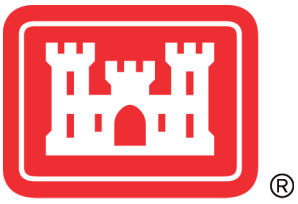

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***Engineer Pamphlet 415-1-261_7**

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CECW-EC

Construction
Quality Assurance Representative's Guide
Volume 7: Dredging and Dredge Inspection

FOR THE COMMANDER:

JAMES J. HANDURA
COL, EN
Chief of Staff

Purpose. The purpose of this document is to provide information for assisting and instructing dredging Quality Assurance Representative (QAR) personnel in the performance of technical and administrative duties that are required for the proper inspection of dredging operations. Its chief objective is to promote efficient and uniform procedures for inspecting dredging operations, handling computations, and preparing reports. This pamphlet is a guide only. It does not supersede the technical provisions of any contract or invalidate any Contracting Officers' directives and regulations. Although the procedures are specifically for contract operations, they are equally applicable to government plant and hired labor dredging.

Applicability. This guidance applies to Headquarters, U.S. Army Corps of Engineers (HQUSACE) and all Office of the Chief of Engineers (OCE) elements, major subordinate commands (MSC), District commands, laboratories, and field operating activities (FOA). This document adds a seventh volume to EP 415-1-261 (reference c).

Distribution Statement. Approved for public release; distribution is unlimited.

Proponent and Exception Authority. The proponent of this regulation is the CECW-EC. The proponent has the authority to approve exceptions or waivers to this regulation that are consistent with controlling law and regulations. Only the proponent of a publication or form may modify it by officially revising or rescinding it.

*EP 415-1-261_7 supersedes EP 1130-2-310 dated 28 June 1963.

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1. Purpose

The purpose of this document is to provide information for assisting and instructing dredging Quality Assurance Representative (QAR) personnel in the performance of technical and administrative duties that are required for the proper inspection of dredging operations. Its chief objective is to promote efficient and uniform procedures for inspecting dredging operations, handling computations, and preparing reports. This pamphlet is a guide only. It does not supersede the technical provisions of any contract or invalidate any Contracting Officer's directives and regulations. Although the procedures are specifically for contract operations, they are equally applicable to government plant and hired labor dredging.

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4. References

USACE publications are available at https://armypubs.army.mil/ and https://www.publications.usace.army.mil.

a. **Code of Federal Regulations (CFR) Title 33**
Navigation and Navigable Waters

b. **CFR Title 33, Chapter I, Subchapter C**
Aids to Navigation

c. **CFR Title 33, Chapter I, Subchapter D**
International Navigation Rules

d. **EM 385-1-1**
Safety and Health Requirements

e. **EM 1110-1-1005**
Control and Topographic Surveying

f. **EM 1110-2-1003**
Hydrographic Surveying

g. **EM 1110-2-5025**
Dredging and Dredged Material Management

h. **EP 415-1-260**
Area/Resident Engineer Management Guide

i. **EP 415-1-261**
Quality Assurance Representative Guide

j. **Public Law 64-252**
Adamson Act/Eight-Hour Act

k. **Public Law 71-798**
Davis-Bacon Act of 1931

l. **Public Law 73-324**
Copeland "Anti-kickback" Act of 1934

5. Records Management (Recordkeeping) Requirements

The records management requirement for all record numbers, associated forms, and reports required by this regulation are addressed in the Army Records Retention Schedule – Army (RRS-A). Detailed information for all related record numbers is located in the Army Records Information Management System (ARIMS)/RRS-A at https://www.arims.army.mil. If any record numbers, forms, and reports are not current, addressed, and/or published correctly in ARIMS/RRS-A, see Department of the Army (DA) Pamphlet 25-403, Guide to Recordkeeping in the Army, for guidance.

6. Dredging Program

The USACE annual dredging program involves the removal and placement of approximately 250 million yards of material at a cost exceeding $1 billion. This includes new dredging work as well as maintenance. A continued and extensive dredging program is necessary for the improvement and subsequent maintenance of the interlacing systems of harbors and waterways. The hundreds of commercial harbors and 23,000 miles of waterways being maintained as federally authorized projects handle more than one billion tons of commerce annually. The unrestricted movement of commerce over the navigable waters of the United States is a vital asset to its economic welfare and security (Figure 1).

7. Terminology

In dredging, as in other USACE construction, there are certain administrative and documentary terms so closely related to the work that the Quality Assurance Representative (QAR, often shorted to QA) needs to be thoroughly familiar with their meaning. These terms, as used in this pamphlet, are defined as follows:

a. District Engineer. The District Engineer, nearly always a United States Army Officer, is the highest authority in the District.

b. Contracting Officer. The Contracting Officer is the official authorized to enter into and administer a USACE contract.

c. Administrative Contracting Officer (ACO). The ACO is appointed, in writing, by a Contracting Officer and delegated limited authorities to administer construction contracts, task orders, and/or modifications.

d. Resident Engineer. On USACE construction and maintenance work, the Contracting Officer generally has an authorized representative at the work site who is directly responsible for determining that the terms of the contract are being complied with. On work of major scope, this official is generally a Resident Engineer with a staff of QARs under their supervision. On work of less magnitude, and particularly in dredging operations, the representative is a Resident Engineer or the QAR.

e. QAR. The QAR role ensures the Government Contracting Officer that the quality and safety requirements of the contract have been satisfied. This includes being thoroughly familiar with all the provisions of the contract documents, including submittals. Plans and specifications should include all revisions, changes, and amendments. In addition, QAR should be thoroughly familiar with the administrative policies of their District.

f. Contractor Quality Control. The Contractor Quality Control (CQC) is an employee of the contractor who works directly with the QAR role to ensure quality on the job site. The CQC is responsible for person-hour reporting and other daily reports that are passed to the QAR for review.

g. Supervisory Personnel. The Supervisory Personnel are those officials in the direct chain of command who are responsible for the operation and prosecution of the construction work. The Supervisor is responsible for direct supervision of the QAR's work and issues instructions and orders to the QAR. All communication between the QAR and the District office will be made through the QAR's supervisor, except in emergencies.

h. Higher Authorities. Higher Authorities are those officials whose concern with the work is indirect and supplementary. They include personnel and all officials from Divisions and the Office of the Chief of Engineers.

i. Contractor. The Contractor is that person or group of persons who agrees to do a specific item of work for USACE for a stated sum of money. The term Contractor in this manual embraces the prime contractor and all the subcontractors employed by the prime contractor.

j. Contract. The Contract is a legal written agreement between the Contactor and the Contracting Officer which binds the Contractor to do certain specified work for an agreed sum of money.

k. Plans and Specifications.

(1) The Plan is a drawing that, in general construction, shows the principal proportions and relative positions of the various parts of the work. In dredging, the chief feature of the Plan locates the area to be dredged by means of horizontal boundaries and vertical distances from the water surface. These vertical distances, correlated to a desired datum, are called soundings, and are shown on the Plan either as a series of numerical notations graduated, usually, to tenths of a foot, or by channel cross sections. The Plan includes certain information peculiar to dredging operations such as tide and stream data, type and location of buoys, location of placement areas, etc.

(2) The Specifications are a narrative supplement to the Plan and state what is to be done, the controls required, and how the various items of work are measured and paid for. Together, the Plans and Specifications call for completed work representing the best considered judgment of the District Engineer and are legally a part of the Contract.

l. Hired Labor. Hired labor refers to Federal Government personnel working on USACE-owned and operated equipment or floating plant. It is a regional term common in the Midwest inland rivers and does not refer to contractors or contracted labor.

8. Dredging Definition

Dredging is the removal of material, usually from underwater, for the purpose of constructing new canals or waterways, maintaining existing channel depths and widths,

obtaining fill for reclamation of lowland areas, replenishing beaches, constructing dikes and levees, and obtaining construction materials such as sand, gravel, and shell for commercial use.

Figure 1. USACE Hopper Dredge Essayons

9. Types of Dredges

Dredges are floating excavation machines used to remove materials from underwater. Detailed information on dredging equipment, production rates, and use can be found in EM 1110-2-5025, which is recommended reading for every dredging QAR. The principal dredge types are listed in Table 1. Multiple dredge types may be used on the same navigation project (see EM 1110-2-5025, Engineering and Design, Dredging, and Dredged Material Management). Each dredge type may have several forms, examples from EM 1110-2-5025 are listed below:

Table 1
Principal Dredge Types and Mode of Operation

Category	Type	Mode of Operation
Hydraulic Dredges		Material moved by water through pipe.
Hydraulic Dredges	Pipeline – Plain Suction	Nozzle sucks loose sand or mud. No storage, continuous pipe delivery.
	Pipeline – Cutterhead	Rotary cutter loosens material for nozzle.
	Pipeline – Dustpan	Water jets loosen sand for wide, flat nozzle.
	Seagoing Hopper	Drag nozzle feeds hopper in seagoing vessel.
Bucket Dredges		Digging bucket manipulated from floating hull.
	Clamshell	Two-part bucket swung from stiff-leg derrick.
	Dipper	Rooting bucket on stiff arm.
	Ladder	Chain of buckets on pivoted arm.
	Ladder – Stationary	Mining or gravel producer.
	Ladder – Barge Loading	Belt or chute conveyor to barges alongside.
	Ladder – Seagoing Hopper	Hopper in seagoing vessel.

a. Hydraulic Dredges. Hydraulic dredges are characterized by the use of a centrifugal pump to dredge sediment and transport it in a liquid slurry form to a discharge area. The major types of hydraulic dredges are hopper dredges and cutterhead pipeline dredges. Less common hydraulic types include dustpan and sidecaster dredges. Hopper, pipeline, and sidecaster dredges are named for the method they use to transport dredged material from the dredging site to the placement area. Dustpan dredges are named for their unique suction head configuration.

(1) *Trailing Suction (Hydraulic) Hopper Dredges.*

(a) Hopper dredges are seagoing vessels that excavate material hydraulically and transport it to a placement site in a hopper built into the hull of the vessel. They are self-propelled seagoing ships that, in the United States, vary in length from 180 to 510 feet (55 to 155 meters), with the molded hulls and lines of ocean vessels.

(b) Hopper dredges are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and other special equipment required to perform their

essential function of removing material from a channel bottom or ocean bed and placing that material in open water or upland sites.

(c) Hopper dredges have propulsion power adequate for required free-running speed and dredging against strong currents, as well as excellent maneuverability for safe and effective work in rough, open seas. The vessel hull is compartmented into one or more hoppers. The normal configuration has two drag arms, one on each side of the ship.

- A drag arm is a pipe suspended from the vessel with a suction opening called a drag head. Single drag arms are common on smaller hopper dredges, while a government hopper dredge, the Wheeler, has three drag arms (one on each side and one in the middle). The drag arm is connected to a dredge pump, usually located inside the hull through a flexible “through-hull” connection called a trunnion. In some cases, the dredge pump is located on the drag arm to increase its hydraulic efficiency.
- An example of a self-propelled trailing arm hopper dredge is shown in Figure 2. Figure 3 shows three USACE-owned hopper dredges. Figure 4 shows a hopper dredge sailing low in the water. Figure 5 shows a view from the bridge of a hopper dredge looking down into the hopper. Figure 6 shows the same hopper dredge sailing unloaded and loaded.

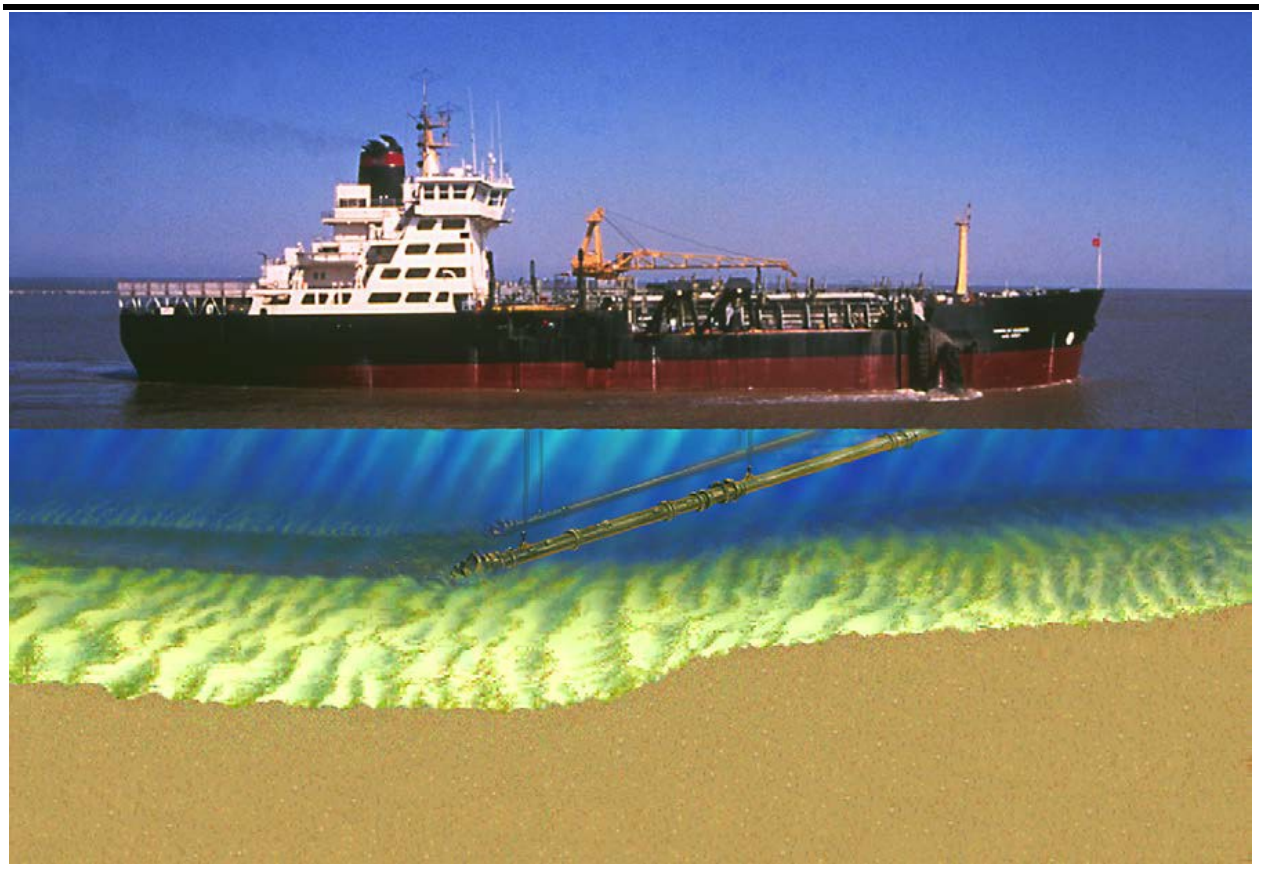

Figure 2: Self-propelled trailing arm hopper dredge with two drag arms deployed. Material is removed from the seafloor and deposited into the vessel’s hopper. (Image from EM 1110-2-5025)

Figure 3: Three USACE-owned hopper dredges: Essayons, Wheeler, and McFarland

Figure 4: Hopper dredge Padre Island (owned/operated by Great Lakes Dredge & Dock) actively dredging with drag head deployed and sailing low in the water while loaded with material

Figure 5: View from the bridge of a hopper dredge Terrapin Island (owned/operated by Great Lakes Dredge & Dock), looking down into the hopper while it is filled with slurry material

Figure 6: Top panel: Dredge Essayons sailing unloaded, note red section of hull visible above waterline. Bottom panel: Dredge Essayons sailing loaded, drafting 12–14 feet lower in the water with very little red section of hull visible above waterline.

(2) Hydraulic Pipeline Cutterhead Dredges.

(a) Pipeline dredges are normally not self-propelled dredges that may employ a mechanical cutter to break up the material, which is then excavated hydraulically and transported to the placement site through a pipeline. The cutterhead dredge is generally equipped with two stern spuds used to hold the dredge in working position and to advance the dredge into the cut or excavating area. During operation, the cutterhead dredge swings from side to side alternately using the port and starboard spuds as a pivot. Cables attached to swing anchors on each side of the dredge control lateral movement. Swing anchors are set out and repositioned by anchor-handling derrick barges or, in areas where water depth precludes derrick barge passage, anchor booms (fastened to the dredge hull) have been used to set the anchors.

(b) The dredge forward movement, or advance, is achieved by lowering the starboard spud (now called the working spud) after the port swing is made and then raising the port spud (now called the walking spud). The dredge is then swung back to the starboard side of the cut center line. The port spud is lowered, and the starboard spud is lifted to advance the dredge. This double-spud configuration is the most common way to advance a cutterhead, but a limited number of dredges use a spud carriage, which consists of a working spud mounted in a hydraulic ram-driven carriage that translates in a longitudinal (parallel to the dredge center line) slot. A spud carriage can advance the dredge more quickly than a double-spud configuration, achieving higher production.

(c) Figure 7 shows a cutaway diagram of a cutterhead dredge while working. Figure 8 shows a cutterhead dredge working on the Columbia River. Figure 9 shows a dredge operating inside a port area. Figure 10 shows a closeup of a cutterhead. Figure 11 shows a hopper dredge and a cutterhead pipeline dredge working in close proximity.

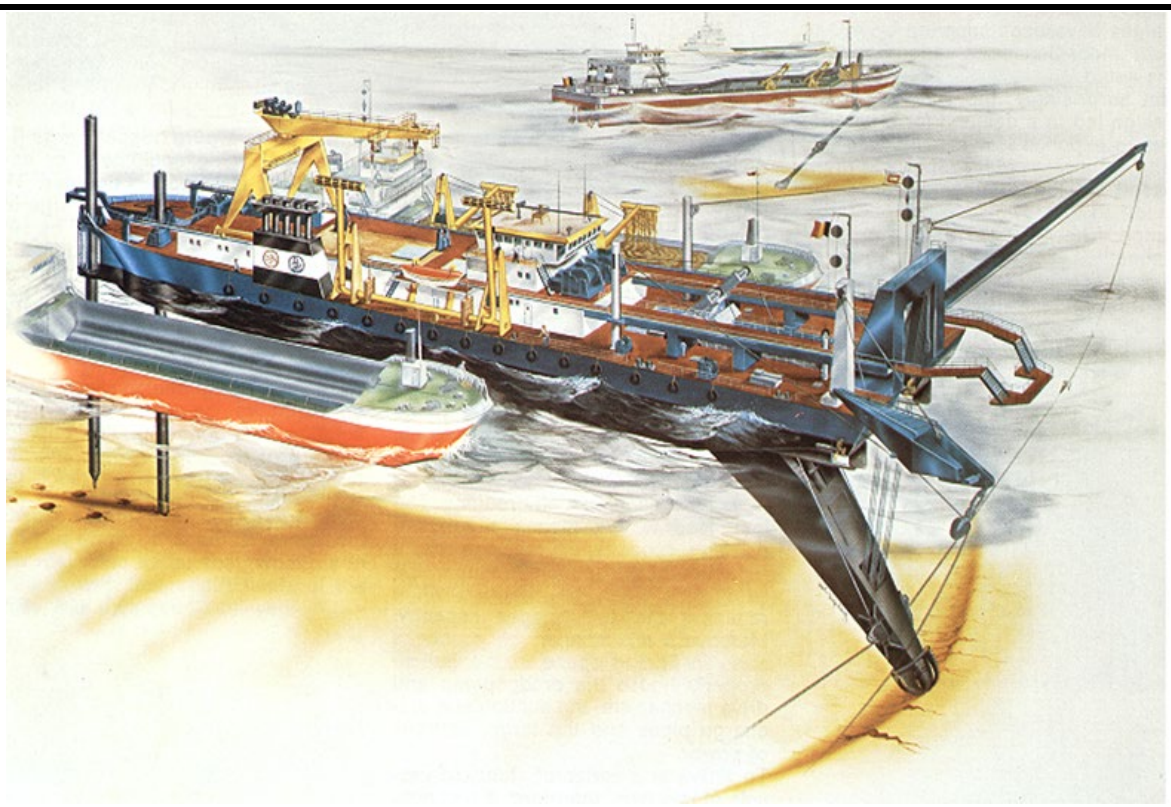

Figure 7: Schematic of a pipeline cutterhead dredge working (Image from EM 1110-2-5025)

Figure 8: Port of Portland owned/operated Dredge Oregon (pipeline cutterhead dredge) operating on the Columbia River. The cutterhead is suspended above the water on the left side of the photo, the discharge pipeline is coming off the back of the dredge to the right.
(Photo from Portland District)

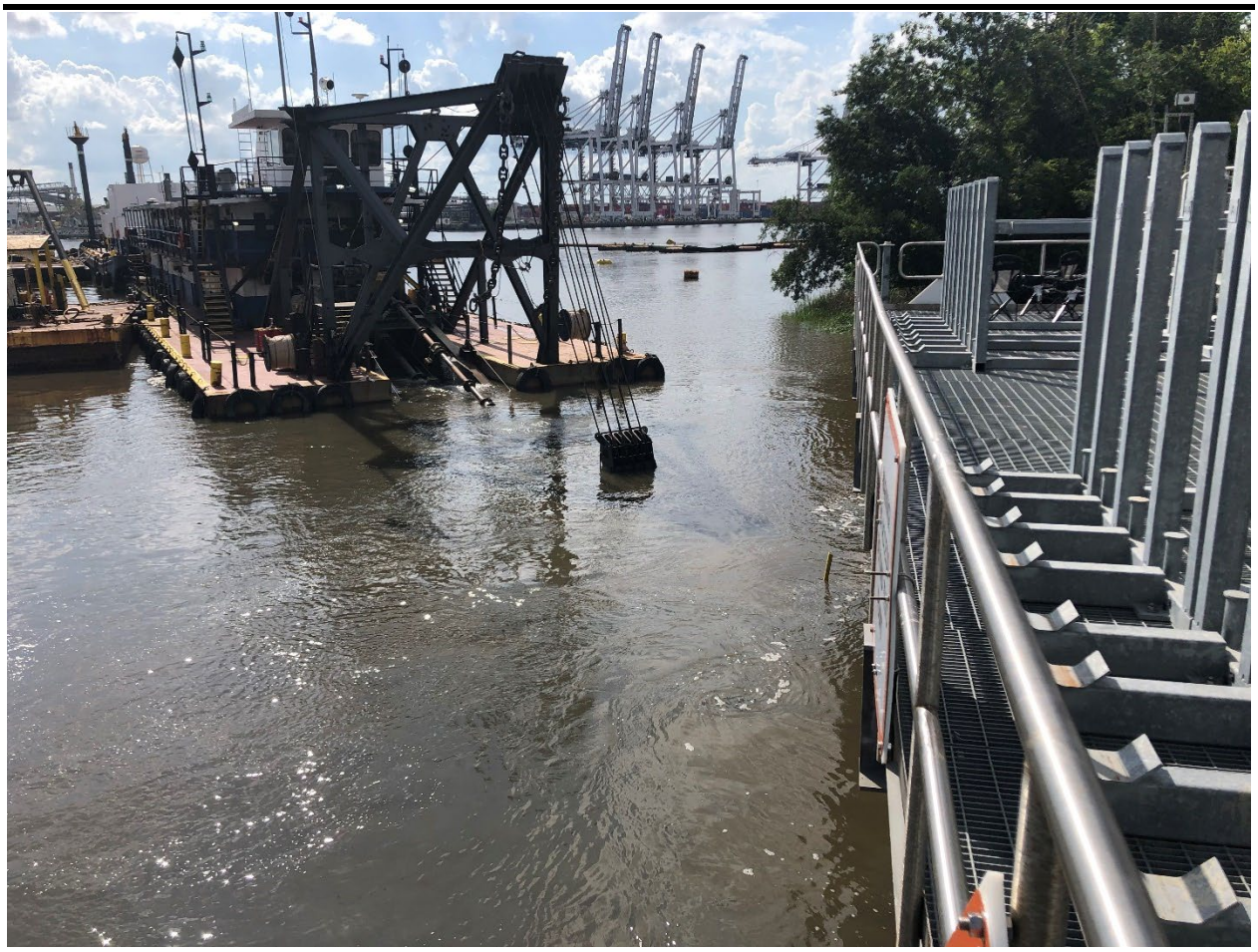

Figure 9: Dredge Hampton Roads (pipeline dredge owned/operated by Marinex Construction, used for maintenance dredging) operating in Savannah Harbor near the intake to the Dissolved Oxygen injection facility (Photo from Savannah District)

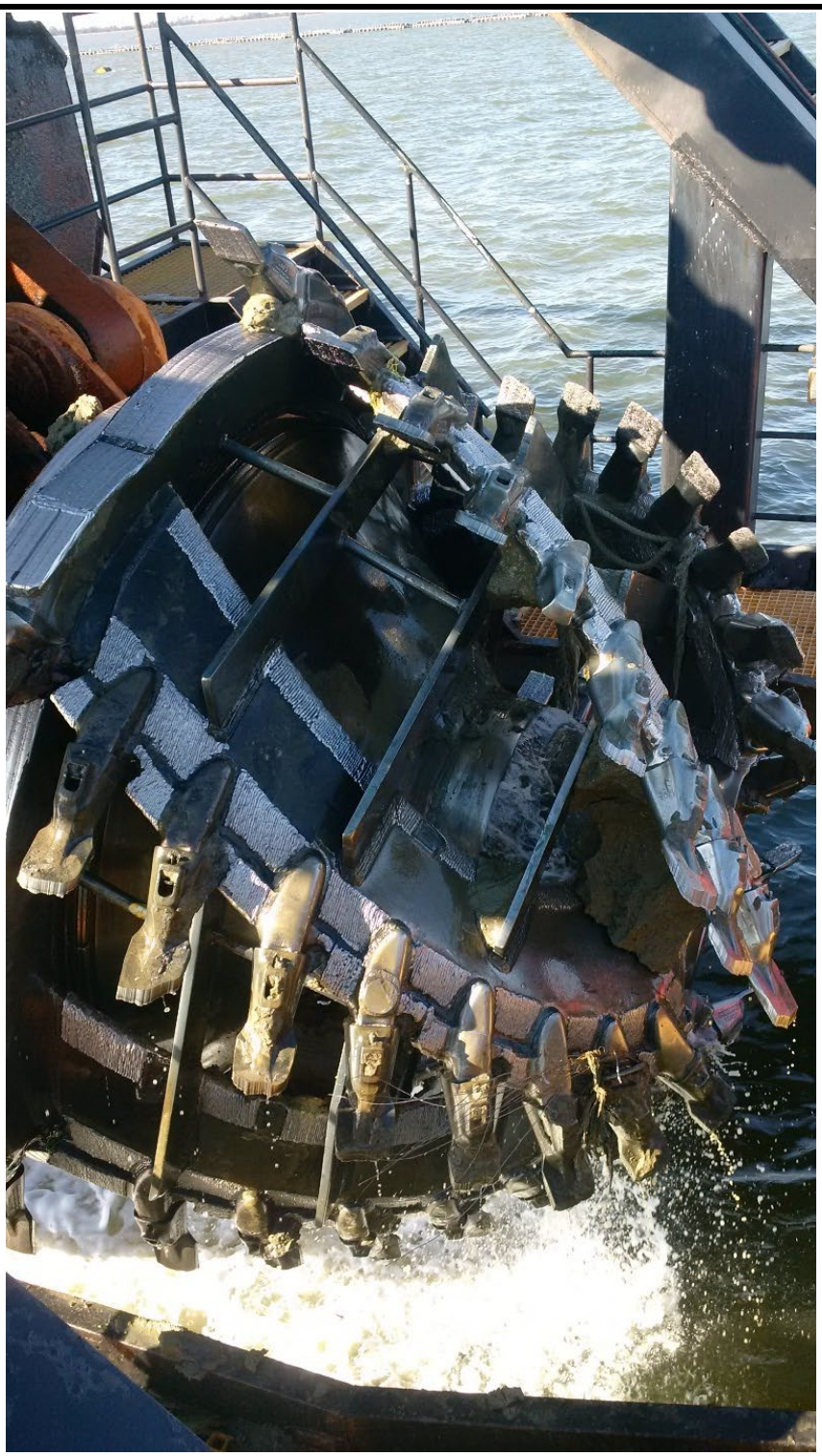

Figure 10: Close-up view of pipeline cutterhead showing interchangeable cutting teeth, which should be securely fastened before use. Debris can be caught in the cutterhead and needs to be cleared periodically. Debris often includes tires and wires.

Figure 11: Multiple dredge types can work on the same navigation project. Top panel: View of hopper dredge Essayons and the cutterhead dredge Oregon from the side. Bottom panel: View from the deck of the Oregon looking toward the Essayons, on the Columbia River.

Note: In these photos, the Essayons and Oregon (owned/operated by Port of Portland) are maneuvering within 200 feet (60.96 meters) of each other while the Oregon's cutterhead is working below the waterline. During this "rehandling" work, the Essayons placed previously dredged material in front of the Oregon so that it could be pumped ashore by the cutterhead pipeline dredge. As a result of this process, the material was

removed from the system. During rehandling events, the two dredges maintain constant radio communication.

(3) *Hydraulic Pipeline Dustpan Dredges.* Dustpan dredges excavate material hydraulically with a unique, water jet-assisted suction head and transport it to an in-water placement site through a relatively short floating pipeline. As shown in Figure 12, the dustpan dredge is a self-propelled hydraulic pipeline dredge that uses a widely flared dredging head along which is mounted pressure water jets. The jets loosen and agitate the sediments, which are then captured in the dustpan head as the dredge itself is winched forward into the excavation. The dustpan dredge operates with a low-head, high-capacity centrifugal pump since the material must be raised only a few feet above the water surface and pumped a short distance. The dredged material is normally discharged into open water adjacent to the navigation channel through a pipeline usually only 800–1,200 feet (250–365 meters) long.

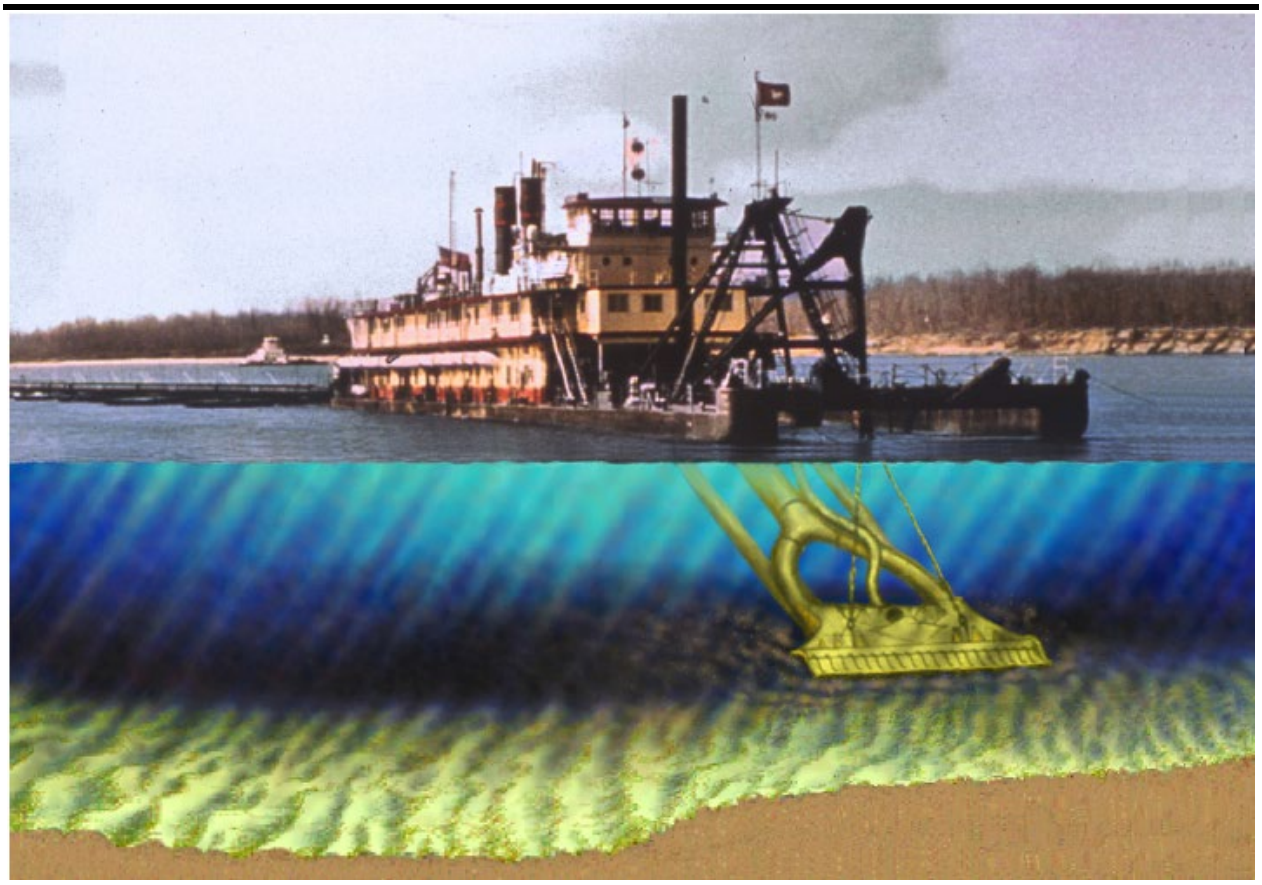

Figure 12. The dustpan dredge was developed by USACE to maintain navigation channels in uncontrolled rivers with bed loads consisting primarily of sand and gravel. Dustpans are predominantly operated in the Mississippi River and inland waterway system. (Image from EM 1110-2-5025)

(4) Sidecaster or Boom Dredges.

(a) Sidecaster dredges are essentially hopper dredges without the hoppers. They excavate the material hydraulically and transport it through a short pipe to an in-water

placement site adjacent to the dredged channel. As shown in Figure 13, the sidecasting type of dredge is a shallow-draft seagoing vessel, specially designed to remove material from the bar channels of small coastal inlets. The hull design is like a hopper dredge; however, sidecasting dredges do not usually have hopper bins. Instead of collecting the material in hoppers onboard the vessel, the sidecasting dredge pumps the dredged material directly overboard through an elevated discharge boom; thus, its shallow draft is unchanged as it constructs or maintains a channel.

(b) The discharge pipeline is suspended over the side of the hull by structural means and may be supported by either a crane or a truss and counterweight design. The dredging operations are controlled by steering the vessel on predetermined ranges through the project alignment. The vessel is self-sustaining and can perform work in remote locations with a minimum of delay and service requirements.

(c) Sidecasters are often assigned to work at unstabilized, small inlets that serve the fishing and small-boat industries. Dangerous and unpredictable conditions prevail in these shallow inlets, making it difficult for a conventional plant to operate except under rare ideal circumstances.

Figure 13. The USACE sidecasting dredge Merritt can work in locations too shallow for hopper dredges and too rough for pipeline dredges

b. Mechanical Dredges. Mechanical dredges use some form of a bucket to excavate and raise the bottom material. They do not normally transport the material to the placement area. In some cases, the dredged material can be deposited directly in the water or on the bank immediately adjacent to the dredging area. Normally the mechanical dredge deposits material into a barge that transports it to the placement area. Mechanical dredges may be classified into two subgroups by how their buckets are connected to the dredge: wire rope connected (clamshell, grab, or dragline) and structurally connected (a backhoe or excavator). Figure 14 shows a clamshell bucket dredge, while Figure 15 shows an excavator (mechanical) dredge.

(1) Mechanical Bucket Dredges.

(a) The wire-rope connected clamshell (or grab) dredge uses a bucket to excavate the material. Different types of buckets can fulfill various types of dredging

requirements. The buckets used include the clamshell, orange-peel, and dragline types, and can usually be quickly changed to suit the operational requirements.

(b) The vessel can be positioned and moved within a limited area using anchors and/or spuds. When the spuds are up, the bucket itself can be used to reposition the dredge by “grabbing” the bottom in the direction of desired translation and pulling the dredge that way by taking in wire rope. The barge is normally equipped with two spuds forward (in the front of the barge) and one spud at the aft end of the barge. The latter is a kicking spud for advancing the dredge.

(c) Alternatively, the barge can be held in place by anchors, which are attached to winches on the dredge hull and can be placed by an attendant tugboat or by a crane boom. The material excavated is either placed in scows or hopper barges that are towed to the placement areas or it is side cast. Buckets used on this type of dredge usually range in capacity from 1 to 30 yd^3 (0.8 to 23 m^3). The crane is mounted on a flat-bottomed barge, on fixed-shore installations, or on a crawler mount.

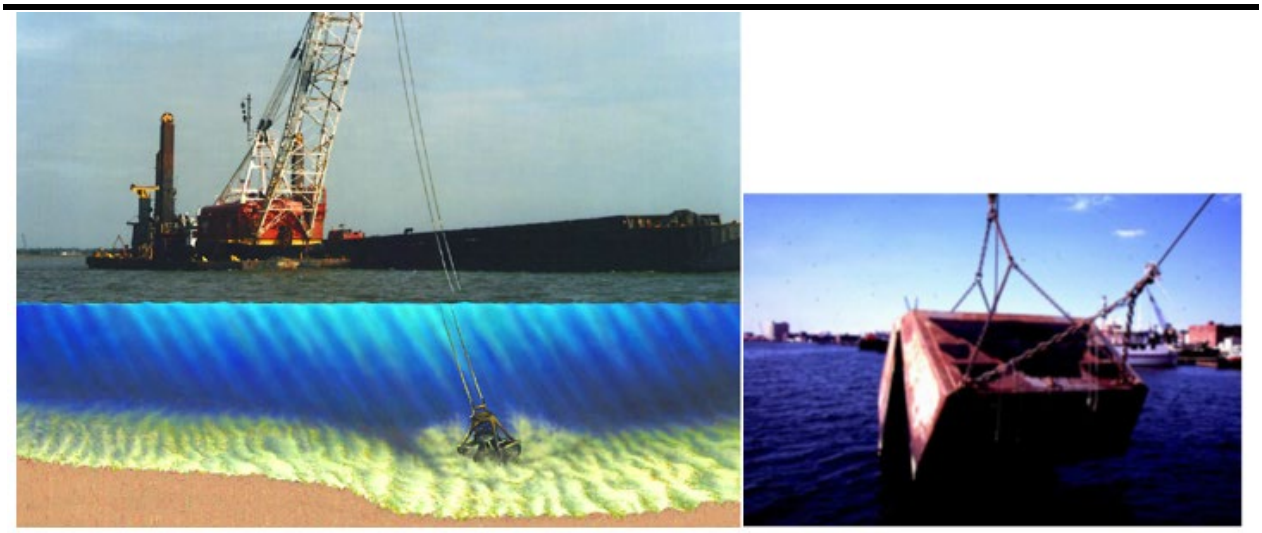

Figure 14. Clamshell bucket dredges remove sediment at near in situ densities (left). Clamshell dredges can be outfitted with an enclosed bucket to minimize the release of sediment and water during excavation. Enclosed buckets are commonly used when there are concerns about sediment contamination (right). (Image from EM 1110-2-5025)

(2) Mechanical Backhoe or Excavator Dredges.

(a) The backhoe dredge uses a bucket that is structurally connected to the dredge by the rigid member configuration. To increase digging power, the dredge barge is moored on powered spuds that transfer the weight of the forward section of the dredge to the bottom to provide reaction forces to the digging-induced forces. The maximum bucket size that can be used for a specific project depends on the rated capacity of the excavator, sediment characteristics, and water depth.

(b) Bucket sizes generally range from 6 to 25 yd^3 (0.6 to 19 m^3). Larger backhoes can excavate to a maximum depth of approximately 80 feet (24 meters). Because the bucket of a backhoe is connected by rigid structural members, more force can be applied to it, allowing these types of dredges to work in harder materials (relatively cohesive consolidated materials, weak rock, and debris) than can cable-connected

buckets. Backhoe operational characteristics provide relatively high excavation accuracy, and they can work closely around structures. The density of sediment excavated is near equal the in situ density but, like other conventional mechanical dredges, it may generate a relatively large amount of sediment resuspension at the dredge site. Figure 15 shows an example of a backhoe dredge working near the shoreline.

Figure 15: Excavator (mechanical) dredge on barge. Excavator dredges are limited in their dredging depth capabilities but can be precisely controlled so there is less danger when dredging around structures. (Photo from J.F. Brennan)

10. Submerged Rock Removal Equipment

a. There are two common types of equipment for breaking up hard rock underwater so it can be handled and removed by a dredge. In USACE work, rock is usually broken up by drilling and blasting, both will have site-specific environmental restrictions. A securely anchored barge called the drill boat is used for drilling and blasting. A series of rock drills secured in vertical guide frames are mounted on the barge to permit operation over the side. An explosive charge is inserted into drilled holes through a pipe or loading tube. The entire operation is systematically controlled to ensure proper and safe procedure.

b. Rock removal involving explosives or drilling is subject to additional environmental monitoring and restrictions. QARs should coordinate with the contractor to follow

required monitoring and observation procedures; District environmental offices will likely be involved as well.

c. Another way to break up rock is to use a rock breaking machine or hydraulic hammer. The equipment is mounted on a barge and operates like a pile driver, raising and dropping a heavy structural steel shape with a hardened point or chisel edge on the submerged rock. The rock breaks up under the impact of the blows being concentrated on a limited area.

11. Dredged Material Placement Equipment

a. The bucket dredge ordinarily requires dump scows for the placement of the dredged materials. The dump scow is a barge divided into a series of bins or pockets, into which the dredged material is deposited. There are two general types of dump scows, distinguished by the method of dumping: the bottom dump and the side dump.

(1) The bottom dump scow is used if the depth of water in the placement area is sufficient to allow the bottom dump gates to open freely. The side dump scow is used in shallower water. The hydraulic dredge, excluding the hopper type, places its material by means of a pipeline extending from the dredge to the location of placement.

(2) The discharge line, fitted with flexible connections at critical sections, is usually made of three parts: the pipe on the dredge, the pipe afloat, and the pipe ashore. The floating pipeline is supported by a series of pontoons adequately spaced to keep the pipe afloat and in line. Under certain conditions, submerged pipe or pipe on trestle is used in the discharge line. Floating pipeline may articulate onto a spill barge and serve as the terminus of the discharge line for targeted in-water placement or can be run ashore for upland placement. Figure 16 through Figure 23 demonstrate different placement practices used around the country.

b. Hydraulic Unloader/Pump-Out Scow. Some scows can pump material out of the scow onto an upland site. Scows are monitored during placement for any excess material left in the scow at the end of the pump-out. Any material remaining in the scow is subtracted from the amount of material used for upland placement.

c. Spider Barge. The spider barge splits the flow of sediment slurry from a cutterhead pipeline dredge into multiple scows that transport the dredged material for placement.

d. Hopper Dredge Pump-Out. All hoppers can discharge material by splitting (opening) the hull (see Figure 16) or through discharge doors on the vessel bottom. Some hopper dredges are equipped with pump-out capability, this is used for upland placement, especially beach nourishment or shallow-water placement. Any material remaining in the hopper at the end of the pump out is subtracted from the amount of material used for upland placement.

Figure 16: Dredge Currituck splitting open the hull to place material in the nearshore environment (Photo from EM 1110-2-5025)

Figure 17: Discharge of a pipeline. Discharge can be directly into an enclosed site, into the open water, or onto a beach. Discharged material is moving at a high velocity and can cause injury. The area of discharge should be avoided because pumping can begin at any time.
(Photo from Portland District)

Figure 18: Pipeline connecting to the Dredge Stuyvesant for pump-ashore (pump-out) beach nourishment work. The tender and tug vessels are used to maintain the anchors on the pipeline.

Figure 19: Beach placement using pump-out from a hopper dredge in San Francisco District. Note the orange safety fencing in the background to keep the public away from the workspace. Security guards were employed onsite. In this location, the sand berm over the pipeline was used to maintain emergency services access.

Figure 20: Example of mechanical dredge performing bank line mechanical placement on an inland waterway. Considerations for this type of placement are to reduce the encroachment of the material into the waterway by getting as close to the bank line as possible. In some cases, a backhoe may be stationed on the bank to pull material onto the shoreline and then push the material up to the natural tree line. Covering the exposed roots of mature trees with the material is done to prevent established trees from falling into the river and degrading the bank line. Material tends to stay on the bank longer if it is placed closer to the natural tree line. Sites may need to be surveyed for species of concern before placement. (Photo from Rock Island District)

Figure 21: Example of site after hydraulic bank line placement followed with post-placement grooming by bulldozers used to knock down the high spots, a common practice along the Mississippi River (Photo from Rock Island District)

Figure 22: Inland river dredging discharge barge (looking upstream toward the dredge). The floating pipeline has several amber lights for visibility (required for safety). Associated navigation notices (notice to mariners) are broadcast that request mariners to radio the dredge at least 30 minutes prior to transiting the area. Each contract will specify the person responsible (usually the contractor's CQC) for distributing the notice to mariners. The QAR should confirm that the notice is distributed and accurately describes the work area. (Photo from Rock Island District)

Figure 23: Detail of an amber light marking a floating pipeline on an active dredging job (Photo from Rock Island District)

12. Quality Assurance Representative Responsibilities

a. Preparation for Duties. A QAR has a responsible and important assignment as the contracting officer's representative at the work site. As preparation for the position, the QAR should take on-the-job training. Knowledge of the surveying and hydrographic surveying process is desirable. Information on these topics is available in EM 1110-2-1003, Hydrographic Surveying, and EM 1110-1-1005, Control and Topographic Surveying. The QAR should study the applicable Engineer Regulations and Manual and retain a copy of the Engineer Pamphlet for ready reference.

b. Contract Plans and Specifications. The QAR's prime responsibility on both contract dredging and hired labor operations is to ensure that the work is being accomplished according to the plans and specifications. The QAR should be thoroughly familiar with these documents and must bear in mind that standard or guide plans and specifications are constantly being revised to incorporate new policies and improved procedures and techniques. For this reason, the QAR should not rely on familiarity with plans and specifications for similar work performed previously but should review such documents for each job assignment. The QAR should pay particular attention to those portions of the contract and specifications pertaining to changed conditions, misplaced material, locations of obstructions such as underwater cables, pipelines, or sunken vessels, and to the project limits defining width, depth, allowable overdepth, and side slopes.

c. Plant and Equipment.

(1) For each job assigned, the QAR must become familiar with the various types of dredging equipment and attendant plant to be used, their capabilities, and their operating procedures. In addition, to understand the dredging operation and progress of the work, the QAR should become familiar with each operator's handling of the equipment.

(2) As part of a Quality Assurance Plan, the QAR may need to verify the paperwork related to the following: U.S. Coast Guard (USCG) Certificate of Inspection for Floating Plant; USCG Licensing of Mates and Captains; Crane operator credentials and medical clearance(s); any contractually required monitoring equipment and Global Positioning Systems (GPS) location equipment (such as Dredging Quality Management sensors); turbidity or dissolved oxygen (DO) monitoring equipment; water quality certificate for the job location; and other environmental permits as required.

(3) In areas where Turtle Exclusion Devices (TED) are used on a hopper dredge, the drag-arm will have white diagonal paint stripes on it as part of the "paint test" (see Figure 24). The paint test is a quality control check to validate the ability of the Turtle Exclusion Device to embed in the seafloor. The paint will wear off from abrasion if the TED is embedding properly in the seafloor.

Figure 24: Hopper drag arm. White diagonal paint strips are part of the paint test. The paint test is a quality control check to validate the ability of the TED to embed in the seafloor. The paint will wear off from abrasion if the TED is embedding properly in the seafloor.

d. Reference Marks, Tide, and Stream Gages. The QAR must learn the locations of reference marks, range markers, tide, and stream gages (temporary and permanent), benchmarks, navigation buoys (lighted and unlighted), base lines, and the various permanent orientation points that are located on the plans. The QAR will know the reference datum plane being used. In contract operations, it is the QAR's responsibility to ensure that the contractor maintains all dredging ranges, gages, stakes, etc., in good condition, and that the contractor maintains lights on all necessary dredging markers

during hours of darkness. GPS is used to verify tide boards for correct height, a QAR should be able to read a tide board in the field.

e. Regulations for Lights and Signals in Navigable Waterways. All dredging operations under USACE supervision must comply with the general regulations of the Department of the Army and the U.S. Coast Guard, as stated respectively, in the following Code of Federal Regulations (CFR): CFR Title 33 (Navigation and Navigable Waters) and CFR Title 33, Chapter I, Subchapter C (Aids to Navigation) and Subchapter D (International Navigation Rules). These regulations govern signal lights, day signals, channel markers and passing other vessels or floating plants working in navigable channels. The QAR is required to become familiar with these regulations and to ensure that they are observed by the operating units concerned. Violations in the case of contract dredging must be brought to the attention of the contractor's representative. In any case, the QAR is to report the violation to their supervisor. QARs should be familiar with the types of Aids to Navigation, commonly referred to by their acronym AtoNs, present in local waterways.

f. Records Management and Site Access. The QAR should be familiar with the required inputs for the Resident Management System (RMS) or other electronic system of record, and obtain any required internet access, access cards, door keys, and login information.

g. General Preparations Before Arrival Onsite. Before reporting to the site of the work for a new assignment, the QAR should confer with their supervisor concerning special instructions necessary for that site. The QAR should obtain a copy of the contract, plans, specifications, pertinent maps, required personal protective equipment (PPE) (such as personal flotation device, hard hat, steel toe shoes), and any necessary tools, instruments, and office supplies.

h. After Arrival Onsite. As soon as possible after reporting to the site of the work, the QAR must confer with the contractor's representative in charge of the operations relative to the layout of the work, ranges, grades, tide or stream gates, safety requirements, and other matters pertinent to that particular job.

i. Safety Onsite. An initial complete safety inspection of the contract plant is generally made by the Contractor's Site Safety Health Officer (SSHO) prior to beginning work, and this must be verified by the QAR or the USACE Safety Officer. All inspections should follow the standard published in EM 385-1-1, Safety and Health Requirements. Within a week after starting operations, the QAR, in the company of the contractor's or hired labor supervisory representative, must make a follow-up safety inspection of the plant and equipment. Each week thereafter, a safety check will be made, and any violations will be called to the attention of the superintendent in charge of the operation with a request for their correction and, at the same time, a report should be made to the QAR's supervisor. If, after a reasonable amount of time, the correction is not made, the QAR's supervisor must be so advised.

j. Safety at Placement Sites. Placement site designs and conditions vary by region. Many Districts use placement sites surrounded by earthen berms to contain dredged material while the water decants, leaving behind sediment. The flow of water at these sites is controlled by weir structures, which have specific safety considerations. Figure 25 through Figure 28 display examples of weirs at different stages of the placement process.

Figure 25: Double weir in the Savannah District, showing ladders, weir boards, and tie-point attachments for a safety lanyard to be used while ascending and descending the ladder. Fall protection should always be worn when working around a weir.

Figure 26: Catwalk to a weir structure. Placement area shows crackled “false surface” that forms after water has been partially decanted but can give way when stepped on. Always use the catwalk when accessing a weir structure but inspect it for structural soundness prior to use (check for signs of deterioration, such as rust, which could result in failure).

Figure 27: Looking down from the top of a weir ladder in the Savannah District. Muck and mud have accumulated around the weir boards and submerged the bottom of the ladder. Ladders that been submerged for extended period of time can decay and should be inspected for soundness before use.

Figure 28: Upland placement site in Portland District. The catwalk and handrail are on floats and adjust to the fill level of the site. Weirs are removed after the site fills up or after placement is complete. The catwalk provides access to the front of the weir to adjust weir boards. Fall protection and personal flotation devices (PFDs) are required because of gaps in the handrails.

13. Tour of Duty

a. The normal tour of duty is 8-hours per day for five days per week. However, this normal tour is subject to change at the discretion of the QAR's supervisor to conform to the work requirements.

b. If the incoming QAR does not report as scheduled on jobs covered by more than one shift per day, the QAR on duty will notify their supervisor as soon as possible and remain on duty until relieved.

c. In the event of sickness or other emergency (personal or otherwise) where the QAR cannot report for duty or must leave the job site, the QAR must notify a supervisor or arrange for such notification in order that a replacement can be made prior to the departure of the QAR, if possible.

14. Authority

As the District Engineer's official representative at the site of work, the QAR has certain direct and indirect authority to ensure that the work is being performed according to the plans and specifications. The QAR must ascertain from their supervisor the full extent of this authority when assigned to the work.

a. The following authorities are generally applicable throughout USACE and may be used by the QAR unless specifically instructed otherwise by a supervisor.

(1) The contractor is required to comply with all requirements of the contract. If the contractor refuses to comply, the QAR must immediately notify the contracting officer's representative, the contracting officer, and the QAR supervisor.

(2) The QAR can direct the suspension of operations at any unit of work where the contractor does not, upon request, correct a safety hazard that is so grave as to endanger life, limb, or property or cause serious damage to the work. Immediately after exercising this authority, the QAR is to inform the contractor's representative at the site in writing, citing the specific safety violation, the date and time of the request for its correction, and the person to whom the request was made, then notify the Government Contracting Officer and the QAR supervisor of the action taken.

(3) The QAR has the authority to interview the contractor's non-supervisory personnel (laborers and mechanics) to determine whether their classifications and wage rates are proper.

(4) It is the contractor's responsibility to comply with the specifications of the contract and environmental permits. The QAR can direct the suspension of work in upland placement operations when the material passing over the spillway from the placement area exceeds the tolerance permitted by the specifications unless corrective action is taken promptly. Operations will not be resumed until the condition has been corrected by the contractor.

(5) The QAR can require the contractor to furnish, on request, the use of personnel and equipment forming a part of the normal crew and equipment as may be reasonably necessary for transportation from designated points on shore to and from the various pieces of plant and the placement sites and for inspecting and supervising the operations.

b. The QAR is <u>not</u> authorized to:

(1) Change any provisions of the contract plans and specifications.

(2) Interpret the results of surveys for acceptance of the work.

(3) Support the contractor verbally or in writing, directly or indirectly, in any interpretation or application of any provisions of the contract in any controversy with the government.

(4) Give order or instructions to any of the contractor's personnel except to the one in charge of the operation at the site and to personnel assisting the QAR in official duties, as stated in paragraph 14*a*(5) above.

(5) Direct the contractor in methods of operations and procedures to be followed in accomplishing the work, except as may be provided in the specifications.

(6) Accept from the contractor any gifts or gratuities of any kind.

15. Relations with the Public

The QAR must always be aware that they are a representative of USACE and the United States Government. Therefore, actions of the QAR in relations with the public should reflect credit on the individual and the organization. The QAR should answer questions regarding the public improvements being made and the resulting advantages to the general welfare, as permitted by applicable security regulations. The QAR is to be courteous and respectful to all visitors with particular concern for their safety and without interference with any official duties. The QAR should cooperate with local public officials in matters related to the work to the fullest extent legally possible and within their authority. Any QAR public interactions should be coordinated in advance with their local Communications Office and Executive Office.

16. Contractor Relations

a. The QAR's position as a representative of the Contracting Officer imposes an obligation to maintain a standard of conduct to command the attention and respect of the contractor and contractor employees. The QAR must not require the contractor to perform work outside of the plans and specifications. It is essential in all relations with the contractor that the QAR be fair, impersonal, and firm without adopting a stiff or unduly formal manner.

b. The QAR should always be courteous and exert reasonable effort to establish and maintain a friendly and cooperative atmosphere with the contractor consistent with the government's interest. Instructions regarding the work are to be given only to the contractor's authorized representative, usually the superintendent or supervisor, except when immediate orders are required to prevent imminent human injury or severe damage to the work. The QAR should not delay the contractor unnecessarily or interfere with the contractor's method of operation unless a continuation of the operation in progress would lead to unsatisfactory and unacceptable work.

c. Differences of opinion between the QAR and the contractor's representative must be referred by the QAR to the QAR's supervisor. The QAR must avoid arguments with the contractor's representative, particularly in front of contractor personnel, and should never criticize the contractor's work in their presence. Differences of opinion between the QAR and other government employees should never be discussed in the presence of the contractor or any contractor employees.

d. There is no contractual relationship between a subcontractor and the government. Therefore, the QAR must deal with the subcontractor through the prime contractor. As a matter of propriety, an understanding between the QAR and the prime contractor relating to direct action with subcontractors should be resolved prior to the start of work under the subcontracts.

17. Accommodations and Meals

a. A standard paragraph in dredging specifications requires the contractor to furnish on board the dredge or other craft upon which they are employed, a suitable separate room for office and sleeping purposes or provide equivalent accommodations ashore. The contract specifications provide that the contractor must, when required, furnish meals of a satisfactory quality to the QAR employed on the work if the contractor maintains an establishment on the work for the subsistence of the contractor's own

employees. There will be no specific reimbursement for QAR meals beyond what is included in the contractor's contract.

b. In order that the government may have information upon which to base the reimbursement, the QAR may be required to submit a report as to the number of meals furnished. QARs should follow any applicable regulations regarding the creation of government travel orders, if required due to the distance from their duty station. QARs should consult with their supervisor regarding transportation to and from a job site, which may require the use of either a government-owned vehicle (GOV) or personally owned vehicle (POV).

18. Labor Relations

a. Every government construction contract contains specific labor clauses with which the contractor must comply. These clauses prescribe certain minimum working conditions on all government construction work. The applications of these provisions in detail can be obtained from the District's labor relations manuals or instructions supplemented by the advice of the District labor advisor.

b. In general, these labor provisions are derived from three principal labor laws: the Davis-Bacon Act, the Eight-Hour Law, and the Copeland (Anti-Kickback) Act. It is the QAR's duty to ascertain whether the contractor is complying with the requirements of these acts. Continuous and careful inspection is essential to the success of the enforcement program. Violations detected and corrected in the early stages of construction may prevent subsequent problems and expensive investigations. To ensure compliance, the QAR will periodically spot check the contractor's laborers and mechanics, recording the results on the Contractor's Employee Interview Report (also known as Employee Wage Interview). The QAR reviews and ensures proper job classification and due compensation to ensure:

(1) That the pay of the laborers and mechanics is not less than the minimum hourly wage rate as shown on the approved Minimum Wage Scale chart, which must be always posted by the contractor at the site of the work at prominent locations accessible to the workers. The QAR should confirm that this chart is posted on the job site. The Contracting Officer, or Contracting Officer's Representative, examines a copy of the official (certified) payroll for compliance (Davis-Bacon Act).

(2) That no mechanic or laborer works more than eight hours in any one calendar day without compensation for each excess hour at not less than one and one-half times the basic rate of pay (Eight-Hour Laws).

(3) That the contractor makes only certain lawful specific deductions from the pay of contractor's laborers and mechanics (Copeland Act).

(4) That the contractor does not discriminate against any employee or applicant for employment because of race, religion, color, or national origin (nondiscrimination clause or other fair contracting requirements). Any additional legal clauses will be reviewed by the USACE contracting office.

19. Inspections by Supervisory Personnel

Inspections by supervisory personnel are generally made once a week or by spot checks, as required. Other inspections from higher authorities can be expected from time to time. Whenever possible, the QAR will be informed by a supervisor of the

impending visit so that they can be present to meet the inspecting officials and to explain the phases of work with which they may be concerned. The QAR should discuss the proposed visit with the contractor, particularly if it is necessary to arrange for transportation utilizing the contractor's equipment. The QAR will record in their log and on the daily report all official visitors who inspect the work under their supervision.

20. Security Regulations

a. Dredging work is generally of non-confidential nature. Security, therefore, in the sense of safeguarding defense information or operations, is not usually of concern to a dredging QAR. In those instances in which the work is of classified nature, the QAR will became familiar with the specific regulations involved and will require their enforcement. Applicable security procedures and instructions should be clarified and approved by the District security officer.

b. As far as the security of plant, equipment, and materials owned by the contractor is concerned, the responsibility for their protection rests entirely with the contractor. However, where government materials have been furnished to the contractor, the QAR is responsible to see that the contractor takes all necessary precautions to safeguard the items provided. The QAR is responsible for the security of personal equipment, papers, and records, which should be kept in a locked desk or cabinet when the QAR is away from the office. The QAR's responsibility is limited to safeguarding government property issued to the QAR.

21. Safety Procedures

a. Every QAR is responsible for seeing that the work under their supervision is being performed in a safe manner according to safety standards as outlined in The Safety and Health Requirements Manual, EM 385-1-1. To assist in attaining this objective, USACE requires that certain standard safety practices be followed in all work under its jurisdiction, whether by contract or hired labor. The QAR will become thoroughly familiar with the contents of this manual with particular attention to those applicable provisions pertinent to the assigned work situation. Printed and electronic versions of this manual are available for reference at the site of the work; a QAR should always have a copy of the manual available on site. The QAR will require all persons, whether contractor or government personnel, to comply with applicable safety requirements, whether stated in the manual or specifically directed by the District Engineer.

b. The QAR must be always safety conscious. The QAR must notify the contractor's superintendent or SSHO immediately of any safety violation and request its correction. If the safety violation is not corrected, the QAR must immediately notify their supervisor, who will take any required further action.

c. If a safety violation endangers life or property or threatens serious damage to the work, the QAR can, without further warning, stop the work at the site of violation and prohibit its resumption until the condition has been remedied.

d. The QAR, by their personal actions, should set a good example and enforce USACE safety policy. The contractor should be informed that safety requirements have been prescribed to protect the health and safety of personnel, to minimize damage to equipment, and to improve the efficiency of operations by eliminating delays caused by accidents. Safety requirements are part of the overall contract with the government.

e. The QAR should always comply with the safety standards, particularly when such actions obviously emphasize a required safety provision, such as wearing a life vest when transferring between floating plant or walking a pontoon line, wearing a hard hat, wearing safety shoes, and wearing all necessary personal protective equipment required for the job site (see Figure 29 and Figure 30 for examples). A Personal Location Beacon (PLB) may be required in a contract but is recommended for all open water job sites.

Figure 29: The personal protective equipment (PPE) worn at the placement site in this photo includes hard hats, high-visibility safety vests, personal flotation devices, shirts with sleeves, long pants, and closed-toe boots. Eye protection and hearing protection are other commonly required PPE.

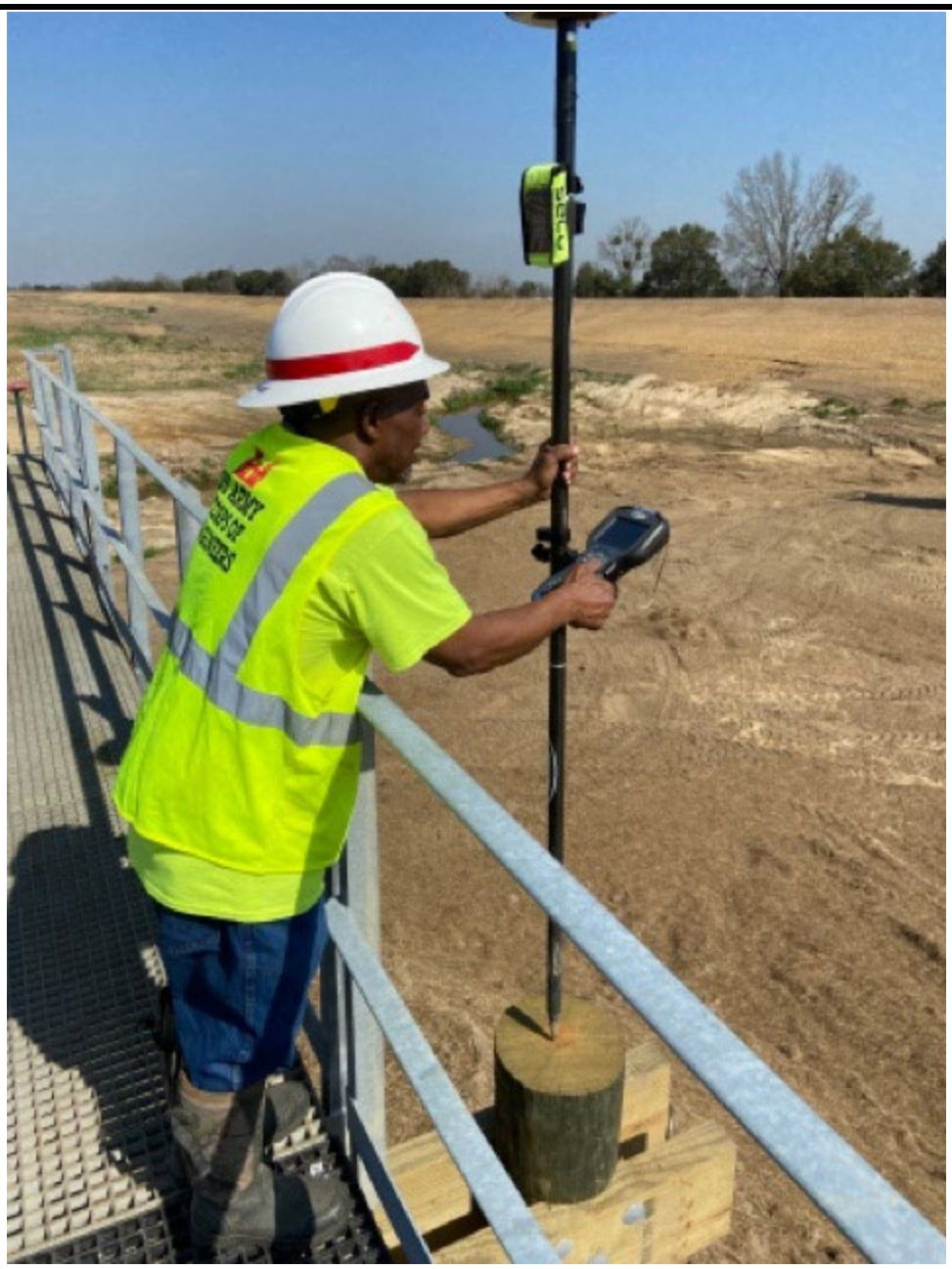

Figure 30: PPE worn at the placement site in this photo includes a hard hat, high-visibility safety vest, shirt with sleeves, long pants, and closed-toe boots

f. In USACE construction contracts, the contractor is required to submit an Accident Prevention Plan (APP) as part of their safety program. This program, when approved by the Contracting Officer, together EM 385-1-1, will be the QAR's guide for determining that adequate and orderly safety procedures are being followed. It is, therefore, important that the QAR obtain a copy of this approved program and to see that the contractor's superintendent is provided with a copy. Usually, such a program lists the frequency of the accident prevention conferences to be held and the person(s) who will

conduct the meetings. The QAR should attend these conferences and assist when requested in solving any safety problems that may arise.

g. One of the requirements of safety procedures is the preparation of a Monthly Exposure Report, prepared by the contractor's CQC. This report is then routed to the Resident Office or Area Office, with information submitted from the field. If required, the QAR will check for agreement between the Monthly Exposure Report and conditions on the job site. Where required, the QAR will submit the desired information in a manner and form specified by their supervisor.

h. In the event of a disabling injury to any employee or accident to any plant or property of the government or contactor involving damage estimated at $5,000.00 (or the minimum value stated in EM 385-1-1), or any accident to which the contractor is a party involving injury or damage to a third party or a third party's property, the QAR must request the contractor's superintendent to submit a Preliminary Accident Notification, commonly referred to as a PAN Form within 24 hours, and an ENG Form 3394 Accident Report within 7 days or as soon as possible, and any other forms as otherwise instructed.

i. Collisions, groundings, and/or other accidents in the vicinity of the work involving parties other than the government and the contractor should be reported by the QAR to their supervisor, giving a complete description of the accident, including a sketch and a statement of contributing causes, such as unfavorable weather and channel conditions prevailing at the time. The QAR should immediately inform their supervisor of any accident resulting in critical or fatal injuries or in property damage estimated at $5,000 or more, or the minimum value stated in EM 385-1-1.

j. The designated QAR must submit a daily report into the Resident Management System (RMS), which includes a safety section as part of the larger daily report.

22. Photographs

Specific policies regarding taking photographs of construction activities, including the issuance of government-owned cameras is regulated by the District.

a. Photographs may be taken for routine progress monitoring and internal review. Photographs should be taken of those features of the work that may be involved in future controversies or claims with the contractor and of any situation that would substantiate a QAR's report or records where such supplemental data may be required. For example: repeated safety violations, accidents, collisions, faulty equipment, substantial change in character of dredged materials from that indicated in the plans and specifications, and damages to navigation aids and range structures.

b. Photographs should be identified sufficiently for future reference and uploaded to digital contract folders. The identification should include the name of QAR taking the picture, date, and time the picture was taken, project name, location of work, contract number, name of contractor, and a brief description of what the picture shows. Some of these data elements are automatically included in a digital photo file. When possible, photographs of problem areas should be taken successively from a predetermined fixed location and fixed foresight. QARs should be familiar with locations of digital contract folders or other record-keeping systems that might be used for photo storage.

23. Progress Schedule

a. A progress schedule (tracking sheet) is required for each job showing the sequence and time required for performing the various features of work. As required by the specifications, the progress schedule is prepared and submitted by the contractor and approved by the Contracting Officer. When approved, the progress schedule is a guide in determining if the work is proceeding satisfactorily.

b. In addition, the QAR must maintain a progress schedule that shows the area covered each day. QARs are required to submit daily reports to the RMS which can be used to track work progress. Contract drawings or before dredging maps are well suited for this purpose. Progress surveys may be used by contractors to capture dredging progress, area drilled and blasted, length of dike placed, etc., for review by QARs.

24. Hydrographic Surveys and Soundings

QARs should be familiar with the hydrosurvey process used in their District and how to read hydrographic surveys taken during construction to verify that the contractor has removed the required sediment. These surveys taken during construction are called progress surveys. The hydrographic survey team is responsible for performing surveys according to their standard of practice (described in EM 1110-2-1003, Hydrographic Surveying) and contract specifications.

a. In dredging operations, the depth of water before and after dredging is required for preparation of daily reports and spot check of the area being dredged. The after-dredging soundings may be used as a basis for partial payments. In some Districts, the QAR may be required to obtain these soundings or witness the soundings if obtained by a contractor.

b. The procedure in taking manual soundings is generally as follows:

(1) A suitable line marked at required intervals (in feet) weighted with lead is lowered into the water at the location desired, usually behind the dredge. When the lead rests on the bottom, which can be readily determined by experience, the water level on the line is noted and recorded. This reading, corrected to the applicable reference plane, is the sounding desired.

(2) To fix the sounding for recording purposes, its horizontal location must be determined. This is accomplished in several ways depending on the nature of the work, type of sounding, and available equipment. For example, when soundings are taken from a dredge, the horizontal locations can be approximately determined from correlations with the dredge position. If a skiff or workboat is used, the soundings can be fixed horizontally by taking them at prescribed intervals along a system of ranges previously established. The intervals should be decreased when sounding the side slopes of the cut.

(3) Geographic positioning systems are the standard equipment used to obtain horizontal locations. The specific procedure in in the QAR's District and detailed instructions for obtaining the sounding will be given to the QAR by their supervisor. In view of the specialized equipment involved, the QAR will usually not be required to use echo or electronic sounding devices.

c. The use of a sounding lead of a particular size and design is governed by the character of the material being dredged. In a sand bottom, a lead weight of about eight pounds is adequate. In silt or mud, a disc at least six inches in diameter should be

attached to the lead. The line itself should be checked periodically to ensure its accuracy.

d. Sounding poles constructed of wood, approximately 2 square inches (5.08 square cm), or hollow aluminum, approximately 2 inches in diameter (5.08 square cm), marked off in feet, can be used in shallow channels or waterways.

25. Horizontal and Vertical Control

a. No construction work can proceed with any degree of accuracy without a system of horizontal and vertical controls enabling each part of the work to be related to its proper position. In dredging, taking soundings, location of work, fixing the dredge, placing range markers, buoys, etc., all depend on such control.

b. Generally, the contractor is responsible for laying out the work from benchmarks, base lines, and water level or tide gages established by the government. To follow the work and make independent checks, the QAR must become familiar with these basics, as well as other parts of the horizontal and vertical control system (GPS). Periodically and as far as possible, the QAR must check range markers, range targets, tide, and stream gages, dredging buoys, etc. to ensure that they remain properly located and calibrated throughout the length of the job. The QAR should periodically check the Contractor's determination of the dredge location.

26. Character of Materials

Determinations of the character of materials being dredged and the percentage of each type are required for record purposes and may be used to ascertain that the material is like that described in the contract specifications or delineated on the plans from the boring logs. Contract specifications will require what equipment the contractor must use to acquire the sediment sample(s), the CQC and the QAR must witness and document this process. This data may be obtained daily and recorded in the QAR's daily report. The QAR must ensure that samples are sent to the designated laboratory for analysis. The determination of sediment characteristics in the field is to be the QAR's best estimate obtained from a visual and physical inspection of samples of the material. A general classification of dredged materials and a guide to their identification are:

a. Rock. Solid ledges of hard strata of substantial thickness that usually must be drilled and blasted before removal. Thick slabs of rock may be broken by chisels or rock cutterheads.

b. Sand. Small, hard-grained, individually visible particles of soil up to 0.18″ (0.475 cm) in diameter having a distinctly gritty feeling.

c. Gravel. Smooth rock fragments usually mixed with sand, water-worn, with particles ranging from 0.18″ (0.475 cm) to 3″ (7.6 cm) in diameter.

d. Cobbles. Stone worn and rounded, detached from its original bed, ranging from 3″ (7.6 cm) to about 10″ (25.4 cm) in diameter.

e. Boulders. Large stone, worn and rounded, generally over 10″ (25.4 cm) in diameter.

f. Clay. A cohesive soil, plastic when wet, smooth and greasy to the touch, sticking to the fingers when moist.

g. Hard Pan (Caliche). A cemented soil formation composed of clay, boulders, sand, and gravel.

h. Mud. Finely powdered materials mixed with organic particles of animal and vegetable matter, dark color, and usually having an odor of decaying vegetable matter.

i. Silt. Fine grained, non-cohesive material ranging in particle and size between clay and sand.

j. Shell Pack or Shell Hash. Compacted or semi-compacted shell fragments from 3/4″ (1.9 cm) to 1.5″ (3.8 cm) in diameter. Material composed of predominantly (>75%) coarse-grained sand to gravel-sized whole or broken shell. See Figure 31.

k. Pumice. Compacted volcanic ash forming lightweight solids ranging from 3/4″ (1.9 cm) to 3″ (7.6 cm) in diameter, color varies from light gray to black. See Figure 31.

Figure 31: Left panel: Sediment made up of quartz and carbonates with shell hash. Mean grain sizes range from 0.20 to 0.50 mm (0.007 to 0.19 inches), sample collected in Florida. Right panel: Example of sediment made up of volcaniclastics, pumice, quartz, and oxides, mean grain sizes range from 0.20 to 0.50 mm (0.007 to 0.19 inches). Sample collected in the Columbia River, Portland District.

Note: Sediments with larger grain sizes and sharper edges (such as gravel, shell hash, pumice) tend to be more abrasive to equipment and pipes, causing them to wear out more quickly.

27. Surveys

a. Progress Surveys. According to District policy, progress surveys may be made by the contractor or by District hydrosurvey staff. Any surveys conducted by the contractor should be witnessed by the QAR.

b. Surveys for Payment. According to District policy, surveys for payment may be made by the contractor or by District hydrosurvey staff. Any surveys conducted by the contractor should be witnessed by the QAR. Any volume calculations comparing before dredge and after dredge conditions should be made by government staff at the District office. In some cases, the contractor may perform a side-by-side survey using their own equipment on their own vessel, at the same time as the government survey.

c. Land-Based Surveys. If the dredged material is to be placed in an upland site, a land-based survey will be performed. The QAR should know what type of survey is planned (flyover, drone, or light detection and ranging (LiDAR) survey, or a land-based survey). The QAR should be given the opportunity to witness any land-based surveys performed by the contractor.

28. Computations

a. The linear distance (length of cut), average width of cut, area, and volume dredged are basic items of information required each day for recording of the progress of the work and for inclusion on the QAR's daily report:

(1) The length of cut is the distance advanced by the dredge in a dredge cut. It is readily obtained from physical measurements or computations of distances between known ranges.

(2) The width of the cut is the width of that area covered by the dredge in a dredge cut.

(3) The area dredged is the product of the length of the cut and the width of the cut.

(4) The average depth dredged is the difference between the average depths in the dredge cut before and after dredging.

(5) The volume of material dredged is the product of the area dredged and the average depth dredged.

b. In general, the following equation (see Equation 1) can be used for computing the volume of cubic yards of materials dredged in any area desired, exclusive of side slope areas.

$$V = \frac{WxDxL}{27} \qquad \text{Equation 1}$$

Where:

V = Volume in cubic yards
W = Average width of cut in feet
D = Average depth of cut in feet
L = Length of cut in feet

c. Computations for obtaining volumes of materials in the slopes of the channel vary with the District and type of dredging plant used. Accordingly, the QAR will receive instructions for making slope calculations from their supervisor.

d. The average end area method (prismoidal formula, Equation 2) of computing the volume of excavation is readily adapted to long narrow channels or canals. In the calculation of the volume by this method, let A_1, A_2, A_3, … An represent the areas of successive cross sections, D the constant distance between sections, and V the desired volume, then:

$$V = \left(\frac{A_1+A_2}{2}\right)D + \left(\frac{A_2+A_3}{2}\right)D + \cdots \left(\frac{A_{n-1}+A_n}{2}\right)D \qquad \text{Equation 2}$$

$$= \frac{D}{2}(A_1 + 2A_2 + 2A_3 + \cdots 2A_{n-1} + A_n)$$

$$= D\,(\frac{A_1}{2} + A_2 + A_3 + \cdots A_{n-1} + \frac{A_n}{2})$$

Where:

V = Desired volume in cubic yards

A_n = Area of cross section

D = The constant distance between sections

e. In some cases, computer software can be used to perform these calculations. The QAR should receive instruction from their supervisor about which calculation method is the District standard (such as double end area method, end area method, average between two sections).

29. Records

a. Reporting.

(1) The QAR must keep notes for all significant actions or incidents such as collisions, groundings, etc., and any special instructions pertinent to the work. These should be entered into the RMS daily report (or other official electronic system of record). The QAR daily reports should record any occurrence that could lead to a future claim by or against the United States Government. On jobs of more than one shift, each QAR will make their own daily report during a shift and each shift's entries will be followed by the QAR's signature.

(2) It cannot be emphasized too strongly that it is of the utmost importance to maintain an accurate and complete log, as it is the most valid documentary record of the progress of the work. The RMS daily report should include (but not be limited to) the following entries:

(a) Date.

(b) Weather.

(c) Delaying factors and the length of delays. Work stoppages including time stopped, time resumed, reason for stoppage, the number of personnel and equipment involved, and resolution of the problem causing the delay.

(d) General description of work performed.

(e) Discussions with the contractor or contractor's representative (include name and title of person with whom discussed), including particularly those relative to interpretation of plans and specifications, deviations from contract requirements, and any statements that might indicate that a claim may be filed. This can include any controversial issues or non-compliance events with descriptive information and resulting corrective action(s) taken.

(f) Conditions differing in any respect from those indicated in the plans and specifications, particularly factors that may be classified under the Changed Conditions article of the contract.

(g) Instructions from supervisor and resultant action.

(h) Labor relations, including interviews, difficulties, and strikes.

(i) Names and titles of visitors.

(j) Accidents and near-miss accidents with names of persons and type of equipment involved. Any injury or damage to property should be recorded. The frequency of these events provides an important record.

(k) Any other pertinent matters that may be of value later.

(3) The daily report should be kept in a formal manner, including only factual information.

b. Files. The QAR must maintain a working file in their office, including a copy of the contract, plans and specifications and supplements, modifications, and changes thereto; before and after dredging maps; copies of all pertinent correspondence relative to the work; memoranda from their supervisor; and executed reports. This information should be accessible in digital records systems, such as RMS, while on the job site.

30. Reports

An important duty of the QAR is the preparation of the reports required in connection with dredging operations. Since the type and method of operations vary throughout the country, the required reports will vary somewhat with each District. However, there are several reports that are applicable throughout USACE, most important of which are shown, together with instructions for their preparation, in the Appendixes. The District will supplement these with any other reports it feels desirable and necessary.

Appendix A
Example: Quality Assurance Plan, Job-Specific Site Supplement

CONTRACT NUMBER:

Contract Name and Location:

Contract Number: #, Task Order #
Award Date:
NTP Date:
Required Start of Dredging:
Completion Date of Dredging:
Contractor Name and Address:
Primary Customer(s): River Pilots; Ports of Portland, Kalama, Vancouver, Longview, and Woodland; and Portland District's Channels and Harbors
Description of Contract Scope: Dredging Columbia River and Lower Willamette River Navigation Channels

1. Project Staffing Assignments

a. Contracting Officer (CO):
b. Contracting Specialist:
c. Chief of Construction:
d. Vancouver Resident Engineer:
e. Primary Administrative Contracting Officer (ACO):
f. Alternate Administrative Contracting Officer (AACO):
g. Contracting Officer's Representative (COR):
h. Technical Lead:
i. Contract Admin Tech:
j. Government Quality Assurance Representative (GQAR):
k. Project Manager:

2. Quality Assurance Training Required for this Project

Dredge Inspector Training Seminar (required for new dredge inspectors):
a. QA/QC Roles.
b. Reporting Requirements.
c. Safety and Accident Prevention.
d. Environmental Compliance.
e. Partnering and Ethics.
f. Timekeeping and Travel.
g. Media Contacts.
h. Miscellaneous.

3. Resident Engineer Responsibilities (Name of Resident Engineer)

Provide after-hour support to the dredge as needed.

4. Primary or Alternate ACO (Name) (after obtaining warrant)

a. Approve overtime (OT) requests for QAR and Contractor.
b. Oversee preparation of all modifications.
c. Approve changes to estimated time/cost.
d. Sign pay estimates.
e. Sign correspondence.
f. Approve/reject major maintenance plan.
g. Backup for the COR in HYPACK, monitoring over-dredging and mounding in the placement site.
h. Prepare Situation Report and distribute.
i. Approve Work Authorization Documents (WADs).
j. Approve Project Specific Management Plan (PSMP).
k. Lead annual preconstruction conference.

5. COR and Technical Lead Responsibilities (Name)

a. Daily:
(1) Contact GQARs to discuss ongoing work and any issues.
(2) Contact the Contractor by phone to discuss ongoing work and any issues.
(3) Coordinate with District for new placement plans and/or action plans to correct mounding.
(4) Review all surveys in HYPACK.
(5) Review QC and Environmental Monitoring Reports.
(6) Review and sign QAR reports.
(7) Coordinate work/information flow in Project Delivery Team (PDT).
(8) Resolve contractor issues in a timely manner.
b. Weekly:
(1) Weekly coordination meetings.
(2) Prepare meeting agenda.
(3) Chair meeting.
(4) Monitor Contractor schedule.
(5) Review Master Sheet.
(6) Review deficiency log.
(7) Track Government Supervision and Administration (S&A) to ensure adequate funding for entire project.
(8) Track contract funds for immediate needs and to ensure compliance with annual plan.
c. Periodically:
(1) Attend annual floating plant/equipment inspections.
(2) Review pay estimates.

(3) Review surveys utilizing HYPACK; perform quantity computations and cross sections for review; resolve discrepancies with necessary parties.

(4) Visit dredge.

(5) Review PSMP and any PSMP updates. Coordinate review by PDT and resolution of comments.

(6) Update QA Plan as required, or annually.

(7) Prepare correspondence for Administrative Contracting Officer (ACO) or Contracting Officer (KO) signature.

(8) Update Resident Management System (RMS) status by the 10th of each month.

(9) Update Critical Path Method (CPM) (COR Report) status by the 15th of each month.

(10) Review monthly hourly reports.

(11) Review and process funding accruals by the 25th of each month.

(12) Coordinate with Contractor to complete annual environmental reports.

(13) Provide input for accident or spill in Commander Critical Information Requirement (CCIR) format and send to Resident Engineer.

(14) Provide after-hour support to the dredge as needed.

(15) Coordinate review/acceptance/WAD closeout of each work area when closeout package is received.

(16) Review annual major maintenance plan and capital project requests, draft approval/rejection memos for ACO signature.

(17) Prepare annual budget forecasts for future fiscal years for Project Manager (PM) review.

(18) Coordinate with Cost Estimating team for annual Independent Government Estimate (IGE) based on draft work plan each year.

(19) Coordinate quarterly financial meetings with Contractor.

(20) Monthly, complete an analysis to compare proposed days and costs vs. actual days and costs. Use this information to project when additional funding will need to be added to the contract.

(21) Track and coordinate Defense Contract Audit Agency (DCAA) audits.

d. Annually:

(1) Review contractor’s PSMP.

(2) Prepare environmental reporting documents.

(3) Prepare documents for future year’s task orders.

(4) New work area.

(5) Attend preparatory/initial meetings if possible.

(6) Prepare dredge orders/work authorization documents.

(7) Prepare layout drawings.

(8) Review and validate all pre-dredge surveys in HYPACK prior to Contractor starting work.

(9) Update survey summary spreadsheet and environmental info (same sheet).

6. QAR Responsibilities (Name)

a. QARs must limit their work hours to no more than 12 hours per day. If it is necessary to extend those hours for any reason, advance verbal approval needs to be obtained from ACO, or in their absence, the COR. For safety of personnel, duty time should be limited to 12 hours per day except in unusual circumstances, such as the need to attend safety meetings or drills.

b. QARs must coordinate directly with the contractor to arrange pick-up times at the dock for daily inspection and for visits by all USACE personnel.

c. In the event of a spill, safety incident, or mis-dump, the QAR on shift must notify the COR, ACO, or Resident Office person on call immediately and report the following:

(1) Time of incident.

(2) Work location.

(3) Actions taken by the Contractor.

(4) Type of spill/accident/mis-dump.

(5) Estimated quantity/severity of injury.

d. Prior to beginning work each season, GQAR will:

(1) Conduct initial floating plant inspection on all plants.

(2) Ensure Water Quality Certificates are on the dredge, launch, and water quality monitoring boat.

(3) Ensure spill containment supplies are onsite.

(4) Ensure Safety Data Sheet (SDS) materials are onsite.

(5) Check that the project sign is posted and accurate.

(6) Review Coast Guard Certificate of Inspection (COI), stability letter, load line certificate, and ullage table.

(7) Ensure all required notices are posted.

(8) Ensure emergency telephone numbers for accident response, accident reporting, and spill reporting are posted for Contractor and Government personnel.

(9) Review QC reports, environmental reports, safety/QC discrepancy reports, and master sheet.

e. Prepare daily QA reports. Ensure number of personnel onsite during shift and disciplines are noted.

f. Review PSMP and PSMP updates.

g. Provide after-hour support to the dredge as needed.

h. Check the contractor's water quality monitoring instruments (if required) for compliance with the contract.

i. Attend Weekly Coordination Meetings.

j. Conduct Labor Standard interviews.

k. Review Equipment Logs.

l. Conduct daily safety walks with SSHO as often as possible.

m. Oversee placement site operations and reporting.

n. Coordinate work with Dredge Captain and other Superintendents.

o. Resolve contractor issues in a timely manner.

p. Review annual Major Maintenance Plan and Capital Project Requests, provide feedback to COR.

q. QAR responsibilities include, in general:

(1) Be thoroughly familiar with the contract specifications, drawings, and pre-dredge surveys.

(2) Be thoroughly familiar with Contractor submittals, plans, and schedules.

(3) Be thoroughly familiar with the Water Quality Certificates and their location on each vessel.

(4) Participate in Contractor's Preparatory Inspection meetings.

(5) Participate in Initial Inspection meetings.

(6) Wear required personal protective equipment at all times when work is in the vicinity of the water, including PLBs and PFD lights for work performed outside of daylight hours.

r. QAR Preparatory Inspection tasks include:

(1) Ensure that the contract plans, specifications, and most recent pre-dredge surveys are on the dredge.

(2) Ensure floating plant inspection is complete and all identified deficiencies corrected.

(3) Check control and layout of work.

(4) Check dredging coordinates on the GPS screen on the dredge (make notes in the QAR report).

s. QAR Initial and Follow-up Inspections (make note of all inspections on the daily QAR report):

(1) Conduct daily quality assurance inspections according to the attached checklists.

(2) Conduct weekly and periodic quality assurance inspections according to the attached checklists.

t. Review Job/Activity Hazard analyses for:

(1) Dredging.

(2) Placement.

(3) Cutting and welding.

(4) Personnel transfer.

(5) Water quality monitoring.

(6) PLBs.

(7) Spill response/reporting.

(8) Work in confined spaces.

(9) Load handling equipment.

(10) Hazardous energy.

u. Periodically spot-check Contractor's spare parts list and verify inventory, and as requested by the COR.

7. Water Quality Monitoring

The Contractor is required to complete water quality (WQ) monitoring tests of the type and frequency noted in the specifications. Turbidity monitoring at all locations must be performed during daylight hours. Visual or instrument sampling is acceptable.

Instrument sampling will be taken at a depth of 15 feet +/- 2 feet, or the midpoint of the water column for depths less than 20 feet. Take background observations immediately prior to compliance sampling. Observations should be taken up-current from the dredging and placement locations. Monitor dredging operations twice per day on each tide (ebb and flood) at 900 feet downstream of the dredge and within 150 feet laterally from the centerline of the dredge. Monitor in-water and shoreline placement twice per day on each tide (ebb & flood) at 900 feet downstream of the discharge point and not more than 150 feet laterally from the discharge point. Monitor upland placement operations every 4 hours at 300 feet downstream of the discharge point.

If an exceedance is measured, a re-test will be taken immediately. If the value of the re-test is in exceedance, action must be taken according to contract specifications and environmental permit requirements. If an exceedance is observed during dredging or in-water placement operations, cease operations until an additional observation indicates turbidity has returned to acceptable levels. If an exceedance is observed during shoreline or upland placement operations, cease operations, and implement best management practices to reduce turbidity. If exceedances are registered at two consecutive monitoring intervals, cease operations until an additional observation indicates turbidity has returned to acceptable levels.

8. Final Inspection Process

Final acceptance for a work area is based on acceptability of the WAD closeout documentation. Decisions on the acceptability of each work area will be made jointly with the Project Manager (Name), Technical Lead (Name), and/or the ACO (Name).

9. Contract Administration Responsibilities

Contract administration responsibilities will be performed by the COR and ACO, and supported by the Contract Admin Tech.

10. Definable Features of Work

a. Mobilization/demobilization.
b. Active dredging, maintenance during dredging, security/fire watch (dredging at each work location is considered a feature of work).
c. Dredge season maintenance and repairs.
d. Major maintenance – partial or full crew.
e. Site prep – early or during dredging.
f. Water quality monitoring.
g. Surveys.

11. Points of Contact (POC) List

Name, Government Cell: (###) ###-####
Name, Government Cell: (###) ###-####
Name, Government Cell: (###) ###-####
Name, Government Cell: (###) ###-####

Prepared By: [Name]
Contracting Officer's Representative
Approved By: [Name and Digital Signature]

Appendix B
Example Quality Assurance Plan: Definable Features of Work and Associated Quality Assurance Activities

Table B–1
Section 01331, Hydrographic Surveys

Section Paragraph	Feature Description	Submittal Requirement	Frequency of QAR Observations	Quality Assurance Test & Activity Requirements		
				Type	Perf By	Remarks
	Professional Certification	Certification	Every survey	Review	Professional Engineer (PE)	PE review certification from licensed land surveyor for all surveys performed.
	Fathometer	Verification of survey equipment	Prior to use	Review	QAR/PE	Review equipment certification to ensure fathometer specs for range of operation 3 to 100 feet; vertical scale 0.1 inch equals 1 foot; manual control to offset electrical zero over range from minus 4 to plus 22 feet; minimum 534 soundings per minute; frequency from 8 to 28 kHz; accuracy .05 of 1%; chart paper speed of 1, 2, 3 and 4 inches per minute; stylus speed from 57 to 63 Hz; fixed marker switch.
	Calibration	Bar check and Velocity Probe	Prior to use, thereafter daily prior to and after each survey	Witness	QAR	Witness calibration of fathometer at depths of 5, 10, 15, 25, 30, 35, 40, 45, 50 feet before and after each survey.
	Preliminary Field Surveys	Preliminary Original Cross Sections	Prior to starting dredging	Witness	QAR	Witness controlled preliminary cross-section surveys at 1,000-foot intervals, locating all towers, buoys, channel markers. Cross sections to extend 300 feet each side of channel centerline.
	Before and After Dredging Cross Sections	Before and After Dredging Surveys	Prior to starting dredging; thereafter, periodically depending upon advance	Witness	QAR	Witness before and after dredging cross sections at 200-foot intervals.
	Acceptance Profiles	After-Dredging Surveys	Upon completion of dredging	Witness	QAR	Witness after-dredging profiles taken on centerline and each bottom edge of cut.

Section Paragraph	Feature Description	Submittal Requirement	Frequency of QAR Observations	Quality Assurance Test & Activity Requirements		
				Type	Perf By	Remarks
	Survey Data	Field books, plotted cross sections	Upon completion of surveys	Witness	QAR	Witness and review surveys/original/after-dredging cross sections for scale 1 inch equals 50 feet horizontally, 1 inch equals 5 feet vertically. Review/accept after-dredging surveys that indicate dredging performed to required template. Witness/submit original surveys for reach at least 2,000 feet ahead of dredging.

Table B–2
Section 01352, Environmental Protection

Section Paragraph	Feature Description	Submittal Requirement	Frequency of QAR Observations	Quality Assurance Test & Activity Requirements		
				Type	Perf By	Remarks
1.4.1	Environnemental Pollution Control Plan	Yes	Prior to Start of Work	Review	QAR/PE	Plan required within 10 days of award.
			Daily	Visual	QAR	Ensure contractor complies with his plan and specifications. Report violations immediately. Report compliance in QAR report daily.
1.6	Storm Water Discharge	Yes	Prior to Start of Work	Review	QAR	Ensure Notice of Intent sent to state environmental office.
			Completion of Work	Review	QAR	Ensure Notice of Termination sent to state environmental office.

3.1	Protection of Land Resources		Daily	Visual	QAR	Construction activities confined to areas defined by contract. Remove only those trees and shrubs required for construction. Removal of any soils displaced into uncleared areas. Scarred trees immediately painted with tree wound paint. Notify Area Engr immediately of any historical or archeological finds.
3.2	Protection of Water Resources		Daily	Visual	QAR	No discharge of fuels or chemicals into lakes, ditches, groundwater, rivers, bayous, canals, waterways, or reservoirs. Ensure temporary erosion and sediment control measures such as dikes, hay bales, silt screens, etc. are always maintained.
3.3	Protection of Fish/Wildlife		Daily	Visual	QAR	Ensure contractor does not disturb native habitat adjacent to the project area.
3.4	Janitor Services		Weekly	Visual	QAR	Ensure buildings are kept clean. Ensure toilets are kept clean. Ensure collection and proper disposal of trash and debris.
3.5	Disposal of Hazardous and/or Regulated Solid Waste	Yes	Prior to start of activity	Review	QAR/PE	Plan required for disposal of any hazardous or regulated solid waste generated by contractor's operations. Disposal must be consistent with appropriate regulations identified in contract.
3.7			Daily	Visual	QAR	Ensure contractor complies with plan and appropriate regulations when disposing of hazardous or regulated solid waste.

3.9	Reporting of Pollution Spills		At time of occurrence	Witness	QAR	Ensure contractor notifies the National Response Center or the U.S. Coast Guard immediately of any spills.

Table B–3
Section 02482, Dredging

Section Paragraph	**Feature Description**	**Submittal Requirement**	**Frequency of QAR Observations**	**Quality Assurance Test & Activity Requirements**		
				Type	**Perf By**	**Remarks**
1.2.5	Timely Performance of Quantity Surveys	Cross Sections	Before and after dredging	Witness	QAR	Ensure before dredging (BD) surveys are submitted at least 2,000 feet in advance of dredging and after dredging (AD) surveys within 2,000 feet (609 m) behind dredge.
1.6.1.1	Pump curve and dredge data submittal	Data	Prior to dredging	For info only	PE	Forward pump curve and plant data info as required.
3.2.2	Required dimensions	Plan of operations	Prior to dredging operations	Review	PE	Review and approve contractor's plan of operation at utility crossings. Ensure contractor notifies utility owners at least 7 days in advance of work within 500 feet of utility.
3.3.1.1	Government furnished placement areas	Plan for placement operations	7 days prior to start	Review	PE	Review/approve placement plan, including discharge locations.
3.3.3	Excessive discharge pipe leakage		Daily	Visual	QAR	Ensure that pumping is ceased in the event of excess leakage
3.3.4	Deposition in non-approved areas		Daily	Visual	QAR	Ensure that placement is in approved designated areas and that material deposited elsewhere is removed.

Section Paragraph	Feature Description	Submittal Requirement	Frequency of QAR Observations	Quality Assurance Test & Activity Requirements		
				Type	Perf By	Remarks
3.3.6	Submerged discharge lines		Prior to start of dredging, thereafter daily	Visual	QAR	Ensure that discharge line placed in shallow water where small crafts may traverse over the line is marked with orange buoys and signs at intervals of 150 feet throughout the length of the line.

SUMMARY of CHANGE

New Document: EP 415-1-261, Quality Assurance Representative's Guide, Volume 7, Dredging and Dredge Inspection

Old document: EP 1130-2-310 dated 28 June 1963
United States Army Corps of Engineers (USACE)

This administrative revision, dated 30 July 2022 includes the following changes:

- Updated and added information on dredging equipment, sediment types, and safety equipment.
- Updated description of reporting requirements.
- Added appendixes to use for planning and communication workflows.