

CHAPTER 39

RESTORING A SMALL BOAT BASIN DAMAGED BY THE 1964 ALASKA EARTHQUAKE

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ABSTRACT

This paper presents problems associated with restoring and expanding a small boat basin at Cordova, Alaska following the Alaskan earthquake of 27 March 1964. It shows that even under very adverse conditions, work can proceed and a workable result can be obtained. The paper is primarily non-technical but lessons learned here may be of use to Project Engineers in scheduling project features for design and construction of complicated or expedited projects. Landmass uplift at Cordova of 6.5 feet caused the need to deepen and enlarge the existing small boat basin. Damage to a dock by the Tsunami required immediate repair to maintain the economy and commerce. The limited working area, exceptionally tight schedules and the need to maintain mooring facilities for the fishing fleet during construction created exceptional scheduling and coordination problems. The project was completed by means of 14 separate construction contracts and 9 supply contracts totalling \$2.5 million (Tables 1, 2 & 3). The wide variety of work necessary to complete the project while maintaining usable facilities included emergency dock restoration, debris cleanup, constructing retaining bulkheads and dikes, storm sewer extension, removing and reconstructing two docks, restoring utilities, removing and replacing mooring floats, constructing a road, providing rock slope protection, repairing breakwater, dredging and other features.

INTRODUCTION

PRE-EARTHQUAKE CONDITIONS

The city of Cordova, with a population of 1,500, is located in South Central Alaska on the East side of Prince William Sound. The principal economy is, and has been, fishing although minor construction and transportation activity has caused a slight population increase in the past decade. Seventy-five percent of the industrial activity in the Prince William Sound area was concentrated at Cordova. An 8 1/4 acre small boat harbor, built in 1938, was originally designed for 500 boats but because of the increase of boat size in the past few years, the basin had space for only 220 boats at the time of the earthquake (figure 1 and photo 1). Overcrowding was apparent, however, whenever that many boats attempted to use the harbor at the same time. About 400 boats comprise the Cordova fishing fleet, so many boats depended on natural, but inadequate, coves and inlets for semi-protected moorage.

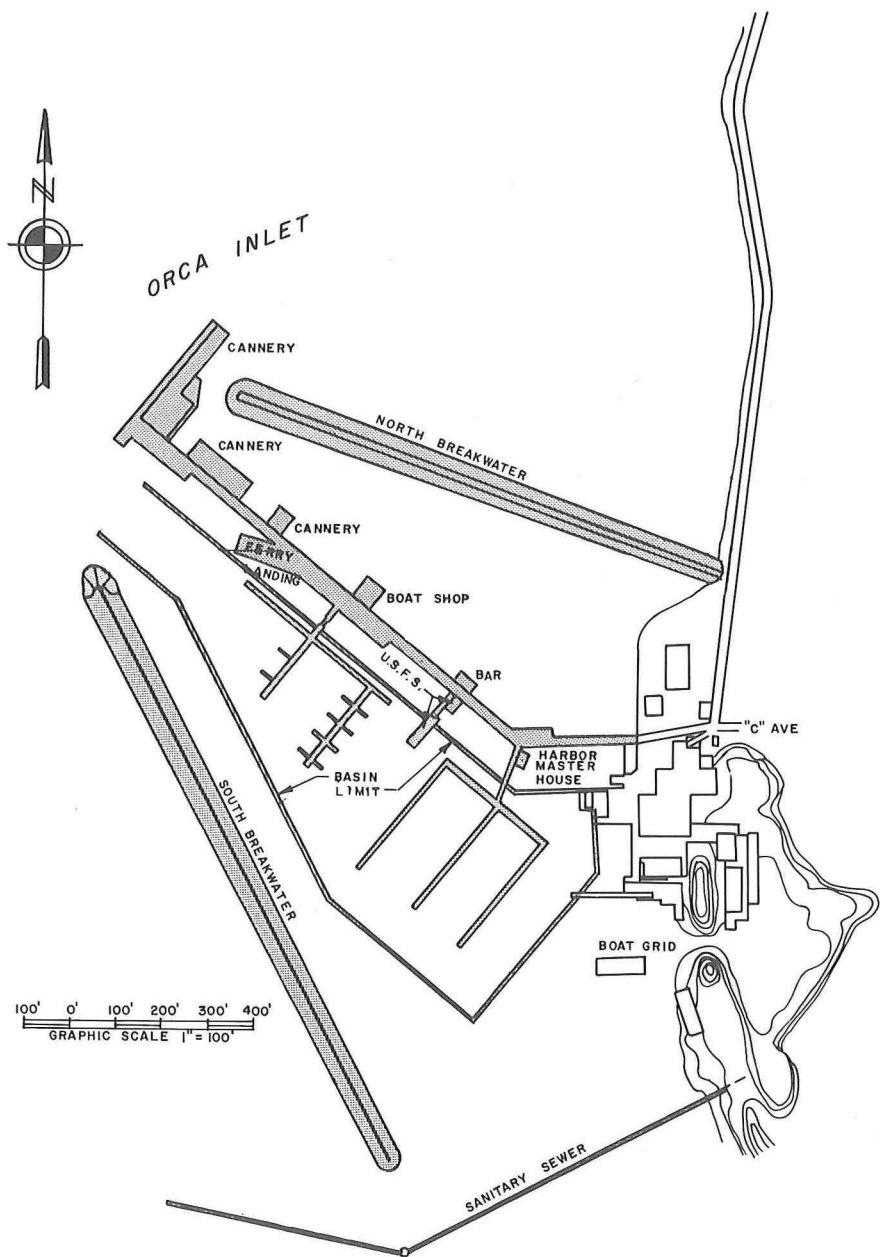


Figure 1

CORDOVA SMALL BOAT BASIN, ALASKA
CONDITION 27 MAR. 1964
(PRE - EARTHQUAKE)



Photo 1. 13 May 1964, Aerial during first increment of construction

DAMAGE BY EARTHQUAKE AND TSUNAMI

The Alaskan earthquake of 27 March 1964 had a Richter magnitude of about 8.5 and released at least twice as much energy as the 1906 earthquake which wracked San Francisco. It was felt over an area of almost half a million square miles, caused permanent uplift in an area of about 475 by 75 miles and subsidence in an area about 475 by 125 miles. Maximum uplift of about 40 feet occurred on Montague Island about 80 miles south-west of Cordova. Little structural damage occurred at Cordova from the earthquake but 6.5 feet of uplift reduced the depth of the small boat basin from 12 feet to 5.5 feet at Mean Lower Low Water, resulting in inadequate depth for any but the smallest skiffs at low tide. In addition, the natural inlets providing protection to boats prior to the earthquake were rendered useless due to the uplift.

The earthquake generated a Tsunami which hit coastlines as far away as Siberia, Midway Island, Japan and Hawaii. It caused deaths along the Oregon and California coast, notably at Crescent City, California where several blocks of business area were destroyed and many boats damaged extensively. At Cordova the Tsunami struck shortly after the earthquake stopped. A ship, tied to the main cannery dock when the Tsunami struck, moved violently and the mooring lines pulled the dock seaward leaving the piling leaning at about a 15 degree angle. In addition, the water surface rose above the deck of the dock pulling the pile caps loose from the drift pins. When the water level receded, many pile caps were set down off the piles.

PLAN OF RESTORATION AND EXPANSION

Restoring the harbor by dredging to its pre-earthquake conditions would have resulted in continuing all of the problem existing prior to the earthquake. Crowding would have been more critical than before because of additional boats seeking protection due to loss of natural mooring areas. It was decided to increase the harbor to 18.7 acres at project depth of 12 feet to moor 450 boats. During the entire operation, three basic criteria governed the restoration and expansion schedule: (1) accomplishing the work in the shortest possible time, (2) maintaining protected moorages for the fishing fleet during construction and (3) upsetting Cordova's economy to the least degree possible. These criteria were adhered to throughout the operation. The plan of restoration and expansion was basically simple. It was: remove the dock, dock approach and commercial establishments abutting it; relocate the dock and ferry terminal; remove and re-install the float system; and repair the break-water ends (figure 1). But the criteria established restraints that were to become clearer as construction progressed. In hindsight, a network diagram could be prepared which shows the complicating factors but at the beginning of the project, no detailed network diagram was possible because of lack of time to establish all the governing restraints. The project therefore developed a step at a time and work was accomplished as it became possible.

REPAIRS, RESTORATION AND EXPANSION

FUNDING

The first and foremost problem of authorizing and funding the project was dispatched through; (1) timely implementation of Public Law 875, administered by the Office of Emergency Planning, which authorized restoration of all essential public facilities; (2) speedy passage by Congress of an amendment to the Alaska Omnibus bill for expansion of the Cordova small boat harbor; (3) by the willing action of the City of Cordova in acquiring real estate necessary for completion of the project; and (4) by the efforts of the State of Alaska before the Federal machinery was oiled and rolling.

REPAIRS

City dock, approach and ferry dock - The economy of the City of Cordova is centered around its small boat basin of which an integral part is the city dock, the ferry terminal, and the canneries. Physical damage due primarily to the Tsunami had rendered this area unsafe for normal use making it imperative that the area be repaired in the most expeditious manner possible. At the time of the earthquake, the State of Alaska had an active contract for extension of the city dock but the day after the earthquake it was apparent that continuing construction as designed was futile. The State implemented a temporary stop order until a master plan could be developed. Within days the Alaska District Corps of Engineers had developed such a plan and notified the State of the direction their efforts should be pointed for the most efficient utilization of their energies, as a result of this, the State modified their contract to include the most necessary repairs to the dock and to start an approach from the dock to the north breakwater. Just a month and thirteen days after the earthquake, the Corps of Engineers took over the State's contract utilizing funds provided by the Office of Emergency Planning for rehabilitation of the dock and repair to the ferry terminal (figure 2).

The only transportation link that the City of Cordova has with the rest of Alaska is through the marine highway between Cordova and Valdez serviced by the state ferry Chilkat which makes twice weekly runs between Cordova and Valdez. To maintain this commerce it was of the utmost necessity that the ferry dock repair be completed and operational as soon as possible. Although it was known these facilities would have to be removed and relocated commensurate with deepening and redesign of an expanded harbor, only the minimum of repair was done to accommodate vital requirements at this most critical interim period. The city dock and ferry dock repair contract was completed on 23 June 1964 at a contract amount of \$76,000. While this work was progressing a contract for \$37,000 was let on 25 May 1964 to clean up debris and remove small structures along Cordova's waterfront that were damaged by the Tsunami. This contract was completed on 8 July 1964.

Sanitary sewer - The sanitary sewer south of the small boat basin had suffered damage during the earthquake with parting of joints. In addition, the uplift at Cordova of 6.5 feet had left the outfall discharging in the

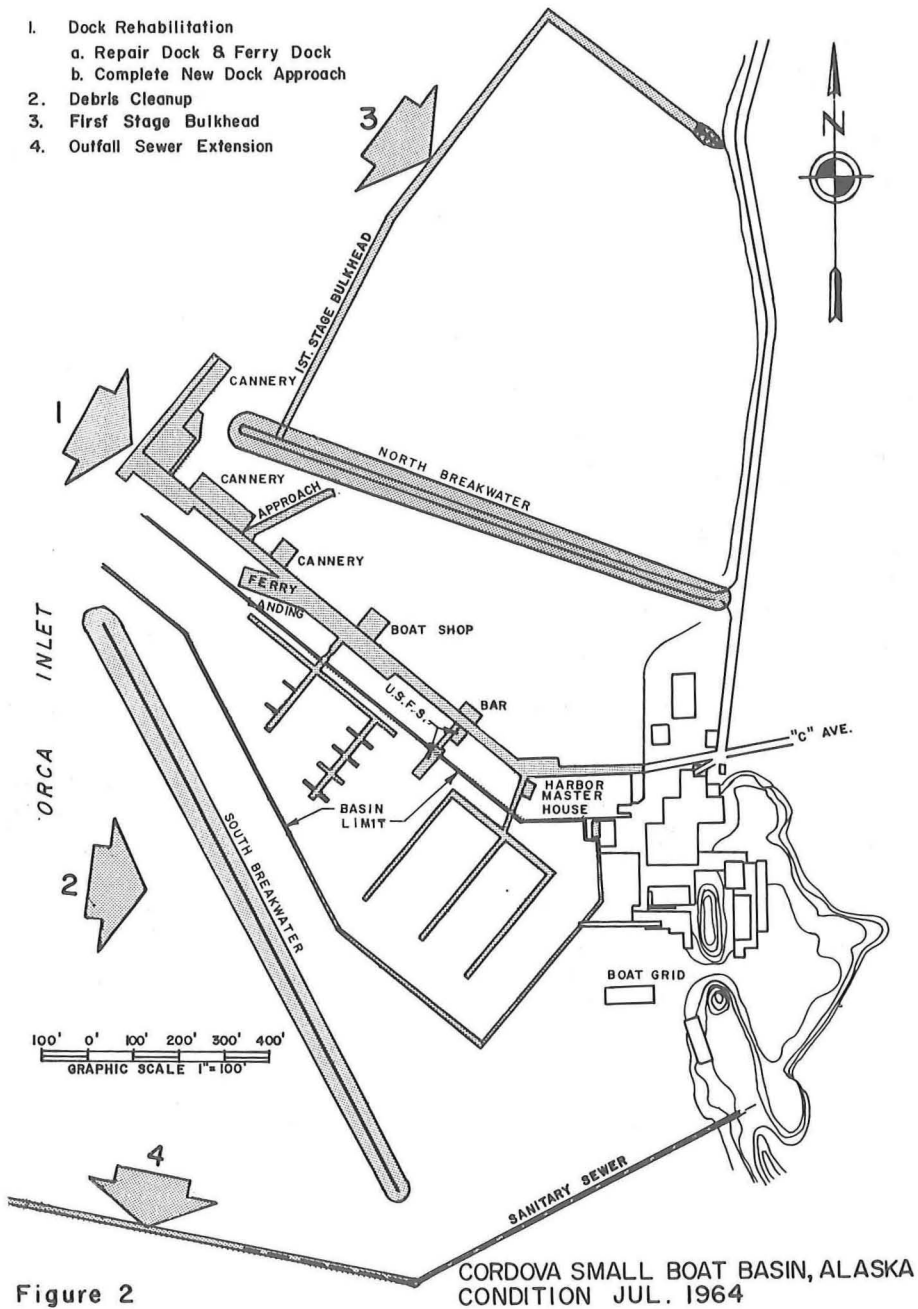


Figure 2

- 5. a. Storm Sewer
- b. Lagoon Dikes
- c. Silt Barrier
- d. Sanitary Sewer Repair
- (No. of Project)
- 6. a. Second Stage Bulkhead
- b. Blanket No. Breakwater
- 7. No. Breakwater Roadway

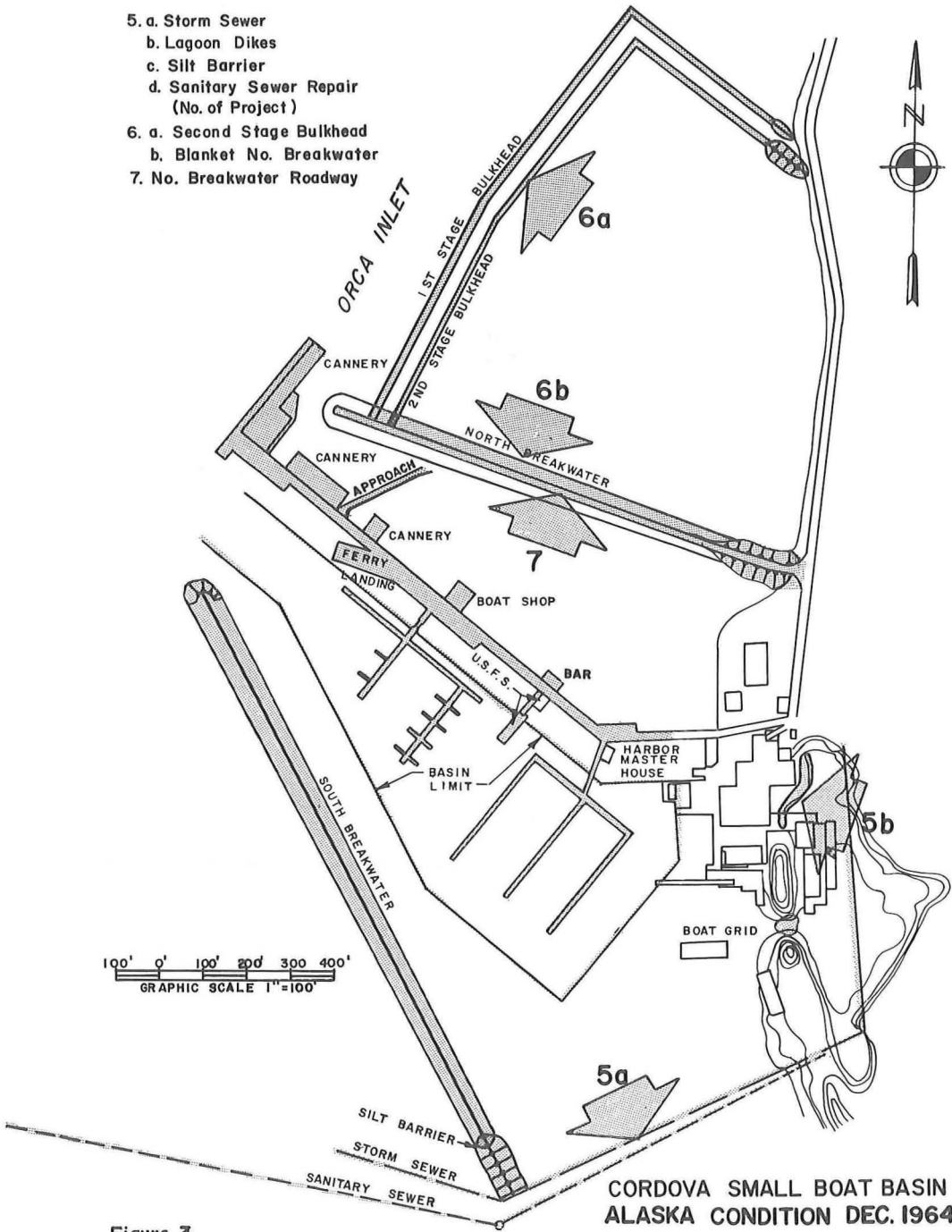


Figure 3

CORDOVA SMALL BOAT BASIN
ALASKA CONDITION DEC. 1964

tide flats well above the Mean Lower Low Water line creating a distinct sanitation hazard as well as creating an obnoxious situation. Work on repair and extension started 29 June 1964 and was completed 29 August 1964 at a cost of \$54,000 (figure 2).

RESTORATION AND EXPANSION

General - The project as planned was basically simple. It included deepening of the old small boat harbor and expanding it to provide moorage for boats which prior to the earthquake moored in bays and inlets surrounding the Cordova area. The dock approach which bisected the proposed basin area required removal prior to dredging as did removal of existing floats. An integral part of the dock approach was the existing ferry terminal as well as the harbor master's house, the US Forest Service facilities, a boat shop, a bar and two canneries.

Basic criteria in developing the *modus oporandi* included upsetting the ferry schedule as little as possible and providing maximum continuity for the businesses adjacent to the dock approach. It was necessary therefore, before moving the dock approach, to provide a new ferry terminal facility. But before the ferry terminal facility could be built, the area in front of it and slopes under it had to be dredged to provide floatation for the ferry. Removal of the approach had to be timed so that it would not delay the hired dredge which cost about \$2600 per day, but yet the approach could not be removed until the ferry facility was completed.

Further complicating the project was the requirement that small boats remain within the harbor so their insurance would remain in effect. This meant that we could only remove the existing floats a few at a time while constructing the new floats within the harbor, but some floats had to be removed before the dredge could start dredging the expansion portion of the basin. Further complicating the project was the requirement of maintaining access and utilities to the Point Chehalis Cannery. This was accomplished early in the schedule by constructing a road on the north breakwater by tying into the approach which had been built immediately following the earthquake. Another complicating factor was that prior to constructing the new city dock, the old city dock, which was damaged extensively by the Tsunami had to be removed. But located on it was the Washington Fish and Oyster Cannery which had to be acquired. At this stage the Alaska State Housing Authority (ASHA) with 90% Federal funds from the Urban Renewal Administration was strongly considering an urban renewal project in Cordova and if the project was approved, the ASHA would obtain the necessary real estate, including the bar, outboard motor shop and canneries on the dock. As it turned out the urban renewal project was delayed so the City of Cordova purchased through condemnation procedures all necessary real estate clearing the way for demolition of the old city dock and approach. Luckily an undamaged privately-owned dock existed nearby that could be used by deep draft and coast guard vessels while the new dock was under construction.

First stage bulkhead and float removal - Although the expansion of the small boat harbor was not approved until August 1964 the plans were



Photo 2. February 1965, Aerial

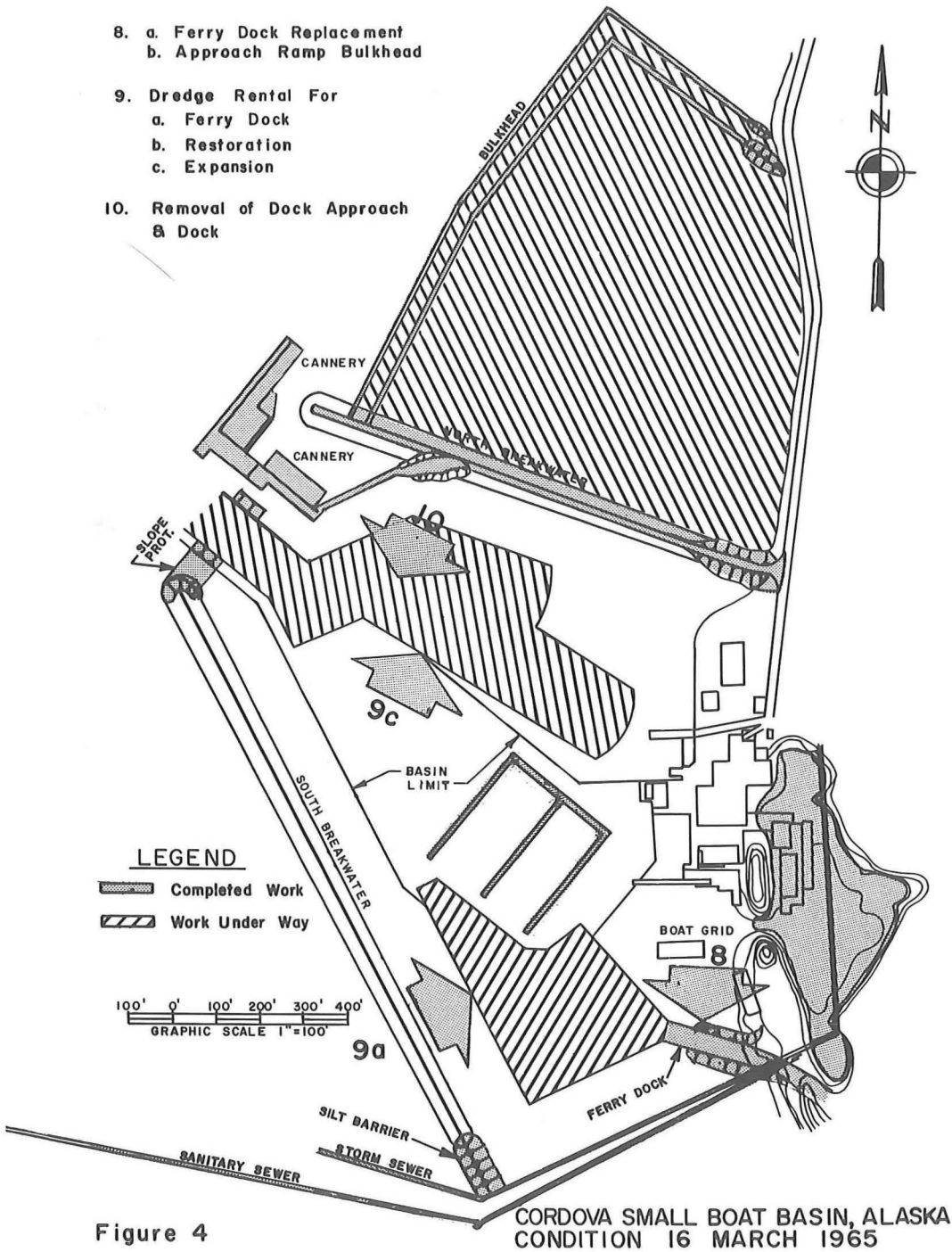
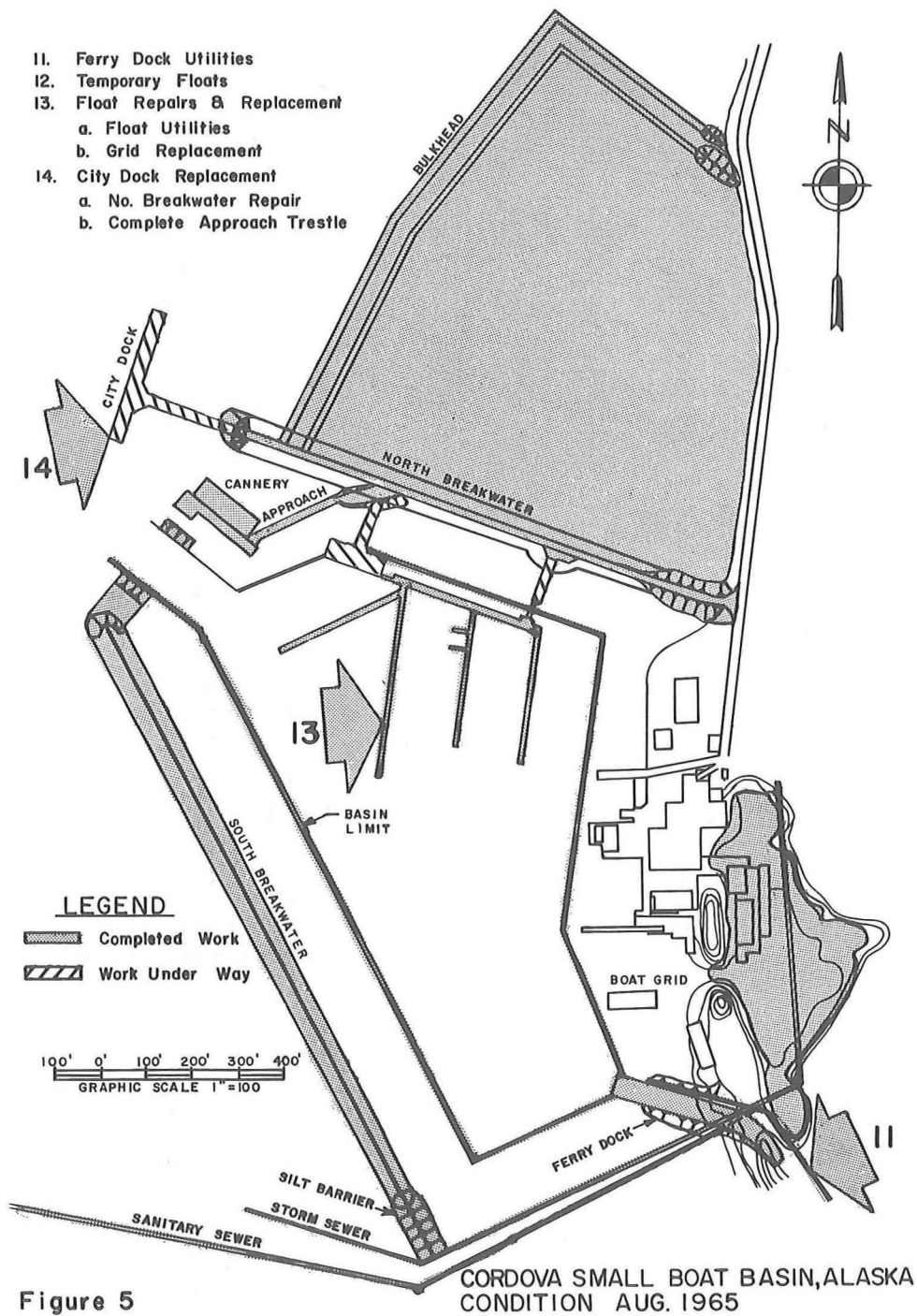


Figure 4



BOAT BASIN RESTORATION

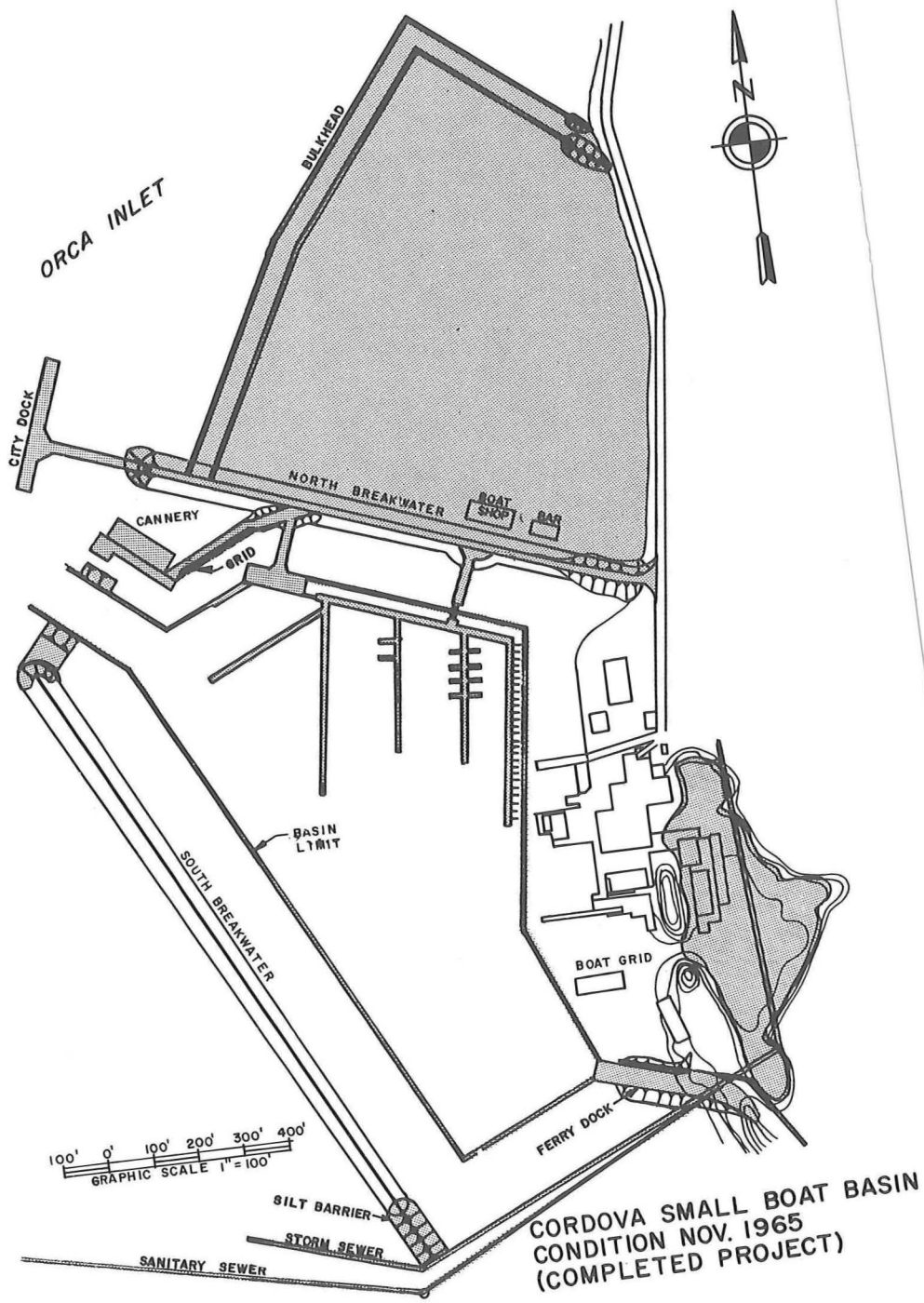


Figure 6

pretty well firmed and had tentative approval in June. One of the major problems in deepening and expanding the small boat harbor was disposal of dredged spoil. A total of about 535,000 cubic yards of material was to be dredged, 140,000 cubic yards in the restoration portion of the harbor, 155,000 cubic yards in the ferry terminal area, and 240,000 cubic yards in the expansion portion of the small boat harbor. Several alternative areas were considered for disposal of material, those being (1) an area south of the small boat harbor; (2) barging the material about two and a half miles across Orca Inlet to a bay; (3) filling of Odiak slough; and (4) filling an area north of the north breakwater. The area north of the north breakwater, area (4), was selected purely on the basis of economics. It was impossible, however, to dispose of material on the beach without retaining bulkheads.

On 24 June 1964 a \$97,000 contract was let for construction of the first stage bulkhead (figure 2). Also included in this contract was an item for removal of existing floats and stockpiling them in preparation for construction of new floats. At the time we very optimistically assumed that the dredging would be accomplished within two to three months and that the floats could be removed while most of the boats were on the fishing grounds, at which time the least need for mooring facilities existed. This assumption proved to be invalid because of problems in scheduling the dredging operation coupled with the major problem of acquisition of real estate. To expedite the construction of the first stage bulkhead two separate supply contracts were required. One for supplying piling and timber and second for providing the hardware. These materials were ordered in May and delivered in June so they would be available for the contractor to begin immediate construction on the first stage bulkhead. Although the contract for the first stage bulkhead and float removal was not closed out until April 1965, the first stage bulkhead itself was completed in mid-August 1964.

With the completion of the first stage bulkhead we had a breathing spell knowing that we had an area where at least some of the material from the dredging could be disposed.

Storm sewer, lagoon dikes and silt barrier - As design of the second stage bulkhead progressed it became more and more apparent that not enough volume existed within the bulkhead area to take all the material from the dredging. There was a possibility that as much as 60,000 cubic yards of material would require another disposal site. A tidal lagoon within the Cordova city limits offered an ideal disposal site for this material. All of the city's storm drainage flowed into this area, which before the earthquake was inundated twice daily allowing mixing of the fresh with the salt water. Due to the 6 1/2 feet landmass uplift the lagoon was dry at all but the highest tide stages. Prior to filling the lagoon with dredged material storm drains had to be extended through the area to prevent glaciation of the storm runoffs which would threaten surrounding development. Thus the dual purpose was accomplished of providing a nearby disposal site as well as alleviating the problem, which had existed throughout the years, of icing within the small boat harbor due to fresh water runoff during extremely cold weather. As much as six inches of ice had at times accumulated within the Cordova harbor causing damage to boats due to springing



Photo 3. 16 March 1965, Aerial



Photo 4. March 1965, Aerial



Photo 5. May 1965, Dredging and filling operation



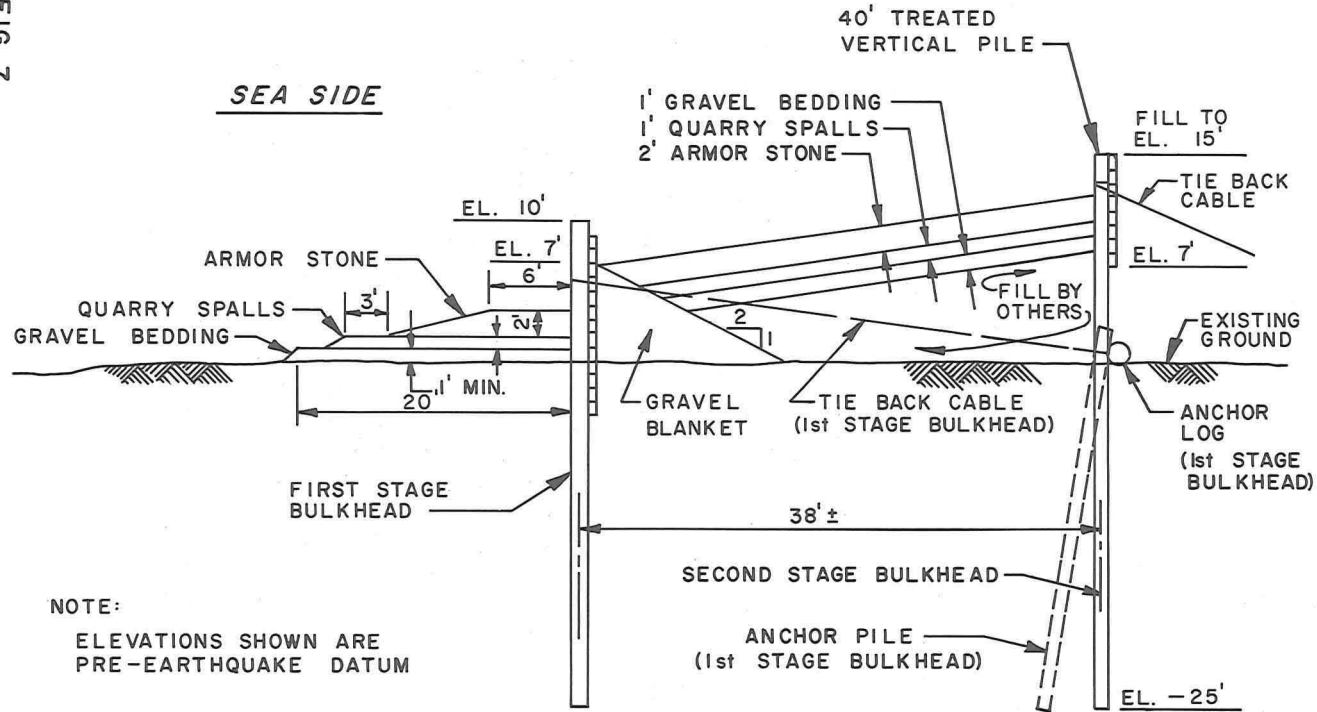
Photo 6. 26 June 1965, Float installation

of seams. The storm sewer was to be carried south of the small boat harbor, roughly parallel with the existing sanitary sewer. The most economical method of construction was to provide a 72" x 44" CMP arch line laid on the mud flats covered with fill material protected by quarry spalls. This method of construction afforded an ideal opportunity to reduce maintenance dredging within the small boat harbor due to the blocking of sediment transport into the harbor around the southeast end of the south breakwater. Only a low dike was required to extend the south breakwater tying into the cover over the storm sewer. This we called the silt barrier. On 1 September 1964 construction was started on the storm sewer, the lagoon dike, and the silt barrier with construction completed on 8 December 1964 at a total cost of \$306,000.

Second stage bulkhead - Of all of the features of the Cordova project, the second stage bulkhead gave the most problem from the technical standpoint. The material underlying the area of the second stage bulkhead is sandy silt incapable of taking the load that a 17' high vertical wall bulkhead would impose when filled with liquified dredged materials. Extensive probing and analysis was accomplished to determine the most economical method of retaining the dredged fill. The bulkhead as finally designed is shown on figure 7 and has major features including an extensive cable tie-back system to deadmen, a facing of armor rock underlain with quarry spalls which in turn was underlain with gravel to provide the filter requirements to retain the dredged spoil, and a strengthening of the first stage bulkhead by adding stone to its seaward face. Our design ended up as a vertical timber wall acting as a membrane to retain the dredged fill with rock facing to hold the slopes against wave action. On 12 November 1964, construction began on the second stage bulkhead as well as strengthening of the first stage bulkhead. Included in this contract was the feature of blanketing the north breakwater with two feet of gravel to prevent seepage of the fine dredged materials through the porous stone north breakwater. This contract was completed 10 May 1965. To expedite completion of the second stage bulkhead another supply contract was entered into for providing the piling and timber. These materials were delivered in September 1964 so that when the contract was let construction could start immediately. After ordering these materials and during construction of the second stage bulkhead another supply contract for 6,500 lineal feet of wire rope was required to provide tiebacks. This material was delivered in December 1964.

North breakwater roadway - At this stage in the project the plan had of necessity been modified to include retaining the end portion of the city dock, particularly adjacent to the Point Chehalis Cannery which was now to remain in place. The City of Cordova had spent virtually all available funds on acquisition of other real estate necessary for the project and no other source of money was available for real estate acquisition. The temporary approach from the dock to the north breakwater had been completed but no road access existed other than over the city dock approach, soon to be removed. Because the Point Chehalis Cannery provides the major economy of Cordova through purchase, processing and shipping the local fish catch it was imperative that the cannery remain in operation, and road access was a primary requisite for its continuing operation.

CROSS SECTION RETAINING BULKHEADS



The Point Chehalis Cannery operation is nearly year-round, with a shutdown of about a month during January, thus establishing the date that access to it was needed. A contract for a road on the north breakwater was let with work starting 23 November 1964 to maintain that access. By this time the pattern had been set for including as much incidental work as we could reasonably foresee and schedule in contracts as they were let. So included in this contract was a feature for repairing of the south breakwater which was being undermined due to the uplift and also included was protection of the entrance channel slope to be placed when dredging was accomplished in the entrance channel. This \$121,000 contract was completed on 5 April 1965 but the north roadway itself was completed 15 January 1965.

Ferry dock replacement and approach ramp bulkhead - Before removing the dock approach, the new ferry dock had to be in place and operating so the Cordova-Valdez ferry schedule would not be upset. But before completing the ferry dock, the moorage area had to be dredged so that the necessary rock protection for the fill could be placed. This is where the most critical timing problem occurred. The dredge was capable of excavating 8 to 10 thousand yards per day and required removal of the dock approach to enter the expansion portion of the small boat basin which was the only other location available for dredging without removing the moored boats from the small boat harbor. Until this time the dredge had been fully occupied in excavation of a channel in Orca Inlet 4 miles south of the City of Cordova. Because of the anticipated bad weather conditions in Orca Inlet in January through April it was felt necessary to complete the most needed portion of Orca Inlet before bringing the dredge into the protected waters of the Cordova small boat basin. Scheduling the start of construction for the ferry terminal was very difficult because we knew that after October the dredge would experience periodic forced shutdown in Orca Inlet due to rough water. No one really knew when the dredge would finish in Orca Inlet.

The ferry dock construction contract was advertised on 5 October with start of construction based on the best guess as to completion of dredging in Orca Inlet. Work started on the ferry terminal on 5 December and as luck would have it, our predictions were fairly accurate. The dredge started work in the ferry terminal area on 22 December and was able to prepare the area in the front of the ferry dock almost to the day that the ferry dock contractor required this work accomplished. The crisis had passed without the major problems we feared could occur. But the problem of completing the ferry dock and dredging in front of it for the use of the Cordova-Valdez ferry before the requirement for removing the old ferry dock still faced us. Lady Luck remained with us through this stage also. The ferry had been scheduled to drydock in Seattle for its annual 3 week winter checkup in November but due to a combination of circumstances including extremely bad weather in the Gulf of Alaska, was not able to start as scheduled. In addition it required more work than anticipated by the State Ferry System and remained in Seattle longer than anticipated. The ferry returned to Cordova on 13 February 1965 to find a completed ferry dock and was able to resume its run to Valdez with no interruption because of our actions.

The absence of the ferry allowed us to remove the city dock approach and ferry landing with work starting 19 January 1965. The critical portion of the dock approach removal was completed in time so that the dredge was not delayed in its move into the expansion portion of the small boat harbor. We also reactivated the older contract still in force for the removal of floats. The contractor for this portion of the work, a local resident, was very sympathetic to our needs for removal of floats by increments. He removed the most seaward floats to allow the dredge access to the expansion portion of the small boat basin leaving the balance of the float removal for a later date.

The ferry dock contract also included the requirement for a bulkhead to the new approach and fill behind this bulkhead tying the approach to the newly constructed road on the north breakwater. This the contractor accomplished concurrently with the ferry dock portion of his contract. This work was completed in mid-December 1964 allowing continued access to the Point Chehalis Cannery.

Because we really did not know the scheduling of the ferry dock construction and because the schedule was so tight, it was necessary to have the materials on hand for the contractor when work was to begin. Four supply contracts were required for obtaining and delivering the material to the site. One was for the lumber for the ferry dock, another for the piling, a third for the hardware, and the fourth to off-load the lumber, piling and hardware at Cordova to storage. The material arrived at Cordova in early October releasing us from the worry of delays of delivery of material and consequent delays in completion of the dock.

With the forthcoming removal of the approach to the city dock, water and electric lines to the Point Chehalis Cannery required removal. Permanent utilities to the cannery were not to be installed until construction of the new city dock in the fall of 1965 so temporary water and power were required to maintain operating capability. The technique of using 4" aluminum irrigation pipe for providing temporary water supply had been developed by the City of Anchorage shortly after the earthquake. This idea had been borrowed for the City of Valdez in the summer of 1964 and some surplus irrigation pipe existed in Valdez. In mid-January 1965 we shipped 3000 feet of irrigation pipe to Cordova and installed it on the mud flats from the city water main to the Point Chehalis Cannery. It was still in use in October 1965. A 50kw diesel powered generator was installed at the cannery. The generator furnished all the required power for continuous operation of the cannery but the starting load for a 15kw motor operating the cannery's freezer overloaded the generator creating operating problems. To start the freezer, other motors and lights had to be shut off. This condition existed for about 3 months until the city installed a cable from town to the cannery.

Completion of dredging and replacement of floats - By the first of March 1965, we began to feel that our problems were over, that schedules

could be made with a fair degree of certainty and that any problem would be minor, but we still had several surprises in store.

Because of all the reconstruction work being accomplished in Alaska, pile-driving equipment for installation of floats was not available at the time required. The criteria for mooring boats within the small boat harbor while dredging was in progress still remained but the floats required removal so the dredge would not be delayed. At the end of March the City of Cordova volunteered to install the floats temporarily in the expansion portion of the basin while dredging in the restoration portion was progressing. Before we could start the permanent float placement, a very strong north wind came up and because of the temporary nature of the float installation, they broke loose, drifting towards the south breakwater into the dredge discharge line which extended from the dredge between the floats and the south breakwater to the disposal area north of the north breakwater. The existence of the dredge discharge line in this location was the only thing that kept the boats and floats from drifting into the south breakwater which because of its very rough surface would have caused appreciable damage to them. The discharge line held, the winds subsided and we had damaged floats on our hands, but very little damage to boats.

On 21 April 1965 the float installation construction began. Here again we had an unwelcome surprise. The most easterly line of floats was found to lie over a rock outcrop which precluded pile-driving in this area. Extensive probings were made to determine the limit of the rock and it was found to extend to the stall floats on the second most easterly line of floats. Because of the small boat basin configuration it was impossible to revise the float layout without jeopardizing its capacity and future most desirable float configuration. The float installation contract was therefore modified by change order to include drilling in the rock to receive the necessary piles. This was time-consuming but necessary so future development would not be jeopardized. The contractor was able to utilize his pile-driving equipment efficiently on the floats not requiring drilling as well as the approaches and new public dock while waiting for arrival of his rock-drilling equipment which was located at Kodiak, about 300 miles away. As soon as the equipment completed necessary work at Kodiak it was started to Cordova by tow across the Gulf of Alaska. Here again an unpleasant surprise awaited. On the way to Cordova the drill barge sank and the project was delayed. The contractor was able to purchase another drill barge in southeastern Alaska and haul it to Cordova, finally completing float installation in August 1965.

City dock replacement and north breakwater roadway - The last and most welcome contract of the whole project was a contract for all uncompleted work incorporating construction of the new city dock, repair of the north breakwater, completing the second lane of the road on the north breakwater, supplying utilities to the dock, and completing the approach trestle. Before design of the dock could begin a siting exercise was in order to determine the most feasible and economical location for the dock.

Many meetings had been held with local interests in Cordova to determine their desires, surveys had been made of several sites, and soil probings were utilized to determine potential dock stability. In addition the access to the dock by deep water vessels had to be considered and after considering several locations the location off the end of the north breakwater was selected. Other locations considered included a dock off the fill north of the north breakwater which was ultimately discarded because of high cost and lack of knowledge as to when the fill would set up sufficiently for the heavy traffic anticipated between Cordova and the dock. The dock as it is now being constructed is 300' long and 30' wide with complete utilities and project depth at the face of the dock at 30' below mean lower low water. Although the dock is long and narrow, it should prove to be a usable structure. We were limited in the size of dock that could be constructed by the Office of Emergency Planning regulations which stated that we could only replace in kind the public portions of the dock. The previous dock although longer and wider had the Washington Fish and Oyster Cannery on it with the area on which the cannery was located leased to the cannery making that portion basically a private dock structure. Although the City of Cordova would have preferred a large dock it was unable to finance an increase in size because of the expenditures the city had made in acquiring real estate for the other portion of the project. Construction of the dock started on 24 June 1965 and is scheduled for completion on 15 November of this year.

Future plans for the City of Cordova - The City of Cordova has actively and energetically utilized its own resources to fully utilize the new small boat harbor, dock and fill areas. The city has recently purchased the Point Chehalis Cannery clearing the way for the cannery to move onto the fill behind the bulkhead. The city has made overtures to other businesses to establish on the fill utilizing the city dock or docks to be constructed off the face of the bulkhead. The old Point Chehalis Cannery building will be temporarily utilized by the city for a harbor master's house and office. The city has requested that the Corps of Engineers build an entrance breakwater to reduce the amount of wave energy entering the Cordova small boat basin. Gathering basic data for wave studies and refraction and diffraction analyses is now underway. In addition we are obtaining information on wave heights within the small boat basin during storms to obtain estimates of damage caused by those waves. The State of Alaska has let a contract for installation of additional float facilities within the small boat harbor to accommodate the boats seeking safe moorage there.

CONCLUSION

The problem of restoring and expanding the Cordova small boat basin after the Alaska earthquake of March 1964 showed that, with coordinated effort on the part of responsible governmental bodies, a workable end result could be obtained. In this particular case the desired timing of the various phases of construction was not controlled by those responsible for construction due to physical restraints and economic factors that conflicted with an ideal case. In spite of these problems the project was completed quickly with a minimum of disruption to the normal economy and commerce.

ACKNOWLEDGMENTS

The Corps of Engineers is grateful to the agencies, governmental elements and contractors for the splendid cooperation evident during the planning and construction phases of this project. Special thanks are due to: The Office of Emergency Planning for smoothing the way on funding and major coordination problems; the City of Cordova for speedily concurring with the basic plan and contributing its resources when needed; the United States Coast & Geodetic Survey for furnishing needed basic data quickly; the State of Alaska for needed help in master planning on the inner harbor facilities; and last, but not least, to the contractors who energetically utilized their skills and resources to complete the various construction contracts on time in spite of severe weather conditions and potential conflict with other contractors.

TABLE 1
CORDOVA SMALL BOAT BASIN
CONSTRUCTION CONTRACTS

Contract Name	Additional Features	Contract Amount	Start of Const	Sched or Actual Compl Date
1. Dock Rehab	Repair Ferry Dock Complete New Dock Approach	\$76,000	9 May 64	23 Jun 64
2. Debris Cleanup		\$37,000	25 May 64	8 Jul 64
3. First Stage Bulkhead and Float Removal		(\$81,000-Corps) \$97,000-Total	24 Jun 64	6 Apr 65
4. Outfall Sewer Extension (South of Project)		\$54,000	29 Jun 64	29 Aug 64
5. Storm Sewer	Lagoon Dikes, Silt Barrier Sanitary Sewer Project (North of Project)	\$306,000	1 Sep 64	8 Dec 64
6. Second Stage Bulkhead	Blanket North Breakwater	(\$249,000-Corps) \$249,000-Total	12 Nov 64	10 May 65
7. North Breakwater Roadway	So. Brkwtr Repair, Entrance Channel Slope Protection	(\$56,000-Corps) \$121,000-Total	23 Nov 64	5 Apr 65
8. Ferry Dock Replace & Approach Ramp Blkh		(\$4,000-Corps) \$53,000-Total	5 Dec 64	1 May 65
9. Dredge Rental	New City Dock, Ferry Landing, Restoration & Expansion	(\$346,000-Corps) \$557,000-Total	22 Dec 64	5 Jun 65

TABLE 1 (Cont)

10. Removal of Dock Approach	Debris Removal	\$165,000	19 Jan 65	16 Feb 65* 1 May 65
11. Ferry Dock Utilities		\$21,000	19 Apr 65	8 May 65
12. Temporary Float Installation		(\$4,000-City) \$4,000-Total	31 Mar 65	3 Apr 65
13. Float Repairs & Replacements	Public Loading Dock, Float Approaches, Float Utilities	\$199,000	21 Apr 65	15 Aug 65
14. City Dock Replacement	North Breakwater Repair, Complete North Breakwater Road, Complete Approach Trestle	(\$20,000-Corps) \$366,000-Total	24 Jun 65	15 Nov 65

*Schedule A only

TABLE 2
CORDOVA SMALL BOAT BASIN
SUPPLY CONTRACTS

Contract Name	Contract Amount	Date Work Started	Completion Date
1. Piling & Timber for 1st Stage Blkhd	\$ 28,000	27 May 64	29 May 64
2. Hardware for 1st Stage Bulkhead	5,000	28 May 64	4 Jun 64
3. Piling & Timber for 2nd Stage Blkhd	86,000	9 Sep 64	19 Sep 64
4. Lumber for Ferry Dock	18,000	17 Sep 64	3 Oct 64
5. Piling for Ferry Dock	17,000	17 Sep 64	3 Oct 64
6. Hardware for Ferry Dock	6,000	17 Sep 64	3 Oct 64
7. Off-Loading Lumber, Piling & Hardware	12,000	19 Sep 64	3 Oct 64
8. Field Survey, Sounding Channel to City Dock	4,000	11 Dec 64	15 Apr 65
9. 6,500 LF Wire Rope 2nd Stage Bulkhead	5,000	21 Dec 64	28 Dec 64
TOTAL	<u>\$181,000</u>		

TABLE 3
CORDOVA SMALL BOAT BASIN
INCIDENTAL CONTRACTS

Contract Name	Contract Amount	Start of Const	Sched or Actual Completion Date
1. Water Supply System	\$236,670	22 Aug 64	16 Oct 64
2. Orca Inlet Dredging (1st Stage)	\$357,000	14 Aug 64	10 Dec 64
3. Orca Inlet Dredging (2nd Stage)	Unknown	Mar 66	Jun 66