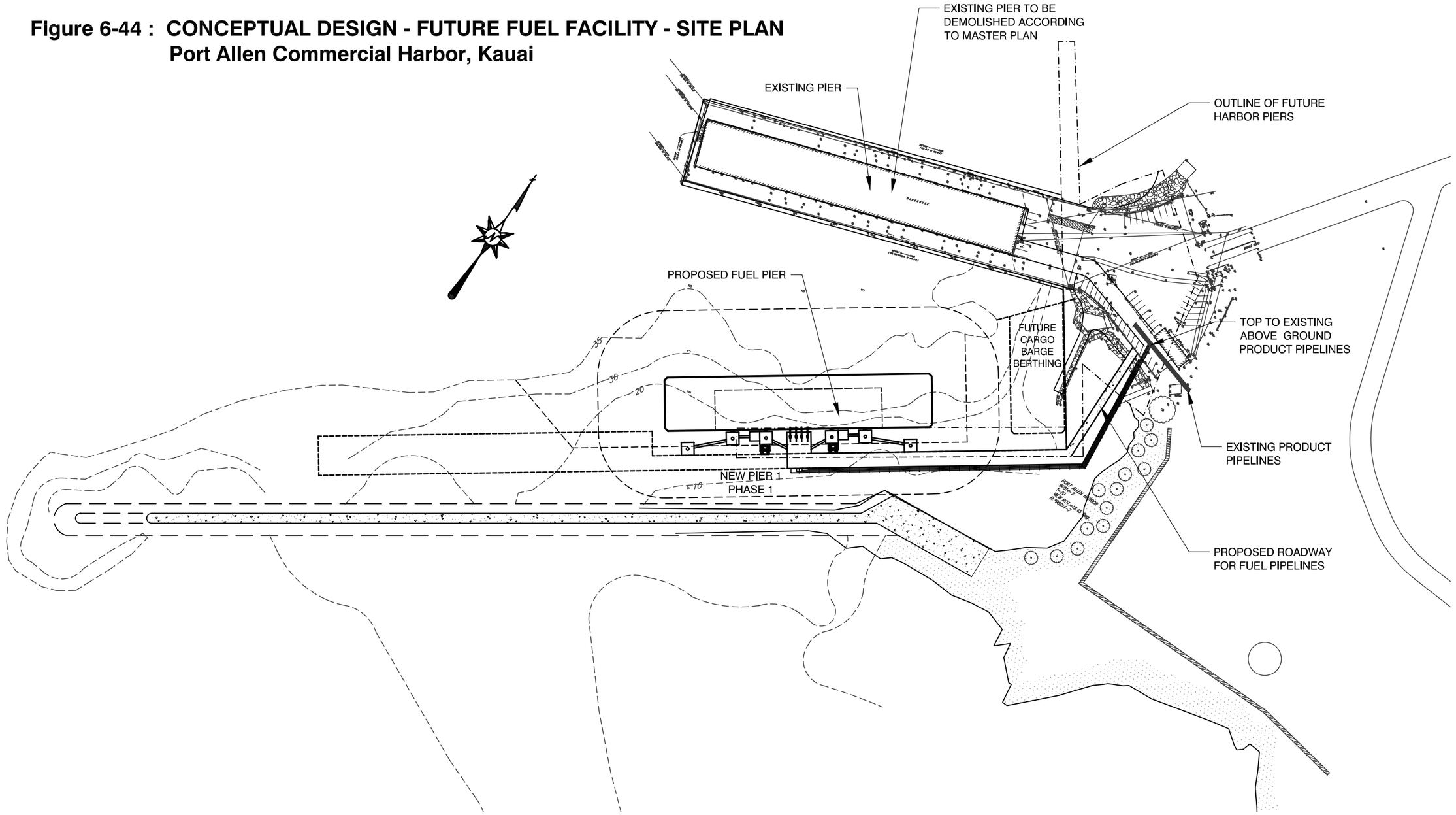

FIGURE 6-44

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GRAPHIC SCALE:
150' 0 150' 150'
SCALE: 1" = 150'-0"

DWG: J:\1244\dwg\Final with Comments (1-05-09)\Port Allen (1-05-09)\Figure 6-44.dwg USER: rreyes
DATE: Jan 06, 2009 1:58pm XREFS: 1244-X-Port Allen 1244-x-TBK Port Allen 11x17 IMAGES:

Figure 6-45 : CONCEPTUAL DESIGN - FUEL PIER - DETAIL PLAN
Port Allen Commercial Harbor, Kauai

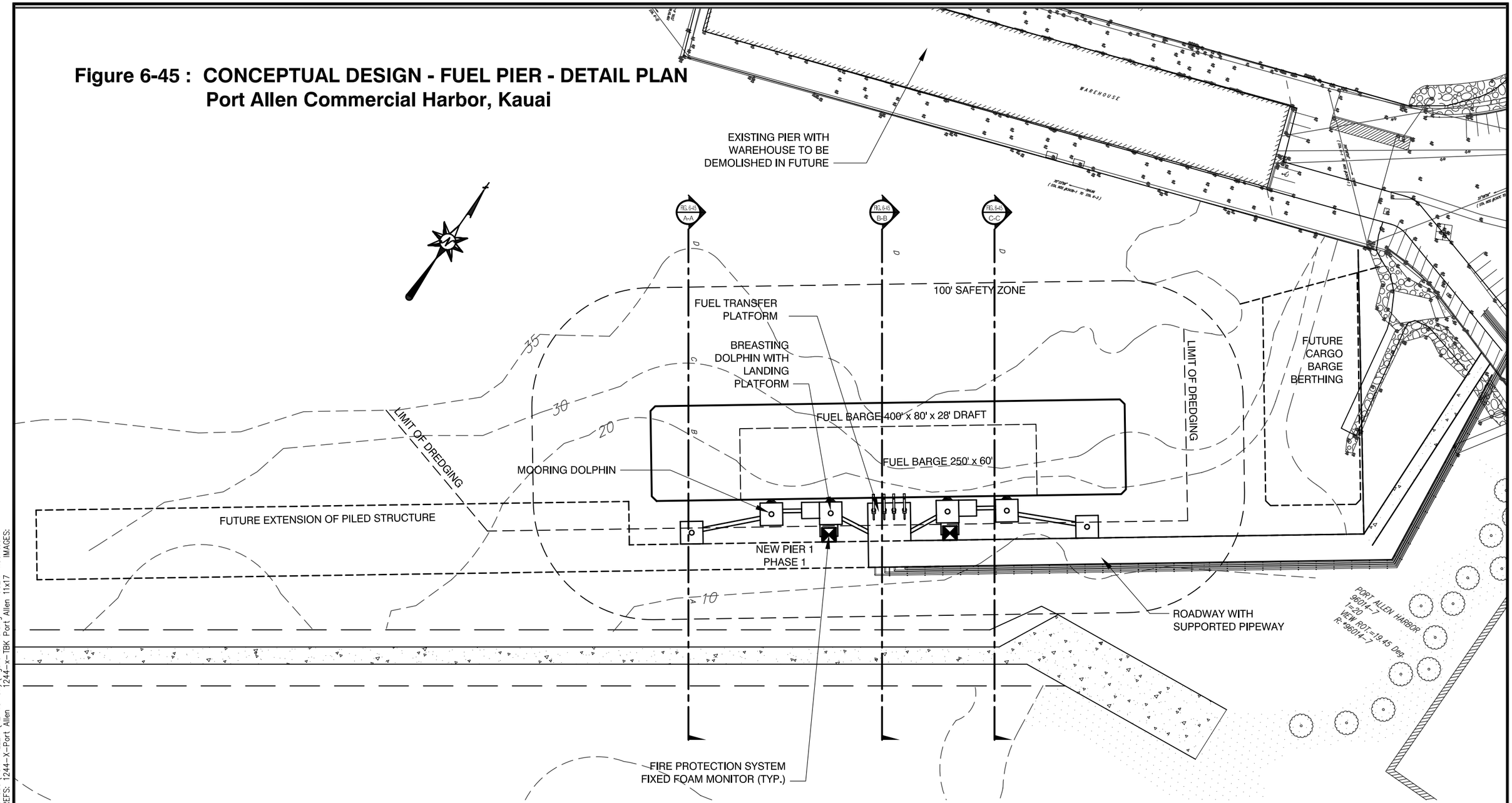

FIGURE 6-45

GRAPHIC SCALE:

80' 0 80' 160'

SCALE: 1" = 80'-0"

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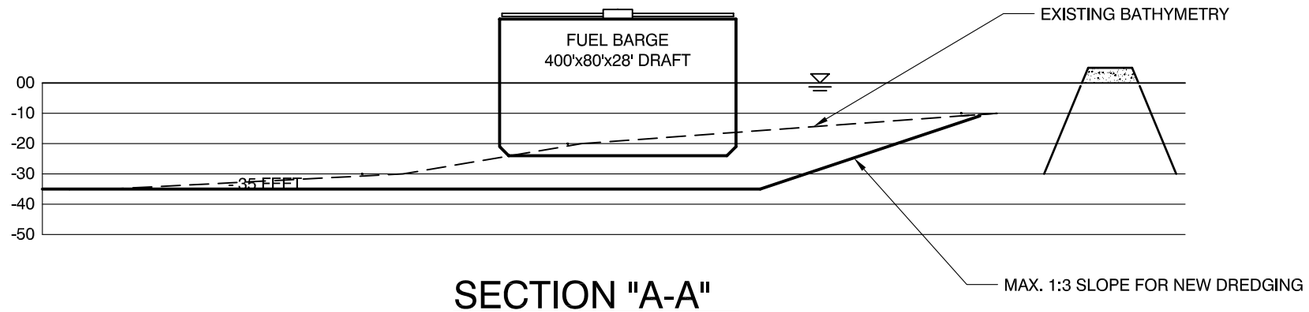
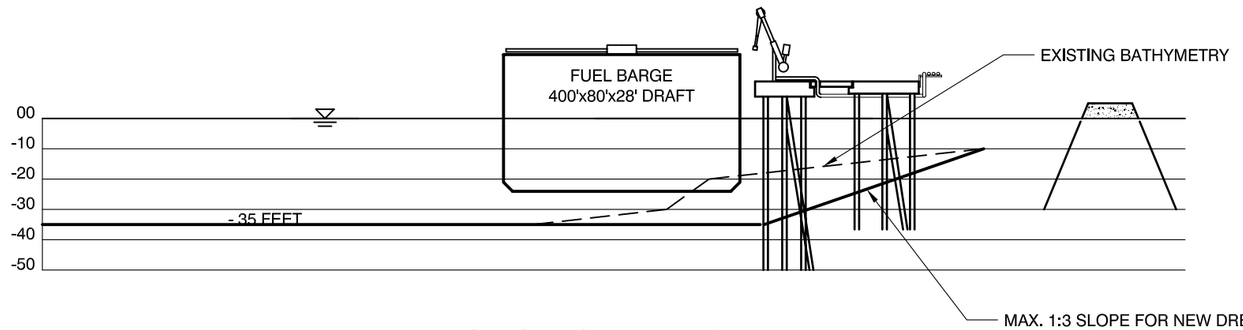
DWG: J:\1244\dwg\Presentation-4_Revised\PORT ALLEN (12-10-07)\Figure 6-45.dwg USER: nsantos
DATE: May 22, 2008 3:37pm XREFS: 1244-X-Port Allen 1244-x-TBK Port Allen 11x17 IMAGES:

Figure 6-46 : CONCEPTUAL DESIGN - DETAIL SECTIONS
Port Allen Commercial Harbor, Kauai



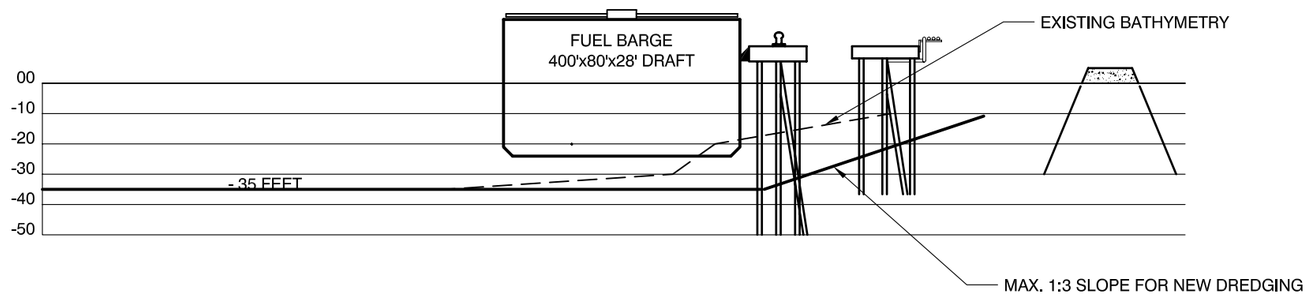
SECTION "A-A"

SCALE: 1"=50'-0"



SECTION "B-B"

SCALE: 1"=50'-0"



SECTION "C-C"

SCALE: 1"=50'-0"

FIGURE 6-46

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GRAPHIC SCALE:

50' 0 50' 50'

SCALE: 1" = 50'-0"

DWG: J:\1244\dwg\Presentation-4_Revised\PORT ALLEN (12-10-07)\Figure 6-46.dwg USER: nsantos
DATE: May 22, 2008 3:38pm XREFS: 1244-x-TBK Port Allen 11x17 IMAGES:

Figure 6-47 : CONCEPTUAL DESIGN - FUEL PIER - DETAIL PLAN WITH HANDYSIZE TANKER Port Allen Commercial Harbor, Kauai

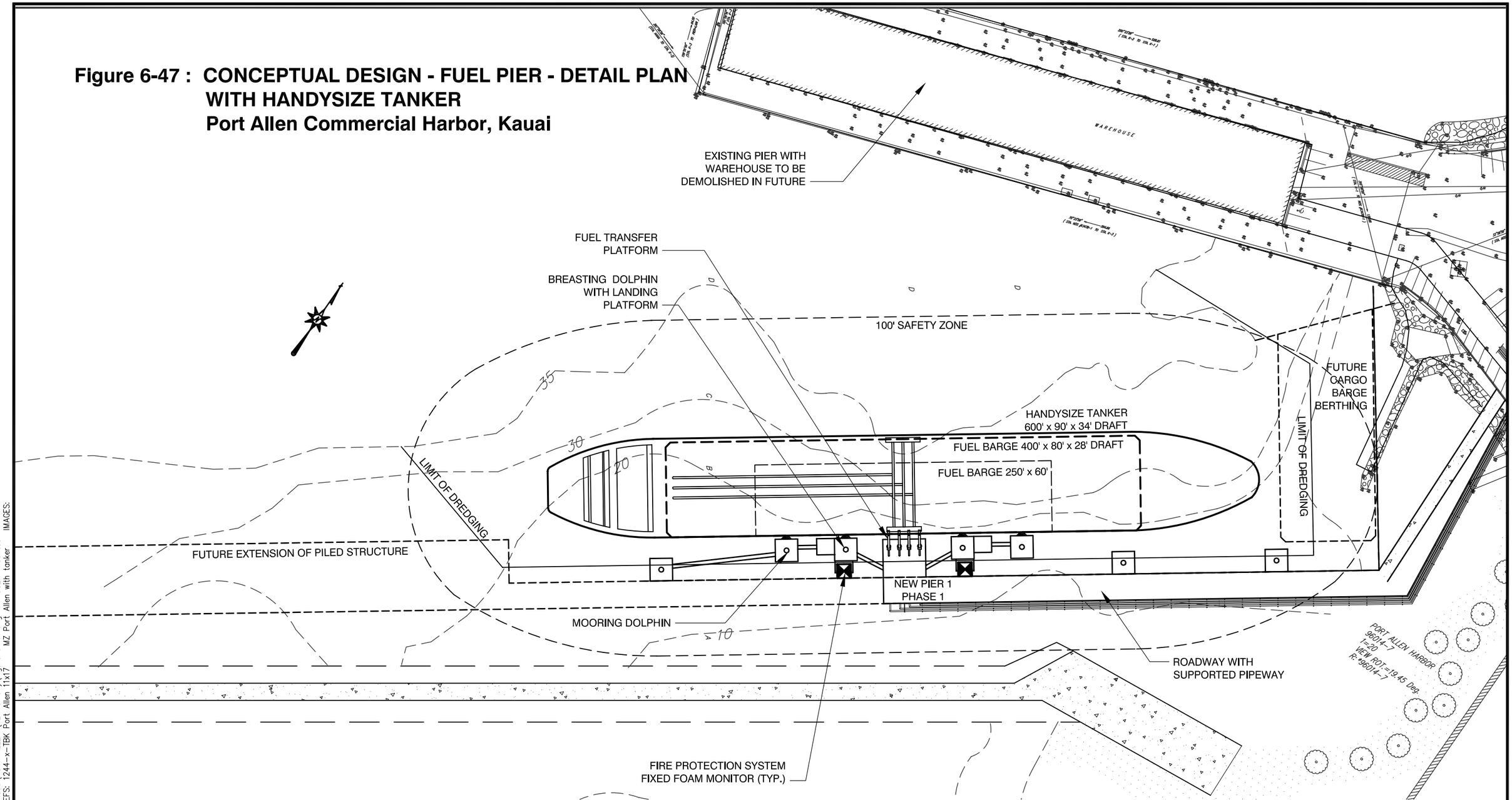

FIGURE 6-47

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GRAPHIC SCALE:

80' 0 80' 160'

SCALE: 1" = 80'-0"

DWG: J:\1244\dwg\Presentation-4_Revised\PORT ALLEN (12-10-07)\Figure 6-47.dwg USER: nsantos
DATE: May 22, 2008 3:39pm XREFS: 1244-x-TBK Port Allen 11x17 MZ Port Allen with tanker IMAGES:

6.6 Fuel Facility Alternatives in Hilo Harbor

Hilo Harbor is the principal harbor for fuel shipments to Hawaii Island. While some quantity of gasoline and diesel are currently transferred in Kawaihae Harbor, the main portions of fuel oil, jet fuel, ethanol and LPG are only shipped through Hilo. Jet fuel, ethanol and LPG are then transported to West Hawaii by fuel trucks. The transfer by truck is a proven and well-established means of supplying the entire island with fuel that arrives in Hilo Harbor. But safety and environmental concerns linked with heavy trucking over long distances and through a narrow and curvy road system renders fuel transfer through Kawaihae Harbor more advantageous. Considering the recommendation of expanding fuel shipments through Kawaihae Harbor, this would likely result in lower fuel volumes through Hilo Harbor.

While the overall quantity of fuel transferred in Hilo Harbor is anticipated to level off, the individual quantity of selected fuel and the variety of fuel types might, however, increase. The future development of fuel transfer facilities in Hilo Harbor will therefore be focused on alleviating competition for berthing space of current level fuel shipments with increasing cargo operations in the commercial harbor.

The construction of the new Pier 4 Inter-Island Cargo Terminal at an undeveloped shoreline near Pier 3 is underway. Before it is completed, it is recommended that the current fuel hatches be relocated to avoid conflicts with the new cargo operations at Pier 4. Because fueling operations require a safety zone, this zone would conflict with Pier 4 cargo operations. As an option, fuel hatches could also be located at Pier 2 to increase flexibility.

6.6.1 Design Framework for Future Fuel Facilities

Considering the three energy design schemes as described in Section 4, Hilo Harbor could support the following future fuel related shipping functions:

1. Off-loading fuel barges that bring petroleum products (including LPG) to Hawaii Island.

2. Off-loading fuel barges that bring liquid feedstock for biofuel production to Hawaii Island.

3. Loading fuel barges that export biofuels from Hawaii Island.

4. Off-loading compressed natural gas (CNG) barges to supply natural gas to the island gas utility (still an evolving technology).

It is anticipated that the range of types of fuel to be handled in the future would include the following:

1. Clean petroleum products (both conventional and evolving), including LPG, possibly also “dirty” fuels, such as residual fuels for power plants.

2. Non-petroleum products (biofuels such as ethanol and biodiesel, biofuel feedstock such as vegetable oil, molasses, etc.).

3. CNG as future fuel option.

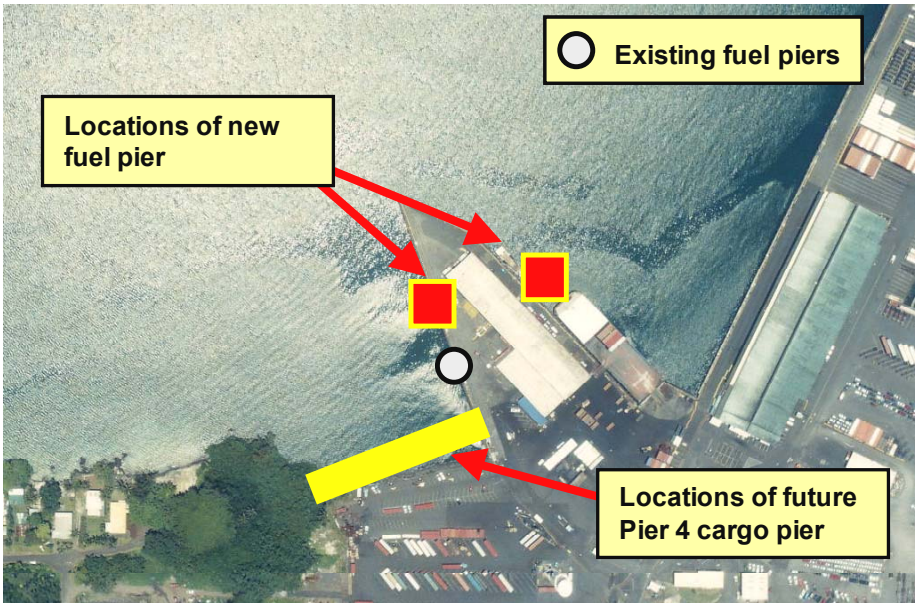

Figure 6-48: Location of Fuel Facility Alternatives for Hilo Harbor

Figure 6-48 shows the location of current fuel transfer facilities in Hilo Harbor and the recommended changes. No new fuel piers are planned. Rather, the existing fuel transfer hatches are relocated in order to keep the cargo operations at the new Pier 4 out of the fuel transfer safety zone. For the three fuel functions, the following vessel types will be accommodated at the future fuel pier:

1. Double-hull fuel barge: 400-foot long by 80-foot wide by 28-foot deep draft, capacity of approximately 80,000 barrels.

2. Gas barge: 246-foot long by 46-foot wide by 12-foot deep draft, capacity of approximately 16,000 barrels.

3. Handysize Tanker: 600-foot long by 95-foot wide by 34-foot deep draft, capacity of approximately 225,000 barrels.

6.6.2 Conceptual Design of Fuel Facility

The conceptual design of the fuel pier is depicted in Figures 6-49. Fuel and LPG barges would be moored at Piers 2 and 3. The proposed fuel pier configuration could use existing breasting and mooring infrastructure located there. The proposed berthing arrangements for the design fuel vessels are shown in Figure 6-50. The fuel hatches in Pier 3 would be relocated towards

the end of the pier in order to establish a satisfactory operational envelope for fueling operations as the Pier 4 development is completed. New transmission fuel pipelines would be installed that would run from the existing to the new fuel hatches. A new fuel transfer station would be installed at the middle of Pier 2. New transmission pipelines would be installed that would connect the fuel transfer station on Pier 2. The transmission pipelines to Pier 2 would branch from pipelines that go to the fuel transfer station on Pier 3. Shutoff valves would isolate the fuel transfer stations in Piers 2 and 3 to increase operational flexibility.

Piers 2 and 3 would have the following components:

1. A fire suppression system with two fixed foam monitors would be installed on Piers 2 and 3. Seawater would be used for the foam generation. Different types of foam using seawater for the foam generation at Piers 2 and 3 would be required for different fuel that would be handled. The fixed foam monitors would be installed at suitable locations to allow good working coverage of foam spray on the fuel berth.

2. Adequate fixed lighting would be installed to illuminate all parts of the fuel pier that are critical for operating the fuel pier.

3. A central fuel monitoring system (fuel flow, pressures, temperatures, etc.) would inform the operator about the fuel transfer progress.

4. Two-stage alarm system that would alert the operator to stop pumping fuel when the unloading arms near its limits of reach or when the mooring line loads are near its limits of loading capacity.

5. An emergency shutdown system could be activated from a central point or at the pier.

6. New portions of transmission pipelines would be added to connect the new fuel transfer station at Pier 3 with the existing fuel lines. The new pipelines would be installed below the piled pier platform.

7. The transmission pipes to the new fuel transfer station at Pier 2 would branch off from pipelines at Pier 3. Pipelines leading to the fuel transfer stations in Pier 2 and 3 would be equipped with valves to isolate flows of fuel to Piers 2 and 3.

Fuel products such as distillate, residual oil, gasoline, ethanol, jet fuel and LPG are off-loaded into existing landside tank farms. All of Hilo Harbor's storage facilities are located on privately owned property. Because of the finite availability of harbor area and the need of such property for cargo use, there are no plans to install any additional storage facilities within Harbors Division's boundaries.

Figure 6-49 : CONCEPTUAL DESIGN - FUEL PIER - SITE PLAN
Hilo Commercial Harbor, Hawaii Island

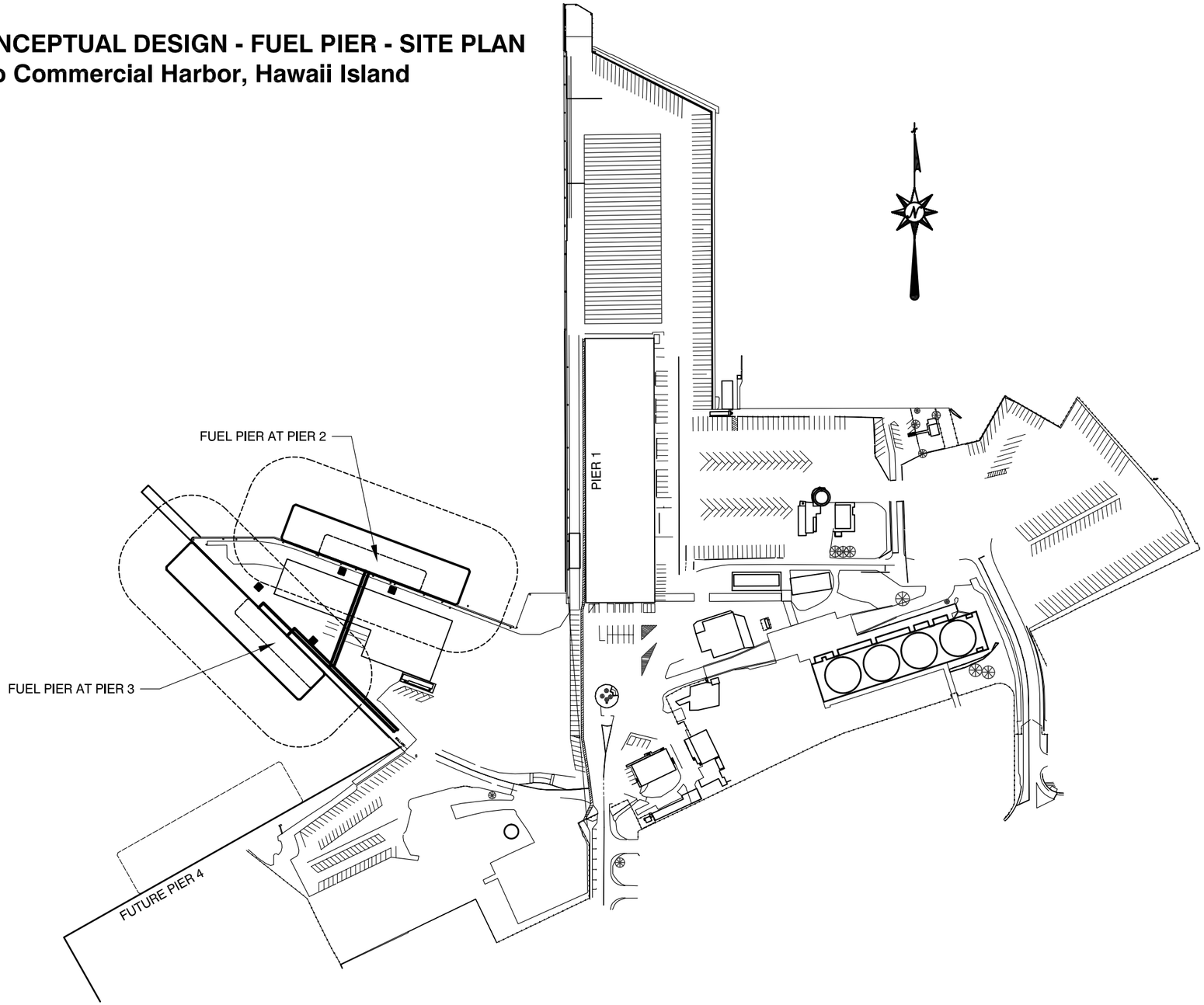

FIGURE 6-49

GRAPHIC SCALE:

250' 0 250' 500'

SCALE: 1" =250'-0"

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DWG: J:\1244\dwg\Presentation-4_Revised\HILO (12-10-07)\Figure 6-49.dwg USER: nsantos
DATE: May 22, 2008 3:41pm XREFS: 1244-x-hilo base plan 1244-x-TBK 11x17 IMAGES:

Figure 6-50 : CONCEPTUAL DESIGN - FUEL PIER - DETAIL PLAN
Hilo Commercial Harbor, Hawaii Island

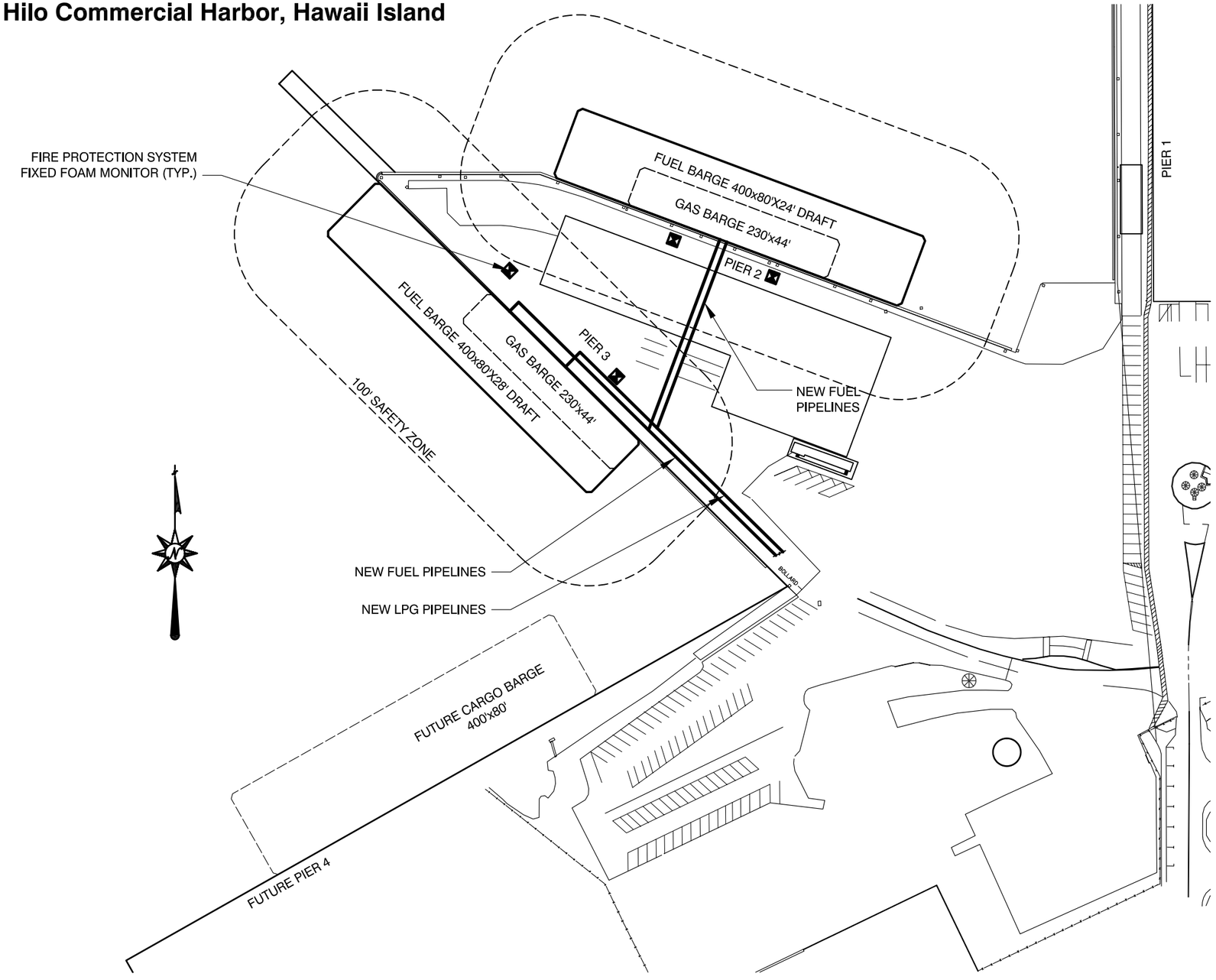

FIGURE 6-50

GRAPHIC SCALE:

125' 0 125' 250'

SCALE: 1" =125'-0"

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DWG: J:\1244\dwg\Presentation-4_Revised\HILO (12-10-07)\Figure 6-50.dwg USER: nsantos
DATE: May 22, 2008 3:42pm XREFS: 1244-x-hilo base plan 1244-x-TBK 11x17 IMAGES:

6.7 Fuel Facility Alternatives in Kawaihae Harbor

As pointed out in Section 5.1.7, it is anticipated that fuel shipments through Kawaihae Harbor will significantly increase because of its strategic location relative to growth patterns on Hawaii Island. Presently, a substantial amount of fuel is trucked to West Hawaii from Hilo Harbor. While West Hawaii is anticipated to continue developing at a brisk rate, the need for petroleum products will increase in the future because of its attraction for development. This requires additional fuel shipments through Kawaihae Harbor as the economies of scale supports this.

An important consideration when increasing the fuel transfer capacities in Kawaihae Harbor is the presence of adequate storage tank capacity. Additional tank capacity represents an operational bottleneck in the development of the fuel infrastructure for the harbor. Adequate storage capacities for the different fuel products have to be made available so that the fuel barges can be efficiently off-loaded. In the preferred scenario, fuel is transferred through pipelines from the fuel barges to remote fuel tanks outside the harbor boundaries. Fuel trucks can then distribute fuel to locations in West Hawaii. Presently, there is one fuel company at Kawaihae Harbor that has fuel storage capacity. Its facility is located landside of Pier 2A and is connected to the fuel transfer station at Pier 2A. The extent of possible expansion of fuel transfer infrastructure at Kawaihae Harbor hinges around adequately sized and diversified tank storage capacity. While the *Hawaii Harbors 2020 Master Plan* designates areas in the harbor for liquid-bulk cargo storage, this recommendation will be re-evaluated in the *Hawaii Harbors 2030 Master Plan* process because of numerous issues associated with the location.

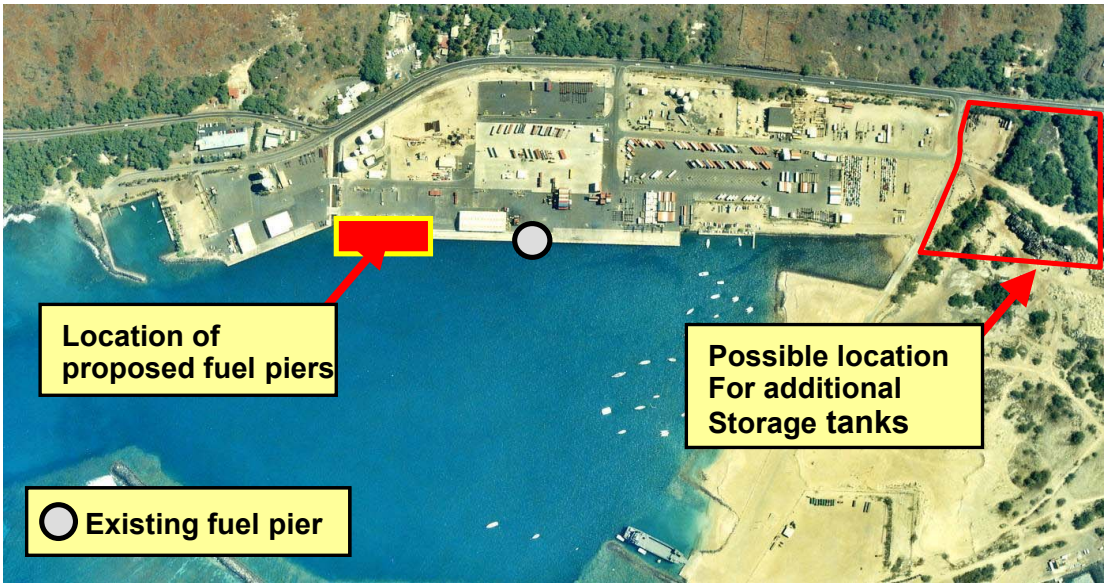

Figure 6-51: Location of Fuel Facility Alternatives for Kawaihae Harbor

The current and proposed fuel facilities in Kawaihae Harbor are shown in Figure 6-51. A possible area for additional storage tanks is also indicated in Figure 6-51.

6.7.1 Design Framework for Future Fuel Facilities

Considering the three energy design schemes as described in Section 4, Kawaihae Harbor could support the following future fuel related shipping functions:

1. Off-loading fuel barges with petroleum products.
2. Off-loading fuel barges with biofuels (e.g., ethanol and biodiesel).
3. Off-loading liquid petroleum gas (LPG) (e.g., propane) barges.
4. Off-loading fuel vessels with biofuel feedstocks for the production of biofuels on Hawaii Island.
5. Loading fuel barges that export biofuels from the island and transporting them between the Hawaiian Islands.

It is anticipated that the range of types of fuel to be handled in the future would include the following:

1. Clean petroleum products such as gasoline, diesel, jet fuel.
2. Non-petroleum products (e.g., ethanol, methanol, biodiesel, biofuel feedstocks such as vegetable oil, molasses, etc.).
3. LPG (e.g., propane).

For the five fuel shipping functions, the following vessel types would be accommodated at the proposed fuel pier:

1. Double-hull fuel barge: 400-foot long by 80-foot wide by 28-foot deep draft, capacity of approximately 80,000 barrels.
2. Gas barge: 246-foot long by 46-foot wide by 12-foot deep draft, capacity of approximately 16,000 barrels.
3. Handysize Tanker: 600-foot long by 95-foot wide by 34-foot deep draft, capacity of approximately 225,000 barrels.

6.7.2 Conceptual Design Alternative A; Pier 2 With Short Pier Extension

The conceptual design of fuel pier is depicted in Figures 6-52. Fuel barges would be moored at Pier 2A. Alternative A would require the installation of two breasting dolphins and one mooring dolphin. The design fuel barge would protrude about 175 feet beyond the northern end of

existing Pier 2. The fuel transfer station would be relocated from the middle section of Pier 2 to its new location. Fuel barges would berth at the northern end of Pier 2. The fuel transfer station would connect to existing fuel transfer pipelines in Pier 2.

Figure 6-53 shows the design fuel barge moored at the fuel transfer facility of Alternative A. The 100 foot safety zone around the fuel barge affects the cargo operations at Pier 2. While the fuel barge is at the fuel pier, one 250 foot and one 400 foot cargo barge can be moored at Pier 2, therefore increasing the current berthing capacity of Pier 2 from two to three barges (including the fuel barge).

Figure 6-54 shows a 600-foot long Handysize Tanker moored at the fuel transfer facility at Alternative A. The 100 foot safety zone around the tanker affects the cargo operations at Pier 2. While the tanker is at the fuel pier, two 270-foot long cargo barges are moored at Pier 2.

Pier 2 Short Extension would have the following components:

1. A new fuel transfer station would be constructed at the northern end of Pier 2. The new fuel transfer station would be protected by bollards against accidental impact from vehicles operating on Pier 2.

2. Two breasting dolphins would be installed in the area between Piers 1 and 2. The breasting dolphins would be constructed as piled structures. The breasting dolphins would extend the breasting line of Pier 2.

3. One mooring dolphin would be installed to the north of the two breasting dolphins.

4. The two breasting dolphins and one mooring dolphin would be connected by catwalks. The first catwalk would connect the innermost breasting dolphin with Pier 2.

5. Fuel loading arms (either single-product or dual-product loading arms) would establish safe and efficient shore-to-ship fuel transfer connections. The number of loading arms would be determined by the type of fuel to be loaded and /unloaded at the fuel berth.

6. A fire suppression system with two fixed foam monitors would be installed on the pier. Seawater would be used for the foam generation. Different types of foam using seawater for the foam generation would be required for different fuel that would be handled. The fixed foam monitors would be installed at suitable locations to allow good working coverage of foam spray on the fuel berth.

7. Adequate fixed lighting would be installed to illuminate all parts of the fuel pier that are critical for operating the fuel pier.

8. A central fuel monitoring system (fuel flow, pressures, temperatures, etc.) would inform the operator about fuel transfer progress.

9. A two-stage alarm system would alert the operator to stop pumping fuel when the unloading arms near its limits of reach or when the mooring line loads are near its limits of loading capacity.

10. An emergency shutdown system that could be activated from a central point or at the pier.

11. Fuel transfer pipelines from the new fuel pier would connect with existing interconnecting pipelines that are installed in Pier 2.

12. Additional fuel pipelines would be installed depending on the type of fuel that would be transferred. More transmission pipelines might be required, if additional fuel products are unloaded/loaded.

An existing tank farm is located adjacent to Pier 2A. It is anticipated that additional storage capacity would have to be installed. The additional storage capacity would be required for the current petroleum products as well as for the new biofuels and emerging petroleum based fuels. The *Hawaii Commercial Harbors 2030 Master Plan* will determine the location of the additional fuel storage.

6.7.3 Conceptual Design Alternative B – Pier 2 Long Pier Extension

The conceptual design of the fuel pier is depicted in Figures 6-55. Fuel vessels would be moored at a piled fuel pier located at the undeveloped shoreline between Piers 1 and 2. Three breasting dolphins and one mooring dolphin would be installed. The breasting line of the fuel pier would be established by three piled breasting dolphins. A small portion of the breasting line would be established by the pier face of the existing Pier 2. The fuel transfer station would be located on a piled platform. The fuel transfer platform would be connected by means of a short roadway.

Figure 6-56 shows the design fuel barge moored at the fuel transfer facility of Alternative B. The 100 foot safety zone around the fuel barge would affect the cargo operations at Pier 2 and Pier 1 (if repaired and operational). While the fuel barge is moored at the Pier 2, two 400-foot long cargo barges could be moored simultaneously at Pier 2, therefore berthing capacity at Pier 2 is increased from two to three barges. Alternative B would affect shipping operations at Pier 1 more than Alternative A, since the safety zone from fuel vessels in Alternative B would intrude into parts of Pier 1.

Figure 6-57 shows a 600-foot long Handysize Tanker moored at the fuel transfer facility of Alternative B. The 100 foot safety zone around the tanker would affect the cargo operations at Pier 2 and Pier 1. While the tanker is at the fuel pier, two 400-foot long cargo barges could moor at Pier 2. The Handysize Tanker moored at the fuel pier of Alternative B would significantly intrude into the operation envelope of Pier 1.

Pier 2 Long Extension would have the same design features as the Pier 2 Short Extension except for following components:

1. Three breasting dolphins would be installed as piled structures each with mooring bollard and fendering systems. Two breasting dolphins would have each a disembarkation platform attached to the breasting dolphin platform in order to provide safe access to fuel barges (Note: the Handysize Tanker might require a larger disembarkation platform as depicted in the figure). The three breasting dolphins would extend the breasting line of Pier 2.

2. One mooring dolphin would be installed.

3. A catwalk would connect the breasting and mooring dolphins among each other and/or to the roadway.

4. A new fuel transfer station would be constructed as a piled platform. The fuel transfer platform would be recessed from the breasting line.

5. A short roadway would connect the fuel transfer station with Pier 2. The fuel transfer pipelines would be installed on pipeline supports that are attached to the roadway.

6. The fuel pipelines between the fuel transfer station and the pipelines in Pier 2 would be supported by pipeline racks, which are attached to the roadway.

6.7.4 Advantages and Disadvantages of Conceptual Design Alternatives

Table 6-3 lists advantages and disadvantages of the two conceptual design alternatives for Kawaihae Harbor.

Figure 6-52 : CONCEPTUAL DESIGN - ALTERNATIVE A - SITE PLAN
Kawaihae Commercial Harbor, Hawaii Island

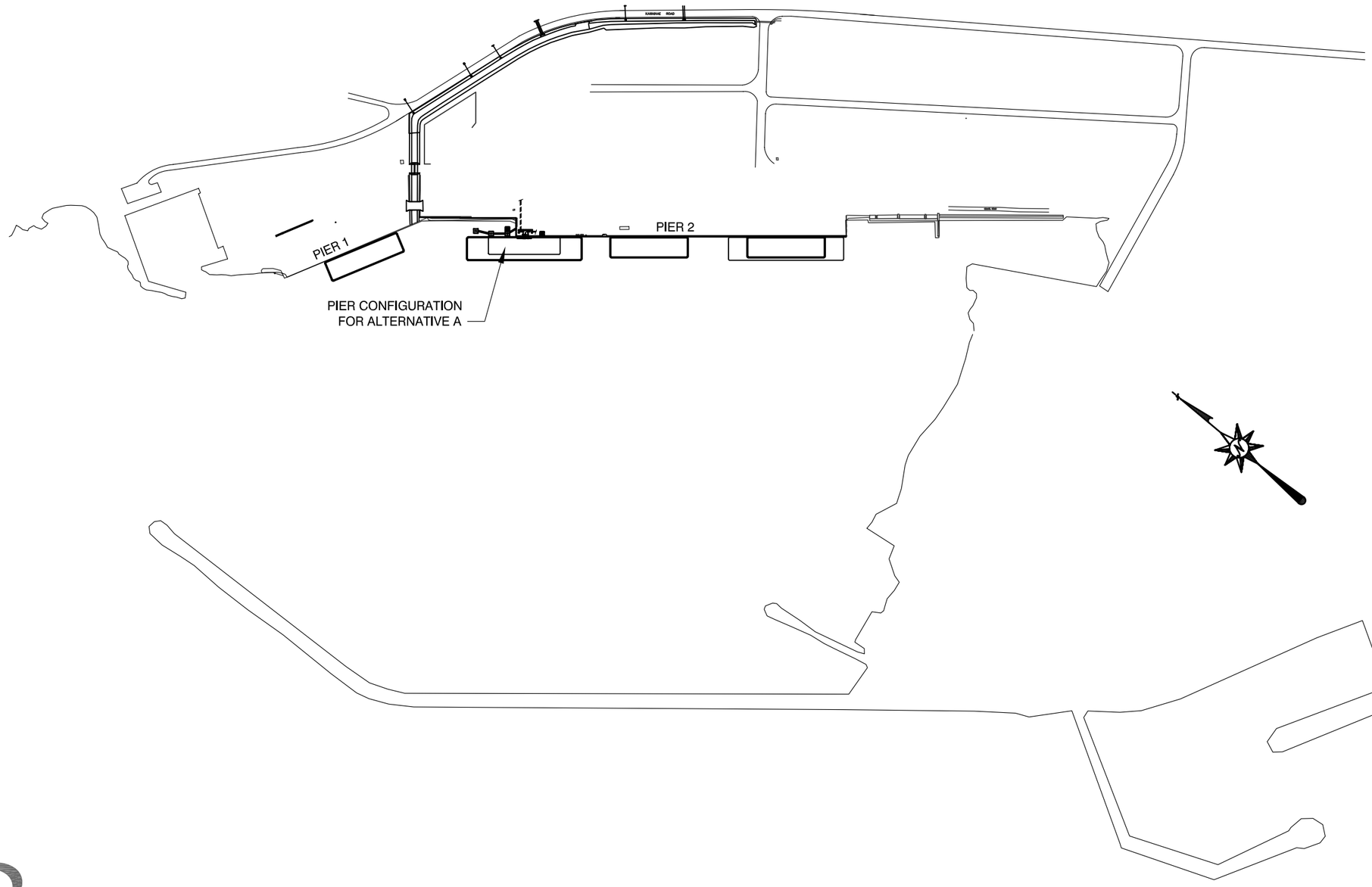

FIGURE 6-52

GRAPHIC SCALE:

400' 0 400' 800'

SCALE: 1" =400'-0"

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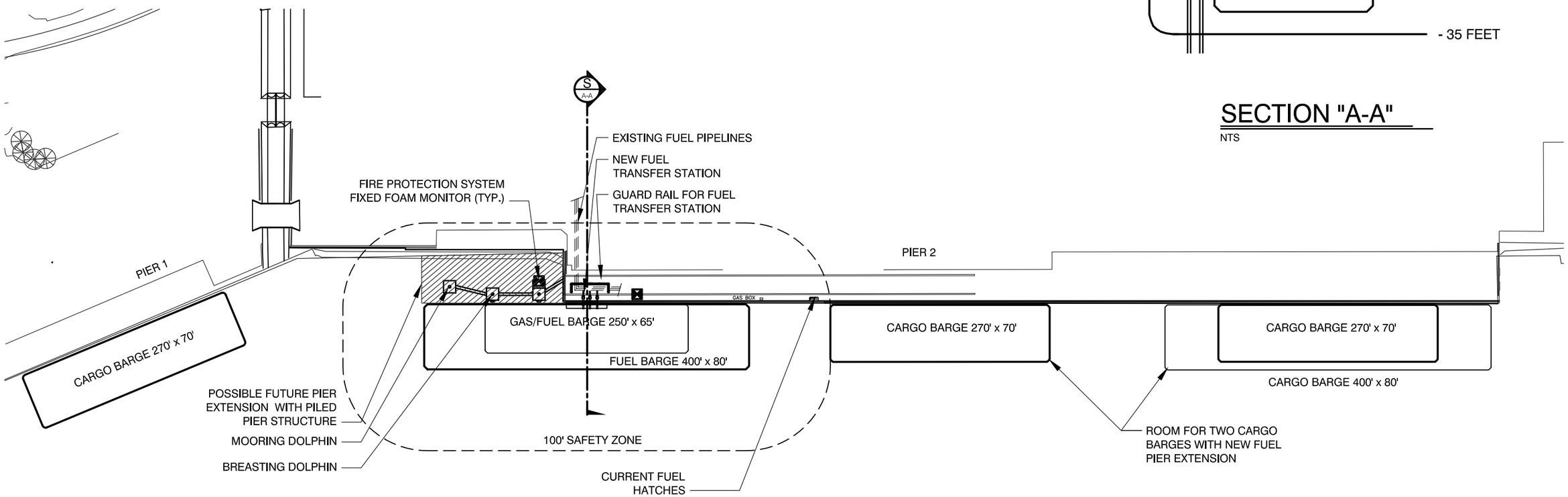
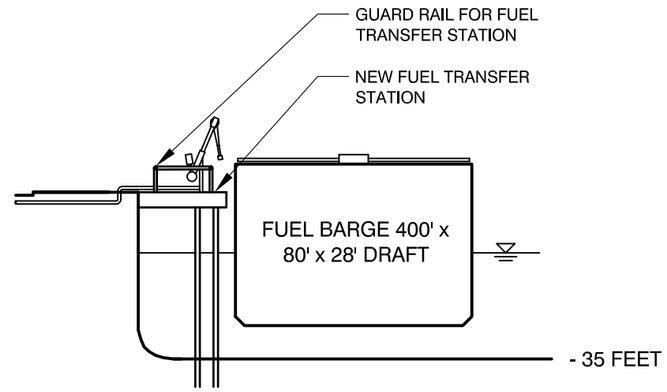
DWG: J:\1244\dwg\Presentation-4_Revised\KAWAIHAE (12-10-07)\Figure 52.dwg USER: nsantos
DATE: May 22, 2008 3:45pm XREFS: 1244-x-TBK Kawaihae 11x17 1244-x-Kawaihae CF-1B IMAGES:

Figure 6-53 : CONCEPTUAL DESIGN - ALTERNATIVE A - DETAIL PLAN
Kawaihae Commercial Harbor, Hawaii Island





SECTION "A-A"

NTS

FIGURE 6-53

GRAPHIC SCALE:

125' 0 125' 250'

SCALE: 1" =125'-0"

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DWG: J:\1244\dwg\Presentation-4_Revised\KAWAIHAE (12-10-07)\Figure 53.dwg USER: nsantos
DATE: May 22, 2008 3:47pm XREFS: 1244-x-TBK Kawaihae 11x17 1244-x-Kawaihae CF-1B IMAGES:

Figure 6-54 : CONCEPTUAL DESIGN - ALTERNATIVE A - DETAIL PLAN WITH 600 FEET HANDYSIZE TANKER
Kawaihae Commercial Harbor, Hawaii Island

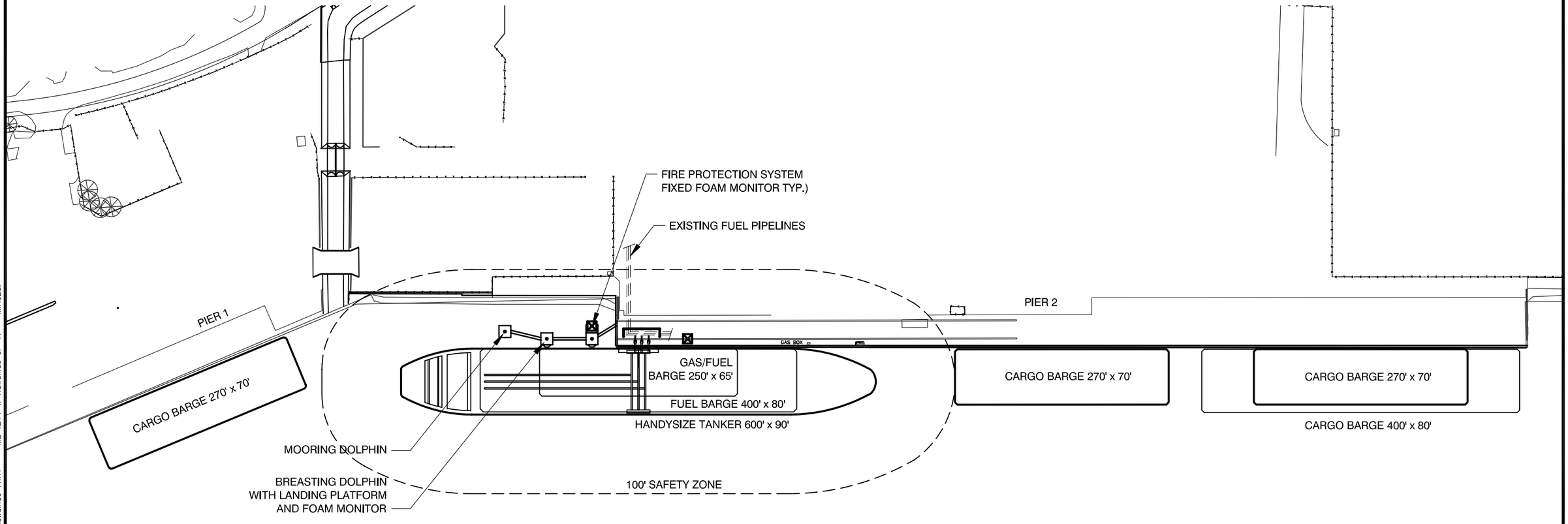

FIGURE 6-54

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GRAPHIC SCALE:
125' 0 125' 250'
SCALE: 1" =125'-0"

DWG: J:\1244\dwg\Presentation-4_Revised\K-KAWAIHAE (12-10-07)\Figure 54.dwg USER: nsantos
DATE: May 22, 2008 3:47pm XREFS: 1244-x-TBK Kawaihae 11x17 MZ 1244-x-Kawaihae CF-11 IMAGES:

Figure 6-55 : CONCEPTUAL DESIGN - ALTERNATIVE B - SITE PLAN
Kawaihae Commercial Harbor, Hawaii Island

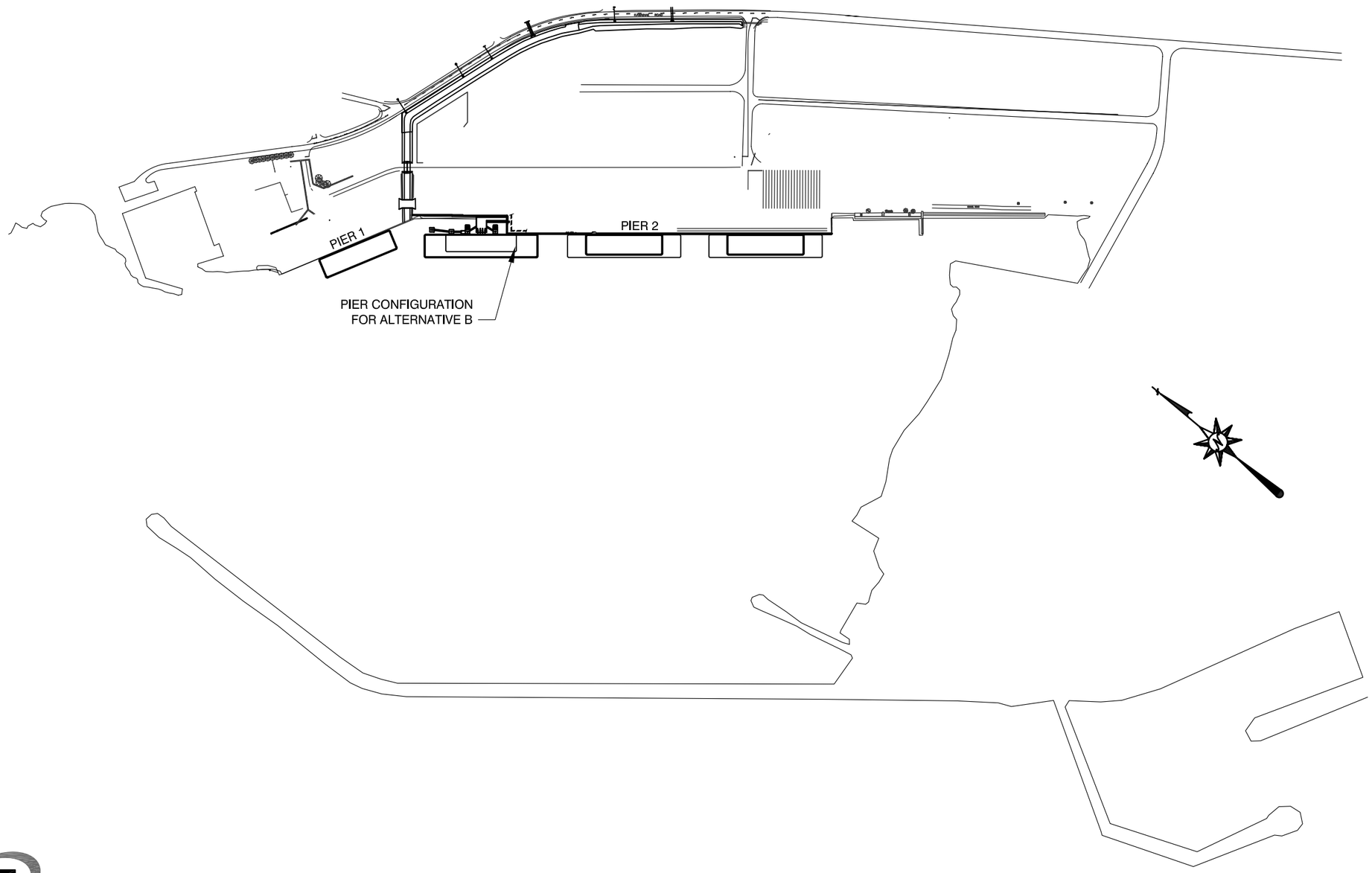

FIGURE 6-55

GRAPHIC SCALE:

400' 0 400' 800'

SCALE: 1" =400'-0"

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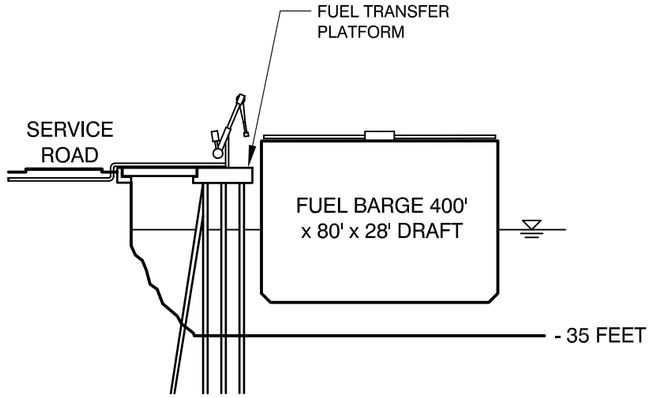
DWG: J:\1244\dwg\Presentation-4_Revised\KAWAIHAE (12-10-07)\Figure 55.dwg USER: nsantos
DATE: May 22, 2008 3:48pm XREFS: 1244-x-TBK Kawaihae 11x17 1244-x-Kawaihae CF-2 IMAGES:

Figure 6-56 : CONCEPTUAL DESIGN - ALTERNATIVE B - DETAIL PLAN
Kawaihae Commercial Harbor, Hawaii Island



SECTION "A-A"
NTS

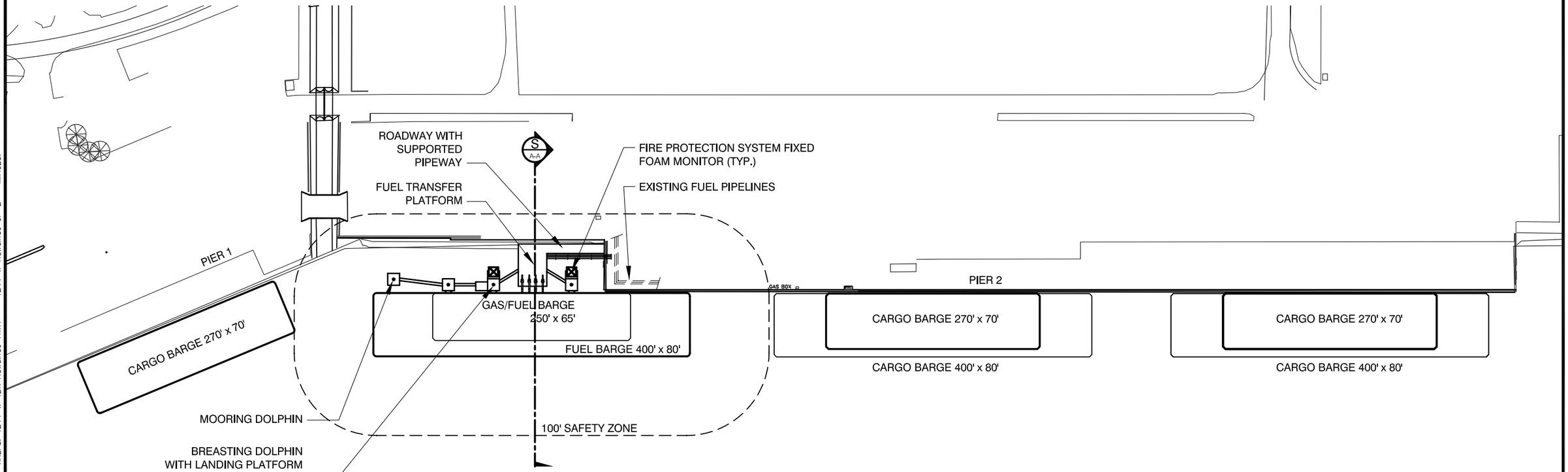


FIGURE 6-56

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GRAPHIC SCALE:
125' 0 125' 250'
SCALE: 1" = 125'-0"

DWG: J:\1244\dwg\Presentation-4_Revised\KAWAIHAE (12-10-07)\Figure 56.dwg USER: nsantos
DATE: May 22, 2008 3:49pm XREFS: 1244-x-TBK Kawaihae 11x17 1244-x-Kawaihae CF-2 IMAGES:

Figure 6-57 : CONCEPTUAL DESIGN - ALTERNATIVE B - DETAIL PLAN WITH 600 FEET HANDYSIZE TANKER
Kawaihae Commercial Harbor, Hawaii Island

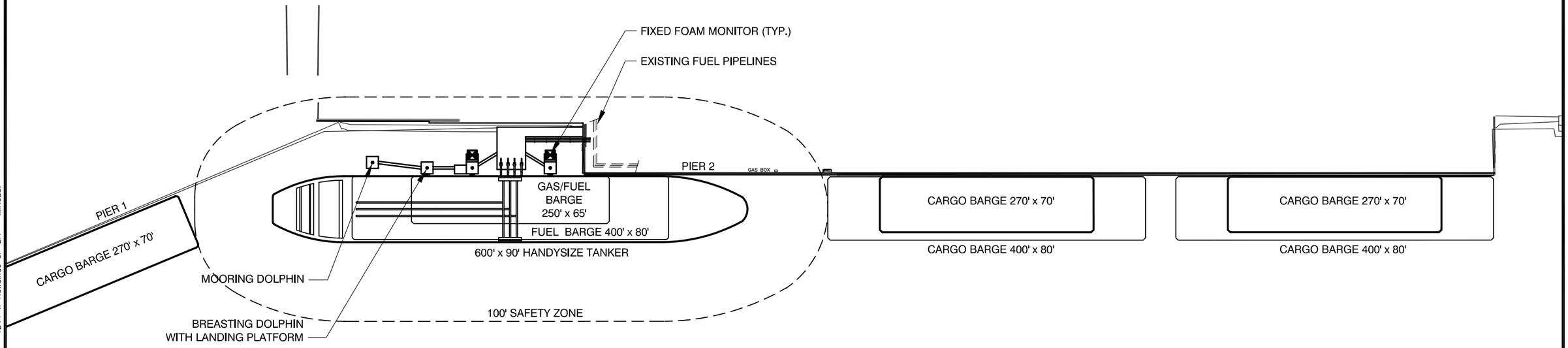

FIGURE 6-57

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GRAPHIC SCALE:

125' 0 125' 250'

SCALE: 1" =125'-0"

DWG: J:\1244\dwg\Presentation-4_Revised\KAWAIHAE (12-10-07)\Figure 57.dwg USER: nsantos
DATE: May 22, 2008 3:49pm XREFS: 1244-x-TBK Kawaihae 11x17 1244-x-Kawaihae CF-2A IMAGES:

Table 6-3 Kawaihae Harbor: Advantages and Disadvantages of Conceptual Design Alternatives (Page 1 of 2)

Kawaihae Alternative A: Pier 2 Short Pier Extension

Advantages	Disadvantages
• The Pier 2 Short Extension would use two breasting dolphins and one mooring dolphin to create an extension of Pier 2. This is a very cost effective improvement of Pier 2 and would provide more berthing space in the harbor. • The Pier 2 short extension would use an otherwise unusable part of the harbor. • The close proximity of the new fuel barge pier to existing interconnecting pipelines minimizes the costs for new transmission pipelines. The new fuel transfer station could directly connect to existing pipelines in Pier 2, thereby further minimizing additional costs. • The fuel transfer station could be located on the existing Pier 2. No new platform for the fuel transfer station would have to be installed. This would be a cost saving factor. • The impact to harbor operation during period of construction would be minimal. During construction, two barges should still be able to berth along Pier 2. • Using loading arms would reduce the vulnerability to fuel transfer operations due to large movements of the barge, which can result from short- and long-period wave action at the harbor entrance. Fuel transfer would be safer and requires significantly less maintenance with loading arms than with flexible hoses. • Dredging required would be minimal. • Impact to operations at Pier 1 is less than for Alternative B (i.e., Pier 2 Long Extension)	• The Pier 2 Short Extension would bring moored fuel vessels within the 100-foot safety zone that surrounds the fuel barges into Pier 1's berthing envelope, and possibly interfering with other operations at Pier 1. • Wave induced motions could be significant, requiring loading arms and capable fendering system to allow for secure and efficient fuel transfer. • The loading arm installation on the existing multi-use Pier 2 would need to be adequately protected against collision by trucks and other cargo handling equipment operating around the area. • Alternative A would provide less berthing room for cargo barges berthed at Pier 2 than Alternative B (i.e., Pier 2 Long Extension)

Table 6-3 Kawaihae Harbor: Advantages and Disadvantages of Conceptual Design Alternatives (Page 2 of 2)

Kawaihae Alternative B: Pier 2 Long Pier Extension

Advantages	Disadvantages
• The Pier 2 Long Extension would use of three breasting and one mooring dolphin to create an extension of Pier 2. This is a very cost effective improvement of Pier 2 and would provide more berthing space in the harbor. • The 2 Long Extension would use an otherwise unusable part of the harbor. • Extending the pier with two piled breasting and one mooring dolphins would provide a total of three berthing spaces for large barges. • The close proximity of the new fuel barge pier to existing interconnecting pipelines minimizes the costs for new transmission pipelines. The new fuel transfer station could connect to existing pipelines in Pier 2, thereby further minimizing additional costs. • The fuel transfer station would be located on a separate piled fuel transfer station equipped with loading arms, therefore avoiding accidental impacts from cargo handling equipment on Pier 2. • The impact to harbor operation during construction would be minimal, since two barges still could use Pier 2 simultaneously. • Using loading arms would reduce the vulnerability to fuel transfer operations due to large movements of the barge, which can result from short- and long-period wave action at the harbor entrance. Fuel transfer would be safer and requires significantly less maintenance with loading arms than with flexible hoses. • Dredging required would be minimal.	• The Pier 2 Long Extension could bring moored fuel vessels within the 100-foot safety zone that surrounds the fuel barges into Pier 1's berthing envelope, and possibly interfering with other operations at Pier 1. • The portion of the pier that would be exposed to the higher incident wave is greater than Alternative A (i.e., Pier 2 Short Extension). • Wave induced motions could be significant, requiring loading arms and a capable fendering system. • A piled platform for the fuel transfer station would have to be installed. In comparison, Kawaihae Alternative A (i.e., Pier 2 Short Extension) would not have a piled platform since the fuel transfer station of Alternative A is located on the existing Pier 2.

SECTION SEVEN

PRIORITY RANKING FOR UPGRADING FUEL FACILTIES

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SECTION SEVEN

PRIORITY RANKING FOR UPGRADING FUEL FACILITIES

Section Seven assigns priorities to upgrade or add fuel facilities among Hawaii's commercial harbors and among multiple proposed design alternatives for three of these harbors. The priority assessment indicated below is based on a number of development and policy criteria, as described below.

7.1 Assigning Priorities for Fuel Facility Upgrades Among the Commercial Harbors

This section assigns priorities among the six commercial harbors for fuel facilities upgrades. This section introduces the methodology for the priority assessment an then performs the quantitative assessment and concludes what priorities are assigned to what commercial harbor.

7.1.1 Methodology of Quantitative Priority Assessment

The priorities are assigned among the commercial harbors by means of an overall Priority Index. The Priority Index, which ranks the commercial harbors in regard to required fuel facilities upgrades, is a combination of overall weights for criteria and quantitative contributions to these weights for specific commercial harbors. The higher the Priority Index for the specific harbor, the more important and timely are the proposed future fuel facility measures.

The overall weight of the individual priority criterion is a quantitative expression of the importance of this priority criterion in regard to the sum of the priority criteria and is expressed as a percentage. Consequently, the sum of overall weights of all priority criteria equals to 100 percent. The overall weights of the priority criteria are not harbor specific and apply to all commercial harbors. The actual scoring of a commercial harbor is determined by the degrees of which the specific commercial harbor is in conformance with the priority criterion.

Five priority criteria, used to determine the priority ranking of the commercial harbor's need for upgrades or new facilities, have different overall weights and are defined as follows:

1. Fuel importation infrastructure: This criterion describes fuel facilities that support fuel importation to Hawaii from out-of-state sources. Such fuel facilities need to accommodate ocean going fuel vessels, typically tankers of at least a Handy-size capacity. Since 90 percent of the current oil supply comes to Hawaii in form of crude oil that is un-loaded offshore and then processed in the two local refineries, fuel facilities for fuel for importation in the commercial harbors have currently an overall lesser importance. As indicated in the report, however, anticipated changes in the world fuel supply and Hawaii's energy system will make such fuel importation facilities more important in the future. Since fuel facilities for importation can also serve exports of excess fuel products from Hawaii, this criterion also covers facilities for the exportation of excess volumes of petroleum products or biofuels from Hawaii. This priority criterion is given an overall weight of **35 percent**.

2. Alleviating harbor congestion - increasing harbor capacity: This criterion describes the need to add cargo capacities to the commercial harbors. As the overall cargo volumes in Hawaii's commercial harbors keep increasing, the different harbor facilities have to be

upgraded to accommodate both cargo and fuel operations. This priority criterion is given an overall weight of **30 percent**.

3. Prerequisite for pending/future upgrades of piers in harbor: This criterion describes the need to add, upgrade or modify fuel facilities in conjunction with other pier developments in the commercial harbors. For example, as general cargo piers are modified or added in harbors the required safety zones around fuel facilities during loading/unloading might overlap with general cargo or passenger operations at these piers, necessitating changes in the fuel transfer facilities. In effect, although the fuel facilities themselves are deemed sufficient, changes to the fuel facilities are required to allow for other construction activities in the harbor. This priority criterion is given an overall weight of **20 percent**.

4. Upgrading security and safety measures: This criterion describes the short-term need of measures to increase security, safety and operational efficiency at fuel facilities in the commercial harbors. These measures also include strategies and technologies to ensure stricter environmental compliance. This priority criterion is given an overall weight of **10 percent**.

5. Compliance to long-range Harbors' master plans: This criterion describes the need to locate and size future fuel facilities in the framework of long-range master plans for the specific commercial harbors. Locations of future fuel facilities are best determined in conjunction with storage tank facilities and other fuel related infrastructure issues. This priority criterion is given an overall weight of **5 percent**.

The specific harbors have different ratings of the priority criteria, described as three scores of priority, high, medium and low. The quantitative measure for the scores of high, medium and low priority are 100, 50 and 25 points, respectively.

The product of the overall weight of the priority criterion and the score of priority gives the priority index points for that priority criterion for the specific commercial harbor. For example, for the priority criterion "Fuel importation infrastructure," a specific harbor is determined to have a "high" priority, thus the Priority Index points are calculated as 35 percent * 100 = 35. As another example, for the priority criterion "Compliance with long-range Harbor Master Plans" a specific harbor is determined to have a "medium" priority, thus the Priority Index points are calculated as 5 percent * 50 = 3 (rounded).

7.1.2 Quantitative Assessment of Priorities

The results of the quantitative assessment suggest different priorities scores for the upgrade of fuel facilities in the six commercial harbors.

Table 7-1 depicts the scoring matrix for the six commercial harbors, for which upgrades of fuel facilities have been identified and described in the preceding sections. All commercial harbors have different Priority Indexes indicating different priorities to implement fuel facility upgrades.

Table 7-2 shows the resulting priority ranking for the six commercial harbors. Figure 7-1 shows a bar chart with the Priority Indexes for the six commercial harbors.

Table 7-1: Scoring of Priority to Upgrade Fuel Facilities in the Six Commercial Harbors

		Kalaeloa BPCH Oahu				**Kahului Commercial Harbor,** Maui				**Nawiliwili Commercial Harbor** Kauai			
Priority Criteria	overall weight	Priority high 100	Priority med. 50	Priority low 25	Priority Index points	Priority high 100	Priority med. 50	Priority low 25	Priority Index points	Priority high 100	Priority med. 50	Priority low 25	Priority Index points
Fuel importation infrastructure	35%	1	0	0	35	0	0	1	9	0	0	1	9
Alleviating harbor congestion - increasing harbor capacity	30%	1	0	0	30	0	1	0	15	0	0	1	8
Prerequisite for pending/future upgrades of piers in harbor	20%	0	1	0	10	0	0	1	5	0	0	1	5
Upgrading security, safety measures and operational efficiency measures	10%	1	0	0	10	0	1	0	5	0	0	1	3
Compliance to long-range Harbor Master Plans	5%	1	0	0	5	0	1	0	3	0	0	1	1
sums >>>	**100%**	Priority Index >>>			**90**	Priority Index >>>			**37**	Priority Index >>>			**26**

		Port Allen Com. Harbor Kauai				**Hilo Commercial Harbor** Hawaii Island				**Kawaihae Commercial Harbor** Hawaii Island			
Priority Criteria	overall weight	Priority high 100	Priority med. 50	Priority low 25	Priority Index points	Priority high 100	Priority med. 50	Priority low 25	Priority Index points	Priority high 100	Priority med. 50	Priority low 25	Priority Index points
Fuel importation infrastructure	35%	0	0	1	9	0	0	1	9	0	0	1	9
Alleviating harbor congestion - increasing harbor capacity	30%	0	1	0	15	0	0	1	8	1	0	0	30
Prerequisite for pending/future upgrades of piers in harbor	20%	1	0	0	20	1	0	0	20	0	1	0	10
Upgrading security, safety measures and operational efficiency measures	10%	1	0	0	10	1	0	0	10	0	1	0	5
Compliance to long-range Harbor Master Plans	5%	1	0	0	5	0	0	1	1	1	0	0	5
sums >>>	**100%**	Priority Index >>>			**59**	Priority Index >>>			**48**	Priority Index >>>			**59**

Table 7-2: Ranking of Priorities for Fuel Facility Upgrades in Hawaii's Commercial Harbors

Ranking No.	Fuel facilities in commercial harbor		Priority Index
1	Kalaeloa BPCH	Oahu	90
2	Port Allen Commercial Harbor	Kauai	59
3	Kawaihae Commercial Harbor	Hawaii	59
4	Hilo Commercial Harbor	Hawaii	48
5	Kahului Commercial Harbor	Maui	37
6	Nawiliwili Commercial Harbor	Kauai	26

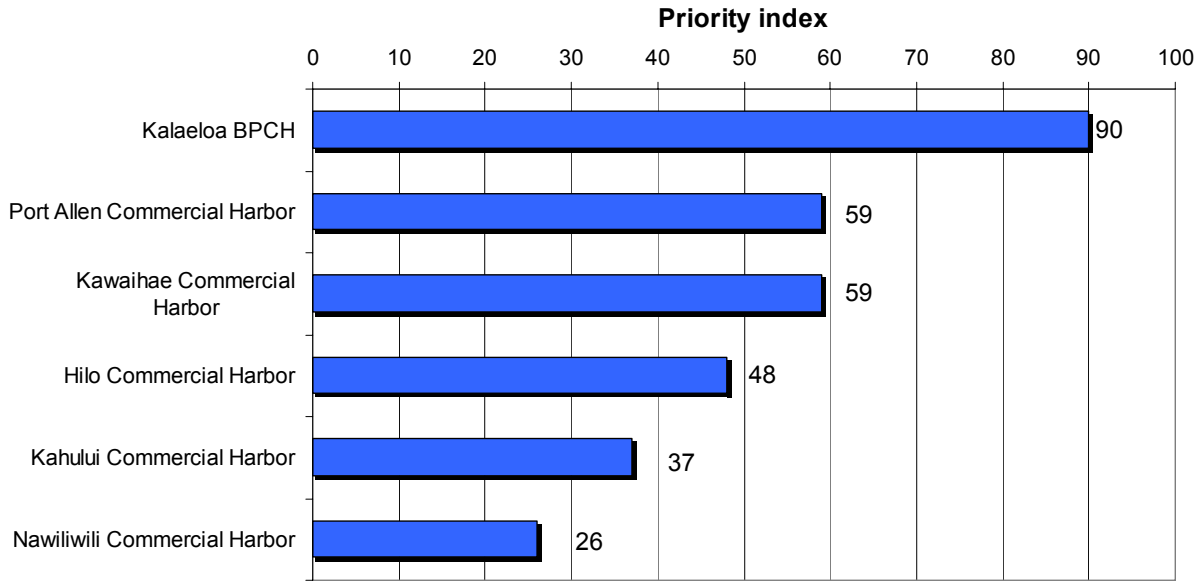

Figure 7-1: Priority Index for Fuel Facilities Upgrades in Hawaii's Commercial Harbors

7.2 Selecting Preferred Design Alternatives in Harbors With Multiple Design Alternatives

Multiple design alternatives were developed for Kahului Commercial Harbor, Nawiliwili Commercial Harbor and Kawaihae Commercial Harbor. The following three sections present the selection of the preferred design alternatives for these three commercial harbors.

7.2.1 Selection of Preferred Design Alternative for Kahului Commercial Harbor

Five Design Alternatives, A through E, were developed for Kahului Commercial Harbor. The Design Alternatives A through E display a significant array of design parameters, such as location of new fuel pier inside the Kahului Commercial Harbor, type of pier structure, type of fuel facilities (dedicated fuel pier of multi-use cargo pier), length of new required fuel transfer pipelines and projected costs. Due to the wide array of design parameters a quantitative scoring selection was used to identify the preferred design alternative.

The method used to identify the preferred design alternative for Kahului Commercial Harbor is similar to the method used in Section 7.1 to determine the priorities ranking under which new fuel facilities should be developed in the six main commercial harbors.

The quantitative scoring method for design alternatives A through E of Kahului Commercial Harbor consists of a two-tier approach. Initially nine priority criteria were defined, which were all assigned a certain overall weights. The sum al the overall weight of the nine priority criteria is unity, or 100 percent, thus the overall weights assigned to one priority criterion reflects its relative importance. In the second tier the specific conformance towards a specific priority criterion were identified for all design alternatives and for all priority criteria. The resulting score for a specific priority criterion is then the product of overall weight of the criterion and the degree of conformance, which is expressed as a numerical value.

For the Priority Criteria 1 through 7, a discrete scale of numbers of one to five is used to describe the degree of conformance with the priority criteria. Herby, number five on the discrete scale refers to total conformance (score = 100 percent) with the selection criterion; number one on the discrete scale referred to minimal conformance (score = 20 percent). The numbers 2, 3 and 4 consequently referred to 40 percent, 60 percent and 80 percent conformance, respectively. The resulting score of the criterion is the product of overall weight and specific score. As an example; the overall weight of a priority criterion might be 10 percent and the degree of conformance for the design alternative might be “3”; then the score for this priority criterion is 10 percent * 60 percent = 6 percent.

For the priority criteria 8 and 9, which address the magnitude of costs for the pier structure and the fuel facilities, a continuous scoring scale is used for all design alternatives. Depending on the magnitude of costs percentage values were assigned on a continuous scale from 0 percent to 100 percent as degrees of conformance for priority criterion 8 or 9.

The nine priority criteria are as follows:

1 Provide additional space for cargo operations or storage: This criterion assigns scores to the design alternatives according to their ability to provide additional space for cargo operation and storage. Mixed-use piers have a high score and dedicated fuel piers have a low score. The overall weight for this priority criterion is **20 percent.**

2 Provide dedicated fuel docks and avoid conflicts between fuel and cargo operations: Design alternatives are consistent with this criterion (e.g., receive a high score) if the new fuel pier causes a reduction in conflicts between fuel transfer and cargo operations. Therefore dedicate fuel piers have a high and mixed-use piers have a low score. The overall weight for this priority criterion is **10 percent.**

3 Avoid significant disruptions of the harbor operations during construction: If a design alternative is likely to cause only few disruptions of harbor operations during construction, then the design alternative is consistent with this criterion and receives a high score. If construction is likely to cause significant disruptions to the harbor operations (e.g., large construction equipment is interfering with cargo and fuel operations; there has to be some degree of dredging), then a low score is assigned. The overall weight for this priority criterion is **5 percent.**

4 Avoid significant disruptions of normal harbor operations: If the completed pier of a design alternative is likely to cause only little disruption of harbor operations (e.g., new pier structure does not limit available space in the harbor basin for ship maneuvering), then the design alternative is consistent with this criterion and receives a high score. If the completed pier of a design alternative is likely to cause significant disruptions, then a low score is assigned. The overall weight for this priority criterion is **10 percent.**

5 New pier can use existing structures to facilitate construction and lower costs: If a design alternative can use a significant portion of an existing pier structure for the new pier configuration then this design alternative is consistent with the priority criteria and is assigned a high score. The overall weight for this priority criterion is **5 percent.**

6 Provide redundancies for other fuel transfer stations in the harbor: If a design alternative provides redundancies to other fuel transfer piers (e.g., new fuel transfer station is separated from an exiting fuel pier and creates fuel transfer station that is independent from the older fuel pier), then this design alternative is consistent with the priority criteria and is be assigned a high score. If the new fuel transfer pier does not add additional locations of fuel transfer, then a low score will be assigned. The overall weight for this priority criterion is **5 percent.**

7 Provide flexibility to install new fuel transfer equipment or modify existing for differing modes of operation (e.g., lower possible conflicts of fuel facilities to conflict with cargo operations and facilitate modifications of fuel installations on the dock): A dedicated fuel dock offers high flexibility to install new or to modify existing fuel transfer equipment. Therefore a dedicated fuel facility has a high score for this criterion. Mixed-used cargo pier fuel facilities

have a low flexibility to install new or to modify existing fuel transfer equipment; therefore their score is lower. The overall weight for this priority criterion is **5 percent.**

8 Lower costs for pier structures: Depending on the type of pier structure, these costs comprise bulkhead piers, breasting/mooring dolphins, mooring bollards, catwalks, access roads, and required ancillary facilities to support the harbor operations. A design alternative with low costs for the pier structure gets a high score; conversely, a design alternative with higher costs scores lower. The overall weight for this priority criterion is **20 percent.**

9 Lower costs for fuel facilities: The costs for the fuel facilities comprise loading arms, fuel pipe connections and appurtenances, pipe racks, pipe galleries, fire fighting systems (fixed or movable), central fuel monitoring system and fuel interconnecting pipelines (to connect the new fuel pier to the existing fuel system in the harbor). The cost differential between design alternatives are mainly due to the extent to connect the new fuel transfer station to the existing fuel system in the harbor and whether or not fuel loading arms are considered. A design alternative with low costs for the new or upgraded fuel facilities gets a high score; conversely, a design alternative with higher costs scores lower. The overall weight for this priority criterion is **20 percent.**

Table 7-3 shows the costs for pier structures and fuel facilities as well as the resulting score values. Table 7-3 also shows the x-coordinates (costs) and y-coordinates (percent score values) that are used to construct the cost-priority criteria scoring lines, which are used to quantify scoring values for pier structure and fuel facility related costs of Design Alternative A through E. For the continuous scoring scales used for criteria 8 and 9 the statistical average of estimated costs of the five design alternatives are assigned a score value of 50 percent. The cost-priority criteria lines are established by the midpoint at the average costs and 50 percent and the end points of the cost-priority criteria lines are defined at costs of one times standard deviation and 25 percent and 75 percent, respectively. The costs of the five design alternatives are assigned score at interpolated values along that line, according to their costs for pier structure and fuel facilities.

Table 7-3: Input Cost Data and Resulting Scoring Values For Continuous Scoring Scale

Design Alternative	Costs for pier structure	Costs for fuel facilities	Total costs	resulting score values	
				cost for pier structures	cost for fuel facilities
A	$11,500,000	$4,700,000	$16,200,000	64.4%	64.4%
B	$9,500,000	$7,600,000	$17,100,000	67.9%	23.4%
C	$41,700,000	$7,700,000	$49,400,000	11.4%	22.0%
D	$26,600,000	$4,200,000	$30,800,000	37.9%	71.5%
E	$9,300,000	$4,400,000	$13,700,000	68.3%	68.6%
average	$19,720,000	$5,720,000		50.0%	50.0%
stand. Deviation	$14,239,452	$1,771,158			
1st point of def. Line	$5,480,000	$3,950,000		75%	75%
2nd point of def. Line	$33,960,000	$7,490,000		25%	25%

Figures 7-2 and 7-3 show the resulting scores for Priority Criteria 8 and 9 for the costs associated with piers and fuel facilities, respectively.

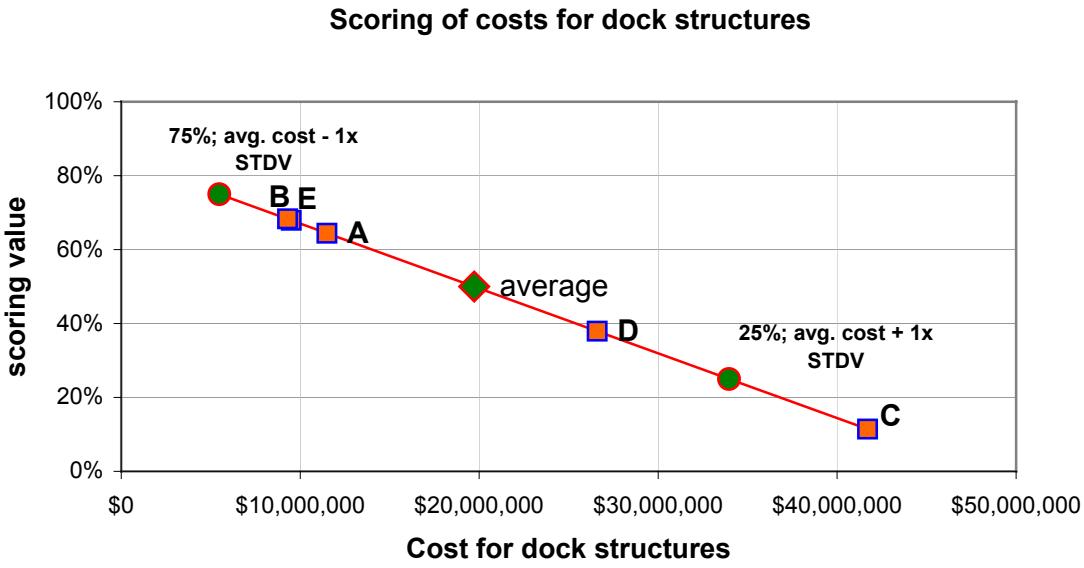

Figure 7-2: Resulting Scores for Priority Criteria 8 - Costs of Pier Structures
("A" through "E" refers to Kahului Commercial Harbor design alternatives A through E)

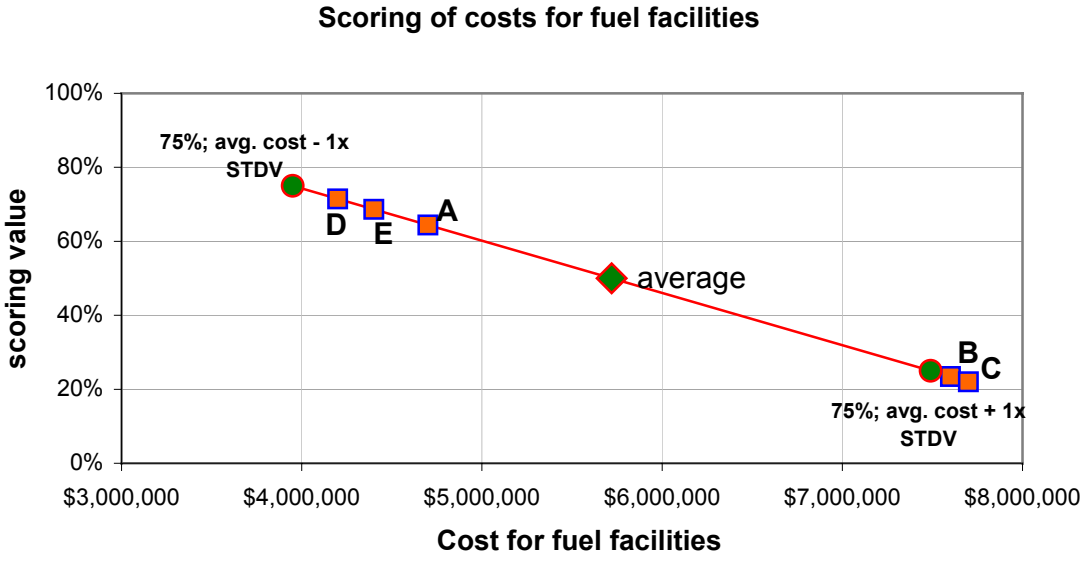

Figure 7-3: Resulting Scores for Priority Criteria 9 - Costs of Fuel Facilities
("A" through "E" refers to Kahului Commercial Harbor design alternatives A through E)

The results of the scoring of the five design alternatives for Kahului Commercial Harbor are shown in Table 7-4 and in Figure 7-4. Table 7-5 shows the ranking of the design alternatives for Kahului Commercial Harbor.

Table 7-4: Scoring of Priority to Upgrade Fuel Facilities in Kahului Commercial Harbor

Description of selection criteria		overall weight	Design Alternative A		Design Alternative B		Design Alternative C		Design Alternative D		Design Alternative C	
No.	Description		grade	result in %	grade	result in %	grade	result in %	grade	result in %	grade	result in %
1.	Provide additional space for cargo operations or storage:	20%	1	4.0%	1	4.0%	5	20.0%	5	20.0%	1	4.0%
2.	Provide dedicated fuel docks and avoid conflicts between fuel and cargo operations	10%	5	10.0%	5	10.0%	2	4.0%	1	2.0%	1	2.0%
3.	Avoid significant disruptions of the harbor operations during construction	5%	1	1.0%	5	5.0%	5	5.0%	4	4.0%	4	4.0%
4.	Avoid significant disruptions of normal harbor operations	10%	1	2.0%	5	10.0%	3	6.0%	2	4.0%	**2**	4.0%
5.	New pier can use existing structures to facilitate construction and lower costs	5%	3	3.0%	1	1.0%	3	3.0%	4	4.0%	5	5.0%
6.	Provide redundancies for other fuel transfer stations in the harbor	5%	1	1.0%	5	5.0%	5	5.0%	2	2.0%	2	2.0%
7.	Provide flexibility to install new fuel transfer equipment or modify existing for differing modes of operation	5%	4	4.0%	5	5.0%	2	2.0%	2	2.0%	2	2.0%
8.	Lower costs for pier structures	20%	64.4%	12.9%	67.9%	13.6%	11.4%	2.3%	37.9%	7.6%	68.3%	13.7%
9.	Lower costs for fuel facilities	20%	64.4%	12.9%	23.4%	4.7%	22.0%	4.4%	71.5%	14.3%	68.6%	13.7%
	sum of overall weight is unity (100%) >>>	100%										
	sum is scoring values is **Priority Index** >>>			**50.8%**		**58.3%**		**51.7%**		**59.9%**		**50.4%**

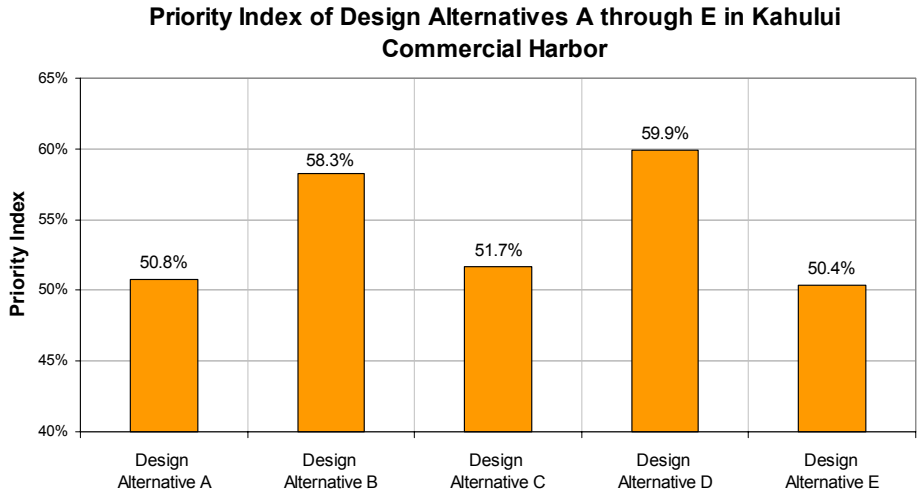

Figure 7-4: Scoring of Priority to Upgrade Fuel Facilities in Kahului Commercial Harbor

Table 7-5: Ranking of Design Alternatives in Kahului Commercial Harbor

Ranking No.	Design Alternative for Kahului Harbor	Priority Index
1	Design Alternative D	59.9%
2	Design Alternative B	58.3%
3	Design Alternative C	51.7%
4	Design Alternative A	50.8%
5	Design Alternative E	50.4%

The results of the scoring suggest that Design Alternatives D and B have similar high scores, whereby Alternaive D has a slightly higher score.

Design Alternative D involves the extension of the existing Pier 3 structure by means of a new piled pier area and the installation of new fuel facilities in close vicinity to the existing fuel transfer station. Design Alternative D would provide new valuable space for harbor operation in the center of the harbor, where additional space for cargo is most needed. The upgraded fuel facilities would be installed close to the existing fuel facilities, therefore the length of new fuel pipelines would be short and associated fuel facility costs small.

Design Alternative B would be a new pier structures in a hitherto un-developed part of the harbor, next to the Pier 1C. The Design Alternative B would be a dedicated fuel pier, consisting of breasting and mooring dolphins, a piled platform for the fuel transfer equipment and a piled causeway connecting the detached fuel pier to the existing Pier 1 C. The location of the new fuel pier, however, would require the construction of about 2,500 feet of new fuel transfer pipelines to connect the new fuel pier with existing fuel infrastructure in the harbor. While the construction costs for the pier structure would be comparatively small compared to Design Alternative D, the costs for the fuel transfer pipelines of Design Alternative B would be substantial.

While the scores of Design Alternatives B and D are not far apart **Design Alternative D is selected as the preferred fuel pier alternative for Kahului Commercial Harbor.**

7.2.2 Selection of Preferred Design Alternative for Nawiliwili Commercial Harbor

Only Design Alternative A and B of Nawiliwili Commercial Harbor are considered for the selection of the preferred design alternative of future fuel facilities. Design Alternative C represents only very limited improvements of the fuel transfer operations in the harbor by consolidating two fuel transfer stations into one location and therefore is more an operational improvement rather than a strategic harbor improvement. Design Alternative C is therefore not considered as a preferred design alternative for Nawiliwili Commercial Harbor

While Design Alternative A and B are at the same location inside the harbor and basically feature identical fuel systems (e.g., loading arms, transfer pipelines), they differ in the type of pier structure used. Design Alternative A is a conventional bulkhead pier structure, whereas Design Alternative B is a detached fuel pier with piled breasting dolphins. The continuous pier configuration of Design Alternative A would allow cargo operations at the new fuel pier. But the location of both Design Alternatives A and B would make regular cargo loading operations next to impractical at the present and for the foreseeable time, until the entire Jetty Pier is developed as cargo piers and harbor-internal roadway connect the new pier to the rest of the harbor. Therefore the benefits of having a continuous pier configuration cannot be realized at the present and would only become important when the Jetty Pier will become an integral part of the cargo operations in the harbor, at an undetermined time in the future.

If Design Alternative B would become part of the future pier development at the Jetty Pier, then the piled pier structure of Design Alternative B could be readily integrated into the future layout (see also Figure 6-41 for possible future pier extension).

The main remaining differentiator of Design Alternatives A and B are therefore the anticipated costs for the pier structure. The costs of the pier structure for Design Alternative B is only 50% of the costs for Design Alternative A, while the costs for the fuel facilities are about equal for both alternatives.

Therefore Design Alternative B is the preferred fuel pier alternative for Nawiliwili Commercial Harbor.

7.2.3 Selection of Preferred Design Alternative for Kawaihae Commercial Harbor

Design Alternatives A and B of Kawaihae Commercial Harbor would be constructed at the identical location, north of Pier 2.

Both alternatives would provide a new fuel transfer station and would allow fuel barges and tankers to extend beyond the northern edge of Pier 2, thereby creating more usable space at Pier 2 for cargo operations.

For Design Alternative A, a new fuel transfer station would be installed on the existing Pier 2 and two breasting and one mooring dolphin would provide safe mooring for the fuel barge. For Design Alternative B a new fuel transfer station would be installed on a piled platform that would be connected to Pier 2 by means of a short causeway. Design Alternative B would require three breasting and one mooring dolphin for safe mooring.

The main differentiators between Design Alternatives A and B are the costs for pier structure and fuel facilities and the fact that the 100-foot wide safety zone around the fuel barges or tankers would approach or overlap Pier 1. While Design Alternative B would create more usable dock space on Pier 2 for cargo operation than Design Alternative A, the larger space improvement at Pier 2 by Design Alternative B might not be required at this point. The total cost for Design Alternative A is about 70 percent of the total costs for Design Alternative B. While for both design alternatives the 100-foot wide safety zone around fuel barges and tankers moored at the new fuel pier affect the operational envelope of Pier 1, the 100-foot wide safety zone of Design Alternative B would overlaps Pier 1.

Therefore Design Alternative A is the preferred fuel pier alternative for Kawaihae Commercial Harbor.

7.3 Summary of Proposed Priority Ranking for Harbors and Preferred Designs Alternatives

Table 7-6 shows the proposed priority ranking with which upgrades and new construction of fuel facilities in Hawaii's main commercial harbors should be executed.

Table 7-6: Proposed Priority Ranking for Commercial Harbors and Design Alternatives

Proposed Priority Ranking	Proposed Fuel Facilities in Commercial Harbor	Island	Preferred Design Alternatives for Harbor
1	Kalaeloa BPCH	Oahu	Only one design scheme of proposed fuel pier configuration for Kalaeloa BPCH
2	Port Allen Commercial Harbor	Kauai	Only one design scheme of proposed fuel pier configuration for Port Allen Commercial Harbor
3	Kawaihae Commercial Harbor	Hawaii	Design Alternative A is the preferred fuel pier alternative for Kawaihae Commercial Harbor.
4	Hilo Commercial Harbor	Hawaii	Only one design scheme of proposed fuel pier configuration for Hilo Commercial Harbor
5	Kahului Commercial Harbor	Maui	Design Alternative D is the preferred fuel pier alternative for Kahului Commercial Harbor.
6	Nawiliwili Commercial Harbor	Kauai	Design Alternative B is the preferred fuel pier alternative for Nawiliwili Commercial Harbor

SECTION EIGHT

PRELIMINARY COST ESTIMATES

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SECTION EIGHT

PRELIMINARY COST ESTIMATES

Section Eight presents preliminary cost estimates for each conceptual design alternative in this study. The preliminary cost estimates consider all major pier structure and outfitting components. However, more detailed design efforts are needed to generate a complete cost assessment. For example, the number of loading arms for the fuel piers is estimated on the basis of the anticipated fuel products that will be transferred in the different commercial harbors. Likewise, the number of product pipes are assumed, based on the number of different fuels to be transferred at the fuel piers.

Major cost items, such as a vapor control system, fire suppression system, marine loading arms and pipe pigging systems, are based on quotes received from various suppliers. Transport costs to Hawaii and increased cost to install such items here have been factored in. Major structural cost items, such as sheet piling and pilings, are estimated on the basis of unit costs estimated from discussions with major contractors. All other cost items are based on historical unit costs. The cost estimates as presented hereafter permit a conservative evaluation of anticipated costs for future fuel facilities in the commercial harbors system based on conceptual designs. They enable a realistic cost comparison among the different conceptual design alternatives presented in Section Six.

8.1 Summary of Preliminary Cost Estimates

The estimated construction costs are summarized in Table 8-1

Table 8-1: Summary of Cost Estimates - Kalaeloa Barbers Point Harbor (Part 1 of 4)

Cost summary: Kalaelo Barbers Point Harbor , Oahu

Note: costs are rounded to nearest $100,000 amount

		Preliminary Cost Estimates			
Harbor	Description	Pier structures and general outfitting	Fuel related infrastructure (pipes,loading arms)	Fuel related infrastructure (I.e. tank farm)	Total costs for fuel pier with general and fuel related infrastructure
Kalaelo Barbers Point Harbor	Fuel pier with two fuel berths: Cost for pier structures and all infrastructure up to and including the service road adjacent to the piers	$15,500,000	$4,200,000		**$19,700,000**
	Ancillary Facility Alternaive A: Includes site development, administration buidings, roads outside dockside service road, tank farm, inter-connecting pipelines	$7,200,000	$5,300,000	$5,800,000	$18,300,000
	Total cost of fuel pier with ancillary facilities Alternative A	$22,700,000	$9,500,000	$5,800,000	**$38,000,000**
	Ancillary Facility Alternaive B: Includes site development, administration buidings, roads outside dockside service road, inter-connecting pipelines installed in pipeline galleries outside of facility boundaries	$7,900,000	$5,300,000		$13,200,000
	Total cost of fuel pier with ancillary facilities Alternative B	$23,400,000	$9,500,000		**$32,900,000**
	Ancillary Facility Alternaive C: Includes site development, administration buidings, roads outside dockside service road, inter-connecting pipelines installed on pipeline racks inside and in pipe galleries outside of facility boundaries	$7,100,000	$5,300,000		$12,400,000
	Total cost of fuel pier with ancillary facilities Alternative C	$22,600,000	$9,500,000		**$32,100,000**

Table 8-1: Summary of Cost Estimates - Kahului Harbor (Part 2 of 4)

Cost summary: Kahului Harbor, Maui

Note: costs are rounded to nearest $100,000 amount

		Preliminary Cost Estimates			
Harbor	Description	Pier structures and general outfitting	Fuel related infrastructure (pipes,loading arms)	Fuel related infrastructure (I.e. interconnecting pipes)	Total costs for fuel pier with general and fuel related infrastructure
Kahului Harbor	**Conceptual Design Alternative A:** Two fuel piers: New pier for 400 feet design fuel barge, built as a detached pier at existing Pier 3; the pier extends perpendicular to Pier 3; the fuel pier also allows a cargo barge to load to and from Pier 3 Modified fuel berth at Pier 1A to accommodate Handysize tanker at Pier 1A	$11,500,000	$4,800,000		**$16,300,000**
Kahului Harbor	**Conceptual Design Alternative B:** Two fuel piers: New pier for 400 feet design fuel barge, built as a detached pier next to existing Pier 1D Modified fuel berth at Pier 1D to accommodate Handysize tanker at Pier 1D	$9,500,000	$4,800,000		**$14,300,000**
	Total costs with Tranfer Alternative T1 Fuel transfer alternative uses individual product pipesfor the 2,400 feet long inter-connecting pipelines between the fuel pier and existing tanks	$9,500,000	$4,800,000	$3,900,000	**$18,200,000**
	Total costs with Tranfer Alternative T2 Fuel transfer alternative uses two piggable product pipesfor the 2,400 feet long inter-connecting pipelines between the fuel pier and existing tanks, cost include pipeline pig launching and retrieval system	$9,500,000	$4,800,000	$1,600,000	**$15,900,000**
Kahului Harbor	**Conceptual Design Alternative C:** Two fuel piers: New pier for 400 feet design fuel barge, incorporated in a new continous pier next to existing Pier 1D Modified fuel berth at Pier 1D to accommodate Handysize tanker at Pier 1D	$41,800,000	$4,300,000		**$46,100,000**
	Total costs with Tranfer Alternative T1 Fuel transfer alternative uses individual product pipesfor the 2,400 feet long interconnecting pipelines between the fuel pier and existing tanks	$41,800,000	$4,300,000	$3,900,000	**$50,000,000**
	Total costs with Tranfer Alternative T2 Fuel transfer alternative uses two piggable product pipesfor the 2,400 feet long inter-connecting pipelines between the fuel pier and existing tanks, cost include pipeline pig launching and retrieval system	$41,800,000	$4,300,000	$1,700,000	**$47,800,000**
Kahului Harbor	**Conceptual Design Alternative D:** Two fuel piers: Extended Pier 3 for 400 feet fuel barge, Fuel pier is incorporated into extended Pier 3; new pier structure is a piled pier structure Modified fuel berth at Pier 1A improved fuel transfer and safty at existing Pier 1A	$26,600,000	$4,300,000		**$30,900,000**
Kahului Harbor	**Conceptual Design Alternative E:** Two fuel piers: Modified Pier 3 for 400 feet fuel barge, Pier 3 is surrounded with a sheet pile apron to allow increasing of depth at Pier 3 to 30 feet depth Modified fuel berth at Pier 1A improved fuel transfer and safty at existing Pier 1A	$9,300,000	$4,400,000		**$13,700,000**

Table 8-1: Summaries of Cost Estimates - Nawiliwili Harbor and Port Allen Harbor (Part 3 of 4)

Cost summary: Nawilili Harbor, Kauai

Note: costs are rounded to nearest $100,000 amount

		Preliminary Cost Estimates			
Harbor	Description	Pier structures and general outfitting	Fuel related infrastructure (pipes,loading arms)	Fuel related infrastructure improvements for Alternaive C	Total costs for fuel pier with general and fuel related infrastructure
Nawilili Harbor	**Conceptual Design Alternative A:** One fuel piers: New pier for 400 feet fuel barge, built as a continuous pier at existing jetty pier, pier alignment will fit into future pier development of Nawiliwili Harbor	$12,400,000	$3,600,000		**$16,000,000**
	Conceptual Design Alternative B: One fuel piers: New pier for 400 feet fuel barge, built as a detached pier at existing jetty pier, pier alignment will fit into future pier development of Nawiliwili Harbor	$6,600,000	$3,700,000		**$10,300,000**
	Conceptual Design Alternative C: Fuel transfer upgrades are limited to relocating the fuel transfer hatches in Pier 2 into one location			$500,000	**$500,000**

Cost summary: Port Allen Harbor, Kauai

Note: costs are rounded to nearest $100,000 amount

		Preliminary Cost Estimates		
Harbor	Description	Pier structures and general outfitting	Fuel related infrastructure (pipes,loading arms)	Total costs for fuel pier with general and fuel related infrastructure
Port Allen Harbor	**Conceptual Design** One fuel piers: New pier for 400 feet fuel barge and Handysize tanker, built as a detached pier structure; pier alignment will fit into future pier development of Poer Allen Harbor	$10,200,000	$2,500,000	**$12,700,000**

Table 8-1: Summary of Cost Estimates - Hilo Harbor and Kawaihae Harbor (Part 4 of 4)

Cost summary: Hilo Harbor, Hawaii Island

Note: costs are rounded to nearest $100,000 amount		Preliminary Cost Estimates		
Harbor	Description	Pier structures and general outfitting	Fuel related infrastructure (pipes,loading arms)	Total costs for fuel pier with general and fuel related infrastructure
Hilo Harbor	**Conceptual Design** One fuel piers: New pier for 400 feet fuel barge and Handysize tanker, built as a detached pier structure; pier alignment will fit into future pier development of Poer Allen Harbor	$1,200,000	$800,000	**$2,000,000**

Cost summary: Kawaihae Harbor, Hawaii Island

Note: costs are rounded to nearest $100,000 amount		Preliminary Cost Estimates		
Harbor	Description	Pier structures and general outfitting	Fuel related infrastructure (pipes,loading arms)	Total costs for fuel pier with general and fuel related infrastructure
Kawaihae Harbor	**Conceptual Design Alternative A:** One fuel piers: Modified Pier 2 for 400 feet fuel barge and Handysize tanker: Fuel transfer facility moved to new location on Pier 2, pier breasting line extended with two breasting dolphins; short extension of Pier 2	$3,300,000	$1,500,000	**$4,800,000**
Kawaihae Harbor	**Conceptual Design Alternative B:** One fuel piers: Modified Pier 2 for 400 feet fuel barge and Handysize tanker: Fuel transfer facility moved to new location on piled platform adjacent to Pier 2, long extension of Pier 2	$5,300,000	$1,700,000	**$7,000,000**

8.2 Breakdown of Cost Estimates - Kalaeloa Barbers Point Harbor

The breakdown of estimated construction costs for all improvements of fuel facilities in the six main commercial harbors are presented in Appendix A.

ABBREVIATIONS / UNITS

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ABBREVIATIONS / UNITS

ABS	American Bureau of Shipping
ATB	Articulated Tug Barge
ATC	Alcohol Type Concentrate
Avgas	Aviation gasoline
CALM	Catenary Anchor Leg Mooring
CFR	Code of Federal Regulations
COTP	Captain of the Port
CNG	Compressed Natural Gas
CP	Cathodic Protection
CPM	Computational Pipeline Monitoring
DBEDT	State of Hawaii Department of Business, Economic Development & Tourism
DOT	Department of Transportation
DWT	Deadweight Tonnage
EPA	Environmental Protection Agency
EIA	Energy Information Administration
FR	Federal Register
HAP	Hazardous Air Pollutant
HFFC	Hawaii Fueling Facilities Corporation
JP-x	Jet Fuel (of different types)
LPG	Liquid Petroleum Gas (in Hawaii mostly propane)
LNG	Liquefied Natural Gas
LOA	Length Over All
MoGas	Motor Gasoline
NGL	Natural Gas Liquids
RC	Reinforced Concrete
RO/RO	Roll-on/roll-off
RFO	Residual Fuel Oil
SNG	Synthetic Natural Gas
SPCC	Spill Prevention Control and Countermeasures
TOP	Take-over-Point (here used for pipeline systems)
ULSD	Ultra-Low Sulfur Diesel
USCG	US Coast Guard
VOC	Volatile Organic Compound

UNITS

Bbl	Barrels
bpd	Barrels per day
btu	British Thermal Unit
°F	Degrees Fahrenheit

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APPENDIX A

BREAKDOWN OF PRELIMINARY COST ESTIMATES

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APPENDIX A

BREAKDOWN OF PRELIMINARY COST ESTIMATES

The breakdowns of preliminary cost estimates for the proposed fuel facilities in the six main commercial in Hawaii are presented in the six sections of Appendix A, as follows:

Section A1 Breakdown of Preliminary Cost Estimates for Kalaeloa Barbers Point Harbor

Preliminary costs of all conceptual design alternatives for Kalaeloa Barbers Point Harbor are presented in Table A1.

Page of Table A1	Description of Costs Items or Cost Groups
1	Estimated construction costs for Fuel Berth 1 for small Panamax Tanker
2	Estimated construction costs for Fuel Berth 2 for 400-foot long fuel barge
3	Major outfitting components for both Fuel Berths 1 and 2
4	Summary of construction cost for Fuel Berths 1 and 2
5	Estimated costs for Ancillary Facility Alternative A
6	Summary of costs of Ancillary Facility Alternative A
7	Estimated costs for Ancillary Facility Alternative B
8	Summary of costs of Ancillary Facility Alternative B
9	Estimated costs for Ancillary Facility Alternative C
10	Summary of costs of Ancillary Facility Alternative C

Note: Total costs and costs in Table A1 are rounded as indicated.

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 1 of 10)
Fuel Berth 1 for Small Panamax Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth 1: for small Panamax tanker				
1	Breasting dolphins (inner dolphins) with mooring bollard, piled structure, dolphin 35 feet x 20 feet,	Lump sum	2	$1,100,000	$2,200,000
2	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 35 feet x 25 feet	Lump sum	1	$1,000,000	$1,000,000
3	Breasting dolphins (outer dolphins) with mooring bollard, piled structure, dolphin 25 feet x 25 feet	Lump sum	1	$750,000	$750,000
4	Access platform from service road, capable to support heavy service truck, spanned RC structure	sqft	1,800	$400	$720,000
5	Catwalks to connect outer breasting dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	100	$400	$40,000
6	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	2,200	$250	$550,000
7	Mooring bollards, heavy loads for 720 feet Panamax , installed on land in casing, complete with ground anchors	Lump sum	4	$280,000	$1,120,000
8	16" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$420,000	$1,260,000
9	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
10	Fuel transfer pipes connecting loading arms with TOP at service road, 16 inch average size, installed below the loading platform and belowground crossing service road (average length per pipe is 150 feet)	lin ft	450	$360	$160,000
				Subtotal for Fuel Berth 1: for small Panamax tanker	**$8,370,000**

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 2 of 10)
Fuel Berth 2 for 400-Foot Long Fuel Barge

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth 2: for 400 foot fuel barge:				
11	Breasting dolphins (inner dolphins) with mooring bollard, piled structure, dolphin 30 feet x 20 feet, dolphin also serves as disembarkation platform	Lump sum	2	$920,000	$1,840,000
12	Breasting dolphins (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 25 feet	Lump sum	2	$820,000	$1,640,000
13	Access way from service road to inner breasting dolphins, width 15 feet, capable to support light service truck, spanned RC structure	lin ft	45	$3,600	$160,000
14	Catwalks to connect outer breasting dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	150	$400	$60,000
15	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	1,600	$600	$960,000
16	Mooring bollards, medium loads for 400 feet fuel barge), installed on land in casing, complete with ground anchors	Lump sum	2	$180,000	$360,000
17	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	4	$290,000	$1,160,000
18	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	4	$190,000	$760,000
19	Fuel transfer pipes connecting loading arms with TOP at service road, 10 inch average size, installed below the loading platform and belowground crossing service road (average length per pipe is 150 feet)	lin ft	600	$280	$170,000
				Subtotal for Fuel Berth 2: for 400 foot fuel barge:	**$7,110,000**

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 3 of 10)
Major Outfitting Components for Fuel Berths 1 and 2

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Major outfitting components for both Fuel Berth 1 and 2				
20	Real time marine weather monitoring system; interfacing with existing system in harbor or installing a new system, generic system assumed	Lump sum	1	$350,000	$350,000
21	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility, generic system assumed	Lump sum	1	$450,000	$450,000
22	emergency shutdown system; generic system assumed	Lump sum	1	$150,000	$150,000
23	fixed lighting for entire pier facility on piers and service roads	Lump sum	2	$60,000	$120,000
24	service berth for utility boat (approx. 30 feet length), floating dock structure, anchors on land with access stairways	Lump sum	1	$60,000	$60,000
25	service road (adjacent to fuel berths 1 & 2, road is concrete with curbs, surface drainage	sqyd	1,900	$220	$420,000
26	utilities in service road (electricity, instrumentation,water)	Lump sum	1	$140,000	$140,000
27	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	2	$660,000	$1,320,000
28	Vapor collection pipelines, connecting fuel berths 1 and 2 with vapor control station	lin ft	1,200	$220	$260,000
29	Vapor control system; consisting of incinerator system with 4 feet diameter vertical stack, thermal oxidator located adequately away from the fuel piers	Lump sum	1	$520,000	$520,000
30	Bilge water colleting pipeline, connecting fuel berths 1 and 2 with bilge and oil water tank	lin ft	1,200	$120	$140,000
31	Bilge and oil water collection and holding tank, incl. transfer pumps	Lump sum	1	$160,000	$160,000
32	dredging to depth of 42 feet	cb yd	10,000	$8	$80,000
				Subtotal for Outfitting for both Berth 1 and 2	**$4,170,000**

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 4 of 10)
Summary of Construction Cost for Fuel Berths 1 and 2

Note: Total costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kalaeloa Barbers Point Harbor** Pier structures and outfitting for new fuel facilitis at Pier 3 and 4	cost for pier struture and general pier outfitting	cost - fuel transfer related	Subtotal
Fuel berth 1 for Panamaxc tanker	$6,380,000	$1,990,000	$8,370,000
Fuel berth 2 for 400 feet fuel barge	$5,020,000	$2,090,000	$7,110,000
Major outfitting components for both Fuel Berth 1 and 2	$4,170,000	$0	$4,170,000
total pier costs (rounded)	**$19,700,000**		

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 5 of 10)
Estimated Costs for Ancillary Facility Alternative A

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
1	Service roadway between public access road and service road at pier	sq yd	3,000	$230	$690,000
2	Building for plant administration, controls, security and maintenance	Lump sum	1	$720,000	$720,000
3	Landscaping of facility area (excluding areas used for facility process equipment)	sq yd	12,000	$45	$540,000
4	Parking spaces for approximately 20 vehicles, including walkways, landscaping	sq yd	900	$350	$320,000
5	Security fence surrounding the fuel facility (1600 feet length) , including one main gate with guard house and one secondary gate	lin ft	1,600	$110	$180,000
6	Tank farm containing three (3) 30,000 barrel fuel tanks and four (4) 11,000 barrel tanks, including containment walls, piping, instrumentation, foundations, fire fighting system consisting of two fixed foam monitors with foam tank and proportioning system	Lump sum	1	$5,800,000	$5,800,000
7	Pipe rack structure, with all safety equipment, pipe supports all 20 feet, ready for pipes installation on pipe rack	lin ft	1,200	$1,600	$1,920,000
8	Fuel transfer pipes installed on pipe rack, number of pipes considered 10, average pipe diam 12 inch, not insulated, pipes with hot fuel have to have adequate thermal expansions	lin ft	12,000	$230	$2,760,000
9	Pumping station, fuel booster pumps, pumping house structures, pumps, controls	Lump sum	1	$115,000	$120,000
10	Pipe gallery structure; with all safety equipment, access hatches, etc.,	lin ft	1,100	$2,400	$2,640,000
11	Fuel transfer pipes installed in pipe gallery, number of pipes considered 10, average pipe diam 12 inch, not insulated, pipes with hot fuel have to have adequate thermal expansions	lin ft	11,000	$230	$2,530,000
12	Fixed lighting for facility outside the service road adjacent to the fuel piers	Lump sum	1	$80,000	$80,000

Total for Ancillary Facility Alternative A (rounded to nearest $10,000) **$18,300,000**

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 6 of 10)
Summary of Costs of Ancillary Facility Alternative A

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kalaeloa Barbers Point Harbor** Ancillary Facility Alternative A	cost for pier structure and general pier outfitting	cost for fuel transfer related
Ancillary Facility (without tank farm)	$7,210,000	$5,290,000
Tank farm	$0	$5,800,000
subtotal	$7,210,000	$11,090,000
total costs for Ancillary Facilities of Alternative A Total costs rounded to nearest $100,000	**$18,300,000**	

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 7 of 10)
Estimated Costs for Ancillary Facility Alternative B

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
1	Service roadway between public access road and service road at pier	sq yd	1,400	$230	$320,000
2	Building for plant administration, controls, security	Lump sum	1	$720,000	$720,000
3	Landscaping of facility area (excluding areas used for facility process equipment)	sq yd	14,000	$45	$630,000
4	Parking spaces for approximately 20 vehicles, including walkways, landscaping	sq yd	900	$350	$320,000
5	Security fence surrounding the fuel facility (1600 feet length) , including one main gate with guard house and one secondary gate	Lump sum	1,400	$110	$150,000
6	Pumping station, fuel booster pumps, pumping house structures, pumps, controls	Lump sum	1	$115,000	$120,000
7	Pipeline gallery structure installed inside facility boundaries; with all safety equipment, access hatches, etc.,	lin ft	800	$2,400	$1,920,000
8	Pipeline gallery structure installed between facility and TOP for external fuel lines; with all safety equipment, access hatches, etc.,	lin ft	1,500	$2,400	$3,600,000
9	Fuel transfer pipelinesinstalled in pipeline galleries, number of pipes considered 10, average pipeline diam 12 inch, not insulated, pipelines with hot fuel have to have adequate thermal expansions	lin ft	23,000	$230	$5,290,000
10	Fixed lighting for facility outside the service road adjacent to the fuel piers	Lump sum	1	$80,000	$80,000

Total for Ancillary Facility Alternative B **$13,150,000**

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 8 of 10)
Summary of Costs of Ancillary Facility Alternative B

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kalaeloa Barbers Point Harbor** Ancillary Facility Alternative B	cost for pier structure and general pier outfitting	cost for fuel transfer related
Ancillary Facility	$7,860,000	$5,290,000
total costs for Ancillary Facilities of Alternative B Total costs rounded to nearest $100,000	**$13,200,000**	

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 9 of 10)
Estimated Costs for Ancillary Facility Alternative C

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
1	Service roadway between public access road and service road at pier	sq yd	1,400	$230	$320,000
2	Building for plant administration, controls, security	Lump sum	1	$720,000	$720,000
3	Landscaping of facility area (excluding areas used for facility process equipment)	sq yd	12,000	$45	$540,000
4	Parking spaces for approximately 20 vehicles, including walkways, landscaping	sq yd	900	$350	$320,000
5	Security fence surrounding the fuel facility (1600 feet length) , including one main gate with guard house and one secondary gate	Lump sum	1,400	$110	$150,000
6	Pumping station, fuel booster pumps, puming house structures, pumps, controls	Lump sum	1	$115,000	$120,000
7	Pipe rack structure, with all saftely equipmwent, pipe supports all 20 feet, ready for pipes installation on pipe rack	lin ft	800	$1,600	$1,280,000
8	Pipeline gallery structure installed between facility and TOP for external fuel lines; with all safety equipment, access hatches, etc.,	lin ft	1,500	$2,400	$3,600,000
9	Fuel transfer pipelines installed in pipe galleries, number of pipes considered 10, average pipeline diam 12 inch, not insulated, pipelines with hot fuel have to have adequate thermal expansions	lin ft	23,000	$230	$5,290,000
10	Fixed lighting for facility outside the service road adjacent to the fuel piers	Lump sum	1	$80,000	$80,000
				Total for Ancillary Facility Alternative C	$12,420,000

Table A1: Summary of Cost Estimates – Kalaeloa Barbers Point Harbor (Page 10 of 10)
Summary of Costs of Ancillary Facility Alternative C

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kalaeloa Barbers Point Harbor** Ancillary Facility Alternative C	cost for pier structure and general pier outfitting	cost for fuel transfer related
Ancillary Facility	$7,130,000	$5,290,000
total costs for Ancillary Facilities of Alternative C Total costs rounded to nearest $100,000	**$12,400,000**	

Section A2 Breakdown of Preliminary Cost Estimates for Kahului Harbor

The breakdown of estimated construction costs of all conceptual design alternatives for Kahului Harbor are presented in Table A2.

Page of Table A2	Description of Costs Items or Cost Groups
1	Estimated construction costs for Conceptual Design Alternative A: Fuel Berth for 400-foot long fuel barge (part 1 of 2)
2	Estimated construction costs for Conceptual Design Alternative A: Fuel Berth for 400-foot long fuel barge (part 2 of 2)
3	Estimated construction costs for Conceptual Design Alternative A: Integrated cargo berth at Pier 4 for 300-foot long cargo barge
4	Estimated construction costs for Conceptual Design Alternative A: Fuel Berth at Pier 1B for 600-foot long Handysize Tanker
5	Estimated construction costs for Conceptual Design Alternative A: Summary of costs
6	Estimated construction costs for Conceptual Design Alternative B: Fuel Berth for 400-foot long fuel barge (part 1 of 2)
7	Estimated construction costs for Conceptual Design Alternative B: Fuel Berth for 400-foot long fuel barge (part 2 of 2)
8	Estimated construction costs for Conceptual Design Alternative B: Fuel Berth at Pier 1D for 600-foot long Handysize Tanker
9	Estimated construction costs for Conceptual Design Alternative B: Fuel transfer between fuel pier and existing Tanks Alternative T1 with several fuel product pipes
10	Estimated construction costs for Conceptual Design Alternative B: Fuel transfer between fuel pier and existing Tanks Alternative T2 with piggable product pipes
11	Estimated construction costs for Conceptual Design Alternative B: Summary of costs for Conceptual Design Alternative B
12	Estimated construction costs for Conceptual Design Alternative C: Fuel Berth for 400 foot long fuel barge
13	Estimated construction costs for Conceptual Design Alternative C: Fuel Berth at Pier 1D for 600 foot long Handysize Tanker
14	Estimated construction costs for Conceptual Design Alternative C: Fuel transfer between fuel pier and existing Tanks Alternative T1 with several fuel product pipes
15	Estimated construction costs for Conceptual Design Alternative C: Fuel transfer between fuel pier and existing Tanks Alternative T2 with piggable product pipes

The cost items, which are presented in Table A2 as follows:

Page of Table A2	Description of Costs Items or Cost Groups
16	Estimated construction costs for Conceptual Design Alternative C: Summary of costs for Conceptual Design Alternative C
17	Estimated construction costs for Conceptual Design Alternative D: Fuel Berth for 400 foot long fuel barge
18	Estimated construction costs for Conceptual Design Alternative D: Fuel Berth at Pier 1A for 600 foot long Handysize Tanker
19	Estimated construction costs for Conceptual Design Alternative D: Summary of costs for Conceptual Design Alternative D
20	Estimated construction costs for Conceptual Design Alternative E: Fuel Berth for 400 –foot long fuel barge (Part 1 of 2)
21	Estimated construction costs for Conceptual Design Alternative E: Fuel Berth for 400 foot long fuel barge (Part 2 of 2)
22	Estimated construction costs for Conceptual Design Alternative E: Fuel Berth at Pier 1A for 600 –foot long Handysize Tanker
23	Estimated construction costs for Conceptual Design Alternative E: Summary of costs for Conceptual Design Alternative E

Note: Total costs and costs in Table A2 are rounded as indicated.

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 1 of 23)
Estimated Construction Costs for Conceptual Design Alternative A:
Fuel Berth for 400-Foot Long Fuel Barge (part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 foot fuel barge				
1	Breasting dolphins (inner dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet, dolphin has two platforms attached, one platform serves as disembarkation platform, second platform serves for fixed fire monitor	Lump sum	2	$920,000	$1,840,000
2	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$820,000	$1,640,000
3	Mooring dolphins with mooring bollard, piled structure, dolphin 15 feet x 15 feet	Lump sum	2	$480,000	$960,000
4	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	240	$400	$100,000
5	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	1600	$580	$930,000
6	Access roadway from Pier 3 to fuel fransfer platform, RC platforms struture , 12 feet wide, capable to support medium service truck, spanned RC structure on piled supports	lin ft	230	$3,300	$760,000
7	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	4	$290,000	$1,160,000
8	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	4	$190,000	$760,000
9	Pipeline rack structure supported by access roadway structure, pipeline rack supports fuel transfer pipelines between fuel transfer platform and Pier 3 structure	lin ft	230	$260	$60,000
10	Fuel transfer pipelines connecting loading arms with Pier 3, considered 8 pipes 10 inch average size, installed on pipe rack (pipeline rack specified above), average length of individual pipe is 350 feet	lin ft	2800	$240	$670,000

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 2 of 23)
Estimated Construction Costs for Conceptual Design Alternative A:
Fuel Berth for 400-Foot Long Fuel Barge (part 2 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
11	Fuel transfer pipelines installed in Pier 3, installed below ground, either blow piles section of Pier or in new pipe gallery at Pier 3, fuel transfer pipelines connect to TOP of existing fuel system adjacent to Pier 3	lin ft	800	$240	$190,000
12	Pipeline gallery in existing Pier 3, cast-in place RC box structure with removable RC covers	lin ft	800	$900	$720,000
13	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
14	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
15	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
16	Fixed lighting for entire pier facility on fuel pier and access roadway	Lump sum	1	$60,000	$60,000
17	Dredging to a depth of 30 feet (includes dredging of cargo pier)	cu yd	53,000	$8	$420,000
				Subtotal for Fuel Berth for 400 feet fuel barge	$11,360,000

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 3 of 23)
Estimated Construction Costs for Conceptual Design Alternative A:
Integrated Cargo Berth at Pier 4 for 300-Foot Long Cargo Barge

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Integrated cargo berth at Pier 4: for 300 foot cargo barge				
18	Breasting dolphins with mooring bollard, piled structure, dolphin 12 feet x 12 feet, mooring dolphins for cargo berth are directly accessible from the access roadway	Lump sum	3	$450,000	$1,350,000
19	Mooring bollard, medium loads for 300 feet cargo barge), piled dolphin structure, accessible over catwalk that is connected from breasting dolphin from fuel pier	Lump sum	1	$450,000	$450,000
20	Catwalks to connect mooring dolphin of cargo berth with breasting dolphin of fuel barge	lin ft	35	$400	$10,000
21	RO/RO stern loading ramp, supplied by cargo handling company, not included in this cost estimate	Lump sum		NA	
				Subtotal for integrated cargo berth at Pier 4: for 300 feet cargo barge	$1,810,000

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 4 of 23)
Estimated construction Costs for Conceptual Design Alternative A:
Fuel Berth at Pier 1B for 600-Foot Long Handysize Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth at Pier 1B: for 600 foot Handysize tanker				
22	16" Loading arms, counter balanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms, installation, shipment	Lump sum	3	$420,000	$1,260,000
23	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
24	New fuel tansfer pipes\lines that connect the loading arms with the existing fuel pipelines	lin ft	450	$300	$140,000
	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
25	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
26	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
27	Fixed lighting for new fuel transfer facility	Lump sum	1	$35,000	$40,000
				Subtotal for fuel berth at Pier 1B: for 600 foot Handysize tanker	$3,100,000

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 5 of 23)
Estimated Construction Costs for Conceptual Design Alternative A:
Summary of Costs

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kahului Harbor** Conceptual Design Alternative A New Pier 4 built at existing Pier 3	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge	$8,580,000	$2,780,000
Integrated cargo berth at Pier 4: for 300 foot cargo barge	$1,810,000	$0
Fuel Berth at Pier 1B: for 600 feet Handysize tanker	$1,130,000	$1,970,000
total costs	$11,520,000	$4,750,000

total pier costs **$16,300,000**

Note: Total costs are rounded to nearest $100,000 amount

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 6 of 23)
Estimated Construction Costs for Conceptual Design Alternative B:
Fuel Berth for 400-Foot Long Fuel Barge (part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
1	**Fuel Berth: for 400 feet fuel barge** Breasting dolphins (inner dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet, dolphin has two platforms attached, one platform serves as disembarkation platform, second platform serves for fixed fire monitor	Lump sum	2	$920,000	$1,840,000
2	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$820,000	$1,640,000
3	Mooring dolphins with mooring bollard, piled structure, dolphin 15 feet x 15 feet	Lump sum	2	$480,000	$960,000
4	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	180	$400	$70,000
5	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	1,900	$520	$990,000
6	Access roadway from Pier 1D to fuel fransfer platform, RC platforms struture, 12 feet wide, capable to support medium service truck, spanned RC structure on piled supports	lin ft	300	$3,300	$990,000
7	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	4	$290,000	$1,160,000
8	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	4	$190,000	$760,000
9	Pipe rack structure supported by access roadway structure, pipe rack supports fuel transfer pipes between fuel transfer platform and Pier 3 structure	lin ft	300	$260	$80,000
10	Fuel transfer pipes connecting loading arms with booster pump installed in pump house on Pier 1D, considered 6 pipes 10 inch average size, installed on pipe rack (pipe rack specified above), average length of individual pipe is 400 feet	lin ft	2,400	$240	$580,000

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 7 of 23)
Estimated Construction Costs for Conceptual Design Alternative B:
Fuel Berth for 400-Foot Long Fuel Barge (part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
11	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
12	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
13	emergency shutdown system;	Lump sum	1	$150,000	$150,000
14	fixed lighting for entire pier facility on fuel pier and access roadway	Lump sum	1	$60,000	$60,000
15	dredging to a depth of 35 feet	cu yd	15,000	$8	$120,000
				Subtotal for Fuel Berth: for 400 foot fuel barge	**$10,340,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 8 of 23)
Estimated Construction Costs for Conceptual Design Alternative B:
Fuel Berth at Pier 1D for 600-Foot long Handysize Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth at Pier 1D: for 600 feet Handysize tanker				
16	16" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$420,000	$1,260,000
17	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
18	Pipe gallery to install the fuel transfer pipes from the loading arms to the fuel booster pumps, pipe gallery has removable RC covers for easy access to pipes	lin ft	380	$900	$340,000
19	Fuel transfer pipes connecting loading arms with booster pump installed in pump house on Pier 1D, considered 6 pipes 10 inch average size, installed on pipe rack (pipe rack specified above), average length of individual pipe is 360 feet	lin ft	2,280	$240	$550,000
20	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
21	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
22	emergency shutdown system;	Lump sum	1	$150,000	$150,000
23	fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
24	Dredging to a depth of 30 feet	cu yd	15,000	$8	$120,000
				Subtotal for fuel berth at Pier 1D: for 600 foot Handysize tanker	**$3,870,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 9 of 23)
Estimated Construction Costs for Conceptual Design Alternative B:
Fuel Transfer Between Fuel Pier and Existing Tanks
(Alternative T1 with several fuel product pipes)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel transfer between fuel pier and existing Tanks: **Alternative T1 with several fuel product pipes**				
	Alternative T1 uses 6 product pipes to convey the fuel products between the new fuel pier and the existing tanks				
25	Booster pumps to increase pressure to convey fuel to existing tanks in or adjacent to the harbor, including a building housing the booster pumps, process piping inside the building, controls, and electrical system	Lump sum	1	$85,000	$90,000
26	Fuel transfer pipelines installed on piperack, length of individual pipe is 2400 feet, assumed are 6 product lines with an average diameter of 10 inch, the pipes are coated,	lin ft	14,400	$240	$3,460,000
27	Piperack structure to support the fuel transfer pipelines, pipeline rack structures are installed every 20 feet according to max. support span for fuel transfer pipelines	Lump sum	2,400	$120	$290,000
				Subtotal for Alternative T1 for fuel transfer from pier to existing tanks	**$3,840,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 10 of 23)
Estimated Construction Costs for Conceptual Design Alternative B:
Fuel Berth at Pier 1D for 600-Foot Long Handysize Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel transfer between fuel pier and existing Tanks: **Alternative T2 with piggable product pipes**				
	Alternative T1 uses 3 product pipes to convey the fuel products between the new fuel pier and the existing tanks; separation pigs are lauched at the booster pump building and are retrived close to the existing fuel tanks, the piggable fuel lines reduce the need for long multiple fuel lines, seperation pigs avoid mixing fuel products contained in batching trains				
28	Booster pumps to increase pressure to convey fuel to existing tanks in or adjacent to the harbor, including a building housing the booster pumps, process piping inside the building, controls, and electrical system; the pig launching station is installed in the building	Lump sum	1	$85,000	$90,000
29	Fuel transfer pipelines installed on pipeline racks, length of individual pipeline is 2400 feet, assumed are 2 product lines with an average diameter of 10 inch, the pipes are coated,	lin ft	4,800	$240	$1,150,000
30	Pilpeline pig launching and retrieval stations for seperation and other pigs; cost item is only preliminary, actual costs depend on pipe rating and fuel types	Lump sum	1	$180,000	$180,000
31	Pipeline rack structure to support the fuel transfer pipes, pipelien rack structures are installed every 20 feet according to max. support span for fuel transfer pipelines	Lump sum	2,400	$60	$140,000
				Subtotal for Alternative T2 for fuel transfer from pier to existing tanks	**$1,560,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 11 of 23)
Estimated Construction Costs for Conceptual Design Alternative B:
Summary of Costs for Conceptual Design Alternative B

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kahului Harbor** Conceptual Design Alternative B New detached fuel pier at existing Pier 1D	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 feet fuel barge	$7,840,000	$2,500,000
Fuel Berth at Pier 1D: for 600 feet Handysize tanker	$1,610,000	$2,380,000
subtotal	$9,450,000	$4,880,000
total costs foer pier structure and outfitting, without interconnecting piping	**$14,300,000**	
Note: Total costs are rounded to nearest $100,000 amount		
Fuel related costs with Tranfer Alternative T1	$0	$3,840,000
total	$9,450,000	$8,720,000
total pier costs with Alternative T1	**$18,200,000**	
Note: Total costs are rounded to nearest $100,000 amount		
Fuel related costs with Tranfer Alternative T2	$0	$1,560,000
total	$9,450,000	$6,440,000
total pier costs with Alternative T2	**$15,900,000**	
Note: Total costs are rounded to nearest $100,000 amount		

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 12 of 23)
Estimated Construction Costs for Conceptual Design Alternative C:
Fuel Berth for 400-Foot Long Fuel Barge

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
1	**Fuel Berth: for 400 foot fuel barge** New 600 feet long pier as an expansion of Pier 1D; pier structure to accommodate multi-purpose cargo operations which will allow fuel transfer as well as general cargo operations, pier structure is combination of piled pier and conventional bulkhead pier; the cost includes: (1) piled outward section of the pier (2) bulkhead pier face composed of a combination sheet piling (3) fill of the pier landwards of the bulkhead pier (4) RC cover of pier area with drainage and utility	sq ft	123,000	$315	$38,750,000
2	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	4	$290,000	$1,160,000
3	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	4	$190,000	$760,000
4	Pipeline gallery to install the fuel transfer pipes from the loading arms to the fuel booster pumps, pipeline gallery has removable RC covers for easy access to pipeline	lin ft	450	$900	$410,000
5	Fuel transfer pipelines connecting loading arms with booster pump installed in pump house on Pier 1D, considered 6 pipes 10 inch average size, installed on pipeline rack (pipeline rack specified above), average length of individual pipeline is 450 feet	lin ft	2,400	$240	$580,000
6	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
7	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
8	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
9	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
				Subtotal for fuel berth: for 400 foot fuel barge	**$42,810,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 13 of 23)
Estimated Construction Costs for Conceptual Design Alternative C:
Fuel Berth at Pier 1D for 600-Foot Long Handysize Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth at Pier 1D: for 600 feet Handysize tanker				
10	16" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including	Lump sum	2	$420,000	$840,000
11	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	2	$190,000	$380,000
12	Pipe gallery to install the fuel transfer pipes from the loading arms to the fuel booster pumps, pipe gallery has removable RC covers for easy access to pipes	lin ft	380	$900	$340,000
13	Fuel transfer pipelines connecting loading arms with booster pump installed in pump house on Pier 1D, considered 6 pipelines with 10 inch average size, installed on pipline rack (pipe rack specified above), average length of individual pipine is 360 feet	lin ft	2,280	$240	$550,000
14	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
15	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
16	Emergency shutdown system	Lump sum	1	$150,000	$150,000
17	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
				Subtotal for fuel berth at Pier 1D: for 600 foot Handysize tanker	**$3,260,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 14 of 23)
Estimated Construction Costs for Conceptual Design Alternative C:
Fuel Transfer Between Fuel Pier and Existing Tanks
(Alternative T1 with several fuel product pipes)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel transfer between fuel pier and existing Tanks: Alternative T1 with several fuel product pipes				
18	Alternative T1 uses 6 product pipes to convey the fuel products between the new fuel pier and the existing tanks				
19	Booster pumps to increase pressure to convey fuel to existing tanks in or adjacent to the harbor, including a building housing the booster pumps, process piping inside the building, controls, and electrical system	Lump sum	1	$85,000	$90,000
20	Fuel transfer pipelines installed on pipeline rack, length of individual pipeline is 2400 feet, assumed are 6 product lines with an average diameter of 10 inch, the pipelines are coated.	lin ft	14,400	$240	$3,460,000
21	Pipeline rack structure to support the fuel transfer pipelines, pipelie rack structures are installed every 20 feet according to max. support span for fuel transfer pipelines	Lump sum	2,400	$150	$360,000
				Subtotal for Alternative T1 for fuel transfer from pier to existing tanks	**$3,910,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 15 of 23)
Estimated Construction Costs for Conceptual Design Alternative C:
Fuel Transfer Between Fuel Pier and Existing Tanks
(Alternative T2 with piggable product pipes)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
22	Fuel transfer between fuel pier and existing Tanks: Alternative T2 with piggable product pipes				
23	Alternative T1 uses 3 product pipes to convey the fuel products between the new fuel pier and the existing tanks; separation pigs are lauched at the booster pump building and are retrived close to the existing fuel tanks, the piggable fuel lines reduce the need for long multiple fuel lines, seperation pigs avoid mixing fuel products contained in batching trains				
24	Booster pumps to increase pressure to convey fuel to existing tanks in or adjacent to the harbor, including a building housing the booster pumps, process piping inside the building, controls, and electrical system; the pig launching station is installed in the building	Lump sum	1	$85,000	$90,000
25	Fuel transfer pipelines installed on pipelien rack, length of individual pipe is 2400 feet, assumed are 2 product pipelines with an average diameter of 10 inch, the pipelines are coated,	lin ft	4,800	$240	$1,150,000
26	Pipeline pig launching and retrieval stations for seperation pig; seperation, cleaning and smart inspection pigs are not included, cost item is only preliminary, actual costs depend on pipe rating and fuel types	Lump sum	1	$280,000	$280,000
27	Pipeline rack structure to support the fuel transfer pipes, pipelie rack structures are installed every 20 feet according to max. support span for fuel transfer pipelines	Lump sum	2,400	$80	$190,000
	Subtotal for Alternative T2 for fuel transfer from pier to existing tanks				**$1,710,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 16 of 23)
Estimated Construction Costs for Conceptual Design Alternative C:
Summary of Costs for Conceptual Design Alternative C

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kahului Harbor** Conceptual Design Alternative C New fuel pier at extended multi-purpose pier Pier 1D	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge	$40,310,000	$2,500,000
Fuel Berth at Pier 1D: for 600 feet Handysize tanker	$1,490,000	$1,770,000
subtotal	$41,800,000	$4,270,000
total costs foer pier structure and outfitting, without interconnecting piping	**$46,100,000**	
Note: Total costs are rounded to nearest $100,000 amount		
Fuel related costs with Tranfer Alternative T1	$0	$3,910,000
total	$41,800,000	$8,180,000
total pier costs with Alternative T1	**$50,000,000**	
Note: Total costs are rounded to nearest $100,000 amount		
Fuel related costs with Tranfer Alternative T2	$0	$1,710,000
total	$41,800,000	$5,980,000
total pier costs with Alternative T2	**$47,800,000**	
Note: Total costs are rounded to nearest $100,000 amount		

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 17 of 23)
Estimated Construction Costs for Conceptual Design Alternative D:
Fuel Berth for 400-Foot Long Fuel Barge

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 foot fuel barge				
1	Pier structure to accommodate multi-purpose cargo operations which will allow fuel transfer as well as general cargo operations, pier structure is a piled pier structure	sq ft	57,000	$420	$23,940,000
2	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	4	$290,000	$1,160,000
3	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	4	$190,000	$760,000
4	Pipeline gallery to install the fuel transfer pipelines from the loading arms to the exisitng fuel transfer pipelines, pipeline gallery has removable RC covers for easy access to pipes	lin ft	170	$900	$150,000
5	Fuel transfer pipeslines connecting loading arms with existing fuel transfer pipes\lines, considered 6 pipes with 10 inch average size, installed in pipe gallery average length of individual pipeline is 200 feet	lin ft	1,200	$240	$290,000
6	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
7	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
8	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
9	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
10	Dredging to 30 feet depth	cu yd	36,000	$8	$290,000
				Subtotal of Fuel Berth: for 400 foot fuel barge	**$27,740,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 18 of 23)
Estimated Construction Costs for Conceptual Design Alternative D:
Fuel Berth at Pier 1A for 600-Foot Long Handysize Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth at Pier 1A: for 600 foot Handysize tanker				
11	16" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$420,000	$1,260,000
12	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
13	New fuel tansfer pipelines that connect the loading arms with the existing fuel pipes	lin ft	450	$300	$140,000
14	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
15	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
16	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
17	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
				Subtotal of Fuel Berth at Pier 1A: for 600 foot Handysize tanker	**$3,120,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 19 of 23)
Estimated Construction Costs for Conceptual Design Alternative D:
Summary of Costs for Conceptual Design Alternative D

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kahului Harbor** Conceptual Design Alternative D Extension of Pier 3 as a multi-purpose pier	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge	$25,530,000	$2,210,000
Fuel Berth at Pier 1A: for 600 foot Handysize tanker	$1,090,000	$2,030,000
subtotal	$26,620,000	$4,240,000

total pier costs **$30,900,000**

Note: Total costs are rounded to nearest $100,000 amount

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 20 of 23)
Estimated Construction Costs for Conceptual Design Alternative E:
Fuel Berth for 400-Foot Long Fuel Barge (Part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
1	**Fuel Berth: for 400 foot fuel barge** Installation of a bulkhead (sheet pile) apron around the existing Pier 3 in order to safeguard pier structure stability for dredging to 30' depth; bulkhead is composed of a combination of loadbearing King piles and intermittend sheet piling. King piles have a length of 80 feet, the sheetpiling has a length of 60 feet. Cost includes material cost and installation & shipping	lin ft	550	$8,100	$4,460,000
2	Installation of sheet piling at the shoreline between Pier 1 and 3 in order to stabilize shoreline and allow dredging of the area North-East of Pier 3; sheetpiles are estimated at 40 feet lengths	lin ft	300	$4,050	$1,220,000
3	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 15 feet x 15 feet	Lump sum	1	$550,000	$550,000
4	Mooring bollard installed on the shoreline; bollards are build as a sheetlpied structure that is anchored to the ground to provide sufficient pull resistance for a 400 feet design fuel barge	Lump sum	1	$180,000	$180,000
5	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	50	$400	$20,000
6	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	4	$290,000	$1,160,000
7	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	4	$190,000	$760,000
8	Pipeline gallery to install the fuel transfer pipelines from the loading arms to the exisitng fuel transfer pipes, pipeline gallery has removable RC covers for easy access to pipes	lin ft	170	$900	$150,000

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 21 of 23)
Estimated Construction Costs for Conceptual Design Alternative E:
Fuel Berth for 400-Foot Long Fuel Barge (Part 2 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
9	Fuel transfer pipelines connecting loading arms with existing fuel transfer pipelines, considered 8 pipes with 10 inch average size, installed in pipe gallery average length of individual pipe is 200 feet	lin ft	1,600	$250	$400,000
10	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
11	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
12	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
13	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
14	Dredging to a depth of 30 feet at Pier 3	cu yd	53,000	$8	$420,000
				Subtotal for fuel berth: for 400 foot fuel barge	**$10,470,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 22 of 23)
Estimated Construction Costs for Conceptual Design Alternative E:
Fuel Berth at Pier 1A for 600-Foot long Handysize Tanker

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth at Pier 1A: for 600 foot Handysize tanker				
15	16" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$420,000	$1,260,000
16	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
17	New fuel tansfer pipelines that connect the loading arms with the existing fuel pipelines, considered are 4 fuel product pipelines, with individual lengths of 200 feet	lin ft	800	$320	$260,000
18	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
19	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
20	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
21	fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
				Subtotal of Fuel Berth at Pier 1A for 600 foot Handysize tanker	**$3,240,000**

Table A2: Summary of Cost Estimates – Kahului Harbor (Page 23 of 23)
Estimated Construction Costs for Conceptual Design Alternative E:
Summary of Costs for Conceptual Design Alternative E

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kahului Harbor** Conceptual Design Alternative E Pier 3 with new sheetpiling apron	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge	$8,150,000	$2,320,000
Fuel Berth at Pier 1A: for 600 foot Handysize tanker	$1,150,000	$2,090,000
subtotal	$9,300,000	$4,410,000

total pier costs **$13,700,000**

Note: Total costs are rounded to nearest $100,000 amount

Section A3 Breakdown of Preliminary Cost Estimates for Nawiliwili Harbor

The breakdown of estimated construction costs of all conceptual design alternatives for Nawiliwili Harbor are presented in Table A3.

Page of Table A3	Description of Costs Items or Cost Groups
1	Estimated construction costs for Conceptual Design Alternative A: Continuo Continuous Pier Structure at Jetty Pier (Part 1 of 2)
2	Estimated construction costs for Conceptual Design Alternative A: Continuous Pier Structure at Jetty Pier (Part 2 of 2) and Summary of Estimated Construction Costs for Conceptual Design Alternative A:
3	Estimated construction costs for Conceptual Design Alternative B: Protruding Fuel Pier Structure at Jetty Pier (Part 1 of 2)
4	Estimated construction costs for Conceptual Design Alternative B: Protruding Fuel Pier Structure at Jetty Pier (Part 2 of 2)
5	Estimated construction costs for Conceptual Design Alternative B: Summary of costs for Conceptual Design Alternative B:

Note: Total costs and costs in Table A3 are rounded as indicated.

Table A3: Summary of Cost Estimates – Nawiliwili Harbor (Page 1 of 5)
Estimated Construction Costs for Conceptual Design Alternative A:
Continuous Pier Structure at Jetty Pier (Part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 foot fuel barge				
1	New continuous pier with a length of 450 feet: Pier structure to accommodate multi-purpose cargo operations which will allow fuel transfer as well as general cargo operations, pier structure is combination of piled pier and conventional bulkhead pier, pier structure serves as service road while the pier is a dedicated fuel pier; the pier has a gates access to the adjacent public roadway	1	1	$9,700,000	$9,700,000
2	Mooring bollard installed on the shoreline; bollards are build as a sheetlpied structure that is anchored to the ground to provide sufficient pull resistance for a 400 feet design fuel barge	Lump sum	2	$180,000	$360,000
3	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$290,000	$870,000
5	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
6	Fuel transfer pipelines connecting loading arms with TOP for new fuel transfer pipelines, considered 4 pipes with 10 inch average size, pipelines are installed in pipeline gallery average length of individual pipeline is 250 feet	lin ft	1,000	$240	$240,000
7	Fuel transfer pipelines installed outside the new fuel pierline; pipelines are connecting to existing fuel pipelines in the harbor, pipelines are installed below ground or below piled pier structures, whatever is less costly, considered 4 pipelines with 10 inch average size, individual length of the pipelines are 2000 feet	lin ft	8,000	$240	$1,920,000

Table A3: Summary of Cost Estimates – Nawiliwili Harbor (Page 2 of 5)
Estimated Construction Costs for Conceptual Design Alternative A:
Continuous Pier Structure at Jetty Pier (Part 2 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
8	Security fence around new fuel pier structure, inluding gate	lin ft	100	$130	$10,000
9	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
10	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
11	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
12	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
13	Dredging to a depth of 35 feet	cu yd	49,000	$8	$390,000
				Total cost of continous fuel pier structure at Jetty Pier	**$15,970,000**

Summary of Estimated Construction Costs for Conceptual Design Alternative E

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Nawiliwili Harbor** Conceptual Design Alternative A Continous Pier Structure at Jetty Pier	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge	$12,370,000	$3,600,000
subtotal	$12,370,000	$3,600,000
total cost of fuel pier **$16,000,000**		
Note: Total costs are rounded to nearest $100,000 amount		

Table A3: Summary of Cost Estimates – Nawiliwili Harbor (Page 3 of 5)
Estimated Construction Costs for Conceptual Design Alternative B:
Protruding Fuel Pier Structure at Jetty Pier (Part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 foot fuel barge				
1	Breasting dolphins (inner dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet, dolphin has two platforms attached, one platform serves as disembarkation platform, second platform serves for fixed fire monitor	Lump sum	2	$920,000	$1,840,000
2	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$820,000	$1,640,000
3	Mooring bollard installed on the shoreline; bollards are build as a sheetlpied structure that is anchored to the ground to provide sufficient pull resistance for a 400 feet design fuel barge	Lump sum	2	$180,000	$360,000
4	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	180	$400	$70,000
5	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	1,600	$600	$960,000
6	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms, installation, shipment	Lump sum	3	$290,000	$870,000
7	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
8	Pipeline gallery to install the fuel transfer pipelines from the loading arms to the TOP of the new pier struture, pipeline gallery has removable RC covers for easy access to pipelines	lin ft	230	$830	$190,000

Table A3: Summary of Cost Estimates – Nawiliwili Harbor (Page 4 of 5)
Estimated Construction Costs for Conceptual Design Alternative B:
Protruding Fuel Pier Structure at Jetty Pier (Part 2 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
9	Fuel transfer pipelines connecting loading arms with TOP for new fuel transfer pipelines, considered 6 pipesines10 inch average size, pipelines are installed in pipline gallery average length of individual pipeline is 250 feet	lin ft	1,500	$240	$360,000
10	Fuel transfer pipelines installed outside the new fuel pier; pipepines are connecting to existing fuel pipelines in the harbor; pipelines are installed below-ground or below piled pier structures, whatever is less costly, considered 4 pipes 10 inch average size, individual length of the pipeline is 2000 feet	lin ft	8,000	$240	$1,920,000
11	Security fence around new fuel pier structure, including gate	lin ft	100	$110	$10,000
12	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
13	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
14	emergency shutdown system;	Lump sum	1	$150,000	$150,000
15	fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
16	dredging to a depth of 35 feet	cu yd	49,000	$8	$390,000
				Total cost of Protruding Fuel Pier Structure at Jetty Pier	$10,330,000

Table A3: Summary of Cost Estimates – Nawiliwili Harbor (Page 5 of 5)
Estimated Construction Costs for Conceptual Design Alternative B:
Summary of costs for Conceptual Design Alternative B:

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Nawiliwili Harbor** Conceptual Design Alternative B Detached Fuel Pier Structure at Jetty Pier	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge	$6,610,000	$3,720,000
subtotal	$6,610,000	$3,720,000
total cost of fuel pier **$10,300,000**		

Note: Total costs are rounded to nearest $100,000 amount

Section A4 Breakdown of Preliminary Cost Estimates for Port Allen Harbor

The breakdown of estimated construction costs of all conceptual design alternatives for Port Allen Harbor are presented in Table A4.

Page of Table A4	Description of Costs Items or Cost Groups
1	Estimated construction costs for Conceptual Design Protruding Segmented Fuel Pier Structure at Breakwater (Part 1 of 2)
2	Estimated construction costs for Conceptual Design Protruding Segmented Fuel Pier Structure at Breakwater (Part 2 of 2)
3	Estimated construction costs for Conceptual Design Summary of costs for Port Allen Harbor Conceptual Design

Note: Total costs and costs in Table A4 are rounded as indicated.

Table A4: Summary of Cost Estimates – Port Allen Harbor (Page 1of 3)
Estimated Construction Costs for Conceptual Design
Protruding Segmented Fuel Pier Structure at Breakwater (Part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 feet fuel barge and 600 feet handysize tanker				
1	Breasting dolphins (inner dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet, dolphin has two platforms attached, one platform serves as disembarkation platform, second platform serves for fixed fire monitor	Lump sum	2	$920,000	$1,840,000
2	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$820,000	$1,640,000
3	Mooring dolphins with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$480,000	$960,000
4	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	200	$400	$80,000
5	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	1,200	$520	$620,000
6	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$290,000	$870,000
7	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
8	Access roadway from fuel transfer platform to TOP of exiting pipelines, RC platforms structure, 20 feet wide, capable to support heavy service truck, spanned RC structure on piled supports	lin ft	650	$5,200	$3,380,000

Table A4: Summary of Cost Estimates – Port Allen Harbor (Page 2 of 3)
Estimated Construction Costs for Conceptual Design
Protruding Segmented Fuel Pier Structure at Breakwater (Part 2 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
9	Pipeline rack structure supported by access roadway structure, pipeline rack supports fuel transfer pipelines between fuel transfer platform and TOP of exiting pipelines	lin ft	680	$250	$170,000
10	Fuel transfer pipelines connecting loading arms with TOP for new fuel transfer pipelines, considered 6 pipes 10 inch average size, pipes are installed in pipeline gallery average length of individual pipeline is 700 feet	lin ft	4,200	$240	$1,010,000
11	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
12	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
13	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
14	Fixed lighting for new fuel transfer facility	Lump sum	1	$60,000	$60,000
15	Dredging to a depth of 35 feet	cu yd	45,000	$8	$360,000
				Total cost of protruding fuel pier structure at breakwater	**$12,650,000**

Table A4: Summary of Cost Estimates – Port Allen Harbor (Page 3 of 3)
Estimated Construction Costs for Conceptual Design
Summary of costs for Port Allen Harbor Conceptual Design

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Port Allen Harbor** Conceptual Design Detached Fuel Pier Structure at breakwater	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 feet fuel barge and 600 feet handysize tanker	$10,200,000	$2,450,000
subtotal	$10,200,000	$2,450,000
total cost of fuel pier **$12,700,000**		
Note: Total costs are rounded to nearest $100,000 amount		

Section A5 Breakdown of Preliminary Cost Estimates for Hilo Harbor

The breakdown of estimated construction costs of all conceptual design alternatives for Hilo Harbor are presented in Table A5.

Page of Table A5	Description of Costs Items or Cost Groups
1	Estimated construction costs for Conceptual Design Modifying Piers 2 and 3
2	Estimated construction costs for Conceptual Design Summary of costs for Modifying Piers 2 and 3

Note: Total costs and costs in Table A5 are rounded as indicated.

Table A5: Summary of Cost Estimates – Hilo Harbor (Page 1 of 2)
Estimated Construction Costs for Conceptual Design
Modifying Piers 2 and 3

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Two Fuel Berths: for 400 foot fuel barge and Handysize tanker Brief: Fuel pier improvements include changing the fuel transfer lines and adding safety equipment to the two fuel berths; two fuel berths are installed, at Pier 2 and 3, where Pier 3 will be the primary fuel berth; no new pier structures have to be built				
1	Modification of fuel transfer pipelines for fuel (other than LPG), relocation of fuel hatch; new fuel lines installed underneath the existing piled pier structure; basis are 4 fuel pipelines with individual lengths of 600 feet	lin ft	2,400	$240	$580,000
2	Modification of fuel transfer pipelines for LPG, relocation of LPG fuel hatch; new fuel lines installed underneath the existing piled pier structure; basis are 2 fuel pipelines with individual lengths of 500 feet	lin ft	1,000	$260	$260,000
3	Fire fighting system for two fuel berths, consisting of (note: teh two fuel berths are sharing the seawater pump, and teh entral foam system) - one remote operated foam monitor per fuel berth, monitor on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors per fuel berth, with local supply of foam agent - one 2,000 gal foam tank, proportioning system to supply the two remote monitors; tank shared by fuel berths - one diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater, seawater pump is shared by fuel berths	Lump sum	1	$710,000	$710,000
4	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
5	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
6	Fixed lighting for new fuel transfer facility	Lump sum	2	$20,000	$40,000
				Sum of fuel pier modifications	**$2,020,000**

Table A5: Summary of Cost Estimates – Port Allen Harbor (Page 2 of 2)
Estimated Construction Costs for Conceptual Design
Summary of costs for Modifying Piers 2 and 3

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Hilo Harbor** Conceptual Design Modifying Piers 2 and 3	cost for pier structure and general pier outfitting	cost for fuel transfer related
Two Fuel Berths: for 400 foot fuel barge and Handysize tanker	$1,180,000	$840,000
subtotal	$1,180,000	$840,000
sum of fuel pier modifications **$2,000,000**		
Note: Total costs are rounded to nearest $100,000 amount		

Section A6 Breakdown of Preliminary Cost Estimates for Kawaihae Harbor

The breakdown of estimated construction costs of all conceptual design alternatives for Kawaihae Harbor are presented in Table A6.

Page of Table A6	Description of Costs Items or Cost Groups
1	Estimated construction costs for Conceptual Design Alternative A Short Extension of Pier 2
2	Estimated construction costs for Conceptual Design Alternative A Summary of costs for Short Extension of Pier 2
3	Estimated construction costs for Conceptual Design Alternative A Long Extension of Pier 2 (Part 1 of 2)
4	Estimated construction costs for Conceptual Design Alternative A Long Extension of Pier 2 (Part 2 of 2)
5	Estimated construction costs for Conceptual Design Alternative A Summary of costs for Long Extension of Pier 2

Note: Total costs and costs in Table A6 are rounded as indicated.

Table A6: Summary of Cost Estimates – Kawaihae Harbor (Page 1 of 5)
Estimated Construction Costs for Conceptual Design Alternative A
Short Extension of Pier 2

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 feet fuel barge and Handysize tanker				
1	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$820,000	$1,640,000
2	Mooring dolphins with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	1	$480,000	$480,000
3	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	120	$400	$50,000
4	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$290,000	$870,000
5	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000
6	Fuel transfer pipelines connecting loading arms with TOP for new fuel transfer pipelines, considered are 4 pipes 10 inch diameter average size, pipelines are installed in pipe gallery average length of individual pipeline is 100 feet	lin ft	400	$240	$100,000
7	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
8	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
9	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
10	Fixed lighting for new fuel transfer facility	Lump sum	1	$20,000	$20,000
				Total cost of extending Pier 2 (short pier extension)	**$4,820,000**

Table A6: Summary of Cost Estimates – Kawaihae Harbor (Page 2 of 5)
Estimated Construction Costs for Conceptual Design Alternative A
Summary of costs for Short Extension of Pier 2

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kawaihae Harbor Harbor** Conceptual Design Alternative A Extending Pier 2 (short pier extension)	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 feet fuel barge and Handysize tanker	$3,280,000	$1,540,000
subtotal	$3,280,000	$1,540,000
total pier costs **$4,800,000**		
Note: Total costs are rounded to nearest $100,000 amount		

Table A6: Summary of Cost Estimates – Kawaihae Harbor (Page 3 of 5)
Estimated Construction Costs for Conceptual Design Alternative B
Long Extension of Pier 2 (Part 1 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
	Fuel Berth: for 400 foot fuel barge and Handysize tanker				
1	Breasting dolphin (inner dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet, dolphin has two platforms attached, one platform serves as disembarkation platform, second platform serves for fixed fire monitor	Lump sum	1	$920,000	$920,000
2	Breasting dolphin (outer dolphins) with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	2	$820,000	$1,640,000
3	Mooring dolphin with mooring bollard, piled structure, dolphin 20 feet x 20 feet	Lump sum	1	$480,000	$480,000
4	Catwalks to connect breasting and mooring dolphins to land and among dolphins, width 4 feet, spanned steel structure	lin ft	160	$400	$60,000
5	Platform to support fuel transfer loading arms, piled RC structure connected to land	sqft	1,900	$520	$990,000
6	Access roadway from Pier 2 to fuel fransfer platform, RC platforms struture , 12 feet wide, capable to support medium service truck, spanned RC structure on piled supports	lin ft	300	$3,300	$990,000
7	10" Loading arms, counterbalanced , manual operation, QC coupling , generic type wide fuel compatible, including alarms,installation, shipment	Lump sum	3	$290,000	$870,000
8	Loading arm system upgrade to supply Double Disc Valve and ERC systems, for improved spill prevention	Lump sum	3	$190,000	$570,000

Table A6: Summary of Cost Estimates – Kawaihae Harbor (Page 4 of 5)
Estimated Construction Costs for Conceptual Design Alternative B
Long Extension of Pier 2 (Part 2 of 2)

Note: Total costs are rounded to nearest $10,000 amount

Run No.	Description (Note)	Unit	Quantity	Unit price	Total price
9	Pipe rack structure supported by access roadway structure, pipe rack supports fuel transfer pipes between fuel transfer platform and Pier 2 structure	lin ft	150	$250	$40,000
10	Fuel transfer pipelines connecting loading arms with TOP for new fuel transfer pipelines, considered are 4 pipes with 10 inch doameter average size, pipelines are installed in pipeline gallery average length of individual pipeline is 250 feet	lin ft	1,000	$240	$240,000
11	Fire fighting system for one fuel berth, consisting of : - two remote operated foam monitors on 30 feet tower with maintenance platform and access ladder, control panel for control of the monitors - 2 manual operated foam monitors with local supply of foam agent - 2,000 gal foam tank, proportioning system to supply the two remote monitors - diesel operated vertical turbine pump to supply 4000 gpm of seawater to foam system, incl piping system for pressurized seawater	Lump sum	1	$660,000	$660,000
12	Central fuel monitoring system; system monitors fuel flow, pressure in barges & tanker , and other important process parameters of fuel facility	Lump sum	1	$280,000	$280,000
13	Emergency shutdown system;	Lump sum	1	$150,000	$150,000
14	Fixed lighting for new fuel transfer facility	Lump sum	1	$30,000	$30,000
				Total cost of extending Pier 2 (long pier extension)	**$7,000,000**

Table A6: Summary of Cost Estimates – Kawaihae Harbor (Page 5 of 5)
Estimated Construction Costs for Conceptual Design Alternative A
Summary of Costs for Long Extension of Pier 2

Note: Costs are rounded to nearest $10,000 amount

Construction cost estimate for proposed fuel facility in **Kawaihae Harbor Harbor** Conceptual Design Alternative B Extending Pier 2 (long pier extension)	cost for pier struture and general pier outfitting	cost for fuel transfer related
Fuel Berth: for 400 foot fuel barge and Handysize tanker	$5,320,000	$1,680,000
subtotal	$5,320,000	$1,680,000
total cost of fuel pier **$7,000,000**		

Note: Total costs are rounded to nearest $100,000 amount

APPENDIX B

LIST OF INDIVIDUALS INTERVIEWED FOR STATEWIDE FUEL FACILITIES DEVELOPMENT STUDY

Marc M. Siah & Associates, Inc.

Consulting Civil • Structural • Environmental & Ocean Engineers
820 South Beretania Street, Suite 201, Honolulu, Hawaii 96813

APPENDIX B: LIST OF INDIVIDUALS INTERVIEWED FOR THE REPORT

List of individuals interviewed for the Statewide Fuel Facility Development Plan

INDUSTRY	NAME	FIRM / AFFILIATION	POSITION
Major Oil	Wade Nakashima	Tesoro	Manager, Supply & Distribution
Major Oil	Capt. Bill Heddaeus	Tesoro	Marine Superintendent
Major Oil	Lance Tanaka	Tesoro	Manager, Governmental Relations
Major Oil	Fran Closure	Tesoro	Vice President, Refining
Major Oil	Carlos De Almeida	Tesoro	Manager, Oils Planning
Major Oil	Jack Clayton	Tesoro	Terminal Manager
Major Oil	Don Ludlam	Chevron	Terminal Manager
Major Oil	Paul Toma	Chevron	Terminal Manager
Major Oil	Richard Conner	Aloha Petroluem	Terminal Manager
Oil	Don Grimes	ASIG, HFFC	General Manager
Oil	Robert Kern	Mid-Pac	Distribution Manager
Oil	Tim Clark	Mid-Pac	Terminal Manager
Oil	Wayne Condit	Shell	Operations Manager
Oil	Baltazar Manibog	Kauai Petroleum	General Manager
SNG	Steven Golden	The Gas Company	Vice President, External Affairs
SNG	Thomas Young	The Gas Company	Vice President, Operations
SNG	Craig Furuta	The Gas Company	Manager, Supply & Distribution
SNG	Marvin Min	The Gas Company	Manager, Hawaii
SNG	Lance Lam	The Gas Company	Division Manager
SNG	Glen Takenouchi	The Gas Company	Manager, Kauai
Transport	Doug Won	Sause Bros.	Vice President
Transport	Brad Rimell	Sause Bros.	Port Captain
Transport	Samuel Malua	Sause Bros.	Operations Manager
Transport	Bill Bolland	Smith Maritime	Operations Manager
Transport	Randy Lau	Smith Maritime	Scheduling Coordinator

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List of individuals interviewed for the Statewide Fuel Facility Development Plan

INDUSTRY	NAME	FIRM / AFFILIATION	POSITION
Utility	Brenner Munger, Ph.D	HECO	Manager, Power Supply
Utility	Scott Seu	HECO	Manager, Energy Projects
Utility	Tom DeMello	MECO	Station Manager
Utility	Michael Ribao	MECO	Manager, Power Supply
Utility	Stan Kiyonaga	MECO	Power Supply
Alternative Energy	Lance Ayrault	Imperium Renewables	Managing Director
Alternative Energy	Mark Warner	Imperium Renewables	Director of Engineering
Alternative Energy	Landis Maez	BlueEarth Biofuels	Manager
Alternative Energy	Scott Matsuura	Pacific West Energy	General Manager
Alternative Energy	Howard Greene	Gay & Robinson	Director of Env Compliance
Alternative Energy	John Jackson	HC&S	Vice President, Planning
Agent	Kevin Kinerney	Transmarine Navigation	District Manager
Misc	Kim Beasley	Clean Islands Council	General Manager
Misc	Richard McQuain	Arctas Capital Group	Hawaii Representative
Misc	Patrick Takahashi	Emeritus Director	Hawaii Natural Energy Institute, SOEST

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