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Howard Hughes H-4 Aircraft Hangar Facility

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DOCUMENTATION REPORT

HOWARD HUGHES H-4 AIRCRAFT HANGAR FACILITY

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VOLUME I
TEXT

PREPARED FOR
THE PORT OF LONG BEACH

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INTRODUCTION OR FOREWARD

This technical report has been prepared by Roger G. Hatheway & Associates and Dr. Lois J. Roberts, consultants, to satisfy the research and documentation needs of the Port of Long Beach LOC HD 1-008, "Documentation Report-Howard Hughes H-4 Aircraft Hangar Facility." Further, the report has satisfied State and Federal criteria for historical documentation of the structures as specified by the State Historic Preservation Officer (SHPO) and by guidelines expressed in the National Historic Preservation Act. The consultants have brought together critical historic and present-day documentary photographs and the useful knowledge of informants. Through an analysis of these (data) the consultants have provided both historic, architectural and technical interpretations relating to the building complex. The findings and recommendations which are presented identify the H-4 aircraft hangar and the associated structures' architectural and historical significance and suggest ways of integrating this significance with the currently proposed plans for relocating the aircraft and certain of the assorted paraphernalia.

The report is organized into five volumes. The first is devoted to textual analysis and the interpretation while the remaining volumes hold critical drawings, photographs and documents necessary to the requirements of the report. These are also referenced in Volume I.

This document is submitted in full completion of the requirement outlined in LOC HD 1-008. The principal consultants, Roger G. Hatheway and Lois Roberts, take full professional responsibility for all information contained in this report.

ACKNOWLEDGEMENTS

Historical

A good many informants, Port of Long Beach employees, Summa personnel, and a fellow historian lent their expertise to the historical section of this project. Joseph Chesler at the Port served as Project Manager and supplied excellent direction and an introduction to our first contacts. The informants who made the oral interviews possible are listed in the Bibliography. We are thankful for the important time away from their own activities that they contributed. RADM Wilbur E. Roberts served as consultant for aeronautical research analysis. In the collection and interpretation of relevant historical data the Principal Investigator worked closely with Dr. Kaye Briegel, Ph.D. author of Long Beach: From Rancho to Renewal (1980). Dr. Briegel made a sizeable contribution to Chapter II of the report sharing the problems of archival research and raising significant historical questions. Mr. Harold Tegart and Mr. George Bromley read portions of the manuscript.

Architectural

Barbara Pritzkat for the technical analysis of buildings and systems of the Long Beach Plant. Mike Wendorf and Steve Sykora for their photographic contributions of the H-4-Hughes Aircraft Hangar Facility. Tom Zimmerman for assistance during the research phase, and for the photographs relating to a personal perspective of the Long Beach Plant. Hank and Julie Konig for rendering the axonometric drawing of the building complex. Bruce Boehner for his excellent large format photography of the site.

In particular we would like to thank the current members of the Long Beach facility for their time and assistance.

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Gery H. Porter, Deputy Chief Harbor Engineer
Donald Moran, Chief Surveyor
Charles Nussbaumer, Civil Engineer
Martha Villacres, Stenographer II
Barbara Embry, Stenographer II

ABSTRACT

The purpose of this study is to satisfy the requirements of LOC HD 1-008 in the preparation of a document entitled, "Documentation Report - Howard Hughes H-4 Aircraft Hangar Facility."

Historical - Prepared by Lois Roberts

Relevant historical data was collected at the Long Beach facility where Hughes Aircraft Company records were available, at the Administration Building, Port of Long Beach, at public archives, and from private collections. Oral interviews were conducted, and both Summa Corp. and Port employees lent us support. The data was organized around the following themes: development of the site and of the structures; the transition of the hangar site from one at which a short term series of tests would be performed to a long term aircraft plant; the flooding of the hangar in 1953 and the legal and lease related after-effects of the flood damage; a description of on-going procedures at the Long Beach plant; and finally, circumstances surrounding the pressure to give up the leasehold. The writing elicited the assurance that sufficient data had been available to meet the scope of work outlined in the LOC. The hangar facility is a significant historical resource chiefly by association with Mr. Hughes and the Flying Boat, but also for qualities it possesses on its own.

Architectural - Prepared by Roger G. Hatheway and Assoc.

The architectural recordation of the Long Beach facility included a research phase, field study and written analysis. All available

documentary information including manuscripts and blueprints was gathered and utilized in a descriptive and technical analysis of building features and systems. This information was supplemented by a comprehensive photo documentation of the facility and by the duplication and inclusion of significant drawings in this report. All written information was presented in a manner which was integrated with both the historical research program and the supplementary photo and drawing volumes. The object of the architectural survey program was to document the site in relation to Executive Order #11593. Briefly, this involved the recordation of the physical characteristics of the building complex prior to demolition. Within a limited time frame, and in completion of the outlined scope of work as presented by the Port of Long Beach, this goal was accomplished.

Significance

The Howard Hughes H-4 Aircraft Hangar Facility was found to be both historically and architecturally significant. As a result, a number of recommendations for further research and mitigation measures beyond the scope of the present study were suggested. These were submitted in consideration of the fact that an understanding had been reached between Wrather Corp. and the Port of Long Beach on September 4, 1980, in regard to the preservation of relevant articles found at the hangar site.

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Chapter I

GEOGRAPHICAL DESCRIPTION

A geographical description of the property is well summarized in the lease of the property itself. This information is recorded as follows:

> 2. AREA. Effective as of the commencement of the term of this lease, City does hereby grant, and Leessee accepts, an exclusive lease of those certain premises located on Pier E in the Harbor District of the City of Long Beach, designated Parcel A and Parcel B, containing fifteen thousand (15,000) square feet and six thousand seven hundred fifty (6,750) square feet, respectively, as depicted on Harbor Department Drawing HD 3113 (Rev. 5-1-72), attached hereto and by this reference incorporated herein. Said parcels are hereinafter referred to as the "leased premises" or the "premises".

For further information please refer to Figures 1, 2 and 3, and to the general site description contained in Chapter 3 of this report. In addition, HD 8613, drawing #3 of Volume IV, is a revision of HD 3113 referenced in the above lease. See also the lease information contained in Volume V for revisions to the original lease.

Chapter II

HISTORY OF SITE, DEVELOPMENT OF STRUCTURES AND ASSOCIATED HISTORICAL QUALITIES

THE BEGINNING

INTRODUCTION

No meaningful discussion of the Hangar for the H-4 Hughes Flying Boat can commence without a few words about the flying boat itself and about Howard Hughes, its builder. A flying boat, an amphibian aircraft, launched Hughes on his flying career as it was in one of these that he had his first airplane ride as a child. He learned to fly as a teen-ager, intensified his training when he was eighteen and independent, and by 1934 in spite of diverse interests was committed to the world of flight. He was fascinated with aeronautical matters, and had his own plane and his own personal airplane mechanic, Glen Odekirk. When Odekirk suggested that Hughes would be satisfied with a plane only when he built his own from scratch, Hughes agreed, rented a hangar at the Glendale Airport, and called it the Hughes Aircraft Company. Hiring two young aeronautical engineers from the California Institute of Technology, the Company began design on the H-1. On January 19, 1937 Hughes flew this plane to break all land plane distance speed records. It is preserved at the Smithsonian Institute. The Company expanded to larger quarters at the Burbank airport and began preparing a plane to fly around the world. The first, a Sikorsky amphibian, was purchased but set aside in favor of the faster Lockheed Lodestar. Hughes flew the modified Lodestar to break the round-the-world speed record in 1938.[1]

Two tragic events of this period bear tangentially upon the subject flying boat hangar. First, there was the fate of the Sikorsky. Hughes used it extensively for personal research in water takeoffs and landings, then offered it to the military. He installed larger engines at the government's request, and as he habitually tested every plane he ever built or modified, he took the Sikorsky to Lake Mead in Nevada for final tests. The plane crashed while landing and sank, killing two passengers. Hughes ordered it brought up, the cause of failure researched, and when the plane was in flying condition it was stored in a locked hangar, but never flown again. Secondly, Hughes Aircraft Company spent several years on a twin-engine, high speed, long range medium bomber called the D-2. It was made of wood. One night while it was still undergoing tests lightning hit its hangar, destroying the plane and a million dollars' worth of research.[2] When Hughes assembled his second wooden plane, the H-4, a water tank was installed at the hangar site before any of the plane's parts arrived.

Space at the Glendale hangar had been too cramped for projects such as the D-2, and when Glen Odekirk showed Hughes some Culver City land in 1939, Hughes told him to go ahead and buy it. The Army visited the new plant in 1941, and 1942 it purchased thousands of an improved machine-gun feed chute which Odekirk had developed, but it was not until 1942 that Hughes Aircraft Co., a Division of Hughes Tool Co., A Delaware Corporation, had a firm order for a government plane. It was the contract for the giant flying boats.[3]

In 1942 German submarines were sinking allied merchant shipping and troop carriers at such a rate that avoiding these losses became one of the

war's prime problems. Henry J. Kaiser, industrialist and ship builder, proposed that he build a huge aircraft capable of transporting hundreds of men and their equipment. Glen Odekirk told Hughes on hearing of it that they had about two hundred engineers who would soon be freed from other projects. Hughes could design it and Kaiser build it at one of his ship yards. At this point it may be appropriate to recall a few lines from a speech Hughes made in New York City in 1938 on the completion of his world flight. In it he had said that he looked forward....

> to the day when you will lean out of a New York skyscraper window and see a ship, a great ship, perhaps not as large as the Queen Mary, but larger than some of the ships that are plying the Atlantic today...just a few feet above the surface, gliding between two rows of bouys marking one of the landing paths across New York harbor[4]

As this report is being written plans are going ahead which will permit people looking out of Long Beach skyscrapers to see not only Hughes' vision of a great flying ship but also the Queen Mary beside it.

On November 16, 1942 Hughes and Kaiser signed a contract with the Defense Plant Corporation authorizing construction of three flying boats for test purposes. The planes were to be built with no more than $18,000,000 of the government's money and to be delivered in two years. Hughes designers got to work on the plans for a wooden flying boat and an agreement was reached with Kaiser whereby he would build the production models. Design went slowly, and when the first of the production models was to have been delivered in 1943 the work had just begun on the hull of the prototype. Then by 1944 the United States was winning the war and had minimized the Nazi U boat threat. Need for the giant cargo plane receded, Kaiser saw no future for the mass production of a flying

boat and withdrew from the contract. Hughes, however, completed the plane at his own expense.[5]

SEARCH FOR A SITE

It is not entirely clear when the problems of assembly and launching fell to the Hughes' engineers. According to Rae Hopper, who was the Chief Engineer at Hughes Aircraft Company when the H-4 was being built, the original plan for launching was that they would simply move the plane to the ocean near the Culver City site and slide it into the water. The area was not built up, so the way was comparatively clear. Following upon the procedures used for other flying boats of the time, they would build a launching platform and slide the plane down on its cradle. However, as design work progressed, the concept changed to that of a very large aircraft. As the parts were being built and the size became apparent, Hopper recalled, they began to wonder just where they were going to launch it.[6] This was a problem for the plant Facilities Engineer to solve. Harold Tegart, who held that post, was directed to find an appropriate site. Tegart had come to work at the Hughes Aircraft Company in 1941. His father who got him the job had laid out the Culver City plant. Young Tegart with his degree in civil engineering and classified as an engineering contractor A, which meant he could build anything, was soon supervising diverse construction projects at the plant. He laid out the pavements and designed the 9000 foot turf runway. In 1943 he was planning and designing all the new plant sites and new buildings. He had been involved in the plans to launch the H-4 onto Ballona Creek near the plant and in alternate plans to construct a new channel from the plant to

the ocean. As these plans were abandoned he searched southward, considering Manhattan Beach and Hermosa Beach. Redondo Beach presented a site surrounded by a small breakwater, but its area was considered inadequate both for manuverability and protection. Tegart then went south to San Pedro Bay and Terminal Island where adequate protection behind the two major breakwaters could be had.[7] Tegart marked his possible site locations at the Los Angeles and Long Beach Harbors on a harbor map in 1944. A triangular plot lying east of Barracuda Street and south of Cannery Street on west Terminal Island was considered, but was ruled out due to wind and waves. Two possibilities lay on the Main Channel of the Los Angeles Harbor: one south of the Municipal Fish Market at Berths 77 and 78 and the other at Berths 235 and 236 south of the Ferry Building. Tegart defined another site on the East Basin, Berths 215 and 216, and still another, a Cabrillo Beach site just north of the recreation area. Hughes made aerial studies and,Tegart looked at several sites in the Long Beach Harbor.[8] A U.S. Army report on a proposed site at Long Beach Harbor Pier A, Berth 6, from their own point of view recited that the Hughes Aircraft Company had made a very exhaustive study of all the Pacific Coast ports for a suitable area to land and test the supercargo planes. The report claimed that some thirty-nine sites in various ports on the Pacific Coast had been examined. This may have been an exaggeration. Even though the Pier A site was in close proximity to the Army Munitions Loading Terminal, the Army approved the Hughes operation there provided that there would be a 700 foot distance between them.[9] A site on Berths 120-121, Pier E, a land-fill pier, was plotted January 6, 1944. This we

know from a drawing executed by Tegart, Hughes Drawing F 5014 entitled "Proposed Long Beach Site" and marked "strictly confidential." On these 7.2 acres he showed the plane heading northwest into a building designed to house the nose and the wing-mounted engines. Rails for gantry cranes are also shown. The launching ramp extended 188 feet beyond the pier bulkheads yet to be back-filled.[10] Our documents lead us to believe that the Pier A site was abandoned by November of 1944 as in that month it was not discussed among the "Possible New Sites for Aircraft Assembly" outlined in a letter from E. J. Amar, Port Manager, Long Beach to John Stearns, Plant Engineer at Hughes. The issues by then were those of adequate size, finding an area not too congested or too close to oil well operations, and availability of access roads and bridges that would carry the loads and provide the clearance needed when the large plane parts were transported to the site from Culver City. A site on Pier D was mentioned; however, in a December 8 letter all of the problems discussed were those associated with the Pier E site; the one that was eventually leased by Hughes Aircraft in September of 1945. Port Manager Amar pointed out the location of the new Navy mole and the degree of protection the outer harbor would have from the open sea as soon as that mole was completed. He included sketches of the Navy pontoon bridge over the Cerritos Channel and profiles of high tides, data necessary for determining bridge, ramp, and apron capacities. Amar estimated the cost of partial fill construction to prepare the site (on Pier E) would be $243.500.00. He pointed out that immediate beneficiaries of the fill operation would be Hughes, if they utilized the area, and the Southern California Edison Company. He pressed for a decision within three weeks so that they could have their contractors commence work on the submerged dikes around the area.[11]

C. W. Perelle, voted General Manager of Hughes Aircraft Company in October of 1944, signed a letter to the Board of Harbor Commissioners, Long Beach on January 11, 1945 applying for the 7.2 acres of "shore property" indicated in the maps he attached for "final assembly, launching and testing of the Cargo Plane HK-1, construction of which is nearing completion at the Culver City Plant."[12] He asked for a three-year lease on Pier E drawn on January 30, 1945, Drawing HD 3007, an area of two parcels: Parcel 1, an area of land to be used for plane assembly, and Parcel 2, an area of water that would be controlled by the use of Parcel 1. Charles L. Vickers, Assistant Harbor Engineer and future Port Manager, drew up the letter which accompanied the drawing sent to Hughes.[13] The Harbor Department refined the provisions for the Hughes Aircraft Lease over the next three months, and on May 1, 1945 released Ordinance No. HD-140 which set forth provisions of the lease. On May 16, John Stearns, Plant Engineer at Hughes, responded with Drawing F 0028 showing the Long Beach Site Plot Plan with graving dock and float slips and Drawing F 0029 showing the cargo plane in position on its cradle within the dry dock structure. The dock gate, Stearns pointed out, would be approximately 75 feet from the southerly boundary of the property line. The portion of the excavation between this boundary line and the gate was not to be made until just prior to launching, after which it was proposed to dewater the dock at sufficient intervals to prevent marine borers from penetrating the green timber and piles to be used in the dock construction.[14]

On August 24, 1945 the Executive Committee of Hughes Tool Company authorized Noah Dietrich, Executive Vice-President of the Company, and C. W. Perelle referred to above to enter into the contract pursuant to Ordnance No. HD-140 for a period of two years with the option for three additional years and at a rental of $1,259.49 per month.

The documents contributing to the above reconstruction of events demonstrated at this level of the Hughes Aircraft Co. operation a fact rather well known about Mr. Hughes. He did not draft, initial, or sign correspondence. According to those who dealt with him, he kept what he knew in his head, and discussed matters verbally with his managers and engineers. Further, the documents used in this section, and indeed those searched for in this report contained only a few scattered references to the things Mr. Hughes had actually said.

The lease, signed in late May by the Hughes executives, became effective through the signature of Port Manager Amar on September 4, 1945. The lease described the premises as those set forth as Parcels 1 and 2 in Drawing HD 3007 referred to above. The Port agreed in paragraphs 5, 6, and 7 to grade the area contained in said Parcel 1 to approximately the subgrade of the general area improvements," to "maintain rock dikes and revetment, and to construct an additional dike if it should become necessary south of the demised premises in order to provide adequate ingress and egress of said plane in and to its cradle, and for the retention of earth fills."[15] The Port in accordance with paragraph 10 would grade and maintain a rock roadway from Seaside Avenue to the property line of the lease with adequate clearances for bringing in the plane parts. Hughes, the lessee, by paragraph 13 would fence the entire area of Parcel 1, except the channel side. Before undertaking to erect any structure, Hughes was to submit plans and specifications to the City of Long Beach and obtain a building permit. Since additional fill operations were planned for the areas west and south of the leased site, paragraph 15 stipulated that the Lessee would cooperate with the Port and not cause any delay.

Paragraph 23 was included to assure the Lessor that Hughes would leave the property at the termination of the lease in substantially the same condition in which it was found on entry. A copy of this lease and all subsequent leases may be found in Volume V, Critical Documents.

PIER E BACKGROUND

The site Hughes Aircraft leased on Pier E had an interesting history of its own that can only be understood in the context of general harbor development and indeed Long Beach City growth. In the first Master Plan for the Long Beach Harbor, completed by George F. Nicholson and James F. Collins in 1940, Pier E included all of the area on the south side of Terminal Island that belonged to the City of Long Beach.[16] The fact that the first Master Plan was drawn in 1940 did not, however, mean that there had not been previous ideas for harbor development. In 1896 many residents of Long Beach urged the U.S. Congress to choose San Pedro rather than Santa Monica as the site of a federally constructed breakwater off the southern California coast.[17] In the next year, 1897, Long Beach incorporated. The city, which had been laid out by real estate speculators in 1880, was now under the control of the local electorate.[18] In 1905 a group of Long Beach citizens along with some out-of-town investors formed the Los Angeles Dock and Terminal Company, acquired eight hundred acres of salt water marsh lands adjacent to Los Angeles harbor and began building wharves there. Their first major industrial tenant was the Craig Shipbuilding Company. Two years later in 1909 Long Beach citizens voted the first bonds for their own harbor development. Cargo landed on the municipal wharf,[19] and the Southern California Edison Company opened its generating plant north of Pier E on Terminal Island.[20] The Dock and

Terminal dredging operations were virtually negated by the floods of 1914 and 1916. The Company deeded its channels to the City, thus leaving future dredging up to Long Beach. City development accelerated in 1921 when oil was discovered on Signal Hill just north of the city limits.[21] Oil was soon discovered within the city limits and a boom period began.[22] As the city expanded, the citizens voted $5,000,000 in bonds and hired Col. Edward Johnson and Maj. R. G. McGlone to plan and carry out additional harbor development.[23] While the primary focus of their plan was to improve the inner harbor area north of Seaside Blvd. some of the material dredged up in this operation happened to be deposited on the southeastern part of Terminal Island, that part later called Pier E.[24] One of the companies involved in the 1924 project was the Fred E. Franks Dredging Company.[25] To protect the dredge and fill work done under a preconceived plan, two moles were built flanking the harbor entrance. The one on the Terminal Island side was a "T" shaped 3501 foot breakwater which included in its construction 700 and 900 foot bulkheads.[26] It was this breakwater now submerged and below land fill and indeed below the historical Pier E as conceived by early Long Beach Harbor planners, that formed the first outline of the present Pier E. We can see this "T" shaped breakwater in historical photographs. (See Vol. 5, Critical Documents.) As harbor improvement continued in 1926 the Richfield Oil Company completed a marine terminal in the inner harbor and adjacent to it they erected a pumping plant and storage tanks that equipped it to handle 500,000 barrels of oil and gasoline a month.[27]

Harbor development in Long Beach slowed following the Wall Street Crash in 1929. It accelerated again, however, after 1936 when oil was discovered in the Long Beach Harbor itself. Long Beach Oil Development Co.

was formed to drill for and produce oil under the Harbor. In 1938 the Board of Harbor Commissioners contracted with Nicholson and Collins for a Comprehensive Report and Master Plan for the harbor using anticipated oil revenues.[28] A year later when the Navy announced plans to build an operating base and shipyard on Terminal Island in Long Beach, Nicholson and Collins had to change their plan to accommodate the new tenant.

The Navy had been active at the harbor for some time. It first welcomed a visiting squadron of the Pacific Fleet in 1903. In 1919 nine dreadnaughts and supply ships of the Pacific Fleet were based off Long Beach. In 1932, Long Beach was home port to nearly fifty vessels and many naval officers and their families lived in Long Beach. It had a landing at Slip 4, Channel 3 and several additional landings. Then on request Long Beach gave them space south of Seaside Boulevard in the 1700 block. This was the beginning of the large Navy landing at Terminal Island. During the war the Navy did a great deal of rock work and built graving docks along their landing, expanding it and virtually taking over what had been Long Beach's earlier concept of Pier E. The Navy even went so far as to have their harbor mapping center at Vicksburg, Mississippi develop a model for the entire harbor. (See Figure 4.)[29] Government dredging for the expanded naval base and shipyards provided fill for the portion of Pier E Long Beach Harbor finished. It eventually developed Berths 123-126 and gave them to the Navy. The Harbor kept Berth 122 to use under the tariff system. Berths 120 and 121 to the east were made ready for occupancy when the Hughes Aircraft Co. demonstrated a serious intention to lease the land in 1945.[30]

Port of Long Beach
General Plan Studies and Development

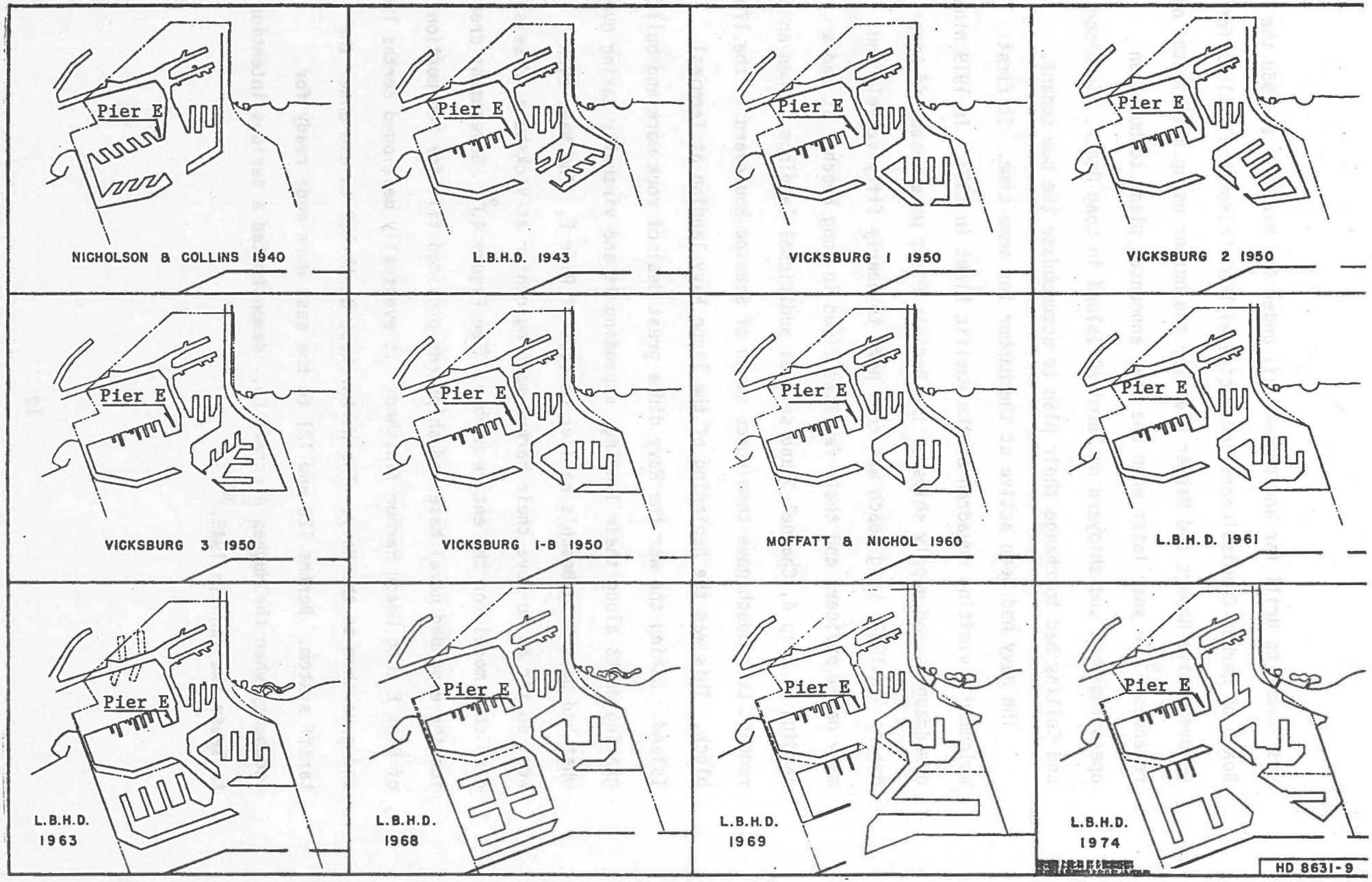

Figure 4. Source: B.N. Hoffmaster, Port of Long Beach General Plan, 1975

PREPARATION OF SITE, ASSEMBLY, AND FLIGHT

Facilities Engineer Tegart, in addition to locating a site, had been gathering the data necessary to make it ready for the assembly of the Flying Boat. In January and February of 1945 he was exchanging Inter-departmental Memoranda at the Hughes Aircraft Company with the Foreman of Final Assembly, Charles Wigmore, and with Tom Nolan in woodworking, and getting together a list of the needed facilities. The Hydraulic, Electrical, and Engineering departments would need housing. The wood veneer, paint, and tools would need protection. In February he had a list so complete that it included not only two gantry cranes but file cabinets and benches as well. Manpower expectations were listed at thirty-six.[31] Tegart then turned his attention to the problems of dry docks for the hull and wing floats. Tegart's plans "proposed that the contractor would dewater the area by wellpoints, perform the excavation of the main dock with the two auxiliary float slips by drag line, leaving an embankment between these docks and the ocean for protection during construction. This embankment [was] to be removed after the three gates were installed."[32] On determining the feasibility and economics of this plan, representatives were called in from the Navy at Alameda and from Pan American Airways. Both the Navy and Pan American Airways concurred in the findings, so detail plans and specifications for construction were prepared and the bids were received in May, 1945. Guy F. Atkinson Company came in with a bid of only some $2,000 above the low bidder J. E. Haddock Co. who bid $131,235.00. Atkinson stated however, that if permitted, he would submit an alternate proposal to construct the dock in concrete, as his equipment for this purpose which he had used in constructing the large Navy Dry Dock adjacent to the Hughes site, was available. The other bidders were similarly

allowed to come up with a bid for a concrete dock, but they could not compete with the Atkinson bid under the circumstances. Guy F. Atkinson Co. could build the same dock in concrete at the price of $129,450.00. When final adjustments were made for time and material a contract was signed for $134,597.60 for building the concrete dock. That same month the Harbor Department was proceeding with excavation and fill on the site.[33]

In January, 1946, John Stearns, Plant Engineer, wrote to Port Manager Amar requesting a building permit to construct a dry dock and other facilities as shown on Hughes Drawing No. 0028.[34] These included the dry dock; a building shelter; land improvements such as fire protection system, paving, and a man-proof fence; and auxiliary utility lines. Application for a building permit for the dry dock (K1879) was received by the City of Long Beach on January 31, 1946. Atkinson and Co. had their equipment, construction sheds, and office on the site the same day ready to begin. Weather permitting, the dock was to be ready in ninety days to receive the hull of the Spruce Goose. Harold Tegart recalls driving out to the site that January day on the Harbor Department's gravel road and parking his car on the flat, leased land. He walked around, then returned to his car to find the wheels almost out of sight and the auto's body resting on the ground. An Atkinson Co. tractor came over to pull him out, but it too bogged down. Finally, a cable attached to a distant crane pulled him free. In addition to this hazard it was well known that the area was subsiding at a rate of an inch a month.[35] The desolate marsh is shown in Figure 5.

Work commenced February 1, 1946. Harold Tegart's Progress Reports and accompanying photographs submitted to the Plant Engineer weekly provide an excellent source for tracing the construction work. His reports included entries on electrical installations, equipment in operation,

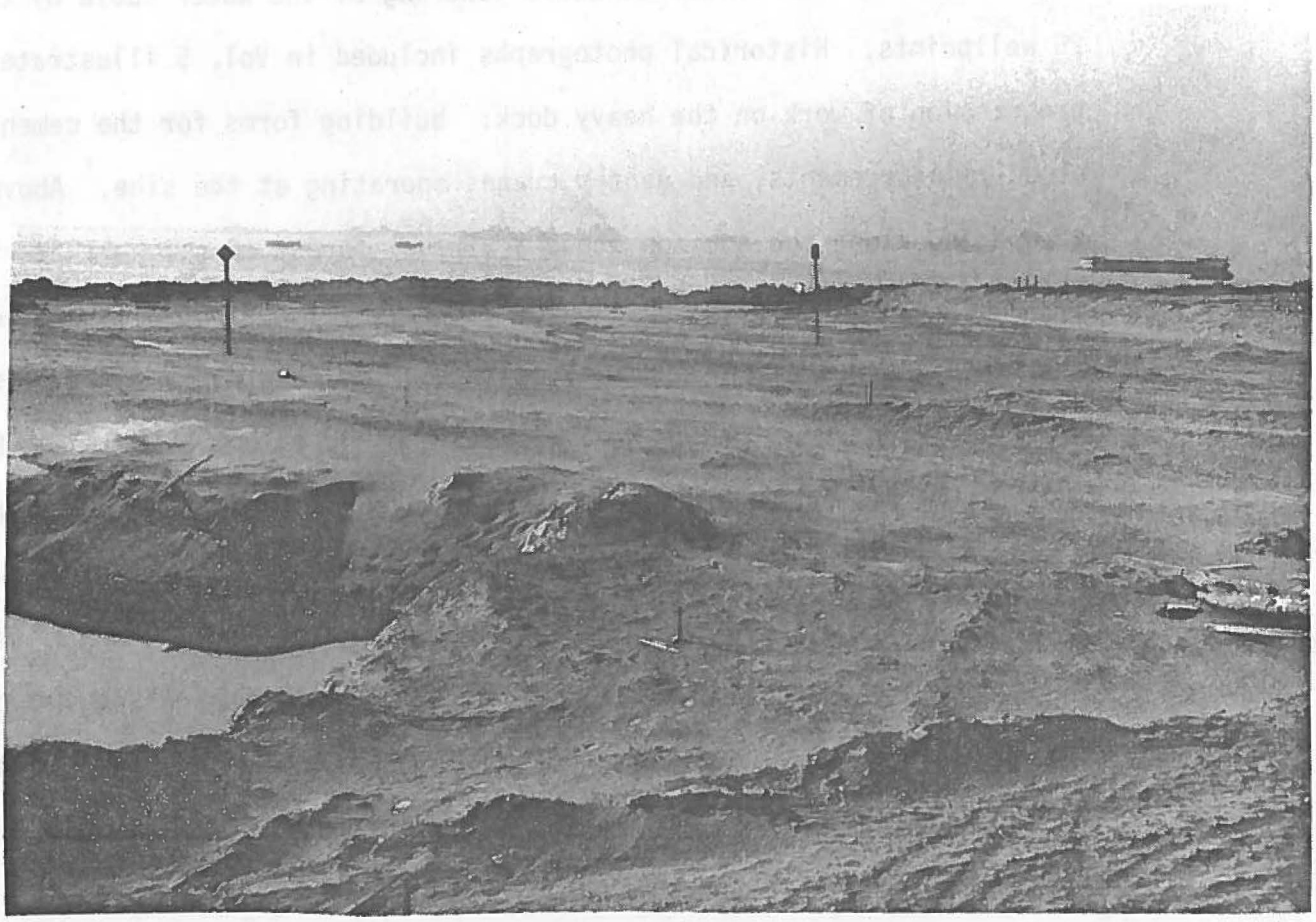

Figure 5. View of Site before Beginning of Operations by Atkinson Company. February 5, 1946. Courtesy Harold Tegart

progress in excavation and construction, road approaches, survey work, completion of contour maps of the site, telephone installations, water lines, and installation of wellpoints. Hull dry dock excavation went foreward and by February 25, 10,700 cubic yards of earth had been moved. Then excavation was halted to await lowering of the water table by the 25 wellpoints. Historical photographs included in Vol. 5 illustrate the progression of work on the heavy dock: building forms for the cement, steel reinforcements, and gantry cranes operating at the side. Above ground and along the horizon stood a virtual forest of oil well derricks, reminders of the ongoing subsidence. The west wing float dock had been excavated and was ninety percent complete. The road approach from Seaside Blvd. had been paved thirty feet wide to the Hughes property line. By March 4 the Atkinson Co. had completed grading on the general site area, compacted it and spread it with decomposed granite. All preparatory work on the facility was done on contract. The contract for a 155,400 gallon fire protection, stand-by water tank, bid at $5,800.00, was awarded to Consolidated Steel Corporation. The contract for the tank foundation went to Pugh Construction Co. for $4,600.00. A contract was signed with the Callahan Construction Company February 15, 1946 for a machine shop building costing $11,315.00 with work to be completed May 18, 1946. Completion was actually August 26, 1946. Hoffman and Jacobs had a contract for power and light installations and Pacific Pipeline Construction Co. had one for water lines. March 11 photographs showed the dry dock excavation to its final depth, a gravel base in place at the bottom of the dry dock, and forms ready for the concrete and reinforcing steel.[36] Guy F. Atkinson's Dry Dock Work Schedule called for the forms and concrete to be in by May 20, the gates completed by May 29, and all work to end on June 5. The work ended on schedule. Tegart then procured from the Navy the marine

equipment and rigging necessary for the launching, such as Navy pontoons, bouys, work boats, and floating docks.

Hughes Aircraft Company made no press releases on the work at the site; nonetheless, on January 14, 1946 the Long Beach Press-Telegram carried a small article which read "A graving dock from which the huge flying cargo boat of the near future will be launched for their trips to the South Pacific, will be erected at Long Beach, with completion scheduled for July 15." On March 12, 1946 the Los Angeles Evening Herald Express appeared to be irritated with the suppression of publicity on the big plane. It carried a picture of the immense Cargo Building at the Culver City plant where crews were working around the clock on what the paper called the $20,000,000 mystery. For lack of any recent releases from the then closed-down public relations office at Hughes Aircraft, the paper recalled the facts and figures given to them in July 1945, to wit "that the flying boat would be launched from a grading [sic] dock to be built in Long Beach sometime in January of this year." Reading on, it reported that it would cost $2,000,000 to move the plane to the launch site. The Los Angeles Times sent a photographer down to take a picture of the graving dock construction and published a picture of it on March 28 with an accurate description of the work in progress.

Concurrent with the site work, Tegart went ahead with plans to move the H-4 flying boat to Long Beach. According to his account,

> This work was planned and coordinated in such a manner that from the time the wings and hull left the Culver City plant, there was no delay at any point along the route to Terminal Island. All possible changes in wire locations were made in advance of the move. Those wires that could not be changed in advance of the move were handled as the loads passed them.[37]

Star House Movers, Inc. made the low bid, $16,970 as opposed to the two others of $34,500.00 and $22,000.00. Tegart arranged for tree trimming and

wire cutting along the route to make way for the wide loads. He recalls that 5,000 wires needed to be cut and spliced. Then at the last moment The Edison Co. north of the plant said it could not make the necessary arrangements for one and a half years. Only then would they move their wires. Tegart looked into other Edison Co. matters, found a point of leverage, and the move was made on time and within the estimated cost. The wings were loaded and moved to Long Beach on June 11 and 12, 1946; the hull on June 15 and 16. The component parts which included the vertical and horizontal stabilizers were moved as required by final assembly.[38] The many photographs taken of the various stages of the move between Culver City and Terminal Island serve as a vital source of information for that historic event.[39] (See Figure 6.) Near the end of the twenty-eight mile trip the parts were hauled over the Navy pontoon bridge to Terminal Island and by road to the northeast end of Pier E. (See Figure 7.) The hull was taken down a ramp into the dry dock which lay below water level. The wings were thus able to be mated and attached with a minimum of lift distance. Water-tight gates held the harbor water from entering the dry dock. Photographs taken at the dock in late June and early July show the Flying Boat assembled with scaffolding built up to the top of the 92 foot high fin, around the nose, and by each engine nacelle. In the photographs the water tank and the Machine Shop or Engineering Building (Figure 3, No. 3) are the only permanent structures on the lease site in addition to the docks. However, various temporary construction sheds and the Atkinson office stand along the fence. Gantry cranes are at work, and parked cars and the presence of workers give the plant a general feeling of activity. Floating docks surround three boats off port side in the water. The access road into the plant is at the northwest corner of the lease.

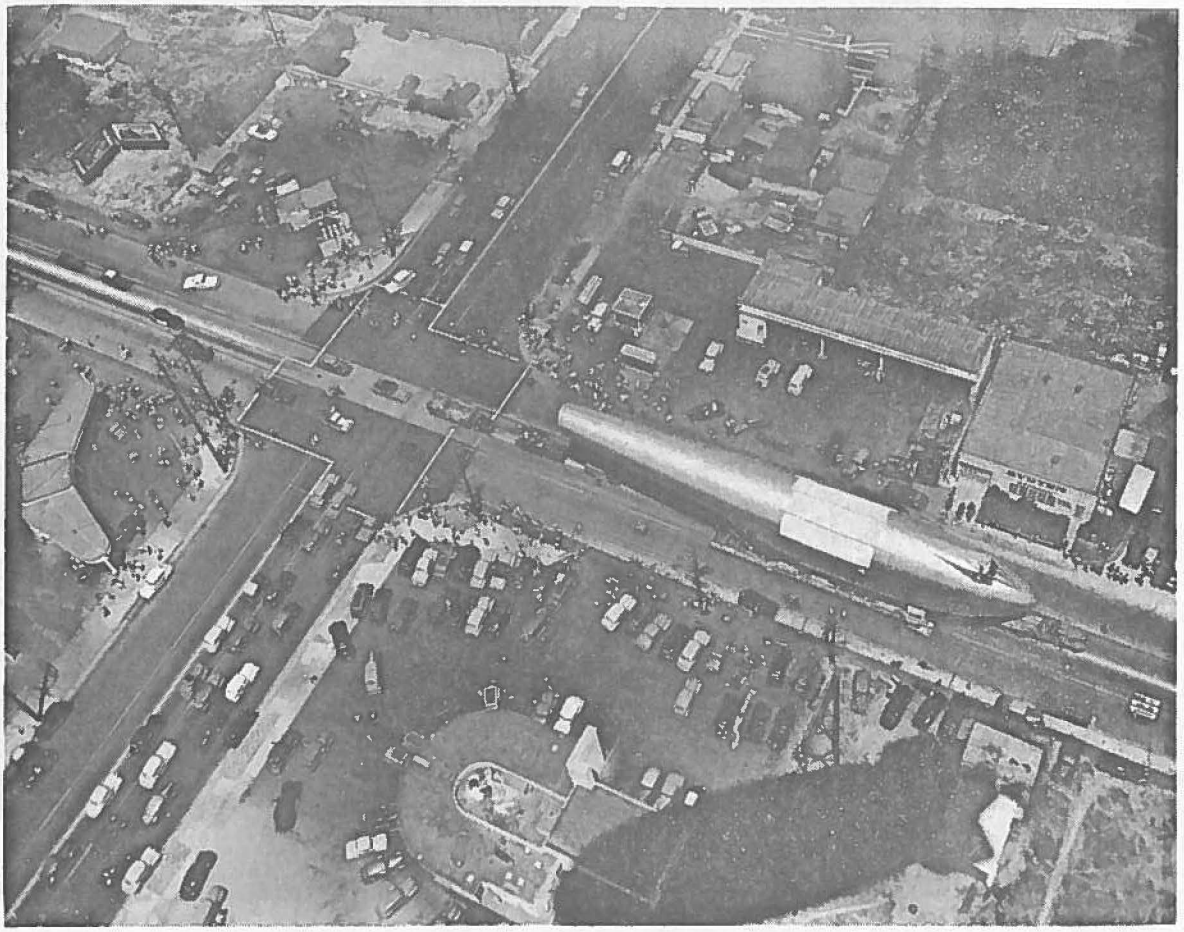

Figure 6. Flying Boat Hull Being Transported by Star Movers from Culver City to the Long Beach Plant on June 16, 1946. Courtesy Harold Tegart

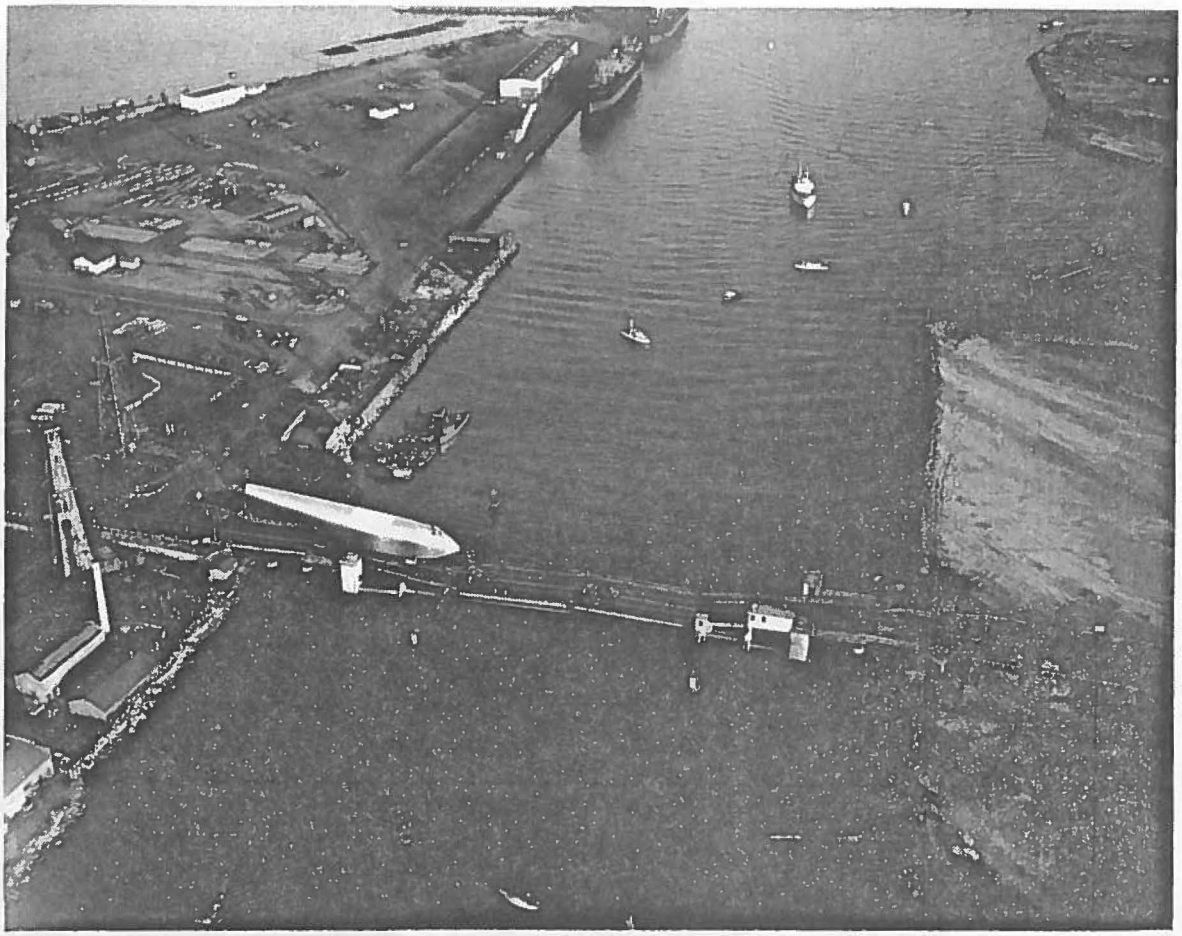

Figure 7. Flying Boat Hull Crossing over the Channel to Terminal Island on the Navy Pontoon Bridge. June 16, 1946.
Courtesy Harold Tegart

Figure 8. Completed Ronney Tubular and Canvas Hangar as it Appeared September 18, 1947. Source: Engineering Vault, Port of Long Beach

Less than a month after the parts arrived at the site, on July 7, 1946, the owner of the Flying Boat, Howard Hughes, took his newly completed XF-11, an experimental high speed twin engine photo-reconnaissance plane with counter rotating propellers, on a test flight. The XF-11 was an outgrowth of the D-2. During the flight the rear four blades of the right propeller suddenly changed into reverse pitch veering the plane violently to the right. Hughes crashed into some houses in Beverly Hills, suffered multiple injuries, and no one in the emergency room at the hospital thought he would live through the night. Hughes hovered near death, then slowly but miraculously recovered. In September of 1946 Hughes was again flying in the pilot's seat of his converted B-23 bomber. His activity made it clear that no physical problem on his account would hold up completion or flight of the H-4.

Meanwhile at the Long Beach plant assembly and testing continued on the H-4, but flight readiness was still a year or two away. According to Project Engineer Tegart, a hangar was designed while the plane was in assembly. It was to be the only hangar built on the site and was temporary in nature. Hughes Aircraft had worked with a company that had Ronney Tubular structures, so Hughes engineers designed a hangar using their materials. Ronney carried a line of aluminum metal tubes. Hughes personnel framed the tubes into trusses with stanchions set in on either side. In order to move the plane the several sections of truss structure were simply lifted off with a crane. The hangar was shaped to cover the hull, wings, empennage, and nose. Historical photographs show the tubular structure in successive degrees of completion and also show the hangar components off to the side when the Flying Boat was taken out of the hangar.[40] (See Figure 8.) On November 26 Robert Shoemaker, Long Beach Harbor Engineer, approved a

Hughes request to construct and install a control tower on the top of the existing water tank. Tegart asked for anchorages for the H-4 Flying Boat and a PB2Y3 Flying Boat and received a Revocable Permit dated December 16, 1946. It read that the "Permittee may use said premises for an anchorage for two (2) flying boats as shown on Hughes Aircraft Company's Drawing No. J-0119, dated 12-16-46, which accompanied the application for this permit. Permittee may also use said premises for such other or additional similar activities as may be approved in writing by the Port Manager of Permitter."[41] Tegart then asked permission to reduce the height of the existing underwater mole which extended in a southerly direction from the southeast corner of the lease property on Pier E. Tegart advised that in view of the anticipated increased activity in the area during the testing period the mole would be a hazard. Bill Berry, the H-4 Project Director, recalled that in early 1947 there was a regular fleet of boats: a PT boat, fuel barge, four sea mules (tugs), and a couple of personnel boats.[42]

In July and August, 1947 the Senate War Investigating Committee held hearings on some of the Hughes Aircraft's contracts. Most of the issues of those hearings do not concern us here, however, during the course of exchange the flight capability of the H-4 was seriously challenged, partly in view of the fact that it was far behind schedule. Hughes then felt compelled to state that the ship was valuable for testing and that it had crossed the size barrier in aviation. He said he was not certain it would fly as tests had not proceeded that far; but if it would not fly he would probably have to leave the country. Having challenged himself thusly, Hughes came back to Los Angeles determined to test the big plane as soon as possible. Work was speeded up on connecting the different systems in the plane, and on October 25 he announced he would conduct

taxi tests in the Long Beach Harbor during the weekend of November 1 and 2. The plane was really only ready for taxi tests and four to five months away from flight test capability.[43]

During these months Harold Tegart had many conferences with Howard Hughes on the launching facilities. When the hull was brought down it was in a steel fabricated cradle with fore and aft structures. It was supported where the bulkhead is. If water came in it would lift in the front (put it in trim) and put all the weight on the aft portion. Thus, the aft would go down and be crushed. Tegart solved this by having beams built across the aft bottom. Hughes was not satisfied with this system and it was subsequently redesigned. Problems surrounding launch such as how to get such a large flying boat out of the dock were new to aviation history. Tegart talked to docking masters all over Terminal Island and studied articles on docking and marine terminals built throughout the world. For example, the levees, breakwaters, and other installations at the German seaplane base at Sylte were studied. The Mars flying boat, large for the time, offered some insights; however it weighed only 85,000 pounds while the H-4 weighed about 225,000 pounds. Conventional methods were not feasible. Tegart figured he had six feet of clearance on each side of the wooden ship as it went through the concrete dock to the water. If a gust of wind hit the eight-story high fin and swung the hull against the concrete, it would wreck the plane. Tegart solved the problem by building a jetty out into the water on either side of the gate. He then borrowed four heavy tractors which could drive out onto the jetties. Tegart's launching method employed winches and cables tying the plane to the heavy tractors which moved with the plane and held it absolutely steady as it slid out of the dock and down to the ramp.[44] In order to

prevent the tractors from following divergent paths and thus pulling the plane apart, a separate cable was run from a tractor on one side completely through the airplane to the opposite tractor on the other side. Tegart had his "Launching and Docking Procedure" ready in every detail by October, 1947 and published a complete manual on the operation. It defined "each motion to be followed in raising the Hughes Flying Boat from its cradle, opening the dock gates, and moving it out into the channel."[45] On November 1 Glen Odekirk drove Mr. Hughes down to the Long Beach Plant for the taxi tests which had been announced in October. Winds prevented taxi tests that day, but on November 2 with the invited press and thousands of spectators on the shore, Hughes made three taxi runs on the choppy waters with a number of the press aboard each time. On the final taxi run with only his crew and one newsman, Jim McNamara, aboard he made the decision to fly the plane briefly. He flew for a distance of about one mile and the plane reached an altitude of 85 feet. Following the flight the plane was towed into the dry dock, tied up, and the gates were closed while it was still floating. The hull was placed on the cradle, and the water was then removed from the dock. The tent and catering services for the press and invited guests were all taken out, and the Long Beach plant went back to tight security.[46]

Footnotes

[1]John Keats, Howard Hughes (New York: Pyramid, 1970), pp. 11, 33, 65, 100, and 133.

[2]Keats, op. cit., 3, 166-168.

[3]Keats, 158-159.

[4]Keats, 159.

[5]D.D. Hatfield, Howard Hughes H-4 Hercules (Inglewood, California: Northrop Institute of Technology, 1972), pp. 1-4.

[6]Interview, Rae Hopper, September 15, 1980.

[7]Interview, Harold Tegart, September 12, 1980. Harold Tegart, "Historical Sketch H-4 Flying Boat"; Illustrated with Drawings and Photographs. Private Papers, Tegart Engineering, Sunland, California.

[8]"Vicinity Maps 901," Summa Corporation Files, Long Beach Plant. All Summa Files used in this report were located at the Long Beach Plant. The plant name will not appear in subsequent footnotes.

[9]"Army Report', Summa Files.

[10]"Vicinity Maps 901".

[11]Letters, E. J. Amar to Hughes Aircraft Company, Nov. 25, and Dec. 8, 1944; Hughes Tool Company 1944-47, Central files Port of Long Beach. Hereafter this will be shortened to Hughes with date, Central Files, PLB.

[12]Hughes 1944-47, Central Files, P.L.B. Classified as a Critical Document, this document may be examined in Volume V of the report. All documents of this nature in the remainder of this chapter will be followed by the abbreviation C.D.

[13]Ibid., C.D.

[14]Ordinance Number HD-140; Letter, J. Stearns to Board of Harbor Commissioners, May 16, 1945; Central Files, Ibid. The marine borer problem was recognized throughout the harbor and watched by the Hughes people as is demonstrated by a report made for them on their graving dock gates in 1950. See Charles Horvath, "Report of Deterioration by Marine Wood Boring Organisms of the Wooden Gates of the Graving Dock and Float Basins of the Hughes Flying Boat Installation at Long Beach." Report by consulting biologist, Terminal Island, California, Dec. 6, 1950, Summa Files.

[15]Lease between City of Long Beach and Hughes Aircraft Company, Sept. 4, 1945, Hughes 1944-47, Central Files, P.L.B. All leases associated with the site may be examined in Volume V, "Critical Documents."

[16]Port of Long Beach, "General Plan," (January, 1975), iv-3 Interview, Charles Vickers, September 12, 1980.

[17]Walter H. Case, History of Long Beach and Vicinity Vol. I (Chicago: S.J. Clarke Publishing Company, 1927), p. 267.

[18]Ibid., 141.

[19]Ibid., 273-282.

[20]Ibid., 338-339.

[21]Ibid., 419-431.

[22]Ibid., 441-448.

[23]"City's Harbor Open to World by Next Year," Press Telegram (Long Beach), December 22, 1924 in Historical Society of Long Beach Scrapbook.

[24]Case (1927), Vol. I, p. 302-303 and "Area of Sixty Acres filled by Dredges; Substantial Beginning Made on Development Plan of Outer Port; Silt is Pumped from Channels; Frontage Being Created at Rate of 14,000 Cubic Yards Daily;" Press Telegram (Long Beach), Dec. 27, 1924, Historical Society of Long Beach Scrapbook.

[25]"Dredging Material from Channel 2 to be Pumped into West Harbor Entrance," Sun (Long Beach), September 23, 1925, Historical Society of Long Beach Scrapbook.

[26]Case (1927), Vol. I, pp. 298-299.

[27]Ibid., 349.

[28]"General Plan" (January, 1975), iv-3.

[29]Walter H. Case, Long Beach Blue Book (Long Beach, California: Arthur H. Cawston, 1942), pp. 146-147. Interview, Charles Vickers, Sept. 12, 1980.

[30]Interview, Charles Vickers.

[31]Letters, Tegart to Nolan, January 17, 1945 and Wigmore to Stearns, February 1, 1945. "Buildings and Ground Improvements," Summa Files.

[32]"A Historical Sketch", Tegart, Private Papers p. 2.

[33]Ibid., p. 3, "Conference held January 28, 1946 at Guy F. Atkinson Company Office, Long Beach," Summa Files, January 29, 1946; Chief Engineers Office, P.L.B.

[34]Letter, John Stearns to Amar, January 22, 1946 Hughes 1944-1947, Central Files, P.L.B.; Long Beach Planning and Building Department. All building permits associated with the site may be examined in Vol. V, "Critical Documents."

[35]Interview, Harold Tegart, September 12, 1980.

[36]"Long Beach Harbor Site Developments Progress Reports February 11, 1946 through March 25, 1946", Tegart Private Papers; Building Permits, K2620, Tank Foundation March 22, 1946 and K2484 Machine Shop, February 28, 1946.

[37]"A Historical Sketch" Tegart, Private Papers, p. 4.

[38]Ibid.

[39]See Photo Series 11479, Engineering Vault, P.L.B.; Vol. 5 CD; Hatfield pp. 32-48; Interview, Tegart September 12, 1980.

[40]Photographs, Tegart Private Papers and Interview, Tegart September 12, 1980. See also Historical Photographs, Vol. 5, CD.

[41]Approval on Letters, Tegart to Long Beach Harbor Department, Nov. 26, 1946. Revocable Permit, Dec. 16, 1946 signed by Amar. Hughes 1944-1947, Central Files, P.L.B.

[42]Letter, Tegart to Long Beach Harbor Department Dec. 16, 1946. Loc cit; Interview Sept. 23, 1980.

[43]Donald L. Barlett and James B. Steele, Empire, the Life, Legend, and Madness of Howard Hughes (New York: W.W. Norton and Company, 1979) pp. 154-157; Interview, Bill Berry, Sept. 23, 1980.

[44]Interview, Harold Tegart, Sept. 23, 1980; "Cradle for a Giant Graving Dock for Hughes H-4" Business Week, June 16, 1945 p. 45; See "Scrapbook, Beaching and Servicing Seaplanes" Tegart Private Papers; Empire p. 157 (Footenote); Drawing F 0139.

[45]Tegart, Private Papers.

[46]Ibid.; Lois J. Weinman, For U.S. Army Engineer District Los Angeles, California Los Angeles-Long Beach Harbor Areas Cultural Resource Center April 1978; Interview, George Bromley, September 12, 1980.

YEARS OF TRANSITION: TEMPORARY TO LONG TERM

1947-1953

INTRODUCTION

Following the test flight, the Long Beach Plant got busy with work on the plane and expansion of the facility. In peak periods personnel ran to as many as three hundred. A permanent hangar and several small structures were built. When a new lease was negotiated the site was enlarged, and the plant fell into a regular work pattern.

PERMANENT HANGAR

When the idea to build a permanent hangar was first introduced is not clear. Harold Tegart recalls that Mr. Hughes wanted a structure built over the docked Flying Boat and asked for a design. Tegart complied using Steve Barnes as the engineer. The hangar was composed of four structures: an empennage section, main body, and two enclosures out over the wings. At a meeting of the Board of Harbor Commissioners, held on March 8, 1948, a permit was granted to erect a steel structure over the center of the Flying Boat pursuant to a Hughes application dated March 2, 1948. A pile driving permit was secured on April 27, 1948 to drive piles for the columns. The pile driving contractor was the Raymond Dike Company.[1] As to the structure Tegart recalls:

> There were two columns immediately behind the rear edge of the wings on either side. Those two columns were supporting the structure. Sixty feet back of them and just before you get to the empennage structure there were two more columns. Those two columns were not support columns, they were hold down columns and kept the building from tipping over on its nose. The piles for these, when they went in, were put down as anchors to keep the building from turning over. Thus, the building was trying to lift these columns, it was not even sitting on them. The building was cantilevered forward of the front columns. It

> went out beyond the engines and extended out over the nose of the ship for a total distance of 115 feet. I designed as if there were 180 pounds on every foot of the perimeter of the cantilever. So the structure could stand the weight of an additional 180 pounds per linear foot around the perimeter of the hangar.[2]

Tegart's original designs, seen in drawings and dated March 19, 1948, depicted canvas sides. The canvas could be raised with counter weights. The openings were engineered to overcome adverse wind conditions. Should the wind hit the canvas and if it had been tight at the bottom and top, the pressure of the wind on it could have blown it out. This in turn would have squeezed the building down and have caused it to turn over on its nose and break. However, the counter weights were fixed so that if the tensile stress got to over 184 pounds per linear foot the canvas would go up. When the design was handed to Mr. Hughes he did not like it, so the curtained hangar was never built.

Hughes wanted a solid hangar, one that could keep the temperature and humidity right for the plane. He suggested that it be closed in for air conditioning to accommodate proper gluings. In addition pieces of wood had to be kept in readiness, kept compatible. The wood shop addition to the hangar was to be humidified exactly like the plane so that any new wood coming in contact with older wood surfaces on the plane would not be rejected. (See No. 2, Woodworking Shop in Figure 3, Site Map.) It will be recalled that the structure would support only 180 pounds per linear foot on the perimeter of the cantilever. Fortunately Hughes's engineers were used to working with light-weight metals. Facilities Engineer William Leas, who came to work at the site in 1950, noted that aluminum siding in buildings was a new use for aluminum, a use that did not come into play until after the war. Incorporation in the H-4 hangar siding

was one of the first applications. John French in the Hughes Materials Department at Culver City made many tests on the aluminum before it was requisitioned for the H-4 hangar. It served well, oxidized, and never had to be painted.[3] Four building permits were issued for the hangar in March of 1949: one for the $110,000 building; one for the installation of aluminum cover over the wing sections, roof only; one for installation of aluminum cover over the wing sections, walls only; and one to raise the hangar three feet. On the permits the existing building was still described as "structural steel, canvas covered." Engineering was again supplied by S. B. Barnes, but the fabrication and assembly was apparently done by Hughes employees.[4]

Tegart's greatest challenge came with the design of the doors. Several solutions presented themselves: roller doors as were used commonly for dirigible hangars, folding doors, or those that would lift up into the building like a garage door. Since aluminum could be used, a lift-up door for a portion of the front lower half of the hull hangar was devised. A building permit was issued on October 24, 1959. The permit provided for a "raisable closure for a portion of the front lower half of the hull hangar" and an "Enclosure, wing tip with sliding doors (both sides) and empennage enclosure."[5] William Leas was the new Harbor Facilities Engineer in 1950, Tegart having returned to work at Culver City. Thus, Leas signed the request to the Board of Harbor Commissioners on March 15, 1950 which provided for six sliding doors for each wing tip portion of the hangar and an enclosure for the empennage. As Leas described the doors four of them were 33 feet six inches by 12 feet and two of the doors were eleven feet six inches by thirty-one feet two inches. They were steel

framed and covered with corrugated aluminum. He wrote, "The doors slide in tracks, one of which is located at the top of the door attaching to the building and the bottom track rests on a concrete foundation. When the hangar is opened these doors slide to a position at the tip of the wing and just behind the wing tip."[6] Building Permit M4982 was issued to cover this work on March 21, 1950. Stairs at the northwest corner and a catwalk were built for the hangar by the Callahan Construction Co. as per Building Permit M2654 issued on October 24, 1949. The design of doors to close other openings in the hangar were discussed and decided upon at a meeting at the Long Beach site in June attended by Mr. Rae Hopper, W. L. Berry, C. B. Jones and Ed Painter. The following openings were involved:

1. An opening 32 feet high by 27 feet wide in the wing tip structure aft of the trailing edge of each wing of the airplane to permit the escape of the wind blast from the propellers when the engines were being run in the hangar. Three horizontally sliding panels for each of the two openings were decided upon.
2. An opening in the empennage enclosure aft of each of the two horizontal stabilizers 14 feet high by 52 feet wide for the same purpose described above. Horizontally sliding panels were decided upon for these openings also.
3. An opening aft of the vertical stabilizer 10 feet high by 41 feet wide to permit adequate visibility around the tail of the plane during launching and docking operations. A vertical lift panel including a walk-in door was decided upon.

4. An opening in the side wall of the hangar 20 feet high by 23 feet wide to permit the crane to move into and out of the hangar. The decision was to close this opening with one horizontally sliding door, which would also have a walk-in door.[7]

In 1950 an addition was made to the hangar for the Wood Shop. (See Building 2 on Figure 3 "site map.") Built of the same materials as the hangar, it was comprised of two floors making up 900 square feet.[8]

SECURING THE LAND

On October 21, 1947, one week before the Flying Boat taxi runs and flight, Hughes Aircraft Co. managed to have the September 4, 1945 lease extended. This lease provided an option to extend the lease for a term of three years. Hughes had already exercised its option by extending the term for one year and was unable to exercise an additional option. Thus, an agreement amending the lease was executed so that "The said Lessee shall have the option to extend the term of said lease for an additional year and the option thereafter to extend said term for still another additional year."[9] As the building of a permanent hangar was getting under way, on April 15, 1949 the Hughes Aircraft Co. made a written request for an extension of their present lease for a period of twenty-five years by ten one-year options for the first ten years and three five-year options thereafter. The Hughes Co. noted that their present lease would expire in September, 1950. They argued that the idea of seaplanes was very important, and that in seeking assurances of a long-time lease they were looking to the possibility of seaplanes having an important place

in the future economy, as well as this particular plane justifying further expenditures at the present site. Howard Hughes was fully dedicated to the Flying Boat, and had written an open letter to his employees at the Company which included the passage:

> "... I assure you that nothing means more to me than the success of the flying boat. And if we do finally succeed in designing, building, and flying an airplane twice as large as anything else in the world, and overcoming the hundreds of serious obstacles which are a part of this tremendous step ahead in the world's progress in aviation, then I believe people will wake up to what we have accomplished."[10]

The Harbor Department on the other hand argued that although they realized that the commercial development of seaplanes would necessitate that they be harbored in a port capable of economically transferring cargo, that factor had been taken into account in future planning of the harbor's Southeast Basin. As to Pier E, that was not planned for seaplane cargo operations. Instead, it was planned for and adapted to other operations such as the handling of bulk cargoes. The Harbor reminded the Company that in 1945 they had located the Hughes lease there for lack of any other acceptable site and with a limited term of occupancy. The Harbor felt reasonably certain that the development of the Port would be such that the present lease would not prove satisfactory for a period of more than ten years maximum, if that long. Pier E was the only City-owned area in the Port where it would be possible in the next few years to efficiently accommodate heavy or bulk types of cargo. Care had to be taken not to preclude the use of the area of such an important activity. In the lease that was hammered out in 1949 and finally executed August 22, 1950, paragraph 3 recited that "the term of this lease shall be three (3) years commencing as of September 4, 1950. In addition to the firm period of the

lease, the said Lessee shall have the option to extend the term of said lease for an additional year and the option thereafter to extend said term for still another additional year... Paragraph 4 read, "In the event Lessee exercises both of the options referred to in paragraph 3, then the parties hereto stipulate that by mutual agreement and written consent of both of the parties this lease may be extended yearly upon the same terms and conditions as herein set forth or upon such modified terms and conditions as the parties agree....The yearly extensions granted hereunder shall not exceed a total of five."[11] Thus, the new lease would run for a period of ten years maximum with the provisions for a firm lease for a period of three years.

A second area of discussion was that pertaining to the proposed Pier E development by the City. The Board pointed out that in line with their Master Plan they intended to undertake a southerly extension of Pier E within the firm three year period of the lease. It indicated that the work would be done in such a manner as not to interfere with the operations of the Hughes Aircraft Company so that removal and berthing of the plane would be no problem. However, there was reason to believe that the Board might be obliged to perform extra work simply by reason of the existence of the Hughes lease. The increased cost then estimated at $80,000, should be borne by the Lessee. This would cover such work as extra filling, bulkheading and diking by reason of the divided operations and not of any permanent value to the City. Hughes agreed to this figure as an estimate in paragraph 6 of the lease.[12]

A third area clarified in letters prior to drawing up the lease was that which dealt with changes due to subsidence in the area.

Paragraph 8 reflected the final agreement on these matters when it read:

> The Lessor, at its own cost, will maintain the rock dikes and revetments along the waterfront side of the demised premises in the event of any changes occurring as the result of subsidence in the area, but the Lessee shall do all preparatory work in advance of the placement of superimposed dikes and revetments, and Lessee shall be fully responsible for all construction, reconstruction or maintenance work required on the interior area of the demised premises and for all structures belonging to Lessee.
>
> It is understood that the obligation which the Lessor intends to assume applies only to the rock dikes and revetments along the waterfront side of the demised premises and said obligation shall not extend to, but rather shall be exclusive of, all facilities and fixed improvements constructed by the Lessee and the junction of such facilities and fixed improvements with the rock dikes.[13]

This lease and the issues it resolved with regard to time, the Pier E extension by the City and subsidence correction,would figure importantly in the controversy over the site that took place in late 1953 when the site was flooded and there was a disagreement over liability and lease extension.

On October 4, 1949 an adjacent area on Pier E,described as Parcel 3, was granted to the Hughes Company for use and occupancy expressly for the purpose of installing a ten-thousand gallon fuel supply tank together with any and all appurtenant pipe lines and necessary connections. This provision was included in the 1950 lease, paragraph 2. Shell Oil Company installed the tank underground. The surface area of 13,157 square feet was to be used for construction of service buildings to be discussed in the section "Building Improvements" below. In addition, the Hughes Company needed space for a facility building to house the boilers, condensers, and refrigeration equipment that related to the air conditioning and humidity systems. The space was provided by moving the boundary of Parcel 1 seventy-three feet ten inches north

easterly on March 15, 1950. Moving the boundary also provided additional area needed for clearance for the empennage portion of the hangar. However the site did not reach its present proportions until August 27, 1956 when Parcel 4, 28,503 square feet, was added to the east and north. Drawing HD 3007 which accompanies the leases in Vol. 5 documents these changes.[14]

SUBSIDENCE CORRECTION

Subsidence was a concern from the beginning at the lease site. As the sense of permanency entered the thinking of those at the Long Beach Plant action was taken. In December, 1948 Hughes engineers pointed out their own problems and asked the Long Beach Harbor Dept. to study them in connection with the Harbor's program and its contracts for general dike work and land raising in the Pier E area. Port Manager Amar responded with the information that it was the harbor's intention to raise the rock dike on Pier E at numerous places including all of the frontage of the Hughes lease. Thus the work would extend from the north property line around the front of the parcel and terminate at the west property line. The project work would include the raising of the two rock promontories which projected southeasterly from the entrance of the hull dry dock. The dikes would be carried up to the walls of the hull dry dock and to the walls of the wing float docks. Since Hughes Aircraft was to assume all work other than the actual furnishing of material for placing of and shaping the rock dike, Harold Tegart made a summary of his own subsidence cost figures. They were as follows:

A.	Dikes and Jetties	$47,436.00
B.	Docks	
	1. Gates	8,323.00
	2. Raising Bottom of Docks	6,235.00
	3. Raising Dock Walls	9,139.00
C.	Sewage	600.00
D.	Boat Dock Dolphins	4,080.00
E.	Drainage System	750.00
F.	Ground Water Control	24,840.00
G.	Raise Cradle	7,000,00
H.1.	Raise Empennage Hangar (later)	13,400.00
2.	Raise Hull Hangar Now	10,300.00
Total	. . . . .	$132,103.00 [15]

Tegart received authorization and the money to perform some corrective work in July. At this point the work included raising the hull dock walls, raising the wing float dock walls, building retaining walls for both sides of the wing float dock approaches, building 67 foot walls on the hull side of each jetty, and putting in steel sheet piling corners for the float docks. Tegart then decided to provide a concrete wall on each side of each jetty with tie rods between (called "twin walls" by Tegart), in place of the single wall on the hull dock side of each jetty as originally designed. This was because the single wall had the disadvantage that erosion could occur in the lower part of the horizontal section without being seen, thus possibly undermining the section to such an extent that the tractor with its horizontal cable pull to the flying boat might cause the wall to fail without warning. Permits were issued for the work September 29 and October 24, 1949. Callahan

Construction Co. was brought in to do a portion of the work.[16]

Subsidence also made it necessary to replace the gates to the dock by March, 1950. Rae Hopper, Chief Engineer at Hughes Aircraft Company requested a new main dry dock gate and new wing tip float gates. Both were made of structural steel frame, planked with Douglas Fir timbers, and hinged at the bottom. The permit was granted at the Board meeting March 30, 1950.[17]

BUILDING AND GROUNDS IMPROVEMENTS

Information about facility improvements discussed in this section was found in a variety of ways. For some we obtained a copy of a building permit for some correspondence, for some maps, and for some we found no written documentation of any sort. This is not to say that written clarification for the improvement's need and introduction to the site does not exist in some file. However, in this search none was seen. In order to fill in the gaps interviewees were asked to supply information out of memory. Two vital sources on paper were the "Plot Plan of Long Beach Facilities," Drawing H 0253 revised to February 22, 1955 and Interdepartmental Correspondence (DC) sent by W. L. Berry to V. C. Olson on June 9, 1955. The Plot Plan has been altered for clarity and appears in this report as Figure 3, "Site Map." The IDC from Berry supplies a list of the Long Beach buildings using the same numbers affixed to them as those that appear on Figure 3, Plot Plan Drawing. The IDC reads in part, "The building number on the Plot Plan Drawing is never changed although the location and use of a building may change." The number appearing in parenthesis after the building or improvement name in the discussion below refers to the Figure 3, "Site Map" for easy reference.[18] Not every improvement was registered

on the plot plan. At the Long Beach plant change was a constant factor until about 1960, and this was reflected in the small additions to existing buildings, in the change of use in change of access to the outside, and in corrections made to keep pace with the ever present subsidence. The pertinent drawings and documentary photographs for the buildings and systems are analyzed from a technical standpoint in Chapter 3.

In approaching the improvements chronologically it will be recalled that the Hangar Building (1), the Wood Working Shop (2), the Engineering Building later called the Machine Shop (3),and the Water Tower (6) discussed in earlier sections were constructed between 1946 and 1950. Harold Tegart assures us that the Gate House (50) was also on the grounds by at least 1947. On March 18, 1949 Harold Tegart requested approval for installation of a mooring for the Hughes Flying Boat. The mooring was located about 580 yards south and slightly west of the southwest corner of the Hughes site. It was held in place by three anchor lines about 120 degrees apart, each consisting of chains and cables. Each of two of the lines was 260 feet long and had a 3,000 pound Danforth anchor at its far end. The third line was 176 feet long and was attached to a 6,000 pound Navy anchor. A submarine cable from the Hughes property to the mooring provided electric power to the Flying Boat when it was tied to the mooring. The submarine cable contained four conductors providing 200 amps of power at 480 volts.[19]

In the fall of 1946 a small air conditioning unit, 30 horsepower, was brought down from Culver City to introduce air conditioning in a minor way. This was used to heat the inside of the Flying Boat. While the permanent hangar was under construction in 1948. Mr. Hughes decided he wanted a real installation and sent down George Shull, a chemist, to

to see the hangar and to propose some way in which the ship could be properly maintained. Shull contacted the usual vendors such as Carrier, Trane, and others. They all told him it was impossible. It was a tin building, not tight, and had no insulation. Shull then went to John Stearns, Plant Engineer, and Stearns referred Shull to George A. Steuder, Mechanical Engineer and a man on whom Hughes relied personally to solve many engineering problems both at the plant and at his other enterprises. Hughes brought Steuder up to date on the problem and Steuder replied, "Of course it can be done." Hughes asked, "Can you guarantee it." Steuder replied, "You know my guarantee isn't worth a nickel and besides it will cost a lot of money, perhaps a million dollars."[20] Hughes told him to go ahead. Steuder spent a year on the design working on various types of equipment. Mr. Hughes's specifications were rigid: requirements for temperature and moisture could only vary 1 to 2 degrees regardless of outside conditions. No air could blow onto the ship. Ambient air would have to take care of the ship entirely. Steuder came up with several firsts such as the use of canvas ducts and the use of high speed air nozzels with low speed piping. The system maintained the kind of conditions Hughes specified over a period of twenty years or more and never had a failure. The secret of Steuder's success was that the upper part of the hangar was ignored. Five units around the hangar made up the air by mixing cold, hot, and moisture, then the conditioned air was discharged through unique cone-shaped nozzels. The system utilized a 400 and 250 horsepower boiler, the smaller one being used for periods when the 400 hp boiler had to be shut down for maintenance. Looking back on the assignment, Steuder observed that on any engineering problem,Mr. Hughes laid down the specifications and the engineer had to figure out the solution.

Everything was like that, otherwise you didn't work for him.

We can trace the actual installation of the air conditioning equipment through documents: Permits were granted for the various installations. An air conditioning pit was designed to be at the left side of the hull near the center of the fuselage outside of the dry dock. By locating the air conditioning equipment below ground level, the cables on the tractors that pulled out the plane would not be obstructed. The center of the pit was 147 feet aft of the ocean end of the dock. This pit was 29 feet by 29 feet by 9 feet 2 inches in depth. The Board granted a permit for this at its September 29, 1949 meeting. Approval of the plans as drawn for the pit by the Plant Protection and Engineering Office for Subsidence Correction was made on March 6, 1950. To meet the increased needs for power the Southern California Edison Company built a Transformer Pad and Rack (42) on land adjacent to but outside of the Hughes leasehold. This was a small additional area to the immediate northwest. The Board granted a revocable permit to cover the use of is 15 foot by 25 foot parcel of land.[21] At first it was proposed that the air conditioning machinery be placed on a barge outside of the dry dock or perhaps inside the dry dock. These ideas were discarded. In April, 1950 Facility Engineer Leas mailed bids for a contractor to put up a prefabricated building to house the boilers and refrigeration equipment. The specified prefab was to be erected on a Hughes slab. Kyle Steel and Construction got the job. Permit M 6041 was issued by the City for the corrugated steel building 32 feet by 100 feet on May 15, 1950. F. Otto Beyerle did the engineering on the Power House (7). The 250 hp boiler arrived in 1950. A memo dated January 12, 1951 documents the shipment of the 400 hp Orr-Sembower boiler from Philadelphia.[22]

Many additions were made to the Power or Boiler House between 1951 and 1954. The Lavatory Facilities (8) has been known by various names and provided extra space beyond the toilet facilities themselves. It was made from Ronney tubular structure removed from the hangar. Aluminum siding was added and since it was constructed of these slavage materials, no permit was required. It was used as a First Aid building, as a Guard Office, a Firemens Office, and finally as a rest room and Plant Foreman's Office. Mr. George Bromely presently occupies the office. Maintenance Storage and Offices (44) was also built without permit of Ronney tubular material removed from the hangar. This 1,080 square foot building is known as the Machine Shop. The Welding Shed Shelter (45) was another addition built without a permit. Some space here was used as a drafting room and then as a utility room. This was walled off to become a kitchen and lunch room. The building permit, O 8200, issued April 27, 1954 described it as "an area 90 feet by 20 feet in an existing building." In some of the correspondence it was referred to as the Hughes Flying Boat Lunch Room. The work was performed at the cost of $7,304 by Company personnel. Prior to 1952 the sewing machines were located in the wood shop in the elevated storage area. The location did not allow sufficient room for laying out the work. Heating, lighting, and space were all poor. Thus, when space was found in the Power House that year, the sewing operation was moved. It was located at the end of the building where the main distribution panel for power was located.[23]

Permanancy led to the construction of the Administration Building (4) toward the end of 1949. The Harbor Board permit was granted November 15, 1949 to an application that read "construction shed." The City building permit M 3285 was issued December 6. The wood frame, composition roof,

wood siding and stucco-walled building according to the permit was to be used as a hangar shop. The dimensions were 17 feet 4 inches by 47 feet. The single story building has long been used as the office for the Director of the Long Beach Plant. It has also been called the Hughes Office. However, Mr. Hughes really had no office at the plant. He visited the plant manager in this building and it was probably his headquarters when he needed an office.[24] Bill Berry was Director of Long Beach plant from 1947 to 1962 when he left the plant. Bob Ford held the post the following 17 years, 1963 till 1980 when he retired. In 1951 the sense of growth was such that plans went ahead for a two-story Personnel Building which would have replaced the Administration Building. The building was to cost $108,000 and was scheduled to have $24,000 worth of air conditioning equipment alone. It was never constructed.[25]

After the decision was made to change from pneumatic to a hydraulic system and electrical controls on the Flying Boat, the Hydraulics and Engine Shop (5) was constructed on Parcel 3. For it another "construction shed" permit was requested in February of 1950. Permit M 4176 was issued on February 9, 1950. This 40 foot by 48 foot building had a Stran steel frame on concrete foundation and corrugated iron siding and roofing. It was pre-fabricated and bolted to redwood sills which were secured to concrete foundations placed at the corners. A request for an addition to this building was granted March 21, 1950. Permit M 5135 bore the description of a 60 foot by 16 foot 1/2 inch building with a corrugated aluminum roof erected on a concrete foundation. H. G. Smith was listed as engineer.[26] A meeting was held April 7, 1952 to survey the additional space requirements to carry on the servicing and maintenance work for the Flying Boat.

During the discussion the need for additional Test Department space was pointed up. More test work was performed at the site as time went on, and the report on the meeting recited that "At present five engineers, four mechanics, including engine test stand personnel and two helpers use the present crowded facilities."[27] The request for 1,700 additional square feet of test space led to the 40 foot by 50 foot extension built onto the main Hydraulic Building. Another much smaller addition on the east wall was constructed about 1953 to enclose an electrical generator set. This addition and parts of the larger addition were made from existing slavage. The Hydraulic and Engine Shop Building with all of these additions had 5,610 square feet of space thus fulfilling in part the needs for a dust free parts service room, test department, and a place for generator testing.

The Reception Building at the access gate is a complex of several wood frame, wood siding, and wood floor buildings used variously throughout the years. Both buildings 10 and 47 have been known under the name Security Office and First Aid even though the 1955 Plot Plan used in Figure 3 calls it Administration Manager's Office. Building 10 is 10 feet by 20 feet while 47 is 12 1/2 feet by 20 feet. "Office"(15) was a 10 foot by 18 foot wood frame building constructed in 1949. It was at one time used as a conference room for visitors. The small Gate House (50) noted above as a 1947 arrival is immediately north of Bldg. 15. These structures were built without permits. The Berry IDC of 1955 recites that Bldg. 10 constructed in 1950 and Bldg. 17 in 1962. Building 47 cost $900.00. Facility Engineer Leas recalls that 15 and possibly 47 had a door to the outside so that visitors, primarily vendors, could enter. To accommodate the vendors a rest room, also with an outside door, was put in next to Bldg. 15 in 1955. This placed the rest room at the southern extremity of the

reception complex. It was a small structure, 6 feet by 7 feet with an exterior of plywood. A building permit, P 4290, was issued for it on March 25, 1955. This arrangement for vendors persisted until after 1960 when access to these buildings from the outside was closed off and other arrangements were made for vendors in the Service Building (49). It should be mentioned at this time that the access road and gate to the plant lay just south of this rest room prior to 1950. Then when the Harbor Department filled in all around the plant, it left the Hughes plant in a hole. With the acquisition of more leased land through an extension of Parcel 1 and the addition of Parcel 4, Hughes was able to move the road to where it presently lies just north of the Gate House (50). This put the road on higher ground and did away with the need to drive down and then up to reach the Power House and its attendant structures.[28]

The Service Building (49) was a structure moved to the Long Beach plant from the Culver City plant by the Star House Movers in 1953. William Leas secured building permit O 5184 on October 30, 1953 to build a foundation for it and to alter it. It was a 28 foot by 40 foot steel frame structure with corrugated iron roof and sides. In December Leas made an estimate of the material and manpower required to relocate the building. As with so many of the added improvements, the work was accomplished by Hughes Aircraft Company personnel.[29] The building was partitioned so as to make space for such things as personnel interviews, vendor calls, union elections, and storage.

Since little documentation,except the Berry-Olson IDC,is available for many of the smaller installations they cannot be discussed in any detail. The Paint Storage Shed (13) 11 1/2 feet by 13 feet, with a steel frame, concrete floor, and aluminum siding and the Paint Shop (14) made of welded pipe frame, aluminum siding and concrete floor(15 feet

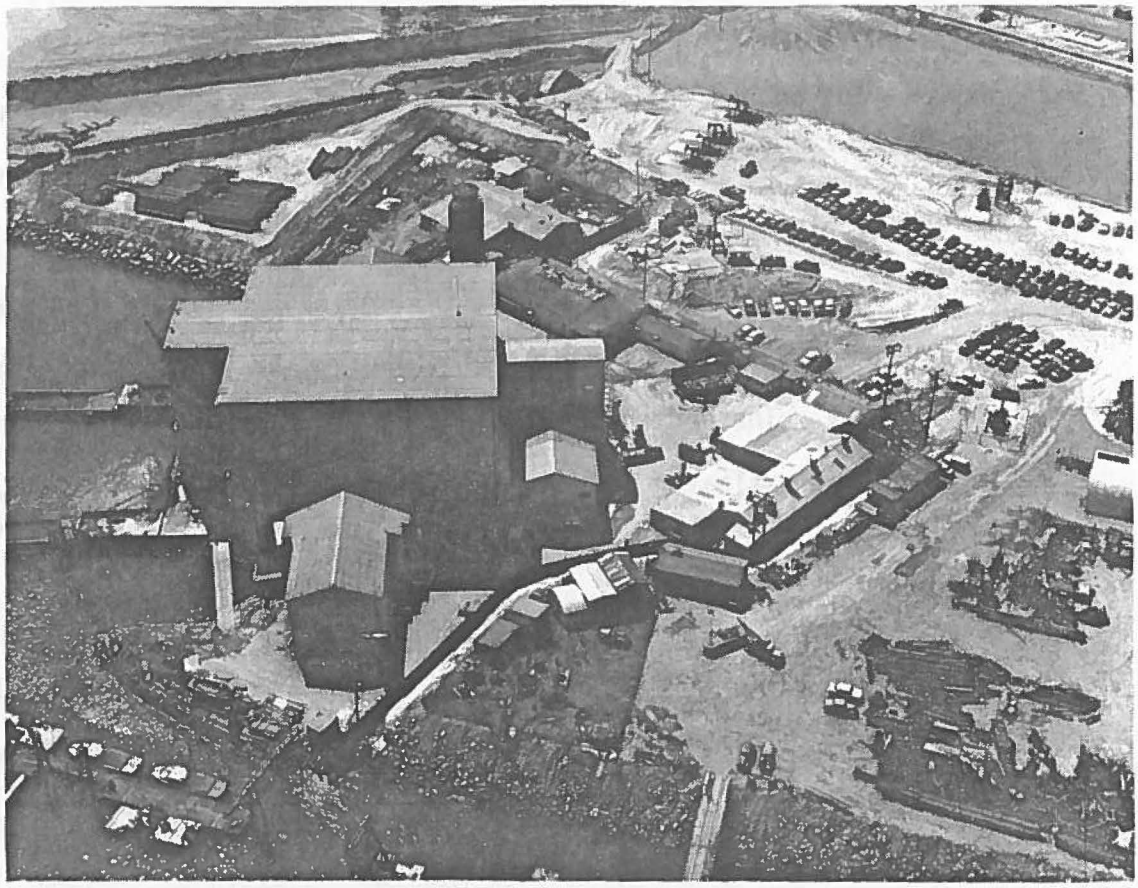

Figure 9

Aerial View of Permanent Hangar and Associated Structures Looking to the Southwest. March 26, 1954. Source: Engineering Vault, Port of Long Beach

feet by 22 and 1/2 feet)were assigned a date of construction in the Berry-Olson IDC of January,1949. Harold Tegart recalled them being there in 1947, and Leas too felt they were up at that early date. The Gasoline Storage and Drumrack (12) was built from slavage in 1952. The Sea Water Pump and Intake Pipe (9) drew salt water from the ocean and provided cooling water for the refrigeration unit in the Power House.[7] The Guard Tower (16) on the south end of the port jetty had formerly been a Switch House. This 6 foot by 6 foot wood frame building with windows on four sides was constructed in January,1949. The Boat Service Shop (17) a wood frame building 10 feet by 6 1/2 feet was also built in January of 1949. There are two Hose Cart Houses (18) 10 feet by 6 1/2 feet. They too went up in 1949. The Pontoon Boat Dock and Pontoon Boat Landing (19 and 20) were actually floating docks and leased equipment brought onto Parcel 2 by Tegart in 1946. A Ric-well pipe installation with concrete pit for steam and condensate return lines, was constructed in 1953 at a cost of $2,000. It was located at the northeasterly corner of the Engineering Building (3).[30] At the end of December 1955 W. L. Berry prepared a list of "space consuming items at the Long Beach plant." This list is included in Vol. 5, Critical Documents.

FOOTNOTES

[1]Letter, Maddy Executive Secretary, L.B. Harbors to Hughes Aircraft March 9, 1948, "Hughes 1948-49", Central files, P.L.B. City of Long Beach; Interview, Tegart, Sept. 12, 1980.

[2]Interview, Tegart.

[3]Interviews, William Leas, Sept. 15, 1980 and George Bromely, Sept. 12, 1980.

[4]Building Permits L 9089, L 9091, L 9092, L 9090, City of Long Beach Planning and Building (Hereafter L.B. Planning).

[5]Permit M 2653. Drawing F 0446 and plot plan Drawing F 0253. For empennage enclosure see Drawing F 0445 and plot plan Drawing F 0253.

[6]See Drawings F 0398, F 0411, and F 0416 ; Interview, Leas.

[7]Letter, Leas to Board of Harbor Commissioners, March 15, 1980, Hughes 1950-1953, Central Files, P.L.B. Interdepartmental Communication (Hereafter IDC.) Leas to Bery et al, July 6, 1950, "Harbor Facilities Structures", Summa Files.

[8]IDC, Berry to Olsen, June 9, 1955. "Building and Ground Improvements" Summa.

[9]Lease, Board of Harbor Commissioners, Lessor and Hughes Aircraft Co., Lessee, September 4, 1945 and "Agreement Amending Lease," October 21, 1947, CD Hughes 1944-47, Central Files, P.L.B.

[10]IDC, Shoemaker to Board of Harbor Commissioners, 5-9-49, Hughes 48-49, Central Files, P.L.B.; quote is from Howard Hughes, typescript, N.D., John Seymour, Interviewee.

[11]Lease, 1950, CD, Hughes 1950-53, Central Files, P.L.B.

[12]IDC, Shoemaker, Ibid; Amar to Hughes Aircraft, June 14, '49, Summa; Lease, 1950.

[13]Lease, 1950.

[14]Drawing HD 3007. See in CD with leases.

[15]Letters, Amar to Harold L. Geroge, Jan. 19, '49, Hughes, Central Files, P.L.B.; IDC, Tegart to Stearns, Feb. 9, 1949, "Subsidence", Summa.

[16]IDC, Tegart to Riddle, July 21, 1949, "Subsidence" Summa; "Expenditure Authorization Request, July 1, 1949 in "Subsidence," Summa; Permits M 2274 and M 2604 LB Planning Drawings F 0416, F 0398, F 0411.

[17]Letters, Hopper to Board, March 27, 1950 and Amar to Hughes March 31, 1950. See Drawings F 0410 and F 0412.

[18]IDC is in "Building and Ground Improvements," Summa CD. It will be used below passim without further citation.

[19]Letters, Maddy to Hughes Co., March 23, 1949 and Tegart to Long Beach Harbor, March 18, 1949, Hughes 1948-49, Central Files, P.L.B.

[20]Letters, Stearns to Long Beach Harbor, Sept. 28, 1949, Maddy to Hughes, Oct. 3, 1949, Tegart to Shoemaker, March 3, 1950; Maddy to Hughes, March 8, 1950, Hughes 1950-1953, Central files, P.L.B. Drawings F 0439 and C 0428. See Permit 5043. Final inspection, Sept. 26, 1950. Interviews George A. Steuder, Oct. 1, 1980 and Bromely.

[21]Letter, Maddy to Hughes, May 9, 1950. Ibid.

[22]IDC, Leas to Patrick, April 26, 1950, and IDC, Leas to Waecther, Jan. 12, 1951 "Harbor Facilities 1950" Summa; Letter, Vicker to Hughes, May 9, 1950, Hughes 1950-53, Central files, P.L.B.; Permit, Long Beach Planning; IDC to Leas to Berry, April 13, 1950, "Harbor Facilities Structures," Summa Files, Interview, Bromely.

[23]IDC, Berry to Olson, October 13, 1955 and Leas to Berry, Dec. 29, 1953 "Building and Ground Improvements," Summa. Permit, Long Beach Planning.

[24]Letter, Maddy to Hughes, Nov. 15, 1949; Permit, L.B. Planning, Interview, Bill Berry, Sept. 23, 1980 and Bob Ford, Sept. 17, 1980.

[25]Letters, R.H. Holmes to Vickers, Feb. 6, 1950; Maddy to Holmes, Feb. 8, 1950; Amar to Hughes, March 21, 1950, Hughes 1950-53, Central Files, P.L.B.; Interview, William Leas, Sept. 15, 1980. Mr. Leas contributed importantly to the understanding of additions and chronology of improvements.

[26]IDC, Leas to Berry, April 15, 1952, "Harbor Facilities Structures" Summa Files.

[27]Berry To Jack Jerman, June 25, 1951, "Harbor Facilities 1951" Summa Files.

[28]IDC, Berry to Olson, October 13, 1955; Summa; Interviews, Leas and Ford.

[29]Permit L.B. Planning, IDC, Leas to Berry, Dec. 4, 1953, "Building and Grounds Improvements," Summa.

[30]Interview, Leas.

THE FLOOD

INTRODUCTION

During the period that the aircraft hangar site hosted its greatest activity, it also suffered physical damage and the first threat of lease termination. This came about in the Fall of 1953 as Pier E southwest of Berths 120 and 121 was being bulkheaded and filled by the Pacific Dredging Co. under contract to Long Beach Harbor. A flood of mud broke through the Dredging Co. dikes, rushed past the fences and onto the site. This localized diaster was heavily documented. In the following it allows us to demonstrate the usefulness of the firemen's logs which were so meticulously kept at the Long Beach plant. The following then is not only a narration of the flood and its consequences, but also a demonstration of how these records in concert with the usual documentation can be used in future research concerning the site.

SUBSIDENCE CORRECTION

Just before midnight on Thursday, September 17, 1953, Fireman Redding reported for duty at the Long Beach Plant and received the company keys from Fireman Cornwall. His log for that date reads, "Plane free of gas fumes. No fire hazard found. Hydrant pressure 85 lbs." If Fireman Redding had looked back over Fireman Cornwall's log entries for the day, he might have noted that there had been spray painting on the Hughes Flying Boat's starboard side, aft and that during a five foot high tide, water entered the hangar on both the port and starboard sides, forward.[1] On the drawing boards of Hughes engineers in 1953 were plans to raise the hangar and other facilities of the Long Beach plant to correct for subsidence, the sinking of the land. It had lowered the Hughes plant and other Long Beach Harbor tenants to below sea level and threatened to flood their facilities.[2]

Subsidence in Long Beach and vicinity was noted in surveys as early as 1928. Until about 1939, elevation changes were small, amounting to an average of about half an inch a year. The development of the Wilmington Oil Field, between 1937 and 1947, led to rapid acceleration of subsidence in the Wilmington-Long Beach Harbor area.[3] The Long Beach Oil Development Corporation, a private corporation under contract to the City of Long Beach,was responsible for pumping oil from under the Long Beach Harbor area. The Long Beach Oil Development Corporation found its office sitting in a hole surrounded by dikes higher than the peak of its tiled roof. Employees had to drive their cars down steep ramps to reach the parking lot. The Edison Plant, just north of the Hughes site on Pier E, sank 27 feet.[4] Hughes's neighbor on the west, the United States Naval Base and Shipyard, had sunk eleven feet by 1950 and predictions, at that time, indicated that there was no reason to expect subsidence to stop. Subsidence was so bad that, in the Spring of 1950, the government decided to close the Naval base. The beginning of the Korean War, however, persuaded the government to keep it active.[5]

Subsidence had been a problem for Hughes employees from the beginning of their tenancy in the Long Beach Harbor. By March, 1949, the Long Beach plant had sunk nearly two and a half feet below the level to which it was filled before Hughes employees arrived. At that time, in 1949, remedial work was required. Then by September, 1953, subsidence had increased to more than seven feet and plans were made for further remedial work at the plant.[6] As Fireman Cornwall noted in his September 17 log entry, water entered the hangar during a five foot high tide. In

addition, Fireman Redding noted in his September 21 entry that there was another high tide accompanied by "usual seepage for 6' tide."[7]

More and more remedial work was needed to correct for subsidence after 1950. In October, 1951, for example, the sea wall was given a temporary extension and the tip float gates and main gates were also extended. In 1952 a concrete wall at the end of the jetty was added as well as new pilings for a boat dock. Subsidence continued. Splash boards were added at the front of the hangar. In April, 1953 the bracing behind the tip float gates was stiffened, extended, and a six foot concrete sill added. The sliding panels over the tip floats were also reworked and the main gate was extended three feet and reinforced.[8]

To stop the sinking, Long Beach officials decided to try water injection. Salt water was injected under extremely high pressure into fault blocks underlying the sinking area to restore underground pressures depleted by oil and gas removal. To carry out this program they put into operation five pumping plants, two on Terminal Island,three in other parts of the harbor area. These plants forced thirty-five million gallons of filtered sea water per day into oil reservoirs under the sunken area. Increased oil recovery, as a result of this water injection,actually paid for its installation and operation.[9] The program effectively stopped subsidence in most of the area. Bench marks located on Pier A, for example, actually recovered as much as one foot between 1960 and 1974.[10]

DISASTER

As the Navy base continued to function, despite subsidence, so did the development of the Long Beach Harbor including the extension of Pier E. Using some of the money that the Port earned from selling the oil that Long Beach Oil Development removed from under it, the harbor commissioners planned an ambitious program of filling and expansion. Included in this program was the extension of Pier E into the ocean toward the federal

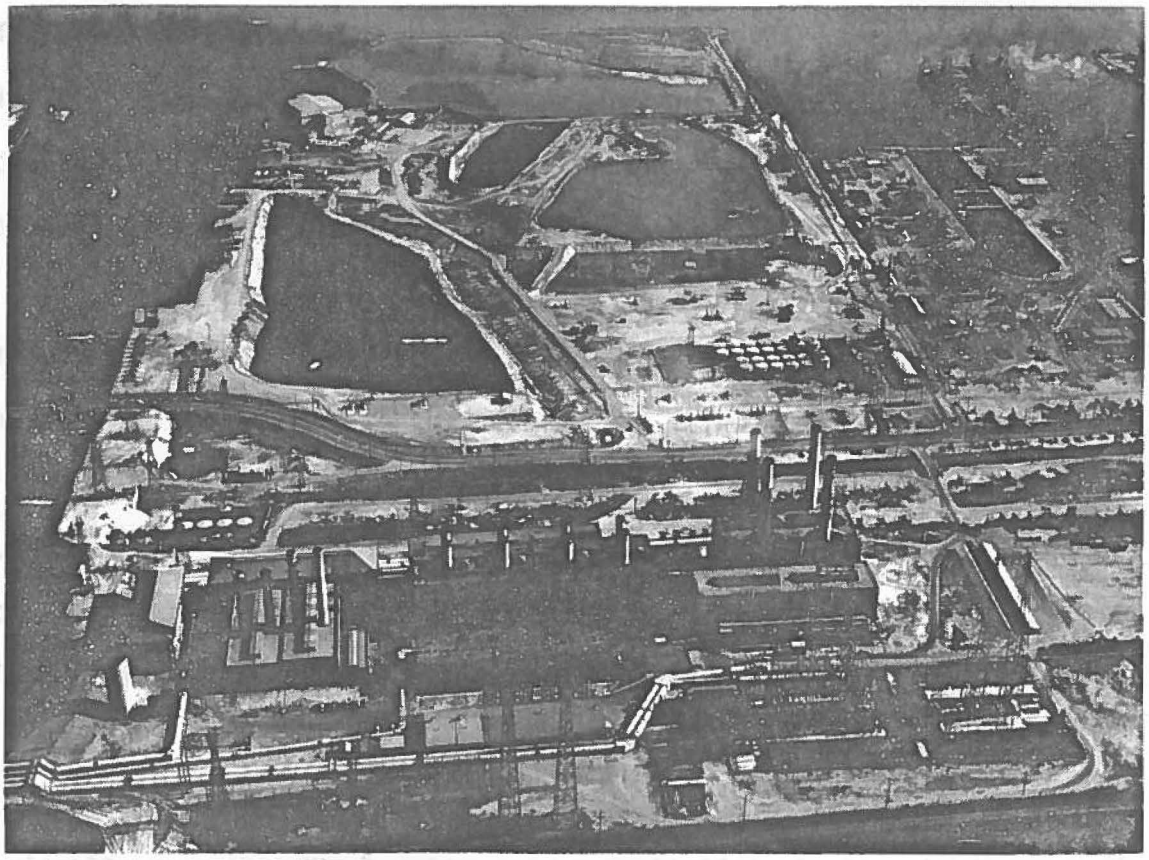

Figure 10. Looking south at Pier E toward the lake of dredged material southwest of the Hughes leasehold on September 18, 1953. The lake broke through under the dikes, flooding the grounds and the Flying Boat Hangar with four feet of soft mud.
Source: Engineering Vault, Port of Long Beach

breakwater. The round cellular bulkheads that were to define the end of the pier were put in place in 1951.[11] A dike was also built along the east side of the pier to close the inlet that had been left there during earlier developments to accommodate the outfall flume of the Southern California Edison Company Plant. The inlet was left until the Edison Company had time to relocate its flume in open water.[12]

When Fireman Redding reported for duty that Thursday night, Pier E accommodated two lagoons or settling basins and a large lake on its south end. One of the lagoons was formed in the inlet that had led to the Edison Company flume.[13] While Fireman Cornwall gave the company keys to Fireman Redding,[14] Pacific Dredging Company was pumping material off the ocean bottom and into one of the lagoons on Pier E. An out-flow pipe system carried the overflowing water from this operation into the large lake at the south end of Pier E. From there, it flowed into the ocean between two of the circular bulkheads. At about 3 am in the morning of September 18, however, this flow somehow was interrupted and the water, rather than flowing out to sea, flowed into the Hughes Aircraft Company Long Beach plant.[15] Fireman Redding wrote in his log, "Dirt fill broke between hangar and electric shop and flooded docks and yard, also Engineering Building. Telephones out of order. Lt. Gray left in own car to give alarm."[16]

As a result of the break, mud, silt, and sea water rushed into the Long Beach plant. Because of subsidence, the land was lower than sea level and the water flowed into the buildings. The Engineering Building, the oldest on the site, was filled to a depth of two and a half feet. Silt was deposited on the floor, in cabinets and on walls and furniture as well as under the building's floor. Celotex wall board and flooring

still show the effect of this flood. The Plant Manager's Office adjacent to the Engineering Building was flooded to a depth of more than a foot. In addition to being inundated by mud, silt and sea water, the office was lifted and moved off its foundation. As a result, the floor buckled, floor tiles were loosened, doors warped and portions of the Celotex ceiling loosened. Inside the buildings large numbers of written records, drawings, engineering data, books, publications, office supplies, furniture and office machines were covered and saturated. Some written records and drawings in the files still show the effects of this flood.[17]

In the shops there was also damage from the flood. The building which housed the Hydraulic, Engine Service, Test Laboratory, and Electrical Shops, and the Paint Shop, were filled with the mud, silt, and sea water. When the water receded, silt was deposited on the floor and tools. Many shop machines and tools, along with accessories, spare parts, and fittings were damaged. Building materials, supplies, and a radio transmitter were also damaged. In the yard the flood covered over sixty thousand square feet of land to a depth ranging from six inches to two feet. Hughes employees spent many days removing the mess.[18]

In the hangar, mud and silt were deposited on the floor to a depth of from two to eight inches. The air conditioning pit, twenty-nine feet square by nine feet deep, was completely filled. In addition, the graving dock and starboard tip float dock were filled. Flooding of the graving dock also damaged the main dock gate and required remedial and protective measures such as the placement of a temporary sand bag dike around the dock. As a result of the flooding in the dry docks the Flying Boat was lifted off its cradle and suffered skin breaks and bruises, sustained structural damage, and damage to the control surfaces of the wings and tail.

One of the engines and parts of the plane's hydraulic and electrical systems were damaged.[19]

One person who heard the alarm that night was Noah Dietrich, executive vice president of Hughes Tool Company. He was happy to learn that the Flying Boat was wrecked. He reports in his book, "...my heart danced. At last a way to escape the crushing expense of the flying whale." Dietrich's happiness, however, was short lived. When he delivered the news of the flood to Howard Hughes, Hughes insisted that the plane be repaired.[20] One of our finest sources for this memorable day is a detailed log kept by Assistant Facilities Engineer Joe G. Hall. Hall measured and recorded the site's elevations monthly in the course of making subsidence checks. He wrote that late Friday morning when he reported to work at the Long Beach Plant, he found the mess. He hurried to Gallagher's restaurant nearby to use the public telephone. First he called the Port of Long Beach General Manager, Charles Vickers. Vickers directed him to contact Dan Gridley of Gridley Construction Company or the Pacific Dredging Company Manager, McCoy. Hall then drove to Pacific's office on Pier E and asked them for equipment to help clean up the Hughes plant. Then he returned to Gallagher's to call General Telephone Company and asked them to install an emergency telephone line at the Long Beach Plant. When Hall returned to the plant, Gridley and his Construction Foreman, T.E. Powers, were waiting outside the gate. Plant Director William Berry explained to Gridley and Powers that he could not admit them "because of circumstances beyond his control." Gridley said they would be close by at their office if they or their equipment were needed.[21]

The same morning, when the first water had somewhat receeded, workers at the plant tried to pump the water, silt and mud out of the main graving

dock and put the Flying Boat back on its cradle. There was so much debris in the dock, however, that water had to be pumped back in to flush it out. Divers were brought in but the water was so muddy that, at first, they could not see to work in it.[22]

On Saturday when Fireman Redding inspected the plant, he recorded in his log that the lights were on in all the buildings and, although fire pumps three and four were in service, pumps one and two were not. During the next shift, Fireman Moore reported more trouble when the starboard electrical panel blew out. He also noted that the fire alarm system was out as a result of dead batteries and that the cables to the Flying Boat and alarm box 2-2 were broken.[23]

On the following Monday, clean up and repair work continued at the Long Beach Plant. Joe Hall arranged for Mr. Gridley, his Construction Foreman, T.E. Powers, and carry-all operator C.T. Rolf to be admitted to the yard. They inspected the mud that Hughes employees had scraped into a pile between the hangar and Engineering Building. Hall arranged for Gridley's twenty-cubic-yard carry-all to be passed through Gate No. 1 and then went to see The Flying Boat being replaced on its cradle. He left, however, when it became apparent that water was leaking through the main dock gate faster than Hughes's pumps could pump it down.[24]

That Monday the Long Beach morning newspaper, the Independent, first reported, "Hughes 'Goose' Wrecked; Damage Totals $5 Million." Apparently aside from Port Manager Vickers, that was how harbor department officials learned of the flood.[25] Later Monday morning, some of them inspected the damaged Hughes site from outside and met with officials of Gridley Construction Company and Pacific Dredging Company. In addition, they arranged for L.E. Smith and William Cook to take photographs.[26] Also

on Monday and again on Tuesday, a carry-all belonging to Gridley Construction was admitted to the Hughes yard to haul away piles of mud and silt.[27] On Tuesday Fireman Sharpe reported in the log that pumps one and two were still out of service and pump three was to be used only in an emergency.[28] Hall arranged for the installation of some new pumps for emergency use. Later he also arranged for George Myron to come to the Long Beach plant from the Hughes Culver City plant and make a survey of the dike protecting the Hughes property from the ongoing dredging operations. Hall helped Myron with the survey which he understood might be useful ultimately for the legal department.[29]

On Wednesday, the Hughes company employed a registered civil engineer, Ben Jarvis, a partner in Matt Graham and Company, to inspect the Long Beach Plant. On his tour, he found that virtually all of the muck had been removed from the premises except for the foot of mud remaining in the air conditioning pit. He also found that much of the machinery that had been inundated was being cleaned, dried and lubricated; furniture was being salvaged, files cleaned, and documents spread out to dry. Hughes employees even devised a blower system to circulate hot air continuously under the Engineering Building to accelerate drying and reduce permanent damage. Jarvis concluded that insurance carriers could not fault the clean-up program carried out by the Hughes employees. In addition, he recommended that in case another problem should occur, several steps be taken. Aerial photographs should be taken immediately and a brief daily log should be kept. Secrecy at the plant also seemed rather foolish to Jarvis as he and two Hughes employees were kept waiting over half an hour before being admitted into the Long Beach plant and inspectors, who might have spotted the potential danger of a failure in the dredging and filling system, were denied admittance to the plant.[30]

Later on that day Hall joined George Myron in his work on the dike survey. He also arranged with Gridley Construction Company for their carry-all to remove more mud from the Hughes yard.[31]

On the following Monday, Hall supervised the replacement of the damaged main dock gate. A new gate had already been picked up at Robertson Company in Compton and moved to a site on Pier D in Long Beach Harbor. The gate was loaded on Smith-Rice's derrick barge and taken across the channel where the barge tied up in front of Hughes's main dry dock. Diver O.L. Smith removed the old gate and the new gate was installed.[32]

THE AFTERMATH

While Hughes employed Jarvis to make an independent survey of their plant,[33] the City of Long Beach and Pacific Dredging Company hired Kenneth Q. Volk and Associates, Consulting Engineers, to make their survey of the damage. Volk, who was denied entrance to the Long Beach plant to inspect the damage and not allowed to talk to Hughes's employees or to look at the Hughes photographs of the scene, estimated the cost of repairs at less than $77,000. The only part of Volk's estimate that seemed to be based on concrete figures was the $4,500 bill presented by General Telephone Company for damage to their switchboard at the Hughes plant.[34] The flood was caused by settlement of a section of one dike. Yet at the same time another section of dike 150 feet south of Hughes's south fence also settled. Volk wondered if these events might be related by something other than coincidence. Inquiry was made, for this reason, at the California Institute of Technology by the Senior Harbor Engineer for the Long Beach Harbor Department, Roy H. Baldridge. At Cal Tech Baldridge reached Charles Richter, the famous seismologist, who replied that on the morning of September 18 at 2:17:55 there was an earthquake with an

intensity of 2.2 on the Richter Scale and the epicenter was about three miles south and east of Pier E. Since the dikes that settled were constructed on top of hydraulic fill, it was pointed out that earthquakes of relatively low intensity might lead to settlement. Volk also pointed out that if Hughes had carried out its plans to raise the walls of its graving dock and pontoon docks on time and had put fill material in place promptly as planned in May, 1953, there would have been no damage to the Flying Boat.[35]

On March 17, 1954, Noah Dietrich of Hughes Tool Co. in Houston signed a "Statement of Claim" against the City of Long Beach for $12 million. The statement alledged that the amount represented the damage suffered by the Flying Boat and other installations and property at Hughes Long Beach plant as a result of the flood.[36] A story in the local Long Beach newspaper noted that Hughes had retained the local law firm of Ball, Hunt and Hart to represent the Company in this action against the city.[37]

Even before the date of the flood, September, 1953, Hughes had planned further subsidence correction work. In February and March of 1953, engineer John Case submitted a set of plans for "Alterations to the Long Beach Plant" to Hughes; Hughes sent copies to the Harbor Department for approval as it prepared to obtain permits to carry out the work that Case suggested.[38] It was not until December 11, 1953 that Hughes issued an "Invitation to Bid and Contract to Perform Alteration Work." The invitation specified that work was to begin on January 4, 1954.[39] The firm that won the contract, Johnson Western Constructors, did not get a permit from the City of Long Beach to begin the work until February 24, 1954. By March, work was finally underway as Plant Director Berry explained in a letter to the Port of Long Beach General Manager E.J. Amar. The Hughes "desire to maintain rigid security" precluded Harbor Department

inspection of the project at that time.[40]

The work contracted for by Johnson Western was essentially to extend the concrete walls on the top of the main dry dock wall and tip float dry dock walls to make them six feet taller. Six-foot long wooden extensions were to be added to the doors on the dry docks. This would provide six feet of additional protection against sea water flowing into the dry docks as the land under them sank. In addition, the floor of the hangar was to be filled under the Flying Boat to make the dock less vulnerable to filling with sea water as subsidence under the hangar continued. To make these changes possible, of course, the Flying Boat had to be raised. And many changes had to be made in pumps, cables, pipes and other parts of the hangar.[41] Along with raising the dock walls and floor of the hangar, other changes were planned to anchor the Flying Boat more securely in its dry docks and prevent damage such as that done during the flood when it was raised and tipped as the main dry dock and one tip float dock flooded.[42]

On March 18, 1954 Hughes employees began jacking and cribbing operations to raise the Flying Boat and the cradle and launching mechanism on which it rested by six feet. Two crews were assigned to work twelve hour shifts, all day and night, until the operation was completed. It was such a delicate operation that observers were posted at fifteen stations around the Flying Boat to make sure that it was raised without damaging it. Observers were instructed to watch carefully at their stations; all observers were also reminded that they could ask the foreman at any time to stop the operation if they felt the plane was in danger of being damaged.[43]

After the Flying Boat, its cradle, and launching mechanism had been raised six feet, other work could be performed. Johnson Western Constructors raised and strengthened the main dock walls and raised the air conditioning

pit six feet. At the same time, they raised the tip float dock walls and the ties to the deadmen to which they were anchored. When Hughes was ready to place fill material inside the H-4 hangar the Company turned to the Harbor Department for the material.[44] Perhaps because the Company was ready to use the fill at about the same time that the Long Beach Harbor Department was ready to do some filling of its own nearby, Hughes permitted a Harbor Department survey crew to enter the yard.[45]

In May, Harbor Department officials and their contractors began to deliver. Deliveries stopped, however, because some of the fill material was scheduled to be placed inside the hangar near the Flying Boat. Ralph Wise of Livingston Truck and Material Company and their sub-contractor, John K. Larson, were concerned. If the Flying Boat were damaged, the contractors were afraid of incurring liabilities beyond the limits of their existing insurance policies.[46] They had the example of the Hughes pending $12 million suit against the city to reinforce their concern. In early June the problem remained. High tides were predicted for the third and last week in June.[47] So an agreement was drawn up between the City of Long Beach on behalf of the harbor and its contractors and Hughes Tool Company to hold the contractors harmless from liability beyond the coverage they enjoyed on their existing insurance policies. It also specifically provided that harbor department employees and contractors be granted ready access to the Hughes site.[48] This was the first time Hughes agreed to such a provision in a legal document.

After the hangar was filled, work continued on the project. Many things, such as winches, electric panels, plumbing and others had to be raised before the project would be complete and the hangar again functioning normally. In addition to this work, there were things to be

done outside the hangar. The forward fingers, bridges and sea walls were raised six feet. Along with that pumps and a fire hydrant had to be relocated and the entire area graded and paved. Finally, drainage of the yard had to be attended to.[49]

Apparently there was cooperation between harbor department officials and Hughes employees during the filling operation in the hangar--at least after the agreement was signed to release the harbor and its contractors from excessive liability in case the Flying Boat were damaged. But in September, 1954 cooperation was replaced by conflict. Harbor Department officials made charges against Hughes employees. Since subsidence was so great on Pier E near Berths 120 and 121, the Harbor Department had ordered their contractors and crews to deliver fill material there in July, 1953. Harbor officials agreed when Hughes employees said that security and coordination with scheduled work inside the plant made it impractical for city crews to arrange the fill material inside the Hughes plant. Harbor officials assumed, however, that the fill material was being used for the purpose for which it was delivered. Yet observers who had watched the Hughes operations from outside the fence reported that Hughes employees had used the material for a different purpose. They claimed that Hughes had bulldozed the protective dike constructed by the city and built a new fence which enclosed within the Hughes yard a large, unleased area. They also claimed that this action completely eliminated the city's dike which originally stood 13.60 feet above low water. Harbor officials compared surveys inside the Hughes yard made in April and May, 1954, with aerial photographs also taken in April and found the result startling. The photographs and survey data indicated that the original dike along the southerly side of the Hughes lease, for which Hughes, under its lease with the harbor, was responsible for maintaining, was no longer a dike. It was

now essentially a flat yard area varying from ten to ninety feet inside the new fence. Harbor officials concluded that Hughes personnel, rather than using materials furnished by the harbor for the purpose of building up the dike to maintain its original elevation, apparently used the materials elsewhere and to the end of making new land. Further, they stated "It can be positively stated that had the original dike been maintained with nominal fredboard, even the subject accident would not have flooded the Hughes yard."[50]

Hughes Long Beach Plant Facilities Manager, William Leas, answered these charges in a letter dated September, 1954. Leas began by explaining that he was going to point out "some inaccuracies" in harbor department officials' charges. First, he wrote, no fence was moved on the south boundary of the Hughes plant. Prior to the extension of Pier E, he continued, this boundary was a shore line and no fence was required. When the fill had reached the maximum height that could be obtained by dredging, there was still no fence. At this point, Leas stated, he called harbor department officials and was assured, he claimed, that Hughes could build a fence along the old shore line. In addition, Leas argued, Hughes employees had not altered the dike on the south boundary of their leases.[51] No one was convinced, however. No resolution of the questions was reached until 1956.

SETTLEMENT

In February 1956, when the $12 million Hughes law suit against the city had not been resolved, the Board of Harbor Commissioners took action. They directed Long Beach City Attorney Walhfred Jacobson to send a letter to Hughes informing the Company that their lease would be terminated on April 1, 1956.[52] This apparently led to an appearance on April 9 before

the Harbor Commissioners of local attorney Jonah Jones and Los Angeles attorney Greg Bautzer, representing Hughes. Jones claimed that he was authorized to negotiate settlement of all outstanding matters between Hughes and Long Beach.[53]

The documents available at this time do not reveal the means by which settlement was reached. In his book on Hughes, Dietrich puts forth his views. After the Harbor Commissioners decided to refuse to renew Hughes's lease if he persisted in his $12 million law suit against the city, Hughes, according to Dietrich, retaliated. Dietrich wrote:

> His counterattack showed Howard Hughes at his most devious. He knew that Long Beach had been embroiled for years in a controversy with the State of California over the tideland oil pools that lay beneath the harbor. Hundreds of millions of dollars in royalties were involved in the lengthy dispute. At last a formula was devised to make a division of the funds between Long Beach and the state. The solution seemed to please everyone, and the legislation was about to go through the Senate and Assembly in Sacramento.
>
> Howard summoned his two high-paid lobbyists.
>
> "Get up to Sacramento and kick Long Beach in the ass on that tideland oil settlement," he ordered.
>
> The lobbyists started working their wiles. They had used Hughes's money to pay campaign bills for many of the assemblymen and senators. The underpaid legislators were beholden to Hughes, and overnight the tidelands bill began to grind to a halt.
>
> The Long Beach interests panicked. After years of trying, they had finally arrived within reaching distance of those oil millions. Now a petulant millionaire was throwing a wrench in the legislative process.
>
> Truce was called, and Long Beach granted a ten-year lease to Howard Hughes for his Hercules. In return, Hughes dropped his $12,000,000 suit against the city and settled for half a million.

There is no evidence, other than Dietrich's assertion, that any of this happened.

In August, 1956, negotiations on a new lease were indeed progressing under the guidance of Jonah Jones. Jones later wrote that the lease was made in settlement of the lawsuit.[55] The Long Beach Independent reported

on August 28 that the harbor department officials proposed that Hughes be granted a new ten year lease under which Hughes would be responsible for subsidence work in its area and the city inspector would be allowed the right to enter and inspect that work outside Hughes buildings. In return, Hughes would drop its $12 million suit against the city and pay its back rent. On August 31, the paper reported "Hughes Voted 10-Year Lease."[56]

Finally,on October 15 at 11 am, representatives of all parties concerned in the flood and its aftermath met in the Harbor Commissioners board room and exchanged documents and money necessary to effect a complete settlement. Hughes paid $67,299.48 in back rent to the harbor. Another aspect of the settlement was a "Release and Indemnity Agreement." In it, Hughes received $600,000 to cover the cost of repairing the Flying Boat and the Long Beach plant after the flood. In return Hughes agreed to release from liability the city of Long Beach, Pacific Dredging Company, Puget Sound Bridge and Dredging Company and Macco Corporation. All of the parties involved agreed not to involve the federal government, the legal owner of the Flying Boat, in further litigation.[57] The new lease, in response to Mr. Hughes's desire for secrecy, set forth the following compromise on entry in paragraph 23:

> "Lessor and its authorized respresentatives shall have free access to the demised premises for purposes of inspection, surveying, or any purpose deemed necessary by Lessor in connection with its operation of the Port of Long Beach. Such right shall be exercised so as to interfere with Lessee's operations as little as possible and shall not include access to the interior of the buildings of Lessee."[58]

The language was still tight enough to keep out curiousity seekers as members of the Board of Harbor Commissioners discovered when they came to test it.

FOOTNOTES

[1]"Fireman's Log #11, 8-3-53 to 12-8-53," p. 105-106 Summa.

[2]"Invitation to Bid and Contract to Perform Alteration Work" in"Subsidence, Johnson Western," Summa.

[3]Long Beach Department of Oil Properties, "Elevation Changes in the City of Long Beach, August 1973-February, 1974" May 28, 1974, p. 5.

[4]Walter A. Tompkins, Little Giant of Signal Hill: An Adventure in American Enterprise (Englewood Cliffs: Prentice-Hall, 1964), p. 130-131.

[5]Lola Masterson, "US NAVY: The Long Beach Story," Long Beach Review (September, 1980), p. 30.

[6]"Subsidence-Long Beach plant" in "Subsidence" file, Summa.

[7]"Fireman's Log #11," p. 105,113.

[8]IDC, W. Leas to W.L. Berry, March 8, 1956 and IDC on subsidence work, unsigned, undated, "Subsidence," Summa.

[9]Tompkins, p. 131-132.

[10]L.B., "Elevation Changes," p. 6.

[11]Letter, John R. Jannarone to Long Beach, Board of Harbor Commissioners, November 21, 1951, "Pier E," Chief Engineers Office, PLB.

[12]Letter from R.R. Shoemaker to Long Beach, Board of Harbor Commissioners, December 11, 1944, "Summa Corp.:, Chief Engineers Office, PLB.

[13]Kenneth Q. Volk, "Report on Estimated Damage to Yard, Buildings and Equipment Due to Accidental Flooding of Hughes Aircraft Plant, Pier E, Long Beach, California, September 18, 1953, Engineering Vault, PLB.

[14]"Fireman's Log #11,"p. 105.

[15]Volk, "Report."

[16]"Fireman's Log #11," p. 105-106.

[17]"Claim," December 4, 1953, "Leases," Summa.

[18]Ibid.

[19]Ibid.

[20]Noah Dietrich and Bob Thomas, Howard, The Amazing Mr. Hughes (Greenwich: Fawcett Publications, 1972), p. 213.

[21]Letter, J.G. Hall to H. Butler, October 12, 1953, untitled file, Summa.

[22]Interview, Chuck Jucker, September 15, 1980.

[23]J.G. Hall, handwritten log, untitled file, Summa.

[24]Ibid.

[25]Independent (Long Beach), September 21, 1953, p. 1. An annotated clipping in "Summa Corp" file, Chief Engineer's Office, PLB.

[26]Robert R. Shoemaker, "Data Pertaining to Hughes Dike Break", March 30, 1954, "Summa Corp", Chief Engineer's Office, PLB.

[27]Hall, log, Summa.

[28]"Fireman's Log #11," p. 113.

[29]Hall, log, Summa.

[30]Letter, C.L. Robinson to Howard Hall, September 24, 1953, "Insurance Buildings and Equipment," Summa.

[31]Hall, log, Summa.

[32]Ibid.

[33]Letter, R.R. Shoemaker to E.J. Amar, January 7, 1954, "Summa Corp" file Chief Engineer's Office, PLB.

[34]Volk, "Report."

[35]Ibid.

[36]"Statement of Claim" March 17, 1954, "Summa Corp," Chief Engineer's Office, PLB.

[37]Don Brackenberry, "Hughes Sues Long Beach for $12,000,000", n.d. in Long Beach Public Library clipping file.

[38]"Hughes Aircraft, Terminal Island, Subsidence Correction, 1952-1954," Engineering Vault, Foreign Files, PLB.

[39]"Invitation to Bid..." December 11, 1953, "Subsidence, Johnson Western," Summa; Long Beach Planning, "Application for Building Permit" February 24, 1954. CD.

[40]Letter, W.L. Berry to E.J. Amar, March 10, 1954, "Hughes 1954-1955" Central Files, PLB.

[41]"Invitation to Bid..." December 11, 1953, "Subsidence, Johnson Western," Summa.

[42]Interview Chuck Jucker.

[43]IDC, W. Leas, March 15, 1954, "Raise Docking Cradle Six Feet," Summa.

[44]"Schedule of Subsidence Work," undated, "Subsidence Program, 1953," Summa.

[45]"Hughes Lease Data," April 27, 1956, "Hughes, 1956-1957" Central Files, PLB.

[46]Letter, "Hughes Tool Company to EJ Amar, May 7, 1954," Summa Corp," Chief Engineer's Office, PLB.

[47]Letter, E.J. Amar to Hughes Tool Company, June 2, 1954, "Summa Corp," Chief Engineer's Office, PLB.

[48]Agreement Between City of Long Beach and Hughes Tool Company, June 10, 1954, "Summa Corp," Chief Engineer's Office, PLB.

[49]"Schedule of Subsidence Work," Undated "Subsidence Program, 1953," Summa.

[50]"Hughes Lease Data" April 27, 1956, "Hughes, 1956, 1957" Central Files, PLB; IDC, Leas to Berry, 3 August 1954, "Pier E Extension," Summa.

[51]IDC, Leas to Berry, September 14, 1954 "Pier E Extension" Summa.

[52]Letter, Walhfred Jacobson to Hughes Aircraft Company, February 21, 1956, "Hughes, 1956-1957" Central Files, PLB.

[53]Letter, Walhfred Jacobson to Hughes Aircraft Company, February 21, 1956, "Hughes 1956-1957" Central Files, PLB.

[54]Dietrich and Thomas, p. 214.

[55]Letter, Jones to Hopper, Oct. 30, 1956 "Leases," Summa.

[56]"Right of Entry Sought in Hughes Settlement" Independent (Long Beach), August 28, 1956; "Hughes Voted 10-Year Lease" Independent (Long Beach), August 31, 1956.

[57]Letter Walhfred Jacobson to Board of Harbor Commissioners, October 18, 1956, "Hughes, 1956-1957," Central Files, PLB; "Release and Indemnity Agreement" October 9, 1956, "Leases," Summa.

[58]Lease between City of Long Beach and Hughes Tool Company, October 15, 1956, "Leases," Summa.

THE LONG BEACH PLANT

INTRODUCTION

For much of the time between 1946 and 1962 several hundred people permanently occupied at the Hangar site. It was a regular aircraft plant and referred to more and more in the Hughes correspondence as the Long Beach Plant. In general, an installation for testing a large airplane requires facilities such as shops and test laboratories, provisions for building maintenance, security, fire fighting, air conditioning, and crane operation. The Hughes Long Beach plant, because of the size and unusual nature of the airplane, required in addition facilities for operating and maintaining the elaborate system of huge doors, a hydraulic system for tilting the airplane, a pumping system for removing water from the docks, and a system for inflating of emergency trim air bags for changing the attitude of the Flying Boat when it was floating in the hangar. Extensive facilities for working and glueing wood were required because the plane was made nearly entirely of laminated birch. A sewing shop was needed because some parts of the plane are covered with fabric rather than with wood.

A prototype airplane undergoing tests requires a much larger crew to operate and maintain it than does a similar production airplane because of the many "bugs" that become apparent only after testing has begun. Problems are frequently encountered with hydraulic and pneumatic systems. Their valves, actuators, pressure regulators, pumps, seals, and other components are subject to leakage, mis-adjustment, chattering, and lack of compatibility with each other. Electrical systems consisting of motors, generators, inverters, dynamotors, circuit breakers, voltage regulators, switches, connectors, et cetera can also have compatibility

problems. The miles of electrical circuits may be found to be incorrectly connected. Short circuits may cause fires.

Control cables and linkages for throttles, cowl flaps, landing flaps, propeller pitch, and flight control surfaces may need frequent adjustment until the optimum settings are found. The pumps, valves, piping, and gages of the fuel system may not function as expected. Engineers are required to design changes to correct flaws uncovered by the testing, mechanics to incorporate the changes, and inspectors to inspect the work after the changes are completed.

PLANT ORGANIZATION AND THE TASKS

Organization of the plant department by department was a matter of evolution. At first, as we know, the operation was temporary. Men came down from the Culver City plant expecting to stay six months and then return. Robert J. Ford was one of these. He was at the site in the summer of 1946 before the plane parts came down. As Assistant Project Engineer he came to work on the plane and was mainly concerned with getting the "bugs," engineering discrepancies,out of the Flying Boat. He helped to get it assembled. Ford remained at Long Beach until he retired in 1979. Later, several other engineers were brought down to help Ford. Bill Berry, Project Engineer, was permanently located at the site by early 1947. George Steuder came from the Culver City plant to design the air conditioning system, expecting to stay for a few months. He stayed until he retired in 1962. Richard Grey hired in at the Long Beach plant in 1946 as a security guard. He was told the job was temporary, about six months. Grey worked at the site until the lease ended.

Some of the first departments were Security, Fire, and Plant Engineering and Maintenance. In the last there were usually about

40 people: painters, riggers, crane operators, welders, electricians, boiler and air condition personnel, and boat handlers. The man in charge of the boats was a diver and did the necessary diving to check on underwater equipment and on problems such as the condition of the gates. There was an Engineering Group for the airplane. Which worked on structures and on electric, hydraulic, and control equipment. The Flight Crew was an aircraft service group which readied the engines and other equipment and would have been operators on the plane if it had flown. There was also a Flight Test Department. All of these departments were responsible for certain reports. For example, there were temperature and humidity checks made at the approximately thirty recorders located in the hangar. A permanent record was kept on these with spot checks sent periodically to Mr. Hughes. The Plant had monthly safety inspection reports which were forwarded to the insurance company.[2]

In searching through the company records a few examples of the kinds of things that occupied the work force were selected for inclusion in this overview. They involved ongoing changes in the facility, procedures concerned with flight of the plane, inspections, and emergency procedures. As to the facility, drainage was a continuing problem because of the subsidence. In September of 1948 we find a diagram of two suggested methods for draining the area around the launching site. The floor deteriorated under the engines of the Flying Boat due to dripping oil so tests were made on materials to protect the floors. In 1957 and with subsidence still a concern, it was found that at high tide the free-board was only nine inches at the main gate. Because of this a 3-1/2 foot extension was made. It had to be hinged since any fixed

extension would have interfered with the opening of the 75 foot hangar door. In 1949 there was docking-cradle work, then a cut-out in the dock wall had to be reworked for propeller clearance. A procedure for installation of a tunnel between the Power House and the Hangar was written in 1950.

In 1951 when it still appeared likely that Mr. Hughes would test fly the plane again the "Launching and Docking Procedure" was revised adding a new phone system, revising the tip float dock pumps, and providing a new procedure to follow in the event of electrical power failure during launch. These detailed procedures of over fifty pages were prepared by William Leas, who headed Plant Engineering and Maintenance. The attitude toward testing at the plant at the time is reflected in the (IDC) sent by Plant Director Bill Berry to George Shull in March. It read:

> At the present time, it is the intention to return the Hughes Flying Boat to the hangar daily, after taxi or flight operations where it will remain afloat.
>
> The removeable doors on the hangar will not be installed and the air conditioning of the hangar and airplane will not be resumed unless conditions are such that the airplane will not be taken out for a period of several days. 3

In those early years the 75 foot hull door in the hangar and the composite panels were checked every two weeks by fully opening and closing them. Both the 75 foot overhead door and the composite panels could be stopped at any point to avoid exposure of the airplane to the sun. The IDC that described the procedure noted that "From the end of the port jetty the airplane between Engine #3 and Engine #6 would be visible," thus making a break in the secrecy barrier. Attached to the IDC were photographs and Drawing F 0253, colored to indicate the various

door panels.[4] Bob Ford observed in a recent interview that the doors have not been opened since about 1962.

Periodically high frequency sound waves were used in an inspection procedure to detect flaws in the glued joints of the airplane. This procedure required that scaffolding be built both inside and outside the plane at specific locations. As the Flying Boat became not only a prototype but also a laboratory for testing equipment there was an increase in precision testing and in inspection activity. Instrumentation had to be certified as to accuracy. All the test instruments had to be cataloged and inspected at regular intervals by the Testing Group.

Hughes specified that the plant must have the best fire detection and fire fighting equipment available. There never was a fire at the Long Beach plant, and in spite of reports of such in one of the Hughes biographies, long time plant employees assured us that this was not the case. To ward off fire in the H-4 hangar there were 4 hydrants, hoses capable of delivering 4,000 gallons of water per minute, carbon dioxide carts, foam, and numerous portable extinguishers. By comparison, the National Fire Protection Association recommended a minimum of one extinguisher unit for each 5,000 square feet of hangar floor area, or nine units for the 42,640 square foot hangar. Instead there were 373 units! Two OCD pumps in location to use sea water in an emergency stood by. Ample photographs exist of the fire fighting equipment and a selection of these appears in Vol. 5, Critical Documents. The 250 and 400 hp boilers were inspected annually. In daily operation the fully automatic gas-fired boilers had a competent boiler operator stationed twenty-four hours per day, seven days per week in the boiler area.[5]

As with all plants, a host of emergencies had to be anticipated and planned for. Submersion in sea water was a constant concern. In the event that sea wall floors or dock gates should rupture during a high tide, many low areas about the plant where electrical equipment was located could have become inundated. Sea water would probably short circuit all the electrical equipment involved, and all the buildings with the exception of the Power House would be expected to be without electric power. Ultimately the air conditioning pit, the test laboratory, motor generators, and wood working motors would become subject to the submersion. Thus, schemes to combat the threatened submersion were devised. The Hughes "Emergency Operations Manual" also contained procedures for the installation of aircell inflation equipment. These were air bags placed in front of the Flying Boat ahead of the cradle so as to provide more bouyancy there and to tilt the plane so that the rear portion went down.[6]

Minutes of the regular meetings held by the General Safety Committee point up the tight regulations that prevailed at the plant, especially concerning fire.

Each of these operations depended upon a specific number of personnel, and accounting for a number in the range of 300 who worked at the site is not difficult.

Maintenance and testing on the H-4 were always the main job at the plant. Bill Berry could recall, however, that the plant built three helicopters in a small area, predecessors of the Model 300. They were built in Long Beach mainly to keep them out of sight. The plant also built two air cushion water vehicles and called one of them a hydrostreak. Again Long Beach had what was unique and needed: the water.

With the exception of the engineers, most of the personnel were shop type people: hydraulics shop, engine shop, and wood shop. Some of the wood workers were Europeans, older men. Women worked at the plant both in the sewing shop and in the secretarial positions. The Hughes News documents some of their social activities. Security in itself employed as many as 28 to 30 guards: three shifts with 4 men each who worked but 5 days a week. After 1950 a closed circuit TV was used to enable a man at the main gate to observe the dock side of the hangar. Patrols were made around the site every 24 hours. A man was at the gate and there were guards at two other posts. There was also a fireman on patrol. Mr. Hughes was never paged so that outsiders would not know he was there. Security also prevailed inside the hangar, and only those with passes could enter. Some employees never saw the Flying Boat. An entry in the Fireman Log tells us that one watchman stood by the starboard hangar crane door checking employee passes into the hangar and was relieved by the next man on duty. On the Monday after the flood, September 21, 1953, Joe Hall spent "nearly all day writing passes for the hangar and for the Flying Boat for William Leas. Perhaps the most poignant statement on secrecy found in the course of this study was one made by Bob Ford who said that he never talked about his work, even to his family, over a period of some 35 years.[7] The plant managers seldom asked Mr. Hughes for permission for anyone to enter the hangar. Hughes had made the statement that if the person was important enough to see the airplane, he would show it to him himself. Hughes did not want the Coast Guard, City Firemen, Police, city officials, or Harbor Board members on the site and certainly not in the hangar. No interference with work was permitted and no time could be taken away from people's jobs. Senator Claude Pepper's visit was one of the rare exceptions to the rule.

meetings were also held at the plant. As could be expected, most of the items listed related directly to the maintenance of the Flying Boat. Yet facility changes were on the lists as well, some requiring Mr. Hughes's presence at the harbor site.[9]

Mr. Hughes showed concern for the Flying Boat and the H-4 hangar when the Santanas, winds coming from the northeast, were strong. Rae Hopper remembers getting calls from Hughes in the early morning when he would say, "Check the building and see if it has flown away."[10] If there had been a problem, the guards would have used their hot line. They would have called a number which would have initiated other calls so that everyone concerned would have been notified. Aside from the damage caused by the flood and by one piece of sheet metal that fell on the Spruce Goose when the hangar was being erected over it, no damage was ever suffered by the Flying Boat in the 34 years it was stored in the hangar.

New instructions by Mr. Hughes were what kept the plant active. By 1962 he was no longer visiting the plant, and there were no new instructions. The belief grew at management levels that the people at Long Beach were just marking time. That year the decision was made to cut 130 people from the work force, leaving about 35 permanent employees at the plant. Those who remained were by and large glad to stay. The Plant Director, Bill Berry, found other locations for most of those who were let go, and at the same time found himself another position within the Hughes Company. During the 1960s the air conditioning was cut back, and in 1970 the entire air conditioning system was disconnected.[11]

For example Noah Dietrich, business manager for Hughes, never visited the H-4 hangar,[8] despite the fact that his position in the Hughes organization was so important that Hughes provided him with a converted B-25 twin-engine bomber, beautifully appointed, for his exclusive use, as well as a full time pilot, Ed Bell.

MR. HUGHES

Howard Hughes was a frequent visitor at the hangar in the early years, coming in weekly. According to Engineer Steuder he was concerned about the condition of the plane and whether or not it could be maintained. This was because he had been told that no one could meet the maintenance requirements he had set up. However, the airplane was maintained.

The Flying Boat also became a laboratory for testing aircraft equipment. Even after it became doubtful as to whether it would be flown again, it had to be maintained so that the pure research experiments could continue. The visits by Hughes became less frequent as the years passed, becoming monthly rather than weekly. The last reference to a planned launching found in the search of the Company records was June 30, 1960. This was a communication from the General Services administration which owned the plane to the Vice President of Hughes Tool Co. Steuder recalls that it was not Mr. Hughes's habit to talk to his engineers on the job. Rather, Hughes made his visits, often at night, and would call the engineer by phone or have him come to his office at the Goldwyn Studios to talk over problems. Among the company records at Long Beach there is indeed little documentation of the Hughes visits. Interdepartmental Correspondence is to be seen that passed between Mr. Berry and Mr. Hopper with the subjects "Jobs Requiring Decisions by Mr. Hughes" or "Items to be Discussed with Mr. Hughes." These IDCs seem to tell us that some

FOOTNOTES

[1]Interviews: Ford, Sept. 17, 1980, Steuder, Oct. 1, 1980, and Grey, Sept. 12, 1980.

[2]Interviews, Berry, Sept. 23, 1980 and Steuder.

[3]Letters, Stearns to Shoemaker, Sept. 28, 1948, Hughes 1947-49, Central Files, PLB; IDCs, French to Leas, 29 July, 1955, "Building and Ground Improvement" Summa Files; Leas to Berry, 15 May 1957, and Berry to Hopper 18, March 1953 CD Harbor Facilities Structures" Summa.
Quote from March 12, 1951, "Harbor Facilities Structures" Summa.

[4]ICD, Barry to Hopper, 18 March 1953, "Harbor Facilities," Summa.

[5]IDC, Pausic to Leas, April 23, 1954, "Harbor Facilities," Summa; "Control and Maintenance Technical Equipment," approved Berry, July 11, 1955, ibid; Holahan to Marsh and Co., Dec. 6, 1962, and Jagosz to Ford, 30 Nov. 1962 in "Insurance, Buildings" Summa; Interview, Bromely, Sept. 9, 1980.

[6]IDCs, Koch to Leas, Jan. 20, 1953 and Leas to Curry, Dec. 11, 1953, "Emergency Operations Manual Report 26-4," Summa.

[7]Interviews, Jucker, Sept. 15, 1980; Grey, Sept. 12, 1980; Berry, Sept. 23, and Ford, Sept. 17. "Firemans Log,"p. 116, Summa.

[8]Interviews, Berry and Bromely.

[9]Interview, Steuder; IDC Berry to Hopper, 3 Dec. 1954 CD, and Dickman to Berry, 28 Dec. 1949, "Conversations with Mr Hughes" Summa; Letter, GSA to Hughes Tool, Dec. 30, 1959 "Hughes Flying Boat, General," Summa.

[10]Interview, Hopper, Sept. 15, 1980.

[11]Interview, Berry.

PRESSURE TO LEAVE

CHANGES ON PIER E, 1955-1960

The 1956 lease recognized the Hughes leasehold in its final and largest form: Parcels 1, 2, 3, and 4. Parcel 4 lay largely outside of the Hughes fence north and east of the Power House. Drawing F 0624/2 clarifies its boundaries in relation to site improvements. Documents tell us that in 1957 a portion of Parcel 4 outside of the Hughes fence was subleased to Franks Dredging Co. Old-timers at the Long Beach plant are unanimous in their lack of any knowledge concerning this arrangement. Nonetheless, in January of 1961 Franks Dredging Company advised Hughes Tool Company by letter of its "desire to terminate our occupancy of such property as your sublease [sic], effective as of February 4, 1961." Franks Dredging was moving out due to construction adjacent to the area.[1] The construction was a Richfield Oil Marine Terminal at Berth 118.

By 1961 a good deal of change had come to Pier E. Looking back, one change had related to the mooring of an Essex class aircraft carrier to Berth 122. The 1956 lease as drafted in September of that year provided that since rights of Hughes to Parcel 2 (all water) were non-exclusive, and since the Port of Long Beach reserved the right to permit other vessels to use a portion of Parcel 2 from time to time, Hughes representatives were obliged to negotiate with the Board of Harbor Commissioners and with the Navy regarding such use. Together they must formulate a plan prior to the signing of the lease scheduled for October 15, 1956, permitting the Harbor to construct a suitable structure at Berth 122 for safe mooring of the carrier. Any agreement, however, would

have to comply with the provisions which Jonah Jones, the Hughes lawyer, had established in paragraph 21 of the lease: "Lessor agrees that it will make the area of Parcel 2 available to Lessee upon first priority upon at least 24 hours written notice from Lessee."[2] The Long Beach Independent published an article on September 8 publicizing Navy concern about space for the Carrier.[3] The first talks conducted ended in agreement over a plan to construct a submerged dolphin with a removable cap of suitable size and strength. The cap once removed would allow the Flying Boat room to maneuver and to have eight feet of clearance above the fixed portion of the dolphin at mean lower low water. In final form, however, the capped dolphin idea was abandoned in favor of a floating set of pontoon struts. The Navy would move the carrier,if moored, and the Harbor Department would remove the pontoon struts all within 24 hours of written notice from Hughes. The Flying Boat had not left its dock for nine years, but all was clear for it to leave its hangar on short notice.

Some of the changes in Pier E were underway even before the 1956 lease was negotiated. The Port was going ahead with the Master Plan. In June of 1955 the Board approved construction of bulkheads and wharfs along the south end costing $475,000. In 1956 130 acres of filled land had been created.[4] The Long Beach Development Corp took out permits relative to its sea water tank farm and water injection plan to combat subsidence on Pier E in 1954, 1958 and 1959. The Richfield Oil Corporation initiated a $1,250,000 oil terminal project in June of 1959. The papers called it the only bulk oil terminal on the Pacific Coast capable of handling super tankers 1000 feet long and with 48 foot draft. The project included a 24 inch pipeline to the Richfield tank farm on Channel 2. Richfield held

a lease on the 20 acre terminal at Berth 118 which would not terminate till 1994.

In 1960 and 1961 Richfield took out city permits for oil hauling facilities, concrete aprons for mooring lines, foundations, and walkways. In the Fall of 1961 Richfield made an application to Long Beach Harbor to lease Berths 120 and 121, the H-4 hangar site, for a Richfield Marine Service Station. The application noted that the Hughes lease would expire in 1966.[5]

On July 10, 1960 one could read in the papers that a German ship would unload 800 Volkswagens at Berth 122, the first commercial use of Pier E. The article went on to recite that the Navy was constructing a two million dollar wharf on the west side of the pier, Berths 125, 126, and 127 and that when it was completed in December, the Navy would return Berth 123 at the tip of the Pier to the Port.[6]

In the midst of all these changes and before the subsidence problem was really solved, William Leas, Plant Facilities Engineer at Hughes, was asked to provide drawings and a procedure to once again raise the H-4 hangar. The plan was to raise the hull hangar fifteen feet; the ship cradle five feet; the hull dock walls five feet; the dock floor eleven feet; the gates six feet; the sea walls, finger piers, and bridges five feet; the horizontal and vertical stabilizer enclosures and wing tip hangars twenty feet; and the tip float docks and gates five feet. The Engineering Building was to be relocated fourteen feet higher on new fill and on concrete footings.[7] The Leas drawings executed in 1958 are in the Long Beach Summa Corp. files, but were never implemented because the subsidence had been essentially checked by 1959.

LEASE NEGOTIATIONS

In January, 1966 the Hughes Long Beach Attorney, Jonah Jones, requested a twenty year extension of the Hughes lease that was to expire in September 1966. He wanted the Harbor Board to consider amending the lease so that Hughes could install water and land facilities to conduct studies in oceanography. This was the only mention of oceanography among the documents, (except in the new lease); however, we might speculate that with the virtual end of tests on the Flying Boat and the end of Mr. Hughes's visits, the plant was considering other options. Port Manager Charles Vickers recommended approval of a lease extension of ten years, but some of the Commissioners on the Harbor Board felt otherwise. At the January meeting:

> "Commissioner Craig objected to the fact that recently he had not been permitted to enter the property although the present lease specifically provides that representatives of the Lessor shall be permitted to do so. Also, he questioned whether the Port could not obtain more revenue from the property through other use of the premises. Commissioner Ridings stated that he would like some assurance that the property would in fact be used to conduct studies of oceanography as asserted in Mr. Jones' communication and noted that the property had seemed very inactive during the past several years.
>
> Mr. Jones addressed the Board regarding their application and to answer the above questions and others imposed by the Board members. He stated that he could not give any assurance that there would be any increased employment on the property nor could he give any information as to studies that might be going on for the Government. He felt that if Hughes was willing to tie up the property under a ten year lease, there must be some use that is planned for the property."[8]

Vickers got together data on the Hughes lease which showed that the City was already getting more per square land foot from Hughes than from Richfield at Berth 118 and stated that the only way the city could make more on the property from other usage would be by investing approximately $2,000,000 to develop it. This apparently convinced the Board, and in

August the lease was drawn up. Jones sent the particulars of it to Bill Gay at the Hughes Hollywood office, and in October Hughes had a new ten-year lease. Three years were firm. After that the lessee had to make an annual extension request. Rent was increased to $36,054.84 a year. Paragraph 18 stipulated that if the lessee should hold over after expiration of the lease, such holding over would be a month to month rental and would include time needed to remove buildings and other improvements. The premises remained the same except for a 50 foot strip which would be excluded from the south side of Parcel 2, the water. For ten years Hughes had allowed the Garvin Towboat and Barge Co. to use this water zone without charge.[9]

Howard Hughes meanwhile had, according to the papers, "hidden" and the Flying Boat had "faded into mystery."[10] The news article obviously was drawing on files a decade old in constructing the article. According to his less than sympathetic biographers Bartlett and Steele Mr. Hughes was having his troubles both in entrepreneurship and physically in those years. Their chapter titles for the years 1957-1966 in their book Empire read "Break down" and "Retreat." The latter ended with Hughes leaving for Boston. He traveled from there to Las Vegas and a "New Career." As he started out for Boston on July 16, 1966 from his Bel Air home his biographers claimed "It was the first time Hughes had been outside in four and a half years."[11]

J.H. McJunkin, then Assistant General Manager of the Port, reminded the Board in 1971 when Hughes requested its annual lease extension that the 7.2 acres was the sole remaining undeveloped marine terminal site of its magnitude in the Port. The Board's action was to instruct the Lessee that no additional extensions would be granted after 1971 as a condition

even if the extension was given. Rae Hopper, Hughes Tool Company, Aircraft Division, received word in March that there would be no extension. With no clarification in the written records to explain it, a new request made in July received the following action from the Board," Recind previous action. One year extension granted."[12]

Robert J. Ford, Director of the Long Beach Plant, was already involved in a search for a new hangar site. He had contacted the U.S. Naval Facilities Engineering Command, San Bruno, California, considered Navy yards up and down the coast, and found North Island at San Diego the most promising. As Ford recalled, they had known for years that the Port wanted the site and periodically would make a search for a new location. Nothing worked out.[13]

On February 4, 1972 Hughes made its annual request for lease extension. This time the Board referred to Harbor Department plans to develop the area as part of a deep-water terminal capable of accommodating super tankers at dockside and noted that the main entrance channel was immediately adjacent to the leasehold and had been deepened to handle those ships. No one-year extension was granted, and notice was served to vacate per the lease by March 4, 1973.

Hughes immediately renewed its efforts to find a new location and to make arrangements to move the plane. But to complicate matters the General Services Administration gave notice that the Flying Boat would be sold at auction in January 1973; thus, the Hughes lease on the plane itself would also terminate. Vice-President Hopper argued to the Harbor Board unless Hughes could made some arrangements to continue in possession of the plane, they would not be in a position to move someone else's property.

Because of the embarrasing position which this situation posed for Hughes, Hopper proposed that the lease be renewed and that the rent be raised to $100,000 a year. The Board approved the rent and a provision for a firm two year extension. A "First Amendment to Lease" was signed November 2, 1972. The newspaper reported "Hughes Spruce Goose will keep its nest for two more years,"[14] A "Second Amendment to Lease Agreement" negotiated in September 1975 extended the term to June 30, 1978. It also included paragraph 17 "Surrender of Possession" which read that "Lessee shall have the right to transfer title to said improvements to City by paying City such price as shall be mutually agreeable; or Lessee shall remove all...at its sole cost..."[15] Due to Corporate rearrangements the Long Beach Plant fell at this time under the Hughes Helicopter Division, Summa Corporation.

In 1972 Atlantic Richfield and Shell Oil Co. had entered into agreements to share Berth 118 and for Shell to construct a pipeline from Pier E to Richfield and Shell facilities inland for the use of both Oil companies. Rights-of-way for the pipeline were acquired by Shell in 1976.[16] As is well known, ARCO made plans to relocate at Berths 120-121. In May of 1978 the Port reaffirmed its plans to construct a marine petroleum tanker terminal on the Hughes leasehold and stated clearly that it did not want the task of demolition of existing structures to fall upon the City. Instead, Summa should pay a hold over monthly rent while with "all possible dispatch" it undertook the job of removal and demolition.[17] On March 7, 1980 Summa Corporation's law firm in Houston received a letter from Port General Manager McJunkin notifying them that the month-to-month tenancy would expire September 30, 1980.[18]

Much effort was put forth between 1978 and 1980 to save the Spruce Goose; but no voice was raised save the H-4 Hangar. By a written understanding reached in March, 1980 Summa would remove the hangar and other surface installations at its expense and pay the Port $500,000 in lieu of removing the graving docks and building foundations.[19] This is the last documentation examined for the H-4 hangar site. From that date of March, 1980 attention was turned toward the Queen Mary/Hughes Flying Boat Exhibit Center and the ARCO Terminal Relocation schedule. The latter stated "Remove Summa Buildings and Hangar (by Summa Corp)" during the month of October 1980.[20]

FOOTNOTES

[1]IDC, Leas to Berry, 15 Nov. 1960 and Chatten to Hughes, Jan. 3, 1961, in "Long Beach Plant Leases," Summa. See paragraph 14 of 1956 base on arrangement for subletting property.

[2]Lease, 1956. CD.

[3]"Board Eyes Pier Lease for Hughes," Sept. 8, 1956.

[4]Long Beach Independent March 23, 1955, June 7, 1955 and July 10, 1960.

[5]L.B. Planning, Independent Telegram June 7, 1959; Letters, Vickers to Richfield Oil, Nov. 4, 1960 and Durham to Hoffmaster, Nov. 10, 1961, Hughes 1960, Central Files, PLB.

[6]Independent, July 10, 1960.

[7]Letters, John Case to Leas, Sept. 25, 1958 and Case to Lease, December 11, 1958.

[8]Harbor Board "Hughes Tool Company Application..." Jan. 27, 1966, "Leases" Summa.

[9]Letter Jones to Day, August 2, 1966, "Leases," Summa; Memo, Vickers to J. Mansell, City Manager Feb. 14, 1966 and Lease 1966, CD, Hughes 1958-77, Central Files, PLB.

[10]L.B. Independent, Sept. 26, 1967.

[11]P. 275.

[12]Quote is from Memo, Thorley to Board, July 16, 1971. See also Thorley to Hughes Tool, March 3, 1971; McJunkin to Board, Feb. 4, 1971; and Thorley to Hughes Tool, Feb. 29, 1972, Hughes 1958-77, Central Files, PLB.

[13]See "Site Exploration" file, Summa; Interview, Ford.

[14]L.B. Independent, August 22, 1972; Letter, Hopper to Board, 10 August 1972; Memo, Thorley to Board, Aug. 17 and 21, 1972; Lease Amendment 1972 CD, Hughes 1958-77, Central Files, PLB.

[15]Lease Amendment, 1975 CD, Hughes 1958-77.

[16]Environmental Resources Group, Draft EIR on ARCO Marine Tanker Terminal Relocation to Berths 120-121. (1979) p. I-2.

[17]McJunkin to Summa, May 3, 1978, Summa Corp. Central Files, PLB.

[18]McJunkin to Daryl B. Crown, March 7, 1980,"Summa," Chief Engineers Office, PLB.

[19]Ibid.

[20]Schedule (Jan. 18, 1980) Summa File, Chief Engineer Office, PLB.

Chapter III

ARCHITECTURE: FORM AND FUNCTION

The following chapter details the architectural and technical features of the Howard Hughes H-4 Aircraft Hangar Facility. Major buildings and systems are described in detail, with reference to both photo and drawing numbers contained in Volumes III, IV, and V. The most significant buildings were described from both an exterior and interior analysis. Building numbers refer to the designations found on H-0253, Print #4 contained in Volume IV.

General Description

Print #'s 1-6

The Hangar Complex consists of sixteen prominent building and structural features: a hangar building, wood shop, engineering office, administration building, hydraulics and engine shop, water tank and control room, power house, reception building, oil drum rack, paint storage shed, paint shop, office, guard house, hose cart house, and a removable steel bridge. All of the buildings and structural features are designed in a utilitarian/industrial manner. The present complex consists of ~~an~~ extensive ~~number of~~ additions and alterations to the original facility. The majority of features present today were, however, completed by 1954, and there have been relatively few exterior alterations since. As a result, the site has retained a profound sense of time and place.

The entire building complex is fenced to the north and east, and is open to the water on the south and west. The facilities unique location highlights the design features of the two most prominent buildings, the hangar and the water tower/control room.

HANGAR AND ASSOCIATED FEATURES

Building #1, 2, 24, 25, 26, 22, 23

Print #'s 7-24

Photo #'s 1-135,164-177,200-210

Architectural Description

Exterior

The hangar is an irregular, multi-story structure of steel frame construction with aluminum sheathing. It is built in a cruciform plan and is designed in a utilitarian/industrial manner. Major architectural features include a large central mass flanked by two spreading wings, a complex system of doors, two large steel buttresses flanking and to the rear of the central mass, and a concrete jetty and launching ramps on the water elevation. Architectural details include corrugated siding, a concrete foundation, metal frame industrial windows, flat window and door openings, and industrial lighting.

The hangar is, in addition, a complex of systems including, air conditioning and moisture control, a wood shop, a launching cradle, a dry dock, and a heel control system.

Interior

The interior of the hangar is dominated by the relationship of the aircraft to the building. All structural elements are exposed.

Major features include the main dry dock, concrete flooring, and the cantilever form of construction. This method of construction allows the entire facade of the hangar to be opened to facilitate the launching and docking process. The main dry dock is located directly in the center of the hangar. The concrete flooring is relieved only by winches and hoists used in handling the aircraft.

Technical

After the H-4 aircraft was assembled and installed in the dry docks in early 1947, there was concern for the effect of weathering on its surfaces. Four Ronney tubular-steel frameworks were erected, one for the hull and inboard wings, one for the empennage, and one each for the wing tips. They consisted of tubular columns set in pipes in the ground and braced by cables, supporting trussed-roof sections. Canvas panels covered the walls and roofs. For launching, it was necessary to remove the hull enclosure with a crane.

The canvas panels were troublesome: they bulged and whipped in the wind and required considerable maintenance. In addition, it was difficult and time-consuming to roll them up and down.

In spring of 1949, plans were approved to build a permanent steel-framed hangar for the hull, strengthen the existing framework for the wing tips and empennage, add a nacelle section on each side, and incorporate it all into a single building. The canvas panels were removed and the entire structure was covered with corrugated aluminum siding and roofing. While plans were being drawn, the effect of subsidence on the site was becoming more serious, and the planned hull hangar height was increased by three feet. The building was

completed in early 1950.

The structure was built on steel pilings and steel-reinforced concrete foundations. The design, using steel-beam columns, large steel trusses and one great lateral steel buttress, resulted in a cantilevered roof over the entire span of the aircraft, 120 feet deep at the center front. Steel cables braced the empennage trusses.

When all the front doors were open and the front panels removed, the 342-foot front of the hangar facing the harbor was unencumbered, and the aircraft could easily be launched.

In 1951, when the contained air-conditioning units were added to the hangar, the building was sealed for this purpose and the interior lost much of its natural light. Therefore, to restore some of this light for safety and economy, windows were installed of 1/4 inch fire-resistent wired glass. The windows over the 75-foot door were of transparent glass for observation purposes; the rest were of skylight translucent glass. Those windows through which sunlight fell on the aircraft were equipped with adjustable curtains.

Additional building and/or structural features relating to the hangar include the wood shop, the main dry dock, the pontoon dry docks, the main dock gate, and the pontoon dock gates.

WOOD SHOP

Building #2

Print #'s 25-27

Photo #'s 187-188

In late 1950, the storage area on the starboard side of the hangar aft of the outboard wing was enlarged to house the woodworking shop. It was constructed in two levels with woodworking power tools on the 58 x 14 foot lower level, and Duramold hot-room storage and glue-and-clamp-room on the 48 x 10 foot upper level. A ceiling-hung air conditioner and ducts kept the Duramold room at the desired temperature and humidity.

MAIN DRY DOCK, PONTOON DRY DOCKS, MAIN DOCK GATE, PONTOON DOCK GATES

Building #'s 25, (25,26), 22, 23

Print #'s 47-60

Photo #'s 137,138,140-143,148-163

The first modification made to the Terminal Island site in 1947 was the construction of the dry docks (graving docks) to house the H-4 aircraft when it arrived from Culver City. The site was graded, steel sheet-pilings were driven below the entrance to the docks, the docks' foundations, floors and walls were poured, and the ground around them paved with asphalt.

The docks were three steel-reinforced concrete pits, the main one for the aircraft hull and docking cradle, and two smaller ones for the wing pontoons. Gates were installed on the front of each dock, which

opened into the harbor in order to launch the aircraft. For launching, external pumps first filled the pontoon docks with sea water, then filled the main dock, and when the aircraft was afloat, (and the fixed aligning and tie-down systems released), the dock gates were opened, (outward and downward) and the aircraft was towed out into the harbor.

The main dock was 39 x 240 x 20 feet deep. Its steel reinforced concrete floor was 5 feet thick, and the walls were 12 inches thick at the top increasing to 20 inches at the bottom. The pontoon docks were 16 x 60 x 12 feet deep, with floors 2 feet thick and walls a constant 12 inches thick.

The main dock gate (39 x 22 feet high) and the pontoon dock gates (16 x 12 feet high) were made of steel-beam frames covered pressure-creosoted Douglas fir. The frame was inboard, covered with 6 x 10 inch planking set vertically, a layer of 30-pound felt, and next to the water, 1 x 6 inch tongue-and-groove siding, set horizontally. Steel hinge points along the bottom of the gates (five on the main gate, two each on the pontoon gates) connected to corresponding positions on the dock floors. Cables on each side of each gate, fixed to the jetty, stopped the gates at full-open position. The gates were started open with crane or boat; they continued opening by gravity. The main gate could be closed with an electric motor winch, or, as with the pontoon dock gates, with crane or sea mule.

Gasoline-powered pumps on the jetties (two for the main dock, one each for the pontoon docks) filled and emptied the docks with sea water through inlet pipes prior to launching. In the main gate there was also a manually-operated gate valve, controlled from on top, which

permitted the dock to be filled by gravity.

As continuing subsidence caused the site to sink, there were two specific problems concerning the docks and gates: the threat of flooding of sea water over the dock gates, and the weakening of the gates as water pressure on them increased. The first counteraction was in 1951 when the main gate hinge-line was raised 4 feet 8 inches by raising the dock floor along the front. A concrete sill with reinforcing concrete buttresses was poured to form the new hinge line. Next the gate was strengthened and sealed against increasing leaking by the addition of steel plate to the inboard face.

In 1953, the walls of all three dry docks were increased in height by six feet and substantially strengthened. New floors were poured in the pontoon docks, 6 feet above the old ones, and in the main dock, the aircraft and docking cradle were jacked and shimmed up 6 feet and six concrete pedestels were poured underneath them. At the same time, new gates were installed on all three docks, which were later extended higher at the top and strengthened with steel-beam trusses. The height extension on the main gate was hinged so that the 75-foot door could swing open.

Architectural Integrity

The architectural integrity of the hangar was, during the initial field investigation, excellent. The building was in good condition. The launching ramps have however, been severely impaired by subsidence, and it is doubtful that the building is functional in relation to the launching and docking procedure. In addition, the temperature and humidity control systems have been removed.

WATER TOWER AND CONTROL ROOM

Building #10

Print #'s 35, 36

Photo #'s 178,214.237,238

Architectural Description

Exterior

The structure consists of a circular tank with a radio and flight control room above. The tower is of steel construction. The control room is built on an octagonal wooden platform which is mounted on steel beams above the upper and open end of the tank. Above the platform there is an octagonal, one-room enclosure consisting of wood construction with plate glass windows. Access to the control room is provided by a metal ladder with a circular cage and a stairway/scaffold. Architectural details include flat window and door openings, and a searchlight mounted on the roof of the control room.

Interior

The interior of the control room consists of wood flooring, waist level shelving and storage cabinets, and various pieces of radio equipment. The radio equipment is original, and appears unaltered.

Technical

In April 1946, as the dry docks and engineering building were being constructed, concentric circles of Douglas fir pilings were being driven to make the foundation for the water tower, which was to provide an emergency source of water for fire control. Forty nine

of the creosoted piles, one foot in diameter and 40 feet long, were covered with two feet of steel-reinforced concrete to form a 29-foot diameter pad upon which the 155,000 gallon standpipe tower was bolted. The open-topped tower was 23 feet in diameter and 51 feet tall, made of 1/4 inch steel plate in its lower 12 feet and 3/16 inch plate for the upper 39 feet. It was kept filled by water from the Long Beach City water system.

An outlet pipe on the east side of the tower permits this water, through a series of valves, to connect to the fire control water system. An access hole on the north side permits entry into the tower for repairs. An overflow nozzle is located 12 inches below the rim of the tank.

In early 1947, an aircraft control room was added to the top of the tower. Four steel I-beams were welded to the vertical sides of the water tower to form columns. Four more I-beams were welded to the top of these columns making a platform on top of the tower on which the octagonal control room was constructed. The maximum diameter of the observation platform was 23 feet (the same as the water tower) and of the room, 16 feet. Eight steel T-beams were welded to the base frame and sloped up and out at each corner at 15° from vertical to form the frame of the room. The platform had wood decking and was surrounded by a 4-1/2 foot wood railing. The lower part of the room exterior was covered with painted redwood siding; the upper part consisted of seven panes of 1/4 inch plate glass, pitched in at the same angle as the steel beams and set in wood sash. In the eighth bay, facing north, was a wood door with a glass window.

It was not possible to carry supplies to the control room by means of the water tower ladder so in late 1947, a metal scaffolding was permanently attached to the tower near the ladder, and wooden steps installed. Another metal ladder was attached to the exterior wall of the control room, to give access to the flat roof.

An aircraft clearance light was mounted 3 feet above the center of the roof. A yard light extended horizontally from the roof and illuminated the steps, and a search light was mounted at roof's edge on the south side.

Architectural Integrity

The control room is an addition to the original tank. When the control room was added the original metal ladder was supplemented by a stairway scaffold. The tower and control room have since been unaltered with the exception of the boarding up of one of the plate glass windows.

ENGINEERING BUILDING

Building #'s 3, 34, 35, 36

Print #'s 28-31

Photo #'s 192,193,223,188,263-272

Architectural Description

Exterior

The engineering building consists of a one story stucco and wood frame structure. It is built in a rectangular plan and is designed in a utilitarian/industrial manner. Major architectural features include

an arched composite roof, a centrally located sliding door on the south facade, a concrete foundation, offset entrances on the east and west facades, and a major addition to the east. Architectural details include flat window and door openings, small pane sash windows, sliding windows, industrial exterior lighting, and a stairway/scaffold providing roof access.

Interior

The interior of the structure consists of a one-room enclosure partitioned by beaverboard and wood frame room and loft areas. The interior is currently used as a storage area for H.F.B. spare parts, plans, and patterns. Toilet facilities and a machinery area are contained within the enclosure.

Technical

In April 1946, at the same time that excavations were begun for the concrete dry docks, foundations were poured for the engineering building. As it was the only building on the site for many months, and therefore housed engineers, engine and system mechanics and woodworkers, it was also referred to as the shop building and the wood shop.

The building was constructed on a 50-foot by 100-foot concrete foundation and slab floor. The walls were of wood-frame construction and the roof was supported on a 50-foot wood arch-rib truss. Wood flooring was laid over felt on the slab, and wood frame partitions divided the work areas. The exterior was plastered and the roof was sealed with tar and asphalt felt. When it was the only building on the site, the engineering building housed power machinery for the wood

workers, shop equipment, glue room, offices and radio transmitter.

Lavatory facilities in the SW corner of the building included a toilet for women's use. There were many alterations and most of the toilets were removed.

A wooden stairway near the SW corner of the building leads up to a mezzanine area approximately 11 feet wide that runs along the entire west side of the building, partially utilizing the under-roof area. Between 1948 and 1952, this was used as a sewing room for making fabric covers for wing pads (so personnel would walk inside the wings) and access hole pads for the aircraft.

In 1948, a 9 x 20 foot wood-frame room (36) was added at the south end of the building with a shed roof 9 feet high. It was first used for Duramold storage, and by 1958 had been modified to house a dark room and X-ray room. It was removed in 1975.

In 1948 a series of wooden catwalks and platforms were added to the roof, with access by wooden ladders at the south end. Samples of wood used in the H-4 with various finishes were tested for exposure durability on these platforms, and temperature-and-humidity sensing equipment was installed in a small cabinet on the roof, to measure ambient temperature and humidity in relation to hangar air conditioning.

By 1958, with other shop buildings available, the building was furnished with engineers' drafting boards, desks and office equipment.

In 1949, a 5 x 10 foot shed was added along the east wall at the south end of the building which houses a 50 kW DC motor-generator (34). This supplied electrical power to the aircraft for control surface and systems testing through 1976.

Architectural Integrity

The building has served a variety of functions and it has been altered accordingly. The major alterations have however, taken place on the interior of the structure including, the building of additional loft space, storage areas, toilet facilities, and the change of use from a wood shop to an engineering building. The exterior of the structure has been altered by the addition of a shed and an associated but structurally separate administration building.

POWER HOUSE COMPLEX

Building #'s 7, 8, 41, 44, 45, 48 49

Print #'s 37, 38, 61 62

Photo #'s 230,242-244,250,251,254-257,293-307

Architectural Description

The power house building complex incorporates a number of associated structures including a power plant, lavatory facilities, maintenance area, storage, transformers, offices, welding shed, kitchen, and employees lunch room. The complex consists of adjoining one-story structures built in an irregular building plan. All building components are designed in a utilitarian/industrial manner. Major architectural festures include both pitched and shed roofs, steel frame and pipe construction, corrugated aluminum siding, and concrete foundations. Architectural details include industrial lighting, sliding and hinged doors, flat window and door openings, skylights, and industrial ventilators.

Interior

The interior of the complex consists of concrete flooring, exposed structural elements, industrial lighting, and metal and wood partitions. Each facility can be isolated by a system of doors. All facilities are however, structurally or functionally interrelated.

Technical (Numbers refer to appropriate building #)

POWER HOUSE (7). Built in early 1951 to house the boilers and refrigeration units for the hangar air conditioning, this 30 x 100 foot structure was built on a concrete slab and covered with corrugated siding and roofing. See 44, 45 and 48 below.

LAVATORY FACILITIES (8). In early 1951, this 18 x 29 foot structure was built on a concrete floor and the pipe frame covered with corrugated aluminum siding and roofing. The interior was divided into an office and a restroom which had five toilets, two urinals, five lavatories, and one shower.

MAINTENANCE STORAGE AND OFFICE (44). This 29 x 40 foot shed roof building was added to the Power House complex in mid-1951 to serve as a machine shop. The pipe frame structure was built on a concrete floor and covered with corrugated aluminum siding and roofing.

WELDING SHED AND KITCHEN (45). Another addition to the Power House complex in mid-1951 was this 29 x 50 foot shed roof structure. It was built on a concrete floor and covered with corrugated aluminum siding and roofing. The area was divided by wood frame walls into a partially open welding shop, a plumbing shop, and a kitchen.

EMPLOYEES LUNCH ROOM (48). In early 1954 a 181 x 50 foot lunch room was added to building 47, continuing the same shed roof line.

The pipe frame structure was built on a concrete floor and covered with corrugated aluminum siding and roofing.

SERVICE BUILDING (49). This building (often called material building, purchasing or shipping) was moved to the Terminal Island site from Culver City in 1953. It was a steel frame structure with corrugated iron roof and walls, on a concrete slab floor. Once the building was installed, four skylights were put in the roof, each made of two sheets of green Coralux. At the same time, the area between this building and the adjacent welding shed was roofed over.

Two offices were formed at the north end of the building with 8 foot wood partitions and ceilings covered with fiberboard. As the north office was used for interviewing prospective employees and vendors, an outside door (in the west wall) and windows were added.

Architectural Integrity

The complex originally consisted of a power house building. Additions and alterations to the original comprise the present group of associated buildings. The integrity of the buildings is however, excellent as all of the structures are built in a compatible manner. Recent alterations consist of the removal of the power equipment following the termination of temperature and humidity control within the hangar.

HYDRAULIC BUILDING

Building #5

Print #'s 33, 34

Photo #'s 179,180,184-185,212-213,219,273-287

Architectural Description

Exterior

The hydraulic and engine service and test building is a one story L-shaped structure. It is designed in a utilitarian/industrial manner. Major architectural features include a low-pitched roof over the central building, a shed roof over an addition, sliding and hinged doors, wood and aluminum siding, and a concrete foundation. Architectural details include flat window and door openings, and industrial lighting.

The original structure is built of a steel frame with aluminum siding. The addition is built of steel pipe with wood siding.

Interior

The interior of the structure consists of concrete flooring, exposed of concrete flooring, exposed structural systems, and wood frame office and storage area partitions. The central feature of the building is the Franl Stranl, a hydraulic test station.

Technical

In early 1950, a Stran steel frame building on concrete foundation with corrugated iron siding and roofing.

systems. As the need for this space increased, the building was modified. In 1952, it was increased in length from 50 to 100 feet. In 1953, a 24 x 65 foot shed-roof addition was made.

In 1950, the Franl Stranl, a working mock-up of the aircraft hydraulic systems, was brought from Culver City and installed in the hydraulic building.

Architectural Integrity

The hydraulic building has been altered by one major addition. The addition is, however, designed in a visually compatible manner. The hydraulic equipment adds greatly to the sense of time and place of this facility.

ADMINISTRATION BUILDING

Building #4

Print #32

Photo #'s 240,288-293

Architectural/Technical Description

This building consist of a one story wood structure built in a rectangular plan. It is designed in a predominantly utilitarian manner. Major architectural features include a pitched roof, and wood siding. Architectural details include two entrances, a 3/4 porch and flat window and door openings. The building has few decorative features. However, there is scalloped siding in the gable area on the east elevation. The building is adjacent to the engineering building but is a structurally distinct feature.

The interior of the building consists of three rooms. Some of the laminated furniture remains.

The building is a 17 x 47 foot structure with wood siding and a composition roof. It is constructed on concrete piers, and occupies an area of 813 sq.ft.

The building appears to have been unaltered, and has thereby retained its design integrity.

RECEPTION BUILDING

Building #'s 10, 47, 50

Print #'s 39, 43, 44, 63

Photo #'s 241,308-312

Architectural/Technical Description

The reception building consists of three associated buildings, plant security, a guard house, and a first aid office. The buildings are associated but structually distinct features. Major architectural features include both pitched and shed roof construction, concrete foundations, wood flooring, flat window and door openings, composition roofing, and wood siding.

The security office and first aid building is 12.5 x 20 feet. The former guard house (building #10) is 20 x 20 feet. The combined area of these buildings is 470 sq.ft.

The guard house (#50) is 6 x 9 foot structure built on a concrete slab with wood siding and a composition shed roof.

The buildings are in good comdition and are built and designed in a compatible manner. They appear, with the exception of minor

interior modifications to have been virtually unaltered. The first aid office is of particular interest as it contains some of the original medical equipment.

PAINT SHOP AND PAINT STORAGE

Building #'s 14, 13

Print 45

Photo #'s 182,219,236

Architectural/Technical Description

The paint shop is a one story structure built in a rectangular plan. It is designed in a utilitarian/industrial manner. Major architectural features include a shed roof, porch, and aluminum siding. Architectural details include flat window and door openings, industrial lighting, and an offset entrance. The structure is built of welded pipe frame with a concrete floor. It is 15 x 22.5 feet and occupies an area of 337.5 sq.ft.

The paint storage shed is a one story structure built in a virtually square plan. Architectural features include a shed roof, aluminum siding and concrete flooring. Architectural details include flat window and door openings, and industrial lighting. The structure is built of steel frame construction. It is 11.5 x 13 feet and occupies an area of 149.5 sq.ft.

Both of the structures are associated functionally and architecturally. They appear to have been virtually unaltered, with the exception of minor interior modifications.

HOSE CART HOUSE

Building #18

Print #46

Photo #'s 196,215-216

Architectural/Technical Description

This consists of a small one room structure built of wood framing, plywood sides and a composition roof. It is designed in a utilitarian manner, and is built in a rectangular plan. Architectural features include a shed roof, and double, modified two-frame doors. The building is 10 x 6.5 feet, and it occupies an area of 65 sq.ft.

GASOLINE STORAGE

Building #12

Photo #'s 181,183

The structure consists of an open rack with a pitched roof. It is built in a rectangular plan and is designed in a utilitarian/ industrial manner. Architectural features include open frame construction with steel bolts and mesh, and a composition roof. The structure was from salvage material and appears unaltered.

Note: The photographs cited are representative examples only. For additional information please refer to the index of photographs and to the photo survey map.* * * * * *

DOORS

Building #1

Print #'s 64-72

Photo #'s 4,5,31,34-37,39-43,74-75

The main door in the center front was 30 feet wide and 75 feet high. It weighed 10,000 pounds and was raised as a unit, permitting the vertical tail to pass through. The door was moved up and into the building with rollers at each upper corner, and at the middle point at each side. The top rollers ran in a track that went into the building, the track being secured to the lower chord at the roof trusses. The rollers at the middle of the side panels ran up a track attached to knee-braces sloping back 45° to the ceiling line of the building. The door was raised by roller chain, driven by sprockets and powered by a 2 HP electric motor. A counterweight in the hangar roof structure was attached to the door by a cable system to facilitate raising. The door took about 30 minutes to be raised, and could be stopped at any position to avoid exposure of the aircraft to the sun.

On each side of the 75-foot door were three composite door panels. They were each 40 feet high. The ones next to the 75-foot door were 10 feet wide; the ones at right angles to the 75-foot door were 34 feet wide; and the outboard doors were 46 feet wide. The panels were raised along vertical stainless steel cables until, when fully open, they rested outside the upper wall panels. The cable reels were operated by 5 HP, 2-speed electric motors, and the doors could be stopped in any position. It took about 20 minutes to raise the six panels.

The lower half of the panels enclosing the nacelles and pontoon dry dock (three on each side of the hangar) were constructed with attachment fittings and were lifted off by crane when it was necessary.

Due to structural interdependencies at the front of the hangar, the front doors had to be operated in a certain sequence. The 75-foot door was raised first. Then the composite panels were raised, because one pair of their door guide tracks was attached to the nacelle panels. The other pair of guide tracks were next removed by crane. Lastly the nacelle panels were removed.

The doors enclosing the wing tips consisted of four panels (12 feet wide and 31 feet high) on each side of the hangar. They were mounted with rollers at top and bottom and rolled horizontally in curved tracks inside the hangar so that, when fully open, the outboard panel was behind the wing and the inboard panel was along the hangar sidewall. They were manually operated.

During engine run-up it was necessary to open the hangar aft of the engines. For this purpose there were horizontally sliding doors, aft of the outboard engines, on each side of the hangar. They consisted of three panels, each 10 feet wide and 34 feet high. Rollers at the top and bottom of each door rolled in track so that, when fully open, the three doors were stacked outside fixed hangar wall panels. They were operated manually and moved outboard.

There were two drive-through doors, one on each side of the hangar aft of the wings. They were 20 feet wide and 22 feet high and rolled horizontally on track in the floor and on the outside hangar wall.

For engine run-up, there were aft horizontally-rolling doors on each side. Each consisted of five panels 11 feet wide and 28 feet high that were manually rolled around to the side of the aft hangar on curved

tracks inside the hangar.

For engine run-up, or low-level access to the empennage, there was a 41 foot wide by 10 feet high door that was raised manually along vertical track by means of cables attached to a counterweight. To work on the whole empennage, it was necessary to remove this door as well as the three narrow upper empennage panels, using a crane.

FIRE CONTROL

Print #'s 85-88

Water for fire control from the Long Beach City system enters the site at 80 psi through meters and an eight-inch main outside the north fence. These lines lead to four O.C.D. Passive Defense booster pumps powered by gasoline engines, two on each side of the back of the hangar, designated numbers 1, 2, (starboard) 3, and 4 (port). There are Kennedy hydrants adjacent to each pump as well as one in front of the hangar at the head of each jetty, and inside the hangar by the port and starboard hangar nacelle panels. City fire equipment can hook up to each of these eight hydrants. There is hose storage near each pump and hydrant; for pumps 2 and 3 and for the jetty hydrants, the hoses are stored inside the hangar. In addition, there are two fire hose sheds (18) with hoses stored on carts, one outside of the starboard wing tip hangar and one on the port side near pump 3. Water from the water tower (6) can be fed into the existing lines through valves at the east side of the tower. A Long Beach City fire hydrant is located outside the gate near the present guard house (50).

There are portable fire extinguishers in the aircraft, in the hangar, and throughout the site. Under each engine nacelle is a cart with portable equipment especially designed for control of engine fires.

There are eleven manual fire alarm pull boxes located throughout the site, which transmitted coded signals to a central audio alarm and a visual alarm at the main gate. There are five aircraft, two more inside the hangar, and one on the port wing tip hangar exterior wall. The other three are near the power house, the engineering building, and the front starboard fence.

In the event of fire, it might be necessary to turn off electricity and gas. Main switches for eelctric service are by the door in the east side of the service building (49) and in the SE corner of the engineering building (3). Gas was used to fire the boilers in the power house and a small heating furnace in the maintenance shop (44). The main gas shut-off valve is on the north side of the power house, at the east end.

AIR CONDITIONING

Print #'s 98, 99

The first attempts to heat the aircraft were in the winter of 1946-47. Kerosene heaters were placed at a distance from the aircraft to minimize fire hazard and plywood ducting carried the heat into the interior. In 1949, a 30 HP boiler stationed aft of the empennage provided steam heat through ducts to the aircraft interior.

In 1950, the hangar was completed and partially weather-sealed and it was feasible to install air conditioning equipment to protect the

aircraft. A 27 x 27 x 12 feet deep pit for air conditioning equipment was constructed of steel-reinforced concrete pit aft of the port inboard wind. The below-ground installation prevented obstruction to the cable on the tractors that were used during aircraft launching. A 50-ton air conditioning unit in the pit delivered air to the interior of the aircraft and to the dry dock, with the controls in the aircraft. Later a 25-ton portable unit was added for the aircraft interior and the 50-ton unit was returned to dry dock use. There were portable heating and humidity units around each wing and rudder area and over the nose, and heaters in the pontoon docks. The system was inadequate to maintain the whole aircraft at the desired temperature and humidity, as it was too small for the size of the craft and it provided no refrigeration.

Specifications were drawn up for a comprehensive hangar air conditioning system that would maintain the hangar at 75°F, 58% RH if conditions did not exceed 83°F, 60% RH in summer or go below 43°F, 36% RH in winter. In anticipation of the new system, a request was made to the Edison Company in June 1950 for increased electrical service and plans were made to construct a power house (7) to house the steam boilers and refrigeration units with attendent equipment. The power house was completed in January 1951 and the air conditioning system operated from mid-1951 until it was turned off in 1977.

During the flood in 1953, the air conditioning pit was filled with mud and it was not used again. It was filled with decomposed granite and roofed over with a concrete slab in 1954.

IN THE HANGAR. Two Carrier air conditioning units were placed on elevated platforms on each side of the hangar aft of the pontoon dry docks. Each unit included blowers, coils for chilled water and for steam, and mixing dampers. Distribution ducts were specifically designed to prevent air from blowing directly on the aircraft. Two more Carrier air conditioning units were installed on the port side of the empennage. The Duramold storage room in the woodworking shop (2) also had a heater-humidity control unit.

IN THE POWER HOUSE. Three 100 HP freon refrigeration compressors were installed in the power house. The condensors were cooled by sea water brought in by pump and intake pipe (9) in the northeast corner of the site through elevated pipes along the north side of the site. [The wooden pipe supports and the piping are still there, used to carry yard drainage water from a sump to the harbor.] Underground pipes carried the chilled water from the refrigeration units to the coils in each hangar air conditioning unit, and returned the water for recycling. Two gas-fired boilers (400 HP and 250 HP) were also installed in the power house. A water-softener unit (41) outside the west end of the power house softened the incoming Long Beach water for the boilers.

LAUNCHING AND DOCKING

Print #'s 93-97

The launching and docking procedure was a complex operation involving a number of systems including the dock gates, doors, heel, cradle, and tilt control, and electrical and fire control.

The procedure began with the opening of the hangar doors. The emergency heel control lines were then removed, and the cradle set at an angle which the Hughes Flying Boat would trim when floated. The cable and hoist systems were then checked and the dry docks flooded. These operations were coordinated by telephone.

Once the H.F.B. was floated it was controlled by the previously activated cable systems and the hoist operator. Tractor lines maintained control of the aircraft until it was clear of the jetties. The aircraft was then towed to its mooring.

The docking procedure consisted of a series of operations, in reverse, similar to the launching operation.

HEEL, CRADLE, AND TILT CONTROL

Print #'s 73-80

Photo #'s 136,139,144,145

The heel, cradle, and tilt control systems were an integral part of the launching and docking operation. The heel and tilt control systems were designed to prevent damage to the aircraft during both the launching and docking procedure, and during the event of an uncontrolled flooding of the hangar. The cradle system was designed to aid in launching and to serve as a suitable structural frame on which the aircraft would rest while inactive. The present cradle consists of a modification to the original. It is operated hydraulically.

ELECTRICAL SYSTEM

Print #'s 89-92

Electrical power was provided by the Southern California Edison Company through a 1500 KVA transformer (42) in the NW corner of the site. Adjacent to the Edison Company transformer is a Hughes Corporation 1000 KVA transformer. Another Hughes Corporation transformer (500 KVA) is located at the SW corner of the engineering building.

Electrical power was distributed to the power house equipment (including salt water pumps) and to the air conditioning units in the hangar through the 1000 KVA transformer and a switchboard in the SW end of the boiler house. Electrical power to the rest of the site was through the 500 KVA transformer and switchboards in the SE corner of the engineering building.

SEWAGE DISPOSAL/LAVATORY FACILITIES

Print #'s 39, 40, 100, 101

In 1951, toilet facilities for the 350 employees at the site were all in the engineering building. These included a total of twelve toilets, two urinals, and two lavatories. There was no existing sewer system to attach to. A plan for sewage treatment was submitted by Hughes Aircraft company to the Regional Water Pollution Control Board and approved in March 1951. The system consisted of a closed Imhoff septic tank and cesspool (39). The effluent from the septic tank was discharged into the leaching cesspool and from there pumped into the

waters of Long Beach Harbor. Sludge from the treatment tanks was not to be disposed of in the harbor, and there were limitations on the kinds of industrial waste that could be dumped there.

In mid-1951, the lavatory facility (8) adjacent to the maintenance shop was added with five toilets, two urinals, five lavatories, one shower, and two floor drains. A 750-gallon septic tank was installed near there and the waste from the adjacent cesspool was drained into harbor waters along the north fence line. Boiler blowdown water was drained to the harbor in these same pipes and refrigeration unit cooling water was also piped to the harbor.

In 1955, a visitors' toilet with one toilet and one lavatory was added outside the administration manager office (47). The waste was drained to the first septic tank.

By 1971, employee population had dropped to 13, there was still no sewer system, and waste disposal standards had become more stringent. A new waste disposal system was implemented that eliminated all waste disposal to the harbor. The waste pipes from the two septic tanks were sealed off. The old septic tank by the water tower was used as a holding tank for the engineering building facilities which now consisted of only two toilets and two lavatories. This tank was regularly pumped out and the sludge hauled away. It was later replaced by a new holding tank in the same area.

Additional property on a higher level was leased north of the existing property line for the construction of a waste disposal field consisting of four 100-foot leaching lines. Waste from the existing septic tank was pumped to these lines for disposal by pumps in the east end of the power house (7).

SITE DRAINAGE/WATER SYSTEM

Print #'s 81-84

Before the hangar was sealed for air conditioning (1951) and before subsidence lowered the site substantially, rain water (the only drainage concern) was drained through the hangar into the main dry dock and pumped into the harbor. Gradually the problem became less rainwater and more sea water infiltration and drainage from neighboring land-fill projects. Where feasible, changes were made to the yard contours and to the hangar slab, and a system was evolved of drainage culverts, pipes, sumps and pumps.

There are sump pumps near the NE corner of the hydraulic building (5), the NE corner of the engineering building (3), in the hangar just inside the starboard aft wing sliding door, in the south wall of the maintenance shop (44), and by the fence outside the port drive-through door. Catch basins in the sumps permit heavy particles to settle out before the drainage water is pumped to the harbor. One drainage outlet is along the north fence, using the pipes that used to carry the salt water for refrigeration unit cooling in the power house. The sump pumps are automatically controlled by sump water-level, and are equipped with counters to record how often they are actuated.

Long Beach City water for use other than fire control enters the site by a three-inch line through meters outside the north fence at approximately 80 psi.

SEA WATER PUMPING/INTAKE PIPE

Print #'s 41, 42

This system was an integral part of the cooling of the power house equipment. The system is built on elevated pylons, and is built in a strictly industrial manner. This system was chosen for obvious reasons including a cheap and readily available supply of coolant.

* * * * * *

SUMMARY

In summary, it is clear that the Howard Hughes H-4 Aircraft Hangar Facility represents a unique architectural and engineering solution to a difficult set of problems. The buildings and systems are of necessity, functionally interrelated. The building complex has therefore, a unique sense of purpose and a given sense of time and place that greatly contribute to its significance.

Chapter IV

SUMMATION OF HISTORICAL/ARCHITECTURAL SIGNIFICANCE

This report has been written to fulfill the requirement that the Port of Long Beach comply with Executive Order 11593, to wit; when a historic structure is scheduled for demolition and it is of such historical significance, it must be preserved in record. These records include measured drawings, photographs, and written data. The purpose of this chapter is to clearly identify the historical and architectural significance of the H-4 Flying Boat Hangar and associated structures that define them as historic resources. Specific criteria will be inserted here since they apply directly to the project at hand.

1. Qualities that are associated with events that have made a significant contribution to the broad patterns of our history.

2. Qualities that are associated with the lives of persons significant in our past.

3. Qualities that embody a distinctive method of construction.

Historical

The historical significance of the H-4 Flying Boat Hangar Site will always be associated with Howard Hughes and with the Flying Boat. However and whatever significance it may warrant on its own, we must return to that prime association. In the documentation surrounding the hangar site and in the interviews made to supplement that documentation, it was difficult, if not impossible, to separate the Hangar from those associations. The Hangar is unique, and the site has experienced a short but unique history. Yet,

no historical society, no public agency, no group brought together to save the Flying Boat from destruction has to our knowledge made any effort to nominate the Hangar as a historical site or to place it on a local, state, or national register of historic places. The only written evidence of it being on an inventory of historical places is that in the Cultural Resource Survey made for the U.S. Army Corps of Engineers in 1978.[1] The subject resource is historically speaking rather new, only 35 years old, and this accounts appreciably for the lack of attention. The documentary search undertaken for this report, however, revealed several points on which the Hangar site takes on an historic significance of its own. These are of both a national and local nature.

Briefly, from a national point of reference, the Long Beach plant and the Hangar has had to accommodate an extremely large aircraft. It may well be argued that the H-4 is the world's largest plane. Howard Hughes said in an interview with newsmen in 1971, "There's a lot that still could be learned from that airplane . . . There are problems which are related to aircraft size, and which vary with size, which can be explored with this blying boat."[2] Hughes was talking about the plane; however, the same concepts can easily be transferred to the problems of designing a hangar for a large wooden plane. The H-4 moisture systems, air conditioning systems, and door openings may well serve as the historic beginnings for hangars of the future to borrow from. Mr. Hughes knew he had a unique facility, and this was demonstrated when he considered using the hangar design for his Lockheed Jet Stars. Hughes was often Lockheed's only

[1] Interview, Ed Jones, Committee to Save the Flying Boat, September 12, 1980. L. Weinman, Los Angeles-Long Beach Harbor Areas Cultural Resource Survey.

[2] "Report with Newsmen, December 7, 1971 (A voice identified as Hughes conversed with newsmen that day.) Sederberg Files, Carl Byoir Associates.

customer on these planes. When Lockheed appeared ready to close down the Jet Star line for lack of orders, Hughes would order one to keep the tooling active. Hughes built hangars for these planes throughout the country. And he sent John Seymour, his Director of Flying, to make a close examination of the H-4 Hangar and to make a report on it.[3] Seymour, who had been in aviation and flying all of his life, found it an amazing and vital structure. Interestingly, he was one of the few Culver City Hughes Aircraft Company employees who ever entered the hangar.

The flight of the H-4 November 2, 1947, will go down as a historical event in aviation history. The events associated with this day are well documented photographically. The launching procedure for the huge boat was put to a test, and all of the activities at the site that day will excite historians a century hence. Howard Hughes will grow as a historic figure. All things associated with him will grow in importance and especially those associated with his commitment to aviation. His genuine interest in the hangar site apparently to the end of his life is known. The decisions on changes and installations at the site are not well documented since he did not draw up correspondence. However, as the text in Chapter II has demonstrated, he held a personal interest in the Long Beach plant, and in the years that he visited it regularly his managers there waited for his judgement on even the smallest matters.

Harold Tegart, the Facility Engineer who designed the hangar, gave a paper on the H-4 hangar doors to the American Society of Civil Engineers at Honolulu in the early 1960s. It was well received, and Tegart is now gathering materials from which to write an article for the Society's journal. This should stimulate interest nationally, and response to his

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[3]Interview, Seymour, August 25, 1980.

article may help us know just how unique these doors are to hangar construction.

The hangar site is locally significant. It is part of Long Beach Harbor history. In 1930, the Richfield inner harbor marine terminal was equipped to handle 500,000 barrels of oil and gasoline a month. ARCO, Richfield's successor, has lent to the pressure to move out the Flying Boat and indeed will replace Hughes as the lessee of Berths 120-121. ARCO will be able to handle 40,000 to 50,000 barrels per hour in the new terminal at berth 120. The unique hangar, so long a landmark on the channel will go, a sacrifice to historic progression. Local historians will read the old newspapers and see lines such as, "The Flying Lumberyard which has been resting in a Summa-owned storage shed in Long Beach for 30 years . . ." or "Lodged in an atmosphere-controlled, form-fitted complex of corrugated steel structures, the Spruce Goose exists today almost ghost-like in carefully guarded seclusion."[4] Questions will be asked about the hangar. Historians too will write of the controversial lease, of the suit Hughes Aircraft Company at one time filed against the City in regard to the site. Finally, as a part of labor history at the harbor the Long Beach plant will deserve a chapter. Tight security made the plant unique, its size also was a factor that drew its employees together. Several of the men who worked there are determined to write about their years at the site. Hughes respected engineer types and listened to them. Conversely, Mr. Bromley spoke for more than himself when he observed, "Everything Hughes did had great purpose. His dealings man to man were always extremely fine, extremely fair."[5] In returning

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[4]Herald Examiner, June 6, 1976, and Newsweek, May 1, 1972.

[5]Interview, September 12, 1980, and Arelo Sederberg, January 31, 1977.

to this ever present factor of association with Howard Hughes it is only to underline the unique working style that pervaded the plant because it was so close to its owner. From the onset the decisions that governed plant life were unique. For example, as Bob Ford pointed out, they built the hanger over the plane.

Architectural/Systems

The architectural significance of the H-4-Hughes Aircraft Hangar Facility lies primarily in the fact that it represents a unique engineering and design solution to a given problem. Quite simply, the hangar was built to accommodate the largest aircraft in the world. The most significant features are summarized as follows:

1. The hangar doors are unique in both their vertical height at the center of the facade, and their horizontal length. The entire front of the hangar was, in fact, designed so that it could be opened entirely during the launching and docking of the aircraft. In order to accomplish this the building was constructed using a cantilever system.

2. The cantilever construction of the hanger is of particular interest. It is visible only from the interior of the hangar. This form of construction was utilized in relation to the specific needs presented during the launching and docking of the aircraft.

3. The entire building complex and its associated systems, such as temperature, moisture and fire control, are of interest in that their specific purpose for existence was solely to operate and/or maintain the Hughes Flying Boat. As such, they represent a unique industrial complex with a profound sense of time, purpose, and place.

4. The architectural evolution of the building complex is of considerable significance. The hangar was, for example, originally a canvas enclosure. Additions and alterations to this temporary facility constitute the present permanent structure. The fact that the hangar was literally built around the aircraft is clearly reflected in its cruciform plan with low spreading wings.

Chapter V

FIELD AND ARCHIVAL METHODS

Historical

In the collection and interpretation of relevant historical data classic methods of scholarly research were followed. For an initial overview of the hangar history printed sources were consulted. These, however, dealt almost exclusively with Howard Hughes and the Flying Boat devoting but a few lines to the site itself. Through persons knowledgeable of the Hughes Aircraft Company and the location of the Company records several possible archives were considered. Ultimately, the files of the Summa Corp., Long Beach Plant, were those upon which we depended from the Hughes Company point of reference. The other major source became the papers, drawings and photographs kept at the Port of Long Beach. The Bibliography displays the various archives consulted. A general outline of the H-4 Aircraft Hangar history was established, the data organized by subject and chronically, and a time frame for compliance with the Letter of Contract was made. Once the gaps in the literature became apparent and useful questions could be formulated, oral interviews were scheduled and carried out. Almost half of the time allotted for the contract was devoted to writing and the compilation of critical documents.

Architectural

All information was gathered and utilized in a systematic manner which included a records search, field study, and the preparation of documentary information. The records search consisted of the gathering

of documentary information relating to the form and function of the H-4 Flying Boat Hangar and Building Complex. The field study consisted of the on-site analysis of structures, the photo documentation of the site, and an analysis of building and equipment systems. The preparation of documents consisted of the writing of a technical report, an architectural and technical analysis of the site, preparation of axonometric drawings, the assemblage of photograph and blueprint volumes, and the gathering of critical documents.

Records Search

The analysis of documentary information involved the use of material obtained in the files of Mr. George Bromley, Plant Manager, Summa Corp., Hughes Helicopters at Terminal Island. The material can be divided into two broad categories, manuscripts and blueprints, both of which were extensively utilized in the architectural and technical analysis of buildings and systems. In particular, the blueprints provided specific data relating to the form and function of the building complex. During the research process the most relevant blueprints were selected for duplication. These drawings appear in Volume IV of this report.

Field Study

The field study was initiated following a preliminary analysis of available documentary information. It was, for example, clear that a complete set of working drawings for the entire building complex was unavailable, and axonometric drawings were prepared to supplement the

existing information. A systematic photo survey was also initiated to completely record the interior and exterior features of the entire building complex. This survey involved photography from fixed and surveyed points. Please refer to the index of photographs for additional information relating to the methodology of the photo survey. The field study also included the on-site analysis and description of buildings and building features. (FIGURE 11)

Preparation of Documents

This phase of investigation principally involved the assemblage of previously gathered information into written form, and the preparation of blueprint and photo volumes. This information was prepared with the understanding that it would be reviewed by representatives of the Port of Long Beach and the State Office of Historic Preservation. This information was also reviewed by members of Hughes Aircraft Company staff in draft form.

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All information is presented in compliance with Executive Order #11593. The above methodology was prepared following conversations with members of State Office of Historic Preservation.

Chapter VI

DATA LIMITATION

Historical

The H-4 Flying Boat Hangar is extremely well documented. In the course of this study it is believed that the records most important to its history were made available to the researchers collecting historical data. This was not an exhaustive historical work, and the records of the Hughes Aircraft Company and those of the Port of Long Beach made it possible for us to comply with the scope of work outlined in LOC HD 1-008.

At the outset it appeared that Summa and Hughes Aircraft Company files should be gone through not only at the Long Beach plant but also at Culver City, Las Vegas, and at Bekin's Storage in Hollywood. The latter sources in the end proved to be either inaccessible or nonexistent. Our best information on the Culver City files having to do with the hangar site was that only a flight deck mock up of the H-4 plane had been left there. Whatever files Culver City had once had apparently had been moved to Long Beach or to the Summa Corp. archives at the Bekin's warehouse. Fred Lewis, Vice President, Summa Corp., was able to advise us that anything of interest to our study and kept by Summa would be at the Bekin's Storage. Yet, since several law suits are pending with the Internal Revenue Service over taxation, the files there are part and parcel of a lawsuit. To get any part of the files out will be increasingly difficult to do till the lawsuits are over. Other informers told us that the files, if they still exist, deal largely with the flying boat and with publicity matters.

There were observable gaps in our data. The administrative files at Culver City, those dealing with the decisions and the early orders sent down to the Long Beach plant were not at our disposal. For example, Harold Tegart sent weekly Progress Reports to the Culver City plant. He made those available to us for the few weeks when he had kept his own copy. We know in this case what we missed. As Chapter II demonstrates, the general outlines of the hangar site history were made clear in spite of the limitations referred to above.

Architectural

The information contained in this report constitutes a comprehensive recordation of all buildings and building features relating to the H-4 Flying Boat Hangar and Building Complex in compliance with the scope of work outlined in LOC HD 1-008.

The information contained in this report does not, however, constitute an exhaustive evaluation of all building systems or a complete architectural recordation of all structural building features as this would have been impossible due to time limitations. In addition, not all of the architectural drawings known to have been prepared were located during the research phase of investigation. (Refer to the drawing list contained in Volume V for a complete listing of drawings.) Much information is known to have been lost or destroyed during floods of the building complex. However, it is possible that files kept by Summa, at a future date and pending litigation, will fill in these data gaps.

Despite these limitations it is believed that the most significant documents and drawings were located, and that the major architectural and systems features of the Long Beach plant were adequately documented during the survey process.

Chapter VII

RECOMMENDATIONS FOR FURTHER RESEARCH AND MITIGATION OF SITE DEMOLITION

Further Research

Historical and Architectural research does not rest upon static themes. We cannot see ahead. We can only guess as to the areas upon which to place emphasis in regard to the H-4 Hangar Site. The following are probable suggestions on the large scale for further research. All are necessary to complete the story of what we know of the site.

1. Administrative and Personnel history. Should the interest arise for this, the day to day records for some of the activities are still extant. They include for example files on Wage and Salary, Training Classes, Biographical Sketches of Key Personnel, Guard Reports, Visit Clearance Requests, and Diaries from Plant Protection.

2. Aviation History. What was the history of maintenance and service at the site on this important prototype? This would necessitate looking through all of the records available on the shops, labs, testing facilities, and other facilities that lent themselves to maintenance and change of the H-4.

3. Long Beach Plant Labor History. What was the breakdown in personnel and what were their tasks? What is known of their participation in labor organization? Did the tight security and isolation play a role, and to what degree did these factors make the plant unique?

4. The September 18, 1953 Flood. Many questions are still unanswered in respect to the law suit which followed it and the agreements met on the subsequent lease in 1956.

5. How closely was the site associated with the life and goals of the historic Howard Hughes? This question especially must wait for the many documents the Summa Corporation holds to be opened for historical research, perhaps two or three decades. The Summa files at Long Beach hold a few folders entitled "Items to be Discussed with Mr. Hughes."

It is recommended that the findings of this report be shared with the Historic American Engineering Record since our writing documents historic engineering and technological work.

6. A search for the missing blueprint drawings should be initiated in conjunction with the planned exhibition of the aircraft. Like much of the missing historical information, it is possible that these drawings could be located in currently inaccessible Summa archives.

7. All architectural and engineering firms known to have participated in the design and/or construction should be contacted at a future date. Many of these firms may have maintained their own archives and it is a possibility that additional data could be obtained which would be useful in the preparation of exhibits relating to the H-4 aircraft hangar facility.

Mitigation of Site Demolition

As the buildings and structural features are demolished we must also address the question of relevant articles found at the hangar site. These would include "H-4 paraphernalia, furniture, equipment, and building/site-related materials, drawings and company records."[1] In accordance with the understanding reached at a September 4, 1980 meeting between representatives for the Director of Port Planning, City of Long Beach and Wrather repre-

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[1]Letter, Leland Ray Hill to Richard S. Stevens, September 10, 1980. C.D.

sentatives, most articles found at the present hangar site, those listed above, would become part of the museum complex. Those items not placed immediately on display "would be appropriately stored and made available for future archival use by qualified researchers."[2] Wrather's historians may wish to review the few suggestions which follow.

In the work performed for this study certain memorabilia were brought to our attention by both employees at the plant by interviewees, and we recommend that these items be given special consideration for permanent preservation.

Desk and Chair

An observation tower has stood for many years atop the water tank. The desk and chair used in the tower are now in the hydraulics building. The desk has a worn navigational map of the harbor on its top which notes soundings in feet. These could well be used in a museum display.

Hydraulic Test Stand

This stand was erected in the Hydraulic Building. It included hydraulic pumps, motor driven, a pilot seat and control wheel, and airplane systems such as a gust lock and cylinder bypass.

Tie Down Buoys and Associated Equipment

These are along the waterfront and could be slavaged and used at the outside of the new showroom hangar for the H-4.

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[2] Ibid.

Plaques

Several metal plaques reading "Classified Area Company Secret" are posted at the hangar personnel doors. Another is at the end of the wing shed. These are strong reminders of the tight security that enveloped the hangar itself as even plant employees were often prevented from taking a look at the plane. These could be posted advantageously in the H-4 showroom with explanatory notations next to them, highlighting the fact that the secrecy of the hangar is one of its historic qualities.

Rainwear

The employees pointed out to us that "Howard Hughes Company" is bold printed on the backs of this wear. No other item with this personal mark is to be found among the memorabilia.

Furniture Built from Laminated Birch

Several sofas, tables, and other incidental items were constructed with the same wood that we find in the H-4 construction. These are obvious museum pieces that Wrather will want to refurbish for display. Samples of these pieces were photographed for the purposes of this report.

* * * * * *

In Summary, it can be reasonably assumed that the planned aircraft display will rightfully focus on the historical qualities of the aircraft. However, it is clear that the hangar and its associated features are of considerable historical and architectural significance. In addition to the above mentioned preservation of memorabilia it is suggested that the

following mitigation measures be undertaken.

1. That a mode or photo display be prepared to demonstrate the opening of the hangar doors in relation to the launching and docking of the aircraft. Mr. Harold Tegart, Facility Engineer and Designer of the doors, has indicated that such a display would dramatize the unique architectural and engineering solution which was necessitated by the size of the aircraft.

2. That a panel or a portion of the hangar be included in the planned display. The planned facility for the display of the aircraft is dramatically different from the current building. The display of a portion of the current hangar would both dramatize this difference and serve as a visable reminder of a sense of time and place.

3. The Hughes leasehold and H-4 Hangar Site is a historical landmark and it needs a marker. The Port of Long Beach may wish to implant some permanent reminder on the site with an engraved plaque that will identify the site for posterity.

Chapter VIII

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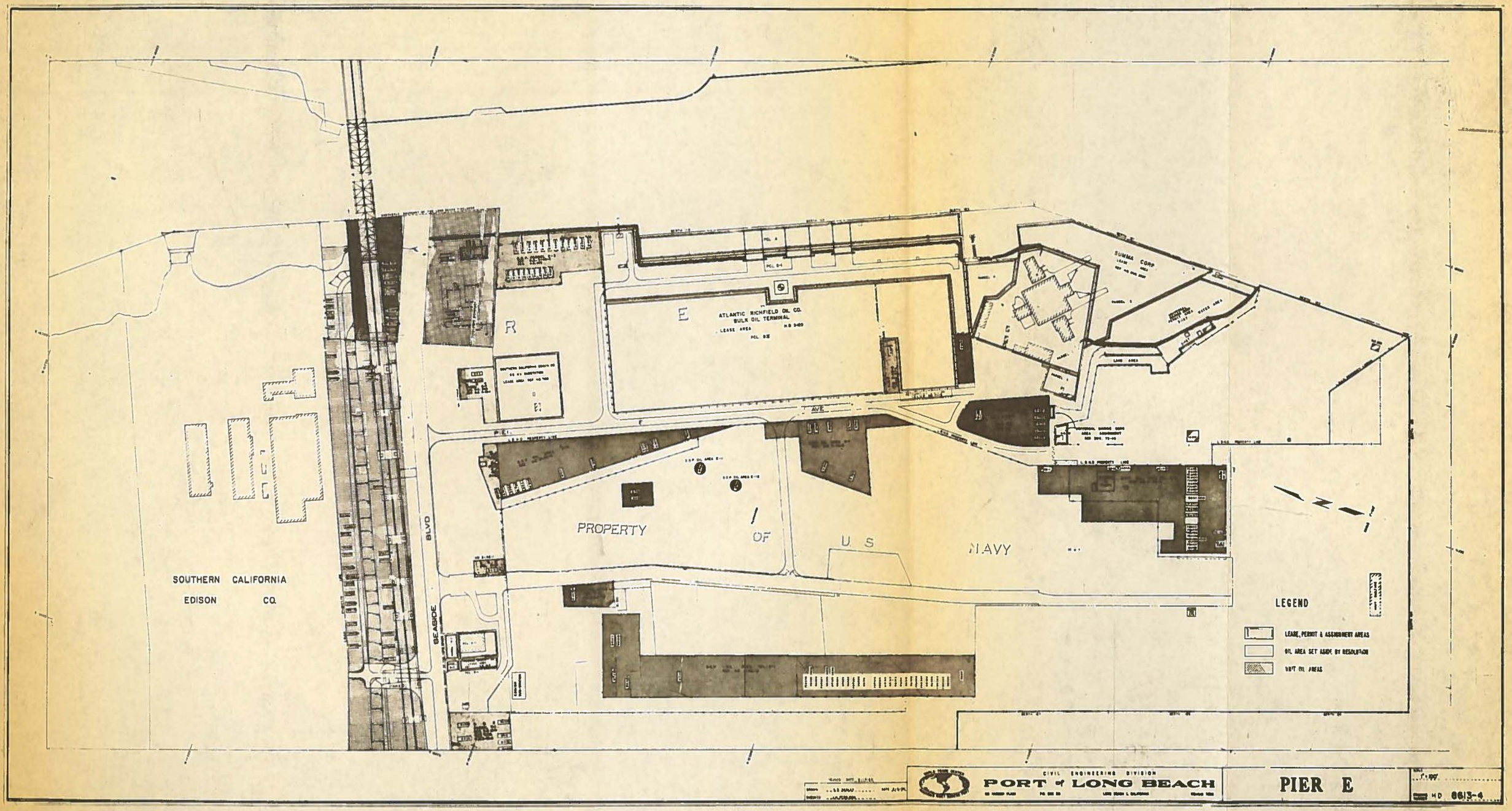
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CIVIL ENGINEERING DIVISION
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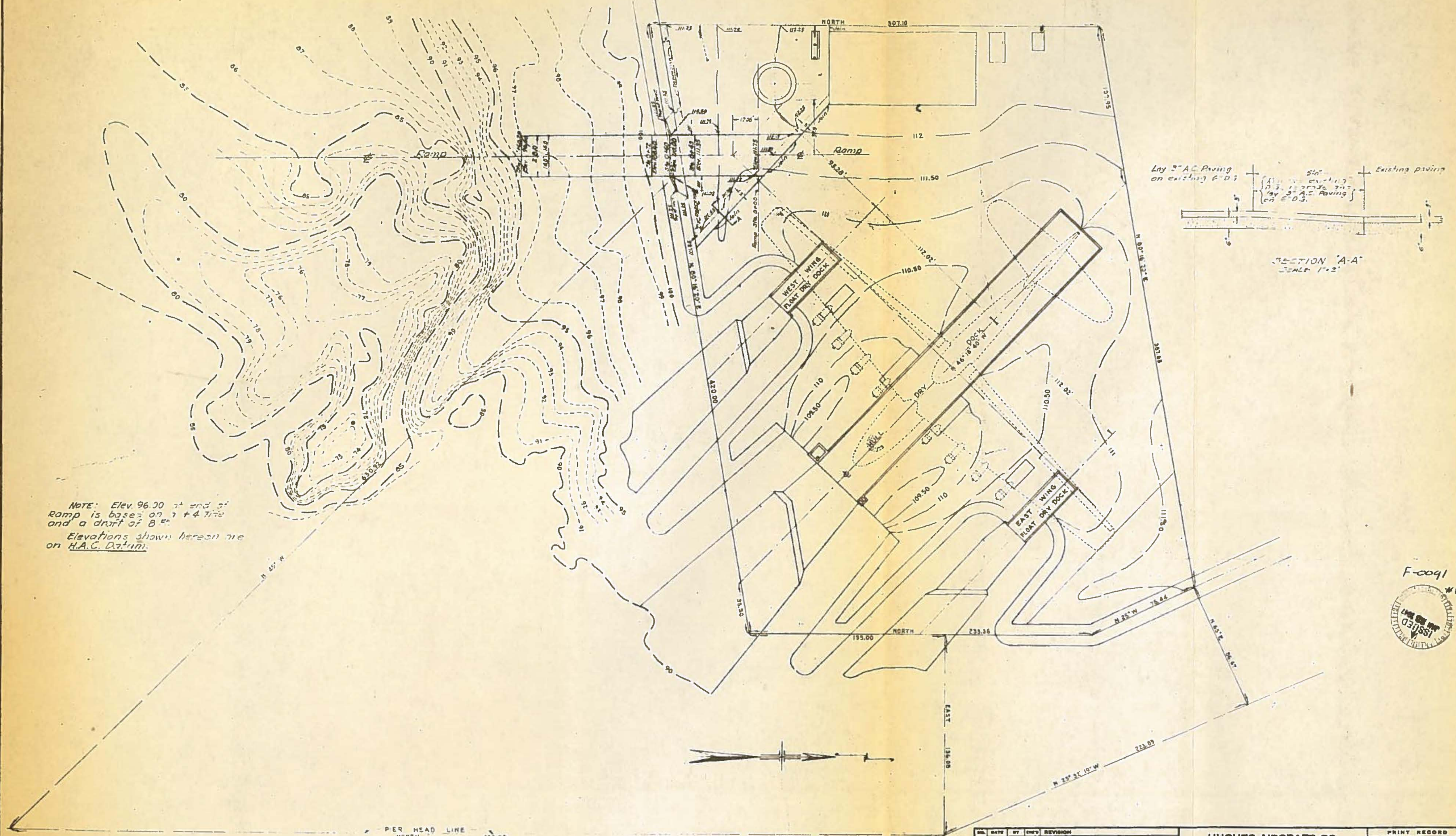

No.	Date	By	Chk'd	Revision

HUGHES AIRCRAFT CO.
PLANT ENGINEERING DEPT.

RAMP
LOCATION & GRADE PLAN
LONG BEACH SITE

Designed by
Drawn by Parker
Traced by Parker
Checked by
Approved by

Scale 1" = 30'
Drawing No. F-0091
Sheet 1

PRINT RECORD

No.	Date	To whom issued

See Drwg. № H-0093 for Plan & Profile.

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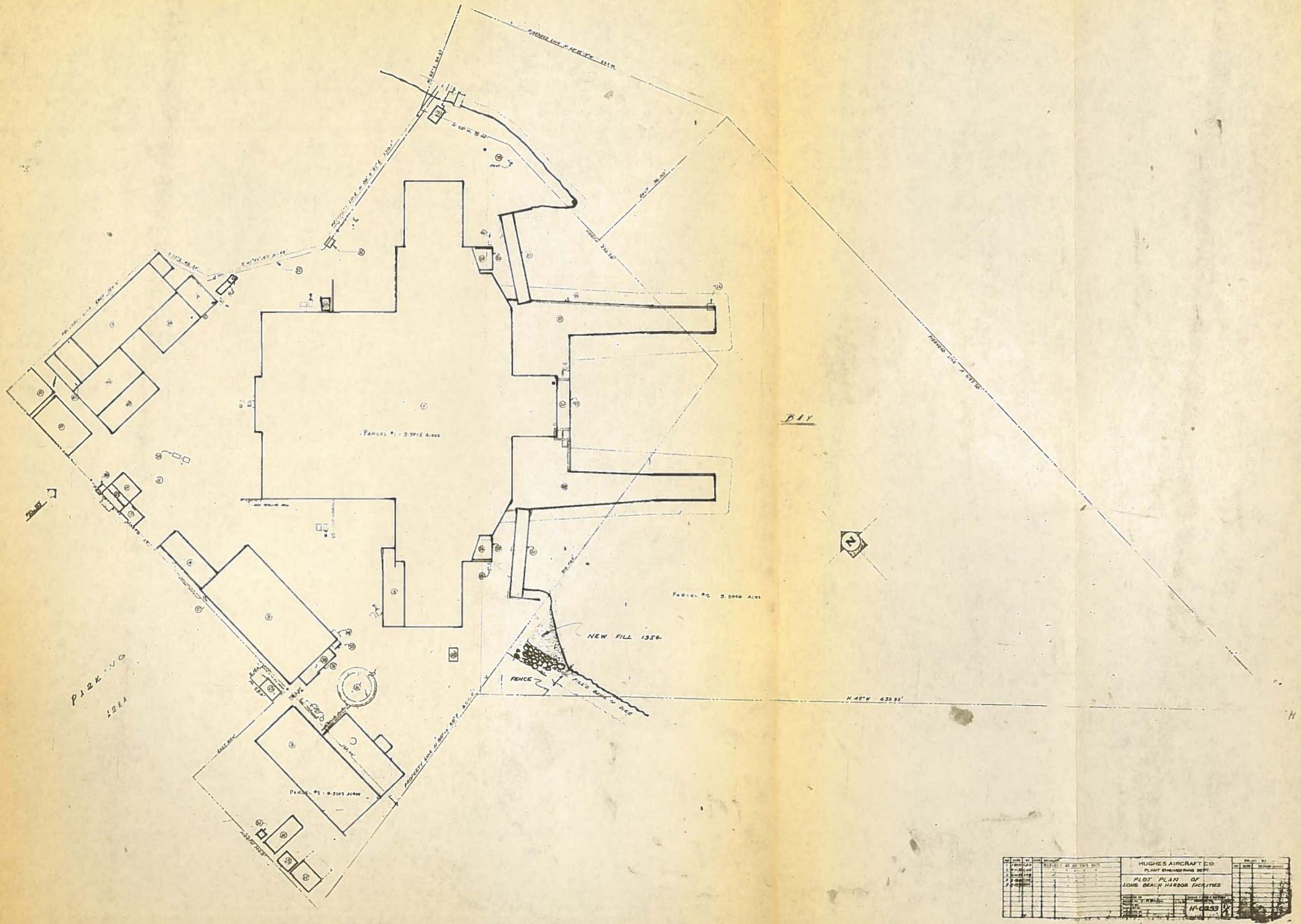
PARCEL #1 - 3.3915 Acres
PARCEL #2 - 3.5046 Acres
PARCEL #3 - 0.5107 Acres
BAY
NEW FILL 1954
FENCE
FILLED AREA IN 1956
PARKING AREA
N 45°W 633.92'
HUGHES AIRCRAFT CO.
PLANT ENGINEERING DEPT.
PLOT PLAN OF
LONG BEACH HARBOR FACILITIES
N° 6853

PHOTOGRAPHIC SURVEY POINTS

SPRUCE GOOSE HANGAR

SEPTEMBER 1980

0 50 ft

NORTH

HARBOR VIEWS

0 250ft